# FLORA EUROPAEA 

VOLUME 1<br>LYCOPODIACEAE TO PLATANACEAE

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CAMBRIDGE
AT THE UNIVERSITY PRESS

PUBLISHED BY
THE SYNDICS OF THE CAMBRIDGE UNIVERSITY PRESS
Bentley House, 200 Euston Road, London, N.W. I American Branch: 32 East 57th Street, New York 22, N.Y. West African Office: P.O. Box 33, Ibadan, Nigeria
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1964

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## PREFACE

Europe, where scientific taxonomy was developed, and whose taxonomists have participated, for more than a century, in the preparation of Floras for other continents, does not possess a Flora of its own. Many hundreds of national and regional Floras exist, together covering almost every part of Europe, but there is no modern work which deals with the area as a whole.

There are obvious historical and political reasons which explain the lack of such a Flora. It is, however, becoming increasingly important, as in all other fields of science, that a work synthesizing the accumulated data from the various regions should be produced. For one thing, the channels of distribution of information are being choked by the accumulation of unassimilated or neglected data and if these channels can be cleared, and the data sifted, collected and arranged, botanical science will be stimulated. Equally important, good taxonomy is the basis for many kinds of scientific research, but this taxonomy must be broadly based and well considered, and must transcend national boundaries. To the biosystematist and the phytogeographer, for example, local taxonomy can be misleading, whereas a wider treatment, on a continental scale, can correct misconceptions and reveal problems that had not been previously suspected. A new, synthetic Flora of Europe will be useful, not only to specialists, but also to biologists of many kinds. It should make it easier for them to give a plant an accurate name, which we regard as one of the primary aims of a Flora, and it should also direct their attention to literature in which further information can be found.

The problems which face those attempting to write a Flora of Europe are formidable. The materials available are of various kinds: there are some outdated catalogues of European plants (such as Nyman's Conspectus Florae Europaeae), some important regional Floras, such as those by Hegi and Komarov (see p. xxii), and many excellent national Floras. In addition, there is a vast accumulation of literature, published in many places and in a variety of languages, much of which is relatively inaccessible and virtually unknown outside its country of origin. The writers of a European Flora must be prepared to seek out this literature and review it critically, in addition to studying for themselves in the herbarium and the field the plants about which they propose to write.

This, then, is the background against which any decision to write a Flora of Europe has to be taken. Mention must be made of the Flora Europaea projected by Werner Rothmaler in the 1940's which was to cover not only Europe but also the Caucasus, Transjordan and parts of North Africa. Owing to the conditions of wartime this scheme was abandoned. The question was reopened in a discussion on 'Progress of Work in the European Flora' at a session of the 8th International Botanical Congress held at Paris in 1954. Although no formal decision to write a Flora was taken, further discussions between a number of European botanists followed, and eventually an informal committee came into being, which held its first meeting at Leicester in January 1956. This committee (the constitution of which is given on p. vii), has remained in being, and, with few modifications, has become the executive committee in charge of the project. It was realized from the start that, while it was obviously advantageous to have a central organization in one part of Europe (the British Isles), the project could only succeed with continuous and substantial advice and help from every part of Europe. Accordingly, invitations to a number of distinguished

European botanists to act as Advisory Editors (p. vii) were issued; the prompt acceptance of these invitations and the approval and support received encouraged the committee to proceed.

The next step was to plan the Flora in detail. As a result of much discussion a booklet entitled The Presentation of Taxonomic Information: A Short Guide for Contributors to Flora Europaea was prepared and published in 1958, and it then became possible to begin the writing of the Flora. Editors for each family were appointed from the editorial committee, and accounts of individual families or genera were obtained from botanists in all parts of Europe. The list of contributors to volume I is given on p. ix. Details of the style and form of the Flora are given below (p. xv).

It should be emphasized that it has been, and remains, the intention of the Editorial Committee to produce a concise and complete Flora in the shortest possible time. Consequently, the principle has been adopted that publication of the Flora cannot be delayed for an indefinite period to allow the lengthy and detailed research required for a complete solution of all the problems that arise during its preparation. The committee believes that it is more valuable to have a complete Flora, representing a synthesis of available information, than a series of detailed monographs where completion could not be foreseen. It is planned to complete the Flora in four volumes over the next eight years.

It is important to emphasize that full collaboration with taxonomists in every part of Europe has been sought and obtained at every stage during the writing of the Flora. A panel of Regional Advisers covering each European State was organized (the full list is given above). All manuscripts were circulated to these Advisers, and their comments on them, based on their specialized knowledge of both taxonomy and local distributions, have been invaluable and constitute an integral part of the organization of the Flora.

Arising out of the contacts established in this way, Symposia have been held, at Vienna in 1959, and at Genoa in 1961, to which all the Advisers of the Flora were invited, and at which topics of common interest were discussed. These Symposia have been important in establishing international collaboration on a firm basis, and in making it possible to plan the future progress of the Flora with confidence. A further Symposium was held in 1963 in Romania.

The names of the authors primarily responsible for writing the accounts of the various families and genera are given in footnotes in the text. In preparing the first volume of the Flora for the press, much trouble has been taken by the editors to produce a selfconsistent manuscript, in a fairly standardized form, incorporating such revision and alteration of taxonomy, nomenclature and distribution as has been necessary. It should therefore be made clear that the Editorial Committee takes full responsibility for the form in which the text is published.

Acknowledgement is made below to the many people and organizations who have given help, financial and otherwise, in the preparation of the Flora. We should, however, record here our special gratitude to the Department of Scientific and Industrial Research in London which, by granting the Committee large sums of money over a period of several years, has made it possible to set up and maintain a permanent secretariat at the University of Liverpool, and to undertake the many ancillary activities which have arisen. It is in the prospect of their continuing support that we are now proceeding with the second volume.

## ACKNOWLEDGEMENTS

The Flora Europaea project received in its early stages several valuable ad hoc grants without which no substantial progress could have been made; these were from the Royal Society, the Botanical Research Fund, the Royal Horticultural Society, and Miss M. S. Campbell. A loan from Mr and Mrs J. E. Raven tided the Committee over a difficult period. In 1959 a successful application was made by the Organizing Committee to the Department of Scientific and Industrial Research for a three-year grant which has now been extended for a further three years. The total amount of the grant for the period $1959-1965$ is $£ 32,000$. This has permitted adequate finance of the Secretariat and its services, and the appointment of a number of full-time Research Assistants: Miss A. Mowat (1959-60), Dr P. W. Ball (1959- ) and Mr A. O. Chater (1960- ). Dr Ball previously held a Leverhulme Research Fellowship at the University of Liverpool to work on the project. The Committee gratefully acknowledges all this generous support.

In addition to this main grant from British sources, the project received direct and indirect financial help from several countries, among which should be mentioned a grant for secretarial printing from the Instituto de Alta Cultura, Lisbon, and grants from the Ministries of Education in Austria and Italy, and from the International Union of Biological Sciences, towards the Symposia held in Vienna and Genoa. The third Symposium which was held in Romania was generously subsidized by the Academy of the Romanian People's Republic. We gratefully acknowledge the sponsorship of our project by the Linnean Society of London.

Acknowledgement is also due to the Universities of Cambridge, Dublin, Durham, Leicester and Liverpool for their support in making facilities available to the members of the Editorial Committee and their assistants. In particular the University of Liverpool has provided accommodation in the Hartley Botanical Laboratories for the Secretariat since 1957.

We are also grateful to the Directors of the various Museums and Herbaria who have provided the Editorial Committee and Regional Advisers with facilities to study their collections and utilize their libraries. Amongst these must be mentioned the Herbarium and Library, Royal Botanic Gardens, Kew, the Department of Botany, British Museum (Natural History), London, the Naturhistorisches Museum, Vienna, and the Herbarium of the Istituto Botanico, Florence. The Trinity College Dublin Trust has made a substantial grant towards the provision of microfilm and a reader.

A very large number of individual botanists have assisted us in various ways. The following deserve special mention: P. Aellen (Basel), Miss P. Edwards (London), Alfred Hansen (København), E. K. Horwood (Leicester), A. C. Jermy (London), N. Y. Sandwith (Kew). P. D. Sell (Cambridge), as well as assisting in several other ways, undertook the laborious tąsk of preparing the index for the press.

The staff of the Secretariat, Mrs R. Seddon, Mrs J. Beck and Mrs T. Donnelly deserve our special gratitude for their great efficiency and loyalty even during times of almost overwhelming pressure.

## INTRODUCTION

The aim of the Flora is in general diagnostic, and the descriptions, while brief, are as far as possible comparable for related species. The Basic and Standard Floras listed on p. xxii, and the monographs or revisions given when appropriate after the descriptions of families and genera may assist the reader in obtaining more detailed information. Other references to published work are occasionally given in cases of special taxonomic difficulty.

All available evidence, morphological, geographical, ecological and cytogenetical, has been taken into consideration in delimiting species and subspecies, but they are in all cases definable in morphological terms. (Taxa below the rank of subspecies are not normally included.)

The delimitation of genera in many families is often controversial and the solution adopted in the Flora may be a somewhat arbitrary choice between conflicting opinions. We have endeavoured to weigh as fairly as possible the various opinions available, but there has been no consistent policy of 'lumping' or 'splitting' genera (or, for that matter, species). The order and circumscription of the Dicotyledones is that of Engler-Diels, Syllabus der Pflanzenfamilien ed. 11 (1936), with some modifications in certain groups.

All descriptions of taxa refer only to their representatives in Europe. In practice, we have relaxed this rule slightly for families and genera to avoid giving taxonomically misleading information, particularly in those cases where a large family or genus has only one or few, perhaps atypical, members in Europe. In such cases we have occasionally added 'in European members' or a similar phrase to emphasize the atypical representation. In no case, however, should it be assumed that the description is valid for all the non-European representatives of these taxa.

Often a short note follows the description of a species or, occasionally, a genus, containing additional information of various kinds.

## (a) Choice of language

Much thought was given to the question of the best language for the Flora. There were many reasons in favour of English, but the alternative of Latin also had much to commend it. After consulting the Regional Advisers, we decided in favour of English. Opinion in Europe was fairly evenly divided, but it seemed likely that whereas in some European countries the professional taxonomist might prefer Latin, the general botanist and other biologists would prefer English. It was also clear that outside Europe English would be preferred. As we were anxious to make the Flora available to as wide a circle of readers as possible, we felt that these considerations were decisive.

We have tried, however, to bear in mind throughout the writing and editing of the work that it will be used by many readers whose knowledge of English is very imperfect. For this reason we have restricted ourselves to a much smaller technical vocabulary than is usual, believing that the gain in ease of understanding would offset the small loss of precision sometimes involved. For the same reason, in most cases where there are two English words with the same meaning, we have preferred the one derived from a Latin root. A glossary has been added, whose purpose is not the usual one of explaining technical terms in simple language (which is impracticable on an international basis), but of giving a Latin equivalent of those English words which are important for an
understanding of the text, and which differ substantially from their Latin equivalents. We have also provided a short list of English definitions of those terms which experience has shown to be open to misconstruction.

Place-names used in the summary of geographical distribution have been given in their English form when they refer to independent States (including the constituent republics of the U.S.S.R.) or to such geographical features of Europe as transcend national boundaries. All other place-names are given in the language of the country concerned. Thus we write Sweden, Ukraine, Danube, Alps, Mediterranean, but Corse, Kriti, Slovenija, Rodopi Planina, Ahvenanmaa. Macedonia is written in its English form if reference is intended to the whole of the region that has traditionally been known by that name; but the Jugoslav and Greek administrative units are referred to as Makedonija and Makedhonia respectively.

In transliteration from Cyrillic characters we have, as far as place-names and titles of publications are concerned, followed the ISO system recommended in the UNESCO Bulletin for Libraries 10: 137 (1956). This is almost identical with the system recommended by Paclt in Taxon 2: 159 (1953). Both are based essentially on the conventions of SerboCroat and, although the number of diacritical signs which they require is an undoubted disadvantage, they are the only systems which have any real claim to be considered international, all others in current use being based frankly on the acceptance of German or English conventions of pronunciation. With personal names, however, we have been influenced by the fact that Russian botanists, in transliterating their own names, usually follow German conventions; we have therefore followed the list of transliterations given in the index-volume (1962) to Not. Syst. Leningrad (Botaničeskie Materialy), and have transliterated personal names which do not occur in this list according to the same conventions.

In transliterating place-names from Greek characters we have, except for omitting the accents, followed The Times Atlas of the World, Mid-Century Edition, vol. 4 (London, 1956).

## (b) Delimitation of Europe

We have tried as far as possible to interpret 'Europe' for the purposes of this Flora in its traditional sense. There is no doubt that phytogeographically a more natural unit would be a 'Greater Europe', bounded by the Sahara desert and the great deserts of Asia, and including, therefore, North Africa and much of south-west Asia. But to have attempted to cover this area would have more than doubled our task and would have meant the inclusion of a disproportionately large number of plants whose status and identity are very uncertain. Europe in its traditional sense, however, is completely covered by Floras which, although they vary widely in competence and modernity, reduce the unsolved problems of taxonomy and distribution to a reasonable compass.

In framing a precise definition of Europe in this traditional sense three questions arose: where the boundary with Asia was to be drawn in the U.S.S.R.; where it was to be drawn in the Aegean region; and which islands in the Mediterranean Sea and the Atlantic and Arctic Oceans were to be included.

Only the first of these questions presented any serious difficulty. The existing administrative structure of the U.S.S.R. makes little or no distinction between Europe and Asia; and phytogeographically the boundary between the flora of European Russia on one hand, and of Siberia, Central Asia and the Caucasus on the other hand, is for much of its length represented by a broad transitional zone. We therefore thought it best to
follow as closely as possible the boundary by which the 'European part' is delimited in the Flora URSS, and which very nearly coincides with the limits of the area covered by Stankov and Taliev (p. xxiii). It appears, however, that this boundary has never been very precisely defined (only a small-scale map is provided in the Flora) and has varied somewhat during the course of publication of the work. We have, therefore, for our own purpose drawn it along the line that is indicated on maps I and III.

It will be seen that, in the Arctic, Franz Joseph Land (Zemlja Franca Josifa) and Novaja Zemlja are excluded, but the islands of Kolguev and Vajgač are included; that the boundary is then defined by the Ural Mountains (with a small deviation eastwards near Sverdlovsk) and the Ural River to the Caspian Sea (thus including in Europe a small portion of W. Kazakhstan); and that the whole of the Caucasus, including the greater part of the Stavropol plateau, is excluded.

In the Aegean region we have drawn our boundary along the deep-water channel which separates the Sporadhes and the islands lying close to the mainland of Asia Minor from those of the C. and W. Aegean. The only large islands under Greek sovereignty which are excluded from Europe are the Sporadhes, Khios, Psara and Lesvos. The only island under Turkish sovereignty which is included in Europe is Imroz; Bozcaada (Tenedos) and all the islands in the Sea of Marmara are excluded. Cyprus is also excluded.

All other islands in the Mediterranean (except those administered from Africa) are included in Europe, as are also the Açores, Færöer, Iceland, Jan Mayen, Björnöya (Bear Island) and Spitsbergen.
(c) Keys

Artificial dichotomous keys are provided within families and genera, and, where necessary, within species. A general key to families is also given (p. xxvi), which includes all the families in the European flora, not only those described in this volume. The keys have been designed to be practical, and do not in general use characters which are difficult to observe, even if important taxonomically; they have also been kept as brief as possible. We have tried to give characters useful both in the herbarium and the field, though this has often been difficult because of the lack of information about field characters in certain areas, notably S.E. Europe.

The choice of the indented key was made only after thorough discussion of the advantages and disadvantages of the many possible types of key. Briefly, the advantage of the indented key is that it may also act to some extent as a conspectus; in Papaver, for example, it separates the scapose species of the section Scapiflorae from the rest of the genus. In this way similar species are often grouped together in the key, and identification of an unknown plant is facilitated. On the other hand, we have not hesitated to key out more than once certain taxa in which the relevant characters are variable.

## (d) Citation and synonymy

The use of abbreviations for author and place of publication has been standardized as far as possible, and lists of these abbreviations are given in Appendices I, II, and III.

Synonyms, whether full or partial, are given in parentheses in the text only when they are used in one of the Basic Floras ${ }^{1}$ or when they are necessary to prevent confusion. Synonyms (or the basionym) are also usually given in the text when the combination has not previously been used in a Flora or monograph, or when the nomenclature is unfamiliar or in need of explanation. Otherwise, synonyms are given in the Index only.

[^0]It is important to note that no attempt has been made to give a complete synonymy. Even at the binomial level, the number of names for European plants is four or five times the number of accepted species, and to include all these would be impracticable. Thus, in addition to the binomials in the text, the Index contains all synonyms at specific rank which are used in the Basic and Standard Floras (see pp. xxii-xxiii), with an indication of the species in the text under which they have been relegated to synonymy. Some subspecific names also appear in the Index. In this way, we hope that users of any Basic or Standard Flora will be able to relate the names used in their own Floras to those in Flora Europaea.

## (e) Species descriptions

In order to save space and facilitate identification, descriptions may take the form of a comparison with another description. The conventional way of setting this out is, to give an example (p. 174):
106. Silene dioica (L.) Clairv.... Like 105 but....

This implies that the description with which it is being compared (in this example 105) applies to this taxon but for the differences noted. It does not necessarily mean that the two taxa are similar in appearance. Additional descriptive information is sometimes also given, but in separate sentences.

Where dimensions are given, a measurement without qualification refers to length. Two measurements connected by $\times$ indicate length followed by width. Further measurements in parentheses indicate exceptional cases outside the normal ranges.

The diploid chromosome number $(2 n=)$ is given where it has been possible to verify that the count was made on material of known wild European origin. This stringent requirement means that many published numbers are not included. It is planned to publish separately a check-list of references to the data on which the published numbers are based.

Ecological information has been given very sparingly, and only where the ecological characteristics of a species are clearly and concisely definable for its total European range. There is an inevitable irregularity of treatment in this respect, but here, as with chromosome number, the editorial committee has thought it best to include only well-verified statements.

The description of each species is followed by an indication of its distribution within Europe. This falls into two parts: (1) a summary in a short phrase; (2) a list of abbreviations of 'territories' in which the species occurs. The summary phrase makes use of everyday geographical phrases and concepts such as 'W. Europe', 'the Mediterranean region', 'the Balkan peninsula', etc. Maps iv and $v$ and the lists accompanying them indicate the interpretation which is to be put on these phrases. We would emphasize that they are to be interpreted in a simple geographical sense, and do not attempt in any way to divide Europe phytogeographically.

Species believed to be endemic to Europe are distinguished by a symbol ( $\bullet$ ) before the summary of geographical distribution.

A more precise indication of distribution is given by the enumeration of the 'territories' (indicated by two-letter abbreviation) in which the plant is believed to occur. The limits of these territories follow, with very few exceptions, existing political boundaries. An alternative plan, which has been suggested by several critics, of dividing Europe into floristic regions and ignoring political boundaries would seem at first sight to have much to commend it. It is, however, impracticable for two reasons. First, although there is
some agreement as to the broad primary units into which Europe might be divided floristically, there is no agreement on where exactly their boundaries are to be drawn, or on how they should be subdivided into smaller units of convenient size. Secondly, the information is more readily available in political than in phytogeographical terms. For rare or localized species it would have been possible to translate the information from one system to the other; but for wide-ranging species which are described as occurring for example dans une grande partie de la France mais très rare dans la région méditerranéenne, the assignment to phytogeographical areas would have meant a search of local Floras and herbaria quite beyond the powers of authors or editors in the time available.

The political divisions have, therefore, been accepted. Each territory represents a sovereign State, with the following exceptions:

1. Certain islands or island-groups have been, on account of their size, isolation, or floristic peculiarities, treated as separate territories. These comprise Kriti, Corse, Sardegna, Sicilia, Islas Baleares, Færöer, Svalbard, Açores.
2. Malta is grouped with Sicilia, and the Channel Islands are grouped with France.
3. The island of Ireland is treated as a single territory.
4. Germany is treated as a single territory.
5. The U.S.S.R. has been subdivided, not according to its constituent republics (though these are referred to by name in the geographical summary), but into six divisions formed by grouping together the floristic regions used in Flora URSS.

A small adjustment has been made in the N . and E . Ukraine, so as to bring the boundaries as far as possible into line with those which delimit the regions used in Flora RSS Ucr.

The territories, of course, vary greatly in size, and Ga , Hs or Ju gives much less precise information than does Fa , Rs (K) or Tu. In all cases, however, the lists provide a statement as to which national Floras should be searched for further detailed information, whether on distribution or on taxonomy.

Occasionally the list of territories is followed by a brief indication, in parentheses, of extra-European distribution. We should, perhaps, explain why we have not done this for all species-a policy that was urged on us by many of our advisers. It is simply because we found that in far too many cases the information was not available. It is one thing to note that a plant has been recorded from China, from Tropical Africa, or from North America under the same name as a European species; it is a very different matter to find out whether, in the opinion of a competent taxonomist, the two should really be judged as conspecific. We therefore thought it better to say nothing than to give further currency to data which have not been critically sifted and which contain many erroneous records.

The only exceptions to this rule are for plants of which the European range is only a small fraction of their total area. If the only European record for a plant is from a limited area of S. Spain the reader may well wish to know whether it is strictly endemic there, or is found also across the straits in Morocco, or is a wide-ranging plant of North Africa that has established a small bridgehead in Europe. The three cases would be distinguished thus:

- S. Spain Hs indicates endemic to S. Spain
S. Spain Hs indicates found also outside Europe
S. Spain Hs (N. Africa) indicates widespread also in North Africa; not primarily a European plant


## (f) Infraspecific taxa

In general the only infraspecific taxa described and keyed in the Flora are subspecies. Any formal treatment of variation below the level of subspecies would have been impossible in a Flora of this kind; most of the known variation of taxa is, however, covered in the descriptions. Taxa below the level of subspecies may also be mentioned when, in the opinion of the author, they seem to have some claim to recognition at higher rank, but require further investigation. Conversely, many taxa published as species or subspecies, but whose claim to the rank seems doubtful, are described or briefly mentioned in supplementary notes under the species to which they seem most closely related.

No 'experimental' categories, such as ecotypes, are used in the Flora in a formal systematic sense, though they are sometimes mentioned in notes.

## ( $g$ ) Treatment of critical groups

In certain cases where it is difficult to distinguish between a number of closely similar species, an ad hoc 'group' has been made, and these groups, not the individual species, are keyed out in the main species-key. They will serve for at least a partial identification. Following the description of a group in the text, a key to the component species is given, and they are then numbered and described so that a more detailed study, or the use of more adequate material, may enable the user to take the identification further. For example, in Silene there is the $S$. mollissima group, which comprises the species $S$. mollissima (L.) Pers., S. pseudovelutina Rothm. and S. velutina Pourret. Such groups have no nomenclatural status.

For the inbreeding and apomictic groups, other ad hoc treatments have been devised. The general approach to such groups is set out and discussed in detail in the Report of the first Flora Europaea Symposium. ${ }^{1}$
(h) Treatment of hybrids

Only those few hybrids which reproduce vegetatively and are frequent over a reasonably large area (e.g. Sagina $\times$ normaniana) are described and keyed as for species. Other common hybrids may be mentioned individually in notes (e.g. Silene alba $\times$ dioica), or collectively for the whole genus (e.g. Quercus).

## (i) Alien species

The question of which alien species should be included is a difficult one for any Flora, and the difficulty is even greater on a continental scale. We have attempted to include the following categories:
(i) Aliens which are effectively naturalized. These include garden plants which have escaped to situations not immediately adjacent to those in which they are cultivated, as well as weeds and other plants which have been accidentally introduced; provided, in both cases, that the plant has been established in a single station for at least 25 years, or is reported as naturalized in a number of widely separated localities.
(ii) Trees or crop-plants which are planted or cultivated in continuous stands on a fairly extensive scale.

Casual aliens, i.e. those which do not persist without constant fresh introductions, are not included unless they have often been mistaken for a native or established species, or are for any other reason of special interest.

[^1]In assessing the status of a species in any part of Europe we have, however, been dependent almost entirely on the information contained in the national Floras, and it is clear that the criteria used by different authors vary widely. There are some genera, for example Chenopodium, in which every transitional state from a casual to a wellestablished weed can be observed. All data on native, established or casual status relating to weeds or other 'palaeosynanthropic' plants must, therefore, be regarded only as approximate.
(j) Publication of Novitates

In the process of writing the accounts, much new material requiring publication has naturally been brought together. For the publication of much of this material, the Committee has made an arrangement with the Editorial Board of Feddes Repertorium, by which taxonomic and nomenclatural notes may be published as part of a series entitled Notulae Systematicae ad Floram Europaeam spectantes. The first of these appeared in 1961. By this arrangement, publication of any new names of combinations in the Flora itself has been avoided.

# LISTS OF BASIC AND STANDARD FLORAS 

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## SYNOPSIS OF FAMILIES

## PTERIDOPHYTA

## LYCOPSIDA

I Lycopodiaceae
II Selaginellaceae
III Isoetaceae

## SPHENOPSIDA

IV Equisetaceae
FILICOPSIDA
V Ophioglossaceae
VI Osmundaceae
VII Sinopteridaceae
VIII Adiantaceae
IX Pteridaceae
X Cryptogrammaceae

XI Gymnogrammaceae
XII Dicksoniaceae
XIII Hypolepidaceae
XIV Davalliaceae
XV Hymenophyllaceae
XVI Thelypteridaceae
XVII Aspleniaceae
XVIII Athyriaceae
XIX Aspidiaceae
XX Elaphoglossaceae
XXI Blechnaceae
XXII Polypodiaceae
XXIII Marsileaceae
XXIV Salviniaceae
XXV Azollaceae

## SPERMATOPHYTA

GYMNOSPERMAE
CONIFEROPSIDA
Coniferales
XXVI Pinaceae
XXVII Taxodiaceae
XXVIII Cupressaceae
TAXOPSIDA
Taxales
XXIX Taxaceae

## GNETOPSIDA

Gnetales
XXX Ephedraceae

## ANGIOSPERMAE

DICOTYLEDONES
Salicales
XXXI Salicaceae
Myricales
XXXII Myricaceae

Juglandales
XXXIII Juglandaceae

## Fagales

XXXIV Betulaceae
XXXV Corylaceae
XXXVI Fagaceae
Urticales
XXXVII Ulmaceae
XXXVIII Moraceae
XXXIX Cannabaceae
XL Urticaceae
Proteales
XLI Proteaceae
Santalales
XLII Santalaceae
XLIII Loranthaceae
Aristolochiales
XLIV Aristolochiaceae
XLV Rafflesiaceae (Cytinaceae)

## Balanophorales

XLVI Balanophoraceae

| XLVII | Polygonales <br> Polygonaceae | $\begin{aligned} & \text { LXIV } \\ & \text { LXV } \end{aligned}$ | Magnoliaceae <br> Lauraceae |
| :---: | :---: | :---: | :---: |
|  | Centrospermae |  | Rhoeadales |
| XLVIII | Chenopodiaceae | LXVI | Papaveraceae |
| XLIX | Amaranthaceae |  | (incl. Fumariaceae) |
| L | Nyctaginaceae | LXVII | Capparidaceae |
| LI | Phytolaccaceae | LXVIII | Cruciferae |
| LII | Aizoaceae | LXIX | Resedaceae |
| LIII | Molluginaceae |  | Sarraceniales |
| LIV | Tetragoniaceae | LXX | Sarraceniaceae |
| LV | Portulacaceae | LXXI | Droseraceae |
| LVI | Basellaceae |  |  |
| LVII | Caryophyllaceae | LXXII | Rosales (part) |
|  | Ranales | LXXIII | Saxifragaceae |
| LVIII | Nymphaeaceae | LXXIV | Parnassiaceae |
| LIX | Nelumbonaceae | LXXV | Hydrangeaceae |
| LX | Ceratophyllaceae | LXXVI | Escalloniaceae |
| LXI | Ranunculaceae | LXXVII | Grossulariaceae |
| LXII | Paeoniaceae | LXXVIII | Pittosporaceae |
| LXIII | Berberidaceae | LXXIX | Platanaceae |

## KEYS TO MAJOR TAXA

1 Plant reproducing by spores; always herbaceous
Pteridophyta
1 Plant reproducing by seeds; often woody
2 Ovules not enclosed in an ovary, borne either on the upper surface of scales arranged in cones, or solitary and terminal
on lateral stems; perianth absent; trees or shrubs
Gymnospermae
2 Ovules completely enclosed in an ovary; perianth usually present; herbs, trees or shrubs

Angiospermae

## KEY TO PTERIDOPHYTA

1 Stems jointed, leaves forming a sheath at the nodes
IV. Equisetaceae

1 Stems not jointed, leaves not fused into a sheath
2 Plants free-floating on water
3 Leaves small, two-ranked, imbricate XXV. Azollaceae
3 Leaves in whorls of 3, two entire, floating, the third submerged and root-like
XXIV. Salviniaceae

2 Plants rooted to the ground, aquatic or terrestrial
4 Leaves not differentiated into lamina and petiole
5 Leaves forming a basal rosette
III. Isoetaceae

5 Leaves not forming a basal rosette
6 Aquatic; leaves filiform
XXIII. Marsileaceae

6 Terrestrial; leaves not filiform
7 Plants homosporous; leaves without ligule I. Lycopodiaceae
7 Plants heterosporous; leaves with ligule II. Selaginellaceae
4 Leaves with distinct lamina and petiole
8 Leaves long-petiolate, with 4 leaflets
XXIII. Marsileaceae

8 Leaves not with 4 leaflets
9 Sporangia without an annulus
10 Plants $60-150 \mathrm{~cm}$; vernation circinate VI. Osmundaceae
10 Plants rarely more than 60 cm ; vernation not circinate
V. Ophioglossaceae

9 Sporangia with an annulus
11 Fertile and sterile leaves dissimilar
12 Leaves entire
XX. Elaphoglossaceae

12 Leaves not entire
13 Leaves 1-pinnate; pinnae entire XXI. Blechnaceae
13 Leaves 2- to 4-pinnate (or if 1-pinnate, pinnae pinnatifid)
14 Leaves pinnate; pinnae pinnatifid or lobed
XVIII. Athyriaceae

14 Leaves 2- to 4-pinnate
15 Perennial; sori $\pm$ marginal, covered by deflexed leaf-margin
X. Cryptogrammaceae

15 Annual; sori superficial, without indusium
XI. Gymnogrammaceae

11 Fertile and sterile leaves similar (or differing only in size)
16 Leaves mostly not more than 1 cell thick
XV. Hymenophyllaceae

16 Leaves more than 1 cell thick
17 Leaves entire, or pinnatifid, or palmately lobed, or dichotomously forked 1-3 times
18 Leaves not pinnatifid
XVII. Aspleniaceae

18 Leaves pinnatifid
19 Leaves covered with scales on lower surface
XVII. Aspleniaceae

19 Leaves not covered with scales XXII. Polypodiaceae 17 Leaves pinnately divided
20 Sori covered by deflexed margin of leaf
21 Leaf-segments long, linear-lanceolate IX. Pteridaceae
21 Leaf-segments not linear-lanceolate
22 Rhizome long, subterranean XIII. Hypolepidaceae

22 Rhizome short, superficia
23 Petiole red-brown or yellow-brown
VII. Sinopteridaceae

23 Petiole black
24 Pinnules cuneate, flabellate, $\pm$ toothed
VIII. Adiantaceae

24 Pinnules shallowly cordate, triangular, entire
VII. Sinopteridaceae

20 Sori not covered by deflexed margin of leaf
25 Indusium absent
26 Leaves not more than 8 cm
XVII. Aspleniaceae

26 Leaves more than 8 cm
27 Pinnae entire
XXII. Polypodiaceae

27 Pinnae divided
28 Leaves forming a crown XVIII. Athyriaceae
28 Leaves solitary
29 Groove of rhachis interrupted to admit grooves of costae; lamina tripartite XIX. Aspidiaceae
29 Groove of rhachis not interrupted to admit grooves of costae; lamina not tripartite
XVI. Thelypteridaceae

25 Indusium present
30 Leaves up to 250 cm , producing young plants vegetatively on the distal part XXI. Blechnaceae
30 Leaves not more than 200 cm , not producing plants vegetatively
31 Rhizome very hairy, without scales
XII. Dicksoniaceae

31 Rhizome not hairy, but with scales
32 Indusium cup-shaped
XIV. Davalliaceae

32 Indusium not cup-shaped
33 Indusium a circumbasal ring of hairy scales
XVIII. Athyriaceae

33 Indusium not a ring of scales
34 Indusium hood-like, attached at basiscopic side of sorus XVIII. Athyriaceae
34 Indusium not hood-like
35 Indusium peltate
35 Indusium not peitate
36 Sori orbicular
37 Sori marginal; indusium lying along vein
XVI. Thelypteridaceae

37 Sori not marginal; indusium lying across vein
XIX. Aspidiaceae 36 Sori ovate or linear
38 Leaves solitary on rhizome
XVIII. Athyriaceae

38 Leaves forming a crown or apical tuft on rhizome
39 Sori ovate; lower margin of indusium bent in the middle XVIII. Athyriaceae
39 Sori linear or ovate; lower margin of indusium straight XVII. Aspleniaceae

## KEY TO GYMNOSPERMAE

1 Leaves all scale-like and usually brownish; internodes long
XXX. Ephedraceae

1 Most leaves green; internodes short
2 Female flowers solitary; seed surrounded by a fleshy aril
XXIX. Taxaceae

2 Female flowers in cones; seeds without a fleshy aril

3 Leaves opposite or whorled
3 Leaves alternate or 2-5 on short shoots
4 Bracts and cone-scales distinct from one another
XXVI. Pinaceae

4 Bracts and cone-scales wholly or partially united
XXVII. Taxodiaceae

## KEY TO ANGIOSPERMAE

This key covers all the families in volume 1 and the great majority of those in volumes 2-4, though some introduced families and, doubtless, some anomalous genera, have been omitted. A comprehensive key will be included in volume 4.

1 Plant free-floating on or below surface of water, not rooted in mud
2 Plant with small bladders on leaves or on apparently leafless stems; leaves divided into filiform segments Lentibulariaceae
2 Not as above
3 Plant without obvious differentiation into stems and leaves
Lemnaceae
3 Plant with obvious stems and leaves
4 Leaves with a cuneate basal part, 4-6 setaceous segments and a terminal orbicular lobe
LXXI. Droseraceae

4 Leaves not as above
5 Floating leaves sessile Hydrocharitaceae 5 Floating leaves long-petiolate 6 Floating leaves orbicular, entire
 6 Floating leaves rhombic, dentate in upper $\frac{2}{3}$

Hydrocharitaceae
1 Land-plants or aquatics rooted in mud
7 2- to 4 -fid coloured staminodes present inside the sepals; leaves often fasciculate LII. Molluginaceae
7 Not as above
8 Perianth of 2 (rarely more) whorls differing markedly from each other in shape, size or colour
9 Petals not all united into a tube at base, very rarely cohering at apex
10 Ovary superior
11 Carpels 2 or more, free, or united at the base only
12 Sepals and petals 3
13 Carpels more than 3
14 Leaves lobed
14 Leaves entire
LXI. Ranunculaceae 13 Carpels 3 15 Leaves palmately divided; petioles spiny Palmae 15 Leaves simple, sessile LXXII. Crassulaceae 12 Sepals or petals more than 3
16 Flowers zygomorphic; petals deeply divided
LXIX. Resedaceae

16 Flowers actinomorphic; petals entire
17 Stamens more than twice as many as petals
18 Shrubs or herbs with stipulate leaves; flowers perigynous Rosace
18 Herbs; stipules 0, though leaf-bases sometimes sheathing; flowers hypogynous
19 Fruit a head of achenes; sepals deciduous
LXI. Ranunculaceae

19 Fruit of 2-5 follicles; sepals persistent
LXII. Paeoniaceae 17 Stamens not more than twice as many as petals
20 Leaves 3-foliolate
Rosaceae
20 Leaves simple
21 Carpels spirally arranged on an elongated receptacle
LXI. Ranunculaceae

21 Carpels in 1 whorl
22 Trees with palmately lobed leaves; flowers in globose capitula
LXXIX. Platanaceae

22 Herbs or shrubs; leaves not palmately lobed; flowers not in globose capitula
23 Herbs or dwarf shrubs with terete stems; leaves $\pm$ succulent
LXXII. Crassulaceae

23 Shrubs with angular stems; leaves not succulent
Coriariaceae
11 Carpels obviously united for c. $\frac{1}{2}$ their length or more, or carpel solitary
24 Flowers actinomorphic
25 Petals more than 10
26 Aquatic herbs with petiolate leaves
27 Leaves floating, usually with a deep basal sinus
LVIII. Nymphaeaceae

27 Leaves not floating, peltate LIX. Nelumbonaceae
26 Terestrial herbs or shrubs with sessile or subsessile leaves
28 Stamens 4-6 LXIII. Berberidaceae
28 Stamens numerous
LII. Aizoaceae

25 Petals fewer than 10
29 Stamens more than twice as many as petals
30 Stamens with their filaments united into a tube
Malvaceae
30 Stamens free or united in bundles
31 Perianth-segments persistent in fruit, 2 large and 2 small
XLVII. Polygonaceae

31 Perianth-segments not as above
32 Ovary on a long gynophore LXVII. Capparidaceae
32 Ovary sessile or nearly so
33 Ovary surrounded by a cup-shaped perigynous zone; ovule 1 Rosaceae
33 No cup-shaped perigynous zone; ovules 2 or more
34 Carpel 1; leaves 2-ternate, lower leaflets stalked
LXI. Ranunculaceae

34 Carpels 2 or more; leaves not as above
35 Large trees; inflorescence with a conspicuous bract partly adnate to peduncle Tiliaceae 35 Not as above
36 Styles more than 1, free
37 All or most leaves alternate; outer perianthsegments petaloid LXI. Ranunculaceae
37 All leaves opposite or verticillate; outer perianth-segments sepaloid Hypericaceae
36 Style 1 or 0
38 Petals 4 LXVI. Papaveraceae
38 Petals 5
39 Ovary 1-locular or septate at base only; stamens numerous

Cistaceae
39 Ovary 3-locular; stamens 15 Zygophyllaceae
29 Stamens not more than twice as many as petals
40 Trees, shrubs or woody climbers
41 Flowers on tough leaf-like cladodes; leaves scalelike, brownish Liliaceae
41 Not as above
42 Leaves small, scale-like or ericoid
43 Perianth-segments in 2 whorls of 3; stamens 3
Empetraceae
43 Perianth-segments and stamens more than 3 in
a whorl
44 Leaves opposite
Frankeniaceae
44 Leaves alternate Tamaricaceae

42 Leaves neither scale-like nor ericoid


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    70 Inner whorl of perianth-segments not
            green
    71 Sepals and petals 4; stamens 4 or }
    72 Stipules absent; stamens usually }
                            LXVIII. Cruciferae
    72 Stipules present; stamens 4
                                    LVII. Caryophyllaceae
    71 Sepals and petals 5; stamens 5 or 10
    73 Leaves with conspicuous, red, viscid,
                glandular hairs
                            LXXI. Droseraceae
        73 Not as above
            74 Leaves with numerous pellucid glands,
                strongly scented when crushed Rutaceae
            74 Leaves without pellucid glands
            75 Style 1; stigma entire or shallowly
                lobed; anthers opening by pores
                                    Pyrolaceae
            75 Style or stigmas more than 1; anthers
                opening by longitudinal slits
            7 6 \text { Stigmas } 5
                7 7 \text { Leaves lobed or pinnate Geraniaceae}
                7 7 \text { Leaves entire}
                7 8 \text { Sepals united; leaves basal}
                                    Plumbaginaceae
            78 Sepals free; leaves cauline Linaceae
                76 Stigmas 2-4
                79 Flowers with conspicuous glandular-
                                    fimbriate staminodes
                                    LXXIV. Parnassiaceae
                79 Glandular-fimbriate staminodes ab-
                sent
                    8 0 \text { Stamens 5 LVII. Caryophyllaceae}
                    80 Stamens 10 LXXIII. Saxifragaceae
    24 Flowers zygomorphic
    81 Flowers saccate or spurred at base
    82 Sepals 2, small
                                LXVI. Papaveraceae
    82 Sepals 3 or 5
            83 Sepals 3, very unequal, 1 spurred; petals 3, not
                spurred
                                    Balsaminaceae
            8 3 \text { Sepals 5; petals } 5
            84 Leaves alternate
            84 Leaves opposite
    81 Flowers not saccate or spurred at base
            85 All, or all but one, of the stamens united into a tube
            86 Anthers opening by pores
                                    Polygalaceae
            8 6 \text { Anthers opening by slits Leguminosae}
            85 All stamens free
            87 Trees or shrubs
            88 Leaves simple
                89 Ovary on a long gynophore
            8 9 \text { Ovary sessile}
                    90 Petals }
                                LXVIII. Cruciferae
                    90 Petals }
                            L
                    88 Leaves compound
                    91 Leaves trifoliate or pinnate
                    LXVII. Capparidaceae
                            Leguminosae
                                    Leguminosae
                    91 Leaves palmate with more than }3\mathrm{ leaflets
                                    Hippocastanaceae
            8 7 \text { Herbs}
            92 Ovary and fruit deeply 5-lobed
            93 Flowers in umbellate cymes; fruit with a long
                beak
                    Geraniaceae
            93 Flowers in racemes; fruit not beaked Rutaceae
            92 Ovary and fruit not deeply 5-lobed
            9 4 ~ P e t a l s ~ f i m b r i a t e ~ o r ~ l o b e d ~
                            LXIX. Resedaceae
            94 Petals entire or emarginate
            95 Stamens }1
                                    Leguminosae
                    95 Stamens not more than }
                    96 Sepals free; ovary 2-locular LXVIII. Cruciferae
                    96 Sepals inserted on a cup-like perigynous zone;
                    ovary 1-locular
                                    LVII. Caryophyllaceae
10 Ovary inferior or partly so
97 Petals numerous
```

98 Aquatic plants; leaves not succulent LVIII. Nymphaeaceae
98 Land-plants; leaves succulent
LII. Aizoaceae

97 Petals 5 or fewer
99 Petals and sepals 3
100 Flowers zygomorphic
101 Style and filaments obvious $\begin{array}{rr}\text { Iridaceae } \\ 101 & \text { Stigma and stamens sessile }\end{array}$
100 Flowers actinomorphic
102 Outer perianth-whorl sepaloid
Hydrocharitaceae
102 Both perianth-whorls petaloid
103 Stamens 6
Amaryllidaceae 103 Stamens 3

Iridaceae
99 Petals and sepals 2 , 4 or 5
104 Stamens numerous
105 Leaves opposite, with pellucid glands
Myrtaceae
105 Leaves alternate, without pellucid glands
106 Leaves serrulate
107 Styles free; fruit fleshy
Rosaceae
107 Styles united, except at the top; fruit a capsule
LXXV. Hydrangeaceae

106 Leaves entire; seeds covered with pulp Punicaceae 104 Stamens 10 or fewer
108 Aquatic; leaves pinnate, segments filiform; flowers in spikes

Haloragaceae
108 Not as above
109 Trees, shrubs or woody climbers
110 Flowers in umbels
111 Climbers
Araliaceae
111 Erect shrubs
112 Evergreen; umbels flat
112 Deciduous; umbels globose
Umbelliferae
110 Flowers not in umbels
113 Leaves palmately lobed LXXVII. Grossulariaceae 113 Leaves not lobed
114 Both perianth-whorls petaloid Onagraceae 114 Outer perianth-whorl sepaloid
115 Calyx-teeth very small; ovules 1 in each carpel; fruit a drupe Cornaceae
115 Calyx-teeth large; ovules numerous; fruit a capsule
116 Stamens 10
LXXV. Hydrangeaceae

116 Stamens 5
LXXVI. Escalloniaceae

109 Herbs
117 Both perianth-whorls sepaloid
Rosaceae
117 Inner perianth-whorl petaloid
118 Petals 5

| 119 | Umbelliferae |  |
| :---: | :---: | :---: |
| 119 | Stamens 5 |  |
| 118 | Stamens 10 | LXXIII. Saxifragaceae |
| 120 | Flowers in umbels surrounded by 4 conspi- |  |
| cuous white bracts | Cornaceae |  |
| 120 | Flowers not in umbels; no conspicuous white |  |
| bracts | Onagraceae |  |

9 Petals all united at base into a longer or shorter tube
121 Ovary superior
122 Stamens at least twice as many as corolla-lobes
123 Herbs with succulent leaves
LXXII. Crassulaceae

123 Shrubs or trees
124 Flowers unisexual
Ebenaceae
124 Flowers hermaphrodite
125 Anthers opening by pores; hairs simple or scalelike Ericacea
125 Anthers opening by longitudinal slits; hairs stellate
122 Stamens as many as or fewer than corolla-lob
127 Flowers zygomorphic; stem stout, erect Orobanchaceae 127 Flowers actinomorphic; stem slender, twining

Convolvulaceae
126 Green plants
128 Sepals 2; flowers actinomorphic
129 Petals 2; leaves in a rosette
Eriocaulaceae
129 Petals 5; leaves not in a rosette
LV. Portulacaceae

128 Sepals more than 2, or flowers zygomorphic
130 Ovary deeply 4-lobed with 1 ovule in each lobe
131 Leaves alternate
Boraginaceae
131 Leaves opposite
Labiatae
130 Ovary not 4-lobed
132 Flowers actinomorphic or nearly so
133 Carpels free
134 Leaves peltate; carpels 5 LXXII. Crassulaceae
134 Leaves not peltate; carpels 2
135 Corolla with a corona; styles 2 , free but united by the stigma Asclepiadaceae
135 Corolla without a corona; styles 2 , united except at the very base Apocynaceae
133 Carpels united
136 Stamens fewer than corolla-lobes
$137 \begin{aligned} & \text { Herbs } \\ & 137 \text { Shrubs or trees }\end{aligned}$
138 Leaves opposite

## Scrophulariaceae

Oleaceae
138 Leaves alternate
139 Flowers yellow
Oleaceae
139 Flowers not yellow Scrophulariaceae
136 Stamens as many as corolla-lobes
140 Stamens opposite the corolla-lobes
141 Styles or stigmas more than 1; ovule 1
Plumbaginaceae
141 Style 1; stigma 1; ovules numerous
142 Herbs Primulaceae

142 Shrubs Myrsinaceae
140 Stamens alternating with the corolla-lobes 143 Leaves opposite
144 Shrubs
145 Large, erect; leaves deciduous Buddlejaceae
145 Small, procumbent; leaves evergreen
146 Leaves elliptical or oblong; flowers pink
Ericaceae
146 Leaves spathulate; flowers white
Diapensiaceae
144 Herbs
147 Land-plants; leaves sessile Gentianaceae
147 Aquatic plants; leaves petiolate
Menyanthaceae
143 Leaves alternate or all basal
148 Sepals, petals and stamens 4
149 Shrubs
Aquifoliaceae
149 Herbs
150 Corolla not violet-blue Plantaginaceae
150 Corolla violet-blue Gesneriaceae
148 Sepals, petals and stamens 5 (rarely sepals fewer)
151 Ovary 3-celled; stigmas 3 or 3-lobed
152 Leaves pinnate Polemoniaceae
152 Leaves simple Diapensiaceae
151 Ovary 2-celled; stigmas 2 or 1
153 Ovules 4 or fewer
154 Flowers numerous, in scorpioidal cymes; corolla-lobes distinct Boraginaceae
154 Flowers solitary or few, not in scorpioidal cymes; corolla not or scarcely lobed

Convolvulaceae 153 Ovules numerous
155 Aquatic or bog-plants; corolla fimbriate
Menyanthaceae
155 Land-plants; corolla not fimbriate
156 Leaves all basal
156 Some leaves cauline
157 Corolla-tube much shorter than lobes; stamens spreading Scrophulariaceae
157 Corolla-tube long, or anthers connivent

Solanaceae
132 Flowers strongly zygomorphic
158 Anthers opening by pores
Ericaceae
158 Anthers opening by slits
159 Flowers small, crowded in capitula Globulariaceae

## 159 Flowers not in capitula

160 Ovary 1-celled; carnivorous plants

## Lentibulariaceae

160 Ovary 2-celled; not carnivorous plants
161 Ovules numerous Scrophulariaceae
161 Ovules 4
162 Bracts shorter than calyx Verbenaceae
162 Bracts or bracteoles much longer than calyx

Acanthaceae
121 Ovary inferior
163 Stamens 8-10, or 4-5 with filaments divided to base
164 Herb; anthers opening by slits; leaves ternate Adoxaceae
164 Woody; anthers opening by pores; leaves simple
Ericaceae
163 Stamens 5 or fewer; filaments not divided
165 Leaves in whorls of 4 or more
Rubiaceae
165 Leaves not in whorls
166 Stamens opposite corolla-lobes
Primulaceae
Rubiaceae
167 Leaves opposite; stipules interpetiolar
167 Leaves alternate, or stipules not interpetiolar
168 Flowers in capitula surrounded by an involucre of more than 2 bracts
169 Anthers coherent in a ring round the style
170 Ovule 1 ; calyx, if present, represented by hairs or scales Compositae
170 Ovules numerous; calyx-lobes conspicuous, green

Campanulaceae
169 Anthers free
171 Ovules numerous; corolla-lobes longer than tube Campanulaceae
171 Ovule 1; corolla-lobes much shorter than tube
Dipsacaceae
168 Flowers not in capitula, or bracts 2
172 Anthers coherent in a tube round the style
Lobeliaceae
172 Anthers not cohering to one another
173 Anthers sessile; pollen-grains cohering in pollinia

Orchidaceae
173 Stamens with filaments; pollen-grains free
174 Stamens 1-3 Valerianaceae
174 Stamens 4-5
175 Shrubs (sometimes small and creeping), or woody climbers Caprifoliaceae
175 Herbs
176 Tendrils present Cucurbitaceae
176 Tendrils absent
Caprifoliaceae 177 Leaves pinnate

## 177 Leaves not pinnate

178 Flowers hermaphrodite; fruit a capsule
Campanulaceae 178 Flowers unisexual; fruit fleshy

Cucurbitaceae
8 Perianth not of 2 or more markedly different whorls
179 Perianth entirely petaloid
180 Parasites or saprophytes without chlorophyll
181 Flowers mostly unisexual; stamen 1
XLVI. Balanophoraceae

181 Flowers hermaphrodite; stamens 6-16
182 Filaments free
Monotropaceae
182 Filaments united in a column
XLV. Rafflesiaceae

180 Green plants
183 Perianth-segment 1, bract-like
Aponogetonaceae
183 Perianth-segments more than 1, or perianth tubular
184 Stems succulent, leafless but with groups of spines
Cactaceae
184 Not as above
185 Stamens more than 12
186 Herbs or, rarely, woody climbers with pinnate leaves
LXI. Ranunculaceae

186 Trees with simple leaves LXIV. Magnoliaceae

187 Flowers in ovoid capitula without an involucre
Rosaceae
187 Flowers not in capitula, or capitula with an involucre
188 Ovary superior
189 Perianth-segments 4
190 Flowers zygomorphic
XLI. Proteaceae

190 Flowers actinomorphic
191 Perianth tubular below
191 Perianth-segments free
192 Herbs
Thymelaeaceae

189 Perianth-segments more than 4
193 Carpels more than 1, free or nearly so
194 Leaves triquetrous, all basal
194 Leas
193 Carpel 1, or carpels obviously united
195 Perianth-segments 6
195 Perianth-segments 5
196 Stigmas 2-3; stipules sheathing, scarious
XLVII. Polygonaceae

196 Stigma 1; stipules absent
197 Ovules numerous; perianth divided almost to base

Primulaceae
197 Ovule 1; perianth with a long tube
L. Nyctaginaceae

188 Ovary inferior, or flowers male
198 Leaves in whorls of 4 or more
Rubiaceae
198 Leaves not in whorls
199 Flowers in capitula surrounded by an involucre
200 Anthers cohering in a tube round the style, or flowers unisexual

Compositae
200 Anthers free; flowers hermaphrodite Dipsacaceae
199 Flowers not in capitula, though sometimes shortly pedicellate in compact umbels
201 Ovules numerous
202 Perianth-segments 3 , or perianth tubular with a unilateral entire limb
XLIV. Aristolochiaceae

202 Perianth-segments 6
203 Stamens 6
Amaryllidaceae
203 Stamens 3
201 Ovules 1 or 2
204 Leaves opposite
Iridaceae

204 Leaves alternate
205 Flowers in simple cymes or solitary
XLII. Santalaceae

205 Flowers in umbels or superposed whorls
Umbelliferae
179 Perianth not petaloid, often absent, if brightly coloured
then dry and scarious
206 Trees or shrubs, sometimes small
207 Parasitic on branches of trees or shrubs
XLIII. Loranthaceae

207 Not parasitic
208 Stems creeping or climbing with adventitious roots; evergreen

Araliaceae
208 Not as above
209 Flowers borne on flattened evergreen cladodes; leaves small, brownish, scale-like Liliaceae
209 Not as above
210 Most leaves opposite or subopposite
211 Stems green and fleshy or leaves fleshy
XLVIII. Chenopodiaceae

211 Neither leaves nor stems fleshy
212 Styles 3
Buxaceae
212 Styles 4, or 1
213 Flowers in catkins
213 Flowers not in catkins
214 Leaves pinnate; stamens 2
XXXI. Salicaceae

214 Leaves simple; stamens 4 or more
Oleaceae 185 Stamens 12 or fewer

215 Stamens 5, alternating with sepals
215 Stamens 8; sepals 5
Rhamnaceae
Aceraceae

210 All leaves alternate
216 Leaves not more than 2 mm wide, oblong or linear
217 Stigma 1
Thymelaeaceae
217 Stigmas 2-9
218 Stamens 3; leaves not succulent
Empetraceae
218 Stamens 5; leaves succulent XLVIII. Chenopodiaceae
216 Leaves more than 2 mm wide
219 Leaves pinnate
220 Ovary inferior; styles 2; pith septate
XXXIII. Juglandaceae

220 Ovary superior; styles 3 or 1 ; pith not septate
221 Style 1; fruit a lomentum Leguminosae
221 Styles 3; fruit a dry, 1 -seeded drupe Anacardiaceae 219 Leaves simple
222 Petiole with dilated base, enclosing the bud
LXXIX. Platanaceae

222 Petiole-base not enclosing the bud
223 Anthers opening by transverse valves
LXV. Lauraceae

223 Anthers opening by longitudinal slits
224 Flowers not in catkins or dense heads
225 Inflorescence of several male flowers, each of 1 stamen, and a female flower, appearing as a stalked ovary, all surrounded by 4 or 5 conspicuous glands; latex present

Euphorbiaceae
225 Inflorescence not as above; no latex
226 Flowers unisexual
227 Peltate scale-like silvery or ferrugineous hairs present beneath the leaves and often elsewhere; ovary 1-locular; fruit fleshy

Eleagnaceae
227 No scale-like hairs; ovary 3-locular; fruit dry Euphorbiaceae 226 Flowers hermaphrodite
228 Trees; perianth-tube short, with stamens inserted near its base XXXVII. Ulmaceae
228 Shrubs; perianth-tube long, with stamens inserted near its apex Thymelaeaceae
224 Flowers in catkins or dense heads
229 Latex present; fruit or false fruit fleshy
XXXVIII. Moraceae

229 Latex absent; fruit dry
230 Dioecious; perianth absent
231 Bracts (catkin-scales) fimbriate or lobed at apex; flowers with a cup-like disk
XXXI. Salicaceae

231 Bracts (catkin-scales) entire; disk absent
232 Leaves without pellucid glands; stamens with long filaments; ovules numerous
XXXI. Salicaceae

232 Leaves with pellucid glands; stamens with short filaments; ovule 1
XXXII. Myricaceae

230 Monoecious; perianth present in male or female flowers or both
233 Styles 3 or more; flowers of both sexes with perianth XXXVI. Fagaceae
233 Styles 2; perianth present in flowers of 1 sex only
234 Male flowers 3 to each bract; perianth present
XXXIV. Betulaceae

234 Male flowers 1 to each bract; perianth absent XXXV. Corylaceae

## 206 Herbs

235 Perianth absent or represented by scales or bristles, minute in flower; flowers in the axils of bracts, a number of which are usually closely imbricate on a rhachis, forming a spikelet; leaves usually linear, grass-like, sheathing below
236 Flowers usually with a bract above and below; sheaths usually open; stems usually with hollow internodes

Gramineae

236 Flowers with a bract below only; sheaths usually closed; stems usually with solid internodes Cyperaceae
235 Perianth present, or flowers not arranged in spikelets
237 Aquatic plants; leaves submerged or floating; inflorescence sometimes emergent
238 Leaves divided into numerous filiform segments
239 Leaves pinnately divided; flowers in a terminal spike

Haloragaceae
239 Leaves dichotomously divided; flowers solitary, axillary
$\begin{array}{ll}238 & \text { Leaves entire or den } \\ 240 & \text { Flowers in spikes }\end{array}$
241 Rhizome densely covered with stiff fibres; spikes subtended by a group of leaf-like bracts (marine)

Posidoniaceae
241 Not as above
242 Flowers hermaphrodite, arranged all round or on 2 sides of a terete rhachis (fresh or brackish water)

Potamogetonaceae
242 Flowers unisexual, arranged on one side of a flat rhachis (marine)

Zosteraceae
240 Flowers not in spikes
243 Flowers solitary or few, sessile or shortly pedicellate, axillary
244 Leaves in whorls of 8 or more Hippuridaceae
244 Leaves not in whorls of 8 or more
245 Carpels 2 or more, free
246 Carpels nearly or quite sessile in fruit
Zannichelliaceae
246 Carpels in fruit with stalks several times their own length

Ruppiaceae
245 Carpels united, or solitary
247 Female flowers with a very long filiform perianth-tube resembling a pedicel

Hydrocharitaceae
247 Perianth-tube short or 0
248 Perianth-segments 4-6; stamens 4 or more; leaves ovate to obovate
249 Perianth-segments 4; ovary inferior Onagraceae
249 Perianth-segments 6; ovary superior Lythraceae
248 Perianth-segments fewer than 4, or perianth absent; stamen 1; leaves linear to lanceolate
250 Leaves alternate (brackish) Zannichelliaceae
250 Leaves opposite (freshwater)
251 Leaves entire, without sheathing base; ovary compressed, deeply 4-lobed Callitrichaceae
251 Leaves spinulose-dentate, with sheathing base; ovary terete, not lobed Najadaceae
243 Flowers in heads on long peduncles or in com-
pound inflorescences
252 Flowers hermaphrodite; heads few-flowered
Juncaceae
252 Flowers unisexual; heads many-flowered
253 Leaves all basal; heads solitary on long scapes
Eriocaulaceae
253 Some leaves cauline; inflorescence with female heads below and male heads above Sparganiaceae
237 Terrestrial plants or, if aquatic, with inflorescence and either stems or leaves emergent
254 Climbing plants with unisexual flowers
255 Leaves opposite; perianth-segments 5
XXXIX. Cannabaceae

255 Leaves alternate; perianth-segments 6 Dioscoreaceae
254 Not climbing, or rarely climbers with hermaphrodite flowers
256 Leaves linear
257 Flowers unisexual
258 Female flowers solitary; male flowers solitary or in short cymes
XLVIII. Chenopodiaceae

258 Male and female flowers numerous, in dense heads or spikes
259 Male and female flowers in separate globose heads

Sparganiaceae

259 Flowers in a dense cylindrical spike, male above, female below
Typhaceae 257 Flowers hermaphrodite
260 Plant densely pubescent XLVIII. Chenopodiaceae 260 Plant glabrous or sparsely hairy
261 Flowers in dense spikes; spikes apparently lateral on a flattened leaf-like stem Araceae

## 261 Not as above

262 Carpel 1
263 Leaves not subverticillate, exstipulate
XLVIII. Chenopodiaceae
263 Leaves subverticillate, with minute stipules
LVII. Caryophyllaceae
262 Carpels more than 1
264 Carpels free (except at base); leaves with a conspicuous pore at apex Scheuchzeriaceae
264 Carpels $\pm$ completely united; leaves without a conspicuous pore at apex
265 Flowers in unbranched racemes; styles short or 0 Juncaginaceae
265 Flowers in cymes in a branched inflorescence; styles 3, distinct Juncaceae
256 Leaves lanceolate or wider, or sometimes small and scale-like, but never linear
266 Leaves compound
267 Flowers in compound umbels Umbelliferae
267 Flowers not in compound umbels
268 Flowers in capitula
269 Leaves simply pinnate; style 1 or 2 Rosaceae
269 Leaves ternate; styles 3-5 Adoxaceae
268 Flowers not in capitula
270 Stamens numerous; epicalyx 0
LXI. Ranunculaceae

270 Stamens 4 or 5-10; epicalyx present Rosaceae 266 Leaves simple or apparently absent
271 Flowers numerous, small, crowded on an axis (spadix) subtended and often $\pm$ enclosed by a conspicuous bract (spathe)

Araceae

## 271 Not as above

272 Inflorescence of several male flowers, each of 1 stamen, and a female flower, appearing as a stalked ovary, all surrounded by 4 or 5 conspicuous glands; latex present Euphorbiaceae 272 Not as above
273 Leaves apparently absent; stem green and succulent XLVIII. Chenopodiaceae
273 Leaves obvious; stem not succulent
274 Lower leaves opposite, upper alternate; monoecious; male flowers with 2-partite perianth, female with tubular perianth

Theligonaceae
274 Not as above
275 Plant densely clothed with stellate hairs; ovary 3 -locular with 1 ovule in each loculus

Euphorbiaceae
275 Not as above
276 Densely papillose annuals
277 Leaves oblong-lanceolate, never hastate; fruit opening by 5 valves LII. Aizoaceae
277 Leaves ovate-rhombic, often hastate; fruit indehiscent LIV. Tetragoniaceae
276 Not densely papillose annuals
278 Leaves whorled
279 Stigma 1; stems hollow Hippuridaceae 279 Stigmas 3; stems solid LIII. Molluginaceae 278 Leaves not in whorls
280 Leaves alternate or all basal (rarely the lower opposite)
281 Stamens numerous; carpels free except sometimes at base LXI. Ranunculaceae
281 Stamens 12 or fewer; carpels not free, or one only

282 Carpels attached to a central axis, otherwise free LI. Phytolaccaceae
282 Carpels united, or one only
283 Stamens 12 XLIV. Aristolochiaceae
283 Stamens 10 or fewer
284 Stipules united into a sheath
XLVII. Polygonaceae

284 Stipules free or absent
285 Leaves very large, palmately lobed, all basal; inflorescence of dense many-flowered spikes much shorter than the leaves Haloragaceae
285 Not as above
286 Epicalyx present; stipules leaflike Rosaceae
286 Epicalyx 0; stipules small or 0
287 Ovary superior
288 Perianth tubular below
289 Ovule basal
XLVIII. Chenopodiaceae

289 Ovule pendent Thymelaeaceae
288 Perianth-segments free or nearly so, rarely absent in female flowers
290 Perianth-segments 4
291 Flowers in ebracteate racemes
LXVIII. Cruciferae

291 Flowers in axillary clusters
XL. Urticaceae

290 Perianth-segments 5
292 Perianth herbaceous, rarely absent in female flowers
XLVIII. Chenopodiaceae

292 Perianth scarious
XLIX. Amaranthaceae 287 Ovary inferior
293 Leaves reniform, cordate
LXXIII. Saxifragaceae

293 Leaves subulate to linearlanceolate XLII. Santalaceae
280 Leaves opposite (rarely a few upper apparently alternate)
294 Leaves toothed or lobed
295 Flowers hermaphrodite
296 Ovary inferior; stigmas 2
LXXIII. Saxifragaceae

296 Ovary superior; stigmas 5 Geraniaceae
295 Flowers unisexual
297 Perianth-segments 4 or 2; style 1
XL. Urticaceae

297 Perianth-segments 3; styles 2
Euphorbiaceae
294 Leaves entire
298 Perianth 0; ovary compressed, 4-lobed Callitrichaceae
298 Perianth present; ovary not compressed and 4-lobed
299 Perianth-segments 3
XLVII. Polygonaceae

299 Perianth-segments 4 or more
300 Ovary inferior
Onagraceae
300 Ovary superior
301 Perianth-segments 6 or 12; style and stigma $1 \quad$ Lythraceae
301 Perianth-segments 4 or 5 ; styles or stigmas 2 or more
302 Leaves without a long spinose apex; fruit unwinged
LVII. Caryophyllaceae

302 Leaves with a long spinose apex; fruit transversely winged
XLVIII. Chenopodiaceae

## EXPLANATORY NOTES ON THE TEXT

|  | Signs and abbreviations |
| :---: | :---: |
| c. | circa, approximately |
| C. | central |
| cm | centimetre(s) |
| E. | eastern, east |
| incl. | including |
| loc. cit. $\mathrm{m}$ | loco citato, on the same page in the work cited above metre(s) |
| mm | millimetre(s) |
| N. | northern, north |
| $2 n$ | the somatic chromosome number |
| op. cit. | opere citato, in the work cited above |
| S. | southern, south |
| Sect. | Sectio |
| sp. ) | species |
| Subfam. | Subfamilia |
| Subgen. | Subgenus |
| Subsect. | Subsectio |
| $\begin{aligned} & \text { subsp. } \\ & \text { subsp. } \end{aligned}$ | subspecies |
| var. | varietas |
| W. | western, west |
| $\pm$ | more or less |
| 0 | absent |
| - | endemic to Europe |
| [ ] | not native |
| * | status doubtful; possibly native |
| ? | (before a two-letter geographical abbreviation) occurrence doubtful |
| $\dagger$ | extinct |

## Abbreviations of geographical territories

(For precise definitions of these territories, see map 1)

| Al | Albania |
| :--- | :--- |
| Au | Austria |
| Az | Açores |
| Be | Belgium and Luxembourg |
| Bl | Islas Baleares |
| Br | Britain |
| Bu | Bulgaria |
| Co | Corse |
| Cr | Kriti |
| Cz | Czechoslovakia |
| Da | Denmark |
| Fa | Færöer |
| Fe | Finland |
| Ga | France |
| Ge | Germany |
| Gr | Greece |
| Hb | Ireland |
| He | Switzerland |
| Ho | Netherlands |
| Hs | Spain |
| Hu | Hungary |
| Is | Iceland |
| It | Italy |
| Ju | Jugoslavia |

Lu Portugal
No Norway
Po Poland
Rin Romania
Rs U.S.S.R. (European part), subdivided thus:
(N) Northern region
(B) Baltic region
(C) Central region
(W) South-western region
(K) Krym (Crimea)
(E) South-eastern region
$\mathrm{Sa} \quad$ Sardegna
Sb Svalbard (Spitsbergen)
Si Sicilia
Su Sweden
Tu Turkey (European part)

## General notes

The sequence of families is that of Engler-Diels, Syllabus der Pflanzenfamilien ed. 11 (1936), except that the Monocotyledons are placed after the Dicotyledons. A few of the families in the Syllabus have been subdivided in accordance with modern practice.

Descriptions of taxa refer only to the European populations of the taxon in question. If extra-European representatives differ substantially, an explanatory note is sometimes added.

Groups of species have been used in some genera where the species are very difficult to separate. These groups have no formal nomenclatural status and are simply a device to enable a partial identification to be made.

Taxa below the rank of subspecies are neither keyed nor described, and varieties are mentioned only when there are special reasons.

Aliens are included only when they appear to be effectively naturalized or when planted in continuous stands on a fairly large scale.

Hybrids are mentioned only when they occur frequently.
A measurement given without qualification refers to length. Two measurements connected by $x$ indicate length followed by width. Further measurements in parentheses indicate exceptional cases outside the normal range.

Synonyms given in the text are principally those names under which the species or subspecies is described in the Basic Floras listed on p . xxii. The index contains (in addition to these) names which occur in any of the Standard Floras (p. xxii) or in wellknown monographs.

Chromosome numbers are given only when the editors are satisfied that the count has been made on correctly identified material known to be of wild European origin.

Ecological information is provided only when the habitatpreference of a species is sufficiently uniform over its European range to permit it to be summed up in a short phrase.

Geographical terms such as 'W. Europe', 'Mediterranean region', etc., are to be interpreted as shown on maps iv and $v$. The statement that a plant occurs in one or more of these regions does not necessarily imply that it occurs throughout the region.

Extra-European distribution is indicated only for those plants whose European range is small and whose range outside Europe is considerably greater.

## PTERIDOPHYTA

Plants with an alternation of free-living generations. Sporophytes with vascular tissue, usually perennial and herbaceous, reproducing by spores which give rise to small filamentous or thalloid gametophytes (prothalli) bearing archegonia and antheridia on either the same or different prothalli.

## LYCOPSIDA

## I. LYCOPODIACEAE ${ }^{1}$

Herbaceous or suffruticose, with more or less elongated branches bearing small leaves which are without veins or with a midrib only; ligule absent. Homosporous; sporangia in the axils of leaf-like sporophylls, frequently in spikes. Prothallus subterranean, mostly saprophytic and with mycorrhiza.

The family is sometimes divided into Urostachyaceae (Huperzia) and Lycopodiaceae (with the remaining genera); a more conservative treatment is adopted here.

1 Stems ascending, regularly divided dichotomously into branches of equal length; sporangia axillary 1. Huperzi
1 Stems creeping, with short lateral branches; sporangia in terminal spikes
2 Leaves opposite and decussate, somewhat scale-like; branches dorsiventral
4. Diphasium

2 Leaves alternate or in whorls; branches radial
3 Leaves subulate, angular, curved upwards; sporophylls similar but somewhat broader and toothed at base
2. Lepidotis

3 Leaves flat, lanceolate, appressed or deflexed; sporophylls different, ovate to broadly lanceolate, with scarious, toothed margins
3. Lycopodium

## 1. Huperzia Bernh. ${ }^{2}$

Stems short, ascending and divided regularly into branches of equal length. Sporangia axillary, reniform, pedunculate, near the top of the branches; spores foveolate-punctate. Prothallus holosaprophytic, subterranean, large and cylindrical.

1. H. selago (L.) Bernh. ex Schrank \& Mart., Hort. Monac. 3 (1829) (Lycopodium selago L.). Stem $5-30 \mathrm{~cm}$, erect, branched. Leaves imbricate, in many rows on the stem, linear to ovatelanceolate, appressed or patent, often bearing in their axils budlike gemmae. $2 n=c .90,264$, c. 272 . Most of Europe, but only on higher mountains in the south. All except Bl Co Cr Gr Lu Sa Si Rs (K) Tu.
1 Leaves with numerous fine teeth on the margins
(c) subsp. dentata

1 Leaves rarely with a few inconspicuous teeth
2 Green; upper leaves $4-8 \mathrm{~mm}$, usually patent, linear-lanceolate; sporangia usually well developed (a) subsp. selago
2 Yellowish; upper leaves $2-2.5 \mathrm{~mm}$, very appressed, ovatelanceolate; sporangia rarely developed (b) subsp. arctica
(a) Subsp. selago: Throughout the range of the species.
(b) Subsp. arctica (Grossh.) Á. \& D. Löve, Bot. Not. 114: 33
(1961): Mossy tundra. Spitsbergen.
(c) Subsp. dentata (Herter) Valentine, Feddes Repert. 69:44 (1964): Açores.

## 2. Lepidotis Beauv. ${ }^{2}$

Leaves subulate, curved upwards; sporophylls similar, but somewhat broadened and toothed at base. Sporangia opening at the
${ }^{2}$ By W. Rothmaler.
base; spores reticulate. Prothallus hemisaprophytic, napiform, with green foliaceous appendages at the apex.
Stems subterranean, creeping, woody, much-branched; spikes
$\qquad$ Stems above ground, herbaceous; spikes more than 1.5 cm , oblong
2. inundata

1. L. cernua (L.) Beauv., Magas. Encycl. 5: 479 (1804) (Lycopodium cernuum L.). Stem subterranean, creeping, with numerous erect ramifying branches. Fertile spikes $0.5-1 \mathrm{~cm}$, ovoid, yellowish, at the end of short branches, with appressed, dentate sporophylls. Açores; naturalized in Portugal (Valongo). Az [Lu ?Si]. (Pantropical.)
2. L. inundata (L.) C. Börner, Fl. Deutsche Volk 285 (1912) (Lycopodium inundatum L.). Stem above ground, short, creeping, herbaceous, usually with few or no branches, and producing a single erect, simple branch with curved, subulate, acute leaves, $4-6 \mathrm{~mm}$. Spike $1 \cdot 5-3 \mathrm{~cm}$ (or more), with subappressed sporophylls. $2 n=156$. Moors, wet heaths and dunes. Most of Europe, except the Mediterranean region and E. Russia. Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W) Su.

## 3. Lycopodium L. ${ }^{2}$

Leaves arranged spirally or in whorls, flat, linear to lanceolate, appressed or deflexed. Sporophylls quite different from leaves, broadly ovate to broadly lanceolate, with scarious, toothed margins. Sporangia opening at the apex; spores markedly muricate-reticulate. Prothallus holosaprophytic, disciform or tuberous, without appendages.
1 Spikes pedunculate; sporophylls with a long white hair at the apex; leaves acute, apically prolonged as a long white hair
3. clavatum

1 Spikes sessile; sporophylls acute; leaves acute or acuminate
2 Leaves 5-10 mm, acute, regularly toothed; branches $10-15 \mathrm{~mm}$ wide

1. annotinum

2 Leaves 3-7 mm, acuminate, entire, rarely with a few teeth; branches $3-7 \mathrm{~mm}$ wide
2. dubium

1. L. annotinum L., Sp. Pl. 1103 (1753). Stems procumbent, elongate, branched; branches $10-15 \mathrm{~mm}$ wide, ascending. Leaves $5-10 \mathrm{~mm}$, linear-lanceolate or linear, patent or deflexed, thin, acute, coarsely toothed, dull green. Spikes $1 \cdot 5-3 \mathrm{~cm}$, solitary, cylindrical, at the ends of erect branches; sporophylls acute. $2 n=68$. Heaths, moors and mountain grassland. N. Europe, extending southwards in the mountains to the Pyrenees, N. Appennini and S. Carpathians. Au Be Br Bu Cz Da Fe Ga Ge He Ho Hs Hu It No Po Rm Rs (N, B, C, W) Su.
2. L. dubium Zoega, Fl. Isl. 11 (1772) (L. pungens La Pylaie ex Komarov). Like 1 but branches $3-7 \mathrm{~mm}$ wide, erect. Leaves shorter ( $3-7 \mathrm{~mm}$ ), horizontally patent to appressed, linearsubulate, thick, nearly entire and acuminate; spikes shorter $(0 \cdot 5-1 \cdot 5 \mathrm{~cm}) .2 n=68$. Mountain grassland and moors. Arctic and subarctic Europe southwards to $62^{\circ} \mathrm{N} . \mathrm{Fa} \mathrm{Fe}$ Is No Rs (N) Su.

Intermediates between 1 and 2 occur, and further investigation may show that they should be given subspecific rank.
3. L. clavatum L., Sp. Pl. 1101 (1753). Stems long, procumbent; branches ascending. Leaves $3-5 \mathrm{~mm}$, bright green, linear, acute, subappressed, prolonged apically as a hyaline hair $2-3 \mathrm{~mm}$ long. Spikes $1-3,3-6 \mathrm{~cm}$; peduncles $1 \cdot 5-15 \mathrm{~cm}$, with remote, yellowish, bract-like leaves; sporophylls ovate, with a long hyaline hair at the apex. $2 n=68$. Heaths, moors and mountain grassland. N. \& C. Europe, extending locally southwards to C. Spain and Portugal, C. Italy and Bulgaria. Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu Is It Ju Lu No Po Rm Rs (N, B, C, W, E) Su .

A variant with single, almost sessile spikes is common in the north of Fennoscandia.

## 4. Diphasium C. Presl ${ }^{1}$

Stems long, creeping, dorsiventral; branches forked several times and usually caespitose. Leaves 4-ranked, opposite and decussate, somewhat scale-like, the lateral leaves carinate. Spikes terminal, sporophylls different from the leaves; sporangia opening at the apex; spores markedly muricate-reticulate. Prothallus holosaprophytic, napiform, with a semiglobose coronula at the apex.
1 Spikes pedunculate; stems usually subterranean
2 Finer branches $2-3 \mathrm{~mm}$ wide, distinctly flattened; lateral leaves wider than the dorsal 1. complanatum
2 Finer branches $1 \cdot 2-1 \cdot 5(-2) \mathrm{mm}$ wide, slightly flattened; lateral leaves as wide as the dorsal.
2. tristachyum

1 Spikes subsessile; stems usually above ground
3 Finer branches cylindrical or slightly flattened; ventral leaves of sterile branches 0.5 mm wide, petiolate, lanceolate; sporophylls lanceolate, acute
4. alpinum

3 Finer branches 2-2.5 mm wide, flattened; ventral leaves of sterile branches sessile, linear; sporophylls ovate, acuminate
3. issleri

1. D. complanatum (L.) Rothm., Feddes Repert. 54: 64 (1944) (Lycopodium complanatum L., L. anceps Wallr.). Stems farcreeping, subterranean, bearing erect, much-branched shoots; the finer branches $2-3 \mathrm{~mm}$ wide, obviously flattened. Lateral leaves broader than the dorsal; ventral leaves on the finer sterile branches $0.5-1.5 \mathrm{~mm}$ long, $\frac{1}{5}$ as wide as the branches. Spikes pedunculate; sporophylls broadly ovate, as long as broad, shortly acuminate; spores $30 \mu$ in diameter. $2 n=46$. N. \&
C. Europe, extending locally southwards to Spain, N. Italy,
Bulgaria and S. Ural; Açores. Au Az Be Bu Cz Da Fe Ga Ge He
Ho Hs Hu It Ju No Rm Rs (N, B, C, W, E) Po Su.

Plants from Açores and Madeira, which differ from 1 in leaf characters and spore size, have recently been described as Lycopodium madeirense Wilce, Nova Hedwigia 3: 93 (1961).
2. D. tristachyum (Pursh) Rothm., Feddes Repert. 54: 65 (1944) (Lycopodium chamaecyparissus A. Braun). Stems deeply subterranean; erect shoots repeatedly branched and caespitose; finer branches, $1 \cdot 2-1 \cdot 5(-2) \mathrm{mm}$ wide, somewhat flattened. Lateral leaves as wide as dorsal; ventral leaves on the finer sterile branches $1-1.5 \mathrm{~mm}$ long, $\frac{1}{3}$ to $\frac{1}{4}$ as wide as the branches. Spikes pedunculate; sporophylls broadly ovate, acuminate; spores $30 \mu$ in diameter. $2 n=46$. C. Europe, extending to S. Fennoscandia, N. and C. Russia, Romania, C. Italy and the Pyrenees. Au Be Cz Da Ga Ge Fe He Ho Hu It Ju No Po Rm Rs (B, C) Su.

Hybridization between 1 and 2 seems to have occurred in some places, and in S. Finland hybrid derivatives are commoner than D. tristachyum, which is very rare. It is also doubtful whether the European and N. American plants, which are here both referred to D. tristachyum, are rightly placed in the same species.
3. D. issleri (Rouy) J. Holub, Preslia 32: 423 (1960). Stems above ground, procumbent, usually with erect shoots and flattened branches $2-2.5 \mathrm{~mm}$ wide. Ventral leaves of sterile branches $2-3 \mathrm{~mm}$, linear, sessile, $\frac{1}{3}$ as wide as the branches. Spikes $1 \cdot 5-$ 2 cm , sessile; sporophylls $1 \cdot 5-2$ times as long as the sporangia, ovate, acuminate; spores $32-38 \mu$ in diameter. Montane grassland and heath. C. Europe, C. France, Ardennes and Britain. Au $\mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Hu} \mathrm{Ju} \mathrm{Po}$.
4. D. alpinum (L.) Rothm., Feddes Repert. 54: 65 (1944) (Lycopodium alpinum L.). Stems above ground, procumbent, horizontal, elongated, with ascending, densely caespitose, glaucous branches; finer branches slightly flattened or cylindrical. Ventral leaves of the sterile branches $2-2.5 \times 0.5 \mathrm{~mm}$, petiolate, lanceolate. Spikes 1.5 cm , sessile; sporophylls twice as long as the sporangia, lanceolate, acute; spores $45 \mu$ in diameter. $2 n=46,48-50$. Moors and heaths. N. \& C. Europe, extending to the Pyrenees, Appennini, Bulgaria and Ural. Au Be Br Bu Cz ? Da Fa Fe Ga Ge Hb He Hs Is It Ju No Po Rm Rs (N, C) Su.

## II. SELAGINELLACEAE ${ }^{2}$

Stems erect or creeping. Leaves numerous, simple, small, 1 -veined, with a ligule on the adaxial surface. Heterosporous; sporangia grouped in strobili; individual sporangia solitary in the axils of the sporophylls, unilocular; spores tetrahedral.

## 1. Selaginella Beauv. ${ }^{3}$

Leaves either all similar and spirally arranged, or dimorphic and 4 -ranked, the lower patent, the upper appressed and pointing forwards. Strobili terminal; megasporangia at the base and microsporangia at the apex of the strobilus.

The only genus; sometimes divided into several genera.

[^2]1 Leafy stems radially symmetrical; leaves all similar
1 Leafy stems dorsiventral; leaves of two sizes
2 Stems $25-100 \mathrm{~cm}$, articulated where branches occur
2 Stems less than 30 cm , not articulated
3 Strobili on erect peduncles $\quad$ 2. helvetica
3 Strobili sessile
4 Leaves slightly asymmetrical; stems much-branched
3. denticulata

4 Leaves markedly asymmetrical; stems not much-branched
4. apoda

1. S. selaginoides (L.) Link, Fil. Sp. 158 (1841) (S. spinulosa A. Braun). Sterile branches horizontal and short, radially symmetrical; fertile branches $3-15 \mathrm{~cm}$, erect. Leaves $1-3 \mathrm{~mm}$, all
similar, spirally arranged, with $1-5$ large teeth on each side. Strobili $1-5 \mathrm{~cm}$, not well differentiated from the rest of the branch, stout, yellowish. $2 n=18$. N. \& C. Europe; Pyrenees. Al $\mathrm{Au} \mathrm{Br} \mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Fa} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}$, B, C, W) Su.
2. S. helvetica (L.) Spring, Flora (Regensb.) 21 (1): 149 (1838). Stem $3-10 \mathrm{~cm}$, creeping, flattened and dorsiventral, not articulated. Leaves up to 3 mm , dimorphic, 4-ranked, weakly denticulate or subentire. Strobili up to 5 cm , solitary or paired, on erect peduncles, sharply differentiated from the rest of the branch, slender. $2 n=18$. C. \& $S$. E. Europe. Al Au Be Bu Cz Ga Ge Gr He Hu It Ju Po Rm?Tu.
3. S. denticulata (L.) Link, Fil. Sp. 159 (1841). Stem $4-10 \mathrm{~cm}$, creeping, flattened and dorsiventral, not articulated, very slender, much branched. Leaves up to 2.5 mm , dimorphic, 4-ranked, the lower larger, ovate, acuminate, markedly dentate and slightly
asymmetrical. Strobili not more than 2 cm , sessile, not sharply defined at the base. $2 n=18$. S. Europe. Bl Co Cr Ga Gr Hs It Ju Lu Sa Si.
4. S. apoda (L.) Fernald, Rhodora 17: 68 (1915) (S. apus Spring). Stem less than 30 cm , dorsiventral, creeping, not articulated, not much branched. Leaves up to 3 mm , dimorphic, 4 -ranked, denticulate, markedly asymmetrical. Strobili 0.5-$2(-3) \mathrm{cm}$, sessile. Naturalized in Germany. [Ge.] (North America.)
5. S. kraussiana (G. Kunze) A. Braun, Ind. Sem. Horti Berol. 1859, app. 22 (1860) (S. azorica Baker). Stem $25-100 \mathrm{~cm}$, creeping, flattened and dorsiventral, articulated where branches occur. Leaves up to 4 mm , dimorphic, 4 -ranked, finely denticulate, asymmetrical. Strobili not more than 2 cm , sessile. Açores; naturalized in $S$. \& W. Europe. $\mathrm{Az}[\mathrm{Be} \mathrm{Br} \mathrm{Ga} \mathrm{Ge} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Si]}$. (Tropical and S. Africa.)

## III. ISOETACEAE ${ }^{1}$

Stems short, 2- or 3-lobed. Leaves in a rosette; leaf-base spathulate, with a membranous margin, and a delicate ligule on the adaxial surface at the point where the leaf narrows. Heterosporous; megaspores tetrahedral, microspores bilateral, in separate sporangia.

## 1. Isoetes L. ${ }^{2}$

Aquatic or terrestrial plants. Leaves terete or trigonous, subulate, occasionally flat and linear, often without stomata. Sporangia solitary, sessile, naked, or covered with a thin tissue (velum).

The only genus in Europe.
Literature: H. P. Fuchs, Nova Hedwigia, Beih. 3 (1962).
1 Leaf-bases not dark and horny, rarely persistent; plants aquatic or, if amphibious, submerged for most of the year
2 At least $\frac{1}{3}$ of sporangium covered by velum
3 Megaspores reticulate; ligule long, subulate
3 Megaspores not reticulate; ligule short, triangular
4 Megaspores $530-700 \mu$, rugose
4. azorica

4 Megaspores $375-580 \mu$, spiny or tuberculate
5 Megaspores with rounded tubercles; stem 3-lobed
6 Leaf-bases not persisting; microspores smooth or minutely papillose
5. boryana

6 Leaf-bases usually persisting as a papery, brown, scaly 'bulb'; microspores $\pm$ spinose
7 Microspores with short spines; leaves yellow-green.
9. velata

7 Microspores with long setiform spines; leaves not yellow-green
10. tenuissima

5 Megaspores spinose; stems 2-lobed
8 Leaves compressed; membranous margin not extending up leaf
2. setacea

8 Leaves terete; membranous margin extending up leaf for $\frac{1}{3}$ of its length
3. brochonii

2 Sporangium not covered by velum
9 Megaspores minutely papillose with inconspicuous ridges; microspores smooth 6. delil
9 Megaspores verrucose with prominent ridges; microspores spinose
10 Leaves $30-80 \mathrm{~cm}$; plants aquatic $\quad$ 7. malinverniana
10 Leaves $10-25 \mathrm{~cm}$; plants amphibious
8. heldreichii

1 Leaf-bases dark, shiny and persistent; plants terrestrial (if submerged then only for a short period in winter)

[^3]$\begin{array}{ll}11 \text { Megaspores } 320-560 \mu \text {, tuberculate } & \text { 11. histrix } \\ 11 \text { Megaspores } 600-800 \mu \text {, reticulate } & \text { 12. durieui }\end{array}$

1. I. lacustris L., Sp. Pl. 1100 (1753). Aquatic; stem 2-lobed. Leaves $8-25(-40) \mathrm{cm} \times 3-5 \mathrm{~mm}$, erect or rarely patent and recurved, coarse, subterete, tapering to apex; stomata usually absent; membranous margin wide at base, abruptly narrowing above sporangium; ligule short, triangular, often 3-lobed. Sporangium only partially covered by velum; megaspores 530 $700 \mu$, rugose; microspores yellow-brown, smooth or with fine irregular furrows. $2 n=c .110$. Up to 8 m deep in lakes and pools. - N. \& C. Europe, extending locally southwards to Spain, N. Italy and S. W. Bulgaria. Au Be Br Bu Cz Da Fe Ga Ge ?Gr Hb He Ho Hs Is No Po ?Rm Rs (N, B, C) Su.
2. I. setacea Lam., Encycl. Méth. Bot. 3: 314 (1789) (I. echinospora Durieu, I. tenella Léman ex Desv.). Like 1 but leaves $5-15 \mathrm{~cm}$, subulate, compressed, more often patent or recurved; megaspores $440-550 \mu$, with long, narrow spines. $2 n=22,>100$. In more oligotrophic waters than 1. N. \& C. Europe, extending southwards to Spain and N. Italy. Au Br Cz Da Fe Ga Ge Hb He Ho ?Hs Is It No Po ?Rm Rs (N, B, C) Su.

Plants from Iceland have been referred to the North American species I. braunii Durieu, Bull. Soc. Bot. Fr. 11: 101 (1864) non Unger (I. echinospora subsp. muricata var. braunii (Durieu) Á. \& D. Löve). Further investigation is needed.
3. I. brochonii Moteley, Act. Soc. Linn. Bordeaux 45: 45, t. 2 (1892). Like 1, but turf-forming; leaves not more than 10 cm and more slender, often pinkish below; membranous margin wide, extending some distance above sporangium; megaspores $c .450 \mu$, tuberculate, ridges narrow and prominent; microspores smooth or with very few large tubercles. Up to 4 m deep in mountain lakes. - E. Pyrenees. Ga ?Hs.
4. I. azorica Durieu ex Milde, Fil. Eur. 278 (1867). Aquatic; stem 2-lobed. Leaves $8-30 \mathrm{~cm}$, slender, flexuous; membranous margin narrow at base; ligule long, subulate. Sporangium partially covered by velum; megaspores $360-490 \mu$, reticulate; microspores brown, more or less spinose. In pools and small lakes. Açores. Az.
5. I. boryana Durieu, Bull. Soc. Bot. Fr. 8: 164 (1861). Aquatic; stem 3-lobed. Leaves $12-20 \mathrm{~cm}$, loosely inserted and usually with stomata, but otherwise very like those of $\mathbf{1}$; ligule deltate. Velum almost or completely covering sporangium; megaspores 375$600 \mu$, granulate with occasional large papillae on upper faces and numerous regular papillae on lower face; microspores red-brown, smooth or very minutely papillose. Shallow lakes. S.W. coast of France and possibly W. Spain. Ga ?Hs.
6. I. delilei Rothm., Feddes Repert. 54: 72 (1944) (I. setacea Bosc ex Delile, non Lam.). Aquatic; stem 3-lobed. Leaves $12-40 \mathrm{~cm} \times 1-2 \mathrm{~mm}$, often numerous, firm, tapering to apex; membranous margin at base up to 5 mm wide, narrowing abruptly just above sporangium and continuing up leaf for c. $\frac{1}{4}$ of its length; ligule ovate. Sporangium without velum; megaspores $440-500 \mu$, minutely papillose, ridges narrow and inconspicuous; microspores smooth. Ponds and small lakes. - S. France; N. Spain; S. Portugal. Ga Hs Lu.
7. I. malinverniana Cesati \& De Not., Ind. Sem. Horti Genuensis 1858: 36 (1858). Aquatic; stem 3-lobed. Leaves $30-100 \mathrm{~cm}$, numerous, subulate at apex; stomata none or few; base with wide membranous margin extending up leaf for $\frac{1}{6}$ of its length; ligule triangular. Sporangium without velum; megaspores c. $600 \mu$, with large cylindrical or conical tubercles which sometimes fuse to form a prominent wart on each of the upper faces, ridges prominent, undulate; microspores spinose. In rapidly flowing water in irrigation channels. - N.W. Italy (provinces of Vercelli and Novara). It.
8. I. heldreichii Wettst., Verh. Zool.-Bot. Ges. Wien 36: 239, t. 8 (1886). Amphibious; stem 3-lobed. Leaves $10-25 \mathrm{~cm} \times 0 \cdot 5-$ 1.5 mm , few, flexuous; stomata absent; basal membranous margin narrow, extending up leaf for $\frac{1}{6}$ of its length; ligule obovateacute, finely and irregularly cut. Sporangium without velum; megaspores $c .660 \mu$, tuberculate; microspores spinose, narrowly winged. Schistose soil by lake margin.
C. Greece (S. end of Pindhos range, near Palaiokastron). Gr.
9. I. velata A. Braun in Bory \& Durieu, Expl. Sci. Algér. Bot. 1: 19, t. 37, f. 1 (1850) (I. variabilis Le Grand, I. baetica Willk.). Amphibious; stem 3-lobed. Leaves $8-24 \mathrm{~cm}$, erect, yellowgreen, firm, tapering to apex; stomata present; membranous margin at base more than 1 mm wide, extending up leaf for $\frac{1}{4}-\frac{1}{3}$ of its length; leaf-bases usually persisting, forming a 'bulb' of brown, papery scales; ligule triangular-ovate. Sporangium
almost or completely covered by velum; megaspores $420-580 \mu$, with scattered large and small tubercles; microspores red-brown, with short spines. Shallow lake-margins. Iberian peninsula and W. Mediterranean region. $\mathrm{Bl} \mathrm{Co} \mathrm{Ga} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.
I. tegulana Genn., Comment. Soc. Crit. Ital. 1: 42 (1861) (I. velata var. tegulensis (Genn.) Fiori), from Sardegna, has leaves $20-30 \mathrm{~cm}$, very slender, with basal margin less than 1 mm wide and microspores often crested. It needs further investigation.
10. I. tenuissima Boreau, Bull. Soc. Industr. Angers 21: 269 (1850) (I. viollaei Hy). Very like 9 but leaves $7-12 \mathrm{~cm}$, slender, not yellow-green; ligule small, triangular; velum never completely covering sporangium; microspores with numerous long, setiform spines. In similar habitats to 9. W.C. France (near Montmorillon). Ga.

Recorded from N.W. Poland, but in error.
11. I. histrix Bory, Compt. Rend. Acad. Sci. (Paris) 18: 1167 (1844) (I. delalandei Lloyd, I. phrygia Hausskn.). Terrestrial; stem 3-lobed. Leaves $5-10 \mathrm{~cm} \times 0.5-1.0 \mathrm{~mm}$, more or less flat, linear; stomata numerous; membranous margin wide at base, narrowing abruptly just above sporangium but continuing up the leaf for $1-2 \mathrm{~cm}$; leaf-bases persistent over several years as black, shiny, horny scales with central, short, broad lobe and two longer lateral, often spine-like lobes. Sporangium completely covered by velum; megaspores $400-560 \mu$, with small tubercles which often become confluent, especially on the basal surface; microspores brown, spinulose. $2 n=20$. Sandy places, where water lies in winter, from cliff-tops to open pinewoods. Mediterranean and Atlantic coasts of Europe, northwards to $50^{\circ} N . \mathrm{Br} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr}$ Hs It Ju Lu Sa Si.

This species is variable in the size and ornamentation of both types of spores and in the form of the persistent leaf-bases.
12. I. durieui Bory, Compt. Rend. Acad. Sci. (Paris) 18: 1166 (1844). Like 11 but leaves $8-12 \mathrm{~cm}$, firm, often recurved; megaspores $600-800 \mu$, reticulate with prominent ridges; microspores minutely papillose. In similar habitats to 11. W. Mediterranean region, Portugal. Bl Co Ga Hs It Lu Sa Si.
I. chaetureti Mendes, Agron. Lusit. 23: 7, t. 1 (1961), described from Portugal (and perhaps occurring elsewhere) is intermediate between 11 and 12, and needs further investigation. It has dark, partially reticulate megaspores, $320-480 \mu$, and minutely papillose microspores.

## SPHENOPSIDA

## IV. EQUISETACEAE ${ }^{1}$

Stems grooved and jointed. Leaves in whorls, united into a sheath at the base. Homosporous; sporangiophores in cones; sporangia borne on the adaxial side of the peltate heads of the sporangiophores; spores with 4 elaters. Prothallus green.

## 1. Equisetum L. ${ }^{2}$

Stems usually with a hollow in the centre surrounded by 2 rings of alternating smaller cavities. Leaves small, usually brownish.

[^4]${ }^{2}$ By T. G. Tutin.

Cones borne at the ends of the main stems and sometimes of the branches also. (Incl. Hippochaete Milde.)

The only genus.
1 No green stems present
2 Sheaths with $20-30$ teeth; cone $4-8 \mathrm{~cm}$
10. telmateia

2 Sheaths with 6-12 teeth; cone 1-4 cm
9. arvense

1 Green stems or stems with green branches present
3 Branches whorled
4 Main stem c. 10 mm in diameter, branched to apex, whitish, almost smooth, with 20-40 fine ribs 10. telmateia

4 Main stem rarely more than 7 mm in diameter, green; ribs well marked, less than 20 , or upper part of stem without branches
5 Sheaths of main stem with broad, subacute teeth which are fewer than the grooves
7. sylvaticum

5 Sheaths of main stem with subulate teeth which are equal in number to the grooves
6 Central hollow at least $\frac{4}{5}$ the diameter of the stem; teeth without ribs
5. fluviatile

6 Central hollow less than $\frac{2}{3}$ the diameter of the stem; teeth with ribs
7 Lowest internode of branches much shorter than sheath on main stem; branches hollow
8 Stem usually with 6-10 grooves; central hollow less than $\frac{1}{2}$ diameter of stem; cone obtuse
6. palustre

8 Stem with $8-20$ grooves; central hollow more than $\frac{1}{2}$ diameter of stem; cone apiculate 2. ramosissimum
7 Lowest internode of branches longer than sheath on main stem; branches solid
9 Central hollow c. $\frac{1}{4}$ diameter of main stem; branches mostly 4 -angled, ascending or suberect $\quad$ 9. arvense
9 Central hollow c. $\frac{1}{2}$ diameter of main stem; branches mostly 3-angled, horizontal or recurved 8. pratense 3 Branches absent or not in whorls
10 Cone apiculate; stems usually persistent; stomata below level of other epidermal cells
11 Teeth of leaf-sheaths caducous

1. hyemale

11 Teeth of leaf-sheaths persistent
12 Stem freely branched; central hollow c. $\frac{1}{2}$ diameter of main stem
2. ramosissimum

12 Stem simple or branched only from base; central hollow c. $\frac{1}{4}$ diameter of main stem, or absent

13 Central hollow $c$. $\frac{1}{4}$ diameter of main stem; sheaths with 6-8 teeth
3. variegatum

13 Main stem solid; sheaths with 3-4 teeth. 4. scirpoides
10 Cone obtuse; stems not persistent; stomata superficial
14 Central hollow at least $\frac{4}{5}$ diameter of main stem; teeth without ribs
5. fluviatile

14 Central hollow less than $\frac{2}{3}$ diameter of main stem; teeth with ribs
15 Outermost cavities about the same size as the central hollow; branches hollow, their lowest internodes much shorter than sheath on main stem 6. palustre
15 Outermost cavities smaller than the central hollow; branches solid, their lowest internodes longer than sheath on main stem
9. arvense

Subgen. Hippochaete (Milde) Baker. Stomata sunk below level of other epidermal cells. Cones apiculate. Stems all alike, hard, usually persistent.

1. E. hyemale L., Sp. Pl. 1062 (1753). Stem $30-100 \mathrm{~cm} \times 4$ 6 mm , persistent, simple; ridges with 2 rows of tubercles; grooves $10-30$; sheaths about as long as broad, whitish with a black band at top and bottom; teeth as many as grooves, very soon caducous; central hollow $\frac{2}{3}$ or more diameter of stem. Cone $8-15 \mathrm{~mm} .2 n=c$. 216. Most of Europe, but rare in the Mediterranean region. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Fa} \mathrm{Sa} \mathrm{Sb} \mathrm{Si}$.

The following hybrids, both of which have abortive spores, occur locally, sometimes in the absence of the parents. E. $x$ moorei Newman, Phytologist 5: 19 (1854) (E. occidentale (Hy) Coste) is like 1 but has more slender, not persistent stems, ridges with irregular tubercles or cross-bands, and the teeth of leafsheaths more persistent. It is possibly $E$. hyemale $\times$ ramosissimum. E. $\times$ trachyodon A. Braun, Flora (Regensb.) 22: 305 (1839) is intermediate between $E$. hyemale and $E$. variegatum, its probable parents.
2. E. ramosissimum Desf., Fl. Atl. 2: 398 (1799) (incl. E. campanulatum Poiret). Stem $10-100 \mathrm{~cm} \times 3-9 \mathrm{~mm}$, usually dying in autumn, freely branched, with scattered tubercles; grooves
$8-20$; sheaths green, becoming brown with a dark band at the bottom; teeth as many as grooves, dark, with a narrow scarious border; central hollow $\frac{1}{2}-\frac{2}{3}$ diameter of stem. Branches hollow; lowest internode much shorter than sheath on main stem. Cone $6-12 \mathrm{~mm} .2 n=c .216$. C. \& S. Europe, extending locally northwards to England, the Netherlands, Latvia and C. Russia. Al Au Az Be Bl Br Bu Co Cr Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs (B, C, W, K, E) Sa Si Tu.
3. E. variegatum Schleicher ex Weber \& Mohr, Bot. Taschenb. 60: 447 (1807). Stem $10-30(-50) \mathrm{cm}$, up to 3 mm in diameter, persistent, simple, or branched from base; ridges finely sulcate, with 2 rows of minute tubercles; grooves 4-10; sheaths green with a black band at apex; teeth as many as grooves, broadly scarious with a dark centre; central hollow $c . \frac{1}{4}$ diameter of stem. Cone $5-7 \mathrm{~mm} .2 n=c .216$. N. \& C. Europe, extending southwards to the Pyrenees, N. Appennini and S. Ural. Au Be Br CoCzDaFe $\mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C)} \mathrm{Sb} \mathrm{Su}$.
4. E. scirpoides Michx, Fl. Bor. Amer. 2: 281 (1803). Like 3 but stem up to $20 \mathrm{~cm} \times 1-1.5 \mathrm{~mm}$, with 3-4 wide, deeply sulcate ridges, so that it appears to be 6 - to 8 -angled; tubercles large, in one row on each angle; central hollow absent. $2 n=c .216$. $N$. Europe; formerly at one station in E. Alps, but now probably extinct. ?Au Fe No Rs (N, B, C) Sb Su.

Subgen. Equisetum. Stomata not sunk below the other epidermal cells. Cones obtuse. Fertile and sterile stems sometimes dissimilar, never persistent.
5. E. fluviatile L., Sp. Pl. 1062 (1753) (E. limosum L., E. heleocharis Ehrh.). Rhizome glabrous. Stem $30-150 \mathrm{~cm} \times 2$ 12 mm , simple or with irregularly whorled branches; ridges very narrow, smooth; grooves $10-30$; sheaths green, closely applied to stem; teeth as many as grooves, black, at least at apex, not ribbed; central hollow at least $\frac{4}{5}$ diameter of stem. Cone $10-$ $20 \mathrm{~mm} .2 n=c .216$. Most of Europe. Al Au Be Br Bu Cz Da Fa Fe Ga Ge Hb He Ho Hs Hu Is It Ju No Po Rm Rs (N, B, C, W, $\mathrm{K}, \mathrm{E}) \mathrm{Su}$.
E. $\times$ litorale Kühlew. ex Rupr., Beitr. Pf. Russ. Reich. 4: 91 (1845) ( E. arvense $\times$ fluviatile) is like 5 but with stems more deeply grooved and with twice as many green bands, more branches, and loose sheaths with teeth black at the apex. It is recorded from numerous localities in N. \& C. Europe.
6. E. palustre L., Sp. Pl. 1061 (1753). Rhizome glabrous. Stem $10-60 \mathrm{~cm} \times 1-3 \mathrm{~mm}$, simple or more often branched; ridges stout, rough; grooves (4-)6-10(-12); sheaths green, rather loose; teeth as many as grooves, green, with blackish apex and broad scarious margin, 1 -ribbed; central hollow less than $\frac{1}{2}$ diameter of stem, about as large as the outer cavities. Cone $10-30 \mathrm{~mm}$. $2 n=c$. 216. Almost throughout Europe. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Rs} \mathrm{(K)}$ Sb.
7. E. sylvaticum L., Sp. Pl. 1061 (1753). Rhizome glabrous. Sterile stems $10-80 \mathrm{~cm} \times 1-4 \mathrm{~mm}$, regularly and abundantly branched; branches recurved, usually again branched; ridges nearly smooth; grooves 10-18; sheaths green below; teeth united into 3-6 broad, obtuse lobes; central hollow $c$. $\frac{1}{2}$ diameter of main stem. Fertile stems usually shorter and less branched. Cone $15-25 \mathrm{~mm} .2 n=c .216$. Most of Europe except S. Russia, but rare in the Mediterranean region. $\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Bu} \mathrm{Cr} ? \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga}$ Ge Gr Hb He Ho Hs Hu Is It Ju No Po Rm Rs (N, B, C, W) Su ?Tu.
8. E. pratense Ehrh., Hannover. Mag. 9: 138 (1784). Rhizome glabrous. Sterile stems $10-60 \mathrm{~cm} \times 1-2 \mathrm{~mm}$, regularly and
abundantly branched; branches patent or recurved, simple; ridges rough; grooves $8-20$; sheaths mostly green; teeth as many as grooves; central hollow at least $\frac{1}{2}$ diameter of main stem. Fertile stems usually shorter, developing short branches after the spores are ripe; sheaths numerous, yellowish-white, with $10-20$ pale teeth. Cone $15-40 \mathrm{~mm} .2 n=c .216 . N .$, C. \& E. Europe. $\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Is} \mathrm{It} \mathrm{No} \mathrm{Po} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C}, \mathrm{W}$, $\mathrm{K}, \mathrm{E}) \mathrm{Su}$.
9. E. arvense L., Sp. Pl. 1061 (1753). Rhizome pubescent. Sterile stems $10-80 \mathrm{~cm} \times(1-) 3-5 \mathrm{~mm}$, usually regularly and abundantly branched; branches ascending or suberect, simple; ridges nearly smooth; grooves (4-)6-19; sheaths green; teeth as many as grooves; central hollow less than $\frac{1}{2}$ diameter of main stem. Fertile stems appearing before the sterile, usually shorter, simple, pale brown, dying after the spores are shed; sheaths 4-6, pale brown, with darker teeth. Cone (4) $10-40 \mathrm{~mm} .2 n=c .216$. Throughout Europe. All except Az.

A serious weed in some areas. In small arctic plants, the fertile stems become green, at least below, and branch irregularly after the spores are shed.
10. E. telmateia Ehrh., Hannover. Mag. 18: 287 (1783) (E. maximum auct., E. majus Gars.). Rhizome pubescent. Sterile stems (15-) $50-200 \mathrm{~cm} \times 10-20 \mathrm{~mm}$, regularly and abundantly branched, ivory-white; branches green, patent, simple; ridges smooth; grooves $20-40$, fine; sheaths pale below, dark at top; central hollow at least $\frac{2}{3}$ diameter of main stem. Fertile stems appearing before the sterile, shorter, simple, pale brown, dying after the spores are shed; sheaths numerous, pale brown, with dark teeth. Cone $40-80 \mathrm{~mm} .2 n=c$. 216. Europe, except the extreme north and most of the U.S.S.R. All except Fa Fe Is No $\mathrm{Rs}(\mathrm{N}, \mathrm{C}, \mathrm{E}) \mathrm{Sb}$.

In addition to those mentioned above, six other interspecific hybrids have been reported, but all are rare.

# FILICOPSIDA ${ }^{1}$ 

## V. OPHIOGLOSSACEAE ${ }^{2}$

Rhizomes short, fleshy, without scales. Leaves not circinate in bud, consisting of a sterile lamina and a fertile spike or panicle of spikes. Homosporous; sporangia large, thick-walled, sessile; without an annulus and opening by a transverse slit. Prothallus subterranean, tuber-like, saprophytic, with mycorrhiza.

Literature: R. Clausen, Mem. Torrey Club 19: 123 (1938).
Lamina linear to ovate, entire, with reticulate venation; fertile spike with sunk and coalescent sporangia

1. Ophioglossum

Sterile and fertile parts of leaf both $\pm$ compound; veins dichotomous, free; sporangia free, subsessile
2. Botrychium

## 1. Ophioglossum L. ${ }^{3}$

Lamina undivided, somewhat fleshy, with reticulate veins. Fertile spikes linear, with 2 rows of sunk and coalescent sporangia.

1 Leaves single; lamina more than $3 \times 2 \mathrm{~cm}$
3. vulgatum

1 Leaves often 2-3 together; lamina usually less than $3 \times 2 \mathrm{~cm}$
2 Lamina attenuate at base; veins without free endings

1. lusitanicum

2 Lamina cuneate at base; veins in the larger meshes with free endings
2. azoricum

1. O. lusitanicum L., Sp. Pl. 1063 (1753). Leaves $1-3$ together; lamina $1-3 \times 0.2-0.7 \mathrm{~cm}$, erect, sessile or stalked, attenuate at the base, lanceolate to linear-lanceolate, obtuse, net-veined, with no fine secondary meshes and no included free vein-endings. Fertile spike with $5-10$ sporangia on each side; spores smooth. $2 n=$ $250-260$. Mediterranean region and $W$. Europe. ? Az Bl Br CoCr Ga Gr Hs It Ju Lu Sa Si Tu.
2. O. azoricum C. Presl, Tent. Pteridogr. Suppl. 49 (1845). Leaves (1)2-3 together; lamina $1 \cdot 5-3(-5) \times 0 \cdot 5-2(-3) \mathrm{cm}$, deflexed, shortly stalked, cuneate at the base, lanceolate to ovate, acute, net-veined, with fine, oblong secondary meshes and free vein-

[^5]endings. Fertile spike with 6-15 sporangia on each side; spores tuberculate. $2 n=c .480$. W. Europe; very rare in C. Europe. $\mathrm{Az} \mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Hb} \mathrm{Hs} \mathrm{Is} \mathrm{Po}$.
Often regarded as a subspecies of 3 ( $O$. vulgatum subsp. ambiguum (Cosson \& Germ.) E. F. Warburg, or subsp. polyphyllum auct. non A. Braun).
3. O. vulgatum L., Sp. Pl. 1062 (1753). Leaves usually single, rarely in pairs; lamina $3-15 \times 2-6 \mathrm{~cm}$, erect, sessile, with truncate or cordate, rarely cuneate base, broadly ovate to ovate-acuminate, net-veined, with fine, ovate or roundish secondary meshes and free vein-endings. Fertile spike with $12-40$ sporangia on each side; spores tuberculate. $2 n=480$, c. $496,500-520$. Almost throughout Europe, but rare in the Mediterranean region. All except Az Bl Fa Is Sb Tu .

## 2. Botrychium Swartz ${ }^{3}$

Lamina usually compound, 1 - to 4-pinnate, rarely simple, oblong to triangular, somewhat fleshy, with dichotomous free veins. Fertile spikes always compound, with subsessile free sporangia in two rows.
1 Lamina oblong, ovate or triangular-ovate, longer than wide, almost glabrous
2 Lamina simple, trilobed, or pinnate; pinnae with dichotomous veins and without midrib
3 Lamina petiolate, simple or trilobed or pinnate, with 2(-4) pairs of pinnae
3 Lamina sessile, always pinnate, with (2)3-9 pairs of pinnae
2. lunaria

2 Lamina 2-pinnate; segments with $\pm$ conspicuous midrib
4 Segments about as long as wide, triangular to rhomboid or ovate 3. boreale
4 Segments longer than wide, lanceolate to oblong (if wider, then pinnatifid)
5 Segments acute, lanceolate to linear-lanceolate, with pronounced midrib 5 . lanceolatum
5 Segments obtuse, ovate to oblong, with somewhat inconspicuous midrib 4. matricariifolium

1 Lamina broadly triangular, wider than long, hairy at least when young.
6 Lamina fleshy, petiolate, 2- to 3-pinnate; segments obtuse 6. multifidum

6 Lamina membranous, sessile, 3- to 4-pinnate; segments acute 7. virginianum

1. B. simplex E. Hitchc. in Silliman Amer. Jour. Sci. Arts 6: 103 (1823). Leaves $2-10(-15) \mathrm{cm}$; lamina with a long petiole, simple, trilobed, trifoliolate or pinnate, with 2 or rarely 3-4 pairs of obovate or roundish, entire pinnae with rounded (rarely lobed) apex. $N . \& C$. Europe from $66^{\circ}$ N. southwards, extending to C. France, the Italian Alps and C. Jugoslavia. Au Be Co Cz Da Fe Ga He Is It Ju No Po Rs (N, B, C) Su.
2. B. lunaria (L.) Swartz in Schrader, Jour. für die Bot. 1800 (2): 110 (1802). Leaves $5-30 \mathrm{~cm}$; lamina sessile, oblong, always pinnate, with (2)3-9 pairs of trapezoid or flabellate pinnae; pinnae with semilunar-cuneate base and often semicircular, rounded, entire or rarely incised apex, without midrib. $2 n=90,96$. Almost throughout Europe, but rare in the Mediterranean region. All except Bl ? Cr Lu Sa Sb Tu .
3. B. boreale Milde, Nova Acta Acad. Leop.-Carol. 26 (2): 627, 757 (1858). Leaves $10-30 \mathrm{~cm}$; lamina nearly sessile, triangularovate, somewhat longer than broad, 2 -pinnate, with triangular, ovate to rhombic, acute, crenate pinnae tapering to the apex, and with midrib. $2 n=90$. Dry, natural grassland. Arctic and subarctic Europe, southwards to $59^{\circ} \mathrm{N}$. in Sweden. Fe Is No Rs (N) Su.
4. B. matricariifolium A. Braun ex Koch, Syn. Fl. Germ. ed. 2, 972 (1845) (B. ramosum Ascherson pro parte). Leaves 4-20 cm;
lamina nearly sessile, oblong, ovate or deltate-ovate, 2-pinnate; pinnae and pinnules oblong to ovate, obtuse (but tapering to the apex), entire or crenate, with often not very pronounced midrib. N., E. \& C. Europe, extending to C. France, N. Italy and Albania. $\mathrm{Al} \mathrm{Au} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C)}$ Su.
5. B. lanceolatum (S. G. Gmelin) Ångström, Bot. Not. 1854 : 68 (1854). Leaves $5-25 \mathrm{~cm}$; lamina nearly sessile, triangularovate to oblong, 2-pinnate; pinnae lanceolate to linear-lanceolate or oblong, acutely serrate or pinnatifid, with pronounced midrib. $2 n=90$. N. Europe, southwards to $59^{\circ} \mathrm{N}$. in Fennoscandia, rarely also in Alps and W. Carpathians. Au Fe Ga He Hs Is It No Po $\mathrm{Rs}(\mathrm{N}, \mathrm{C}) \mathrm{Su}$.
6. B. multifidum (S. G. Gmelin) Rupr., Beitr. Pff. Russ. Reich. 11: 40 (1859). Leaves $5-20 \mathrm{~cm}$; lamina deflexed, triangular, wider than long, petiolate, 2- to 3-pinnate, always sparsely hairy, coriaceous; pinnae roundish or ovate, obtuse, imbricate, entire to crenate, with pronounced midrib. N. \& C. Europe extending to E. France, the Italian Alps and S. Carpathians. Au Cz Da Fe Ga Ge He Hu It Ju No Po Rm Rs (N, B, C) Su.
7. B. virginianum (L.) Swartz in Schrader, Jour. für die Bot. 1800 (2): 111 (1802). Leaves $20-80 \mathrm{~cm}$; lamina deflexed, triangular, wider than long, sessile, membranous, sparsely hairy, 3to 4-pinnate; pinnae and pinnules oblong to ovate, acuminate, acutely toothed and decurrent, with pronounced midrib. E. \& E. C. Europe, westwards to Sweden, E. Tirol and Slovenija; E. Switzerland. Au Cz Fe Ge He Hu Ju Po Rm Rs (N, B, C, W) Su.

## VI. OSMUNDACEAE ${ }^{1}$

Stems erect, without scales. Leaves large, pinnately divided. Homosporous; sporangia not in definite sori, with walls 1 cell thick; without an annulus and opening by a longitudinal slit. Prothallus green.

## 1. Osmunda L. ${ }^{2}$

Stems short, stout, covered by persistent leaf-bases. Leaves in a dense crown, not persistent, 2-pinnate. Sporangia globular or pyriform, massed in dense clusters on certain pinnae of the fertile fronds, where they entirely replace the photosynthetic tissue.

1. O. regalis L., Sp. Pl. 1065 (1753). Leaves $30-150 \mathrm{~cm}$, densely tufted, only the upper (inner) ones of each year's crop being fertile; sterile pinnules $3-5 \times 1-1.5 \mathrm{~cm}$, oblong, obtuse, sessile, sometimes pinnatifid at the base, otherwise usually entire (rarely serrulate), with conspicuous, dichotomous, non-anastomosing lateral veins. Sporangia confined to a few terminal pinnae of the fertile leaves, not occupying more than a quarter of the leaf; fertile pinnules c. $12 \times 3 \mathrm{~mm}$, pale green, rapidly turning brown. $2 n=44$. Damp places; often on peat and with a calcifuge tendency. Widespread in W. Europe, extending very locally eastwards to E. Sweden, Poland and Turkey; much reduced by drainage in many areas. Al Az Be Br Bu Co Cr Cz Da Ga Ge Gr Hb He Ho Hs It Ju Lu No Po Sa Si Su Tu.

## VII-XXII

These families have in the past usually all been placed in a single family, the Polypodiaceae. They have the following characters in common: Stems usually with hairs or scales. Leaves relatively
large. Homosporous; sporangia with walls 1 cell thick; annulus present. Prothallus green.

## VII. SINOPTERIDACEAE ${ }^{1}$

Rhizomes solenostelic, with opaque scales. Petioles dark and shining, with a single vascular strand at the base which divides into 2 or 3 strands distally. Sori submarginal, covered by the

[^6]defiexed leaf-margins which form an indusium; spores tetrahedral or globose.
2. Pellaea

## 1. Cheilanthes Swartz ${ }^{1}$

Rhizomes shortly creeping or tufted. Leaves persistent, rigid, erect to spreading; petioles wiry, with scales at least when young; lamina 2-pinnate; pinnules sometimes pinnatisect. Sori c. 0.5 mm , mostly confluent; indusium narrow, entire or fimbriate, sometimes only seen in very young stages.

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1 Pinnules, at least of adult plants, glabrous beneath; plant smelling of coumarin
2. fragrans
1 Pinnules densely covered with flat or filiform scales beneath; plant not smelling of coumarin
2 Pinnules convex; margins inrolled, covering sporangia
3 Lamina shorter than petiole, deltate, glandular-pubescent beneath
3. hispanica
3 Lamina equalling petiole, oblong, without glandular hairs
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5. persica

2 Pinnules flat, or folded upwards along midrib
4 Upper surface of lamina glabrous 1. marantae
4 Upper surface of lamina covered with filiform scales
4. catanensis

1. C. marantae (L.) Domin, Biblioth. Bot. (Stuttgart) 20: 133, adnot. 1 (1915) (Notholaena marantae (L.) Desv.). Rhizome shortly creeping, densely covered with light brown scales. Leaves $10-35 \mathrm{~cm}$, arising in groups, erect; petiole almost as long as lamina, dark red-brown, dull, with scattered linear-filiform scales; lamina $2-5 \mathrm{~cm}$ wide, linear-lanceolate, pinnate; pinnules pinnatisect or, more rarely, 2-pinnate, glabrous above, densely clothed with light brown or colourless, attenuate-triangular scales beneath. Spores c. $48 \mu$, spherical, lophoreticulate. $2 n=58$. Dry, rocky places. S. Europe, extending northwards to C. France and Austria. Al Au Co Ga Gr He Hs Hu It Ju Rm Rs (K) Si.
2. C. fragrans (L. fil.) Swartz, Syn. Fil. 127/325 excl. descr. et loc. (1806) (C. pteridioides (Reichard) C. Chr., non C. pteroides Swartz, C. odora Swartz). Rhizome short, often branched to form small but dense tufts; apex with brown scales. Leaves $3-15 \mathrm{~cm}$, smelling of coumarin, more or less erect, forming a crown; petiole as long as or slightly shorter than lamina, redbrown, shiny, with scattered scales; lamina $1-3 \mathrm{~cm}$ wide, subtriangular to linear-lanceolate, 2-pinnate for most of its length; lower pinnules pinnatifid with ultimate segments $1-3 \mathrm{~mm}$, oblong or suborbicular, crenate; lamina with sessile glands, glabrous and eglandular beneath, or with few scattered scales when young. Indusium glandular, with fimbriate margin; spores c. $48 \mu$, spherical, finely papillose. Dry, rocky places. S. Europe. Al Az Bl Co Cr Ga Gr Hs It Ju Lu Sa Si.
3. C. hispanica Mett., Abh. Senckenb. Naturf. Ges. 3: 74 (1859).

Like 2 but not smelling of coumarin; lamina $4-8 \mathrm{~cm}$ wide, $\frac{1}{4} \frac{1}{3}$ as long as petiole, deltate, with glandular hairs beneath; ultimate segments $2-6 \mathrm{~mm}$ wide, pinnatifid; spores c. $37 \mu$, striate. Shallow soil on rocky cliffs. Spain and Portugal. Hs Lu.
4. C. catanensis (Cosent.) H. P. Fuchs, Brit. Fern Gaz. 9: 45 (1961) (Notholaena vellea (Aiton) Desv., N. lanuginosa (Desf.) Poiret). Rhizome short; apex covered with brown scales. Leaves $8-25 \mathrm{~cm}$, suberect or spreading, forming a crown; petiole $\frac{1}{4}-\frac{1}{2}$ as long as lamina, yellow-brown, shiny, densely covered with narrow, colourless scales; lamina 2-4 cm wide, linear-lanceolate, 2-pinnate; pinnules crenately lobed, oblong or suborbicular, densely covered on both surfaces with yellow filiform scales, which may fall off from the upper surface as the frond ages. Spores $c$. $62 \mu$, tetrahedral, finely reticulate. Dry, rocky, usually calcareous places. Mediterranean region; Portugal. Bl CoCr Gr Hs It Lu Sa Si.

A larger plant, with more openly dissected leaves, and with 26-29 cells in the annulus as against 18-20 in 4, has been described from Sicilia. It needs further investigation.
5. C. persica (Bory) Mett. ex Kuhn, Bot. Zeit. 26: 234 (1868). Rhizome very shortly creeping, often branched at apex, covered with narrow dark brown scales. Leaves $8-30 \mathrm{~cm}$, suberect or spreading, forming an open crown; petiole as long as lamina, red-brown, shiny, with scattered narrow brown scales; lamina $2-5 \mathrm{~cm}$ wide, oblong or linear-lanceolate, 2-pinnate, with the lower pinnules pinnatisect; upper pinnules lobed; ultimate segments oblong-deltate to suborbicular, glabrous above with occasional scales on midrib below. Indusium with many long filiform scales which cover lower surface of segment; spores $c$. $50 \mu$, more or less spherical, minutely papillose. E. Mediterranean region; Krym. Al Bu Cr Gr It Ju Rs (K).

## 2. Pellaea Link ${ }^{2}$

Rhizomes short. Leaves ovate-lanceolate, 2-pinnate, glabrous, coriaceous; lamina longer than petiole. Sori in contact laterally but not confluent, forming an almost continuous marginal line.

1. P. calomelanos (Swartz) Link, Fil. Sp. 61 (1841). Leaves $10-20 \mathrm{~cm}$; pinnules stalked, shallowly cordate, triangular, 3- or 5 -angled, shaped like the leaf of Hedera helix. Siliceous rocks. N.E. Spain (Province of Gerona). Hs. (S. \& E. Africa.)

## VIII. ADIANTACEAE ${ }^{3}$

Rhizomes solenostelic, with opaque scales. Petioles dark and shining, with 2 vascular strands at the base, which unite to form a single 4 -angled strand distally. Sori borne on the deffexed leaf-margins; spores tetrahedral.

## 1. Adiantum L. ${ }^{4}$

Rhizomes with narrow brown scales. Petioles with scales at the base only; lamina wide, pinnately compound, herbaceous,

[^7]glabrous; veins free. Sori in parallel linear groups of 2-10 on the lower side of the pinnules, along and between the parallel veins.

1. A. capillus-veneris L., $S p$. Pl. 1096 (1753). Leaves $10-60 \mathrm{~cm}$, 2- or 3-pinnate, ovate to ovate-lanceolate; petiole up to 25 cm , black and shining; lamina bright green, of delicate texture; pinnules cuneate, flabellate, on fine capillary stalks, very variable in form and size. $2 n=60$. Damp rocks, often on calcareous tufa. W. \& S. Europe. Al Az Bl Br Bu Co Cr Ga Gr Hb He Hs It Ju Lu Rs (K) Sa Si Tu [Be Ho].

## IX. PTERIDACEAE ${ }^{1}$

Rhizomes solenostelic or dictyostelic, with opaque scales. Petioles with a single U-shaped strand. Sori submarginal, forming coenosori which are borne on the veinlet connecting the vein ends, and which are covered by the scarious, deflexed leafmargins; spores tetrahedral, opaque.

## 1. Pteris L. ${ }^{2}$

Rhizomes short. Leaves tufted, pinnate or 2-pinnate. Sori with paraphyses.
$\begin{array}{lll}1 & \text { Pinnae pinnatisect } & \text { 1. serrulata } \\ 1 & \text { Pinnae simple } & \end{array}$
1 Pinnae simple
2 Not more than 7 pairs of pinnae; lamina ovate in outline
2. cretica

210 or more pairs of pinnae; lamina lanceolate in outline
3. vittata

1. P. serrulata Forskål, Fl. Aegypt. 187 (1775), non L. fil. Rhizome creeping; scales long, narrow, dark brown. Petiole up to $c .50 \mathrm{~cm}$, brown; lamina up to $c .60 \times 30 \mathrm{~cm}$, ovate; pinnae up
to 11 pairs, pinnatisect, the lowest pair often forked, all pinnatisect; segments oblong-lanceolate, falcate, serrate in distal half, acute. Sori occupying lower $\frac{1}{2}-\frac{2}{3}$ of segments, not extending to base of sinus; indusium prominent, thick. A̧̧ores. Az [Lu]. (Madeira, Canarias, Tangier.)
2. P. cretica L., Mantissa 130 (1767). Rhizome shortly creeping; scales small, dark brown. Petiole up to $c .30 \mathrm{~cm}$, light brown; lamina up to $c .40 \mathrm{~cm}$, ovate; pinnae 1-7 pairs, linear, simple (except for lowest 1 or 2 pairs which may be forked), serrate at apex; sterile pinnae serrulate, slightly wider than fertile. Sori occupying entire margin except for the apex; indusium reflexed and inconspicuous when mature. $2 n=58$ (apogamous). S. Europe; often cultivated for ornament and locally naturalized. Co Cr Ga Gr He It Sa Si [Az Ho Hs Hu].
3. P. vittata L., Sp. Pl. 1074 (1753). Like 2, but petiole 10 cm or less; lamina up to 60 cm , lanceolate, with 10 or more pairs of pinnae on adult plants; pinnae always simple, cordate at base. Mediterranean region. Bl Cr Gr Hs It $\mathrm{Si}[\mathrm{Az} \mathrm{Hu}$ ].

## X. CRYPTOGRAMMACEAE ${ }^{1}$

Rhizomes dictyostelic, with opaque scales. Petioles with a single cylindrical vascular strand. Sori submarginal, distinct at first, eventually confluent and borne on the vein ends, covered by the continuous, deflexed leaf-margins; spores tetrahedral, translucent.

## 1. Cryptogramma R.Br. ${ }^{3}$

Rhizomes creeping or ascending. Leaves 2 - to 4 -pinnate, with free veins, dimorphic, the sterile with wide and the fertile with narrower divisions.
$\begin{array}{ll}\text { Leaves tufted } & \text { 1. crispa } \\ \text { Leaves arising singly } & \text { 2. stelleri }\end{array}$

1. C. crispa (L.) R.Br. ex Hooker, Gen. Fil. t. 115 в (1842) (Allosorus crispus (L.) Röhling). Leaves $15-30 \mathrm{~cm}$, up to 7 cm
wide, tufted, 3-pinnate, bright green, dying down in winter; petiole twice as long as lamina; ultimate segments of sterile leaves with a cuneate base, narrowly ovate and coarsely and irregularly toothed; ultimate segments of fertile leaves $1-2 \mathrm{~mm}$ wide, linear. $2 n=120$. Mountain rocks and screes; calcifuge. Distributed over a large part of Europe but rare in the east; only in mountain districts except in the extreme north. Al Au Be Br Bu Co $\mathrm{CzFaFeGaGe} \mathrm{Hb} \mathrm{He} \mathrm{Hs} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{No} \mathrm{Po} \mathrm{?Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{C)} \mathrm{Su}$.
2. C. stelleri (S. G. Gmelin) Prantl, Bot. Jahrb. 3: 413 (1882). Leaves $8-20 \times 2-5 \mathrm{~cm}$ wide, arising singly from a slender creeping rhizome, 2 -pinnate, ovate to ovate-elongate; petiole equalling or rather longer than lamina; ultimate segments of sterile leaves similar to those of $\mathbf{1}$, of fertile leaves $2-3 \mathrm{~mm}$ wide, linear-lanceolate. Rock-crevices in shady places. N. \& C. Ural. Rs (N, C). (N. \& C. Asia; N. America.)

## XI. GYMNOGRAMMACEAE ${ }^{1}$

Rhizomes solenostelic, with opaque scales. Petioles with 2 vascular strands. Sporangia seriate along the veins, and not in well-defined sori, without indusium; spores tetrahedral.

## 1. Anogramma Link ${ }^{4}$

Sporophyte annual; gametophyte said to be perennial. Stock very short; scales few. Leaves weakly dimorphic, 2- to 3-pinnate, margins flat; veins free. Sori spread along the veins.

[^8]1. A. leptophylla (L.) Link, Fil. Sp. 137 (1841) (Gymnogramma leptophylla (L.) Desv.). Stock with a few scales when young. Leaves slightly hairy when young, soon glabrous; outer sterile, much shorter than fertile and with thin obovate-cuneate pinnules, lobed or dentate at apex; fertile leaves $3-20 \mathrm{~cm}$, with narrowly obovate-cuneate pinnules. Sori appearing confluent when mature. Damp shady places. Mediterranean region and W. coast of Europe, extending northwards and westwards to the Channel Islands and Açores; Krym. Az Bl Co Cr Ga Gr He Hs It Ju Lu Rs (K) Sa Si.

## XII. DICKSONIACEAE ${ }^{1}$

Stems solenostelic, stout, erect, densely covered with hairs. Petioles with a single $U$-shaped vascular strand which soon divides into several strands. Sori marginal, covered by a 2 -valved indusium; spores tetrahedral.

## 1. Culcita C. Pres ${ }^{2}$

Leaves pinnately divided, uniform. Sori $2-4 \mathrm{~mm}$, more or less spherical; sporangia maturing basipetally, annulus slightly oblique.

Literature: M. C. de Rezende-Pinto, Bol. Soc. Brot. ser. 2, 17: 93-140 (1943).

1. C. macrocarpa C. Presl, Tent. Pteridogr. 135 (1836). Rhizome with setiform, ferrugineous scales. Leaves $30-90 \mathrm{~cm}$, as long as or rather longer than wide, in a lax tuft; lamina triangular, 4- to 5 -pinnate, coriaceous, shining, about as long as the petiole; ultimate segments inciso-serrate. Indusium reniform. $2 n=132-136$. N.Portugal (Serra de Valongo, near Porto); S. Spain (Algeciras); A̧̧ores. Az Hs Lu. (Madeira, Canarias.)

## XIII. HYPOLEPIDACEAE ${ }^{1}$

Rhizomes with a perforated solenostele and covered with hairs. Petioles with several vascular strands which fuse to form a single $U$-shaped strand. Sori marginal, borne on the connecting veinlet, and covered by both the deflexed margin of the leaf and by an inner indusium; spores tetrahedral.

## 1. Pteridium Scop. ${ }^{2}$

Rhizomes subterranean, long. Leaves distant; petioles long; lamina 3-pinnate; lower pinnae with nectaries at base; ultimate segments numerous, ovate to linear. Sori contiguous, on the marginal vein, covered both by the revolute leaf-margins and by the indusia.

Literature: R. M. Tryon jun., Rhodora 43: 1-31 and 37-67 (1941).

1. P. aquilinum (L.) Kuhn in Decken, Reis. Ost. Afr. Bot. 3 (3): 11 (1879) (Pteris aquilina L.). Leaves $40-400 \mathrm{~cm}$, ovate-triangular, more or less woolly on the lower surface, glabrous or almost so on the upper; margins glabrous; petiole tomentose at base, becoming glabrous above; pinnules shortly acuminate to obtuse, usually almost at right angles to the costa. Indusium ciliate. $2 n=104$. Almost throughout Europe; mainly on mountains in the south. All except Is Fa Sb.

A cosmopolitan species with several geographical races, not all of which are well defined. Most European plants are placed by Tryon in var. typicum, but var. latiusculum Underw., which has the indusium glabrous and the pinnules at an oblique angle to the costa, is widely distributed in N. and C. Europe. P. aquilinum subsp. brevipes (Tausch.) Wulf, Fl. Taur. 1: 20 (1927) is found in the Caucasus and extends to Krym, and has leaves coriaceous and thickly lanate beneath; its relationship to the main European populations needs further investigation.

## XIV. DAVALLIACEAE ${ }^{1}$

Rhizomes polystelic, with broad dorsal and ventral meristeles, and with clathrate scales. Leaves distant, in two ranks, articulated to rhizome; petioles with several vascular strands. Sori submarginal, with indusium; spores bilateral.

## 1. Davallia Sm. ${ }^{3}$

Rhizomes rather stout, with ciliate scales. Lamina deltate to narrowly ovate, rather finely divided, coriaceous, glabrous; veins
free. Indusium attached at base and sides, cup-shaped, almost reaching the margin of the ultimate segments.

1. D. canariensis (L.) Sm., Mém. Acad. Sci. Turin 5: 414 (1793). Rhizome with bright chestnut-coloured scales. Leaves 12-50 cm, solitary; petiole with scales at base only, about equalling lamina; lamina glabrous, deltate, 3- to 4-pinnate; ultimate segments lanceolate or ovate-oblong, mostly bidentate. On rocks and walls, and epiphytic on trees. Portugal and W. Spain. Hs Lu. (Madeira, Canarias.)

## XV. HYMENOPHYLLACEAE ${ }^{1}$

Plants small. Rhizomes slender, extensively creeping. Lamina dark, translucent green, only one cell thick except on the veins. Sori gradate, marginal; indusium tubular or 2-valved, symmetrical; spores tetrahedral.

[^9]A predominantly austral and tropical family. Delimitation of species is difficult, and the plants from Europe are held by some authors to be conspecific with those in the tropics or the Southern hemisphere; but they are, as here delimited, believed to extend outside Europe only to the Atlantic Islands (Madeira and Canarias).

Literature: E. B. Copeland, Philipp.Jour. Sci. (Bot.) 67: 1 (1938).

Rhizome filiform; indusium of 2 distinct valves; receptacle included

1. Hymenophyllum

Rhizome $2-4 \mathrm{~mm}$ in diameter; indusium tubular; receptacle exserted
2. Trichomanes

## 1. Hymenophyllum $\mathrm{Sm} .^{1}$

Very small, with the habit of bryophytes, and often growing with them. Rhizomes filiform, less than 1 mm in diameter, smooth. Leaves more or less procumbent, persistent after withering, forming a dense mat of foliage, deeply pinnatisect, the segments asymmetrical, subentire on their proximal side, deeply lobed on their distal side with 2-15 oblong, obtuse, dentate lobes. Sori solitary, more or less globose, situated near the base of the distal segments of the frond; indusium of 2 ovate or suborbicular valves, united only at the base.

Literature: E. B. Copeland, Philipp.Jour.Sci.(Bot.) 64: 1 (1937).
Valves of indusium dentate; leaves bluish-green

1. tunbrigense Valves of indusium entire; leaves somewhat olive-green
2. wilsoni
3. H. tunbrigense (L.) Sm. in Sowerby, Engl. Bot. 3; t. 162 (1794). Lamina usually $22-45 \times c .15 \mathrm{~mm}$, flat, of a somewhat glossy, slightly bluish-green. Indusium-valves suborbicular, fimbriate-dentate in distal half, nearly flat. $2 n=26$. Woods and other damp, shady, sheltered places. Locally in W. Europe from the Pyrenees to Scotland; A̧ores; isolated stations in N. Italy and E. Germany. Az Be Br ? Co Ga Ge Hb Hs It ?Ju.
4. H. wilsonii Hooker, Brit. Fl. 450 (1830) (H. unilaterale auct., vix Bory). Like 1 but with usually narrower leaves, which are deflexed laterally and therefore appear even narrower, of a darker, somewhat olive-green. Indusium-valves ovate, entire, convex. $2 n=36$. Similar situations to 1 but more tolerant of exposure. N.W. Europe; Açores. Az Br Fa Ga Hb No.

## 2. Trichomanes L. ${ }^{1}$

Like Hymenophyllum, but with stouter, more hairy rhizomes, larger, erect, more intricately divided leaves, and elongate, cylindrical sori, of which the basal part is protected by a tubular, slightly 2 -lipped indusium, the apical part eventually protruding, and persisting in the form of a bristle-like receptacle after the sporangia have fallen off.

Copeland (op. cit.) has divided this large genus into numerous smaller genera; in his treatment the European species is assigned to Vandenboschia Copel.

1. T. speciosum Willd., Sp. Pl.5(1):514(1810)(T.radicans auct., vix Swartz). Rhizome $2-4 \mathrm{~mm}$ in diameter, covered with black hairs. Leaves $20-35(-50) \mathrm{cm}$, the winged petiole about equalling the ovate, deeply 3- or 4-pinnatisect lamina; ultimate segments oblong, obtuse, entire, disposed symmetrically, not unilaterally as in Hymenophyllum. $2 n=144$. By waterfalls, at mouths of caverns, and in similar damp, dark situations. Extreme west of Europe; very local and rare. Az Br Ga Hb Hs Lu .

## XVI. THELYPTERIDACEAE ${ }^{2}$

Rhizomes dictyostelic, with hairs, or with papillate or hairy scales. Hairs on leaves and rhizomes always unicellular. Petioles with 3-7 vascular strands; rhachis grooved but not interrupted to admit grooves of costae. Sori submarginal; spores bilateral.

All veins free, or the lowermost veins from adjacent leaf-segments just meeting at the sinus

1. Thelypteris

At least the lowermost veins from adjacent leaf-segments uniting some way below the sinus
2. Cyclosorus

## 1. Thelypteris Schmidel ${ }^{3}$

Rhizomes creeping or ascending. Leaves pinnate with pinnatifid pinnae, or 2-pinnatisect, hairy at least beneath, veins free. Sori orbicular or oblong, near the margin of the segment, or linear, spread out along lateral vein of segment; indusium lobed and reniform, or absent.

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1 Leaves bent back at junction of rhachis and petiole; lowestpair of pinnae deflexed
3. phegopteris 1 Leaves not bent back at junction of rhachis and petiole; lowest pair of pinnae not deflexed
2 Leaves tufted, lemon-scented when crushed
1. limbosperma
2 Leaves solitary, not lemon-scented
3 Rhachis with few short hairs; sori round
3 Rhachis with numerous long hairs; sori linear
2. palustris 4. pozoi
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1. T. limbosperma (All.) H. P. Fuchs, Amer. Fern Jour. 48: 144 (1958) (Dryopteris oreopteris (Ehrh.) Maxon, Lastrea oreopteris (Ehrh.) Bory, Nephrodium oreopteris (Ehrh.) Desv., Polystichum

[^10]oreopteris (Ehrh.) DC.). Rhizome stout, ascending; apex covered with brown, ovate-lanceolate, papillose scales. Leaves $30-100 \mathrm{~cm}$, forming a crown at apex of rhizome, suberect, pinnate; petiole $\frac{1}{5}-\frac{1}{8}$ as long as lamina, with scattered, brown, ovate to ovatelanceolate scales; lamina lanceolate or oblanceolate, firm, yellowish-green, lemon-scented when crushed; pinnae linearlanceolate, pinnatisect, the longest $5-12 \mathrm{~cm}$, becoming shorter towards the base; lower surface glandular; veins hairy beneath. Indusium irregularly toothed, glandular, caducous; spores winged, with raised reticulum. $2 n=68$. Woods, especially by streams, and in relatively open situations as on screes. C. \& N.W. Europe, extending to S. Sweden, W. Ukraine, C. Italy and the Pyrenees. Au Be Br Co Cz Da Ga Ge Hb He Hs Ho Hu It Ju No Po Rm Rs (W) Su.
2. T. palustris Schott, Gen. Fil. observ. ad gen. Nephrodium (1834) (Dryopteris thelypteris (L.) A. Gray, Lastrea thelypteris (L.) Bory, Nephrodium thelypteris (L.) Strempel, Polystichum thelypteris (L.) Roth). Rhizome slender, far-creeping, hairy, with few, ovate, papillose scales when young. Leaves (15-)25-75(-120) cm , usually solitary, erect, pinnate; petiole as long as, to slightly longer than lamina, greenish-yellow, blackish at base, glabrous except for occasional colourless hairs; lamina lanceolate, thin, pale green; pinnae pinnatisect, the longest $5-12 \mathrm{~cm}$, linearlanceolate; segments linear, entire, blunt; sterile $c .5 \mathrm{~mm}$ wide, flat, fertile narrower, with inrolled margins. Sori more or less confluent; indusium lobed, glandular, often caducous; spores echinate. $2 n=70$. Fens and marshes. Most of Europe except Spain and the extreme north. Al Au Be Br Bu Co CzDaFe Ca Ge Gr Hb He Ho Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, ?E) Su .
3. T. phegopteris (L.) Slosson in Rydb., Fl. Rocky Mount. 1069 (1918) (Dryopteris phegopteris (L.) C. Chr., Lastrea phegopteris (L.) Bory, Nephrodium phegopteris (L.) Prantl, Phegopteris vulgaris Mett., Polypodium phegopteris L.). Rhizome slender, creeping, with light brown, hairy, lanceolate scales when young. Leaves $10-50 \mathrm{~cm}$, solitary, pinnate; petiole up to twice as long as lamina, greenish-yellow, sparsely covered with colourless hairs and occasional brown scales; lamina $5-15 \mathrm{~cm}$ wide, tri-angular-ovate, thin, yellow-green, bent back almost at right angles to petiole; pinnae lanceolate, attenuate, pinnatisect, the lowest deflexed; segments linear-oblong, entire or crenate, rounded at apex, hairy on both surfaces, with narrow lanceolate scales on veins. Indusium absent; spores rugulose-granulate. $2 n=90$. Shady places. Most of Europe, but rare in the south. Au Be Br Bu CoCzDaFa Fe Ga Ge Gr Hb He Ho Hs Hu Is It Ju No Po Rm Rs (N, B, C, W) Su.
4. T. pozoi (Lag.) C. V. Morton, Bull. Soc. Bot. Fr. 106: 234 (1959) (Hemionitis pozoi Lag., Ceterach hispanicum sensu Willk. pro parte). Rhizome creeping, with ovate-lanceolate, hairy, brown scales, at least on younger parts. Leaves $25-60(-75) \times 6-15 \mathrm{~cm}$, solitary, erect, pinnate; petiole as long as or rather shorter than lamina, brownish-yellow, with scattered hairs; lamina lanceolate, firm, light green; rhachis densely hairy; pinnae regularly pinnatifid; segments entire, obtuse, divided about half-way to the mid-
rib, hairy on both surfaces. Sori $2-3 \mathrm{~mm}$, linear; sporangia with occasional spines, spread out along lateral vein of segment; indusium absent; spores echinate. Sheltered valleys near the sea. Spain; Açores. Az Hs.

## 2. Cyclosorus Link ${ }^{1}$

Rhizomes creeping. Leaves pinnate, with pinnatifid pinnae, hairy; veins free except for the lowermost pair of each segment, which unite with those from the adjacent segments to form a single vein, excurrent in the sinus. Sori orbicular, superficial; indusium reniform, densely hairy.

1. Cyclosorus dentatus (Forskål) R.-C. Ching, Bull. Fan Mem. Inst. Biol. (Peking) Bot. 8: 206 (1938) (Aspidium molle Swartz). Rhizome stout; apex covered with shiny brown, lanceolate, hairy scales. Leaves $30-100 \mathrm{~cm}$, forming a crown at apex of rhizome, pinnate; petiole $\frac{1}{4}-\frac{1}{5}$ as long as lamina, light brown, hairy; lamina lanceolate to elliptical, tapering abruptly at apex; lower pinnae often very reduced in size; longest pinnae $10-15 \times 1-2 \mathrm{~cm}$, pinnatifid; segments parallel-sided, truncate at apex, sparsely hairy above, densely hairy beneath. Spores papillose; papillae often confluent to form ridges. Damp places beside streams. Açores. Az. (Madeira, Africa, tropical America.)

## XVII. ASPLENIACEAE ${ }^{2}$

Rhizomes dictyostelic, with clathrate scales. Petioles with 2 vascular strands often fusing to form a single $X$-shaped strand. Sori superficial, borne along one or both sides of the fertile veins; spores bilateral.
1 Leaves pinnately divided
2 Indusium present

1. Asplenium
2 Indusium absent
2. Pleurosorus
1 Leaves not pinnately divided
3 Leaves pinnatifid, covered with scales on lower surface
3. Ceterach

3 Leaves not pinnatifid
4 Leaves palmately or digitately lobed

1. Asplenium

4 Leaves entire, linear or hastate
4. Phyllitis

## 1. Asplenium L. ${ }^{3}$

Rhizomes short, erect or occasionally creeping, with dark, lineartriangular to linear-lanceolate, sometimes filiform scales. Leaves in apical tufts; petiole dark, at least at the base, often glabrous; lamina entire or variously dissected; veins free. Sori elliptical to linear; indusium resembling the sorus in shape and size, usually opening towards the vein.

Many interspecific hybrids have been recorded but, with one exception $(16 \times 5)$, are not frequent enough to be mentioned individually. (For list of hybrids see A. H. G. Alston, Proc. Linn. Soc. London 152 (2): 132-44 (1940) and D. E. Meyer, Amer. Fern Jour. 50: 138-45 (1960).)
1 Leaves simple, cordate to palmately lobed 1. hemionitis 1 Leaves compound, not cordate or palmately lobed

[^11]2 Leaves dichotomously forked or 3-partite 3 Leaves usually 2 - or 4-partite, leaf-segments $\pm$ linear
16. septentrionale

3 Leaves usually 3-partite, leaf-segments narrowly rhombic 17. seelosii

2 Leaves neither dichotomously forked nor 3-partite
4 Leaves 1-pinnate
5 At least some scales with dark opaque cells; rhachis brown or black, brittle
6 Petiole with dense glandular hairs 3. petrarchae 6 Petiole $\pm$ glabrous
7 Pinnae more than twice as long as wide, usually with only one long sorus
4. monanthes

7 Pinnae less than twice as long as wide, usually with several small sori (often appearing confluent at maturity)
8 Rhachis green at apex; lamina thin, light green
6. adulterinum

8 Rhachis reddish-black throughout; lamina thick, dark green
5. trichomanes

5 Scales composed of hyaline cells; rhachis green (or if black, then stout and not brittle)
9 Lamina $2-4 \mathrm{~cm}$ wide, coriaceous
2. marinum

9 Lamina $1-2 \mathrm{~cm}$ wide, not coriaceous
10 Pinnae suborbicular, shortly stalked
7. viride

10 Pinnae oblong, adnate to rhachis
8. jahandiezii

4 Leaves 2- or 3-pinnate
11 Leaves 2-pinnate
12 Leaves deltate; base of petiole swollen; sori lying next to midrib (13-15). adiantum-nigrum group
2 Leaves elliptic to ovate (if almost deltate, then sori nearer to margin than to midrib); base of petiole not swollen
13 Rhizome much-branched, densely caespitose; ultimate leaf-segments $\pm$ rhombic, distant
14 Lamina glandular; ultimate segments crenately lobed
19. lepidum

14 Lamina eglandular; ultimate segments finely toothed
18. ruta-muraria

# 13 Rhizome rarely branched, not densely caespitose; ultimate leaf-segments $\pm$ ovate, not distant <br> 15 Lamina narrowly elliptical; lowermost pinnae distinctly shorter than the rest <br> 9. fontanum <br> 15 Lamina ovate to lanceolate; lowermost pinnae not distinctly shorter than the rest <br> 16 Lamina lanceolate; sori near midrib 10. forisiense <br> 16 Lamina ovate-lanceolate; sori near margin 

(11-12). obovatum group
11 Leaves 3-pinnate
17 Lamina lanceolate; pinnules palmately dissected
20. fissum

17 Lamina deltate; pinnules pinnately dissected
(13-15). adiantum-nigrum group

1. A. hemionitis L., Sp. Pl. 1078 (1753). Rhizome-scales with purplish sheen. Leaves $20-35 \mathrm{~cm}$; petiole about twice as long as lamina, reddish-brown with few filiform scales at base; lamina $10-20 \mathrm{~cm}$ wide, light green, glabrous, usually palmately 5 -lobed, lobes acute, middle lobe longer than rest. Sori linear, often running full length of vein. Portugal, Açores. Az Lu. (N. Africa.)
2. A. marinum L., Sp. Pl. 1081 (1753). Plant robust. Rhizome with filiform scales at apex. Leaves $15-30(-40) \mathrm{cm}$; petiole about $\frac{1}{2}$ as long as lamina, reddish-brown; lamina linear-lanceolate, pinnate, coriaceous, glabrous; rhachis with green wings; pinnae, $1-4 \mathrm{~cm}$, oblong, more developed on the upper side, crenateserrate, base truncate or broadly cuneate, apex rounded. $2 n=72$. Rocks and walls exposed to sea-spray. W. Europe, extending eastwards very locally to S. Italy. Az Bl Br Co Ga Hb Hs It Lu No Sa Si.
3. A. petrarchae (Guérin) DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 238 (1815). Rhizome caespitose; scales filiform, consisting of black opaque cells, except occasionally for a narrow border of pellucid cells. Leaves $4-12 \mathrm{~cm}$; petiole and rhachis reddishblack with green apex, dull, densely covered with glandular hairs, persistent when dead and forming wiry tufts; lamina $\frac{2}{3}-\frac{3}{4}$ length of leaf, narrow-elliptic, pinnate, thin, bright green, covered above and beneath with glandular hairs; pinnae $0 \cdot 5-1 \mathrm{~cm}$, ovate, truncate or broadly cuneate at base, incisocrenate to lobed. $2 n=144$. Calcareous rocks. - Mediterranean region; Portugal. $\mathrm{Al} \mathrm{Bl} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Si}$.
4. A. monanthes L., Mantissa 130 (1767). Rhizome-scales narrow, attenuate, with dark central stripe. Leaves $20-30(-45) \mathrm{cm}$, often with proliferating buds at base of rhachis; petiole $\frac{1}{4}$ as long as lamina, dark reddish-brown, glabrous; lamina linear-elliptical, light green, pinnate; pinnae $0 \cdot 5-1 \mathrm{~cm}$, oblong to rhombic, entire to crenulate-dentate, base truncate, apex rounded. Sori oblong, usually singly on pinna. A̧ores. Az. (Africa and C. America.)

Plants of $A$. monanthes from Madeira are apogamous, with $2 n=108$. It is likely that plants from Açores are similar.
5. A. trichomanes L., Sp. Pl. 1080 (1753). Rhizome caespitose; scales up to 5 mm , with dark central stripe. Leaves 4-20(-35) cm; petiole $c . \frac{1}{4}$ as long as lamina, dark reddish-brown; lamina pinnate, thicker and darker green than in 3, with occasional glandular hairs beneath or glabrous; rhachis dark reddish-brown to the apex, with a narrow, pale brown wing; pinnae $0.25-1.2 \mathrm{~cm}$, ovate, oblong or rarely suborbicular, entire or crenate-serrate, base truncate or asymmetrically cuneate, apex rounded. Sori small, linear, but sporangia covering pinna at maturity. Rocks and walls. Throughout Europe. All except Sb.
(a) Subsp. trichomanes: Rhizome-scales less than 3.5 mm , lanceolate. Pinnae $0.25-0.75 \mathrm{~cm}$, suborbicular or more rarely oblong, more distant than in (b), especially near the apex of the
lamina, thin; insertion of upper pinnae oblique. Mean sporelength $29-36 \mu$. $2 n=72$. Non-calcareous rocks, usually in mountainous districts. Most of Europe. ?Al $\mathrm{Au} \mathrm{Bl} \mathrm{Br} \mathrm{Bu} \mathrm{?Co} \mathrm{Cz} \mathrm{Fe}$ Ga Ge Gr Hb He Hs ?Hu It Ju No Po Rm Rs (N, C) Sa ?Si Su.
(b) Subsp. quadrivalens D. E. Meyer, Ber. Deutsch. Bot. Ges. 74: 456 (1962): Rhizome scales 5 mm , linear-lanceolate. Pinnae $0.4-1 \cdot 2 \mathrm{~cm}$, oblong, more crowded than in (a) and usually more robust; insertion of upper pinnae at right angles or slightly oblique. Mean spore length $34-43 \mu .2 n=144$. Base-rich rocks and mortared walls. Throughout the range of the species.

In addition to the above, a diploid plant from calcareous rocks in C. and S.E. Europe has recently been reported by J. D. Lovis, Brit. Fern Gaz. 9: 155 (1964).
A. csikii Kümmerle \& Andraszovsky, Magyar Bot. Lapok 21: 3 (1922), which is intermediate between 3 and 5 , is a plant of calcareous rocks in N.E. Albania (Djalica e Lumës) which needs further investigation.
6. A. adulterinum Milde, Höheren Sporenpfl. Deutschl. Schweiz 40 (1865). Intermediate between 5 and 7. At least some rhizomescales with dark central stripe. Pinnae intermediate in shape and texture between those of 5 and 7, with scattered glandular hairs beneath; rhachis reddish-brown, becoming green towards apex. $2 n=144$. Ledges and crevices of serpentine rocks. - Mountains of E.C. Europe, and isolated localities in Fennoscandia. Au Cz Fe Ge He Ju No Po Rm Su.
7. A. viride Hudson, Fl. Angl. 385 (1762). Rhizome caespitose; scales without dark central stripe. Leaves $5-15(-20) \mathrm{cm}$; petiole c. $\frac{1}{3}$ as long as lamina, reddish-brown at base, abruptly becoming green; lamina linear to linear-lanceolate, light green, pinnate, thin, glabrous; rhachis green, not winged, with occasional glandular hairs; pinnae c. 5 mm , often convex, especially when young, semi-circular to suborbicular, crenate to incised, broadly cuneate at base. Sori small, elliptical, but sporangia often covering entire surface of lamina at maturity. $2 n=72$. Rockcrevices and ledges. Most of Europe, mainly in the mountains. Al Au Be Br Bu Co Cz Fe Ga Ge Gr Hb He Hs Hu Is It Ju No Po Rm Rs (N, C, K, W) Su.
8. A. jahandiezii (Litard.) Rouy, Fl. Fr. 14: 437 (1913). Leaves $3-12 \mathrm{~cm}$; petiole $\frac{1}{6}-\frac{1}{4}$ as long as lamina, green, with occasional narrow scales; lamina linear-elliptical, pinnate, with occasional scales on the rhachis and costules; pinnae $0.5-1.0 \mathrm{~cm}$, adnate to the rhachis, lower margin decurrent in a narrow wing, oblong, serrate, occasionally becoming incised at base. Sori lying near the midrib. $2 n=72$. Limestone cliffs. - S.E. France (Gorges du Verdon, Var). Ga.
9. A. fontanum (L.) Bernh. in Schrader, Jour. für die Bot. 1799 (1): 314 (1799). Leaves $5-25 \mathrm{~cm}$; petiole $\frac{1}{f}-\frac{1}{2}$ as long as lamina, red-brown at base, soon becoming straw-coloured or greenish; lamina lanceolate to narrowly clliptic, thin, light green, 2-pinnate, the lower pinnae decreasing in length towards base of leaf; rhachis with occasional glandular hairs; pinnac $0.5-1.5 \mathrm{~cm}$, with 3-8 pairs of pinnules, terminal segment $\ddagger$ as long as pinna or less; pinnules pinnatifid with mucronate lobes. Sori lying near the midrib. $2 n=72$. Calcareous rocks. S. \& C. Europe. ?Au Bl Co $\mathrm{Cr} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It}$.
A. majoricum Litard., Bull. Géogr. Bot. (Le Mans) 28 (1911), from Islas Baleares, may be related to cither 7 or 9 . It is similar to 9 but has leaves up to 8 cm ; petiole $c .1 \mathrm{~cm}$, purplish-black; lamina pinnate to pinnatisect, with scattered glands; $2 n=144$.
10. A. forisiense Le Grand, Stat. Bot. Forez 252 (1873) (A. foresiacum (Le Grand) Christ). Like 9, but rhizome with
filiform scales at apex; leaves $10-20 \mathrm{~cm}$; petiole reddish-brown, becoming green at base of rhachis; lamina lanceolate, acuminate, thicker, 2 -pinnate, not decreasing to any marked extent towards base of leaf; pinnae with 1-3 pairs of toothed, rounded pinnules, terminal segment about half as long as pinna, not deeply cut. $2 n=144$. Siliceous rocks. - W.C. Europe, from N. France to Sardegna. ?Be Co Ga He ?Hs It Sa.
A. bornmuelleri Kümmerle, Bot. Közl. 19: 81 (1921) and A. macedonicum Kümmerle, Bot. Közl. 15: 145 (1916) are closely related taxa from the Balkan peninsula which need further investigation.
(11-12). A. obovatum group. Rhizome-scales narrow, becoming filiform at apex of rhizome. Leaves $15-30 \mathrm{~cm}$; petiole equalling lamina or shorter, but not less than half its length, not swollen below, light reddish-brown, with few filiform scales; lamina ovate-lanceolate, acuminate, bright green, glabrous, 2pinnate, rhachis and midrib with occasional filiform scales; pinnae $2-4 \mathrm{~cm}$; pinnules oblong to suborbicular. Sori ovate, nearer margin than vein.
A group of 2 closely related species which may be distinguished as follows:
Pinnae deeply divided only in proximal half; pinnules with obtuse, mucronate teeth 11. obovatum Pinnae deeply divided for most of their length; pinnules with acute teeth
12. billotii
11. A. obovatum Viv., Fl. Lib. 68 (1824) (A. lanceolatum auct. non Hudson). Pinnae ovate-triangular, pinnately divided but only in the proximal half, pinnatifid distally; pinnules suborbicular, with obtuse mucronate teeth. $2 n=72$. Ledges, rocks and walls, often near the sea. - Mediterranean region; Portugal. ? Bl Co Ga Gr Hs It Lu Sa Si Tu.
12. A. billotii F. W. Schultz, Flora (Regensb.) 28: 738 (1845) (A. lanceolatum Hudson non Forskål). Pinnae lanceolate, pinnate for most of their length, the longer pinnae often recurved; pinnules oblong, narrower than in 11, with acute mucronate teeth. Ledges, rocks and walls, often near the sea. $2 n=144 . W$. Europe, extending eastwards to W. Germany and S. Italy. Az Be $\mathrm{Br} \mathrm{Co} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Hs} \mathrm{Lu} \mathrm{It} \mathrm{Sa} \mathrm{Si}$.
(13-15). A. adiantum-nigrum group. Rhizome ascending or shortly creeping; scales attenuate, with some filiform scales at apex of rhizome. Leaves $10-50 \mathrm{~cm}$; petiole about as long as lamina, swollen at junction with rhizome, reddish-brown, with narrow scales at base; lamina deltate, dark green, coriaceous, glabrous, 2 - to 3 -pinnate; pinnae triangular-ovate to triangularlanceolate, the longest $2.5-7 \mathrm{~cm}$; pinnules pinnatisect. Sori adjacent to the veins.

A group of three closely related species, which may be distinguished as follows:
1 Ultimate leaf-segments flabellate, with obtuse teeth
15. cuneifolium

1 Ultimate leaf-segments lanceolate to linear, with acute teeth
2 Leaves and pinnae caudate
14. onopteris

2 Leaves not caudate
13. adiantum-nigrum
13. A. adiantum-nigrum L., Sp. Pl. 1081 (1753). Lamina not caudate, dark green. Ultimate segments lanceolate, obtuse at base, with acute teeth. $2 n=144$. Rocks, walls and hedge-banks. Most of Europe except the east and extreme north; rare in the Mediterranean region. All except Bl Fe Is $\mathrm{Rs}(\mathrm{N}, \mathrm{B}, \mathrm{C}, \mathrm{E}) \mathrm{Sb}$.
14. A. onopteris L., Sp. Pl. 1081 (1753). Lamina caudate, darker and more shining than in 13; pinnae and pinnules
caudate, usually curved towards the apex of leaf and pinna respectively; ultimate segments narrowly lanceolate to linear, acute at base, with acute teeth. $2 n=72$. Base-poor rock. S., W. and parts of C. Europe. Al Az Bl Br Bu Co Cr Ga ? Ge Gr Hb Hs It Ju Lu Po Rm Sa Si Tu.
15. A. cuneifolium Viv., Fl. Ital. Fragm. 16 (1808) (A. serpentini Tausch). Lamina not caudate, paler and less shining than in 13; ultimate leaf-segments flabellate, with obtuse teeth. $2 n=72$. Usually on serpentine rock. S. \& C. Europe. Al Au Co Cz Ga Ge Gr He ?Hs It Ju Po Rm.
A. forsteri Sadler, Descr. Pl. Epiphyll. Hung. 29 (1820), which resembles 15 but has persistent leaves, and occurs in C. Europe, is given specific rank by some authors.
16. A. septentrionale (L.) Hoffm., Deutschl. Fl. (Krypt.) 12 (1795). Rhizome caespitose, sometimes shortly creeping. Leaves $5-15 \mathrm{~cm}$; petiole 2-3 times as long as lamina, dark reddish-brown only at base, abruptly becoming green; lamina much reduced, thick, dark green, glabrous, dichotomously forked 1-3 times; segments c. 1 mm wide, linear, decurrent along rhachis, minutely forked again at apex. Sori elongate, running whole length of segment. $2 n=144$. Siliceous rocks and walls. Throughout Europe except the extreme west and south. Al Au Be Br Bu Co Cz Da Fe Ga Ge Gr He Hs Hu It Ju Lu No Po Rm Rs (N, C, W, K) Sa Si Su Tu.

Hybrids between 16 and 5a (A. $\times$ alternifolium Wulfen, $A . \times$ germanicum auct., $A . \times$ breynii auct.) are scattered throughout Europe with the parents. They differ from 16 as follows: petiole equalling to twice as long as lamina, almost entirely dark reddishbrown; lamina pinnate, pinnae $c .2 \mathrm{~mm}$ wide, the lowest forked. $2 n=108$.
17. A. seelosii Leybold, Flora (Regensb.) 38: 348 (1855). Rhizome caespitose, sometimes shortly creeping. Leaves 310 cm ; petiole 2-3 times as long as lamina, dark reddish-brown at base, abruptly becoming green above; lamina much reduced, thick, dark green, glandular-hairy, usually 3-partite; segments c. 1 mm wide, rhombic, decurrent along rhachis, toothed at apex, often incised, terminal segment often again 3-lobed. $2 n=72$. Calcareous rocks. - C. \& E. Alps; E. Pyrences. Au Ge Hs It Ju.

Plants from E. Pyrenees which are glabrous and have shorter, less incised leaf-segments, have been described as A. seelosii subsp. glabrum (Litard. \& Maire) Rothm. in Cadevall, Fl. Catalunya 6: 339 (1937).
18. A. ruta-muraria L., $S p . P l .1081$ (1753). Rhizome branched, often creeping; scales very narrow, filiform at apex of rhizome. Leaves $4-15 \mathrm{~cm}$; petiole about as long as lamina, dark only at very base, otherwise green, with occasional glandular hairs; lamina $1-3 \mathrm{~cm}$ wide, ovate-lanceolate, glabrous, 2-pinnate; pinnae of 3-5 segments, segments often again similarly divided; ultimate segments $2-3 \mathrm{~mm}$, broadly flabellate to rhombic, apex serrate to incised. Sori linear, sporangia covering whole segment when mature. $2 n=144$. Walls and base-rich rocks. Almost throughout Europe. All except Az Cr Fa Is Sb .

A diploid plant from dolomitic rocks in N. Italy has recently been reported by J. D. Lovis, Brit. Fern Gaz. 9: 143 (1964).
19. A. lepidum C. Presl, Verh. Ges. Vaterl. Mus. Böhm. 1836: 63 (1836). Rhizome caespitose, much-branched; scales very dark, without or with very few filiform scales at apex of rhizome. Leaves very like those of $\mathbf{1 8}$, but covered throughout with shortly stalked glands; petiole more slender, wiry, persistent; lamina light green, of thinner texture, and less divided; ultimate segments narrower, crenately incised. Sori oblong, sporangia not covering
segment at maturity. $2 n=144$. S.E. Europe, extending locally westwards to S.E. France. Al Au Bu ?Cr Ga Gr Hu It Ju Rm Si.
20. A. fissum Kit. ex Willd., Sp. Pl. 5(1): 348 (1810). Rhizome branched and shortly creeping; scales with central stripe of opaque cells. Leaves $15-22(-32) \mathrm{cm}$; petiole as long as to twice as long as lamina, blackish-red, darkening with age, green distally; lamina very much reduced, lanceolate, glabrous, 3-pinnate; pinnules palmately dissected; ultimate segments $c .1 \mathrm{~mm}$ wide. Sori oblong. $2 n=72$. Deep fissures in calcareous rocks. Mountains of S.C. \& S.E. Europe, from the Maritime Alps and the Alps of Bayern to S. Italy and N. Greece. Al Au Bu ?Ga Ge Gr It Ju.

## 2. Ceterach DC. ${ }^{1}$

Small, xerophilous. Rhizomes short. Leaves tufted, pinnatifid, thick, glabrous above, densely scaly beneath; veins of the leafsegments pinnate and forked, anastomosing near the margin. Sori linear; indusium rudimentary or absent.

1. C. officinarum DC. in Lam. \& DC., Fl. Fr. ed. 3, 2: 566 (1805). Leaves 3-25 cm, persistent, oblong; petiole short, $\frac{1}{6}-\frac{1}{4}$ as long as lamina, covered with scales; lamina greyish to dark green above, covered with light brown, overlapping scales beneath; leaf-segments alternate, ovate or oblong, 9-12 on each side, entire or crenate, rounded at the apex. Sori c. 2 mm . Mean spore-length $41-48 \mu .2 n=144$. Dry rocks and walls. W., S. \& C. Europe, northwards to Scotland and S. Sweden, eastwards to Krym. All except Az Da Fa Fe Is No Rs (N, B, C, W, E) Sb; only as naturalized alien in Po.

A taxon from S.E. Europe, differing from 1 in chromosome number ( $2 n=72$ ) and mean spore-length ( $32-39 \mu$ ), has recently been described, as Asplenium javorkeanum, by G. Vida, Acta Bot. Acad. Sci. Hung. 9: 197 (1963).

## 3. Pleurosorus Fée ${ }^{2}$

Rhizomes short, with narrow, dark scales. Petiole and lamina with long, pale hairs; lamina pinnate with lobed pinnae; veins repeatedly forked. Sori elongate along the small veins, without indusium.

1. P. hispanicus (Cosson) C. V. Morton, Bull. Soc. Bot. Fr. 106: 233 (1959) (Ceterach hispanicum (Cosson) Mett.). Leaves 38 cm , tufted; petiole and lamina about equal in length; pinnae 1 cm or less, rather distant, shortly stalked or subsessile, cuneate at the base, pinnatifid or lobed; each fertile pinna with 3-5 small, ovate or elliptical sori. $2 n=72$. Shady places on calcareous mountains. N.W. \& S. Spain. Hs. (N. Africa.)

## 4. Phyllitis Hill ${ }^{2}$

Rhizomes short. Leaves simple or slightly lobed, with free veins. Sori oblong to narrowly linear, arranged in opposite pairs, those of two neighbouring veins parallel and close, and ultimately appearing like a single sorus; indusia linear, each attached on one side of the receptacle, those of a pair opening towards each other.
1 Lamina entire, not auricled or lobed at base

1. scolopendrium
1 Lamina auricled, lobed or pinnatifid at base 2 Lamina with projecting lobes or auricles at base 2. sagittata
2 Lamina irregularly pinnatifid
2. hybrida
3. P. scolopendrium (L.) Newman, Hist. Brit. Ferns ed. 2, 10 (1844) (Asplenium scolopendrium L., Scolopendrium officinale Sm.). Leaves $10-60 \mathrm{~cm}$, persistent; petiole up to half as long as lamina; lamina $3-6(-7) \mathrm{cm}$ wide, linear-lanceolate, cordate at base, margin slightly undulate, entire. Sori $8-18 \mathrm{~mm}$ wide, linear, usually occupying more than half the width of the lamina. $2 n=72$. Shady places. S., W. \& C. Europe, but rare in the Mediterranean region; S. Sweden. All except Fa Fe Is Sb Rs (N, B, C, E).

Many varieties of this species, some with curled or cleft fronds, are known both in nature and in cultivation. Hybrids with Asplenium trichomanes L. and A. adiantum-nigrum L. have been described by A. H. G. Alston (Proc. Linn. Soc. London 152: 142 (1940)) from Britain, and with A. lepidum C. Presl by G. Vida (Acta Bot. Acad. Sci. Hung. 9: 197 (1963)).
2. P. sagittata (DC.) Guinea \& Heywood, Collect. Bot. (Barcelona) 4 (2): 246 (1954) (P. hemionitis O. Kuntze, Scolopendrium hemionitis Swartz). Leaves $12-30 \mathrm{~cm}$, tufted, persistent; petiole half as long as or equalling lamina; lamina oblonglanceolate, deeply cordate and auricled at base; auricles of young leaves rounded, of mature leaves triangular, more or less lobed, sometimes projecting horizontally for $3-4 \mathrm{~cm}$, and leaves then hastate. Sori elliptical, shorter and wider than in 1. $2 n=72$. Moist shady places. Mediterranean region. Bl Co Cr Ga Gr Hs It Ju Sa Si.

Biropteris antri-jovis Kümmerle, Magyar Bot. Lapok 19: 2 (1922), with ovate, lobed sterile leaves, and narrowly lanceolate, laciniate fertile leaves, has been described from rocks in Kriti. Its status is doubtful, and it may be a monstrous form of 2.
3. P. hybrida (Milde) C. Chr., Ind. Fil. 492 (1906). Leaves up to $12 \times 2 \mathrm{~cm}$, petiole about half as long as lamina; lamina oblonglanceolate, obtuse, irregularly pinnatifid and often with rounded auricles at base, not deeply cordate. Sori narrowly elliptical to broadly ovate. $2 n=144$. Rocks and walls. Islands of N.W. Jugoslavia. Ju.

It has been suggested that this species is of hybrid origin, with $P$. sagittata and diploid Ceterach officinarum as possible parents.

## XVIII. ATHYRIACEAE ${ }^{3}$

Rhizomes dictyostelic, with opaque scales. Petioles grooved, with 2 vascular strands which unite distally. Sori superficial, lying on the veins; spores bilateral.

## 1 Fertile and sterile leaves dissimilar

2 Sterile leaves up to 170 cm , veins free
2 Sterile leaves up to 50 cm , veins anastomosing
5. Matteuccia 1 Fertile and sterile leaves similar

3 Indusium absent

1. Athyrium

3 Indusium present
4 Indusium a circumbasal ring of hairy scales
4. Woodsia

4 Indusium not a ring of scales
5 Indusium hood-like, attached at basiscopic side of sorus
3. Cystopteris

5 Indusium flap-like, linear or oblong, attached laterally
6 Leaves forming a crown at apex of rhizome 1. Athyrium
6 Leaves solitary and distant on rhizome
2. Diplazium

[^12]
## 1. Athyrium Roth ${ }^{1}$

Rhizomes branched, covered with broadly lanceolate, acuminate scales. Leaves uniform, forming a crown at apex of rhizome, 2-pinnate, with pinnatifid or pinnatisect pinnules; lamina broadly lanceolate with pinnae decreasing towards base, veins free. Sori oblong or orbicular; indusium rudimentary and caducous, or persistent, oblong or linear, fimbriate at margin, attached laterally, opening towards the midrib.

Sori oblong; indusium persistent; spores not winged

1. filix-femina

Sori orbicular; indusium rudimentary or absent; spores winged
2. distentifolium

1. A. filix-femina (L.) Roth, Tent. Fl. Germ. 3 (1): 65 (1799). Rhizome short, suberect. Leaves $20-150 \mathrm{~cm}$, suberect or spreading; petiole pale yellow-green or purplish-red, $\frac{1}{4}-\frac{1}{2}$ as long as lamina; lamina thin, flaccid, light green, lanceolate; longest pinnae $3-25 \mathrm{~cm}$, decreasing towards base of leaf, linear-lanceolate, tapered at apex; pinnules $3-20 \mathrm{~mm}$, sessile, oblong or oblong-lanceolate, pinnatifid or pinnatisect. Sori c. 1 mm , more or less oblong; indusia persistent, flap-like, the lower hooked, the upper nearly straight; spore minutely papillose. $2 n=80$. Shady places. Throughout Europe; rare in the Mediterranean region. All except Bl Sb.
This species has many variants, mainly in form and dissection of the leaf, which bear no relation to habitat.
2. A. distentifolium Tausch ex Opiz, Tent. Fl. Crypt. Boem. 1: 14 (1820) (A. alpestre (Hoppe) Rylands, non Clairv.). Like 1 in habit and gross morphology, but usually with segments of pinnules blunt and often tricuspidate at apex. Sori less than 1 mm , orbicular, near edge of lamina; indusium rudimentary or caducous at a very early stage; spore reticulate, with narrow wings. $2 n=80$. Screes and rocky outcrops in exposed places. On mountains throughout most of Europe but rare in the south. Au $\mathrm{Br} \mathrm{Bu} \mathrm{Co} \mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{W}, \mathrm{?C)}$ Su .
A. flexile (Newman) Druce, Brit. Pl. List 87 (1908) (A. alpestre var. flexile (Newman) Milde) is a plant of doubtful status which occurs in Scotland. It has the same chromosome number as 2 but leaves $15-25 \times 2-5 \mathrm{~cm}$, petiole $1-3 \mathrm{~cm}$, markedly deflexed, and very small sori, often of 3-5 sporangia only.

## 2. Diplazium Swartz ${ }^{1}$

Rhizomes creeping, sparsely covered with ovate, dark brown scales. Leaves erect, distant, usually bipinnate, with pinnules deeply pinnatisect, glabrous above; lamina deltate or ovatelanceolate; veins free. Sori oblong or linear; indusium oblong or linear, fimbriate at margin, attached laterally along the vein.

## Pinnules acuminate, glabrous beneath Pinnules rounded at apex; main veins hairy beneath

1. axillare
2. sibiricum
3. D. caudatum (Cav.) Jermy, Brit. Fern Gaz. 9: 161 (1964) (Tectaria caudata Cav.) Leaves $70-100 \mathrm{~cm}$; petiole glabrous, shorter than the lamina; lamina $25-50 \mathrm{~cm}$ wide, ovate or ovatelanceolate; pinnae lanceolate, acuminate or caudate; pinnules lanceolate, acute, basal pairs not markedly shorter than the upper; segments serrate-dentate, glabrous beneath. Sori oblong. Woods and shady places. Açores. Az. (Madeira, Canarias.)

[^13]${ }^{2}$ By J. A. Crabbe.
D. allorgei Tardieu-Blot, Not. Syst. (Paris) 7: 150 (1938), described from San Miguel, Açores, is like 1 but the petiole is dark and hispid, and the pinnules crenate-serrate, obtuse or truncate at apex. It is possible that this plant has been introduced from South America.
2. D. sibiricum (Turcz. ex G. Kunze) Jermy, Brit. Fern Gaz. 9: 160 (1964) (Athyrium crenatum (Sommerf.) Rupr.). Rhizome slender, often much-branched and far-creeping. Leaves $25-$ 60 cm , with glabrous or sparsely scaly petiole as long as lamina; lamina $20-30 \mathrm{~cm}$ wide, deltate; pinnae lanceolate, lowest inflexed; pinnules obtuse or rounded, decreasing in size towards base, segments crenate-dentate, oblong, main veins covered beneath with multicellular crispate hairs. Sori small; indusium obscure, often caducous. $2 n=82$. Picea woodland. N.E. Europe and one small region of $N$. Norway. Fe No Rs (N, C).

## 3. Cystopteris Bernh. ${ }^{2}$

Rhizomes blackish. Leaves uniform, delicate, slender-stalked, dying down in winter; veins free. Sori orbicular; indusium hoodlike, pale, attached across the vein at basiscopic side of sorus, becoming deflexed and shrivelled as the sporangia mature.
$\begin{array}{lll}1 & \text { Rhizomes short, stout; leaves tufted; lamina lanceolate, usually } \\ \text { longer than petiole } & \text { 1. fragilis } \\ 2 & \text { Spores echinate } & \text { 2. dickieana } \\ 2 & \text { Spores rugose } & \\ \begin{array}{lll}\text { 1 } & \text { Rhizomes creeping, slender; leaves solitary; lamina deltate, }\end{array} \\ \begin{array}{lll}\text { usually shorter than petiole } & & \text { 3. montana } \\ 3 & \text { Proximal basiscopic pinnule conspicuously the longest } \\ 3 & \text { Proximal basiscopic pinnule not the longest } & \text { 4. sudetica }\end{array}\end{array}$

1. C. fragilis (L.) Bernh. in Schrader, Neues Jour. Bot. 1 (2): 27 (1806) (C. alpina (Roth) Desv., C. regia (L.) Desv.). Rhizome c. 5 mm in diameter, short, much-branched, covered with old leaf-bases, and with lanceolate, acuminate scales at the apex. Leaves $5-45 \mathrm{~cm}$, tufted, 2 - to 3 -pinnate; petiole $\frac{1}{3}-\frac{2}{3}$ as long as lamina; lamina dull green, glabrous, lanceolate, acute; pinnae up to $c .5 \mathrm{~cm}$, subopposite, subsessile, ovate-lanceolate, becoming increasingly distant below, the second pair from the base usually the longest; pinnules up to $c .15 \mathrm{~mm}$, ovate to oblong, entire and dentate to pinnate; teeth acute to obtuse, sometimes bidentate at the apex, often dentate on the margins; veins ending in the apices of the teeth or excurrent from the retuse sinus. Indusium ovatelanceolate, acuminate; spores echinate. $2 n=168,252$. Mostly on shady, basic rocks. Throughout Europe; mainly on mountains in the Mediterranean region. All except Tu.
C. alpina and C. regia include mainly calcicolous, alpine plants with small dissected leaves and with veins which frequently end in the apical notch of emarginate teeth. Because of the considerable intergradation of morphological characters, distribution, and habitat between these and typical C. fragilis, it has been necessary to treat them all as a single species.
2. C. dickieana R. Sim, Gard. Farm. Jour. 2 (20): 308 (1848). Like 1 but with rugose spores. $2 n=168$. Probably occurring sporadically throughout the range of $1 . \mathrm{Br} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs}$ Is No Rs (N) Sb Si Su.

Originally described from Britain, where the plants represent a variant in which the pinnae are deflexed and horizontally overlapping and inclined, and the pinnules wide, obtuse, more or less overlapping, crenate to crenately lobed. C. baenitzii Dörfler in Baenitz, Herb. Eur. Prosp. 1891: 4 (1890), is a Scandinavian variant which is more like 1.
$\mathbf{1}$ and $\mathbf{2}$ form a widespread, polymorphic, polyploid complex in which it is difficult to classify the variation. Tetraploid and hexaploid populations of 1 cannot as yet be distinguished with certainty either from one another or from diploid populations which have been recorded from North America. Sterile hybrids between 1 and 2 are known.
3. C. montana (Lam.) Desv., Mém. Soc. Linn. Paris 6: 264 (1827). Rhizome c. 2 mm in diameter, creeping, little-branched, with a few scattered scales on the younger parts. Leaves $10-$ 40 cm , solitary, 3-pinnate; petiole 1-2 times as long as lamina; lamina deep green, more or less thinly glandular, deltatepentagonal; pinnae up to $c .10 \mathrm{~cm}$, subopposite, subsessile, obliquely triangular-ovate, acute, the lowest pair the longest; pinnules up to $c .5 \mathrm{~cm}$, the proximal basiscopic pair the longest; ultimate segments up to $c .10 \mathrm{~mm}$, ovate to oblong, more or less acute, pinnately divided. Indusium suborbicular, often glandular, caducous; spores muricate. $2 n=168$. Mountain woods, usually on basic rocks. N. \& C. Europe, extending southwards to the Pyrenees and C. Jugoslavia. Au Be Br Cz Da Fe Ga Ge He Hs It Ju No Po Rm Rs (N, C, W) Su.
4. C. sudetica A. Braun \& Milde, Jahresb. Schles. Ges. Vaterl. Kult. 33: 92 (1855). Like 3 but lamina ovate-deltate, yellow-green; pinnae oblong-lanceolate, proximal basiscopic pinnules not the longest; ultimate segments more or less obtuse. $2 n=168$. Mountain woods. Carpathians and Sudeten mountains; isolated stations in S. Germany, Norway and N. Russia. Cz Ge No Po Rm Rs (N, ?C, W).

## 4. Woodsia R.Br. ${ }^{1}$

Rhizomes short, covered by persistent leaf-bases. Leaves tufted, pinnate, with lobed to pinnatisect pinnae; petioles articulated above the base; veins free. Sori orbicular; indusium divided into a fringe of hair-like scales surrounding the base of the sorus.

Literature: J. Poelt, Mitt. Bot. Staatssamm. (München) 5:16747 (1952). R. E. G. Pichi-Sermolli, Webbia 12: 179-216 (1955).

1 Petiole dark, brownish above the black base; petiole and rhachis sparsely to densely covered with scales and hairs
2 Rhachis and lower surface of pinnae $\pm$ densely covered with scales and hairs; longest pinnae with 4-8 lobes on each side 1. ilvensis

2 Rhachis sparsely clothed with scales and hairs; lower surface of pinnae with few scales and hairs, or glabrous; longest pinnae with 1-4 lobes on each side 2. alpina
1 Petiole pale, greenish to straw-coloured above the black base; petiole and rhachis glabrous or with very few scales or hairs
3 Leaves lanceolate; lowest 1-4 pinnae orbicular, the rest ovate to lanceolate
3. pulchella

3 Leaves linear-lanceolate to linear; lowest 4-8 pinnae orbicular, the rest ovate to lanceolate
4. glabella

1. W. ilvensis (L.) R.Br., Trans. Linn. Soc. London (Bot.) 11 : 173 (1815) (W. ilvensis subsp. rufidula (Michx) Ascherson). Leaves $4-20 \mathrm{~cm}$, dull or brownish-green; petiole densely covered with lanceolate scales near base, with subulate scales above, and with flexuous hairs throughout; lamina oblong-lanceolate, with 7-18 pinnatifid or rarely pinnatisect pinnae on each side; longest pinnae $7-20 \mathrm{~mm}, 1 \frac{1}{2}-2$ times as long as wide, with 4-8 obtuse lobes on each side; rhachis and lower surface of pinnae densely covered

[^14]with subulate scales ( $2-3 \mathrm{~mm}$ ) and flexuous hairs. $2 n=82$. Crevices of siliceous rocks. N. Europe, and on mountains southwards to $44^{\circ} N . \mathrm{Au} \mathrm{Br} \mathrm{Cz} \mathrm{Fe} \mathrm{?Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hu} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm}$ Rs (N, B, C, W, K) Su.
2. W. alpina (Bolton) S. F. Gray, Nat. Arr. Brit. Pl. 2: 17 (1821) (W. hyperborea (Liljeblad) R.Br., W. ilvensis subsp. alpina (Bolton) Ascherson). Usually smaller than 1; leaves paler or yellowish-green; petiole with few scales or hairs, glabrescent; lamina linear-oblong, with 7-14 pinnately lobed or pinnatifid pinnae on each side; longest pinnae $5-15 \mathrm{~mm}, 1-1 \frac{1}{2}$ times as long as wide, with $1-4$ very obtuse lobes on each side; rhachis sparsely clothed with subulate, rarely lanceolate scales ( $1-2 \mathrm{~mm}$ ) and with hairs; lower surface of pinnae with very few scales or hairs, or glabrous. $2 n=164$. Rock-crevices, rarely on walls. N. Europe, and on mountains southwards to $42^{\circ} \mathrm{N}$. in Italy and the Pyrenees. $\mathrm{Au} \mathrm{Br} \mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{C}$, W) Su .
3. W. pulchella Bertol., Fl. Ital. Crypt. 1: 111 (1858) (W. glabella auct. eur. centr., non R.Br.). Leaves $3-12 \mathrm{~cm}$, usually yellowish-green and more or less translucent; petiole with very few scales or hairs at the base, glabrous above; lamina broadly or narrowly lanceolate; pinnae 5-16, pinnately lobed or pinnatifid, not or scarcely overlapping; longest pinnae $4-7(-10) \mathrm{mm}$ with 2-7 obtuse to subacute lobes on each side; the lowest 1-2 pinnae on each side orbicular, the rest ovate-lanceolate to lanceolate; rhachis and lower surface of pinnae usually completely lacking scales or hairs. (The leaves somewhat resemble those of small plants of Cystopteris fragilis.) $2 n=78$. Rockcrevices; calcicole.
E. Alps, and rarely in C. Alps; ?Savoie. Au ? Ga Ge He It Ju.
4. W. glabella R.Br. in Franklin, Narr. Journey App. 26 (1823), non. auct. eur. centr. Leaves $1.5-6 \mathrm{~cm}$, rarely longer, usually yellowish-green, less translucent than in 3; petiole stouter; lamina linear-lanceolate or linear, with 5-16 pinnately lobed or pinnatifid, usually crowded and often overlapping pinnae; longest pinnae $3-5(-6) \mathrm{mm}$ with $1-5$ obtuse lobes on each side; the lowest 2-4 pinnae on each side orbicular, the rest ovate to lanceolate; distribution of scales and hairs as in 3. (The leaves somewhat resemble those of Asplenium viride.) $2 n=c .80,164$. Rock-crevices; calcicole. Arctic and subarctic Europe; N. Ural; one station in S. Carpathians. Fe Is No Rm Rs (N) Sb Su.

## 5. Matteuccia Tod. ${ }^{2}$

Rhizomes stout. Leaves tufted, pinnate with lobed or pinnatifid pinnae, dimorphic, with free veins; fertile leaves smaller, less dissected and with longer petioles than the sterile; petiole spathulate at the base. Sori contiguous, in longitudinal rows, covered by the inrolled margin of the leaf.

1. M. struthiopteris (L.) Tod., Gior. Sci. Nat. Econ. Palermo 1: 235 (1866) (Struthiopteris filicastrum All., S. germanica Willd.). Rhizome short, erect, producing underground stolons. Sterile leaves up to $170 \times 35 \mathrm{~cm}$, not persistent; petiole very short; lamina oblong-lanceolate, soft, bright green; pinnae 30-70, alternate, narrowly lanceolate, pinnatifid. Fertile leaves up to $60 \times 6 \mathrm{~cm}$, persistent, eventually dark brown; pinnae linear, obtuse. $2 n=c .80$. N., E. \& C. Europe, extending to E. Belgium, S.W. Alps and C. Jugoslavia. Au Be Cz Da Fe Ge He Hu It Ju No Po Rm Rs (N, B, C, W, E) ?Si Su [Ga Hb].

Cultivated for ornament and occasionally naturalized.

## 6. Onoclea L. ${ }^{1}$

Rhizomes creeping. Leaves dimorphic, the sterile glabrous, pinnately divided, herbaceous, with anastomosing veins, the fertile bipinnate without laminar expansion, the pinnules lobed. Sori one on each lobe, the lobes recurved and collectively forming a globose structure enclosing a group of sori; indusium caducous.

1. O. sensibilis L., Sp. Pl. 1062 (1753). Sterile leaves up to 50 cm , dying down in winter, triangular, deeply pinnatifid, with winged rachis and $2-16$ pairs of sinuate or coarsely pinnatifid pinnae. Fertile leaves equalling the sterile, lanceolate, stiffly erect, becoming dark brown or black with age. Damp places. Naturalized in a few localities in N.W. Europe. [Be Br Ho.] (North America and E. Asia.)

## XIX. ASPIDIACEAE ${ }^{2}$

Rhizomes dictyostelic, with opaque scales. Petioles with 5-7 vascular strands; rhachis grooved, interrupted to admit grooves of costae. Sori superficial; spores bilateral.

1 Indusium absent; rhizome long, slender 3. Gymnocarpium
1 Indusium present (though sometimes caducous); rhizome stout

2 Indusium peltate

1. Polystichum
2. Dryopteris

## 1. Polystichum Roth ${ }^{1}$

Rhizomes short, ascending. Leaves tufted; lamina 1- to 3-pinnate, the ultimate segments with acuminate, bristle-pointed teeth. Sori orbicular; indusium peltate.
P. falcatum (L. fil.) Diels (Cyrtomium falcatum (L. fil.) C. Presl), a native of E. Asia, and P. munitum (Kaulfuss) C. Presl and P. acrostichoides (Michx) Schott, natives of North America, are naturalized in a few isolated localities.

1 Leaves pinnate; pinnae undivided
1 Leaves usually 2 - to 3 -pinnate; pinnae divided
2 Pinnules distinctly stalked, not decurrent
2 Pinnules sessile or subsessile, decurrent
3 Leaves rigid; pinnules glabrous above
3 Leaves soft; pinnules hairy above

1. lonchitis
2. setiferum
3. aculeatum 4. braunii
4. P. lonchitis (L.) Roth, Tent. Fl. Germ. 3 (1): 71 (1799) (Aspidium lonchitis (L.) Swartz). Rhizome short. Leaves 1560 cm , rigid, persistent; lamina 2-6 cm wide, coriaceous, linearlanceolate, pinnate; pinnae 15-50 on each side, sometimes overlapping, slightly curved, very shortly stalked, auricled on the upper side at the base, undivided; margin serrate. Indusium irregularly dentate. $2 n=82$. In open, rocky and often montane habitats. Throughout most of Europe, but rare and local in many districts. Al Au Be Br Bu Co Cr CzFaFe Ga Ge Gr Hb He Hs Hu Is It Ju No Po Rm Rs (N, B, C, W, K) ?Si Su.
$P . \times$ illyricum (Borbás) Hayek $(\mathbf{1} \times 2)$ is widely distributed in S. \& C. Europe ( $\mathrm{Al} \mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Ju} \mathrm{Rm)}$.

2 P. aculeatum (L.) Roth, Tent. Fl. Germ. 3 (1): 79 (1799) (P. lobatum (Hudson) Chevall., Aspidium lobatum (Hudson) Swartz). Rhizome thick, woody. Leaves $30-90 \mathrm{~cm}$, rigid, usually persistent; lamina 5-22 cm wide, lanceolate, pinnate or 2-pinnate; pinnae up to 50 on each side, pinnate or pinnatifid; pinnules serrate, sessile or subsessile, obliquely decurrent; proximal acroscopic pinnule of each pinna longer than the rest, its proximal side straight, its distal acutely auricled, the two sides forming an acute angle at the base. Indusium thick, persistent. $2 n=164$. Most of Europe, except the east and extreme north; local and only

[^15]on mountains in the south. Al Au Be Br Bu Co Cz Da Ga Ge Gr Hb He Ho Hs Hu It Ju No Po Rm Rs (B, W) Sa ?Si Su Tu.
3. P. setiferum (Forskål) Woynar, Mitt. Naturw. Ver. Steierm. 49: 181 (1913) (P. aculeatum auct. non (L.) Roth, P. angulare (Kit. ex Willd.) C. Presl, Aspidium aculeatum Swartz pro parte). Rhizome thick, woody. Leaves, $30-120 \mathrm{~cm}$, soft, usually not persistent; lamina $10-25 \mathrm{~cm}$ wide, lanceolate, 2 -pinnate; pinnae up to 40 on each side; pinnules serrate, distinctly stalked, not decurrent; proximal acroscopic pinnule scarcely longer than the rest, its proximal side rounded below, its distal obtusely auricled, the two sides forming an obtuse angle at the base. Indusium thin, caducous. $2 n=82$. S., W. \& C. Europe. Al Au Az Be Bl Br Bu Co Ga Ge Gr Hb He Ho Hs Hu It Ju Lu ?Po Rm Rs (K) Sa Si Tu.
P. $\times$ bicknellii (Christ) Hahne $(2 \times 3)$ is found with the parents in many places in W. \& C. Europe; the plants are often infertile and vigorous, most of them presumably being triploid, but it is often difficult to name individual plants from hybrid complexes.
4. P. braunii (Spenner) Fée, Mém. Fam. Foug. 5: 278 (1852) (Aspidium braunii Spenner). Leaves up to 80 cm , soft, usually dying in autumn; lamina up to 20 cm wide, oblong-lanceolate, generally 2-pinnate; pinnae up to 40 on each side; pinnules up to 15 on each side, softly hairy above, margins serrate; proximal acroscopic pinnule not larger than the rest; pinnules sessile or subsessile, obliquely decurrent, not or scarcely auricled, acuteangled at the base. $2 n=164$. Woodland and shady places. Mainly in Central Europe, but extending locally to the C. Pyrenees, Crna Gora, C. Russia (near Kazan) and to $66^{\circ}$ N. in Norway. Au Cz Ga Ge He Hu It Ju No Po Rm Rs (B, C, W) Su.
$P . \times$ luerssenii (Dörfler) Hahne $(2 \times 4)$ is fairly widely distributed in C. Europe.

## 2. Dryopteris Adanson ${ }^{3}$

Rhizomes short, erect or ascending, densely covered with broad, soft, often fimbriate scales. Leaves tufted, 1 - to 4 -pinnate; veins free. Sori orbicular; indusium reniform.

1 Leaves pinnate with deeply pinnatifid pinnae, or 2-pinnate
2 Leaves $10-20 \times 2-3 \mathrm{~cm}$, narrowly lanceolate 10 . fragran
2 Leaves normally much larger and broader, lanceolate or oblong
3 Fertile leaves longer and more erect than the sterile leaves; pinnae $10-20$ on each side 5. crista
3 Fertile leaves similar to the sterile leaves; pinnae 20-35 on each side
(1-3). filix-mas group
1 Leaves 2-pinnate with pinnatifid pinnules, or 3 - to 4 -pinnate
4 Leaves 2-pinnate with pinnatifid pinnules; proximal 3 or 4 pinnules on both sides of basal pinna $\pm$ equal in length
4. villarii

4 Leaves virtually 3- or 4-pinnate; proximal basiscopic pinnule on basal pinna much longer than the proximal acroscopic pinnule
5 Scales on the petiole concolorous; glands on the indusium sessile or absent
6 Leaves lanceolate or ovate-lanceolate; pinnules $\pm$ flat; indusium eglandular 6. carthusiana
6 Leaves triangular-ovate or -lanceolate; pinnules $\pm$ concave; indusium with sessile glands on the margin
9. aemula

5 Scales on the petiole usually bicolorous, dark brown or blackish in the centre and pale brown at the margin; glands on the indusium stalked
7 Proximal basiscopic pinnule of basal pinna nearly always less than half as long as the pinna; spores dark brown with obtuse tubercles
7. dilatata

7 Proximal basiscopic pinnule of basal pinna at least half as long as the pinna; spores pale brown with acute tubercles
8. assimilis
(1-3). D. filix-mas group. Rhizome erect. Fertile leaves similar to sterile leaves, pinnate with deeply pinnatifid pinnae, or 2-pinnate; pinnae 20-35 on each side, teeth not mucronate.
1 Point of insertion of secondary rhachis blackish; pinnules or their ultimate segments usually obliquely truncate, denticulate only at apex
2. borreri

1 Point of insertion of secondary rhachis not blackish; pinnules or their ultimate segments rounded, denticulate, crenate, serrate or lobed all round
2 Large plant with 1 or only a few crowns; usually 3 or more sori on each pinnule; sori 1.5 mm

1. filix-mas

2 Small plant with several crowns; usually 2 sori at most on each pinnule; sori usually less than 1 mm
3. abbreviata

1. D. filix-mas (L.) Schott, Gen. Fil. t. 9 (1834) (Nephrodium filix-mas (L.) Strempel). Rhizome stout, crowns one or few. Leaves (15-) $30-130(-150) \times 5-25 \mathrm{~cm}$; petiole $\frac{1}{4}-\frac{1}{2}$ as long as lamina, pale brown, somewhat scaly, scales pale brown; point of insertion of secondary rhachis not blackish; lamina oblonglanceolate to elliptical-lanceolate, pinnate, flat or recurved at apex; pinnae linear- to oblong-lanceolate, sessile, deeply pinnatifid to pinnate, flat or recurved at margin; pinnules or their ultimate segments oblong to oblong-lanceolate, denticulate, crenate-serrate or lobed all round, rounded at apex. Sori 1.5 mm in diameter, at least 3 and usually 5 or 6 on each pinnule; indusium not glandular, not embracing the sporangium when young. $2 n=164$. Most of Europe except the extreme north and south. All except Az $\mathrm{Bl} \mathrm{Fa} \mathrm{Sa} \mathrm{Sb} \mathrm{Si}$.
2. D. borreri Newman, Hist. Brit. Ferns ed. 3, 189 (1854) (D. paleacea (D. Don) Hand.-Mazz. pro parte, non (Swartz) C.Chr., D. filix-mas auct., pro parte). Like 1 but petiole and rhachis densely scaly; scales reddish to chestnut brown; point of insertion of secondary rhachis blackish; pinnules or their ultimate segments usually obliquely truncate, denticulate only at apex; indusium embracing the sporangia when young. $2 n=82,123,130$, c. 160. S., W. \& W.C. Europe, northwards to S.W. Norway. Au $\mathrm{Az} \mathrm{Be} \mathrm{Br} ? \mathrm{Fa} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{No} \mathrm{?Rm}$.

The detailed distribution of this species in the E. Mediterranean region is uncertain.
D. $\times$ tavelii Rothm., intermediate between the parents $(\mathbf{1} \times \mathbf{2})$ occurs in many parts of S. \& W. Europe, including areas where 2 does not occur.
3. D. abbreviata (DC.) Newman, Hist. Brit. Ferns ed. 3, 192 (1854). Like 1 but crowns several, crowded; leaves 30-50(-120) cm ; lamina covered with minute glands beneath, margins of pinnae and apex of leaves curving upwards; sori usually less than
$1 \mathrm{~mm}, 1-2(-4)$ on each pinnule. $2 n=82$. Mainly in W. Europe, but distribution not yet fully known. $\mathrm{Br} ? \mathrm{Fa} \mathrm{Ga} \mathrm{Hs} \mathrm{Is} \mathrm{It} \mathrm{?Lu} \mathrm{No}$
4. D. villarii (Bellardi) Woynar ex Schinz \& Thell., Viert. Naturf. Ges. Zürich 60: 339 (1915) (D. rigida (Swartz) A. Gray, Nephrodium villarii (Bellardi) G. Beck, Polystichum rigidum (Swartz) DC.). Rhizome procumbent or ascending. Leaves $15-40 \times 5-15 \mathrm{~cm}$, tufted, forming a single crown; petiole $\frac{1}{3}-\frac{1}{2}$ as long as lamina, rarely more, pale yellow to greenish-yellow above the black base; scales concolorous, reddish-brown; lamina lanceolate to oblong- or triangular-lanceolate, dull or pale green, usually covered with yellowish glandular hairs, fragrant, 2-pinnate or almost 3 -pinnate; pinnae $15-25$ on each side, ovate- to oblong-lanceolate, sessile, pinnate; pinnules pinnatilobed to subpinnate. Sori in 2 rows on each fertile pinnule; indusium glandular. $2 n=82,164$. Rocks and rock-crevices. C., S. \& W. Europe, northwards to N. England. Al Au Bl Br Bu Co Cr Ga Ge Gr He Hs It Ju Sa Si.
(a) Subsp. villarii: Leaves dull green, densely glandular above, 2-pinnate. Throughout the range of the species except for most of the Mediterranean region.
(b) Subsp. pallida (Bory) Heywood, Feddes Repert. 69: 44 (1964): Leaves pale green, not or only slightly glandular above, almost 3-pinnate. Mediterranean region.
5. D. cristata (L.) A. Gray, Man. Bot. North. U.S. 631 (1848). Rhizome procumbent or creeping. Leaves of two kinds, the sterile $15-30 \times 3-8.5 \mathrm{~cm}$, patent, the fertile $30-60 \times 14-20 \mathrm{~cm}$, erect; petiole of sterile leaves half as long as lamina, of fertile leaves almost equalling lamina; scales pale brown; lamina linear- to oblong-lanceolate, glabrous, pinnate or 2-pinnate; pinnae $10-20$ on each side, triangular-ovate or -oblong to lanceolate, shortly stalked, deeply pinnatifid or pinnate; pinnules oblong, obtuse, pinnately lobed or serrate. Sori in 2 rows on each fertile pinnule; indusium eglandular. $2 n=164$. Wet places. Europe, southwards to S. France, N. Jugoslavia and S.C. Russia. $\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}$, C, W, E) Su.
6. D. carthusiana (Vill.) H. P. Fuchs, Bull. Soc. Bot. Fr. 105: 339 (1958) (D. spinulosa Watt). Rhizome procumbent or creeping. Leaves $12-60 \times 5-25 \mathrm{~cm}$, stiffly erect; petiole about as long as lamina; scales pale brown, concolorous; lamina lanceolate or ovate-lanceolate, light to yellowish-green, with minute glandular hairs beneath, 3-pinnate or almost so; pinnae 15-25 on each side, triangular-ovate or -lanceolate, shortly stalked, pinnate; pinnules pinnate or almost so, more or less flat. Sori $0.5-1 \mathrm{~mm}$ in diameter, in 2 rows on each fertile pinnule; indusium eglandular. $2 n=164$. Most of Europe, but only on mountains in the south; in the north, nearly to $70^{\circ}$. Al Au Be Br Bu Co Cz Da Fe Ga Ge Hb He Ho ?Hs Hu It Ju No Po RmRs (N, B, C, W, E) Su.
7. D. dilatata (Hoffm.) A. Gray, Man. Bot. North. U.S. 631 (1848) (D. austriaca auct.). Rhizome erect or ascending. Leaves $10-150(-180) \times 4-40 \mathrm{~cm}$, laxer and not so erect as in 6 ; petiole from $\frac{1}{2}$ as long to as long as lamina; scales ovate-lanceolate, bicolorous, dark brown or blackish in the centre, pale brown at the margin; lamina triangular-ovate to -lanceolate, 3-pinnate, usually dark green with a few glands beneath; pinnae 15-25 on each side, stalked, triangular-ovate or -lanceolate, pinnate; pinnules oblong-ovate to -lanceolate, pinnate; the proximal basiscopic pinnule of the basal pinna nearly always less than $\frac{1}{2}$ as long as the pinna; third order pinnules ovate to oblong, toothed or pinnately lobed. Sori $0.5-1 \mathrm{~mm}$ in diameter; indusium with stalked glands; spores dark brown, with obtuse
tubercles. $2 n=164$. Europe, southwards to Portugal, Bulgaria and C. Russia. Au Az Be Br Bu Co Cz Da Fa Fe Ga Ge Hb He Ho Hs Hu Is It Ju Lu No Po Rm Rs (N, B, C, W) Su.
D. azorica (Christ) Alston, Bol. Soc. Brot. 30: 14 (1956), which has been described from Açores, has dark, concolorous, almost linear scales on the petiole and rhachis, and a finely dissected leaf with spinulose segments. This may be related to North American plants, and needs further investigation.
8. D. assimilis S. Walker, Amer. Jour. Bot. 48: 607 (1961). Very like 7 but lamina light green; proximal basiscopic pinnule of the basal pinna at least $\frac{1}{2}$ as long as the pinna; spores pale brown, with acute tubercles. $2 n=82$. - Mountains of Scandinavia, Scotland, Germany, Switzerland and probably elsewhere. Br Ge He Hu No Su .
9. D. aemula (Aiton) O. Kuntze, Revis. Gen. Pl. 2: 812 (1891). Rhizome erect or ascending. Leaves $15-60 \mathrm{~cm}$, tufted; petiole about as long as lamina; scales narrowly lanceolate, concolorous, reddish-brown; lamina triangular-ovate to -lanceolate, bright green, with minute sessile glands on both surfaces, fragrant, 3to 4-pinnate; pinnae 15-20 on each side, stalked, triangular-ovate to -lanceolate, pinnate; pinnules triangular-ovate to lanceolate or oblong, the basal very shortly stalked, the others sessile, pinnate; pinnules of the third or fourth order with upturned margins, pinnately toothed. Sori $0.5-1 \mathrm{~mm}$ in diameter; indusium with sessile glands. $2 n=82$. W. Europe, from Açores and N.W. Spain to N.W. Scotland. Az Br Ga Hb Hs.
10. D. fragrans (L.) Schott, Gen. Fil. t. 9 (1834). Rhizome short and thick, more or less vertical. Leaves (5-) $10-20(-40) \times$ $3-4 \mathrm{~cm}$, tufted; petiole up to $\frac{1}{3}$ as long as lamina, scales concolorous, shining, brown or reddish; lamina lanceolate, green, covered with minute glands, fragrant, pinnate; pinnae 15-40 on each side, lanceolate, deeply pinnatifid, often inrolled at the margin. Rocks and screes. Arctic Finland (Utsjoki); N. Ural. Fe Rs (N). (N. Asia, Japan, N. America.)

## 3. Gymnocarpium Newman ${ }^{1}$

Rhizomes slender, creeping; scales on younger part only, light brown, broadly ovate, fringed with papillae. Leaves solitary, in two ranks, erect; petiole $1 \frac{1}{2}-3$ times as long as lamina, blackish- brown below, brownish-yellow above; lamina deltate; veins free. Sori submarginal, round orelongated, often confluent; indusiumabsent.

Leaves glabrous, eglandular, bright green
Leaves with short glandular hairs, dull green

1. dryopteris 2. robertianum
2. G. dryopteris (L.) Newman, Phytologist 4: 371 (1851) (Dryopteris linneana C.Chr., Phegopteris dryopteris (L.) Fée, Polypodium dryopteris L., Lastrea dryopteris (L.) Bory, Nephrodium dryopteris (L.) Michx). Rhizome far-creeping. Leaves $10-$ 40 cm , rolled up when young so as to form three small balls; petiole glabrous, with few scales near the base; lamina up to 30 cm wide, markedly deflexed, light green, glabrous; pinnae linear-lanceolate, opposite, pinnately lobed; each of lowest pair of pinnae often as large as rest of lamina, triangular, pinnate, basiscopic pinnule larger than acroscopic; ultimate segments more or less oblong, entire, toothed or lobed. $2 n=160$. Woods, and shady places amongst rocks. Most of Europe, but rare in the south. All except Az Bl Lu Sa Sb Si Tu.
3. G. robertianum (Hoffm.) Newman, Phytologist 4: 371 (1851) (Dryopteris robertiana (Hoffm.) C.Chr., Phegopteris robertiana (Hoffm.) A. Braun, Polypodium robertianum Hoffm., Lastrea robertiana (Hoffm.) Newman, Nephrodium robertianum (Hoffm.) Prantl). Very like 1, but leaves usually $15-60 \mathrm{~cm}$, rolled up when young to form a single ball; petiole sparsely glandular below but increasingly glandular towards apex; lamina not obviously deflexed, dull green, with shortly-stalked glands on rhachis, veins and under surface; each of lowest pair of pinnae smaller than rest of lamina. $2 n=160-168$. Limestone rocks and screes, in less shaded situations than 1. Most of Europe, but usually local, and absent from considerable areas; rare in the Mediterranean region. Al Au Be Br Bu Co Cz Fe Ga Ge Gr Hb He Ho Hs Hu It Ju No Po Rm Rs (N, B, C, W, K) Su.

## XX. ELAPHOGLOSSACEAE ${ }^{2}$

Rhizomes polystelic, with dark, latticed scales. Leaves dimorphic; petioles with 5-7 vascular strands. Sporangia occupying the whole fertile surface, and not in distinct sori; spores bilateral.

## 1. Elaphoglossum Schott ex Sm. ${ }^{3}$

Epiphytic. Sterile leaves simple and entire, coriaceous, with scales on both surfaces; veins free; fertile leaves smaller and narrower than the sterile, petioles longer.

1. E. hirtum (Swartz) C.Chr., Ind. Fil. 308 (1906). Leaves $10-$ $40 \times 1-3 \mathrm{~cm}$, oblong, narrowed at the base and at the subacute to rounded apex; petiole $2-10 \mathrm{~cm}$, covered, like the lamina, with brown fimbriate scales. Epiphytic in Ericetum azoricae. Açores. Az. (Tropical Asia and America; Réunion; Madeira.)

## XXI. BLECHNACEAE ${ }^{2}$

Rhizomes dictyostelic, with latticed scales. Petioles with 2 vascular strands; veinlets branching and anastomosing, forming a row of areolae on each side of the costae. Sori discrete in areola, or forming a coenosorus along costae; indusium present; spores bilateral.

Leaf pinnate, not producing young plants vegetatively

1. Blechnum Leaf 2-pinnatifid, producing young plants vegetatively on distal part
2. Woodwardia

## 1. Blechnum L. ${ }^{4}$

Rhizomes short, oblique. Leaves dimorphic; lamina pinnate, coriaceous, glabrous, pinnules entire or crenate; sterile leaves with
free veins. Sori long and linear, forming a coenosorus which occupies practically the entire length of the pinnae of the fertile leaves; indusium firm, linear.

1. B. spicant (L.) Roth, Ann. Bot. (Usteri) 10: 56 (1794). Leaves $8-70 \times 3-7 \mathrm{~cm}$, oblong-lanceolate, attenuate at the base, with $20-60$ pinnae on each side. Sterile leaves patent, with pinnae $3-5 \mathrm{~mm}$ wide; fertile leaves erect, with pinnae $1-2 \mathrm{~mm}$ wide. $2 n=68$. Usually calcifuge. Europe, eastwards to S. Finland, Latvia, E. Carpathians and Turkey, but rare in the Mediterranean region. All except Al Bl Rs (N, C, K, E) Sb.

## 2. Woodwardia Sm. ${ }^{1}$

Plants large. Rhizomes ascending. Leaves all similar; lamina coriaceous, 2-pinnatifid; veins anastomosing to form areolae but
free towards the margin of the lamina. Sori arranged in one or more rows on the outer side of the areolae, parallel and close to the midrib.

1. W. radicans (L.) Sm., Mém. Acad. Sci. Turin 5: 412 (1793). Leaves up to 2.5 m , arcuate, producing young plants vegetatively on the distal part; lamina equalling petiole, deltate or ovatelanceolate, pinnate; pinnae up to 30 cm , deeply and regularly pinnatifid; segments falcate, acuminate, serrulate. Sori oblong, in two rows along either side of the midrib of the pinnules; indusium coriaceous. S.W. Europe, eastwards to S.W. Italy. Az Hs It Lu Si.

## XXII. POLYPODIACEAE ${ }^{2}$

Rhizomes polystelic or solenostelic, with opaque scales. Leaves 2-ranked on upper side of rhizome and articulated to it; petioles with 1-3 major vascular strands. Sori superficial, without indusium; spores bilateral.

## 1. Polypodium L. ${ }^{3}$

Rhizomes creeping. Leaves uniform; lamina pinnatifid or pinnate, glabrous, without scales; pinnae entire or dentate, veins free. Sori orbicular or elliptical, without indusium.

The genus consists, in Europe, of a polyploid complex in which 3 fairly well-defined taxa can be recognized. These all have deeply pinnatifid leaves up to 50 cm or more in length; the lamina is longer than the petiole, and the pinnae are usually alternate, and 5-28 on each side. The sori are arranged in one row on either side of the midrib of the pinna. All the species grow on rocks and walls, or, in the wetter parts of Europe, as epiphytes on trees.

Literature: M. G. Shivas, Jour. Linn. Soc. London (Bot.) 58: 13-38 (1961).

Sori with paraphyses; scales of rhizome $5-11 \mathrm{~mm}$ 1 Sori without paraphyses; scales of rhizome $3-6 \mathrm{~mm}$
2 Sori orbicular; annulus with $10-15$ indurated cells
2 Sori elliptical; annulus with 6-10 indurated cells
2. vulgare 3. interjectum

1. P. australe Fée, Mém. Fam. Foug. 5: 236 (1852) (P. serratum (Willd.) Sauter, non Aublet). Rhizome-scales $5-11 \mathrm{~mm}$, linearlanceolate. New leaves produced in autumn; leaves ovate to
triangular-ovate; pinnae narrow, acute, usually dentate, the basal pair projecting forward; secondary veins with 3-4(-6) bifurcations. Sori elliptical; paraphyses present; annulus with 4-7 indurated cells. $2 n=74$. S. \& W. Europe, northwards to $53^{\circ} \mathrm{N}$. in Ireland. Al Az Bl Br Bu Co Cr Ga Gr Hb He Hs It Ju Lu Rs (K) Sa Si.
2. P. vulgare L., Sp. Pl. 1085 (1753). Rhizome-scales 3-6 mm, lanceolate. New leaves produced in early summer; leaves lanceolate to linear-lanceolate; pinnae obtuse or somewhat acute, the basal pair not projecting forward; secondary veins with $1-3$ $(-4)$ bifurcations. Sori orbicular; paraphyses absent; annulus with $10-15(-20)$ indurated cells. $2 n=148$. Most of Europe except the extreme north and south, only on mountains in the south. All except Bl Co Cr Sa Sb Si Tu .
3. P. interjectum Shivas, Jour. Linn. Soc. London (Bot.) 58: 28 (1961). Rhizome-scales 3-6 mm, linear-lanceolate. New leaves produced in summer; leaves ovate to ovate-lanceolate; pinnae acute, the basal pair projecting forward; secondary veins with $3(-4)$ bifurcations. Sori elliptical; paraphyses absent; annulus with $7-10$ indurated cells. $2 n=222$. W. \& W.C. Europe, northwards to Scotland and extending locally eastwards to near Kaliningrad. Be Br Da Ga Ge Hb He Ho Hs Hu It Lu Rs (C).

There is some disagreement as to the rank of these taxa. The treatment of Shivas is followed here, but W. Rothmaler unites 2 and 3 as $P$. vulgare L., dividing it into subsp. vulgare $(=2)$ and subsp. prionodes (Ascherson) Rothm., Mitt. Thür. Bot. Ver. 38: 106 (1929) (=3).

## XXIII. MARSILEACEAE ${ }^{2}$

Semi-aquatic. Rhizomes slender, creeping, hairy, bearing leaves and roots at each node. Leaves alternate, 2-ranked, filiform or cruciformly 4 -foliolate. Sporocarps tough and stony, borne singly in the leaf axils or on stalks adnate to the petiole, and containing sori of megasporangia and microsporangia, each sorus surrounded by an indusium; annulus lacking or rudimentary. Female prothallus many-celled, male prothallus minute.

[^16]Leaves compound, long-stalked; lamina 4-foliolate Leaves simple, filiform

1. Marsilea
2. Pilularia

## 1. Marsilea L. ${ }^{4}$

Leaves long-petiolate; lamina cruciform, consisting of 2 contiguous pairs of opposite, sessile, obdeltate to cuneate leaflets with flabellate, anastomosing venation. Sporocarps brown to blackish with brown hairs, 2 -chambered, dehiscent along the ventral suture into 2 valves, stalked or sessile; each chamber with several sori within a delicate indusium.

Plants of this genus are rarely seen and seem to be becoming rarer; they usually occur at irregular intervals. All three species occur in habitats subject to periodic shallow inundation, e.g. water-meadows, rice-fields. Submerged, floating and terrestrial forms, usually sterile, are sometimes found.

## 1 Sporocarps more or less sessile, obovoid <br> 3. strigosa

1 Sporocarps pedicellate
2 Sporocarps ellipsoid, not sulcate; pedicels $10-20 \mathrm{~mm}, 2$ - to 4-branched, rarely simple

1. quadrifolia

2 Sporocarps cuboid, sulcate; pedicels c. 5 mm , simple
2. aegyptiaca

1. M. quadrifolia L., Sp. Pl. 1099 (1753). Usually far-creeping, with nodes more than 1 cm apart. Leaves glabrous; petioles $7-20 \mathrm{~cm}$; leaflets $1-2 \mathrm{~cm}$, obdeltate, with entire to slightly undulate, rounded apex. Sporocarps $3-5 \mathrm{~mm}$, near base of petiole, ellipsoid, glabrescent, with small basal teeth, pedicellate; stalks $1-2 \mathrm{~cm}$, erect, 2- to 4 -branched, rarely simple, usually partly connate, adnate to the petiole. S., W. and (very locally) C. Europe, northwards to France $\left(48^{\circ}\right.$ N.), S. Poland and S.W. Ukraine; Volga delta. Al Au Bu Cz Ga Ge He Hs Hu It Ju Lu Po Rm Rs (W, E).
2. M. aegyptiaca Willd., Sp. Pl. 5 (1): 540 (1810). Usually subcaespitose, with nodes less than 1 cm apart. Leaves sparsely hairy or glabrous, dimorphic; some leaves with leaflets $2-5 \mathrm{~mm}$, narrowly cuneate, with deeply crenate to lobed, rounded apex, on petioles $(1-) 3(-4) \mathrm{cm}$; other leaves with leaflets 10 mm , cuneate to obdeltate, with crenate to entire, rounded apex, on petioles (4-)5-6(-9) cm. Sporocarps 3 mm , axillary, cuboid, with a strigose-hairy sulcus in the apex, base and sides, with prominent upper basal teeth and no lower basal teeth; pedicels c. 5 mm simple, erect. Moldavia; Volga delta. Rs (W, E). (Egypt and S.W. Asia.)
3. M. strigosa Willd., Sp. Pl. 5 (1): 539 (1810) (M. pubescens Ten.). Usually caespitose, with crowded nodes and copious
brown-silky buds. Leaves sparsely hairy or glabrous; petioles $2 \cdot 5-30 \mathrm{~cm}$; leaflets $5-15 \mathrm{~mm}$, cuneate to obdeltate, with entire to crenulate, rounded apex. Sporocarps $3-5 \mathrm{~mm}$, axillary, obovoid, laterally flattened, with conspicuous raphe and obscure basal teeth, more or less sessile, crowded, often imbricate. $S$. Europe; widely disjunct and very rare. Ga ?Hs It Lu Rs (E) Sa.

## 2. Pilularia L. ${ }^{1}$

Leaves filiform, subulate, entire. Sporocarps globose, blackish, with brown hairs, 2 - or 4-chambered, dehiscent into as many valves as chambers.

Commonly semi-aquatic, but submerged and terrestrial forms, usually sterile, also occur.
Sporocarps c. 3 mm in diameter, erect, subsessile, 4 -chambered; leaves usually 5 cm or more 1. globulifera Sporocarps c. 0.75 mm in diameter, deflexed, long-stalked, 2-chambered; leaves usually 4 cm or less
2. minuta

1. P. globulifera L., Sp. Pl. 1100 (1753). Caespitose or creeping, with nodes up to 4 cm apart. Leaves usually 5 cm or more, 0.5 mm wide. Sporocarps 4 -chambered, c. 3 mm in diameter, erect, subsessile; megaspores ovoid, constricted above the middle, 15-20 to a chamber. Shallow water, marshy ground, wet heaths and rice-fields. - W. Europe, northwards to $61^{\circ} \mathrm{N}$., extending very locally eastwards to Finland, Poland, Czechoslovakia and Jugoslavia. There are unconfirmed records for Greece, Romania and W. Kazakhstan. Be Br Cz Da Fe Ga Ge Hb $\dagger \mathrm{He}$ Ho Hs It Ju Lu No Po Su.
2. P. minuta Durieu ex A. Braun, Monatsber. Koenigl. Akad. (Berlin) 1863: 435 (1864). Caespitose or creeping, with nodes up to 1 cm apart. Leaves usually 4 cm or less, 0.3 mm wide. Sporocarps 2-chambered, $c .0 .75 \mathrm{~mm}$ in diameter, deflexed, on stalks 2-3 times their length; megaspores globose, not constricted, solitary in each chamber. In seasonally wet hollows and at margins of ditches. W. Mediterranean; very local. Ga ?Hs Lu Sa Si.

## XXIV. SALVINIACEAE ${ }^{2}$

Stems slender, branched, floating. Leaves in whorls of 3, very hairy; two of the leaves entire, floating, the third submerged. Heterosporous; sori at the base of the submerged leaves, stalked, surrounded by a thin-walled, hairy indusium, and consisting of either numerous microsporangia or a few megasporangia, or occasionally mixed.

## 1. Salvinia Adanson ${ }^{3}$

Aquatic annuals. Floating leaves covered with papillae, submerged leaves finely divided and root-like. Microsporangia producing 64 microspores; megasporangia with 1 megaspore; prothalli developing inside the floating spores.

The only genus.
Literature: T. K. J. Herzog, Hedwigia 74: 257-84 (1935).

[^17]Papillae on the floating leaves $0.2-0.8 \mathrm{~mm}$; megasporangial sori spherical 1. natans Papillae on the floating leaves $2-3 \mathrm{~mm}$; megasporangial sori ellipsoidal
2. rotundifolia

1. S. natans (L.) All., Fl. Pedem. 2: 289 (1785). Annual, with slender branching stems. Floating leaves $10-14 \times 6-9 \mathrm{~mm}$, with $3-5$ lateral veins on each side, papillae $0 \cdot 2-0.8 \mathrm{~mm}$; submerged leaves $2-7 \mathrm{~cm}$. Sori up to 3 mm , in groups of 3 to 8 ; those with megasporangia spherical. $2 n=8,18$. C. \& S.E. Europe, extending westwards to Holland and Spain. $\dagger \mathrm{Be} \mathrm{Bu} \mathrm{Cz} \dagger \mathrm{Ga} \mathrm{Ge} \mathrm{Gr}$ Ho Hs Hu It Ju Po Rm Rs (W, K, E) Si.
2. S. rotundifolia Willd., Sp. Pl. 5 (1): 537 (1810). Like 1 but floating leaves up to $15 \times 15-20 \mathrm{~mm}$, with papillae $2-3 \mathrm{~mm}$; megasporangial sori ellipsoidal. Locally naturalized in Spain. [Hs.] (Central and South America.)
S. auriculata Aublet, Hist. Pl. Guian. 2: 969 (1775), another species from South America, occurs occasionally and temporarily as an escape from aquaria.

## XXV. AZOLLACEAE ${ }^{1}$

Stems slender, branched, floating; roots simple. Leaves small, 2-ranked, imbricate, bilobed. Heterosporous; sori in groups of 2 or 4 on the lower lobe of the first leaf of each branch, surrounded by an indusium; larger sori with several microsporangia, smaller sori with 1 megasporangium.

## 1. Azolla Lam. ${ }^{2}$

Small aquatic plants. Leaves always harbouring the blue-green alga Anabaena, the upper lobe herbaceous, the lower larger and hyaline. Microsporangia producing several groups of microspores (massulae), often covered with specialized hairs (glochidia); megasporangia producing a single megaspore with 3 floats, which germinates at the water surface to produce a small prothallus.

The only genus.
Upper lobe of leaf obtuse, with a broad membranous margin

1. filiculoides
[^18][^19]Upper lobe of leaf subacute, with a very narrow membranous margin
2. caroliniana

1. A. filiculoides Lam., Encycl. Méth. Bot. 1: 343 (1783). Plant $1-10 \mathrm{~cm}$ in diameter, elliptical, subglaucous or reddish. Upper lobe of leaf $2.5 \times 0.9-1.4 \mathrm{~mm}$, obtuse, with a broad membranous margin. Microsporangial sori 2 mm ; massulae 5-8; glochidia not septate. Naturalized in W., C. \& S. Europe. [ $\mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Ho} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Rm} \mathrm{Sa]}. \mathrm{(Tropical} \mathrm{America)}$.
2. A. caroliniana Willd., Sp. Pl. 5 (1): 541 (1810). Plant $0 \cdot 7-$ 2.5 cm in diameter, suborbicular, olive-green or brownish. Upper lobe of leaf $1.5 \times 0.7-1.1 \mathrm{~mm}$, subacute, with a very narrow membranous margin. Massulae 3-6; glochidia septate. Naturalized in W., C. \& S. Europe. [ $\mathrm{Be} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Lu} \mathrm{Rm]}$. (America.)
A. pinnata R.Br., Prodr. Fl. Nov. Holland. 167 (1810), a native of S. Africa and S.E. Asia, which has massulae without glochidia, is occasionally seen as a casual.

## SPERMATOPHYTA

## GYMNOSPERMAE

Usually evergreen trees or shrubs. Leaves acicular or scalelike, more rarely broader, and then ovate to lanceolate. Xylem without vessels (except in Gnetales). Flowers unisexual. Ovules not enclosed in an ovary.

# CONIFEROPSIDA 

## CONIFERALES

## XXVI. PINACEAE ${ }^{1}$

Monoecious; resiniferous trees, rarely shrubs, with spirally arranged leaves. Flowers (cones) made up of numerous spirally arranged scales. Scales of male cones (microsporophylls) bearing 2 pollen-sacs on the lower surface. Scales of female cones (megasporophylls) made up of two parts-an upper ovuliferous scale (cone-scale) bearing 2 ovules on the upper surface, and a lower, subtending scale (bract). Fruit a usually woody cone. Seeds winged.

[^20]
## 1. Abies Miller ${ }^{2}$

Evergreen trees with regularly whorled branches. Short shoots absent. Leaves spirally arranged, linear, flattened, grooved above, rarely 4 -sided; resin-canals 2, longitudinal, either marginal (in the hypodermis), or median (in the mesophyll); leaf-scars circular, not at all projecting. Male flowers in leaf-axils on under surface of twigs. Cones ripening in the first year, erect, cylindrical to ovoid; scales falling from the persistent axis when ripe.

The descriptions of twigs and leaves apply only to vegetative, lateral twigs and to the leaves on them.

In addition to the species described below, A. balsamea Miller, Gard. Dict. ed. 8, no. 3 (1768), from N.E. North America, and A. homolepis Siebold \& Zucc., Fl. Jap. 2: 17 (1842) from Japan, are occasionally grown on a small scale in experimental plantations. Both resemble $A$. alba in the bilateral arrangement of leaves on the twigs: A. homolepis may be distinguished by the glabrous young twigs and resinous buds; A. balsamea by the resinous buds, sparsely pubescent young twigs and median resin-canals.

Most of the species described, and several others, are cultivated for ornament in parks and gardens.

Literature: J. Mattfeld, Mitt. Deutsch. Dendr. Ges. (Jahrb.) 1925: 1-37 (1925). J. do Amaral Franco, Abetos. Lisboa. 1950.

1 Leaves rigid, acute
2 Leaves $15-35 \mathrm{~mm}$; resin-canals marginal; bracts exserted from cone
8. cephalonica

[^21]${ }^{2}$ By A. O. Chater.

2 Leaves $10-15 \mathrm{~mm}$; resin-canals median; bracts included in cone
1 Leaves flexible, emarginate or obtuse
3 Leaves gląucous above (with several longitudinal rows of stomata); twigs with reddish pubescence
4 Twigs brown; resin-canals marginal; cones $12-20 \mathrm{~cm}$; bracts long-exserted from cone, deflexed 1. procera
4 Twigs ashy-grey; resin-canals median; cones $5-10 \mathrm{~cm}$; bracts included in cone
3. lasiocarpa

3 Leaves dark or bright green above (with longitudinal rows of stomata only at apex, or absent); twigs with whitish or brownish, but not reddish pubescence, or glabrescent
5 Leaves less than 15 mm (Sicilia)
7. nebrodensis

5 Leaves 15 mm or more
6 Buds resinous, small; cones $5-10 \mathrm{~cm}$; bracts included in cone
7 Twigs silvery-grey; leaves $1-1.3 \mathrm{~mm}$ wide; resin-canals median 4. sibiric
7 Twigs olive-green; leaves $1 \cdot 5-2.5 \mathrm{~mm}$ wide; resin-canals marginal 2. grandi
6 Buds not resinous; cones $10-20 \mathrm{~cm}$; bracts exserted from cone
8 Crown compact; twigs sparsely pubescent; each stomatiferous band on under surface of leaf composed of 8-10 rows of stomata; cones $4-5 \mathrm{~cm}$ wide 5. nordmannian
8 Crown wide; twigs densely pubescent; each stomatiferous band on the under surface of leaves composed of 6-8 rows of stomata; cones $3-4 \mathrm{~cm}$ wide
6. alba

1. A. procera Rehder, Rhodora 42: 522 (1940) (A. nobilis Lindley, non A. Dietr.). Up to 80 m ; trunk stout. Young twigs densely covered with reddish pubescence; buds resinous only at apex. Leaves on the upper surface of the twigs appressed and curving upwards, not leaving a parting. Leaves $10-35 \times 1-$ 1.5 mm , obtuse; resin-canals marginal. Cones $12-20 \times 5-8 \mathrm{~cm}$; bracts long-exserted and deflexed, almost completely concealing the cone. Planted for timber in N. \& W. Europe. [ Br Da Ge Hb No.] (W. North America.)
2. A. grandis (D. Don) Lindley, Penny Cycl. 1: 30 (1833). Up to 75 m ; trunk fairly stout. Young twigs sparsely puberulent; buds resinous. Leaves on the upper surface of the twigs pointing horizontally outwards, leaving a distinct parting. Leaves $20-$ $60 \times 1 \cdot 5-2.5 \mathrm{~mm}$, emarginate. Cones $5-10 \times 3-4 \mathrm{~cm}$; bracts included. Planted for timber in N. \& C. Europe. $[\mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Ge}$ Hb He It No.] (W. North America.)
3. A. lasiocarpa (Hooker) Nutt., N. Amer. Sylva 3: 138 (1852). Up to 48 m ; crown narrowly pyramidal; trunk slender. Young twigs with reddish pubescence; buds resinous. Leaves on upper surfaces of twigs pointing forwards and curving upwards, not leaving a parting. Leaves $15-40 \times 2 \mathrm{~mm}$, flexible, obtuse or slightly emarginate; resin-canals median. Cones $5-10 \times 3.5 \mathrm{~cm}$; bracts included. Occasionally planted for timber in N. Europe. [Is Su.] (W. North America.)
4. A. sibirica Ledeb., Fl. Altaica 4: 202 (1833). Up to 30 m ; crown pyramidal; trunk slender. Young twigs sparsely pubescent; buds very resinous. Leaves on the sides of twigs spreading horizontally; those on the upper surface pointing forwards and
upwards, and not leaving a parting. Leaves $15-30 \times 1-1 \cdot 3 \mathrm{~mm}$, thin, flexible, rounded at apex or slightly emarginate; resin-canals median. Cones $6-8 \times 3 \mathrm{~cm}$; bracts half as long as cone-scales, included. Forming extensive forests in N.E. Russia, westwards to c. $41^{\circ} \mathrm{E}$. and southwards to c. $55^{\circ} \mathrm{N}$. Planted for timber in parts of N. Europe. Rs (N, C) [Da Fe Is]. (N. Asia.)
5. A. nordmanniana (Steven) Spach, Hist. Vég. (Phan.) 11:418 (1842). Up to 70 m ; trunk stout. Young twigs sparsely pubescent, buds not resinous. Leaves on the upper surface of the twigs spreading forwards and upwards, not leaving a parting. Leaves $15-35 \times 1 \cdot 5-2 \mathrm{~mm}$, emarginate; resin-canals marginal. Cones $12-18 \times 4-5 \mathrm{~cm}$; bracts exserted and deflexed. Planted for timber in C. Europe and occasionally elsewhere. [ Au Cz Da It Lu Rm Su Tu.] (W. Caucasus, N. Anatolia.)
6. A. alba Miller, Gard. Dict. ed. 8, no. 1 (1768) (A. pectinata (Lam.) DC.). Up to 50 m ; crown pyramidal; trunk stout. Young twigs densely pubescent; buds not resinous. Leaves on the sides of twigs spreading horizontally; those on the upper surface pointing outwards and upwards, leaving a distinct parting. Leaves $15-30 \times 1 \cdot 5-2 \mathrm{~mm}$, thick, flexible, emarginate at apex; resin-canals marginal. Cones $10-20 \times 3-4 \mathrm{~cm}$; bracts exserted, deflexed. $2 n=24$. - Forming forests in the mountains of $C$. Europe, extending to the Pyrenees and adjacent mountains of N. Spain (Montseny), S. Italy and Macedonia with outlying lowland forests in W. France (Normandie), and E. Poland (Bialowieza). Planted for timber in N. \& W. Europe. Al Au Bu Co Cz Ga Ge Gr He Hs Hu It Ju Po Rm [Be Br Da Lu No Su].
A. pardei Gaussen, Bull. Soc. Hist. Nat. Toulouse 57: 357 (1929), is cultivated in France, and may perhaps occur wild in Calabria. It is very like $A$. alba, but has median resin-canals.
7. A. nebrodensis (Lojac.) Mattei, Boll. Orto Bot. Palermo 7: 64 (1908). Up to 15 m ; crown broad, somewhat flattened; trunk stout. Young twigs glabrescent; buds resinous. Leaves all patent, dense, spreading evenly from the sides and upper surfaces of twigs, often leaving a parting on under side. Leaves $8-13 \times$ 2 mm , thick, rigid, obtuse, rarely apiculate; resin-canals marginal. Cones c. $20 \times 5 \mathrm{~cm}$; bracts exserted, deflexed. About 20 immature native trees in N. Sicilia (Le Madonie). Formerly forming extensive forests on the mountains of N. Sicilia, and now being replanted. Si.

On account of the scarcity of material of this species the above description is partly based on vegetative twigs of immature trees, and partly on flowering twigs of mature trees, and is not therefore strictly comparable to the descriptions of the other species. Some authors regard this taxon as only an insular variant of A. alba, but in the present state of knowledge it seems best to consider it as a species. Vide A. Messeri, Rendic. Accad. Naz. Lincei ser. 8, 25 : 547-56 (1958).
8. A. cephalonica Loudon, Arbor. Fruticet. Brit. 4: 2325 (1838). Up to 30 m ; crown pyramidal; trunk fairly stout. Young twigs glabrous; buds very resinous. Leaves all patent, dense, spreading evenly from the sides and upper surfaces of twigs, less dense and often leaving a parting on under side. Leaves $15-35 \times 2-2.5 \mathrm{~mm}$, thick, rigid, acute and pungent, rarely subobtuse; resin-canals marginal. Cones $12-16 \times 4-5 \mathrm{~cm}$; bracts exserted, deflexed. - Mountains of Greece between 750 and 1700 m ; planted for timber in Italy. Gr [It].
${ }^{1}$ By J. Amaral Franco.
A. borisii-regis Mattf., Notizbl. Bot. Gart. Berlin 9: 235 (1925), is a name applied to trees in the Balkan peninsula from $\mathbf{S}$. Albania to Thrace. They are of varying form, but always more or less intermediate between 6 and 8 . The young twigs are densely pubescent, the buds are resinous, and the leaves are usually like those of 8 in shape and in arrangement. It is probable that they are of hybrid origin; cones are very rarely produced.
9. A. pinsapo Boiss., Biblioth. Univ. Genève ser. 2, 13: 402, 406 (1838). Up to 30 m , crown pyramidal; trunk stout. Young twigs glabrous; buds resinous. Leaves patent, spreading evenly all round twigs. Leaves $10-15 \mathrm{~mm}$, thick, rigid, acute; resin-canals median. Cones $10-16 \times 3-4 \mathrm{~cm}$; bracts less than half as long as cone-scales, included. North-facing slopes on limestone mountains between 1000 and 2000 m . S.W. Spain (near Ronda). Occasionally planted for timber elsewhere. Hs [Au Lu].
A. $\times$ insignis Carrière ex Bailly, Revue Hort. (Paris) 1890: 230 (1890), a hybrid between 9 and 5, first raised in France in 1872, is very common as an ornamental tree in parks throughout Europe. It is like 9 but the young twigs are pubescent, the leaves are $10-33 \times 1.5-2.5 \mathrm{~mm}$, acute or obtuse, less dense, and often leaving a parting on the under side of the twigs, the cones are $11-20 \times 3 \cdot 5-5 \mathrm{~cm}$, and at least the lower bracts are slightly exserted.

## 2. Pseudotsuga Carrière ${ }^{1}$

Like Abies but branches irregularly whorled; resin-canals 2, marginal; leaf-scars elliptical, slightly projecting; cones deflexed, pendent, ovoid or cylindrical; scales persistent.

1. P. menziesii (Mirbel) Franco, Conif. Duar. Nom. 4 (1950) ( $P$. douglasii (Lindley) Carrière, P. taxifolia Britton). Tree up to 100 m , with ridged, dark red-brown bark on adult trees. Twigs pubescent. Leaves $20-35 \mathrm{~mm}$, entire at the apex, fragrant when bruised. Cones $5-10 \times 2-3.5 \mathrm{~cm}$, ovoid. Extensively planted for timber in many parts of Europe. [ Au Be Br Bu Cz Da Fe Ga Ge Gr Hb He It Ju Lu Po Rm Su.] (W. North America.)

## 3. Tsuga (Antoine) Carrière ${ }^{1}$

Evergreen trees with irregularly whorled branches. Short shoots absent. Leaves spirally arranged, linear, flattened or tetragonal; resin-canal 1 ; leaves borne on prominent, persistent cushions. Male flowers in leaf-axils of previous year's twigs. Cones ripening in the first year, pendent, ovoid or cylindrical; scales persistent; bracts rarely exserted.
Buds globose; leaves with broad, white stomatiferous bands
beneath 1. heterophylla Buds ovoid; leaves with narrow, white stomatiferous bands beneath
2. canadensis

1. T. heterophylla (Rafin.) Sarg., Silva N. Amer. 12: 73 (1898). Tree up to 70 m , with a narrow-pyramidal crown. Buds globose. Leaves $6-20 \mathrm{~mm}$, flattened, with two broad white stomatiferous bands beneath. Cones $20-25 \mathrm{~mm}$, reddish-brown. Occasionally planted for timber in N.W. Europe. [Da Ga Ge Hb No.] (W. North America.)
2. T. canadensis (L.) Carrière, Traité Gén. Conif. 189 (1855). Tree up to 30 m , with a broad-pyramidal crown. Buds ovoid. Leaves $8-18 \mathrm{~mm}$, with two narrow, white stomatiferous bands beneath. Cones $15-20 \mathrm{~mm}$, pale chestnut-brown. Occasionally planted for timber. [Ge.] (North America.)

## 4. Picea A. Dietr. ${ }^{1}$

Evergreen trees with regularly whorled branches. Short shoots absent. Leaves spirally arranged, linear, flattened or tetragonal; resin-canals $0-2$; leaves borne on persistent, peg-like projections. Male flowers in leaf-axils of previous year's twigs. Cones ripening in the first year, ovoid or cylindrical; scales persistent; bracts minute, not exserted.

1 Leaves flattened, with two white stomatiferous bands only on the upper surface

$$
2 \text { Leaves } 15-25 \mathrm{~mm} \text {, pungent; cones } 6-10 \mathrm{~cm} \text { 6. sitchensis }
$$

2 Leaves 8-18 mm, obtuse and mucronulate; cones 3-6 cm
7. omorika

1 Leaves tetragonal, stomatiferous on all four sides
3 Twigs glabrous or with scattered, minute pubescence
4 Cones $3 \cdot 5-5 \mathrm{~cm}$; leaves with a strong, unpleasant smell when crushed 3. glauca
4 Cones $6-18 \mathrm{~cm}$; leaves not smelling unpleasantly when crushed
5 Cones 6-10 cm ; leaves bluish-green
5. pungens

5 Cones $10-18 \mathrm{~cm}$; leaves dark green
3 Twigs densely and shortly pubescent
6 Leaves 6-10 mm, obtuse

1. abies

6 Leaves $10-25 \mathrm{~mm}$, acute
7 Twigs brown; leaves $10-18 \mathrm{~mm}$; scales obovate, with rounded and entire or emarginate apex 1. abies
7 Twigs pale yellowish-brown; leaves $15-25 \mathrm{~mm}$; scales rhombic-oblong, narrowed, truncate and erose at apex
4. engelmannii

1. P. abies (L.) Karsten, Deutsche Fl. Pharm.-med. Bot. 324 (1881). Up to 60 m . Twigs usually brown. Leaves tetragonal, stomatiferous on all four sides, acute, dark green. N. Europe, extending southwards in the mountains to the S. Alps and Bulgaria. Widely planted elsewhere for timber. Al Au Bu Cz Fe Ga Ge He It Ju No Po Rm Rs (N, B, C) Su [ Be Br Da Hb Ho Hs Hu].
(a) Subsp. abies (P. excelsa (Lam.) Link, P. vulgaris Link): Up to 60 m . Twigs glabrous or with scattered, minute hairs. Leaves $10-25 \mathrm{~mm}$. Cones $10-18 \times 3-4 \mathrm{~cm}$, cylindrical; scales rhombicovate, with truncate, and erose or emarginate apex. $2 n=22,24$. - Throughout the range of the species in Europe. Largely cultivated as a forest tree in N., C. \& W. Europe. Al Au Bu Cz Fe Ga Ge He It Ju No Po Rm Rs (B, C) Su [Be Br Da Hb Ho Hs Hu .
(b) Subsp. obovata (Ledeb.) Hultén, Svensk Bot. Tidskr. 43: 388 (1949) ( $P$. obovata Ledeb., P. fennica (Regel) Komarov): Up to $30(-50) \mathrm{m}$. Twigs densely pubescent with short hairs. Leaves $10-18 \mathrm{~mm}$. Cones $6-8 \mathrm{~cm}$, cylindric-ovoid; scales obovate, with rounded, sometimes emarginate apex. N.E. Europe. Fe No Rs ( $\mathrm{N}, \mathrm{C}$ ) Su. (N. Asia.)
In the Alps, plants somewhat intermediate between (a) and (b) are sometimes recognized as a third subspecies, subsp. alpestris (Brügger) Domin.
2. P. orientalis (L.) Link, Linnaea 20: 294 (1847). Up to $40(-60) \mathrm{m}$. Twigs densely pubescent, pale brown. Leaves $6-$ 10 mm , tetragonal, stomatiferous on all 4 sides, obtuse, dark green, shining, densely crowded and appressed. Cones $6-9 \mathrm{~cm}$, cylindric-ellipsoid; scales obovate, rounded and entire at apex. Occasionally planted for timber on a small scale. [Au Be It Tu.] (S.W. Asia.)
3. P. glauca (Moench) Voss, Mitt. Deutsch. Dendrol. Ges. 16: 93 (1908). Up to 30 m . Twigs glabrous, greyish or pale brown. Leaves $8-18 \mathrm{~mm}$, tetragonal, stomatiferous on all 4 sides, acute or subacute, bluish-green, with a strong unpleasant smell when
crushed. Cones $3 \cdot 5-5 \mathrm{~cm}$, cylindric-oblong; scales suborbicular, rounded and entire at apex. Planted for timber in N. Europe. [Au Be Da Fe Is No.] (N. North America.)
4. P. engelmannii Parry ex Engelm., Trans. Acad. Sci. St. Louis 2: 212 (1863). Up to 50 m . Twigs minutely glandular-pubescent, pale yellowish-brown. Leaves $15-25 \mathrm{~cm}$, tetragonal, stomatiferous on all four sides, acute, usually bluish-green, with an unpleasant smell when crushed. Cones $3 \cdot 5-7 \cdot 5 \mathrm{~cm}$, cylindricoblong; scales rhombic-oblong, narrowed, truncate and erose at apex. Planted for timber, mainly in N. Europe. [Au Be Da Fe Is No.] (W. North America.)
P. mariana (Miller) Britton, Sterns \& Poggenb., Prelim. Cat. 71 (1888), from N. North America, a tree up to $20-30 \mathrm{~m}$, with densely pubescent twigs, leaves $6-18 \mathrm{~mm}$, glaucous, and cones $2-3.5 \mathrm{~cm}$, has been planted experimentally for timber in Europe.
P. rubens Sarg., Silva N. Amer. 12: 33 (1898), from N.E. North America, a tree up to 30 m , with densely pubescent twigs, leaves $10-15 \mathrm{~mm}$, dark or yellowish-green, and cones 3-4 cm, has also been planted experimentally.
5. P. pungens Engelm., Gard. Chron. nov. ser., 11: 334 (1879). Up to $30(-50) \mathrm{m}$. Twigs glabrous, becoming yellowish-brown. Leaves $20-30 \mathrm{~mm}$, tetragonal, stomatiferous on all four sides, rigid, pungent, bluish-green. Cones $6-10 \mathrm{~cm}$, cylindric-oblong; scales rhombic-oblong, narrowed and erose at apex. Planted for timber, mainly in N. \& C. Europe. [Au Cz Ga He Is It No.] (W.C. North America.)
P. asperata Masters, Jour. Linn. Soc. London (Bot.) 37: 419 (1906), from W. China, intermediate in most respects between 1 and 5 , has been planted experimentally for timber in Europe.
6. P. sitchensis (Bong.) Carrière, Traité Gén. Conif. 260 (1855) (P. falcata (Rafin.) Valck.-Suringar). Up to $40(-60) \mathrm{m}$. Leaves $15-25 \mathrm{~mm}$, flattened, with two broad, white stomatiferous bands above, dark green beneath, pungent. Cones $6-10 \times 2 \cdot 5-3 \mathrm{~cm}$, cylindric-oblong; scales rhombic-oblong. Cultivated for timber in N.W. \& C. Europe. [Au Br Ga Ge Hb Ho Is No.] (W. North America.)
7. P. omorika (Pančić) Purkyně, Österr. Monatschr. Forstwes. 27: 446 (1877). Up to 30 m , of very slender habit. Leaves $8-18 \mathrm{~mm}$, flattened, with two broad, white stomatiferous bands above, dark green beneath, obtuse and mucronulate. Cones 3-6 $\times 1.5-2.5 \mathrm{~cm}$, ovoid-oblong; scales suborbicular, denticulate. - C. Jugoslavia (Drina basin). Cultivated for timber in some Scandinavian countries. Ju [Da Su].

## 5. Larix Miller ${ }^{1}$

Deciduous trees with irregularly whorled branches. Twigs of two kinds: long shoots bearing scattered leaves; and persistent spurlike shoots bearing tufts of leaves. All leaves linear, usually flattened and thin. Resin-canals 2. Cones ripening in the first year, subglobose to oblong; scales rounded, persistent; bracts exceeding ovuliferous scales in flower, hidden or exserted at maturity.

In addition to the species described below L. laricina (Duroi) C. Koch, Dendrol. 2 (2): 263 (1873), from E. North America is cultivated on a small scale in Europe. It is like 4, but with somewhat shorter leaves, and young branches usually glaucous.
1 Young shoots glaucous; leaves with two distinct white, stomati-
ferous bands beneath; cone-scales recurved at apex

1. kaempferi

1 Young shoots not glaucous; leaves without white stomatiferous bands beneath
2 Cone-scales glabrous outside
4. gmelinii

2 Cone-scales puberulent or shortly tomentose outside
3 Cone-scales straight, about twice as long as the bracts
2. decidua

3 Cone-scales slightly incurved at apex, convex, about three times as long as the bracts
3. russica

1. L. kaempferi (Lamb.) Carrière, Fl. Serres Jard. Eur. 11: 97 (1856) sec. Franco, Anais Inst. Sup. Agron. (Lisboa) 19: 18 (1952) (L. leptolepis (Siebold \& Zucc.) Endl.). Up to 30 m . Twigs yellowish- or reddish-brown, glaucous. Leaves $15-25 \mathrm{~mm}$, with two conspicuous, white stomatiferous bands beneath. Cones $1 \cdot 5-3 \cdot 5 \mathrm{~cm}$, ovoid; scales numerous, the upper edge recurved, slightly pubescent. Planted for timber, mainly in N.W. Europe. [ $\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Ho} \mathrm{Rs} \mathrm{(B)} \mathrm{Su]}. \mathrm{(Japan)}$.
2. L. decidua Miller, Gard. Dict. ed. 8, no. 1 (1768) (L. europaea DC.). Up to 35 m . Twigs yellowish, glabrous. Leaves $20-$ 30 mm , thin and soft, with two greenish stomatiferous bands beneath. Cones $2-3.5 \mathrm{~cm}$, ovoid; scales $40-50$, rounded, loosely appressed, softly pubescent. Alps; W. Carpathians; planted elsewhere for timber. Au Cz Ga Ge He It [ $\mathrm{Be} \mathrm{Br} \mathrm{Fe} \mathrm{Ju} \mathrm{No} \mathrm{Rs} \mathrm{(B)} \mathrm{Su]}$.

Plants with smaller cones and more concave, rounded scales, from Poland and N.W. Ukraine are sometimes regarded as a subspecies, L. decidua subsp. polonica (Racib.) Domin, Pl. Čechosl. Enum. 12 (1936) (L. polonica Racib.). Other variants have been described in detail by K. Šiman in Klika et al., Jehličnaté 95-126 (1953).

A hybrid of this species with 1 (L. $\times$ eurolepis A. Henry) is planted for timber in parts of Europe.
3. L. russica (Endl.) Sabine ex Trautv., Acta Horti Petrop. 9: 212 (1884). Up to 40 m . Twigs light yellowish-grey, more or less hairy. Leaves up to 35 mm . Cones $c .3 .5 \mathrm{~cm}$; thin and soft with two greenish stomatiferous bands beneath; scales $c .30$, becoming erecto-patent, finely tomentose outside. N.E. Russia, westwards to c. $36^{\circ} \mathrm{E}$. and southwards to c. $57^{\circ} \mathrm{N}$. Planted for timber in N. Sweden and Finland. Rs (N, C) [Fe Su]. (Siberia.)
4. L. gmelinii (Rupr.) Kuzeneva, Trav. Mus. Bot. Acad. Pétersb. 18: 41 (1920). Up to 30 m . Twigs yellowish or reddish, often pubescent. Leaves c. 30 mm , bright green, with two greenish stomatiferous bands beneath. Cones $2-2.5 \mathrm{~cm}$, ovoid; scales c. 20, glabrous outside. Planted for timber in N. Europe. [Da Fe No.] (E. Asia.)

## 6. Cedrus Trew ${ }^{1}$

Like Larix but leaves evergreen, usually 3 -sided; cones ripening in the second year; scales falling from persistent axis when ripe; bracts minute.
1 Leading shoot pendent; leaves up to 50 mm ; female cones rounded at apex 1. deodara
1 Leading shoot stiff, erect; leaves not more than 30 mm ; female cones truncate or umbilicate at apex $\quad$ 2. atlantica

1. C. deodara (D. Don) G. Don fil. in Loudon, Hort. Brit. 388 (1830). Up to 60 m or more, with pendent leading shoot. Twigs densely hairy. Leaves $20-50 \mathrm{~mm}$, usually green. Male cones $5-12 \mathrm{~cm}$. Female cones 8-12 $\times 5-8 \mathrm{~cm}$, rounded at apex. Planted for timber in S. Europe. [Ga Gr It Lu.] (Afghanistan and N.W. Himalaya.)

[^22]2. C. atlantica (Endl.) Carrière, Traité Gén. Conif. 285 (1855). Up to 40 m , with stiff leading shoot. Young twigs downy. Leaves $10-30 \mathrm{~mm}$, green or glaucous. Male cones $3-5 \mathrm{~cm}$. Female cones $5-8 \times 3-5 \mathrm{~cm}$, subcylindrical, truncate or umbilicate at apex. Planted for timber in S. Europe. [Ga Gr It Lu.] (Algeria and Morocco.)
C. libani A. Richard in Bory, Dict. Class. Hist. Nat. 3: 299 (1823), from S.W. Asia (S. Anatolia and Lebanon) is frequently planted as an ornamental tree, but not on a large scale. It differs from 2 in its glabrous young twigs, dark green leaves and larger female cones ( $7-12 \mathrm{~cm}$ ).

## 7. Pinus L. ${ }^{2}$

Evergreen trees or shrubs with regularly whorled branches. Twigs of two kinds: long shoots bearing scale-like leaves; and deciduous short shoots bearing acicular leaves in clusters of $2-5(-8)$. Resin-canals 2 or more, varying in position. Male flowers catkin-like, clustered at the base of the young twigs. Cones ripening in the second or third year, eventually falling in their entirety, cylindrical to ovoid; ovuliferous scales woody; bracts minute; the exposed part of the scales (apophysis) with a prominent protuberance (umbo), usually ending in a spine or prickle.

Literature: H. Gaussen, Les Gymnospermes, Fasc. vi, ch. xi, Pinus (1960). J. Klika et al., Jehličnaté. Praha, 1953.
1 Leaves in groups of 5
2 Seed winged; leaf with 2-4 marginal resin-canals
3 Young shoots with fine, reddish-brown hairs; apophysis not swollen
20. strobus

3 Young shoots glabrous or glabrescent; apophysis swollen
4 Leaves rigid, directed forwards to apex of branches; cone $8-15 \mathrm{~cm}$, curved
19. peuce

4 Leaves not rigid, pendulous; cone $15-25 \mathrm{~cm}$, straight
18. wallichiana

2 Seeds not winged; leaf with 2-3 median resin-canals
5 Bud-scales shiny; cones more than $1 \frac{1}{2}$ times as long as wide; seeds with fragile husk 17. sibirica
5 Bud-scales dull; cones less than $1 \frac{1}{2}$ times as long as wide; seeds with hard husk
16. cembra 1 Leaves in groups of 2 or 3
6 Leaves in groups of 3, rarely mixed with some in pairs
7 Winter buds cylindrical, resinous; leaves stout; umbo with strong, persistent mucro $\quad$ 5. ponderosa
7 Winter buds ovoid, not resinous; leaves slender; umbo with small caducous mucro, or not mucronate
8 Leaves not more than 150 mm ; bud-scales closely appressed; cones $7-14 \mathrm{~cm}$, strongly asymmetrical 3. radiata
8 Leaves $150-300 \mathrm{~mm}$; bud-scales free, deflexed; cones $10-$ 20 cm , symmetrical
14. canariensis

6 Leaves in pairs
9 Seeds wingless or with wings less than 1 mm 15. pinea
9 Seeds with well-developed wings more than 1 mm
10 Twigs grey in first year
11 Leaves less than 1 mm wide; resin-canals submarginal, rarely median
12. halepensis

11 Leaves more than 1 mm wide; resin-canals median
12 Twigs turning brown in second year; hypodermis of 2-3 layers; apophysis flat, with very short, acute mucro
11. heldreichii

12 Twigs remaining whitish-grey for 3 years; hypodermis of
3-5 layers; apophysis pyramidal, with recurved mucro
10. leucodermis

10 Twigs not grey in first year
13 Buds not resinous; scales recurved at apex
14 Resin-canals marginal or submarginal; cone $5-11 \times$ 4 cm 13. brutia

| 14 | Resin-canals median; cone $8-20 \times 5-8 \mathrm{~cm}$ | 2. pinaster |
| :---: | :---: | :---: |
| 13 | Buds resinous; scales not recurved at apex |  |

13 Buds resinous; scales not recurved at apex
Resin-canals median metrical

1. contorta

16 Leaves usually more than $80 \times 1.5 \mathrm{~mm}$, not or scarcely twisted; cone $\pm$ symmetrical
4. banksiana

17 Cones strongly curved; leaves dark green
7. sylvestris

18 Leaves bright green; cone shining, obtuse, patent
19 Erect tree up to 25 m ; cone $5-7 \mathrm{~cm}$; apophysis very prominent, recurved and hooked 9. uncinata concavo-convex, not recurved and hooked 8. mugo

Subgen. Pinus (subgen. Diploxylon (Koehne) Pilger). Leaves mostly in groups of 2 or 3 (rarely 5-8), with 2 fibro-vascular bundles; scale-leaves decurrent; umbo dorsal.

1. P. contorta Douglas ex Loudon, Arbor. Fruticet. Brit. 4: 2292 (1838). Tree 6-10 m; bark dark brown, with numerous scales; branches short, contorted. Twigs glabrous, clear green in first year, then orange or brown. Leaves $30-70 \times 0 \cdot 9-1 \cdot 1 \mathrm{~mm}$, acute, in pairs, twisted; resin-canals median. Cone $2-6 \times 2-$ 3 cm , ovoid-conical, symmetrical, pale brownish-yellow, shining; apophyses near base of cone pyramidal; umbo with slender, fragile mucro. Seeds $4-5 \mathrm{~mm}$; wing c. 8 mm . Cultivated for timber in N. Europe and occasionally elsewhere. $[\mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Fe}$ Ge Hb Is It No Rm Su.] (W. North America.)
2. P. pinaster Aiton, Hort. Kew. 3: 367 (1789). Up to 40 m ; bark becoming deeply fissured, reddish-brown. Buds oblong, fusiform, not resinous. Twigs glabrous, reddish-brown. Leaves $100-250 \times 2 \mathrm{~mm}$, in pairs, green, rigid and spiny; resin-canals $2-9$, median. Cone $8-22 \times 5-8 \mathrm{~cm}$, conic-ovoid, symmetrical or almost so, light brown, shining; apophysis rhomboidal, keeled, with prominent, prickly umbo. Seeds $7-8 \mathrm{~mm}$; wing up to 30 mm . $2 n=24$. S.W. Europe, extending eastwards to S. Italy; sometimes planted elsewhere for timber, sand-binding or shelter. Co Ga Hs It *Lu Sa Si [Be Br Gr Ju Tu].

The following two subspecies are sometimes recognized but the distinguishing characters of (b) may be partly the result of modification due to cultivation of the Mediterranean plant on Atlantic coasts.
(a) Subsp. pinaster ( $P$. mesogeensis Fieschi \& Gaussen): Leaves $18-25 \mathrm{~cm}$; resin-canals more than 2 under the sheath. Cones $14-22 \mathrm{~cm} . C . \& W$. Mediterranean region.
(b) Subsp. atlantica H. del Villar, Bol. Soc. Esp. Hist. Nat. 33: 427 (1933): Leaves $10-20 \mathrm{~cm}$; resin-canals 2 under the sheath. Cones 9-18 cm. S. France; Atlantic coast of Spain, Portugal.
3. P. radiata D. Don, Trans. Linn. Soc. London (Bot.) 17: 442 (1836). Up to 40 m ; bark becoming thick, fissured, dark brown. Buds ovoid-cylindrical, resinous. Twigs glabrous, reddish-brown. Basal sheath of short shoots less than 15 mm . Leaves 100 150 mm , in threes, slender, acute, densely crowded; resin-canals median. Cone $7-14 \times 5-8 \mathrm{~cm}$, ovoid-conical, very asymmetrical, sessile or shortly stalked, deflexed; apophyses on upper side of cone rounded; umbo with small caducous mucro. Seed c. 7 mm ; wing $c .20 \mathrm{~mm}$. Planted for timber or for shelter in W. Europe. [ $\mathrm{Az} \mathrm{Br} \mathrm{Ga} \mathrm{Hb} \mathrm{Hs} \mathrm{It} \mathrm{Lu]}. \mathrm{(S}. \mathrm{California)}$.
P. rigida Miller, Gard. Dict. ed. 8, no. 10 (1768), from E. North America, a tree up to 25 m with numerous epicormic shoots,
stiff leaves $70-140 \mathrm{~mm}$, and cones $3-7 \mathrm{~cm}$, has been planted in several countries on a small scale.
4. P. banksiana Lamb., Descr. Gen. Pinus 1: 7, t. 3 (1803) ( $P$. divaricata (Aiton) Sudworth). Up to 25 m ; bark becoming reddish-brown and forming thick scales; branches usually irregularly arranged. Buds ovoid, very resinous. Twigs glabrous, green in first year, then brownish. Leaves $20-40(-50) \mathrm{mm}$, in pairs rigid, acute or obtuse, twisted; resin-canals marginal. Cone $2-5 \times 1 \cdot 5-2.5 \mathrm{~cm}$, long-conical, very curved, erect, yellowish, shining, persistent ; apophysis flat or convex; umbo without mucro. Seed $3-6 \mathrm{~mm}$; wing $8-12 \mathrm{~mm}$. Planted for timber in C. Europe and rarely elsewhere. [Au Cz Da Ge Rm.] (N.C. \& N.E. North America.)
5. P. ponderosa Douglas ex P. \& C. Lawson, Agric. Man. 354 (1836). Up to 75 m ; bark becoming very thick, yellowish or dark reddish-brown. Buds cylindrical, resinous. Twigs glabrous, at first brownish or greenish, becoming blackish. Basal sheath of short shoots more than 15 mm . Leaves $100-250 \times 1.5 \mathrm{~mm}$, in groups of 3 (rarely 2 or 5), rigid, curved, densely crowded, deep yellow-green, very aromatic; resin-canals median. Cones $8-15 \times 3 \cdot 5-5 \mathrm{~cm}$, ovoid, symmetrical, subsessile, patent or slightly deflexed; apophysis concave or plane; umbo with strong, erect, persistent mucro. Seed c. 8 mm ; wing c. 18 mm . Occasionally planted for timber in C. \& S. Europe. [Au Ge Gr It Rm.] ( $W$. North America.)
P. jeffreyi Grev. \& Balf. in A. Murray, Bot. Exped. Oreg. 2 (1853), from W. North America, a tree up to $40(-60) \mathrm{m}$, with non-resinous buds, glaucous twigs, greyish-blue-green leaves $120-200 \mathrm{~mm}$, cones $15-25 \mathrm{~cm}$, and the umbo with recurved mucro, is also occasionally cultivated, sometimes under the name of $P$. ponderosa.
P. sabiniana Douglas, Trans. Linn. Soc. London (Bot.) 16: 749 (1833), from California, a tree up to $15(-25) \mathrm{m}$, with lax habit, sparse, pale green leaves $200-300 \mathrm{~mm}$, and cones $15-25 \mathrm{~cm}$, is cultivated for timber on a small scale in Europe.
6. P. nigra Arnold, Reise Mariazell 8 (1785) (P. laricio Poiret). Up to 50 m ; bark grey to dark brown. Buds ovoid or cylindrical-ovoid, acute, slightly resinous. Twigs glabrous, pale brown to orange-brown. Leaves $40-190 \times 1-2 \mathrm{~mm}$, in pairs, light or dark green, somewhat rigid, and flexuous, straight or curved; 1-5 layers of hypodermal cells; resin-canals 3-17, median. Cone $3-8 \times 2-4 \mathrm{~cm}$, yellowish-brown or light brown, shining, subsessile; apophysis slightly or obtusely keeled; umbo mucronate. S. Europe, extending northwards to Austria and S. Carpathians; extensively planted in N. Europe (especially subsp. (c)) for timber or shelter. Al Au Bu Co Cr Gr Hs It Ju Rm Rs (K) $\mathrm{Si} \mathrm{Tu}[\mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Su]}$.

Very variable and divided into many geographical variants which are often not clearly separable. Much of the variation follows a clinal pattern. Vide P. Fukarek, Rad. Polj. Šum. Fakult. Sarajevu 3 (2): 1-92 (1958) for a detailed account. The following subspecies, which are sometimes regarded as distinct species, deserve recognition.
1 Leaves $\pm$ flexible; 1-2(-3) rows of slightly thickened hypodermal cells
2 Leaves $1 \cdot 2-1 \cdot 9 \mathrm{~mm}$ wide, somewhat pungent; 1-2(-3) rows of hypodermal cells $\quad$ (c) subsp. laricio
2 Leaves $1-1.2 \mathrm{~mm}$ wide, not pungent; 1 row of hypodermal cells
(b) subsp. salzmannii

1 Leaves $\pm$ rigid; 2-5 rows of strongly thickened hypodermal cells

3 Leaves 4-7 cm
3 Leaves 7-18 cm
4 Leaves straight or incurved; leaf-sheath $10-16 \mathrm{~mm}$
(a) subsp. nigra

4 Leaves twisted or irregularly curved; leaf-sheath (15-)1826 mm
(e) subsp. pallasiana
(a) Subsp. nigra: Tall tree with pyramidal crown. Leaves $80-160 \times 1.5-2.0 \mathrm{~mm}$, rigid, pungent; 2-3 rows of hypodermal cells. Cone $5-8 \mathrm{~cm}$; apophysis somewhat keeled. From Austria to C. Italy, Greece and Jugoslavia.
(b) Subsp. salzmannii (Dunal) Franco, Dendrologia Florestal 56 (1943) ( $P$. pyrenaica sensu Willk.): Medium-sized tree with narrow, pyramidal or cylindrical crown. Leaves $80-160 \times 1 \cdot 1-$ 2 mm , not pungent; 1 row of hypodermal cells. Cone $4-6 \mathrm{~cm}$; apophysis somewhat keeled. Cevennes, Pyrenees, C. \& E. Spain.
(c) Subsp. laricio (Poiret) Maire, Bull. Soc. Hist. Nat. Afr. Nord 19: 66 (1928): Tall tree with narrow ovoid-elongate crown. Leaves $80-160 \times 1.2-1.9 \mathrm{~mm}$, slightly pungent, twisted; 1 or sometimes 2 rows of hypodermal cells. Cone $6-8 \mathrm{~cm}$, yellowbrown; apophysis obtusely keeled. Corse, Calabria, Sicilia.
Trees from Calabria and Sicilia are often regarded as a distinct subspecies or variety characterized by its more lax leaves with 2 (sometimes 3 ) rows of hypodermal cells, and brown cones with only slightly keeled apophyses.
(d) Subsp. dalmatica (Vis.) Franco, op. cit. 55 (1943): Small tree with broadly pyramidal crown. Leaves $40-70 \times 1.5-1.8 \mathrm{~mm}$, quite rigid; 3-5 rows of hypodermal cells. Cone $3-5-4.5 \mathrm{~cm}$. Coastal region and islands of N.W. Jugoslavia.
(e) Subsp. pallasiana (Lamb.) Holmboe, Bergens Mus. Skr. ser. 2, 1 (2): 29 (1914) (P. pallasiana Lamb.): Medium-sized tree with broadly ovoid crown. Leaves $120-180 \times 1 \cdot 6-2 \cdot 1 \mathrm{~mm}$; 2-5 rows of hypodermal cells. Cone $5-12 \mathrm{~cm}$. Balkan peninsula; S. Carpathians; Krym.

Plants from N.W. Romania are sometimes regarded as a distinct species, P. banatica (Georgescu \& Ionescu) Georgescu \& Ionescu, Feddes Repert. 41 : 183 (1936).
P. resinosa Aiton, Hort. Kew. 3: 367 (1789), from E. North America, a tree up to $25(-50) \mathrm{m}$, with reddish-brown bark, leaves $120-170 \mathrm{~mm}$, marginal resin-canals, and cones $4-6 \mathrm{~cm}$, is cultivated for timber on a small scale in Europe.
7. P. sylvestris L., Sp. Pl. 1000 (1753). Up to 40 m ; bark dark brown on lower part of trunk, pale ochre-red and flaking on upper part of trunk. Buds acute, more or less resinous. Twigs glabrous, yellowish-green at first, becoming greyish-brown. Leaves $30-70 \times 2 \mathrm{~mm}$, in pairs, glaucous, twisted; resin-canals submarginal. Cone $3-6 \times 2-3.5 \mathrm{~cm}$, dull yellowish-brown, acute, deflexed, caducous; apophysis flat, or shortly pyramidal on back of cone, weakly keeled; umbo muticous. Seed $3-5 \mathrm{~mm}$; wing c. $10 \mathrm{~mm} .2 n=24 . N . \& C$. Europe, extending southwards in the mountains to S. Spain, N. Italy and Macedonia. Al Au Br Bu Cz Fe Ga Ge Gr He *Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, K) Su [ Be Da Hb Ho Is Tu].

More than 150 variants have been described. Some have been regarded as subspecies, but much of the variation follows clinal patterns and it is not possible to give a consistent formal treatment of it. The variants may, however, be conveniently arranged in the following geographical groups:

Group I (var. lapponica Fries). Crown narrow, branched; bark with small, thin scales. N. Fennoscandia.

Group II (var. rigensis (Desf.) Ascherson \& Graebner; var. septentrionalis Schott). Tall tree with conical crown, slender, straight trunk and thin bark. Baltic coast.

Group $I I I$ (var. scotica (Willd.) Schott). Crown long remaining pyramidal, rounded only in old trees; bark thin at least above. Scotland.

Group IV (var. aquitana Schott; var. brigantiaca Gaussen; var. catalaunica Gaussen; var. hercynica Münch; var. iberica Svob.; var. pyrenaica Svob.; var. vindelica Schott). Crown conical; trunk straight; branches at right angles to trunk; bark thin, with large scales. Mountains of $W$. Europe from C. Spain to C. Germany and the W. Alps.
Group V (var. batava Schott; var. borussica Schott; var. carpatica Klika; var. engadinensis Heer; var. haguenensis Loudon; var. illyrica Svob.; var. nevadensis Christ; var. pannonica Schott; var. rhodopaea Svob.; var. romanica Svob.; var. sarmatica Zapal.; var. vocontiana Guinier \& Gaussen). Trunk crooked; branches at an acute angle to the trunk; crown broad, rounded; bark thick, deeply fissured. Lowlands, and foothills of mountain ranges of C. Europe, extending eastwards to Russia and southwards to the N. Appennini; Sierra Nevada.

Var. uralensis Fischer, from Ural, and var. cretacea (Kalenicz.) Fomin, from Ukraine, are eastern variants of uncertain affinities.
P. kochiana Klotzsch ex Koch, Linnaea 22: 296 (1849) is like 7, but has leaves 1 mm wide and a slightly shining cone with strongly keeled apophyses and a shortly mucronate umbo. It occurs in Ukraine (where it has been called $P$. forminii Kondrat. or $P$. hamata (Steven) D. Sosn.). The status of this plant is uncertain; it is clearly separable from $P$. sylvestris var. armena Koch only on anatomical features.
8. P. mugo Turra, Gior. Ital. (Grisilini) 1: 152 (1764) (P.montana Miller, P. mughus Scop.; incl. P. pumilio Haenke). Shrub with thick, decumbent, ascending or erect branches up to 3.5 m . Twigs green at first, becoming brown. Buds ovoid-cylindrical, very resinous. Leaves $30-80 \times 1.5-2 \mathrm{~mm}$, in pairs, bright green. Cone $2-5 \times 1.5-2.5 \mathrm{~cm}$, shining, subsessile, symmetrical, obtuse; apophyses flat, or convex above and concave below; umbo central or below the middle, with a small mucro. Mountains of $C$. Europe and the Balkan peninsula; N. \& C. Appennini. Planted for sand-binding and shelter in N. Europe. Al Au Bu Cz Ga Ge Gr He It Ju Po Rm Rs (W) [Da].
9. P. uncinata Miller ex Mirbel in Buffon, Hist. Nat. Pl. 10: 213 (1806) (incl. P. rotundata Link.). Like 8 but usually a tree with erect trunk up to 25 m ; cones $5-7 \times 2-3 \mathrm{~cm}$; apophyses very prominent, recurved and hooked, or rounded and hooded; umbo excentric. - C. \& W. Alps, Pyrenees and C. Spain. Ga Ge He Hs It.

There has been widespread introgressive hybridization between 8 and 9 , giving rise on the one hand to a variant of $P$. mugo with erect branches, cones $4-5 \times 2.5 \mathrm{~mm}$, apophyses convex above and concave below, and an excentric umbo, sometimes recognized as P. mugo var. pumilio (Haenke) Zenari ( $P$. pumilio Haenke); and on the other hand to a variant of $P$. uncinata with shrubby habit and rounded or hooded apophyses, sometimes recognized as $P$. uncinata var. rotundata (Link) Antoine ( $P$. rotundata Link).
10. P. leucodermis Antoine, Österr. Bot. Zeitschr. 14: 366 (1864). Up to c. 30 m ; crown pyramidal; bark ashy-grey, flaking to leave yellowish patches. Twigs glabrous, whitish-grey for the first 3 years. Buds not resinous. Leaves $70-90 \times 1.2 \mathrm{~mm}$, in pairs, rigid, pungent, with $3-5$ layers of hypodermal cells; resin-canals $4-6$, median. Cone $7-8 \times 2.5 \mathrm{~cm}$, slightly shining; apophysis pyramidal, with recurved mucro. Seed c. 7 mm ; wing c. 25 mm . S. Italy; C. \& W. parts of Balkan peninsula. Al Bu Gr It Ju.
11. P. heldreichii Christ, Verh. Naturf. Ges. Basel 3: 549 (1863). Up to 20 m ; crown rounded-pyramidal; bark ashy-grey, flaking to leave yellowish patches. Twigs glabrous, grey only in the first year, then brown. Buds not resinous. Leaves $60-90 \times 1.5 \mathrm{~mm}$, in pairs, rigid, more or less pungent, with 2-3 layers of hypodermal cells; resin-canals $2-11$, median. Cone $7-8 \times 2.5 \mathrm{~cm}$, slightly shining; apophysis flat, with very short, straight mucro. Seed c. 7 mm ; wing c. 25 mm . Mountains of C. part of Balkan peninsula. Al Gr Ju.
12. P. halepensis Miller, Gard. Dict. ed. 8, no. 8 (1768). Up to 20 m ; crown rounded; trunk and branches often crooked; bark silvery-grey, becoming reddish-brown and deeply fissured. Twigs glabrous, remaining light grey for many years. Buds not resinous. Leaves $60-150 \times 0.7 \mathrm{~mm}$, in pairs, slender, clear green, with $1-3$ layers of hypodermal cells; resin-canals $3-8$, submarginal (sometimes with 1-2 median). Cone $5-12 \times 4 \mathrm{~cm}$, shining, brown; apophysis convex; peduncle $1-2 \mathrm{~cm}$, recurved. Seed c. 7 mm ; wing c. 20 mm . Mediterranean region. $\mathrm{Bl} \mathrm{Co} ? \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It}$ Ju Sa Si [Lu].
13. P. brutia Ten., Prodr. Fl. Nap. lxxii (1811). Up to 20 m ; crown rounded; trunk and branches straight; bark silvery-grey, becoming reddish-brown and deeply fissured. Twigs glabrous, reddish-yellow or greenish. Buds not resinous. Leaves $120-$ $80 \times 1-1.5 \mathrm{~mm}$, in pairs, thick, rigid, dark green, with $1-3$ layers of hypodermal cells. Cone $5-11 \times 4 \mathrm{~cm}$, slightly shining, brown; apophysis convex; peduncle short, not recurved. Seed c. 8 mm ; wing c. 20 mm . Calabria; Kriti; Turkey. Cr It Tu.
P. pityusa Steven, Bull. Soc. Nat. Moscou 11:49 (1838), from the Aegean region (and from Anatolia), with shorter leaves, is variously regarded as a variety or as a separate species. Its precise distribution in Europe is uncertain.
P. stankewiczii (Suk.) Fomin, Monit. Jard. Bot. Tifis 34: 21 (1914) endemic in Krym, apparently differing in details of conestructure and leaf-anatomy, is also sometimes maintained as a distinct species.
14. P. canariensis Sweet ex Sprengel, Syst. Veg. 3: 887 (1826). Up to 30 m ; bark becoming thick, slightly fissured, reddishbrown. Twigs glabrous, yellow. Buds ovoid, not resinous; scales broadly white-fringed. Leaves $200-300 \times 1 \mathrm{~mm}$, in threes, slender, acute, densely crowded; resin-canals submarginal. Cone $10-20 \times 4-7 \mathrm{~cm}$, ovoid-conic, shortly stalked, deflexed; apophysis depressed-pyramidal; umbo not mucronate. Seed c. 12 mm ; wing $c .20 \mathrm{~mm}$. Planted for timber in Italy and to a smaller extent elsewhere in the Mediterranean region. [It.] (Canarias.)
P. taeda L., Sp. Pl. 1000 (1753), from S. \& S.E. North America, a tree up to $30(-50) \mathrm{m}$, with glaucous twigs, rigid leaves $120-$ 250 mm , submarginal resin canals and cones $6-10 \mathrm{~cm}$, is cultivated for timber on a small scale in Europe.
15. P. pinea L., Sp. Pl. 1000 (1753). Up to 30 m , parasolshaped; bark greyish-brown, flaking to leave reddish-orange patches. Twigs glabrous, greyish-green, becoming brown. Buds not resinous; scales white-fringed. Leaves $100-200 \times 1 \cdot 5-2 \mathrm{~mm}$,
in pairs, acute; resin-canals submarginal. Cone $8-14 \times 10 \mathrm{~cm}$, shining, brown; apophysis weakly pyramidal. Seed $15-20 \times 7-$ 11 mm ; wing less than 1 mm , caducous; husk hard. Mediterranean region and Portugal. Al Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.

Subgen. Haploxylon (Koehne) Pilger. Leaves in groups of 5, with one fibro-vascular bundle; scale-leaves not decurrent; umbo terminal.
16. P. cembra L., Sp. Pl. 1000 (1753). Up to 25 m ; bark reddish-grey, becoming scaly on old trees. Twigs strongly pubescent with orange-brown tomentum. Bud-scales dull, with white, membranous margin. Leaves $50-80 \times 1 \mathrm{~mm}$. Cone $5-$ $8 \times 3 \cdot 5-5 \mathrm{~cm}$, less than $1 \frac{1}{2}$ times as long as wide. Seed $12(-14) \mathrm{mm}$; wing absent, or less than 1 mm and caducous; husk hard. Alps and Carpathians; occasionally planted for timber in N. Europe. $\mathrm{Au} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)} \mathrm{[Fe} \mathrm{Is} \mathrm{No} \mathrm{Su]}$.
17. P. sibirica Du Tour, Nouv. Dict. Hist. Nat. 18: 18 (1803). Like 16 but up to 40 m ; bud-scales shining, brown; leaves $60-130 \times 0.8-1.2 \mathrm{~mm}$; cone $6-13 \times 5-8 \mathrm{~cm}$, more than $1 \frac{1}{2}$ times as long as wide; seed with fragile husk. N.E. Russia, westwards to $57^{\circ}$ E. Rs (N, C). (N. Asia.)
Perhaps not specifically distinct from 16.
18. P. wallichiana A. B. Jackson, Kew Bull. 1938: 85 (1938) (P. excelsa Wallich, non Lam.). Up to 50 m ; bark grey-brown and smooth on young trees, becoming shallowly fissured on old trees. Twigs glabrous, yellowish-green at first, becoming brownishyellow. Leaves $80-200 \times 0.7 \mathrm{~mm}$, flexible, pendent. Cone $15-$ $25 \times 3 \mathrm{~cm}$, cylindrical, straight, becoming pendent. Seed 8$9 \times 5-6 \mathrm{~mm}$; wing $10-20 \mathrm{~mm}$. Planted for timber in Italy. [It.] (Temperate Himalaya.)
19. P. peuce Griseb., Spicil. Fl. Rumel. 2: 349 (1845). Up to 30 m ; crown narrowly and densely pyramidal; bark grey, fissured, with small scales. Twigs glabrous. Leaves 70-120× 0.7 mm , rigid, acute, densely crowded, forwardly directed. Cone $8-15 \times 2.5 \mathrm{~cm}$, more or less curved. Seed $8 \times 5 \mathrm{~mm}$; wing 15 mm . - Mountains of Balkan peninsula from c. $41^{\circ}$ to $43^{\circ} \mathrm{N}$. Al Bu ? Gr Ju .
20. P. strobus L., Sp. Pl. 1001 (1753). Up to 50 m ; crown pyramidal at first, later becoming broader; bark greyish-green and smooth on young trees, becoming brown and fissured on old trees. Twigs glabrescent, or remaining pubescent below leaftraces. Leaves $50-140 \mathrm{~mm}$, slender, flexible, patent. Cone 8$20 \times 3-4 \mathrm{~cm}$, cylindrical, often curved near apex, pendent. Seed $5-8 \mathrm{~mm}$; wing $18-25 \mathrm{~mm}$. Planted for timber, especially in C. Europe. [Au $\mathrm{Be} \mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{It} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C)} \mathrm{Su}$ Tu.] (E. \& C. North America.)
P. aristata Engelm., Amer. Jour. Sci. Arts ser. 2, 34: 331 (1862), from S.W. United States, a procumbent shrub or small tree up to 15 m , with leaves $20-40 \mathrm{~mm}$, covered with a conspicuous resinous exudation, and cones $4-9 \mathrm{~cm}$, is cultivated for timber on a small scale in Europe.

## XXVII. TAXODIACEAE ${ }^{1}$

Monoecious; resiniferous trees, rarely shrubs, with spirally arranged leaves. Flowers (cones) made up of numerous spirally arranged scales. Scales of male cones (microsporophylls) bearing $2-8$ pollen-sacs on the lower surface. Scales of female cones (megasporophylls) bearing 2-12 ovules on the upper surface; subtending scale (bract) indistinct, wholly or partially united with the cone-scale. Fruit a more or less woody cone. Seeds winged.

1 Leaves of lateral twigs linear to linear-oblong, flat, distichous
2 Deciduous; leaves pale green
3. Taxodium

2 Evergreen; leaves dark green

1. Sequoia

1 All leaves subulate
3 Leaves radially arranged, appressed or slightly patent at the apex, triangular in section; cones $5-8 \mathrm{~cm}$, ovoid
2. Sequoiadendron

3 Leaves in 5 ranks, patent, incurved, quadrangular in section; cones $1 \cdot 25-2 \cdot 5 \mathrm{~cm}$, subglobose
4. Cryptomeria

## 1. Sequoia Endl. ${ }^{2}$

Evergreen trees with irregularly whorled branches. Winter-buds scaly. Leaves of two kinds: those on the leading and conebearing twigs spirally arranged, subulate, scale-like, keeled above, appressed or slightly patent; those on the lateral twigs distichous, linear to linear-oblong, flat, with 2 white stomatiferous bands beneath. Cones persistent, ripening in the second year; conescales 15-20.

1. S. sempervirens (Lamb.) Endl., Syn. Conif. 198 (1847). Up to 100 m and suckering freely from the base in the wild; trunk $3-4.5 \mathrm{~m}$ in diameter; outer bark thick, exfoliating in dark brown plates, revealing the inner, bright red bark. Leaves of lateral twigs $6-20 \times 2 \mathrm{~mm}$, distichous, linear to linear-oblong, flat, acute, often falcate, dark green above, with white stomatiferous bands on either side of the prominent green midrib beneath; leaves of leading and cone-bearing twigs 6 mm , radially arranged, subulate, scale-like, incurved and with a sharp callose point at the apex, decurrent at the base. Cone $18-25 \times 12 \mathrm{~mm}$, ovoid; scales expanded into a rhomboidal disc, rarely with a mucro. Seeds 3-5 on each scale. Planted for ornament and occasionally for timber. [Br Ga It.] (W. North America.)

## 2. Sequoiadendron Buchholz ${ }^{2}$

Like Sequoia, but winter-buds naked; leaves of one kind only, radially arranged, subulate, appressed or slightly patent at the apex; cone-scales 25-40.

1. S. giganteum (Lindley) Buchholz, Amer. Jour. Bot. 26: 536 (1939). Up to 90 m in the wild, with narrow pyramidal crown; trunk up to 7 m in diameter above the thickened, buttressed base; bark thick and spongy, bright brown or reddish. Leaves $c .1 \mathrm{~cm}$, becoming longer on older twigs, ovate to lanceolate, subulate, flat above, convex beneath, broadly decurrent at the base. Cones $5-8 \times 3-4.5 \mathrm{~cm}$, terminal, ovoid; scales expanded into a rhomboidal disc, with a depression in the middle often bearing a slender mucro. Seeds 3-7 on each scale. Planted for ornament and occasionally for timber. [Au Ga.] (California, W. North America.)

## 3. Taxodium L. C. M. Richard ${ }^{2}$

Deciduous trees. Winter buds scaly. Lateral twigs deciduous with the leaves. Leaves flat, linear; those of the persistent terminal twigs spirally arranged; those of the deciduous lateral twigs distichous and somewhat longer. Male cones in terminal panicles. Female cones globose, ripening the first year.

1. T. distichum (L.) L. C. M. Richard, Ann. Mus. Hist. Nat. (Paris) 16: 298 (1810). Tree up to c. 40 m , with rather narrow outline, often with conspicuous buttresses at the base of the trunk. Bark reddish-brown, fibrous, peeling. Leaves up to 20 mm , acute, channelled above. Male cones purplish, in slender panicles. Female cones $15-30 \mathrm{~mm}$ in diameter; some of the scales sterile, others bearing 2 irregularly trigonous seeds. Planted for timber in S. Europe, especially on alluvial ground. [ Bu Ga Ge It Rm .] (S.E. United States.)

## 4. Cryptomeria D. Don ${ }^{3}$

Evergreen pyramidal trees with irregularly whorled branches. Leaves spirally arranged, linear-subulate, incurved, decurrent. Cones persistent, ripening in the first year; cone-scales 20-30.

1. C. japonica (L. fil.) D. Don, Trans. Linn. Soc. London (Bot.) 18: 167 (1841). Up to 50 m in the wild, with short ascending branches forming a narrow, dense crown; bark reddish-brown, exfoliating in long shreds. Leaves $6-12 \mathrm{~mm}$, in 5 ranks, bright green, gradually shortening towards the apex of the twig. Cones $2-3 \mathrm{~cm}$, subglobose; scales thick, cuneate, persistent, furnished with the recurved point of the adnate bract on the back and with pointed processes at the apex. Seeds 2-5 on each scale. Planted for ornament and occasionally for timber; naturalized in Açores. [Az Br Da It.] (C. \& S. Japan.)

In the Açores this species sometimes produces suckers from the base, a phenomenon not known elsewhere for the species.

## XXVIII. CUPRESSACEAE ${ }^{1}$

Monoecious or dioecious; resiniferous trees or shrubs with opposite or whorled, usually scale-like, leaves. Flowers (cones) made up of opposite or whorled scales. Scales of male cones (microsporophylls) bearing 3-5 pollen-sacs on the lower surface. Scales of female cones (megasporophylls) bearing 2-many erect

[^23]ovules on the upper surface, and completely adnate to the subtending bract. Fruit a $\pm$ woody cone, or rarely the scales becoming fleshy and the fruit berry-like, indehiscent. Seeds winged or not.
1 Fruit indehiscent, berry-like, with fleshy, coalescent scales
5. Juniperus

1 Fruit a dehiscent cone with $\pm$ woody scales
2 Cone-scales 4, in a single whorl
4. Tetraclinis

2 Cone-scales in 3-8 pairs
3 Ripe cone-scales flat, oblong, imbricate
3. Thuja

3 Ripe cone-scales peltate, valvate
4 Twigs terete or 4 -angled; seeds narrowly winged, 6-20 on each scale
4 Twigs flattened; seeds broadly winged, up scale

1. Cupressus
to 5 on each
2. Chamaecyparis

## 1. Cupressus L. ${ }^{1}$

Monoecious; trees (rarely shrubs). Twigs terete or 4-angled. Leaves opposite, decussate; scale-like, appressed and imbricate on adult plants; acicular and patent on young plants and rarely on leading shoots. Cones solitary, terminal on young twigs, ripening the second year, globose to ellipsoid-globose; cone-scales in 3-7 pairs, peltate, woody. Seeds flattened, 6-20 on each scale, narrowly winged.

In addition to the species described below, C. torulosa D. Don, Prodr. Fl. Nepal. 155 (1825), has been planted for timber on a small scale in Italy. It has obtuse, appressed leaves and cones c. 12 mm in diameter, with 4-5 pairs of scales.

1 Leaves obtuse, closely appressed; cones green when young; cone-scales 8-14
2 Leaves on lateral twigs $0.5-1 \mathrm{~mm}$; staminate flowers $4-8 \mathrm{~mm}$; ripe cone yellowish-grey 1. sempervirens
2 Leaves on lateral twigs $1-2 \mathrm{~mm}$; staminate flowers $3-5 \mathrm{~mm}$; ripe cone brown 2. macrocarp
1 Leaves acute to acuminate, free at the apex; cones glaucous when young; cone-scales 6-8
3 Leaves greyish when young, emitting a disagreeable odour when rubbed; cones up to 30 mm 4. arizonica
3 Leaves green to glaucous, not emitting a disagreeable odour; cones $10-15 \mathrm{~mm}$
3. lusitanica

1. C. sempervirens L., Sp. Pl. 1002 (1753). Tree up to 30 m . Leaves $0 \cdot 5-1 \mathrm{~mm}$, dark green, obtuse. Male cone $4-8 \mathrm{~mm}$; female $25-40 \mathrm{~mm}$, ellipsoid-oblong (rarely globose), green when young and shining yellowish-grey when ripe, with 8-14 shortly and obtusely mucronate scales. Seeds $8-20$ on each scale. Native to the Aegean region; for long planted throughout S. Europe and naturalized in many districts. $\mathrm{Cr} \mathrm{Gr}[\mathrm{Al} \mathrm{Bl} \mathrm{Bu} \mathrm{Co} \mathrm{Ga} \mathrm{He} \mathrm{Hs}$ It Ju Lu Rs (K) Sa Si Tu].

There are two well-known forms: f. sempervirens, with upright branches forming a fastigiate crown, is the most commonly cultivated; f. horizontalis (Miller) Voss, with patent-ascending branches forming a pyramidal crown, is the wild form, and is much less common in cultivation.
2. C. macrocarpa Hartweg, Jour. Hort. Soc. 2: 187 (1847). Tree up to 25 m , with erecto-patent branches, forming a pyramidal crown when young, broad and flat-topped in old trees. Leaves $1-2 \mathrm{~mm}$. Male cone $3-5 \mathrm{~mm}$; female $20-35 \mathrm{~mm}$, globose to ellipsoid, shining brown when ripe, with $8-14$ shortly and obtusely mucronate scales. Seeds 8-20 on each scale. Planted for shelter and for ornament, and occasionally for timber, in W. \& S. Europe, especially near the sea. [ $\mathrm{Br} \mathrm{Ga} \mathrm{Hb} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Si]}. \mathrm{(S}. \mathrm{California)}$.
3. C. lusitanica Miller, Gard. Dict. ed. 8, no. 3 (1768). Tree up to 30 m , with spreading branches and more or less pendent leading shoot and twigs, forming a pyramidal crown on young trees, usually flat-topped on old ones. Leaves $1 \cdot 5-2 \mathrm{~mm}$, green to glaucous, acute to acuminate. Male cone $4-6 \mathrm{~mm}$; female $10-15 \mathrm{~mm}$, globose, glaucous when young but shining brown when fully ripe, with 6-8 usually prominently mucronate scales.
${ }^{1}$ By J. Amaral Franco.
${ }^{2}$ By T. G. Tutin.

Seeds 8-10 on each scale. Planted for timber and ornament in S. Europe. [Ga Hs It Lu.] (Mexico and Guatemala.)

A very polymorphic species, varying greatly in habit and leafcolour.
4. C. arizonica E. L. Greene, Bull. Torrey Club 9: 64 (1882). Tree up to 30 m , with a narrow pyramidal crown on young trees, becoming broad and open when older. Leaves greyish when young, becoming glaucous later, resinous-glandular, emitting a disagreeable odour when crushed. Female cone up to 30 mm . Planted for timber in Italy, and on a smaller scale elsewhere in S. Europe. [It.] (N. Mexico and S.W. United States.)

## 2. Chamaecyparis Spach ${ }^{2}$

Like Cupressus but with flattened twigs; cones ripening in the first year or (rarely) early in the second, globose; seeds up to 5 on each scale. Seedlings and occasional branches of older plants of all species produce acicular, patent leaves.

1. C. lawsoniana (A. Murray) Parl., Ann. Mus. Stor. Nat. Firenze nov. ser., 1: 181 (1866). Tree up to 65 m . Leaves opposite and decussate, the lateral ones larger than the others, all closely appressed, acute, with translucent glands, and with white markings beneath. Male cone pink or red; female cone c. 8 mm in diameter, globose, yellowish-brown when ripe; scales 8 , each with a central depression in which is a projecting ridge. Seeds 2-4(-5) on each scale, ovoid, with conspicuous resinous tubercles, winged. Widely planted for timber and for shelter, locally naturalized. [Au Br Da Ga Ge Hb It Lu No Rm Tu.] (W. United States.)

Other commonly cultivated species are C. obtusa (Siebold \& Zucc.) Siebold \& Zucc. in Endl., Syn. Conif. 63 (1847), with obtuse leaves, minutely glandular, with white X - or Y -shaped markings beneath; C. pisifera (Siebold \& Zucc.) Siebold \& Zucc. in Endl., Syn. Conif. 64 (1847), with acute, obscurely glandular leaves with white markings beneath and cones $5-6 \mathrm{~mm}$ in diameter; and C. nootkatensis (Lamb.) Spach, Hist. Vég. (Phan.) 2: 333 (1834), with dull green, eglandular leaves without white markings and with cones which ripen early in the second year. The first two are native to Japan and the third to W. North America.

## 3. Thuja L. ${ }^{2}$

Like Cupressus but twigs flattened; cones oblong or conical, ripening in the first year; scales thin and flexible; seeds up to 5 on each scale.

1. T. plicata D. Don ex Lambert, Descr. Gen. Pinus 2: 19 (1824). Up to 65 m . Trunk not branched from the base. Leaves opposite and decussate, ovate, acute or obtuse, appressed, eglandular or with an obscure gland, usually with faint white markings beneath. Cone $c .12 \mathrm{~mm}$, conical, brown when ripe; scales 10-12, thin, with a thickened process on the inner side, projecting beyond the thin, triangular, deflexed apex. Seeds 2-3 per scale, elliptical, winged. Planted for timber and locally naturalized. [ Au Br Da Ge It Lu No.] (W. North America.)
T. occidentalis L., Sp. Pl. 1002 (1753), from E. North America, is also sometimes planted, mainly in C. Europe. It has conspicuously glandular leaves which are yellowish- or bluish-green and without white markings beneath; the cones are oblong and bright brown when ripe.
T. orientalis L., Sp. Pl. 1002 (1753), from China, is occasionally
planted, mainly for ornament. It usually has several basal branches as long as the main stem; entirely green leaves; the cone with $6(-8)$ thick scales, each with a stout hooked or recurved apical boss, and the seeds without a wing. $2 n=22$.

## 4. Tetraclinis Masters ${ }^{1}$

Monoecious; tree. Buds concealed by the leaves. Twigs flattened. Leaves in fours, the lateral ones larger than the others, all adnate to the twig except at the scale-like apex. Cones solitary; scales 4, in a single whorl, valvate, woody. Seeds with 2 wide wings.

The only species.

1. T. articulata (Vahl) Masters, Jour. Roy. Hort. Soc. 14: 250 (1892). Pyramidal tree $12-15 \mathrm{~m}$. Cone $8-12 \mathrm{~mm}$ in diameter; scales glaucous, triangular, 2 obtuse and 2 acute at apex, deeply grooved, with a small spine near the apex. S.E. Spain (near Cartagena); Malta. Hs Si. (N.W. Africa.)

## 5. Juniperus L. ${ }^{2}$

Monoecious or dioecious; trees or shrubs. Leaves opposite or in whorls of 3, acicular or scale-like; always acicular on young plants; frequently all scale-like in mature plants, or all acicular, or a combination of both. Cones axillary or terminal, ripening in the first, second or third year, usually ovoid to globose, indehiscent, berry-like; cone-scales fleshy, coalescent. Seeds ovoid or oblong, angled or terete, 1-12 in each cone, never winged.

5-10 are sometimes placed in a separate genus Sabina Miller, with leaves usually all or partly scale-like (or if acicular then not jointed at the base), winter buds not distinct and flowers terminal.
1 All leaves in whorls of 3, acicular, rigid, jointed at the base; cones axillary
2 Male cones in axillary fascicles; female cone $20-25 \mathrm{~mm}$; seeds united to form a stone

1. drupacea

2 Male flowers solitary, axillary; female cone 6-15 mm , seeds free
3 Leaves with one broad stomatiferous band above (which is rarely divided by a faint midrib in the basal half); cone $6-9 \mathrm{~mm}$, black when ripe 2. communis
3 Leaves with two stomatiferous bands above; cone 6-15 mm, reddish-brown to dark purple when ripe
4 Leaves loosely set, patent 3. oxycedrus
4 Leaves closely set, strongly incurved and subimbricate
4. brevifolia

1 Leaves of two kinds: in juvenile plants acicular and patent; in adult scale-like and imbricate (rarely acicular and then not jointed at base); cones terminal
5 Acicular leaves usually in whorls of 3 ; scale-like leaves obtuse, with a narrow but distinct scarious border; ripe cone dark red
5. phoenicea

5 Acicular leaves decussate (in whorls of 3 on leading shoots); scale-like leaves without a scarious border; ripe cone dark purple or blackish
6 Ripe cone 7-12 mm
7 Twigs 1 mm wide, quadrangular; scale-like leaves 1.5 2 mm , acute or acuminate; seeds 1-4
8 Twigs distichously arranged; cone dark purple, pruinose; seeds 2-4
6. thurifera

8 Twigs irregularly arranged; cone almost black; seeds 1-2, rarely 3
7. foetidissima

7 Twigs $0.6-0.8 \mathrm{~mm}$, in diameter, terete; scale-like leaves $1-1.5 \mathrm{~mm}$, acute; cone dark purplish-brown; seeds 4-6
8. excelsa

6 Ripe cone 4-6 mm
${ }^{1}$ By T. G. Tutin.
${ }^{2}$ By J. Amaral Franco.

> 9 Scale-like leaves appressed, not free at the apex, obtuse to subacute; cone subglobose, on short, recurved stalk; shrub

9 Scale-like leaves free at the apex, acute to acuminate; cone ovoid, on erect or patent stalk; tree up to 30 m
10. virginiana

1. J.drupacea Labill., Icon.Pl.Syr. 2:14, t. 8 (1791). Dioecious; tree up to 15 m , with a broad pyramidal crown (but assuming a columnar habit under cultivation). Leaves $10-25 \times 2-4 \mathrm{~mm}$, linear-lanceolate, acuminate, patent, with two white bands above. Cone $20-25 \mathrm{~mm}$, ripening in the second year, ovoid to subglobose, brown or bluish-black, pruinose. Seeds 3, minute, united to form a single large stone. S. Greece (N. end of Parnon Oros, Arkadhia.) Gr. (Asia Minor and Syria.)

Referred by several authors to a monotypic genus (Arceuthos Antoine \& Kotschy).
2. J. communis L., Sp. Pl. 1040 (1753). Dioecious; tree or shrub. Leaves with a single white band above, which is rarely divided by a faint midrib in the basal half. Cone $6-9 \mathrm{~mm}$, ripening in the second or third year, ovoid to globose, green the first year, then pruinose, and black when fully ripe. Seeds free, usually 3. Throughout Europe, mainly on mountains in the south. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Cr} \mathrm{Sb} \mathrm{?Tu}$.
1 Leaves up to 20 mm , acuminate-subulate, patent
2 Leaves $1-1.5 \mathrm{~mm}$ wide, loosely set, linear, with a glaucous stomatiferous band; tree to 15 m or shrub
(a) subsp. communis

2 Leaves 1.3-2 mm wide, closely set, linear-oblong, with a broad, white stomatiferous band; shrub (b) subsp. hemisphaerica
1 Leaves $10-15 \mathrm{~mm}$, closely set, upturned or upcurved, acute to obtuse, mucronate, with a broad, white stomatiferous band; shrub, usually spreading and mat-like
(c) subsp. nana
(a) Subsp. communis: $2 n=22$. Scattered throughout most of Europe.
(b) Subsp. hemisphaerica (J. \& C. Presl) Nyman, Consp. 676 (1881): S. Europe, mainly on mountains.
(c) Subsp. nana Syme in Sowerby, Engl. Bot. ed. 3, 8: 275, t. 1383 (1868) (J. sibirica Burgsd., J. nana Willd.): $2 n=22$. Higher mountains of Europe; also at low altitudes in the north.
3. J. oxycedrus L., Sp. Pl. 1038 (1753). Dioecious; shrub or tree up to 14 m . Leaves patent, with two glaucous bands above. Cone ripening in the second year, globose to pyriform, reddish, yellowish when unripe. Seeds free, usually 3. S. Europe. Al Bl Co Ga Gr Hs It Ju Lu Rs (K) Sa Si Tu.
1 Leaves 4-12 $\times 1-1.5 \mathrm{~mm}$, obtuse and mucronulate; ripe cone $7-10 \mathrm{~mm}$, red; shrub up to 2 m , usually fastigiate
(c) subsp. transtagana

1 Leaves up to 25 mm , acuminate-subulate on young or freely growing plants, but subobtuse and scarcely mucronate on old ones; ripe cone dark red to purple
2 Leaves up to 2 mm wide; ripe cone $8-10 \mathrm{~mm}$, shining (sometimes scarcely pruinose while young); small tree or erect shrub
(a) subsp. oxycedrus

2 Leaves up to 2.5 mm wide; ripe cone 12-15 mm, dull (pruinose while young); small tree to prostrate shrub
(b) subsp. macrocarpa
(a) Subsp. oxycedrus (J.rufescens Link): Almost throughout the range of the species, on dry hills or mountainous tracts to 1900 m , usually not reaching more than 100 km inland (except in Spain and Jugoslavia).
(b) Subsp. macrocarpa (Sibth. \& Sm.) Ball, Jour. Linn. Soc. London (Bot.) 16: 670 (1878) (J. macrocarpa Sibth. \& Sm., J. umbilicata Godron): Throughout the range of the species, but confined to maritime sands near the sea, or rocky places.
(c) Subsp. transtagana Franco, Feddes Repert. 68: 166 (1963) (J. oxycedrus subsp. rufescens auct. lusit.): Maritime sands. - S.W. Portugal.
4. J. brevifolia (Seub.) Antoine, Kupress.-Gattung. 16 (1857). Dioecious; erect shrub or small tree with a broad pyramidal crown. Leaves $3-10 \times 1-2 \mathrm{~mm}$, closely set, strongly incurved and subimbricate, linear-lanceolate to ovate-linear, with two broad, white stomatiferous bands above. Cone $8-10 \times 6-8 \mathrm{~mm}$, ripening the second year, subglobose, green and pruinose while young, dark reddish-brown when ripe. Seeds 3, free, ovoid, triquetrous. Mountain slopes up to 1500 m . Açores. Az.
5. J. phoenicea L., Sp. Pl. 1040 (1753). Monoecious; small tree up to 8 m , or shrub (procumbent on the sea-shore). Twigs 1 mm in diameter, terete, scaly. Juvenile leaves $5-14 \times 0.5-1 \mathrm{~mm}$, acicular, patent, acute, mucronate, with two stomatiferous bands both above and beneath; adult leaves $0.7-1 \mathrm{~mm}$, scale-like, ovate-rhombic, closely appressed, obtuse to somewhat acute, with an oblong furrowed gland on the back, and a distinct scarious border. Cone $8-14 \mathrm{~mm}$, ripening in the second year, globose to ovoid, blackish when very young, later green or yellowish and not or slightly pruinose, dark red when ripe. Seeds 3-9, free. Mediterranean region and Portugal, mainly near the coast. Al $\mathrm{Bl} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.
6. J. thurifera L., Sp. Pl. 1039 (1753). Dioecious; pyramidal tree up to 20 m . Twigs 1 mm wide, quadrangular, scaly, distichously arranged. Leaves all decussate; the adult $1 \cdot 5-2 \mathrm{~mm}$, appressed but free at their incurved acuminate or acute apices, with an oblong furrowed gland on the back, and an entire or slightly toothed, but not scarious, border. Cone $7-8 \mathrm{~mm}$, ripening in the second year, pruinose when young, dark purple when fully ripe. Seeds 2-4, free. Mountains of S., C. \& E. Spain; French Alps. GaHs .
This species has been cited by several authors as native in Portugal and Greece. The former records should be referred to 5, and the latter to 7.
7. J. foetidissima Willd., Sp. Pl. 4 (2): 853 (1806). Monoecious or dioecious; tree up to 17 m , with a straight stem, and a narrow
conical crown. Twigs 1 mm wide, distinctly quadrangular, scaly, irregularly arranged. Leaves fetid when crushed, all decussate; the adult 1.5 mm , ovate-rhombic, free at their acuminate apices, mostly eglandular, the border entire, not scarious. Cone 712 mm , ripening in the second year, globose, pruinose when young, dark reddish-brown to nearly black when ripe. Seeds 1 or 2 (rarely 3) free. Mountains of Balkan peninsula, from Albania and Makedonija southwards; Krym. Al Gr Ju Rs (K).
8. J. excelsa Bieb., Beschr. Länd. Terek Kasp. 204 (1800). Monoecious or dioecious; tree up to 20 m , with a conical crown when young, later broad and open. Twigs $0 \cdot 6-0.8 \mathrm{~mm}$ in diameter, terete, scaly. Juvenile leaves $5-6 \mathrm{~mm}$, very few; scale-like leaves $1-1.5 \mathrm{~mm}$, ovate-rhombic, closely appressed, acute, with a central, ovate or linear gland on the back, entire, the border not scarious. Cone 8 mm , ripening in the second year, globose, slightly pruinose, dark purplish-brown when ripe. Seeds 4-6, free. Balkan peninsula; Krym. Bu Cr Gr Ju Rs (K).
9. J. sabina L., Sp. Pl. 1039 (1753). Dioecious; shrub, usually low and spreading. Twigs $0.6-0.8 \mathrm{~mm}$ wide, quadrangular. Leaves strongly fetid, all decussate; the adult $1-1.25 \mathrm{~mm}$, ovate, appressed, obtuse to subacute, with an elliptical gland on the back, entire, the border not scarious. Cone $4-6 \mathrm{~mm}$, ripening in the autumn of the first year or in the following spring, usually depressed-globose, bluish-black, pruinose; stalk short, recurved, scaly. Seeds usually 2, free. $2 n=22$. Mountains of $S . \& C$. Europe, from 1000 to 2300 m ; also at low altitudes in S.E. Russia and W. Kazakhstan. Au Bu Cz Ga Ge He Hs It Ju Po Rm Rs (?C, K, E).
10. J. virginiana L., Sp. Pl. 1039 (1753). Dioecious; pyramidal tree up to 30 m . Twigs $0.6-0.8 \mathrm{~mm}$ in diameter, very slender. Leaves all decussate; the juvenile $5-6 \mathrm{~mm}$, often present on adult trees, long, spiny-pointed; the adult $0.5-1.5 \mathrm{~mm}$, appressed but free at their-acute or acuminate apices, often with a small gland on the back, entire and without a scarious border. Cone 4-6 mm, ripening in the first year, ovoid, glaucous, brownish-violet when ripe; stalk erect or patent. Seeds 1 or 2, free. Planted for timber in parts of C. \& S. Europe. [Ga Hu It Rm.] (North America.)

## TAXOPSIDA

## TAXALES

## XXIX. TAXACEAE ${ }^{1}$

Usually dioecious; evergreen trees or shrubs with spirally arranged, linear, flattened leaves; not resiniferous. Male flowers axillary, solitary or in small spikes. Female flowers axillary, solitary or two, with one or more sterile scales: the ovuliferous scale terminal, bearing a solitary erect ovule. Seed partly or wholly surrounded by an aril.

## 1. Taxus L. ${ }^{2}$

Twigs irregularly alternate. Male flowers solitary, each consisting of 6-14 peltate anthers with 4-8 pollen-sacs. Female flower consisting of several imbricate scales, the uppermost fertile. Seeds

[^24]${ }^{2}$ By J. Amaral Franco.
ovoid, partly surrounded by a fleshy (usually scarlet) aril, ripening the first year.

1. T. baccata L., Sp. Pl. 1040 (1753). Shrub or tree up to 20 m , with a wide pyramidal crown. Leaves $10-30 \mathrm{~mm}$, dark, glossy green above, with two pale green stomatiferous bands beneath. Seed $6-7 \mathrm{~mm} .2 n=24$. At low altitudes in the north; only on higher mountains in the Mediterranean region. Europe, except the east and extreme north, extending northwards to c. $63^{\circ} \mathrm{N}$. in Norway and eastwards to Estonia, White Russia and Turkey. All except Cr Fa Is Rs (N, E) Sb ; almost extinct in Az.

Cultivated for centuries, with many cultivars differing in habit, leaf-characters and aril-colour.

## GNETOPSIDA

## GNETALES

## XXX. EPHEDRACEAE ${ }^{1}$

Dioecious; shrubs with opposite or whorled leaves, usually reduced to short, more or less coalescent sheaths; not resiniferous. Inflorescences axillary, on short shoots. Flowers enclosed in 2-4 membranous perianth-segments. Fruit a globose syncarp formed from 1 or 2 seeds, surrounded by 2 pairs of red or yellow, fleshy bracts.

## 1. Ephedra L. ${ }^{2}$

Twigs green. Male flower with free perianth-segments and a few 2- to 3 -celled microsporangia, opening by apical, horizontal slits. Female flowers with connate perianth-segments; ovule orthotropous, with integument prolonged into a slender tube.

Literature: O. Stapf, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 56 (2): 1-112 (1889). F. Widder, Phyton (Austria) 1: 71-5 (1948).

1 Twigs flexible; fruit $8-9 \mathrm{~mm}$; seed almost completely concealed by bracts 1. fragilis
1 Twigs rigid; fruit 5-7 mm; upper part of seed emerging from bracts
2 Leaves green on back; male inflorescence ovoid-oblong, with 4-8 pairs of flowers; female inflorescence 2-flowered 2. distachya

2 Leaves almost completely membranous; male inflorescence globose, with 2-4 pairs of flowers; female inflorescence 1 -flowered
3. major

1. E. fragilis Desf., Fl. Atl. 2: 372 (1799) (E. altissima sensu Willk.). Scrambling up to 5 m , or procumbent. Leaves up to 2 mm , with green back. Male inflorescence subsessile, ovoid, with 4-8 pairs of flowers; bracts firm, suborbicular. Female inflorescence 1- to 2 -flowered, with 2-3 pairs of bracts. Tube of integument 3 mm . Fruit $8-9 \mathrm{~mm}$, red. Mediterranean region; S. Portugal. Al Bl Bu Cr Gr Hs It Ju Lu Si Tu.
(a) Subsp. fragilis: More or less erect; twigs very readily disarticulating at the nodes; pith yellow to brown. Inflorescence very slender. W. Mediterranean region; S. Portugal.

[^25](b) Subsp. campylopoda (C. A. Meyer) Ascherson \& Graebner, Syn. Mitteleur. Fl. 1: 258 (1897): Climbing and pendent; twigs less fragile; pith white. Inflorescence broad. E. Mediterranean region.
2. E. distachya L., Sp. Pl. 1040 (1753) (E. vulgaris L. C. M. Richard). Low shrub up to 0.5 m , with subterranean rhizome. Leaves up to 2 mm , green on back; old leaf-sheaths whitish-grey. Male inflorescence sessile or stalked, ovoid-oblong, with 4-8 pairs of flowers. Female inflorescence 2 -flowered, generally with 3 pairs of bracts. Tube of integument 1.5 mm . Fruit $6-7 \mathrm{~mm}$, red. $S$. Europe, extending northwards to N.W. France, S. Slovakia, C. Ukraine and c. $55^{\circ}$ N. in E. Russia. Al Bu Co Cz Ga Gr He Hs Hu It Ju Rm Rs (C, W, E) Sa Si.
(a) Subsp. distachya: Twigs ascending, pale green or glaucous. Female inflorescence stipitate. Tube of integument straight. $2 n=24,28$. Sandy shores and stream-banks. Almost throughout the range of the species.
(b) Subsp. helvetica (C. A. Meyer) Ascherson \& Graebner, Syn. Mitteleur. Fl. 1: 260 (1897): Twigs erect, deep green. Female inflorescence subsessile. Tube of integument twisted. Rocks. - S.W. Alps.
3. E. major Host, Fl. Austr. 2: 671 (1832) (E. nebrodensis Tineo ex Guss., E. scoparia Lange). Shrub up to 2 m . Leaves up to 3 mm , completely membranous; old leaf-sheaths dark brown. Male inflorescence sessile, globose, with 2-4 pairs of flowers. Female inflorescence shortly stipitate, 1 -flowered, generally with 2 pairs of bracts. Tube of integument 3 mm . Fruit $5-7 \mathrm{~mm}$, red or yellow. Mediterranean region. Ga Gr Hs It Ju Sa Si .
(a) Subsp. major: Twigs rough. Female inflorescence broad. Seed ovoid. $2 n=14$. W. \& C. Mediterranean region.
(b) Subsp. procera (Fischer \& C. A. Meyer) Markgraf, Feddes Repert. 70: 1 (1964) (E. procera Fischer \& C. A. Meyer): Twigs smooth. Female inflorescence long and slender. Seed ovoidoblong. - Mountains of S. Greece.

## SPERMATOPHYTA

ANGIOSPERMAE

## DICOTYLEDONES

Trees, shrubs or herbs, rarely parasitic or saprophytic. Xylem with vessels. Flowers hermaphrodite or unisexual. Ovules enclosed in an ovary. Seeds with 2 cotyledons, rarely 1 by abortion.

## SALICALES

## XXXI. SALICACEAE ${ }^{1}$

Dioecious. Trees or shrubs. Leaves alternate, very rarely subopposite; stipules present. Flowers subtended by bracts and arranged in catkins; perianth absent; glands present, sometimes nectariferous. Male flowers with 2 -many stamens; filaments filiform, free or more or less united. Female flowers with one unilocular carpel with 2-4 parietal placentae; ovules numerous, ascending, anatropous. Fruit a capsule dehiscing by 2-4 valves. Seeds numerous, very small, each with a tuft of long hairs.
Buds with 1 outer scale; bracts entire

1. Salix

Buds with several outer scales; bracts dentate or ciliate-fimbriate
2. Populus

## 1. Salix L. ${ }^{2}$

Buds with one outer scale. Leaves variously shaped. Flowers entomophilous, appearing before or after the leaves, in catkins, each flower with one or two small nectaries and subtended by an entire bract. Stamens usually 2, 3 or 5 . Capsule 2-valved. Seeds numerous.

Although sections have been described in this genus they will not be indicated in the text, since most of them are represented only by a single species or species-group in Europe (with the exception of Sect. Capreae, species 35-43).

Hybridization plays a very important role in Salix. Most hybrids are highly fertile, and in some regions hybrid-swarms obscuring the limits of the species occur. Complex hybrids are also known. On the other hand certain taxa of evidently hybrid but uncertain origin are fairly well stabilized. These have not been included in the key but are mentioned after the species to which they show most resemblance. It is not possible to provide a separate key for non-flowering plants as there is too much parallel variation in most species in indumentum, leaf-shape, and leaf-margin, etc.

The key is therefore based on the rather unrealistic assumption that the plant to be named is represented by branches bearing male catkins, female catkins, and leaves, and that notes on its habit and habitat are also available.

The following hints may prove useful, however, when attempting to identify incomplete specimens:

1. Plant procumbent, with stem appressed to the ground: 6. reticulata, 9-11. retusa group, 12. rotundifolia, (13-15). myrsinites group in part, 16. arctica, 21. pyrenaica, 22. reptans.
2. Stems underground: (a) mountains and arctic: 7. herbacea, 8. polaris; (b) bogs, swamps or on sand: 48. myrtilloides, (49-51). repens group.
3. Branches with a bluish, waxy bloom: 69. daphnoides, 70. acutifolia.
4. Decorticated twigs with prominent ridges: 26. bicolor, 36. aegyptiaca, (37. appendiculata), 39. cinerea, 41. aurita, (45. cantabrica), 40. atrocinerea.
5. Leaves narrowly linear and more or less entire: (50. rosmarinifolia), (60-61). viminalis group, 62. elaeaegnos, (65. caspica), 66. wilhelmsiana.
6. Leaves very glossy above: 1. pentandra, 32. glabra.
7. Leaves regularly blackening on drying: 29. nigricans, 32. glabra, 63. purpurea
8. Leaves glabrous even when young: 1. pentandra, 2. fragilis, 5. triandra, 32. glabra, 63. purpurea, 67. caesia.
${ }^{1}$ Edit. T. G. Tutin.
${ }^{2}$ By K. H. Rechinger.
9. Leaves with appressed silky indumentum: 3. alba, (18-20). glauca group, 45. cantabrica, (49-51). repens group, (60-61). viminalis group and hybrids.
10. Leaves with rust-coloured hairs beneath: 40. atrocinerea and hybrids.
11. Stamens free: most species except 63. purpurea, 64. amplexicaulis, 67. caesia.
12. Stamens united: 63. purpurea, 64. amplexicaulis, 67. caesia.
13. Stamens 2: most species except 1. pentandra, 5. triandra.
14. Stamens 3: 5. triandra.
15. Stamens more than 3 (usually 5): 1. pentandra.
16. Ovary glabrous; 7. herbacea, (9-11). retusa group, 12. rotundifolia, (23-24). lanata group, 25. phylicifolia, (29-31). nigricans group, 32. glabra, 33. crataegifolia, 35. silesiaca, (49-51). repens group in part, 55. hastata, 56. pyrolifolia, 62. elaeagnos, 69. daphnoides, 70. acutifolia.

Leaf-characters refer to adult leaves unless otherwise stated. Catkin-characters refer to the female catkins unless otherwise stated.

Literature: N. J. Andersson, Kungl. Svenska Vetensk. Akad. Handl. 6 (1): 1-180 (1867). N. J. Andersson in DC., Prodr. 16 (2): 191-323 (1868). R. Buser, Ber. Schweiz. Bot. Ges. 50: 567-788 (1940). A. \& E. G. Camus, Jour. Bot. (Paris) 18: 177-213, 245-96, 367-72 (1904); 19: 1-68, 87-144 (1905); 20: 1-116 (1906). B. Floderus in Holmberg, Handb. Skand. Fl. 1 (b, 1): 6-160 (1931). E. F. Linton, Jour. Bot. (London) 51 : suppl. (1913). A. Toepffer, Ber. Bayer. Bot. Ges. 15: 17-233 (1915). F. Wimmer, Salices Europaeae. 1866.
1 Low shrub of the arctic or high mountains; catkins terminal or subterminal (see also 18-24 and 58-59)
2 Woody stem subterranean, with slender herbaceous leaf- and flower-bearing aerial stems
3 Leaves orbicular or reniform, usually emarginate at apex, often wider than long, crenate-serrate; ovary glabrous
7. herbacea

3 Leaves broadly elliptical; margin entire or shallowly sinuate near the base; ovary tomentose
8. polaris

2 Woody stem above ground
4 Leaves with 2-5 pairs of lateral veins, usually orbicular
5 Petiole $5-15 \mathrm{~mm}$; capsule tomentose $\quad$ 6. reticulata
5 Petiole $2-3 \mathrm{~mm}$; capsule glabrous 12. rotundifolia
4 Leaves with 7-8 pairs of lateral veins, usually ovate, obovate or narrower
6 Ovary villous; twigs usually dark-coloured; catkins longpedunculate
7 Bracts with dark apex; leaves with prominent lateral veins
8 Stipules much longer than the very short petioles, especially on the terminal leaves; leaves narrowly lanceolate, densely glandular-serrate; peduncle leafiess
17. pulchra

8 Stipules much shorter than the petioles, often inconspicuous; leaves ovate or obovate, $\pm$ entire; peduncle leafy
16. arctica

7 Bracts uniformly pale; lateral veins of leaves not prominent
9 Stipules absent; petiole $3-5 \mathrm{~mm}$; bracts ferrugineous, hairy on both surfaces 21. pyrenaica
9 Stipules as long as the petiole; petiole less than 3 mm or almost absent; bracts ciliate, almost black in their upper part
22. reptans

6 Ovary glabrous or glabrescent; twigs brownish or greenish; catkins sessile or subsessile
10 Leaves hairy, at least when young; catkins large, dark purple
(13-15). myrsinites group

10 Leaves usually glabrous, even when young; catkins small, greenish or yellowish
( $9-11$ ). retusa group
1 Trees and shrubs usually of lower latitudes or lower altitudes; catkins lateral
11 Trees; bracts uniformly pale; flowers with 2 or more nectaries, or male flowers with 2 and female with 1
12 Twigs long, slender, pendent (' weeping willows')
4. babylonica

12 Twigs not pendent
13 Mature leaves $\pm$ densely covered with persistent silky hairs
3. alba

13 Mature leaves completely glabrous
14 Leaves glossy above, finely and evenly serrate with yellow glands; stamens (4-)5(-12)

1. pentandra

14 Leaves not conspicuously glossy, rather coarsely serrate with white teeth; stamens (2-3)
15 Stipules persistent; bark of old stems flaking off; twigs not easily breaking off
5. triandra

15 Stipules usually caducous; bark of old stems not flaking off; twigs easily breaking off
2. fragilis

11 Shrubs; bracts with dark apex and paler base; flowers with one nectary
16 Filaments connate for at least half their length
17 Low shrub up to 1 m ; leaves suborbicular or up to twice as long as wide; catkins less than 2 cm
18 Leaves suborbicular; peduncle c. 2 mm 68. tarraconensis
18 Leaves elliptical or obovate; ovary sessile or subsessile
67. caesia

17 Tall shrubs; leaves usually many times as long as wide; catkins 2 cm or more
19 Leaves lanate beneath at maturity; ovary glabrous
62. elaeagnos

19 Leaves $\pm$ glabrous beneath at maturity; ovary hairy
20 Young twigs and leaves $\pm$ densely silky
66. wilhelmsiana

20 Young twigs (and usually leaves) $\pm$ glabrous
21 Leaves with very prominent veins beneath
65. caspica

21 Leaves without prominent veins beneath
22 Leaves semi-amplexicaul or truncate at base, most or all opposite and sessile or subsessile
64. amplexicaulis

22 Leaves narrowed, cuneate or narrowly rounded at base, often alternate, often petiolate 63. purpurea
16 Filaments free (rarely connate in abnormal flowers)
23 Leaves usually ovate-lanceolate, elliptical or orbicular, not many times as long as wide, glabrous, or with dull grey tomentum, or with white lanate tomentum of short irregularly arranged hairs (rarely somewhat silky and slightly shiny) beneath
24 Shrubs of subarctic or high mountains; branches usually thick, lanate, dark brown
25 Catkins, at least after flowering, with long, leafy peduncles; bracts uniformly pale; veins of leaves rather inconspicuous
26 Erect shrubs 1-3 m; leaves rather large
(18-20). glauca group
26 Procumbent or ascending shrubs up to 50 cm ; leaves small
27 Stipules absent; petiole $3-5 \mathrm{~mm}$; bracts hairy on both surfaces, ferrugineous
21. pyrenaica

27 Stipules as long as petiole; petiole less than 3 mm or almost absent; bracts ciliate, almost black towards apex 22. reptan
25 Catkins always sessile or subsessile; bracts black towards apex; veins of leaves usually prominent
28 Stipules wide, persistent; leaves ovate, obovate or oblanceolate; ovary glabrous (23-24). lanata group
28 Stipules small, caducous; leaves usually ovatelanceolate; ovary tomentose (57-59). lapponum group
24 Shrubs or trees usually of lower latitudes or lower elevations
29 Leaves turning black on drying, glabrous or $\pm$ pubescent on both surfaces, green or glaucous beneath

30 Leaves coriaceous, glossy, with thick waxy bloom over whole lower surface, including apex
32. glabra

30 Leaves not glossy, with waxy bloom beneath disappearing towards the apex or sometimes entirely lacking
(29-31). nigricans group
29 Leaves never turning black on drying, glabrous or densely pubescent beneath
31 Ovary subsessile
32 Ovary glabrous
33 Twigs with a bluish waxy bloom
69. daphnoides

33 Twigs without a bluish waxy bloom
34 Petiole up to 10 mm , stout
55. hastata

34 Petiole $10-30 \mathrm{~mm}$, slender
35 Leaves about twice as long as wide, silky beneath when young
33. crataegifolia

35 Leaves scarcely longer than wide, glabrous
56. pyrolifolia

32 Ovary pubescent (rarely glabrescent)
36 Pedicels 2-4 times as long as nectary; catkins appearing with or after the leaves (25-28). phylicifolia group
36 Pedicels shorter than nectary or absent; catkins appearing before or with the leaves
37 Leaves dull on upper surface, $\pm$ entire; petioles $2-3 \mathrm{~mm}$ 67. caesia
37 Leaves shiny on upper surface, often serrate; petioles often more than 3 mm
(52-54). arbuscula group
31 Pedicel at least half as long as ovary
38 Ovary and pedicel glabrous
39 At least the main stems creeping; leaves rarely more than 2 cm , usually entire
40 Leaves usually rounded at both ends, finally glabrous; veins not or scarcely prominent above
48. myrtilloides

40 Leaves usually narrowed at both ends, $\pm$ persistently sericeous, at least beneath; veins fine but prominent above (49-51) repens grou
39 Main stems erect; leaves more than 2 cm , never entire
41 Young twigs and leaves glabrous or almost so; in-florescence-axis with scattered short hairs; bracts with short hairs
35. silesiaca

41 Twigs and leaves with persistent thick felt; in-florescence-axis densely hairy; bracts with long white hairs
34. pedicellata

38 Ovary and pedicel pubescent
42 Small shrub with at least the main stems creeping; leaves rarely more than 2 cm (49-51). repens group
42 Usually large shrub or small tree with $\pm$ erect stems; leaves usually more than 5 cm (but cf. 40, 41)
43 Leaves with shiny, appressed silky hairs on both surfaces 45. cantabric
43 Leaves $\pm$ pubescent or glabrous, never with shiny silky hairs
44 Leaves 3-5 times as long as wide; stipules patent, with deflexed apex
44. salvifolia

44 Leaves normally less than 3 times as long as wide; stipules, if present, never patent with deflexed apex
45 2- to 4 -year old twigs without or with few scarcely prominent ridges beneath the bark
46 Leaves $\pm$ glabrous beneath; shrub less than $1 \mathrm{~m} \quad$ (46-47). starkeana group
46 Leaves persistently hairy beneath; usually more than 1 m
47 Leaves $1 \frac{1}{2}-2$ times as long as wide, ovate or obovate to ovate-oblong; no ridges beneath the bark (42-43). caprea grou
47 Leaves usually more than twice as long as wide, obovate to oblanceolate or narrowly elliptical; scattered $\pm$ indistinct ridges usually present beneath the bark
48 Stipules usually absent ( $\mathbf{4 6}$-47). starkeana group 48 Stipules well developed

49 Twigs grey-brown or grey, with flat leafscars; mature leaves rather thick, veins closely reticulate, impressed above, prominent beneath
37. appendiculata

49 Twigs blackish with protruding leaf-scars; mature leaves thin, veins widely reticulate, $\pm$ prominent above, scarcely prominent beneath
38. laggeri

45 2- to 4-year old twigs with numerous very prominent ridges beneath the bark
50 Buds and twigs of the previous year pubescent
51 Ridges beneath the bark short, discontinuous; leaves finally $\pm$ glabrous above, and with sparse grey persistent indumentum beneath
36. aegyptiaca

51 Ridges beneath the bark long, continuous; leaves persistently but sparsely pubescent above, and with dense grey felted persistent indumentum beneath
39. cinerea

50 Buds and twigs of the previous year $\pm$ glabrous
52 Catkins $1-2.5 \mathrm{~cm}$; leaves c. $2-3 \mathrm{~cm}$, rugose, grey, $\pm$ tomentose beneath 41. aurita
52 Catkins $2-5 \mathrm{~cm}$; leaves 3 cm or more, not rugose, sparsely pubescent beneath; hairs, especially along the veins, rust-coloured 40. atrocinerea 23 Leaves usually narrow, linear-lanceolate or oblonglanceolate, many times as long as wide; glabrous, or lower surface with silky appressed hairs all longitudinally arranged
53 Young twigs with a bluish waxy bloom; mature leaves glabrous, serrate; ovary glabrous
54 Leaves oblong-lanceolate to oblong-ovate, acute or shortly acuminate; lateral veins $8-12$ pairs; bracts about as long as ovary
69. daphnoides

54 Leaves lanceolate to linear-lanceolate, long-acuminate; lateral veins 15 or more pairs; bracts $c . \frac{1}{2}$ as long as ovary
70. acutifolia

53 Young twigs without a waxy bloom; leaves silky beneath, entire; ovary silky
55 Usually low shrubs of swamps, bogs or damp sand; style short; catkins rarely as much as 2.5 cm
(49-51). repens group
55 Tall riverside shrubs or small trees; style $\pm$ long; catkins more than 2.5 cm
(60-61). viminalis group

Subgen. Salix. Trees or tall shrubs. Leaves lanceolate, gradually acuminate. Catkins on leafy peduncles arising from lateral buds of the previous year. Bracts concolorous, yellowish. Stamens 2 or more, free. Male flowers with 2 nectaries; female flowers with 1 or 2 nectaries.

1. S. pentandra L., Sp. Pl. 1016 (1753). Shrub or small tree up to 7 m . Twigs glabrous, shining, not fragile. Leaves $5-12 \mathrm{~cm}$, more or less elliptical, 2-4 times as long as wide, acuminate, rounded or broadly cuneate at base, finely and very regularly serrate, with yellow glands, glabrous, dark green and glossy above, paler beneath, somewhat coriaceous when mature, sticky and fragrant when young; petiole with 1-3 pairs of glands near the top. Stipules small, caducous. Catkins $2-5 \times 1 \mathrm{~cm}$, appearing after the leaves, cylindrical. Stamens (4-)5(-12). Female flowers with 2 nectaries. Europe, except the extreme north and south and most of the islands. Al Au Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju No Po Rm Rs (N, B, C, W, E) Su [Be].
2. S. fragilis L., Sp. Pl. 1017 (1753). Tree up to 25 m , often pollarded. Bark greyish, becoming fissured but not flaking off. Twigs glabrous and olive, very fragile at the junctions. Leaves $6-15 \times 1 \cdot 5-4 \mathrm{~cm}$, lanceolate, usually $4 \frac{1}{2}-9$ times as long as wide, long-acuminate, usually asymmetrical at apex, cuneate at base, rather coarsely serrate, glabrous and shiny above, with a glaucous bloom or, less often, paler green beneath; petiole with 2 glands at
the top. Stipules usually caducous. Catkins $3-7 \mathrm{~cm}$, appearing with the leaves, drooping, rather dense, cylindrical. Stamens 2, free; anthers yellow. Female flowers usually with 2 nectaries. $2 n=76$. Most of Europe except the Arctic; local in the Mediterranean region. Au Be Br Bu Co CzDaGa Ge Gr Hb He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Sa Si Su ?Tu [Az Bl Fe].
S. alba $\times$ fragilis ( $S . \times$ rubens Schrank) is probably the most frequent of all Salix hybrids. It often resembles 2, from which it differs, inter alia, in the silky pubescence of the young leaves, and the narrower, more gradually tapering leaves. It is commoner and more widespread than pure $S$. fragilis and more frequently cultivated.

Several derivatives of this hybrid, some of them of garden origin, are naturalized in Britain. They are distinguished from each other chiefly by leaf-characters and by the length of catkins and ovaries. One of them, S. $\times$ basfordiana Scaling, is readily identified by its glossy orange-yellow twigs, bright green tapering leaves $10-15 \times 1 \cdot 5-2 \mathrm{~cm}$, with finely but sharply serrate margins; long drooping catkins $5-10 \mathrm{~cm}$; and ovary 2 mm , shortly pedicellate, exceeding the sparsely hairy bract.
S. excelsa S. G. Gmelin, Reise Russl. 3: 308 (1774) is very like S. alba $\times$ fragilis but has stouter catkins, and broader, often slightly brownish, not bearded bracts.
3. S. alba L., Sp. Pl. 1021 (1752). Tree up to 25 m , often pollarded. Branches ascending, appearing silvery-grey in life. Bark greyish, not flaking. Twigs silky when young, later glabrous and olive, not easily breaking off. Leaves $5-10 \mathrm{~cm}$, usually $5 \frac{1}{2}-7 \frac{1}{2}$ times as long as wide, acuminate, not or slightly asymmetrical at apex, cuneate at base, finely serrate, covered with white silky appressed hairs on both surfaces; petiole without glands. Stipules usually caducous. Catkins appearing with the leaves, dense, cylindrical. Bracts uniformly yellowish. Stamens 2, free; anthers yellow. Female flowers usually with 1 nectary. Europe except the Arctic; local in the Mediterranean region. Often planted. Al Au Be Br Bu Co Cr Cz Da Ga Ge Gr Hb He Ho Hs Hu It Ju Lu Po Rm Rs (N, B, C, W, K, E) Sa Si Tu [Fe No Su].
1 Twigs bright yellow or orange
(c) subsp. vitellina

1 Twigs brown or grey
2 Leaves dull bluish-green beneath, soon glabrescent
(b) subsp. coerulea

2 Leaves not bluish-green, covered with $\pm$ persistent silky appressed hairs
3 Leaves dark green, $\pm$ glabrescent above; ovary subsessile
(a) subsp. alba

3 Leaves silky on both surfaces, densely covered with long appressed silky hairs; ovary on a short but distinct pedicel
(d) subsp. micans
(a) Subsp. alba: Twigs brown or yellowish-brown, erect. Leaves covered on both surfaces with appressed silky hairs, more or less glabrescent above. Ovary subsessile. Throughout most of the range of the species.
(b) Subsp. coerulea (Sm.) Rech. fil., Österr. Bot. Zeitschr. 110: 338 (1963) (S. coerulea Sm .): Twigs brown or grey, erect. Leaves bluish-green, sooner and more completely glabrescent than in (a). Frequently planted, occasionally naturalized.
(c) Subsp. vitellina (L.) Arcangeli, Comp. Fl. Ital. 626 (1882): Twigs bright yellow or orange, thin, sometimes pendent. Leaves paler green and indumentum less dense than in (a). Frequently planted.
(d) Subsp. micans (N. J. Andersson) Rech. fil., loc. cit. (1963) (S. micans N. J. Andersson): Like (a) but leaves with very long persistent hairs on both surfaces, therefore very shiny; ovary distinctly pedicellate. Greece.
4. S. babylonica L., $S p$. Pl. 1017 (1753). Tree up to 20 m . Twigs long, pendent, drooping almost to the ground. Leaves $8-16 \times$ $0.8-1.5 \mathrm{~cm}$, narrowly lanceolate or linear-lanceolate, acuminate, serrulate, glabrous at maturity; petiole $3-5 \mathrm{~mm}$. Catkins up to $2 \times 0.3-0.4 \mathrm{~cm}$, curved. Bracts concolorous, glabrescent. Female flowers with 1 nectary. Ovary glabrous, sessile; stigma emarginate. Widely planted and sometimes more or less naturalized. (Native country uncertain, probably China.)
S. alba subsp. vitellina $\times$ babylonica ( $S$. chrysocoma Dode) is frequently planted and combines the silky indumentum and the yellow twigs of the former with the 'weeping' growth of the latter. It is more hardy than pure S. babylonica. S. albax babylonica ( $S . \times$ sepulcralis Simonkai) is frequently cultivated. $S$. babylonica $\times$ fragilis $(S . \times$ blanda N. J. Andersson) is also cultivated, but less frequently.
5. S. triandra L., Sp. Pl. 1016 (1753) (S. amygdalina L.). Shrub or small tree $4-10 \mathrm{~m}$. Bark smooth, flaking off in patches. Twigs glabrous, greenish- or reddish-brown. Leaves $5-10 \mathrm{~cm}$, usually $3 \frac{1}{2}-7 \frac{1}{2}$ times as long as wide, oblong-ovate or oblong-lanceolate, acute or shortly acuminate (not asymmetrical), rounded at base, serrate, glabrous, dark green and somewhat shining above, glaucous or pale green beneath; petiole with 2-3 small glands at the top. Stipules large, persistent. Catkins appearing with the leaves, erect, cylindrical; male $3-5 \mathrm{~cm}$, slender; female rather shorter and denser than male. Stamens 3, free. Female flowers with 1 nectary. River banks. Most of Europe, except the Arctic, local in the Mediterranean region. Al Au Be Br Bu Cz Fe Ga Gr $\mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{Lu} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C}, \mathrm{W}, \mathrm{K}, \mathrm{E)} \mathrm{Sa} \mathrm{Su}$.
(a) Subsp. triandra: Leaves pale green beneath; petiole $\frac{1}{8} \frac{1}{2}$ as long as the leaf. $2 n=38$. Common in the lowlands of N.W. Europe.

This subspecies more frequently forms hybrids than subsp. discolor. The hybrid with S. viminalis is one of the most frequent in N.W. Europe as a planted shrub, but is extremely rare elsewhere.
(b) Subsp. discolor (Koch) Arcangeli, Comp. Fl. Ital. 626 (1882): Leaves glaucous or whitish beneath; petiole $\frac{1}{5}-\frac{1}{6}$ the length of the leaf. Common in the $S . \& E$. of the area of the species and in the valleys of the Alps.

The native distribution of the two subspecies is difficult to define precisely because they are frequently cultivated. Var. villarsiana (Flügge) Rouy is characterized by short, shiny branches and small, ovate or elliptical leaves rounded at the base, white beneath (France, Switzerland). It seems to be common in some valleys of the W. Alps and, though related to subsp. discolor, might represent another geographical subspecies.

Subgen. Chamaetia Dumort. Creeping or procumbent shrubs. Leaves orbicular or ovate. Catkins on leafless peduncles arising from terminal buds of the previous year. Bracts concolorous. Stamens 2, free. Flowers with 1 or 2 nectaries.
6. S. reticulata L., Sp. Pl. 1018 (1753). Dwarf shrub with a creeping and rooting stem, and short, few-leaved twigs. Leaves $1-3(-5) \mathrm{cm}$, less than twice as long as wide, orbicular or ovate, rounded to retuse at apex, cordate (rarely cuneate) at base, entire, coriaceous, dark green, subglabrous and rugose with impressed veins above, whitish, subglabrous and prominently reticulateveined beneath; lateral veins 2-5 pairs; petiole $5-15 \mathrm{~mm}$. Stipules absent. Catkins $1 \cdot 2-3 \mathrm{~cm}$, appearing after the leaves, terminal on leafless pubescent peduncles up to 2.5 cm . Bracts obovate, lightbrown, villous within. Capsule ovoid, sessile or subsessile, tomentose; style short. $2 n=38$. Arctic and subarctic Europe (excluding Faeröer and Iceland) and in the high mountains south-
wards to the Pyrenees, Italian Alps and Macedonia. Au Br Bu Cz Fe Ga Ge He Hs It Ju No Po Rm Rs (N, C, W) Sb Su.
7. S. herbacea L., Sp. Pl. 1018 (1753). Dwarf shrub with long, creeping, branched underground stems. Aerial twigs usually $2-3 \mathrm{~cm}$, with $2-5$ leaves. Leaves $0 \cdot 6-2 \mathrm{~cm}$, orbicular or reniform, less than $1 \frac{1}{2}$ times as long as wide and sometimes wider than long, rounded or emarginate, cordate or rounded at base, crenateserrate, glabrous, bright green and shining, veins prominent on both surfaces; petioles up to 5 mm . Stipules usually absent. Catkins $0.5-1.5 \mathrm{~cm}, 2$ - to 12 -flowered. Bracts more or less obovate, yellowish-green, usually glabrous. Female flowers with 2 nectaries. Capsule ovoid-conical, obtuse, glabrous, often reddish; style short. $2 n=38$. Arctic and subarctic Europe, extending southwards in the mountains to the Pyrenees, C. Appennini and Bulgaria. Au Br Bu Cz Fa Fe Ga Ge Hb He Hs Is It Ju No Po Rm Rs (N, W) Sb Su.

Hybridizes frequently with several species in Scandinavia, Iceland and Scotland but very rarely in other areas. The influence of $S$. herbacea in the hybrids is always very evident in growth and leaf-shape.
8. S. polaris Wahlenb., Fl. Lapp. 261 (1812). Dwarf shrub, stems underground, aerial twigs very slender. Leaves $1.5 \times 1.2 \mathrm{~cm}$, broadly elliptical, dark green, very shiny above, paler green beneath, entire or shallowly sinuate near base; lateral veins 3-4 pairs, slightly reticulate; petiole relatively long. Stipules absent. Catkins c. 15 -flowered. Bracts firm, rather large, more or less urceolate, purplish-black, with rather dense long straight hairs. Filaments purple, smooth. Ovary subsessile, hairy; style long. Arctic Europe, southwards to $60^{\circ} \mathrm{N}$. in Norway. Fe No Rs (N), Sb Su.

Hybridizes freely with S. herbacea in N. Fennoscandia.
(9-11). S. retusa group. Branches procumbent, glabrous, dark. Leaves glabrous, green on both surfaces, almost entire; petiole very short. Ovary glabrous.

The 3 species, though very closely related, are usually easily recognized. Intergradation between 9 and 11 has been observed only locally, mainly in the S.E. Alps. Hybrids of 9 are locally frequent and always similar in habit and in leaf-characters to this species. The influence of the other parent is evident mainly in the terminal leaves of elongated shoots.
1 Extremely compact; petiole c. 0.5 mm ; leaves $0.4-1 \times 0.2$ 0.4 cm , almost imbricate; catkins globose; flowers 3-8; style c. $\frac{1}{4}$ as long as the ovary
11. serpyllifolia

1 Procumbent or ascending, more lax; petiole $1-2 \mathrm{~mm}$; leaves larger; catkins 2-4 times as long as wide; flowers 10 or more; style shorter
2 Procumbent; leaves $0.8-2 \times 0.5-0.8 \mathrm{~cm}$, often truncate or emarginate at apex; veins indistinct; style $c$. $\frac{1}{6}$ as long as the ovary
9. retusa

2 Ascending; leaves $2-3.5 \times 0.7-1.1 \mathrm{~cm}$, rounded or subacute at apex; veins distinct; style $\frac{1}{6}-\frac{1}{8}$ as long as the ovary
10. kitaibeliana
9. S. retusa L., Syst. Nat. ed. 10, 2: 1287 (1759). Stem procumbent. Leaves $0.8-2 \times 0.5-0.8 \mathrm{~cm}$, more or less truncate or emarginate at apex; petiole c. 1 mm . Catkins up to $2 \times 1 \mathrm{~cm}$, with more than 10 flowers, cylindrical, developing with the leaves. Style $c$. $\frac{1}{6}$ as long as the ovary. Alps, Pyrenees, Appennini, Carpathians, Balkan peninsula. Al Au Bu Ga Ge ? Gr He Hs It Ju Po Rm Rs (W).
10. S. kitaibeliana Willd., Sp. Pl. 4 (2): 638 (1806). Lax, ascending; branches long. Leaves $2-3.5 \times 0.7-1 \cdot 1 \mathrm{~cm}$, cuneate,
rounded or subacute at apex, veins more distinct than in 9 and 11, more shiny; petiole $1-2 \mathrm{~mm}$. Catkins $2-4 \times 1 \mathrm{~cm}$, with $10-25$ flowers, developed with the leaves. Style $\frac{1}{6}-\frac{1}{8}$ as long as the ovary. - Carpathians. Cz Po Rm Rs (W).
11. S. serpyllifolia Scop., Fl. Carn. ed. 2, 2: 255 (1772). Very compact, completely appressed to the soil. Leaves $0.4-1 \times 0.2-$ 0.4 cm , imbricate, acute or emarginate; petiole $c .0 .5 \mathrm{~cm}$. Catkins 0.5 cm , globose, with 3-8 flowers, developed after the leaves. Style $c . \frac{1}{4}$ as long as the ovary. © E. \& C. Alps. Au He It Ju.
12. S. rotundifolia Trautv., Nouv. Mém. Soc. Nat. Moscou 2: 304 (1832) (incl. S. nummularia N. J. Andersson). Dwarf spreading shrub, stems and twigs above the surface, often very long, not rooting. Vegetative stems usually with c. 4 leaves. Leaves $0 \cdot 5-$ 1.5 cm , orbicular, with subcordate base and emarginate apex, entire or finely serrate in the lower part, sometimes hairy when young, later entirely glabrous, light green, prominently reticulate above; lateral veins 4-5; petiole $2-3 \mathrm{~mm}$. Stipules usually absent. Catkins c. 3-flowered. Bracts thin, pale, with scattered short hooked hairs. Filaments glabrous. Female flowers with 1 nectary. Ovary subsessile, glabrous; style long. Arctic Russia. Rs (N).
(13-15). S. myrsinites group. Branches procumbent or ascending, thick, crooked, knotty. Leaves green and shiny on both surfaces, with reticulate veins slightly prominent on both surfaces, and long straight hairs more or less evanescent but persisting mainly on the margins. Catkins large, dense, dark purple. Ovary covered with short, somewhat crooked evanescent hairs.

The three closely related species are geographically isolated, except that 14 and 15 overlap in parts of the eastern Alps and slight intergradation may be observed locally (vide Samuelsson, Vierteljahrsschr. Naturforsch. Ges. Zürich. 67: 247-50 (1922)).

1 Leaf-margins entire; catkins slender; stems procumbent 15. alpina
1 Leaf-margins glandular-serrate; catkins stout; stems ascending
2 Dead leaves deciduous
14. breviserrata

2 Dead leaves persistent until the end of the following growing season
13. myrsinites
13. S. myrsinites L., Sp. Pl. 1018 (1753). More or less ascending. Leaves shiny on both surfaces, dark green, margin glandularserrate, dead leaves persisting until the end of the following growing season. Ovary sparsely hairy, becoming glabrous. $2 n=190$. Fennoscandia; Scotland; Ural. Br Fe No Rs (N) Sb Su.
S. myrsinites hybridizes freely with S. glauca and S. nigricans. These hybrids usually inherit the shiny green lower surface of the leaves and the purplish flowers of $S$. myrsinites.
14. S. breviserrata B. Flod., Arkiv Botanik 29 (18): 44 (1940). More or less ascending. Dead leaves deciduous; margin densely glandular-serrate. Catkins stout. Capsule broad; style short. - Alps; Pyrenees and N. Spain. Au Ga Hs It Ju.
15. S. alpina Scop., Fl. Carn. ed. 2, 2: 255 (1772). More or less procumbent. Dead leaves deciduous; margin entire. Catkins slender. Capsule narrow; style long. E. Alps; Carpathians. Au Cz Ge It Ju Po Rm Rs (W).
16. S. arctica Pallas, Fl. Ross. 1 (2): 86 (1788). Twigs glabrous, shiny. Leaves $3-4 \times 2-3 \mathrm{~cm}$, ovate or obovate, rounded or broadly cuneate at the base, thick, leathery, hairy only when young, with more or less reticulate veins slightly prominent beneath and slightly impressed above. Stipules shorter than the petiole, often conspicuous. Catkins $c .5 \times 1 \mathrm{~cm}$; peduncles leafy,
long. Bracts brownish, rounded at apex. Ovary densely covered with long white hairs; style long, filiform, more or less cleft; stigma bifid. Vajgač, N. Ural. Rs (N). (Arctic Asia.)
17. S. pulchra Cham., Linnaea 6: 543 (1831). Low shrub; twigs procumbent or more or less ascending, dark purplishbrown, shiny. Leaves narrowly lanceolate, glandular-serrate (sometimes indistinctly), glabrous on both surfaces, finely reticulate; petiole short. Stipules $3-10 \mathrm{~mm}$, glandular-serrate, narrow, acute, tapering towards the base, much longer than the petioles, especially in terminal well-developed leaves. Catkins $4-5 \times 1.5 \mathrm{~cm}$; peduncles leafless. Bracts dark, acute. Ovary covered with long silky hairs; style long; stigma narrow, long. Arctic Russia. Rs (N). (Arctic Asia and America.)

Subgen. Caprisalix Dumort. Shrubs or small trees. Catkins sessile or on leafy peduncles, from lateral buds of the previous year. Bracts with dark apex. Stamens 2, free or united. Male and female flowers with a single nectary.
(18-20). S. glauca group. Branches 1-2 m, thick, knotty, grey-brown, shiny, covered with long hairs, more or less glabrescent. Leaves flat, entire, grey-green, with shallowly impressed veins above, pale blue-green beneath, covered with grey woolly rather long hairs on both surfaces. Catkins long and stout; peduncles leafy. Ovary subsessile, grey-woolly.

The three species given here are distinguished from each other by rather subtle characters, but their taxonomic value is fairly well supported by field evidence as well as from herbarium material.
1 Stipules present, lanceolate
19. stipulifera

1 Stipules usually absent
2 Leaves oblanceolate, subacute, with 7-9(-14) pairs of lateral veins, silky with appressed hairs on both surfaces; capsule 6-7(-10) mm
20. glaucosericea

2 Leaves obovate, $\pm$ obtuse, with 5-6(-7) pairs of lateral veins, less silky, with more intricate hairs; capsule $10-12 \mathrm{~mm}$.
18. glauca
18. S. glauca L., Sp. Pl. 1019 (1753). Leaves obovate, more or less obtuse, thin, rather bright green, decolorizing rather easily on drying; indumentum moderately dense, of somewhat silky, slightly intricate, hairs; lateral veins 5-6(-7) pairs; petiole short. Stipules usually absent. Pedicel distinct, as long as the nectary. Capsule 10-12 mm. Iceland, Faeröer, N. \& W. Fennoscandia, arctic Russia. Fa Fe Is No Rs (N) Su.

The plant from Faeröer and Iceland has been considered as a distinct species, S. callicarpaea Trautv., Nouv. Mém. Soc. Nat. Moscou 2: 295 (1832). It has $2 n=190$.
19. S. stipulifera B. Flod. ex Hayrén, Mem. Soc. Faun. Fl. Fenn. no. 5, 133 (1929). Leaves obovate or oblanceolate, rounded at apex; lateral veins $5-7$ pairs. Stipules present, lanceolate. Capsule $8-10(-12) \mathrm{mm}$. $2 n=152$. N. Fennoscandia and arctic Russia. Fe No Rs (N) Su.
20. S. glaucosericea B. Flod., Svensk Bot. Tidskr. 37: 169 (1943). Leaves $5.5-7.5 \times 1 \cdot 5-2.2 \mathrm{~cm}$, oblanceolate, subacute, pale green and somewhat shiny above, glaucous beneath, silky with appressed hairs on both surfaces; lateral veins 7-9(-14) pairs. Stipules usually absent. Capsule 6-7(-10) mm. Alps. Au Ga He It.
21. S. pyrenaica Gouan, Obs. Bot. 77, no. 8 (1773). Low shrub up to 50 cm , with ascending reddish-brown glabrescent twigs. Leaves ovate-elliptical, rarely obovate, with more or less
rounded base, slightly shiny and with few long hairs above, glaucescent and with numerous long appressed hairs beneath, glabrescent but hairs persistent at the entire margin; lateral veins 8 pairs; petiole $3-5 \mathrm{~mm}$, pubescent. Stipules absent. Catkins lax-flowered, terminal on leafy, more or less elongated branches. Bracts 2 mm , obovate, obtuse, ferrugineous, long-hairy on both surfaces. Capsule ovoid, obtuse, tomentose, somewhat glabrescent near the base; pedicel 0.5 mm ; style bifid. - Pyrenees, Cordillera Cantábrica. Ga Hs.
22. S. reptans Rupr., Beitr. Pf. Russ. Reich. 2: 54 (1845). Twigs procumbent, glabrescent, green, suffused with red. Leaves ovate to lanceolate, entire, sometimes almost cordate at the base, glabrescent and glaucous beneath. Stipules as long as the very short petiole, entire, elliptical, with straight apex. Catkins denseflowered, on leafy branches. Bracts almost black in the upper part, obovate or ovate, with long fringes. Capsule tomentose, large; style short, bifid. Vajgač, Kolguev. Rs (N). (Arctic Asia.)
(23-24). S. lanata group. Shrub up to 3 m . Twigs with persistent felt. Stipules persistent. Leaves with whitish-grey wool, but finally glabrescent, not blackening on drying. Catkins with short peduncles. Ovary glabrous.

Stipules entire; leaf-margin undulate, eglandular \begin{tabular}{c}
23. lanata <br>

| Stipules with sharp glandular teeth; leaf-margin |
| :--- |
| glandular | <br>

24. densely <br>
glandulifera
\end{tabular} glandular
25. glandulifera
26. S. lanata L., Sp. Pl. 1019 (1753). Leaves large, thick, broadly ovate or obovate, more or less cordate at base and with a short deflexed apex, bright yellow-hairy when young; margin entire, eglandular, undulate; lateral veins 5-6 pairs. Stipules broad, subobtuse, entire. Peduncles with scale-like leaves. Bracts ovate, blunt, becoming blackish-brown, golden-hairy. Nectaries long, narrow, entire or shallowly cleft. Stamens yellow. Stigmalobes long, narrow filiform, entire, yellow or brownish. Arctic and subarctic Europe, extending southwards to C. Scotland. Br Fa Fe Is No Rs (N) Su.

## Hybridizes freely with $S$. hastata and $S$. caprea.

24. S. glandulifera B. Flod., Bot. Not. 1930: 338 (1930). Like 23 but leaves usually oblanceolate, with $6-8$ pairs of lateral veins; margin flat, densely glandular; stipules long, acute, with sharp glandular teeth. $2 n=38$. Arctic Europe. Fe No Rs (N) Su.
S. recurvigemmis A. Skvortsov, Not. Syst. (Leningrad) 18: 37 (1957), from E. arctic Russia (and N. Siberia), an often-procumbent shrub with persistent bud-scales, and the ovary pubescent when young, has been recognized as another member of the S. lanata group, but its relationships are unclear.
(25-28). S. phylicifolia group. Shrub up to 4 m . Twigs dark, shining, glabrous or glabrescent. Leaves glabrous at maturity, more or less shiny above, more or less glaucous beneath, not blackening on drying. Catkins subsessile or shortly pedunculate, rather lax in fruit. Ovary silky pubescent; pedicel 2-4 times as long as nectary.

This is one of the most difficult groups in Salix. It is the more complicated because of the strong tendency to hybridize with S. nigricans as well as with species of Sect. Capreae (species 3941) and of the S. glauca group.

1 Leaves silky, hairy when young, glabrescent later; decorticated wood with short distinct ridges
26. bicolor

1 Leaves almost glabrous even when young; decorticated wood without ridges
2 Leaves with short glandular teeth, shiny above
25. phylicifolia

2 Leaves entire or with very indistinct crenulate-glandular teeth
3 Leaves indistinctly glandular-serrate, widest above the middle, often tapering towards the base; lateral veins $7-10$ pairs; petiole $3-6 \mathrm{~mm}$
27. hegetschweileri

3 Leaves almost entire, widest at or below the middle; often with rounded base; lateral veins $9-12$ pairs; petiole $2-3 \mathrm{~mm}$
28. hibernica
25. S. phylicifolia L., Sp. Pl. 1016 (1753). Ridges on decorticated wood absent. Buds narrow, acute, dark brown. Leaves obovate-lanceolate to ovate or narrowly elliptical, tapering at both ends, shiny above, with short glandular teeth. Catkins $2-4(-10) \times 1 \mathrm{~cm}$. Filaments entirely glabrous. $2 n=114$. N. Europe, southwards to England and Latvia. Br Da FaFe Hb Is No Rs (N, B) Su.
26. S. bicolor Willd., Berl. Baumz. 339 (1796). Ridges on decorticated wood short but distinct. Buds short, yellowish or orange; scale persistent after opening of bud. Leaves obtuse, silky-hairy on both surfaces when young, punctate, less shiny above than in 25. Catkins and capsule shorter than in 25. Filaments often sparsely hairy near the base. Mountains of Europe, from C. Germany to N. Spain and Bulgaria, but not in the Alps. $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Hs} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.
27. S. hegetschweileri Heer in Hegetschweiler, Fl. Schweiz 963 (1840). Ridges on decorticated wood absent. Buds $6(-8) \mathrm{mm}$, chestnut-brown, rarely yellowish. Young twigs more or less felted, later glabrescent. Leaves obovate or ovate, broadest above the middle, often tapering towards the base, with very indistinct scattered glandular teeth (rarely entire or with more numerous glands), completely glabrous; petiole $3-6 \mathrm{~mm}$. Catkins $2 \cdot 4(-4) \times 1.8 \mathrm{~cm}$. Filaments crisped-hairy in lower half. Capsule c. 4 mm . Alps. Au ? Ga He It.
28. S. hibernica Rech. fil., Österr. Bot. Zeitschr. 110: 340 (1963). Like 27 but leaves broadly lanceolate to almost elliptical, almost entire, broadest at or below the middle, broadly cuneate or rounded at base, apex very shortly acuminate (not tapering as in 25); lateral veins $9-12$ pairs; petiole $2-3 \mathrm{~mm}$, stout. Catkins c. 3 cm , dense. - N.W. Ireland (Ben Bulben near Sligo). Hb.
(29-31). S. nigricans group. Shrub or small tree 1-4 m. Twigs pubescent, often glabrescent, blackish- to brownish-green. Leaves green and rather dull above, paler green or glaucous, pubescent or almost glabrous beneath, usually turning black on drying. Stipules usually rather large, semi-cordate. Catkins rather lax; peduncles short, leafy. Ovary glabrous.

This is probably the most polymorphic group in Salix as to size, outline, serration and pubescence of leaves. The circumscription of the group here follows Enander, Salic. Scand. 3: 9 (1910) and excludes all plants with a hairy ovary. Plants showing this character usually show one or more correlated characters pointing to hybridization with S. phylicifolia and S. myrsinites in Scandinavia, with S. atrocinerea and S. phylicifolia in Britain, or with $S$. cinerea or other members of the Capreae in other parts of Europe. One of the more reliable vegetative characters of $S$. nigricans is the waxy bloom fading out towards the apex on the lower surface of leaves.

1 Adult leaves more or less glaucous beneath (but always green at apex), going black on drying; twigs slender; catkins appearing before the leaves; style and stigma long, slender
29. nigricans

1 Adult leaves $\pm$ green beneath, going black less easily on drying; twigs thicker and more nodose; catkins appearing with the leaves; style and stigma often shorter and thicker

2 Indumentum of young twigs and young leaves of rather dense whitish hairs; leaves $\pm$ elliptical; catkins with a long manyleaved peduncle
30. borealis

2 Indumentum of short hairs, soon $\pm$ evanescent; leaves lanceolate to obovate; catkins with a short, few-leaved peduncle
31. mielichhoferi
29. S. nigricans Sm., Trans. Linn. Soc. London 6: 120 (1820) (S. myrsinifolia Salisb.). Often a shrub. Twigs slender. Young twigs whitish-pubescent, often glabrescent. Leaves orbicular-ovate to lanceolate, often glaucous beneath (but the apex always green), serrate or subentire, going black on drying; veins slender and not prominent. Catkins shortly pedunculate or subsessile, appearing before the leaves. Style and stigma long, slender. $2 n=114$. $N$. \& C. Europe. Au Br Cz Da Fe Ga Ge Hb He It Ju No Po Rs (N, B, C, W, E) Su.

The following hybrids occur frequently:
S. cinerea $\times$ nigricans. Often like 29 but more hairy, decorticated wood with ridges, and ovary more or less hairy.
S. nigricans $\times$ phylicifolia. Often like 29 but less hairy, waxy bloom of lower surface of leaf more pronounced, and ovary more or less hairy.
S. myrsinites $\times$ nigricans. Leaves more or less green and shiny on both surfaces; catkins purplish.
S. atrocinerea $\times$ nigricans. Like 29 or intermediate; decorticated wood with ridges; ovary hairy; indumentum sometimes tending to be rust-coloured on the lower surface of leaf.
30. S. borealis Fries, Bot. Not. 1840: 193 (1840). Like 29 but often a tree; twigs thicker and more nodose; young twigs with whiter and denser indumentum. Leaves more coriaceous, larger, often more or less elliptical, often deeply serrate with large glands, going black less easily on drying; less glaucous beneath, with longer and whiter hairs; veins thicker, reticulation more prominent; petiole thicker, with long hairs; stipules larger; catkins with longer, thicker, more woolly peduncles, appearing with the leaves; style and stigma often shorter and thicker. N. Fennoscandia and N. Russia. Fe No Rs (N) Su.
31. S. mielichhoferi Sauter, Flora (Regensb.) 32: 662 (1849). Shrub. Twigs thicker and more nodose than in 29. Indumentum of young leaves and young twigs consisting of short hairs which soon disappear. Leaves lanceolate to obovate, almost entire, green beneath, with thick prominent reticulation, scarcely going black on drying. Catkins with a short, few-leaved peduncle, appearing with the leaves. E. Alps. Au ?He ?It.
32. S. glabra Scop., Fl. Carn. ed. 2, 2: 255 (1772). Erect shrub up to 1.5 m . Twigs dark brown, entirely glabrous even when young. Leaves broadly elliptical or obovate, sometimes oblanceolate, crenulate-serrate to coarsely dentate, coriaceous, glossy, with thick waxy bloom over whole lower surface, glabrous even when young, reticulation fine but prominent on both surfaces. Stipules rarely developed, semi-cordate, serrate. Catkins $7 \times 1 \mathrm{~cm}$; peduncles up to 20 mm , with small obovate, serrate leaves. Ovary entirely glabrous; pedicel $c . \frac{1}{3}$ as long as ovary. E. Alps. Au Ge He It Ju.

The hybrid with 29 (S. $\times$ subglabra Kerner) is not frequent and can be recognized by the young and adult leaves which are more or less hairy, at least along the midrib, and by the waxy bloom of the lower surface of the leaf which fades out below the apex.
33. S. crataegifolia Bertol. in Desv., Jour. Bot. Appl. 2: 76 (1813). Procumbent or erect shrub up to 1 m . Twigs covered at
first with long hairs, becoming glabrous, dark purple. Leaves $6.5-11.5 \times 3.4-4 \mathrm{~cm}$, elliptical, bright green above with silky hairs beneath, ultimately glabrous; lateral veins $8-12(-20)$ pairs. Female catkins $5(-12) \times 0.8-1 \mathrm{~cm}$; axis almost glabrous. Bracts reddish-brown, with long white silky hairs near apex. Ovary 5 mm , glabrous; pedicel short; style $1 \cdot 5(-2) \mathrm{mm}$. $\quad$. Italy (Alpi Apuane, ?Moncenisio). ?Ga It.
34. S. pedicellata Desf., Fl. Atl. 2: 362 (1799). Tall shrub or tree up to 10 m . Decorticated wood with numerous prominent ridges. Young twigs grey-tomentose, older ones gradually glabrescent. Leaves oblong or obovate-lanceolate, dentate, crenate or nearly entire, thinly pubescent beneath, glabrescent above; lateral veins at least $10-12$ pairs, connected by a fine reticulation, prominent beneath, impressed above. Stipules large, semi-cordate, dentate, deciduous. Bracts with short hairs. Catkins 3-6×11.5 cm . Ovary glabrous; pedicel $3-4 \mathrm{~mm}$; style short or moderately long. Mediterranean region. Co Gr Hs It Sa Si ?Tu.

Plants similar in vegetative characters but with hairy ovary are probably of hybrid origin.
35. S. silesiaca Willd., Sp. Pl. 4 (2): 660 (1806). Shrub up to 3 m . Twigs slightly pubescent when young, or almost glabrous from the beginning. Decorticated wood sometimes with scattered ridges $5(-10) \mathrm{mm}$. Leaves oblanceolate, more or less broadly cuneate towards the base, almost glabrous and green on both surfaces or bluish-green beneath; reticulation prominent beneath; apex flat, triangular; margin serrate, crenate or nearly entire. Stipules reniform or semicordate, irregularly glandular-sinuate, more or less equalling the petiole. Catkins $1.5-3.5 \times 0.5-1 \mathrm{~cm}$; peduncles short. Bracts dark red-brown, bearded with long white hairs. Ovary glabrous; pedicel equalling the bract, later elongating slightly. Riversides and damp clearings. Sudety, Carpathians, Balkan peninsula. Bu Cz Ge Ju Po Rm Rs (W).

Absent from the Alps; records from Steiermark are referable to S. appendiculata $\times$ caprea. Hybridizes freely with S. aurita, S. caprea and locally with S. lapponum.
36. S. aegyptiaca L., Cent. Pl. 1: 32 (1755). Tall shrub up to 4 m , occasionally a tree. Decorticated wood with numerous short, prominent ridges. Young twigs reddish, with dense grey tomentum, persistent on older branches. Leaves lanceolate, cuneate or rounded at the base, thick, crispate-serrate; lamina with short sparse grey persistent indumentum and prominent reticulation beneath, glabrescent above; lateral veins $c .15$ pairs; petiole $5-10(-15) \mathrm{mm}$, thick, tomentose. Stipules semihastate, serrate, acute, deciduous. Catkins $5-6 \times 1(-1 \cdot 5) \mathrm{cm}$. Ovary tomentose; pedicel c. 2 mm ; style $0 \cdot 5(-1) \mathrm{mm}$. Thraki (Moussafacli); S. Russia and S. Ukraine. Gr Rs (W, K, E). (Mountains of Asia.)
37. S. appendiculata Vill., Hist. Pl. Dauph. 3: 775 (1789) (S. grandifolia Ser.). Tall shrub or small tree with short divaricate branches. Decorticated wood with few, sometimes indistinct elevated ridges. Twigs pubescent with short hairs, more or less glabrescent. Leaves variable in size and shape, obovate to oblanceolate, usually widest above the middle, more or less glabrescent above and permanently pubescent beneath; margin roughly erose-dentate to entire; veins deeply impressed above, and very prominent beneath; petiole c. 10 mm . Stipules well developed, semicordate, coarsely serrate. Catkins up to $3 \times 1 \mathrm{~cm}$, lax-flowered. Filaments with few long hairs near the base. Pedicel as long as or longer than the grey-pubescent ovary. $C$. Europe, Appennini, N.W. Balkan peninsula. Au Ga Ge He It Ju.

Absent from Sudety and Carpathians; records of 37 from here are referable to 35 or its hybrids.
S. appendiculata hybridizes freely, especially with S. caprea (to give $S . \times$ macrophylla Kerner) but also with many subalpine species. The influence of S. appendiculata is usually shown in the rugose leaves, broadest above the middle, and the dense very prominent reticulation of the lower surface.
38. S. laggeri Wimmer, Flora (Regensb.) 37: 162 (1854). Shrub 2-3 m. Twigs divergent, thick, knotty, dark brown to blackish, woolly-felted with long white hairs when young, glabrescent only in the second or third year. Leaves narrowly elliptical to oblonglanceolate, tending to turn black on drying, lanate-pubescent above, deep green and almost shiny when mature, woolly-felted with greyish-white hairs beneath; petiole $6-20 \mathrm{~mm}$. Stipules semisagittate, cuneate-serrate. Catkins $2-3.8 \times 1.2-1.7 \mathrm{~cm}$. Filaments with long hairs in lower half or near the base only. Ovary densely covered with whitish hairs. Alps. Au Ga He.
39. S. cinerea L., Sp. Pl. 1021 (1753). Shrub up to 6 m. Twigs rather stout, shortly and persistently pubescent, grey. Decorticated wood with narrow continuous ridges. Leaves up to $11 \times 4 \mathrm{~cm}, 2-3 \frac{1}{2}$ times as long as wide, lanceolate or oblanceolate, apiculate or rounded, cuneate at base, persistently pubescent beneath and grey or somewhat glaucous above; margin often somewhat undulate, distantly crenate-serrate or subentire; petiole up to 15 mm . Stipules usually well developed, semicordate, toothed. Catkins appearing before the leaves, dense, subsessile, finally $3 \cdot 5-5 \mathrm{~cm} .2 n=76$. Most of Europe but local in the west and the Mediterranean region. Al Au Be Br Bu Co Cz Da Fe Ga Ge Gr Ho Hu It Ju No Po Rm Rs (N, B, C, W, E) Sa Su Tu.

Absent from most of W. Europe, where records of 39 are mostly referable to $\mathbf{4 0}$ or its hybrids.
40. S. atrocinerea Brot., Fl. Lusit. 1: 31 (1804) (S. cinerea auct. eur. occid., S. oleifolia Sm .). Tall shrub or small tree up to 10 m . Young twigs somewhat pubescent, glabrescent, shining in the second year. Decorticated wood with ridges. Leaves obovate or oblong-oblanceolate, slightly denticulate to almost entire, soon glabrescent above and somewhat shiny, glaucous, with very short curved rust-coloured hairs beneath; lateral veins $8-15$ pairs. Catkins $2-5 \mathrm{~cm}$, appearing before the leaves, cylindrical, dense, sessile or subsessile; axis grey-hairy. Capsule tomentose. $2 n=76$. W. Europe, from Britain to Portugal. Be $\mathrm{Br} \mathrm{Ga} \mathrm{Hb} \mathrm{Hs} \mathrm{Lu} \mathrm{[Az]}$.

Subsp. catalaunica R. Görz, Cavanillesia 2: 142 (1930) from E. Spain (Cataluña) is said to have a petiole 3-5(-8) mm, leaves with rounded base and sinuate-dentate margin, very short style, and very indistinct stigma; it somewhat resembles $S$. aurita.
S. atrocinerea hybridizes freely with S. aurita and S. caprea and evidently also with $S$. cinerea, wherever they meet.
41. S. aurita L., Sp. Pl. 1019 (1753). Shrub 1-2(-3) m, with numerous patent branches. Twigs rather slender, soon glabrous, brown, usually angular and with wide-angled branching. Decorticated wood with ridges. Leaves $2-3 \mathrm{~cm}$, c. $1 \frac{1}{2}-2 \frac{1}{2}$ times as long as wide, obovate, shortly cuspidate with the cusp often obliquely recurved, more or less cuneate at base, undulate, toothed to subentire, distinctly rugose, dull grey-green and more or less pubescent above, more or less grey-tomentose beneath. Stipules large and conspicuous, more or less reniform, persistent. Catkins $1-2.5 \mathrm{~cm}$, appearing before the leaves, subsessile, cylindrical. $2 n=76$. Europe, except the Arctic and the Mediterra-
nean region. Au Be Br Co Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju No Po Rm Rs (N, B, C, W, E) Su.
(42-43). S. caprea group. Shrub or small tree $3-10 \mathrm{~m}$; bark coarsely fissured. Twigs rather stout. Decorticated wood without ridges. Leaves $5-10 \mathrm{~cm}, 1 \frac{1}{2}-2$ times as long as wide, more or less obtuse or shortly acuminate, with the apex obliquely deflexed, persistently hairy beneath. Stipules semicordate. Catkins appearing before the leaves, dense, subsessile. Male catkins $2-3.5 \times 1 \cdot 5-2 \mathrm{~cm}$, oblong-ovoid. Female catkins finally $3-7 \mathrm{~cm}$, lax. Bracts blackish at the apex. Both male and female flowers with 1 nectary.
Previous year's twigs $\pm$ glabrous; leaves $\pm$ glabrous above, rounded at base
42. caprea

Previous year's twigs grey-lanate; leaves hairy above, cuneate at base
43. coaetanea
42. S. caprea L., Sp. Pl. 1020 (1753). Previous year's twigs almost or quite glabrous. Buds with outwardly curved apex. Leaves usually broadly ovate to ovate-oblong, rounded at the base, sinuate-dentate or almost serrate, dark green and finally almost glabrous above, persistently softly and densely greytomentose beneath; margin somewhat undulate, crenate to entire; lateral veins $6-9$ pairs, forming almost a right angle with the midrib, very prominent on the lower surface; petiole long. Stipules usually large. Most of Europe, but absent from the extreme north and south. Au Be Br Bu Co Cz Da Fe Ga Ge Gr Hb He Ho Hs Hu It Ju No Po RmRs (N, B, C, W, K, E) Si Su Tu.
43. S. coaetanea (Hartman) B. Flod., Bot. Not. 1930: 331 (1930). Previous year's twigs dull grey-lanate. Buds with short straight apex. Leaves obovate, somewhat tapering below and cuneate at the base, more or less shiny, with silky, dense, rather appressed, long, straight hairs above, and silvery-grey-tomentose beneath; margin sinuate or nearly entire; lateral veins 5-8 pairs, forming an acute angle with the midrib, less prominent beneath than in 42; petiole shorter than in 42; stipules usually absent. N. Sweden, Norway, Finland, N. Russia, Scotland. Br Fe No Rs (N) Su.
44. S. salvifolia Brot., Fl. Lusit. 1: 29 (1804) (S. oleifolia auct. hisp.). Tall shrub or tree up to 6 m . Young twigs grey-tomentose, indumentum persistent on the old ones. Decorticated wood with prominent ridges. Leaves linear-lanceolate or linear-oblong, 3-5 times as long as wide, gradually attenuate towards the base, shortly acuminate and almost rounded towards the apex, white tomentose on both surfaces, tomentum dense and persistent beneath, thinner above; margin slightly serrate or almost entire; lateral veins numerous; petiole up to 6 mm . Stipules semicordate, serrate or crenate, patent, with deflexed apex. Fruiting catkins $3-4 \times 1 \mathrm{~cm}$. Capsule tomentose; pedicel short; style very short. Spain, Portugal. Hs Lu.

The capsule is hairy according to the original description and in the majority of specimens seen. Similar plants but with glabrous capsule have been seen from the Sierra Morena and the Guadalquivir valley.
45. S. cantabrica Rech. fil., Österr. Bot. Zeitschr. 109: 374 (1962). Shrub $2-3 \mathrm{~m}$. Young twigs covered with shiny hairs, the older twigs glabrescent. Decorticated wood with scattered but distinct ridges. Leaves broadly lanceolate, rounded or rarely cuneate at the base, acute at apex, more or less entire, with indumentum of silky, appressed hairs, denser beneath; midrib prominent; veins scarcely impressed above and scarcely prominent beneath; petiole short. Stipules lanceolate, acute, shorter than petiole. Ovary silky-white-tomentose; pedicel shorter than
bract. Along mountain rivers.

- N. Spain (C. part of Sierra Cantábrica). Hs.

Only female flowers are known.
(46-47). S. starkeana group. Shrubs or rarely trees. Leaves broadly lanceolate, orbicular-obovate or oblanceolate, thin. Catkins $1.5-3 \times 0.5-1 \mathrm{~cm}$, lax; peduncle up to 2.5 cm . Pedicel almost as long as ovary, densely covered with grey-white hairs. Nectaries slender, ovate, $\frac{1}{4} \frac{1}{3}$ as long as the bracts.
Twigs and leaves $\pm$ glabrous; petiole up to 5 mm ; filaments glabrous 46. starkeana
Twigs and leaves hairy; petiole $6-8 \mathrm{~mm}$; filaments hairy
47. xerophila
46. S. starkeana Willd., Sp. Pl. 4 (2): 677 (1806) (S. livida Wahlenb.). Low shrub, rarely up to 1 m , with ascending branches. Twigs slender, pale and glabrous in the first year. Buds appressed, greenish-orange-yellow, with flattened apex. Leaves broadly lanceolate to orbicular-obovate, slightly pubescent and reddish when young, soon glabrous, bright green, more or less shiny above, pale green or greyish with very prominent veins beneath; margin glandular serrate; lateral veins 5-7 pairs. Stipules well developed, broadly elliptical or $\frac{1}{2}$-reniform, with glandular margin. Bracts lanceolate, usually greenish-yellow. Filaments glabrous. Stigmas erect, ovoid, more or less urceolate. N. \& C. Europe, extending to N. Ukraine and C. Russia. Cz Fe Ge He No Po Rm Rs (N, B, C, W) Su.
47. S. xerophila B. Flod., Bot. Not. 1930: 334 (1930). Shrub, rarely a tree, up to $c .6 \mathrm{~m}$, with erect branches. Twigs dull, more or less woolly. Buds somewhat patent, conical, reddish-brown. Leaves oblanceolate, grey-woolly with appressed, somewhat curved hairs; margin entire; lateral veins 7-8 pairs. Stipules usually absent. Bracts obovate, brown. Filaments hairy. Stigmas divergent, cylindrical, usually deeply cleft, longer than in 46. N. Fennoscandia, N. Russia. Fe No Rs (N) Su.
48. S. myrtilloides L., Sp. Pl. 1019 (1753). Low shrub with subterranean creeping stem. Twigs $30-50 \mathrm{~cm}$, erect, brown, with short evanescent hairs. Leaves orbicular to narrowly elliptical with short, sometimes plicate apex, usually more or less rounded at both ends, dull green above, paler beneath, veins not prominent; margin entire and more or less reflexed; petiole up to 5 mm . Catkins c. 2 cm . Nectaries $\frac{1}{2}$ as long as the bracts. Ovary glabrous; style short. Swamps and peat-bogs. N. \& C. Europe to C. Ukraine. Cz Fe Ge He No Po Rm Rs (N, B, C, W) Su.

The hybrid with S. aurita L. (S. $\times$ rugulosa N. J. Andersson) is frequent and can be recognized easily by the more or less crenate, rugose leaves with more prominent reticulation and more or less pubescent ovary. S. myrtilloides $\times$ repens ( $S . \times$ finnmarchica Willd.) is also frequent.
(49-51). S. repens group. Recognizable, in spite of the extreme variability of most characters, by the creeping stem with ascending branches, the silky indumentum of the more or less entire leaves, the small catkins (not more than 2.5 cm ) and the short style. Though the 3 components of the group evidently have different centres of distribution and in part also different ecological requirements, much intergradation is found, sometimes over extensive areas, and locally more or less stabilized intermediate populations may be observed.

[^26]1 Previous year's twigs slender, pale, glabrous or sparsely covered with short hairs; stipules absent; leaves ovateelliptical or linear, finally $\pm$ glabrous above, silky beneath
2 Leaves ovate-elliptical, with 4-6 pairs of lateral veins; catkins cylindrical; capsule glabrous
49. repens

2 Leaves linear, with 10-12 pairs of lateral veins; catkins globose; capsule hairy
50. rosmarinifolia
49. S. repens L., Sp. Pl. 1020 (1753). Branches more or less procumbent. Previous year's twigs slender, pale, glabrous. Leaves ovate-elliptical, finally glabrous at least above, silky beneath; margin flat and glandular; lateral veins 4-6 pairs. Stipules absent. Catkins cylindrical. Bracts flat, with dark apex. Stigma relatively long. Pedicel, capsule and filaments glabrous. $2 n=38$. Bogs and swamps. N., W. \& C. Europe extending to Italy and the Ukrainian Carpathians. Au Be BrCzDaFe Fa $\mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{No} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{W)} \mathrm{Su}$.
S. aurita $\times$ repens group (S. $\times$ ambigua Ehrh.) is common wherever the parents meet.
50. S. rosmarinifolia L., Sp. Pl. 1020 (1753). Previous year's twigs slender, sparsely covered with short hairs, with often crowded basal shoots. Leaves more or less erect, thin, almost linear, dark green, finally more or less glabrous above, covered with silky hairs beneath; margin entire or slightly sinuate, finely glandular, flat; lateral veins 10-12 pairs. Stipules absent. Catkins globose. Bracts hairy. Filaments glabrous. Capsule hairy. $2 n=38$. Bogs and swamps. C. \& E. Europe extending to Belgium, Sweden and N. Italy. Au Be Bu Cz Da Ge He Hu It Ju Po Rm Rs (N, B, C, W, E) Su.
51. S. arenaria L., Sp. Pl. 1019 (1753). Previous year's twigs stout, hairy, dark. Leaves obovate, more or less spreading, short, firm, with remote, sharp, glandular teeth, densely covered on both surfaces with long silky hairs, finally dull grey-green above with hooked hairs; margin deflexed; lateral veins 5-8 pairs. Stipules often present. Catkins ovoid. Bracts hairy. Filaments hairy. Capsule usually hairy. Stigma short, more or less globose. $2 n=38$. Mainly on maritime dunes. Atlantic coasts of Europe extending to Poland. Be $\mathrm{Br} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Ho} \mathrm{Lu} \mathrm{No} \mathrm{Po} \mathrm{Su}$.
(52-54). S. arbuscula group. Shrubs up to 2 m . Twigs glabrous. Leaves shiny above, glaucous beneath, never turning black on drying. Stipules minute or absent. Ovary hairy. Pedicel shorter than the nectary or absent.

The last-mentioned character is useful for distinguishing the S. arbuscula group from the S. phylicifolia group, which is rather similar in leaf-characters to the former but has the pedicel 2-4 times as long as the nectary (vide K. H. Rechinger, Feddes Repert. 45: 87-94 (1938)).

1 Leaves 3-5 cm, obovate or elliptical, indistinctly and remotely crenate-serrate, sometimes subentire; catkins $1.4-3.5 \times 0.5-$ 0.8 cm ; peduncle long 54. waldsteiniana

1 Leaves $0.5-3 \mathrm{~cm}$, lanceolate or elliptical-lanceolate, densely and regularly serrate; catkins $1.3-1.8 \times 0.4-0.5 \mathrm{~cm}$; peduncle short
2 Leaves acutely serrate, with large white glands; lateral veins 5-10 pairs; catkins $c$. twice as long as wide 53. foetida
2 Leaves subacutely serrate with small glands; lateral veins 7-12 pairs; catkins c. 3 times as long as wide 52. arbuscula
52. S. arbuscula L., Sp. Pl. 1018 (1753). Leaves $0 \cdot 5-2(-4) \mathrm{cm}$, lanceolate-elliptical, acute, serrate, with small glands; lateral veins $7-12$ pairs. Catkins c. 3 times as long as wide; peduncle short. Fennoscandia, N. Russia, Scotland. Br Fe No Rs (N) Su .
53. S. foetida Schleicher in Lam. \& DC., Fl. Fr. ed. 3, 3: 296 (1805). Leaves up to 3 cm , elliptical-lanceolate, small, densely and acutely serrate, with large white glands; lateral veins 5-10 pairs. Catkins $2 \frac{1}{2}-3$ times as long as wide; peduncle short. - W. \& C. Alps; C. Pyrenees. Au Ga He It.
54. S. waldsteiniana Willd., Sp. Pl. 4 (2): 679 (1806). Leaves $3-5 \mathrm{~cm}$, with cuneate base, obovate or elliptical, indistinctly and remotely crenate-serrate, sometimes subentire. Catkins 4-5 times as long as wide; peduncle long. E. Alps, N.W. Balkan peninsula. $\mathrm{Al} \mathrm{Au} ? \mathrm{Bu} \mathrm{Ge}$ ? He It Ju .
55. S. hastata L., $S p$. Pl. $1017^{\circ}(1753)$. Ascending or erect shrub up to 1.5 m . Branches greenish or brownish, shiny, glabrous. Leaves broadly elliptical or obovate, sometimes lanceolate, very variable in size and outline, rather thin, not shiny, pale and dull green above, paler but without a bloom beneath, somewhat hairy when young, soon glabrous; venation finely reticulate but scarcely prominent; margin entire or more or less finely serrate; petiole up to 1 cm . Stipules often welldeveloped, obliquely ovate, serrate. Female catkins $6(-10) \times$ $1(-2) \mathrm{cm}$, dense-flowered; peduncle up to 3 cm , leafy. Bracts with long white hairs. Pedicel $\frac{1}{3}$ as long as the ovary, glabrous in the second or third year. Leaves narrowly elliptical to oblong. Nectaries $\frac{1}{2}$ as long as the pedicel. $2 n=c .110 . N . \& C$. Europe, locally on mountains in the south. Al Au Cz Da Fe Ga Ge He Hs It Ju No Po Rm Rs (N, W) Su.

A polymorphic species of wide distribution, divisible into at least 3 subspecies.
1 Petiole 2-3 mm; leaves orbicular $\quad$ (b) subsp. vegeta
1 Petiole more than 3 mm ; leaves broadly elliptical, obovate or narrower
2 Leaves lanceolate, entire (c) subsp. subintegrifolia
2 Leaves broadly elliptical or obovate, finely serrate
(b) subsp. hastata
(a) Subsp. hastata: Throughout most of the range of the species.
(b) Subsp. vegeta N. J. Andersson, Kungl. Svenska Vet. Akad. Handl. 6 (1): 172 (1867): Lowlands. S. Fennoscandia and parts of C. Europe.
(c) Subsp. subintegrifolia (B. Flod.) B. Flod in Holmberg, Skand. Fl. $1(\mathbf{b}, \mathbf{1}): 120(1931):$ N. part of the range of the species.
56. S. pyrolifolia Ledeb., Fl. Alt. 270 (1833). Tall shrub or tree. Branches rather thick, reddish-brown, smooth and shiny, or with scattered hairs. Leaves c. $5 \times 4 \mathrm{~cm}$, thin, orbicular-ovate or -elliptic, whitish and glabrous with prominent venation beneath; lateral veins forming an angle of $60-85^{\circ}$ with the midrib; petioles up to 3 cm , slender, often brown or pink beneath like the midrib. Stipules up to $1-1.5 \mathrm{~cm}$ wide, orbicular-reniform. Catkins small, c. 100-flowered; peduncles much reduced and often almost leafless. Capsule $3-4 \mathrm{~mm}$, yellowish-brown, glabrous; style c. 1 mm , stigma short; pedicel usually hairy. N. Finland, N. Russia and Ural. Fe Rs ( $\mathrm{N}, \mathrm{C}$ ).
(57-59). S. lapponum group. Shrubs $0 \cdot 5-4 \mathrm{~m}$. Twigs greybrown, rather slender, more or less glabrescent and becoming chestnut-brown. Leaves often asymmetrical, of varied outline, lanate or greyish-pubescent, not shiny, on both surfaces; base rounded, rarely cordate. Stipules small, caducous. Peduncle short, leafless. Ovary greyish- or whitish-felted.
1 Indumentum of leaves and ovary grey, $\pm$ sparse; leaves crowded at the ends of branches; catkins sessile, remaining dense when ripe
59. lapponum

1 Indumentum of leaves and ovary white, $\pm$ dense; leaves not crowded at the ends of branches; catkins pedunculate, elongated and $\pm$ lax when ripe

2 Plant 1.5-2 m; leaves c. $4 \times 2 \mathrm{~cm}, \pm$ glandular sinuate-dentate; catkins $3(-8) \times 1 \mathrm{~cm}$
57. helvetica

2 Plant $0.5-1.5 \mathrm{~m}$; leaves smaller, entire; catkins smaller
58. marrubifolia
57. S. helvetica Vill., Hist. Pl. Dauph. 3 (2): 783 (1789). Indumentum dense, white. Leaves not crowded at ends of twigs. Leaves obovate or obovate-oblanceolate, usually widest above the middle, shortly acuminate or rounded at apex, glabrescent (especially along midrib), and greenish and shiny on upper surface, white-tomentose beneath, therefore distinctly discolorous. Catkins $1 \frac{1}{2}-3$ times as long as wide, more slender and laxflowered than in $\mathbf{6 0}$, very elongate when ripe, pedunculate. Ovary ovoid, obtuse, sparsely tomentose, rather dull, style $0.8-1.5 \mathrm{~mm}$, $\frac{1}{3}-\frac{1}{2}$ as long as ovary; stigma distinctly bifid. Alps. Au Ga He It.
58. S. marrubifolia Tausch ex N. J. Andersson in DC., Prodr. 16 (2): 276 (1868). Like 57 but leaves smaller; hairs on the lower surface somewhat crispate (as in 59); catkins smaller; filaments and capsules shorter. Sudety and Carpathians. Cz Ge Po Rm Rs (W).
59. S. lapponum L., Sp. Pl. 1019 (1753). Indumentum, especially of leaves and ovary, less dense than in 58, grey. Leaves crowded at ends of twigs, elliptical or broadly lanceolate, usually broadest near the middle, tapering gradually or abruptly at the base, moderately hairy above, and therefore the upper and lower surfaces almost concolorous. Catkins stout, denseflowered, scarcely becoming laxer when ripe, sessile, with caducous leaves at base. Ovary very long, silky with crisped and patent hairs; style $1 \cdot 2-2.5 \mathrm{~mm}$, filiform, $\frac{1}{2}-\frac{2}{3}$ as long as ovary; stigma scarcely emarginate. N. Europe, extending southwards locally in the mountains to the Pyrenees and Bulgaria. Br Bu $\mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Hs} \mathrm{No} \mathrm{Po} \mathrm{Rs} \mathrm{(N}, \mathrm{B)} \mathrm{Su}$.
(60-61). S. viminalis group. Shrubs or small trees $3-5 \mathrm{~m}$. Twigs long, straight, flexible, very leafy. Leaves long, narrow, entire, with many lateral veins and a silky, shiny indumentum beneath; bracts hairy, pale brown, darker at the apex, not concealing the ovary. Flowers with one nectary.

> Buds acute; leaves cuneate at base; style more than $\frac{1}{2}$ as long as ovary Buds obtuse; leaves rounded at base; style shorter $\quad 60$ viminalis
60. S. viminalis L., Sp. Pl. 1021 (1753) (S. veriviminalis Nasarov). Young twigs grey-pubescent. Buds acute. Leaves up to 1.5 cm wide when mature, narrow, linear with very narrow cuneate base, green above, silky beneath; margin reflexed; lateral veins usually $20-35$ pairs. Catkins appearing before the leaves. Style more than $\frac{1}{2}$ as long as ovary. C. Europe extending westwards to Ireland and eastwards to the Ukrainian Carpathians, and Bulgaria. Au Be Br Cz Ga Ge Gr * Hb He Ho Hu Ju Po Rm Rs (W) [Da Fe Hs It Lu No Su].

In U.S.S.R. largely replaced by 61.
61. S. rossica Nasarov in Komarov, Fl. URSS. 5: 135 (1936). Twigs rather slender, switch-like, pale brownish or yellowish, usually glabrous. Buds obtuse, larger than in $\mathbf{6 0}$. Leaves narrowly oblanceolate, with narrow rounded base, somewhat hairy above, greyish-green, not very densely covered with hairs, usually silky, shining, with prominent glands along the reflexed margin; lateral veins $15-30$ pairs. Catkins appearing with the leaves. Style short, thick, usually shorter than the stigmas. U.S.S.R. Rs (N, B, C, W, E).
S. pseudolinearis Nasarov in Komarov, Fl. URSS. 5: 137 (1936) from C. \& E. Russia is doubtfully distinct. It has leaves $0 \cdot 2-0 \cdot 4(-0.6) \mathrm{cm}$, narrowly linear-lanceolate, silky on both surfaces, glabrescent above, with wide reffexed margins and short almost entirely black bracts.

Plants showing intermediate characters between 60 and 39-42 occur quite frequently, mainly in W. \& N. Europe. They have in common long leaves, more or less silky beneath, with many lateral veins, all characters inherited from $S$. viminalis. Three taxa are often referred to by binary names because their parents are not known with certainty, and must be mentioned here, since they behave like species (vide R. D. Meikle, Watsonia 2: 243-8 (1952)).

1 Leaves $9-11 \times 2.5-4 \mathrm{~cm}$, broadly lanceolate-ovate; stigma shorter than style $\mathrm{S} . \times$ calodendron
1 Leaves $10-13 \times 1.5-3 \mathrm{~cm}$, narrowly lanceolate; stigma as long as or longer than style
2 Bracts light brown, acute; leaves $1 \cdot 5-2 \cdot 5 \mathrm{~cm}$ wide, silkypubescent beneath S. $\times$ stipularis
2 Bracts dark brown, subobtuse; leaves $2-3 \mathrm{~cm}$ wide, thinly pubescent or subglabrous beneath
S. $\times$ dasyclados
S. $\times$ calodendron Wimmer, Salices Europ. 187 (1866) (S. acuminata Sm., non Miller). Often cultivated and escaping. [ Br ? $\mathrm{Da} \mathrm{Ge} \mathrm{Hb]}$.
S. $\times$ stipularis Sm. in Sowerby, Engl. Bot. 17: t. 1214 (1803). Cultivated and occasionally escaping. [ $\mathrm{Br} \mathrm{Ge} \mathrm{Rs}(\mathrm{W}$ ).] (Possibly S. atrocinerea $\times$ viminalis.)
S. $\times$ dasyclados Wimmer, Flora (Regensb.) 32: 25 (1849). Cultivated and occasionally escaping. [ Au Cz Da Ge Ho Po Rs (N, C, E) Su.] (Possibly S. caprea $\times$ cinerea $\times$ viminalis.)
62. S. elaeagnos Scop., Fl. Carn. ed. 2, 2: 257 (1772) (S. incana Schrank). Shrub up to 6 m , or rarely tree up to 16 m . Twigs slender, yellowish- to reddish-brown, thinly covered with whitish hairs when young. Leaves erect, linear-lanceolate to narrowly linear, tapering at both ends, densely lanate on both surfaces when young, more or less glabrescent above, remaining lanate beneath, not shiny; margin deflexed, finely glandular-serrate, mainly in the apical part; veins more or less impressed above, slightly prominent beneath, often not visible because of the dense indumentum; petiole up to 5 mm . Stipules usually absent. Catkins up to $6 \times 0.8 \mathrm{~cm}$; peduncle up to 1 cm , with small, lanceolate leaves. Bracts about half as long as the ovary. Filaments united at the base or up to the middle, hairy near the base. Ovary glabrous; pedicel about $\frac{1}{4}$ as long as the ovary. C. Europe extending to France, Spain, Italy and the Ukrainian Carpathians. $\mathrm{Al} \mathrm{Au} \mathrm{Bu} \mathrm{Co} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)} \mathrm{[Ho]}$.
(a) Subsp. elaeagnos: Leaves up to $12 \times 2 \mathrm{~cm}$, linear-lanceolate or linear. $2 n=38$. Throughout most of the range of the species.
(b) Subsp. angustifolia (Cariot) Rech. fil., Österr. Bot. Zeitschr. 104: 314 (1957). Leaves c. $12 \times 0 \cdot 5-1 \mathrm{~cm}$, very narrowly linear. Largely replacing (a) in S. France and Spain. Frequently cultivated elsewhere.

Hybrids of S. elaeagnos are not rare, especially along some of the rivers coming from the Alps; the most prominent characters inherited from $S$. elaeagnos are the long, narrow curved catkins and the leaves with more or less parallel margins, lanate on the lower surface.
63. S. purpurea L., Sp. Pl. 1017 (1753). Rather slender shrub up to 5 m . Bark bitter. Twigs slender, straight, glabrous, shining, usually purplish at first, becoming greenish- or yellowish-grey. Leaves 3-12 cm, 3-15 times as long as wide, sometimes opposite, at least near the ends of twigs, obovate-oblong to oblanceolate-
linear, acute or acuminate, very finely serrate, glabrous, dull and slightly bluish-green above, paler and often glaucous beneath. Stipules small, caducous. Catkins $2-4.5 \mathrm{~cm}$, appearing before the leaves, dense, cylindrical, suberect to spreading, subsessile. Bracts blackish at the apex. Stamens 2, completely united and appearing as one. Ovary pubescent. Most of Europe, except Fennoscandia. Au Be Br Bu Co Cz Ga Ge Gr Hb He Ho Hs Hu It Ju Lu Po Rm Rs (N, B, C, W, K, E) Sa Si Tu [Da No Su].
(a) Subsp. purpurea: Leaves alternate throughout (exceptionally one or two pairs at the base of the terminal shoots opposite) narrowly lanceolate-lingulate, cuneate at the base, serrate only above the middle, $c .10$ times as long as wide on long twigs, $c .5$ times as long as wide on short twigs; petiole $c . \frac{1}{2}$ as long as the leaf. Widespread, particularly in mountain regions.
(b) Subsp. lambertiana (Sm.) A. Neumann ex Rech. fil., Österr. Bot. Zeitschr. 110: 341 (1963): At least some leaves opposite, more or less broadly lingulate, narrowly rounded at the base, serrate for almost their whole length, 4-8 times as long as wide on long twigs, $c .4$ times as long as wide on short twigs; petiole $\frac{1}{15}-\frac{1}{20}$ as long as the leaf. Widespread, mainly in the lowlands.
S. purpurea $\times$ viminalis ( $S . \times$ rubra Hudson) is a frequent hybrid.
$S . \times$ forbyana Sm ., an exceptionally vigorous bush, is probably S. atrocinerea $\times$ purpurea $\times$ viminalis; it has yellowish twigs and dark green, lustrous leaves (resembling the leaves of S. triandra). The female catkins are like those of S. purpurea; the male plant is unknown.
64. S. amplexicaulis Bory, Expéd. Sci. Morée 3: 277 (1832). Like 63 (b) but most or all leaves opposite, often smaller, sessile or subsessile, truncate or semi-amplexicaul at the base. Balkan peninsula. Al Bu Ju Gr.
65. S. caspica Pallas, Fl. Ross. 1 (2): 74 (1788). Twigs brown when young, usually becoming yellowish-white, shiny, glabrous. Leaves $5-8(-12) \times 0.4-1 \mathrm{~cm}$, narrowly linear-lanceolate, very acute, strict, serrate (rarely almost entire), 8-10 times as long as wide, glabrous at maturity; veins prominent beneath. Stipules absent. Catkins $c .2 \cdot 5 \mathrm{~cm}$. Ovary whitish-sericeous, finally somewhat glabrescent, subsessile or with very short pedicel. S.E. Russia. Rs (E). (W. \& C. Asia.)
66. S. wilhelmsiana Bieb., Fl. Taur.-Cauc. 3: 627 (1819). Young twigs more or less densely silky, rarely almost glabrous, very thin, flexible, often forming almost a right angle with the stem. Leaves $2-6 \times 0.4-1 \mathrm{~cm}, c .5$ times as long as wide, linear, entire or finely glandular-serrate, densely covered with silky hairs when young, shiny, finally more or less glabrescent; petiole very short. Stipules usually absent. Catkins $2-3 \mathrm{~cm}$, slender. Bracts very acute. Ovary densely silkily-hairy; stigma sessile. S.E. Russia. Rs (E). (S.C. Asia.)
67. S. caesia Vill., Hist. Pl. Dauph. 3: 768 (1789). Shrub up to 1 m . Twigs entirely glabrous, brown and dull when young. Leaves elliptical or obovate, twice as long as wide, shortly acuminate, sometimes plicate at the apex, rounded or subcordate at the base, entire or with very few remote marginal glands, rigid, with a dull bloom on both surfaces; petiole $2-3 \mathrm{~mm}$. Stipules minute. Catkins $1-1 \cdot 5(-2) \mathrm{cm}$ : nectaries about as long as the bract. Stamens free or more or less united. Ovary woolly or more or less appressed-silky; sessile or subsessile. Alps; S. Ural. Au Ga It He Rs (C).
68. S. tarraconensis Pau in Font Quer, Treballs Inst. Catal. Hist. Nat. 1915: 7 (1915). Shrub up to 1 m . Young twigs grey-
hairy, becoming glabrous in second year. Leaves $0.5-3 \mathrm{~cm}$, suborbicular or elliptical-obovate, up to $1 \frac{1}{2}$ times as long as wide, with a small, oblique, deflexed apex, rounded or cordate at base, glabrous above except along midrib, greyish or glaucescent and subglabrous or with only very short hairs beneath; margin irregularly sinuate-crenate; lateral veins $4-5(-6)$ pairs; petiole $0 \cdot 5-2(-7) \mathrm{mm}$. Stipules present only on elongate shoots. Catkins $0.5-1 \mathrm{~cm}$. Nectaries much shorter than bracts. Stamens united for at least half their length; filaments glabrous. Ovary greyhairy; pedicel c. 2 mm ; style $0 \cdot 3-0.4 \mathrm{~mm}$. Calcareous rocks, 900-1400 m. - Spain (S.E. Cataluña). Hs.
69. S. daphnoides Vill., Prosp. Pl. Dauph. 51 (1779). Tall shrub or tree $7-10 \mathrm{~m}$. Twigs with a bluish waxy bloom. Leaves $5-$ $10 \mathrm{~cm}, 2 \frac{1}{2}-4$ times as long as wide, oblong-lanceolate or oblongovate, acute or acuminate, glandular-serrulate, soon glabrous, dark green and shining above, glaucous beneath; lateral veins $8-12$ pairs; petiole $2-4 \mathrm{~mm}$. Stipules large, semicordate. Catkins 3-4 cm, appearing before the leaves, subsessile, cylindrical, dense. Bracts blackish at apex, obovate, hairy. Ovary ovoid-conical, glabrous, subsessile; style long, slender. $2 n=38$. Norway, Sweden; widely planted especially in C. \& E. Europe, but rarely naturalized. No Su [ $\mathrm{Au} \mathrm{Ga} \mathrm{Ge} \mathrm{He]}$.
70. S. acutifolia Willd., Sp. Pl. 4 (2): 668 (1806). Tall shrub, rarely a tree. Leaves $6-15 \mathrm{~cm}$, more than 5 times as long as wide, lanceolate to linear-lanceolate, long and sharply acuminate, serrate, dark green and shiny above, pale to grey-green and dull beneath, only the very young ones with a faint silky indumentum; lateral veins 15 or more pairs; petiole up to 15 mm . Stipules lanceolate, acuminate, serrate. Catkins appearing before the leaves, covered with long, whitish, shiny hairs before flowering; peduncles short. Bracts $c$. $\frac{1}{2}$ as long as the ovary. Pedicel $c$. $\frac{1}{3}$ as long as the ovary. $2 n=38$. Most of U.S.S.R. Rs (N, C, W, E).

## 2. Populus L. ${ }^{1}$

Deciduous trees. Buds with several unequal scales. Leaves usually ovate or triangular, entire, dentate or lobed. Petiole usually long, terete or flattened. Flowers anemophilous, appearing before the leaves, in pendent stalked catkins, each flower with a stalked, cup-shaped disc and subtended by a toothed or laciniate bract. Stamens 4 to many. Capsule 2- to 4 -valved. Seeds numerous, minute.

Many hybrids, most of them of recent origin, are now planted for pulp-wood in Europe.

[^27]7 Leaves rhombic-elliptic to obovate, cuneate at base;petioles $0 \cdot 5-2 \cdot 5 \mathrm{~cm}$; twigs glabrous $\quad 5$. simonii
7 Leaves deltate-ovate, usually cordate; petioles $3-6 \mathrm{~cm}$; twigs hairy
6. gileadensis
4 Leaves with a translucent margin, sometimes very narrow
8 Leaves with a very narrow translucent margin; petioles terete, though sometimes grooved on upper side
7. $\times$ berolinensis
8 Leaves with an obvious translucent margin; petioles laterally flattened
9 Leaves $10-18 \mathrm{~cm}$, deltate-ovate to ovate, densely ciliate; stamens $30-60$
10. deltoides
9 Leaves $7-10 \mathrm{~cm}$, rhombic or deltate, ciliate or not; stamens 15-30
10 Lamina not ciliate, without glands at base; trunk usually with large bosses
8. nigra
10 Lamina shortly ciliate, usually with one or two glands at base; trunk without bosses
9. $\times$ canadensis

Sect. Populus (sect. Leuce Duby). Bark smooth, becoming rough on old trunks; buds tomentose, or glabrous and viscid; terminal bud present; leaves tomentose or glabrous, without a translucent margin, more or less dimorphic; bracts fringed, tardily deciduous.

1. P. alba L., Sp. Pl. 1034 (1753). Up to 30 m , with a broad crown, suckering freely. Bark white on young stems. Twigs and buds white-tomentose. Leaves of long shoots $6-12 \mathrm{~cm}$, ovate, with 3-5 coarsely toothed lobes, dark green above, whitetomentose beneath; leaves of short shoots ovate to ellipticoblong, sinuate-dentate, usually greyish beneath. Stamens 6-10. Fruiting catkins $8-10 \mathrm{~cm} .2 n=38$. C., E. \& S.E. Europe; often planted elsewhere. Al Au Bu Cz Ge Gr Hu It Ju Po Rm Rs (C, W, K, E) Sa Tu [Az Be Br Co Da Ga He Ho Hs Lu].

The fastigiate variety (cv. Roumi=f. pyramidalis (Bunge) Dippel) is commonly planted in streets.
2. P. canescens (Aiton) Sm., Fl. Brit. 3: 1080 (1804). Like 1 but leaves of long shoots deltate-ovate, cordate, grey-tomentose beneath; leaves of short shoots suborbicular to ovate-glabrescent. Stamens $8-15.2 n=38$. W., C. \& S. Europe. Au Be Br Bu Ga Ge Hb He Ho Hu It Po Rm Rs (C, W) [Da Gr Hs Lu Su].
3. P. grandidentata Michx, Fl. Bor. Amer. 2: 243 (1803). Up to 20 m , with a rather narrow crown. Young twigs and buds greytomentose. Leaves of long shoots $7-10 \mathrm{~cm}$, ovate, acuminate, truncate to cuneate at base, coarsely dentate, grey-tomentose beneath when very young, then glabrous; leaves of short shoots elliptical. Stamens 6-12. Fruiting catkins $3 \cdot 5-6 \mathrm{~cm}$. Extensively planted in Austria. [Au.] (North America.)
4. P. tremula L., Sp. Pl. 1034 (1753). Up to 20 m , short-lived, suckering freely. Buds glabrous, slightly viscid. Leaves $3-8 \mathrm{~cm}$, suborbicular, sinuately crenate-dentate, thin, glaucescent beneath; petiole up to 6 cm , strongly flattened; leaves on young plants and suckers up to 15 cm , ovate. Stamens 5-12. Fruiting catkins up to 12 cm . Most of Europe (but only on mountains in the south). Al Au Be Br Bu Co Cz Da Fe Ga Ge Gr Hb He Ho Hs Hu Is It Ju No Po Rm Rs (N, B, C, W, K, E) Sa Su Tu.
P. $\times$ hybrida Bieb. $(\mathbf{2} \times \mathbf{4})$, occurs occasionally in the areas where the parents are found together, and is also sometimes found in cultivation.

The hybrid between $P$. tremuloides Michx, a North American species, and 4 is widely planted in Finland and Sweden and to a lesser extent in Austria.

Sect. Tacamahaca Spach. Bark rough and furrowed; buds large, very viscid, with a strong balsam-like odour; terminal bud

[^28]present; leaves whitish (but not tomentose) beneath, without a translucent margin, often dimorphic.
5. P. simonii Carrière, Revue Hort. (Paris) 1867: 360 (1867). Up to 12 m or more, with a narrow crown. Twigs slender, terete, glabrous, reddish-brown. Leaves $4-12 \times 3-8 \mathrm{~cm}$, rhombic-elliptic to obovate, abruptly acuminate, cuneate at the base, crenulate, glabrous; petiole $5-25 \mathrm{~mm}$, reddish. Stamens 8. Planted for timber in C. Europe; occasionally for ornament elsewhere. [Au Cz $\mathrm{Ga} \mathrm{Ge} \mathrm{Ho} \mathrm{Hu} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs]}. \mathrm{(N}. \mathrm{China)}$.
6. P. gileadensis Rouleau, Rhodora 50: 235 (1948). Up to 20 m or more, with a broad open crown, often suckering. Twigs stout, angled, hairy, brown. Leaves $6-16 \mathrm{~cm}$, deltate-ovate, acuminate, usually cordate at the base, crenate-serrate, ciliate, densely pubescent on the veins beneath; petiole $3-6 \mathrm{~cm}$, terete. Fruiting catkins 7-16 cm. Planted for timber and occasionally naturalized. [ $\mathrm{Br} \mathrm{Da} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{Po} \mathrm{Rs} \mathrm{Su]}$.

Of unknown origin; perhaps a hybrid between P. balsamifera L. and $P$. deltoides Marshall; it was known in cultivation before 1755 , but only as female plants.
P. trichocarpa Torrey \& Gray ex Hooker, Ic. Pl. t. 878 (1852), from W. North America, is also planted. It is like 6 but has truncate to subcordate leaf-bases and acutely angled twigs.

Sect. Aigeiros Duby. Bark on adult trunks furrowed; buds viscid, the terminal present; leaves deltate, ovate or rhombicovate, green on both surfaces, with a well-defined translucent margin; bracts glabrous, soon deciduous.
7. P. $\times$ berolinensis C. Koch, Wochenschr. Gart. Pflanzenk. 8: 239 (1865) ( $P$. laurifolia $\times$ nigra cv. Italica). Columnar tree. Twigs slightly angular, hairy, yellowish-brown, later yellow-ish-grey. Leaves $7-12 \times 4-7 \mathrm{~cm}$, ovate or rhombic-ovate, longacuminate, crenate-serrate. Catkins $4-7 \mathrm{~cm}$. Stamens c. 15. Of garden origin; planted for shelter in C. \& E. Europe.
8. P. nigra L., Sp. Pl. 1034 (1753). Up to 30 m , with a broad uneven crown, rarely suckering; trunk usually with large bosses. Twigs terete, first yellowish, later greyish. Leaves not ciliate and without glands at the base; those on long shoots $5-10 \times 4-8 \mathrm{~cm}$, rhombic-ovate, long-acuminate, minutely crenate-serrate; those on short shoots, smaller and broader, often more deltate. Stamens 20-30. Fruiting catkins $10-15 \mathrm{~cm}$. Capsule 2-valved. $2 n=38$. S., C. \& E. Europe; of ten planted elsewhere and sometimes naturalized. Al Au Bu Cr Cz Ge Gr He Ho Hu It Ju Po Rm Rs (C, W, K, E) Tu [ Az Be Br Co Da Hb Hs Lu Rs (N, B) Sa Si].
P. nigra cv. Italica ( $P$. italica (Duroi) Moench, P. pyramidalis Rozan.), is commoner than the type in cultivation; it is characterized by a narrow columnar habit (wider in pistillate trees).
9. P. $\times$ canadensis Moench, Verz. Ausl. Bäume Weissenst. 81 (1785) ( $P$. deltoides $\times$ nigra). Like 8 but much quicker-growing; trunk without bosses; twigs almost terete or slightly angled;
leaves crenate-serrate, shortly ciliate; stamens 15-25. Originated probably in France c. 1750; now planted almost throughout Europe for shelter and for timber.

Several clones are known in cultivation, which apparently arose independently in different places; the most important are:
(i) cv. Serotina, the oldest, staminate, up to 40 m high, with broad crown, glabrous twigs and deltate leaves. Extensively planted in W. \& C. Europe.
(ii) cv. Serotina de Selys, like (i) but fastigiate. Arose in Belgium before 1818.
(iii) cv. Regenerata, pistillate, very similar to cv. Serotina but coming into leaf two weeks earlier; known since 1814. Extensively planted in C. Europe.
(iv) cv. Marilandica, pistillate, differing from cv. Serotina in its more spreading branches; leaves rhombic-ovate, coming into leaf earlier. Much cultivated in C. Europe.
(v) cv. Gelrica, staminate, very quick-growing tree with reddish shoots, coming into leaf between cv. Serotina and cv. Marilandica. Extensively planted in C. Europe and the Netherlands.
(vi) cv. Italia 214, pistillate, with erecto-patent branches; young shoots red, glabrous; leaves large, deltate. Extensively planted in S. Europe.
(vii) cv. Robusta, like (i), but with pubescent twigs and petioles. Extensively planted in C. \& N.W. Europe.

A closely related species is $P$. monilifera Aiton ( $P$. canadensis Michx fil., non Moench, P. deltoides var. monilifera (Aiton) A. Henry), from Canada and N.E. United States, which is like 9 but has slightly angled or almost terete twigs, broadly ovate leaves $7-12 \mathrm{~cm}$, wider than long, cuspidate, shallowly cordate at the base, and thinner. It is very rarely cultivated in Europe, though its name is commonly used erroneously for both 8 and 9.
10. P. deltoides Marshall, Arbust. Amer. 106 (1785). A quickgrowing tree up to 30 m , with erecto-patent branches forming a broad crown. Twigs often strongly angled, first greenish, later greyish-brown. Leaves $10-18 \mathrm{~cm}$, deltate-ovate to ovate but longer than wide, acute, usually truncate at the base, firm, densely ciliate, crenately glandular-serrate. Stamens 30-60. Fruiting catkins $15-20 \mathrm{~cm}$. Capsule 3- to 4 -valved. Planted for timber and along roadsides, and naturalized in several places. [Au $\mathrm{Az} \mathrm{Be} \mathrm{Br} \mathrm{Bu} \mathrm{Ga} \mathrm{Ge} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu]}. \mathrm{(S.E}$. States.)

Sect. Turanga Bunge. Terminal bud absent; leaves very variable; stamens $8-12$; pistillate flowers with a laciniate disc.
11. P. euphratica Olivier, Voy. Emp. Othoman ed. min., 6: 319 (1807) (P. illicitana Dode). Up to 15 m , with slender branches. Bark greyish. Leaves leathery, glabrous, glaucous-green, entire or coarsely dentate, more or less dimorphic, 'juvenile' linear to linear-lanceolate, 'adult' deltate-rhombic to reniform. Female flowers with long pedicels, in very lax catkins. Capsule 2- to 3-valved. Naturalized in S.E. Spain (near Elche (Alicante)) on saline soils. [Hs.] (N. Africa; S.W. \& C. Asia.)

## MYRICALES

## XXXII. MYRICACEAE ${ }^{1}$

Usually dioecious. Flowers in catkins, solitary in the axils of bracts. Male flowers usually without bracteoles; stamens 2-16. Female flowers with 2 or more bracteoles; ovary superior, 1-celled; style short.

## Myrica L. ${ }^{2}$

Shrubs or small trees. Leaves alternate, simple, often glanddotted, with strong aromatic scent. Fruit a drupe or nut.

The only genus.
1 Catkins borne on leafless part of branch, below the current year's growth

1. gale

1 Catkins borne among the leaves, on the current year's growth
2 Evergreen; leaves oblanceolate; catkins branched 2. faya
2 Deciduous; leaves elliptical to obovate; catkins unbranched
3. caroliniensis

1. M. gale L., Sp. Pl. 1024 (1753). Usually dioecious, but plants may change sex from year to year. Deciduous shrub up to 2.5 m . Twigs with scattered yellowish glands. Leaves $2-6 \mathrm{~cm}$, oblanceolate, cuneate at base, more or less serrate near apex, pubescent beneath, with shining yellow fragrant glands on both
surfaces. Catkins unbranched, borne on leafless branches of the previous year's growth. Fruit dry, compressed. $2 n=48$. N.W. Europe, extending to N.W. Spain, C. Germany and N.W. Russia (near Leningrad). Be Br Da Fe Ga Ge Hb Ho Hs Lu No Po Rs (N, B).
2. M. faya Aiton, Hort. Kew. 3: 397 (1789). Evergreen shrub or small tree up to 8 m . Twigs with small ferrugineous peltate hairs. Leaves $4-11 \mathrm{~cm}$, oblanceolate, cuneate at base, entire, with revolute margins, glabrous, without conspicuous glands. Catkins more or less branched, borne among the leaves on the current year's growth. Fruit a drupe, but only slightly fleshy. Açores; naturalized or perhaps native in C. \& S. Portugal. Az *Lu. (Madeira, Canarias.)
3. M. caroliniensis Miller, Gard. Dict. ed. 8, no. 3 (1768). Deciduous shrub up to 3 m . Twigs grey-pubescent and glandular. Leaves $3-10 \mathrm{~cm}$, elliptical to obovate, cuneate at base, usually crenate-dentate towards apex, pubescent and with shining yellow glands on both surfaces. Catkins unbranched, borne among the leaves on the current year's growth. Fruit a subglobose drupe. Naturalized in S. England and the Netherlands. [Br Ho.] (E. North America.)

## JUGLANDALES

## XXXIII. JUGLANDACEAE ${ }^{3}$

Monoecious; deciduous trees with alternate, imparipinnate leaves. Male flowers in catkins borne on twigs of the previous year; perianth present or absent; stamens 3-40. Female flowers usually few, borne on the twigs of the current year; perianth 3-to 5-lobed. Ovary inferior, unilocular or incompletely 2- or 4-celled; ovule 1. Fruit a drupe or nut.

$$
\begin{aligned}
& 1
\end{aligned} \begin{aligned}
& \text { Pith continuous; catkins } 3 \text { or more together; perianth of male } \\
& \text { flowers absent or very small }
\end{aligned}
$$

## 1. Juglans L. ${ }^{4}$

Twigs with septate pith. Buds with scales, sessile. Leaves aromatic. Male catkins solitary, many-flowered, pendent. Female flowers in few-flowered terminal racemes. Fruit a large drupe; mesocarp indehiscent.

1 Leaflets usually 7-9, almost entire

1. regia

1 Leaflets usually 11-23, serrate
2 Leaf-scars without a prominent pubescent band on their upper edge; fruit finely pubescent; stone 4-celled at base
2. nigra

[^29]2 Leaf-scars with a prominent pubescent band on their upper edge; fruit viscid and pubescent; stone 2-celled at base
3. cinerea

1. J. regia L., Sp. Pl. 997 (1753). Tree up to 30 m ; bark grey, smooth, eventually becoming fissured but not scaling. Leaflets $6-15 \mathrm{~cm}, 7-9$, obovate or elliptical, acute or acuminate, glabrescent. Male catkins $5-15 \mathrm{~cm}$. Fruit 4-5 cm, subglobose, green, gland-dotted, glabrous; stone ovoid, acute, wrinkled, easily splitting. Balkan peninsula, Kriti, Romania; widely cultivated elsewhere for its fruits and timber and naturalized in many places. AI $\mathrm{Bu} \mathrm{Cr} \mathrm{Gr} \mathrm{Ju} \mathrm{Rm}[\mathrm{Au} \mathrm{Br} \mathrm{Co} \mathrm{Ga} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Lu} \mathrm{Rs} \mathrm{(W}, \mathrm{K}, \mathrm{E)}$ Sa Si ? Tu].
2. J. nigra L., Sp. Pl. 997 (1753). Tree up to 50 m ; bark brown, fissured. Leaf-scars without a prominent pubescent band on their upper edge. Leaflets $6-12 \mathrm{~cm}, 15-23$, ovate-oblong to ovatelanceolate, acuminate, irregularly serrate, glabrescent above, pubescent and glandular beneath. Male catkins $5-15 \mathrm{~cm}$. Fruit $3.5-5 \mathrm{~cm}$, globose or slightly obovoid, pubescent; stone ovoid, acute, strongly ridged, not splitting. Extensively planted for timber in parts of C. \& E. Europe. [Au Cz Da Ge It Rm.] (E. North America.)
3. J. cinerea L., Syst. Nat. ed. 10, 2: 1272 (1759). Tree up to 30 m ; bark grey, deeply fissured. Leaf-scars with a prominent pubescent band on their upper edge. Leaflets $6-12 \mathrm{~cm}, 11-19$, oblong-lanceolate, acuminate, appressed-serrate, finely pube-
scent above, glandular and pubescent beneath. Male catkins $5-8 \mathrm{~cm}$. Fruit 4-6.5 cm, ovoid-oblong, pubescent, viscid; stone ovoid-oblong with 4 prominent and 4 less prominent sharp ridges and many broken ridges between them, not splitting. Occasionally planted for timber. [Da Rm.] (E. North America.)

## 2. Carya Nutt. ${ }^{1}$

Twigs with continuous pith. Buds with scales, sessile. Leaves not aromatic. Male catkins 3 or more together, many-flowered, pendent. Female flowers in 2 - to 10 -flowered terminal racemes. Fruit a large drupe; mesocarp dehiscing more or less completely into 4 valves.

1 Bud-scales 4-6, valvate, bright yellow; fruit 4-winged in upper half

1. cordiformis

1 Bud-scales 6-12, imbricate, not bright yellow; fruit unwinged or slightly winged near apex
2 Bark not scaling; buds $8-12 \mathrm{~mm}$; fruit slightly winged near apex 2. glabra
2 Bark scaling; buds $13-25 \mathrm{~mm}$; fruit unwinged
3. alba

1. C. cordiformis (Wangenh.) C. Koch, Dendrologie 1: 597 (1869) (C. amara (Michx fil.) Nutt.). Tree up to 30 m ; bark light brown, scaly. Bud-scales 4-6, valvate, bright yellow. Leaflets $8-15 \mathrm{~cm}, 5-9$, ovate-lanceolate to lanceolate, acuminate, serrate, pubescent beneath when young. Fruit $2-3.5 \mathrm{~cm}$, obovoid to subglobose, 4 -winged in upper half; pericarp thin, splitting to below the middle; stone grey, almost smooth. Planted for timber in Germany. [Ge.] (E. North America.)
2. C. glabra (Miller) Sweet, Hort. Brit. 97 (1826) (C. porcina (Michx fil.) Nutt.). Tree up to 40 m ; bark grey, fissured, not scaly. Buds $8-12 \mathrm{~mm}$; scales more than 6 , imbricate, not yellow. Leaflets $8-15 \mathrm{~cm}$, usually 5 , oblong to oblong-lanceolate, acuminate, serrate, almost glabrous. Fruit c. $2.5 \times 2 \mathrm{~cm}$, usually obo-
void, slightly winged near apex; pericarp usually splitting to the middle only; stone pale brown, nearly smooth. Planted for timber in Germany. [Ge.] (E. North America.)
3. C. alba (L.) Nutt., Gen. N. Amer. Pl. 2: 221 (1818). Tree up to 40 m ; bark grey, splitting into long scales. Twigs light reddishbrown, glabrescent. Buds $13-25 \mathrm{~mm}$; scales $10-12$, imbricate, dark; inner scales becoming 6-8 $\times 2 \cdot 5-4 \mathrm{~cm}$, yellowish or purplish when the buds open. Leaflets $10-20 \mathrm{~cm}, 5-7$, the three upper much larger than the lower, all elliptical to oblong-lanceolate, acuminate, serrate, densely ciliate, pubescent and glandular beneath when young, later glabrescent. Fruit $3 \cdot 5-6 \mathrm{~cm}$, subglobose to broadly ovoid, not winged; pericarp splitting to base; stone white, slightly angled. Planted for timber in C. Europe. [Cz Ge Rm.] (E. North America.)
C. tomentosa (Poiret) Nutt., op. cit. 221 (1818) and C. laciniosa (Michx fil.) Loudon, Hort. Brit. 1: 384 (1830) are also planted on an experimental scale in Germany. They are like 3 in having large buds and angled stones, but in C. tomentosa the bark is not scaly and the twigs are tomentose for most of the summer, while C. laciniosa has pale orange twigs and 7-9 leaflets.

## 3. Pterocarya Kunth ${ }^{1}$

Twigs with septate pith. Buds naked, stipitate. Leaves not aromatic. Male catkins solitary, many-flowered, pendent. Female flowers numerous, in pendent catkins. Fruit a winged nut.

1. P. fraxinifolia (Poiret) Spach, Hist. Vég. (Phan.) 2: 180 (1834). Tree up to 30 m , freely suckering, with deeply fissured bark. Leaflets $11-20$ pairs, sharply serrate. Fruit with semiorbicular wings. Widely planted, though never on a large scale. (Caucasus and N. Iran.)

## FAGALES

## XXXIV. BETULACEAE ${ }^{2}$

Monoecious; deciduous trees or shrubs. Leaves alternate, simple. Stipules caducous. Male flowers 3 in the axil of each bract, in pendent catkins; perianth present. Female flowers 2 or 3 in the axil of each bract, in erect catkins; perianth absent; ovary bilocular; styles 2. Fruit a flattened nutlet, usually winged, borne in a dense, cylindrical or cone-like catkin of scales formed from the accrescent, fused bracts and bracteoles.
Fruiting catkin cylindrical or narrowly ovoid; scales 3-lobed, falling with the fruit; stamens 2 , bifid below the anthers 1. Betula Fruiting catkin ovoid, cone-like; scales 5 -lobed, woody and persistent; stamens 4, entire (though with shortly forked connective)
2. Alnus

## 1. Betula L. ${ }^{3}$

Trees or shrubs. Catkins with 2 bracteoles to each group of flowers in the axil of a bract. Male flowers with 2 stamens, bifid from below the anthers; perianth minute. Female flowers 3 to each bract. Fruiting catkins cylindrical or narrowly ovoid; scales three-lobed, falling with fruit.

[^30]The taxonomy of European Betula is much disputed. The following treatment does no more than provide a minimum framework. For more detailed study the bibliography provided by Natho is very useful.
B. papyrifera Marshall, Arbust. Amer. 19 (1785) from North America, a tree up to 40 m , with ovate, subglabrous leaves 4 10 cm , and catkin-scales with suberect lateral lobes, is sometimes planted.

Literature: P. Ascherson \& K. O. P. P. Graebner, Syn. Mitteleur. Fl. 4: 386-412 (1910). G. Natho, Feddes Repert. 61: 211-73 (1959). K. H. Rechinger in Hegi, Ill. Fl. Mitteleur. ed. 2, 3 (1): 141-73 (1957). H. Winkler in Engler, Pflanzenreich 19 (IV. 61): 56-101 (1904).

1 Trees or large shrubs, usually more than 3 m ; young male catkins in winter pendent and unprotected
2 Young twigs glabrous, with numerous peltate resin-glands; leaves usually sharply biserrate with prominent primary teeth; nutlet glabrous

1. pendula

2 Young twigs without resin-glands, often hairy; leaves irregularly serrate, without prominent primary teeth; nutlet puberulent at apex
2. pubescens

1 Small shrubs up to 3 m ; young male catkins in winter erect, protected by bud-scales
$\begin{array}{lll}3 & \text { Leaves longer than broad, acute or subacute } & \text { 3. humilis } \\ 3 & \text { Leaves more or less }\end{array}$
3 Leaves more or less orbicular, obtuse or truncate
4. nana

1. B. pendula Roth, Tent. Fl. Germ. 1: 405 (1788) (B. alba sensu Coste, B. verrucosa Ehrh.). Tree up to 30 m ; bark smooth and silvery-white except towards the base, where it is usually dark and more or less dissected into rectangular bosses. Young twigs glabrous, with numerous appressed, peltate resin-glands; twigs usually very slender and pendent. Leaves $2-7 \mathrm{~cm}$, ovate-deltate, acuminate, sharply biserrate with prominent primary teeth, subglabrous when mature, thin. Male catkins $3-6 \mathrm{~cm}$. Fruiting catkin 1.5-3.5 $\times 1 \mathrm{~cm}$; scales with cuneate base, and with wide, more or less recurved, lateral lobes and a deltate, obtuse median lobe. Wing of fruit $2-3$ times as wide as the narrowly ovoid glabrous nutlet. $2 n=28$. Forming woods, particularly on light sandy soils, often secondary after forest destruction. Throughout most of Europe, from $69^{\circ} \mathrm{N}$. in Norway to Sicilia; local in the south and confined to mountains. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Cr} \mathrm{Fa} \mathrm{Gr} \mathrm{Is} \mathrm{Sa} \mathrm{Sb} \mathrm{Tu;}$ not native in Lu but planted.

Rather variable, especially in leaf-shape and habit. Lindquist (Svensk Bot. Tidskr. 41: 62 (1947)) distinguishes from the typical plant a northern var. lapponica with smooth bark (even in old trees), less pendent twigs and somewhat larger scales and fruits. It may merit subspecific distinction.
B. oycoviensis Besser, Prim. Fl. Galic. 2: 289 (1809), described from S.E. Poland, resembles 1 and has the same chromosome number, but is of shrubby habit, has 3-4 (not about 2) leaves on the flowering twigs, and leaves with almost equal teeth. Other shrubby variants have been described from Scandinavia and elsewhere; some at least seem to be of hybrid origin (see 2).
2. B. pubescens Ehrh., Beitr. Naturk. 6: 98 (1791). Like 1 but small tree or shrub $1-20 \mathrm{~m}$; bark brownish or greyish, not dissected into rectangular bosses; young twigs without resin-glands, not or only slightly pendent; leaves coarsely serrate, usually pubescent at least in axils of veins beneath; scales with slightly ascending lateral lobes and narrowly oblong or triangularlanceolate median lobe; fruit with wing $1-1 \frac{1}{2}$ times as wide as ovoid nutlet; apex of nutlet minutely puberulent. $2 n=56$ (all subspecies). Locally dominant on poor, acid, especially peaty, soils of moorland and mountains, forming extensive woodland or scrub in N. Europe. Throughout N. \& C. Europe, northwards to $71^{\circ}$ N., and locally on mountains southwards from $47^{\circ}$ N. to C. Spain and Jugoslavia (Crna Gora). Au Be Br Cz Da Fe Ga Ge Hb He Hs Hu Is It Ju Lu No Po Rm Rs (N, B, C, W, E) Su.

Extremely variable. The following subspecies are often given specific rank.
1 Young twigs glabrous or subglabrous $\quad$ (b) subsp. carpatica 1 Young twigs distinctly puberulent
2 Tree or tall shrub more than 5 m ; wing of fruit c. $1 \frac{1}{2}$ times as wide as nutlet
(a) subsp. pubescens

2 Shrub up to 12 m ; wing of fruit about as wide as nutlet
(c) subsp. tortuosa
(a) Subsp. pubescens. Tree or tall shrub, usually more than 5 m . Young twigs obviously puberulent. Leaves $3-4 \mathrm{~cm}$. Wing of fruit c. $1 \frac{1}{2}$ times as wide as nutlet. $2 n=56$. Usually lowland; northwards to $c .70^{\circ} \mathrm{N}$. in Finland and N. Russia.
(b) Subsp. carpatica (Willd.) Ascherson \& Graebner, Fl. Nordostd. Flachl. 253 (1898) (incl. B. odorata Bechst., B. coriacea Gunnarsson, B. murithii Gaudin). Small tree or shrub up to 8 m . Young twigs and leaves glabrescent. Leaves often less than 3 cm . Wing of fruit about as wide as nutlet. $2 n=56$. Arctic

Europe, and southwards, mainly in the mountains, to the Pyrenees and Carpathians.
B. borysthenica Klokov, Jour. Bot. Acad. Sci. Ukr. 3: 17 (1946) seems to fall within this subspecies. It grows on alluvial river sand in C. Ukraine, and by the Eruslan river in C. Russia, outside the main range of the subspecies.
(c) Subsp. tortuosa (Ledeb.) Nyman, Consp. 672 (1881) (B. tortuosa Ledeb.; incl. B. kusmisscheffii (Regel) Suk.): Shrub up to 12 m , with many interlacing branches. Young twigs and leaves distinctly puberulent. Leaves less than 3 cm . Wing of fruit about as wide as nutlet. $2 n=56$. Arctic Europe; mountains of Scandinavia; Iceland.

Plants very similar to those from the Arctic occur in Scotland and in the Alps, but require further investigation.

Hybrids between 1 and 2 have been recorded frequently, but cytotaxonomic investigation has shown that the first-generation triploid hybrid, which is highly sterile, occurs rarely, and that most of the putative hybrids have the chromosome number of the tetraploid species. It seems likely that such plants are the complex products of hybridization; they seem particularly common in regions such as Britain where most natural forest has been destroyed.
B. obscura A. Kotula, Jahresb. Schles. Ges. Vaterl. Kult. 65: 314 (1888) (B. atrata Domin), from Poland, Czechoslovakia and W. Ukraine, is probably of such hybrid origin, resembling 1 in most characters except the dark-coloured bark. B. callosa Notø, Tromsø Mus. Aarshefter 23 (1901), described originally from Norway, and reported from other parts of Fennoscandia and Iceland, differs from 2 principally in its ovoid, subsessile female catkins (cylindrical and pedunculate in 2 ) and the long, narrow lobes of the catkin-scales. Its relationships are not clear.
B. celtiberica Rothm. \& Vasc., Bol. Soc. Brot. ser. 2, 14: 147 (1940), which replaces typical B. pubescens in the mountains of N. \& C. Spain and N. Portugal, has glandular twigs, and bark which resembles that of $\mathbf{1}$. The form of the fruit and of the scale fall within the variation shown by 2 (a), and the chromosome number is the same $(2 n=56)$. It seems best to treat it as conspecific with 2.
3. B. humilis Schrank, Baier. Fl. 1: 421 (1789). Small muchbranched shrub, rarely more than 2 m ; twigs and leaves variably puberulent, sometimes subglabrous. Leaves $1-3 \times 0.5-2 \cdot 5 \mathrm{~cm}$, ovate or ovate-orbicular, acute or subacute at apex, rather thick in texture; margin coarsely serrate or crenate. Fruiting catkin $8-15 \mathrm{~mm}$, erect; scales with 3 subequal lobes, the two lateral ascending and often slightly shorter than the median lobe; wing of fruit narrow, $\frac{1}{3}-\frac{1}{2}$ as wide as nutlet. $2 n=28$. Bogs and fens. C. \& E. Europe, from N. Germany and N. Russia to N.E. Switzerland and C. Romania. Au Cz Ge He Po Rm Rs (N, B, C, W).
4. B. nana L., Sp. Pl. 953 (1753). Dwarf shrub rarely more than 1 m , with spreading or procumbent branches; twigs and mature leaves glabrous. Leaves $5-15 \mathrm{~mm}$, more or less orbicular, deeply crenate, thick in texture. Fruiting catkin $5-10 \mathrm{~mm}$, erect; scales with 3 equal erect lobes at apex; wing of fruit very narrow, c. $\frac{1}{6}-\frac{1}{4}$ as wide as nutlet. $2 n=28$. Moorland and bogs. N. \& C. Europe, from the Arctic southwards to the N. Alps, E. Carpathians and C. Russia; local and mainly on mountains in the southern part of its range. Au Br Cz Fe Ga Ge He Is No Po Rm Rs (N, B, C) Sb Su.

Hybrids of $\mathbf{3}$ and 4 inter se and with 1 and 2 are all recorded. B. sukaczewii Soczava, Oč. Fitosoc. Fitogeog. 393 (1929), described from N. Ural, is apparently $4 \times 2$ (c).

## 2. Alnus Miller ${ }^{1}$

Trees or shrubs. Catkins with 2 bracteoles to each group of flowers in the axil of each bract. Male flowers with 4 stamens and 4(-5)-partite perianth; anther-lobes somewhat separated by the shortly forked connective. Female flowers 2 in axil of each bract. Fruiting catkin cone-like, ovoid or ellipsoidal, the scales 5-lobed, thick and woody, long-persistent.
1 Buds sessile; catkins appearing with the leaves, in inflorescences with 2-3 leaves at base

1. viridis

1 Buds shortly stalked; catkins appearing before the leaves, without leaves at the base of the inflorescence
2 Inflorescence with 1-3 female catkins; leaves crenate-dentate
5. cordata

2 Inflorescence with 3-8 female catkins; leaves serrate or laciniate
3 Leaves serrulate or slightly biserrate, with red-brown hairs at least in the axils of the veins $\quad$ 3. rugosa
3 Leaves distinctly biserrate, glabrous or with yellow or grey hairs
4 Leaves obtuse or retuse; young twigs viscid; bark dark brown, fissured; female catkins distinctly pedunculate
2. glutinosa

4 Leaves acuminate to subacute; young twigs not viscid; bark grey or yellowish, smooth; female catkins $\pm$ sessile 4. incana

1. A. viridis (Chaix) DC. in Lam. \& DC., Fl. Fr. ed 3, 3: 304 (1805). Shrub $0 \cdot 5-2 \cdot 5(-4) \mathrm{m}$; buds sessile. Twigs glabrous or puberulent, greenish or red-brown. Leaves elliptical to suborbicular, cuneate to subcordate at base, biserrate, viscid when young. Catkins appearing with the leaves, in inflorescences with $2-3$ leaves at base. Fruiting catkins $8-15 \times 4-8 \mathrm{~mm}$, usually 3-5 in a slender, pedunculate raceme. Nutlet with broad membranous wing. Mountains of C. Europe, Corse and Balkan peninsula; N.E. Russia. Au Bu Co $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{W)}$.

This species shows considerable variation in shape and size of leaf, and in indumentum. At least 3 subspecies can be recognized in Europe.
1 Leaves broadly ovate or suborbicular, obtuse or with a very short acumen; lower surface glabrous or with tufts of hairs in the axils of the veins
(c) subsp. suaveolens

1 Leaves elliptical or ovate, acute or acuminate; lower surface usually pubescent, at least on the veins
2 Leaves $1-5(-9) \mathrm{cm}$, usually $\pm$ cuneate at base, with $5-8$ pairs of lateral veins
(a) subsp. viridis

2 Leaves 3-8(-12) cm, cuneate to subcordate at base, with 7-10 pairs of lateral veins
(b) subsp. fruticosa
(a) Subsp. viridis: Mountains of C. Europe and Balkan peninsula.
(b) Subsp. fruticosa (Rupr.) Nyman, Consp. 672 (1881): N.E. Russia. (N. Asia and North America).
(c) Subsp. suaveolens (Req.) P.W. Ball, Feddes Repert. 68: 186 (1963): Corse.
2. A. glutinosa (L.) Gaertner, Fruct. Sem. Pl. 2: 54 (1790). Tree or shrub up to $20(-35) \mathrm{m}$, with dark brown, fissured bark;

[^31]buds shortly stalked. Young twigs viscid, usually glabrous. Leaves (3-)4-10 cm, obovate-elliptical to suborbicular, obtuse or retuse, cuneate or rounded at base, biserrate, green on lower surface, usually glabrous except for tufts of yellowish hairs in the axils of the veins; lateral veins 5-8 pairs. Fruiting catkins $10-$ 30 mm , ovoid, pedunculate, $3-5$ in a raceme. Nutlet narrowly winged. $2 n=28$. Europe, except the extreme north and south. All except Bl Cr Fa Is Sb ; introduced in Az .
A. glutinosa $\times$ incana ( $A . \times$ pubescens Tausch) is not uncommon in the areas where the parents grow together. It usually has the young twigs pubescent, leaves obtuse to shortly acuminate, usually pubescent at least on the veins, and the female catkins shortly pedunculate.
3. A. rugosa (Duroi) Sprengel, Syst. Veg. ed. 16, 3: 848 (1826). Shrub or small tree up to 10 m . Young twigs reddish-brown, pubescent, soon becoming glabrous, glutinous. Leaves $5-10 \mathrm{~cm}$, elliptical or obovate, acute or obtuse, rounded or subcordate at base, serrulate, with red-brown hairs at least in the axils of the veins; lateral veins $8-13$ pairs. Fruiting catkins $10-15 \times 8-10 \mathrm{~mm}$, ovoid, 4-10 in a raceme, the upper sessile, the lower shortly pedunculate. Frequently planted and naturalized, mainly in $C$. Europe. [Cz Da Ge Po Su.] (North America.)
4. A. incana (L.) Moench, Meth. 424 (1794). Tree or shrub up to $10(-25) \mathrm{m}$, with smooth bark; buds shortly stalked. Young twigs pubescent or tomentose. Leaves $3-8(-12) \mathrm{cm}$, ovatelanceolate to ovate-orbicular, cuneate, biserrate, grey-green on lower surface, puberulent or tomentose at least when young; lateral veins $7-12$ pairs. Fruiting catkins $11-17 \times 9-12 \mathrm{~mm}$, ovoid or suborbicular, sessile, $3-5$ in a raceme. $2 n=28$. N.E. Europe and Fennoscandia; C. Europe ; locally in the mountains of S. Europe. $\mathrm{Al} \mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C)} \mathrm{Su}$ [ $\mathrm{Br} \mathrm{Da} \mathrm{Hb]}$.
(a) Subsp. incana: Bark grey, opaque. Leaves acuminate, usually tomentose on the lower surface. Wing of nutlet $c .0 .5 \mathrm{~mm}$ wide. $2 n=28$. Throughout the range of the species.
(b) Subsp. kolaensis (Orlova) Â. \& D. Löve, Bot. Not. 114: 51 (1961): Bark yellow, translucent. Leaves obtuse or shortly acute, glabrous or pubescent on the veins on the lower surface. Wing of nutlet c. 1 mm wide. Arctic Europe.
5. A. cordata (Loisel.) Loisel., Fl. Gall. ed. 2, 2: 317 (1828). Tree up to 15 m ; buds shortly stalked. Young twigs viscid, usually glabrous. Leaves $2-11 \mathrm{~cm}$, ovate or suborbicular, obtuse or shortly acuminate, truncate or cordate at base, crenate-dentate, usually glabrous or with tufts of hairs in axils of veins; lateral veins $6-8$ pairs. Fruiting catkins $15-30 \mathrm{~mm}$, oblong-ovoid, solitary or up to 3 in a raceme. Nutlet narrowly winged. - Corse and S. Italy; sometimes planted in S.W. Europe. Co It ? Sa [Az Hs].

This species shows some variation in shape and size of leaf. Plants from Italy usually have acute or acuminate leaves $6-11 \mathrm{~cm}$, while those from Corse have obtuse leaves $3-7 \mathrm{~cm}$.

## XXXV. CORYLACEAE ${ }^{1}$

Deciduous trees or shrubs. Leaves alternate, simple; stipules caducous. Flowers monoecious, inconspicuous, anemophilous. Male flowers 1 in the axil of each bract in pendent catkins; bracteoles 2, united with the bract, or 0 ; perianth absent. Female flowers 2 in the axil of each bract; bracteoles present; perianth small, irregularly lobed; ovary 2-locular, inferior; styles 2. Fruit a nut, subtended or surrounded by an involucre formed from the accrescent bract and bracteoles.
1 Buds ovoid, obtuse; leaves usually with fewer than 8 pairs of veins; fruits in clusters of 1-4
3. Corylus

1 Buds fusiform, acute; leaves with 9 or more pairs of veins; fruits numerous, in pendent spikes
2 Bark grey, smooth; male catkins appearing in spring; nut subtended by a 3 -lobed or serrate involucre 1. Carpinus
2 Bark brown, scaly, rough; male catkins visible throughout the winter; nut enclosed in an entire, apiculate involucre
2. Ostrya

## 1. Carpinus L. ${ }^{2}$

Buds fusiform, acute. Leaves with 9 or more pairs of veins. Male flowers without bracteoles. Infructescence lax. Nut small, subtended by the lobed or serrate, strongly veined involucre.
Leaves $4-10 \mathrm{~cm}$; involucre 3-lobed, the mid-lobe $c .3 .5 \mathrm{~cm}$
Leaves $2.5-6 \mathrm{~cm}$; involucre $c .2 \mathrm{~cm}$, not lobed betulus
2. orientalis

1. C. betulus L., Sp. Pl. 998 (1753). Tree up to 25 m , with fluted trunk and smooth grey bark. Leaves $4-10 \mathrm{~cm}$, ovate, acuminate, biserrate, rounded to subcordate at base, pubescent on the veins beneath. Catkins up to 5 cm , pendent. Infructescence $5-14 \mathrm{~cm}$; involucre 3-lobed, the mid-lobe much longer than the laterals, oblong; margin entire or serrate. $2 n=64$. C. \& S.E. Europe, extending to S. Italy, W. France, S.E. England, S. Sweden and White Russia. Al Au Be Br Bu Cz Da Ga Ge Gr He Ho Hu It Ju Po Rm Rs (C, W, E) Su Tu.
2. C. orientalis Miller, Gard. Dict. ed. 8, no. 3 (1768). Shrub or small tree. Leaves 2.5-6 cm, ovate or elliptical, acute, biserrate, cuneate to rounded at base, sparsely pubescent on the veins beneath. Infructescence $3-5 \mathrm{~cm}$; involucre triangular-ovate, serrate but not lobed. S.E. Europe, extending westwards to Sicilia. Al Bu Gr Hu It Ju Rm Rs (K) Si Tu.

## 2. Ostrya Scop. ${ }^{2}$

Buds fusiform, acute. Leaves with 9 or more pairs of veins. Male flowers without bracteoles. Infructescence compact. Fruit a small nut, enclosed in the entire, apiculate involucre.

1. O. carpinifolia Scop., Fl. Carn. ed. 2, 2: 244 (1772). Small tree with brownish, fissured bark. Leaves $5-8 \mathrm{~cm}$, ovate, acuminate, very sharply biserrate, cuneate to subcordate at base, hairy when young, glabrescent. Catkins up to 10 cm , pendent. Infructescence $3-4.5 \mathrm{~cm}$, subcylindrical, resembling that of Humulus; involucre elliptical, with a puberulent mucro. S. Europe, from S.E. France to Bulgaria, extending northwards to S. Austria. Al Au Bu Co Ga Gr He ?Hu It Ju Sa Si ?Tu.

## 3. Corylus L. ${ }^{2}$

Buds ovoid, obtuse. Leaves usually with fewer than 8 pairs of veins. Male flowers with 2 bracteoles. Female inflorescence short, bud-like; stigmas red. Fruit a large nut, surrounded by a more or less tubular involucre which is dentate or laciniate above.

1 Involucre constricted at apex
3. maxima

1 Involucre not constricted at apex
2 Stipules obtuse; involucre about as long as the nut, divided into $\pm$ ovate, irregularly dentate or laciniate lobes 1. avellana
2 Stipules acuminate; involucre much longer than nut, divided into long-acuminate, serrate lobes
2. colurna

1. C. avellana L., Sp. Pl. 998 (1753). Shrub up to 6 m , with smooth brown bark. Leaves suborbicular, acuminate, biserrate, often shallowly lobed, cordate at base; stipules oblong, obtuse. Catkins up to 8 cm , pendent. Infructescence of $1-4$ nuts; involucre about as large as nut, divided to half-way or a little more, into more or less ovate, usually irregularly dentate or laciniate lobes about as long as the nut; nut $1 \cdot 5-2 \mathrm{~cm}$, brown, with a hard woody shell. $2 n=22$. Europe, except some islands and the extreme north and north-east. All except $\mathrm{Az} \mathrm{Bl} ? \mathrm{Cr} \mathrm{Fa}$ Is Sb .
2. C. colurna L., Sp. Pl. 999 (1753). Usually a tree, sometimes up to 22 m . Stipules lanceolate, acuminate. Catkins up to 12 cm , pendent. Involucre much longer than nut, divided almost to the base into many long-acuminate, serrate lobes. Balkan peninsula, Romania. Al Bu Gr Ju Rm Tu.
3. C. maxima Miller, Gard. Dict. ed. 8, no. 2 (1768). Shrub or small tree, like 1 but involucre tubular, contracted above the nut and dentate at apex. Balkan peninsula; cultivated for its nuts elsewhere, and sometimes naturalized. Gr It $\mathrm{Ju} ? \mathrm{Tu}[\mathrm{Au} \mathrm{Br} \mathrm{Cz]}$.

## XXXVI. FAGACEAE ${ }^{3}$

Monoecious; trees or shrubs. Leaves simple, alternate. Male flowers in catkins or heads; perianth 4- to 6-lobed; stamens 8-20, usually twice as many as perianth-lobes. Female flowers $1-3$, surrounded by an involucre of scales (cupule); perianth 4- to 6lobed; styles 3 or 6 . Fruit a 1 -seeded nut, in groups of $1-3$, surrounded by the accrescent cupule.

[^32]1 Male flowers in pendent heads; buds fusiform; nut triquetrous

1. Fagus

1 Male flowers in long, erect or pendent catkins; buds ovoid; nut ovoid to subglobose
2 Male catkins erect, with female flowers in lower part; cupule completely enclosing nuts
2. Castanea

2 Male catkins pendent; female flowers in separate inflorescences; cupule enclosing only lower half of nut
3. Quercus

## 1. Fagus L. ${ }^{1}$

Deciduous trees. Buds fusiform. Flowers anemophilous. Male flowers in long-pedunculate, pendent heads; perianth 4 - to 7 -lobed; stamens $8-16$. Female flowers usually in pairs, surrounded by a stipitate, 4-partite, scaly cupule which becomes woody in fruit; perianth 4 - to 5 -lobed; styles 3 . Nuts 1 or 2 , triquetrous. Germination epigeal.
Leaves ovate, with 5-8 pairs of lateral veins; scales of cupule all subulate (widespread)

1. sylvatica

Leaves obovate, with 8-12 pairs of lateral veins; scales of upper part of cupule linear-oblong, those of lower part spathulate (S.E. Europe)
2. orientalis

1. F. sylvatica L., Sp. Pl. 998 (1753). Tree up to 30 m ; bark grey, smooth. Buds fusiform, acute, reddish-brown. Leaves $4-9 \mathrm{~cm}$, ovate-elliptical, acute, ciliate and silky, at least on the veins. Male flowers numerous; perianth divided almost to base; peduncles $5-6 \mathrm{~cm}$. Nut $12-18 \mathrm{~mm}$, brown; cupule $c .2 .5 \mathrm{~cm}$. $2 n=24$. Native in woods on well-drained soils, often on mountains; widely planted elsewhere. W. \& C. Europe, extending northwards to S.E. Norway, eastwards to the Black Sea and southwards locally in the mountains to C. Greece, Sicilia and C. Spain. Al Au Be Br Bu Co Cz Da Ga Ge Gr He Ho Hs Hu It Ju No Po Rm Rs (W, K) Si Su [Hb].

A variant with leaves with a size-range more or less intermediate between those of 1 and 2 occurs in parts of E.C. \& E. Europe, and has been called F. moesiaca (K. Maly) Czecz., Ann. Soc. Dendrol. Pologne 5: 52 (1933).
2. F. orientalis Lipsky, Acta Horti Petrop. 14: 300 (1898). Like 1 but sometimes up to 40 m ; leaves $9-12(-14) \mathrm{cm}$; perianth of male flowers divided for not more than $\frac{1}{3}$ of its length; cupule with linear-oblong scales above and spathulate scales below. At lower elevations and in more sheltered localities than 1. E. half of Balkan peninsula, Romania, Krym. Bu Gr Rm Rs (K) Tu.
F. taurica Popl., Österr. Bot. Zeitschr. 77: 41 (1928) is intermediate in leaf-characters between 1 and 2, but has the cupulescales of 2 . It is probably best regarded as a variant of 2 and occurs sporadically in the area where the two species meet.

## 2. Castanea Miller ${ }^{1}$

Deciduous trees or shrubs. Buds ovoid. Flowers entomophilous, in erect catkins, male in the upper, female in the lower part of the same catkin. Male flowers with 6-partite perianth; stamens 10-20. Female flowers usually 3 in each cupule; ovary 6-locular; styles 7-9. Fruit a large, brown, coriaceous nut, 1-3 together in an accrescent spiny cupule which dehisces irregularly by 2-4 valves. Germination hypogeal.

Usually a tree; leaves $10-25 \mathrm{~cm}$, coarsely and very sharply serrate 1. sativa Usually a shrub; leaves $8-16 \mathrm{~cm}$, crenate-serrate 2. crenata

1. C. sativa Miller, Gard. Dict. ed. 8, no. 1 (1768) (C. vulgaris Lam.). Tree up to 30 m ; bark brownish-grey with longitudinal, often spirally curved, fissures. Buds ovoid, obtuse, the terminal absent. Leaves $10-25 \mathrm{~cm}$, oblong-lanceolate, acute or acuminate, glabrescent but lepidote beneath, at least near the veins. Nut $2-3.5 \mathrm{~cm}$, brown with a paler base, shining; cupule green, covered with long, branched, sparsely pubescent spines. In woods on well-drained soils, often on mountain slopes; usually calcifuge. S. Europe, from Italy eastwards, and extending northwards to Hungary; extensively planted for its nuts and timber and naturalized
in parts of $W$., C. \& N. Europe. Al Bu *Co Cr Gr Hu It Ju Si Tu [ $\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Lu} \mathrm{Rm} \mathrm{Rs} \mathrm{(W}, \mathrm{K)} \mathrm{Sa} \mathrm{Su]}$.
2. C. crenata Siebold \& Zucc., Abh. Akad. Wiss. (München) 4 (3): 224 (1846). Like 1 but usually a shrub up to $c .10 \mathrm{~m}$; leaves elliptical or oblong-lanceolate, acuminate, crenate-serrate; spines of the cupule almost glabrous. Planted for timber in S. Europe. [Hs It Lu.] (Japan.)

## 3. Quercus L. ${ }^{2}$

Trees or shrubs. Buds ovoid. Leaves usually dentate, sinuate or pinnately lobed, rarely entire; evergreen (persisting for more than a year), semi-evergreen (persisting green through the winter, but falling in spring), or deciduous (withering in autumn, though sometimes not falling till spring). Flowers anemophilous. Male catkins slender, pendent; bracts minute, caducous; flowers numerous, with usually 6-lobed perianth and 6-12 stamens. Female catkins with few flowers, each solitary in an involucre. Styles 3-6. Fruit an oblong or ellipsoidal nut, its base enclosed by the enlarged involucre (cupule). Germination hypogeal.

In the descriptions and key 'lateral veins' indicates those which run to the apices of the teeth or lobes; in some species intercalary veins, which run to the sinuses or do not reach the margin, may also be present.

In many species leaf-shape is very variable, and the leaves of leading shoots or of young trees may differ considerably from the descriptions given below.

Within each subgenus most species are interfertile. Hybrids are therefore common in regions where related species grow together, and much of the intraspecific variation is due to introgressive hybridization.

Literature: A. Camus, Les Chênes: Monographie du genre Quercus 1-3. Paris, 1936-54. O. Schwarz, Cavanillesia 8: 65100 (1936). O. Schwarz, Feddes Repert. (Sonderbeih. D.) 1-200 (1936-9). J. de Carvalho e Vasconcellos \& J. do Amaral Franco, Anais Inst. Sup. Agron. (Lisboa) 21: 1-135 (1954). C. Vicioso, Revisión del Género Quercus en España. Madrid, 1950.

1 Leaves evergreen, coriaceous
2 Mature leaves glabrous; veins prominent above but not beneath; petiole $1-4 \mathrm{~mm}$ 3. coccife
2 Mature leaves tomentose beneath; veins $\pm$ immersed above, prominent beneath; petiole $5-15 \mathrm{~mm}$
3 Midrib of leaf somewhat sinuous; bark very thick, corky
6. suber

3 Midrib of leaf straight; bark not thick and corky
4 Leaves lanceolate to oblong-ovate; stipules thick, hairy; nut bitter 4. il
4 Leaves broadly ovate to suborbicular; stipules membranous, glabrescent; nut sweet
5. rotundifolia

1 Leaves deciduous or semi-evergreen, seldom very coriaceous
5 Fruits ripening in the second year (situated, therefore, on leafless part of twig)
6 Some, at least, of the involucral scales patent or deflexed
7 Mature leaves glabrous and shining; petiole 2-5 mm
7. trojana

7 Mature leaves pubescent or scabrid, dull; petiole usually more than 10 mm
8 Teeth or lobes of leaf aristate; upper surface of leaf smooth
8. macrolepis

8 Teeth or lobes of leaf obtuse or slightly mucronate; upper surface of leaf rough
9. cerris

6 Involucral scales all closely appressed
9 Leaves $10-15 \mathrm{~cm}$ wide, lobed not more than half-way to midrib; involucre $18-25 \mathrm{~mm}$ wide

1. rubra

9 Leaves $5-10 \mathrm{~cm}$ wide, lobed more than half-way to midrib; involucre $10-15 \mathrm{~mm}$ wide
2. palustris
5 Fruits ripening in the first year (situated among the leaves)
10 Scales of fruiting involucre concrescent except for theirsmall triangular apices; fruits usually distant, on a fairly long peduncle
11 Leaves with 8-14 pairs of straight, parallel lateral veins; intercalary veins absent
14. hartwissiana
11 Leaves with 5-9 pairs of often rather irregular lateral veins; intercalary veins usually present
12 Leaves glabrous; lateral veins mostly straight 15. robur
12 Leaves greyish-puberulent beneath; lateral veins arising at an acute angle with the midrib, but then curving outwards towards margin
16. pedunculifiora
10 Scales of fruiting involucre distinct, not concrescent; fruits usually crowded; peduncle short or almost absent
13 Leaves deciduous
14 Young twigs tomentose; petiole not grooved
15 Leaves with usually more than 8 pairs of parallel lateral veins; intercalary veins 0 ; indumentum brownish
16 Leaves $4-8 \mathrm{~cm}$; petiole $10-20 \mathrm{~mm}$; involucre up to $22 \times 25 \mathrm{~mm}$
17. sicula
16 Leaves $10-20 \mathrm{~cm}$; petiole $2-6 \mathrm{~mm}$; involucre not more than $12 \times 15 \mathrm{~mm}$
18. frainetto
15 Leaves with usually fewer than 8 pairs of lateral veins, which are not strictly parallel, and often mixed with intercalary veins; indumentum white or grey
17 Scales of involucre narrowly lanceolate, obtuse, not appressed
18 Leaves densely white-pubescent beneath 19. pyrenaica
18 Leaves grey-green beneath
20. congesta
17 Scales of involucre ovate-lanceolate, $\pm$ acute, appressed
19 Lower scales of involucre broad and glabrescent, upper narrower and pubescent; lateral veins diverging from midrib almost at a right angle 21. brachyphylla
19 Scales of involucre $\pm$ uniform; lateral veins diverging from midrib at an acute angle
20 Petiole $15-25 \mathrm{~mm}$; scales of involucre loosely appressed 22. virgiliana
20 Petiole $5-12 \mathrm{~mm}$; scales of involucre closely appressed
23. pubescens
14 Young twigs glabrous, or sericeous; petiole grooved
21 Leaves with $c .10$ pairs of lateral veins; intercalary veins absent; fruiting peduncles with appressed hairs 10. mas
21 Leaves with 6-8 pairs of lateral veins; intercalary veins usually present, at least near base of leaf; fruiting peduncles glabrous
22 Scales of involucre puberulent, not tuberculate; mature leaves pubescent beneath, at least in the vein-axils
12. petraea
22 Scales of involucre subglabrous, strongly tuberculate; mature leaves glabrous beneath
23 Leaves somewhat coriaceous, regularly sinuate; involucre brownish
11. polycarpa
23 Leaves thin, deeply and irregularly lobed; involucre greyish
13. dalechampii
13 Leaves semi-evergreen
24 Low shrub, seldom more than 50 cm ; leaves subsessile 26. fruticosa
24 Tree or tall shrub; petiole more than 5 mm
5 Young twigs and leaves with abundant, floccose caducous hairs
24. canariensis
25 Indumentum variable, but not floccose and caducous
26 Leaves dull above; twigs and leaves usually glabrescent
27. infectoria
26 Leaves somewhat shining above; twigs, and usually lower side of leaves, with persistent pubescence 25. faginea

Subgen. Erythrobalanus (Spach) Örsted. Leaves deciduous (in species given below). Fruit ripening in second year; endocarp tomentose. (Central and North America.)

1. Q. rubra L., Sp. Pl. 996 (1753) (Q. borealis Michx). Deciduous tree up to 25 m ; twigs glabrous, not pendent, dark red;
buds 6 mm , reddish-brown. Leaves $12-20 \times 10-15 \mathrm{~cm}$, ovate to obovate, lobed about half-way to midrib, with 7-11 pairs of lobes, each with 1-3 aristate teeth, glabrous except for slight pubescence in vein-axils beneath; petiole $25-50 \mathrm{~mm}$. Involucre of fruit shallow, $18-25 \mathrm{~mm}$ wide; scales thin, ovate, closely appressed, finely pubescent. Planted for timber and shelter, especially in C. Europe. [ $\mathrm{Au} \mathrm{Be} \mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Lu} \mathrm{Rm} \mathrm{Rs} \mathrm{(W}$, K) Po Su.] (E. North America.)
2. Q. palustris Muenchh., Hausv. 253 (1770). Like 1 but with twigs somewhat pendent; buds 3 mm , pale brown; leaves $10-$ $15 \times 5-10 \mathrm{~cm}$, obovate, more deeply lobed, with jaggedly toothed lobes; tufts of hairs in vein-axils conspicuous; involucre 10-15 mm wide. Planted for timber, mainly in E.C. Europe, but much less commonly than 1. [Au Da Ge Hu Rm.] (E. North America.)

Subgen. Sclerophyllodrys O. Schwarz. Leaves evergreen, thick in texture. Fruitripening in first or second year; endocarp tomentose.
3. Q. coccifera L., Sp. Pl. 995 (1753) (incl. Q. calliprinos Webb). Evergreen shrub up to 2 m (rarely small tree); young twigs puberulent. Leaves $1.5-4 \mathrm{~cm}$, thin but rigid, broadly ovate or oblong, with cordate or rounded base, spinose-dentate, undulate, dark green with prominent veins above, pale green and smooth beneath, glabrous at maturity; petiole $1-4 \mathrm{~mm}$. Fruit ripening in the second year; scales of involucre rigid, subspinous, usually patent. $2 n=24$. Mediterranean region (but absent from much of Italy); C. \& S. Portugal. Al Bl Bu Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.
4. Q. ilex L., Sp. Pl. 995 (1753). Evergreen tree up to 25 m, or shrub; twigs and buds grey-tomentose. Leaves $3-7 \mathrm{~cm}$, thick but not rigid, oblong-ovate to lanceolate, with cuneate or rounded base, entire, mucronate-dentate or spinose-serrate, dark green, glabrescent and smooth above, grey-tomentose and with prominent veins beneath; midrib straight; lateral veins 7-11 pairs; petiole $6-15 \mathrm{~mm}$; stipules subulate, densely hairy. Perianthlobes lanceolate, subacute; anthers mucronate. Fruit bitter, ripening in the first year; scales of involucre appressed, flat. $2 n=24$. Mediterranean region, extending to Portugal, N. Spain and W.France. Planted elsewhere in W.\&S. Europe andrarely naturalized. Al Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu [Br He Rs (K)].
5. Q. rotundifolia Lam., Encycl. Méth. Bot. 1: 723 (1785) (Q. ballota Desf.). Like 4 but leaves suborbicular or broadly ovate, greyish-glaucous above; lateral veins $5-8$ pairs; stipules membranous, wider, glabrescent; perianth-lobes wide, obtuse; fruit sweet; involucral scales shorter and thicker. $2 n=24$. S.W. Europe. Ga Hs Lu.

Often treated as a subspecies of 4, which it replaces in the south and west.

Subgen. Cerris (Spach) Örsted. Leaves evergreen or deciduous. Fruit usually ripening in second year; endocarp glabrous.
6. Q. suber L., Sp. Pl. 995 (1753) (incl. Q. occidentalis Gay). Evergreen tree up to 20 m , with thick, corky bark; twigs tomentose. Leaves $3-7 \mathrm{~cm}$, ovate-oblong, sinuate-dentate, dark green above, grey-tomentose beneath; midrib sinuous; petiole $8-15 \mathrm{~mm}$. Fruit ripening in the first year in spring-flowering trees, but some trees flower in autumn and ripen their fruits late in the following summer. Upper involucral scales long and patent, the lower usually shorter and more appressed. $2 n=24$. S. Europe, from N.W. Jugoslavia westwards. Co Ga Hs It Ju Lu Sa Si.

Produces the cork of commerce.
7. Q. trojana Webb in Loudon, Gard. Mag. (Loudon) 15: 590 (1839) ( $Q$. macedonica DC.). Semi-evergreen or deciduous tree up to 15 m ; young twigs puberulent. Leaves $3-7(-10) \mathrm{cm}$, obovateoblong, sinuate-dentate with $8-14$ pairs of mucronate or subaristate teeth, shining and subglabrous on both surfaces when mature; petiole $2-5 \mathrm{~mm}$. Fruit ripening in the second year; involucre with lowest scales appressed, middle ones deflexed and upper ones erect or incurved. Balkan peninsula (mainly in the west); S.E. Italy. Al Bu Gr Ju It Tu.
8. Q. macrolepis Kotschy, Eichen t. 16 (1862) (Q. aegilops auct.). Semi-evergreen tree; twigs tomentose. Leaves $6-10 \mathrm{~cm}$, tomentose beneath, smooth above, acute, subcordate, with 3-7 pairs of large, triangular, aristate lobes, often secondarily lobed; petiole $15-40 \mathrm{~mm}$. Fruit ripening in the second year; involucre large and woody, with wide, thick, flat, usually patent scales. S. part of Balkan peninsula; Aegean region; S.E. Italy. Al Cr Gr It ? Ju Tu.
9. Q. cerris L., Sp. Pl. 997 (1753). Deciduous tree up to 35 m ; twigs rough, more or less hairy; buds surrounded by linear, persistent stipules. Leaves oblong to obovate, rounded or subcordate at the base, with 4-7 pairs of lobes or teeth, subglabrous but dull and slightly scabrid above, pubescent or subglabrous beneath; petiole $8-15 \mathrm{~mm}$. Fruit ripening in the second year; scales of involucre subulate, patent. S. \& S.C. Europe (but not in Iberian peninsula), extending to $N . W$. France. Al Au Bu Cr $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Rm} \mathrm{Si} \mathrm{Tu} \mathrm{[Be} \mathrm{Br]}$.
Q. crenata Lam., Encycl. Méth. Bot. 1: 724 (1785) (Q. pseudosuber G. Santi), which is found occasionally in S. Europe from France to Albania, is probably a hybrid between 9 and 6 . It is like 8, but with smaller, mucronate lobes to the leaf, and smaller involucre, with narrower and softer scales.

Subgen. Quercus (Subgen. Lepidobalanus (Endl.) Örsted.). Leaves deciduous or semi-evergreen. Fruit ripening in the first year; endocarp glabrous.
10. Q. mas Thore, Essai Chlor. Land. 381 (1803). Deciduous tree; twigs, buds and lower surface of leaves at first silky-hairy, later more or less glabrous. Leaves $8-18 \mathrm{~cm}$, oblong-ovate, cuneate at the base, sinuately lobed, with $8-10$ pairs of rather narrow, forwardly-directed lobes; no intercalary veins; petiole $15-25 \mathrm{~mm}$. Fruiting peduncle silky-hairy; scales of involucre broadly ovate, obtuse, asymmetrically tuberculate.

- S.W. France and N. Spain. Ga Hs.

11. Q. polycarpa Schur, Verh. Siebenb. Ver. Naturw. 1851: 170 (1851). Small deciduous tree; twigs, buds and mature leaves glabrous. Leaves $6-10 \mathrm{~cm}$, somewhat coriaceous, elliptical, sinuate, with $7-10$ pairs of equal, shallow obtuse lobes; a few intercalary veins sometimes present near the base; petiole 1535 mm . Scales of involucre broadly ovate, acute, strongly tuberculate, puberulent, brownish. S.E. Europe, extending westwards to S.E. Hungary. Bu Gr Hu Ju Rm Tu.

Records of Q. dshorochensis C. Koch, Linnaea 22: 328 (1849) in European Turkey are referable to this species.
12. Q. petraea (Mattuschka) Liebl., Fl. Fuld. 403 (1784) ( $Q$. sessiliflora Salisb., Q. sessilis Ehrh.). Deciduous tree up to 40 m ; twigs glabrous. Leaves $7-12 \mathrm{~cm}$, obovate, cuneate at the base, very finely appressed-hairy beneath, and with persistent tufts of brownish hairs in the vein axils, sinuately lobed with 5-8 pairs of rounded lobes; intercalary veins often present; petiole $18-25 \mathrm{~mm}$. Scales of involucre ovate-lanceolate, thin, not tuberculate,
pubescent. $2 n=24$. Native and dominant in woods, usually on somewhat poorer soils than 15. W., C. \& S.E. Europe, extending northwards to $62^{\circ} \mathrm{N}$. in Norway and southwards to Sicily and C. Albania. Al Au Be Br Bu Co Cz Da Ga Ge Hb He Ho Hs Hu It Ju No Po Rm Rs (B, C, W, K) Si Su Tu.
13. Q. dalechampii Ten., Ind. Sem. Horti Neap. 15 (1830). Deciduous tree; twigs and mature leaves glabrous. Leaves thin, oblong to ovate-lanceolate, pinnately lobed with 4-7 pairs of rather narrow, subacute lobes; petiole $15-30 \mathrm{~mm}$. Scales of involucre subrhombic, tuberculate, shortly pubescent, greyish. S.E. Europe, extending to S.E. Austria and Sicilia. Au Bu Gr Hu It Ju Rm Si.
14. Q. hartwissiana Steven, Bull. Soc. Nat. Moscou 30 (1): 387 (1857). Small deciduous tree up to 10 m ; twigs glabrous, reddish. Leaves broadly obovate to oblong, with asymmetrically subcordate base, sinuate-dentate with $7-10$ pairs of teeth, dark, shining green and glabrous above, sparsely brownish-pubescent beneath; lateral veins straight and parallel, without intercalary veins; petiole $13-22 \mathrm{~mm}$. Peduncle long, with distant fruits; involucre not more than $12 \times 12 \mathrm{~mm}$, thin-walled; scales thin, concrescent except for the scarious apices. E. Bulgaria and Turkey. Bu Tu. (N. Anatolia and W. Caucasus.)
15. Q. robur L., Sp. Pl. 996 (1753) (Q. pedunculata Ehrh.). Deciduous tree up to 45 m , glabrous except sometimes for pubescence on young twigs and lower surface of young leaves. Leaves usually obovate, with 5-7 pairs of lobes; lateral veins making a variable angle with the mid-rib, with several intercalary veins; petiole 5 mm or less. Peduncle usually long; scales of involucre flat, puberulent, concrescent except for the apices. Native and dominant in woods on a variety of soils, especially 'brown earth' soils. Most of Europe, except the extreme north and parts of the Mediterranean region. All except Az Bl ? Co Cr Fa Gr Is Sb Tu .
(a) Subsp. robur (incl. Q. estremadurensis O. Schwarz): Leaves thin, usually glabrous, but occasionally puberulent beneath when young; lobes usually broad and deep. Involucre variable in size, usually $c .12 \mathrm{~mm}$ wide; scales grey-green, concrescent except for a very small apex. $2 n=24$. Throughout the range of the species.
(b) Subsp. brutia (Ten.) O. Schwarz, Notizbl. Bot. Gart. Berlin 13: 13 (1936) ( $Q$. brutia Ten.): Twigs and lower surface of leaves pubescent when young. Leaves rather coriaceous, with long lobes and deep, narrow sinuses. Involucre up to 23 mm wide, thick and woody; scales largely concrescent, but with patent, acute apices. S. Italy.

Perhaps more closely related to 16.
Plants from S.W. Europe tend to have smaller lobes to the leaves and larger involucres; they have been described as subsp. broteroana O. Schwarz, Feddes Repert. (Sonderbeih. D), 108 (1936-9).
16. Q. pedunculiflora C. Koch, Linnaea 22: 324 (1849). Like 15 (b) but leaves somewhat glaucous above and with persistent yellow-grey tomentum beneath; involucral scales verrucose, more concrescent, and pubescent with yellowish hairs. S.E. Europe. Bu Gr Rm Rs (K) Tu.

European records for Q. haas Kotschy, Eichen t. 2 (1862), are referable to this species.
17. Q. sicula Borzi in Lojac., Fl. Sic. 2 (2): 374 (1907). Deciduous tree or tall shrub; young twigs and buds tomentose. Leaves
$4-8 \mathrm{~cm}$, elliptical, with $5-8$ pairs of short, tooth-like lobes, tomentose beneath, at least when young; lateral veins parallel, without intercalary veins; petiole up to 20 mm . Involucre up to $22 \times 25 \mathrm{~mm}$; scales very numerous, triangular-lanceolate, obtuse, pubescent, loosely imbricate. Sicilia. Si.
18. Q. frainetto Ten., Prodr. Fl. Nap. Suppl. 2: 1xxii (1813) (Q. farnetto Ten., Q. conferta Kit.) Deciduous tree up to 30 m ; twigs tomentose; buds large, surrounded by persistent stipules. Leaves $10-20 \mathrm{~cm}$, crowded towards the apex of twig, obovate, tapered to the auricled base, deeply pinnatifid with 7-9 pairs of oblong, often lobed segments, pubescent beneath with grey or brownish hairs; lateral veins parallel, with few intercalary veins; petiole $2-6 \mathrm{~mm}$. Involucre $6-12 \times 12-15 \mathrm{~mm}$; scales oblong, obtuse, pubescent, loosely imbricate. Balkan peninsula, extending northwards to Hungary and Romania; S. Italy. Al Bu Gr Hu It Ju Rm Tu.
19. Q. pyrenaica Willd., Sp. Pl. 4 (1): 451 (1805) (Q. toza Bast.). Deciduous tree up to 20 m , with numerous suckers; twigs tomentose, pendent. Leaves $8-16 \mathrm{~cm}$, obovate or broadly oblong, deeply pinnatifid with 4-8 pairs of narrow, acute segments, more or less glabrous above, densely white-pubescent beneath; petiole up to 22 mm . Involucre usually not more than $15 \times 14 \mathrm{~mm}$; scales narrow-lanceolate, obtuse, loosely imbricate. $2 n=24$. S.W. Europe; N. Italy. Ga Hs It Lu.
20. Q. congesta C. Presl in J. \& C. Presl, Del. Prag. 32 (1822). Deciduous tree or tall shrub; twigs tomentose. Leaves up to 14 cm , ovate to obovate-oblong, sinuate-lobed or pinnatifid, with 6-8 pairs of lobes, grey-green beneath with variably persistent pubescence; intercalary veins present. Peduncles up to 4 cm . Scales of involucre linear-lanceolate, erect but not appressed. - S. France; Sardegna; Sicilia. Ga Sa Si.
21. Q. brachyphylla Kotschy, Eichen t. 9 (1862). Deciduous or semi-evergreen small tree or large shrub; twigs tomentose. Leaves somewhat coriaceous, variable in size, usually pinnatifid, with 5-7 pairs of lobed, often overlapping segments, cordate at the base, tomentose or glabrescent beneath; petiole $10-25 \mathrm{~mm}$. Peduncles $1-4 \mathrm{~cm}$; involucre up to $15 \times 20 \mathrm{~mm}$; scales loosely imbricate, the lower ones tuberculate and glabrescent. W. \& $S$. Greece; Aegean region. Cr Gr .
22. Q. virgiliana (Ten.) Ten., Fl. Nap. $5: 262$ (1836) (Q. apennina auct.). Deciduous tree. Leaves up to 16 cm , broadly obovate, subcordate at the base, sinuate-lobed or pinnatifid with 5-7 pairs of wide, usually lobed segments; petiole $15-25 \mathrm{~mm}$. Scales of involucre ovate-lanceolate, scarcely tuberculate, with erect apex. S. Europe, from Corse and Sardegna to the Black Sea. Bu Co Gr Hu It Ju Rm Sa Si Tu.
23. Q. pubescens Willd., Berl. Baumz. 279 (1796) (Q. lanuginosa Thuill.). Deciduous tree up to 25 m , or shrub; twigs densely pubescent. Leaves $4-12 \mathrm{~cm}$, sinuate to pinnatifid, densely tomentose beneath when young, sometimes glabrescent; petiole $5-12 \mathrm{~mm}$. Fruits subsessile or shortly stalked; involucre up to $15 \times 14 \mathrm{~mm}$; scales lanceolate, pubescent, appressed. W., C. \& S. Europe, extending eastwards to Krym. Al Au Be Bu Co Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs (W, K) Sa Si Tu.

[^33]1 Leaves more or less uniform; involucre hemispherical
2 Leaves usually at least 6 cm ; scales of involucre subequal
(a) subsp. pubescens

2 Leaves rarely more than 6 cm ; scales of involucre unequal
(c) subsp. palensis
(a) Subsp. pubescens: Tree up to 25 m , or shrub $3-4 \mathrm{~m}$. Leaves $6-12 \mathrm{~cm}$, pinnately lobed. Scales of involucre subequal, more or less obtuse. $2 n=24$. Throughout the range of the species, except Spain and Pyrenees.
(b) Subsp. anatolica O. Schwarz, Feddes Repert. 33: 336 (1934) (Q. crispata Steven): Shrub or small tree up to 6 m . Leaves $3-6 \mathrm{~cm}$, variable in outline from subentire to deeply pinnatifid, glabrescent. Scales of involucre subequal, attenuate, apex acute. E. part of Balkan peninsula; Krym.
(c) Subsp. palensis (Palassou) O. Schwarz, Notizbl. Bot. Gart. Berlin 13: 16 (1936): Shrub or tree. Leaves $4-7 \mathrm{~cm}$, sinuatedentate or shallowly lobed, persistently tomentose beneath. Scales of involucre unequal; lower scales short, thickened and more or less fused, upper longer, free, cuspidate. Pyrenees; N.E. Spain.
Q. cerrioides Willk. \& Costa, Linnaea 30: 123 (1859), from E. Spain, with toothed ovate leaves usually more than 6 cm , is probably derived from 23 by hybridization with 25.
24. Q. canariensis Willd., Enum. Pl. Hort. Berol. 975 (1809). Semi-evergreen tree up to 30 m ; twigs and young leaves densely floccose-tomentose, eventually glabrescent. Leaves $6-18 \mathrm{~cm}$, elliptic-ovate, with 9-14 pairs of subacute teeth, glaucous beneath; lateral veins parallel; petiole $8-30 \mathrm{~mm}$. Peduncle short; lower scales of involucre ovate-lanceolate, tuberculate, upper ones much smaller, loosely appressed. S. Portugal and S.W. Spain; N.E. Spain. Hs Lu.
In N. Spain much hybridized with 23.
25. Q. faginea Lam., Encycl. Méth. Bot. 1: 725 (1785) (incl. Q. valentina Cav. and Q. alpestris Boiss.). Semi-evergreen shrub or tree up to 20 m . Leaves $4-10 \mathrm{~cm}$, ovate, elliptical or obovateoblong, sinuate-dentate with 5-12 pairs of more or less forwardly directed triangular teeth, glabrescent and somewhat shining above, usually more or less tomentose beneath; petiole 4-20 mm. Involucre up to $25 \times 12 \mathrm{~mm}$; scales all broadly lanceolate or ovate. $2 n=24$. Spain and Portugal; Islas Baleares. Bl Hs Lu.

Variable, and treated differently by different authors. Q. valentina Cav., Icon. Descr. 2: 25 (1793) is usually shrubby, with smaller and more coriaceous leaves with more acute teeth and a longer tomentum. It occurs in Spain and Portugal.
26. Q. fruticosa Brot., Fl. Lusit. 2: 31 (1804) (?Q. lusitanica Lam., nom. ambig.; Q. humilis Lam.). Semi-evergreen, stoloniferous shrub up to 2 m , but usually much less; twigs purplebrown, shining. Leaves $3-5 \mathrm{~cm}$, coriaceous, glabrescent, obovateoblong with cuneate, entire base and 4-6 pairs of forwardly directed teeth in the distal part; petiole very short. Involucre $6-12 \times 8-12 \mathrm{~mm} .2 n=24$. C. \& S. Portugal, S.W. Spain. Hs Lu.
27. Q. infectoria Olivier, Voy. Emp. Othoman 1: 252 (1801). Semi-evergreen shrub up to 5 m . Leaves 4-6 cm, very rigid, often glabrescent, dull, with conspicuous veins above and spinous teeth (except in leaves at the base of each twig, which are almost entire). Involucre up to 20 mm wide, with lanceolate, closely appressed scales. N. Aegean region. Gr Tu. (Anatolia.)

## URTICALES

## XXXVII. ULMACEAE ${ }^{1}$

Deciduous trees, rarely shrubs, without latex. Leaves alternate, simple, usually asymmetrical at base. Flowers all hermaphrodite or male and hermaphrodite. Perianth herbaceous; stamens erect in bud. Fruit a drupe or samara.
1 Bark fissured; leaves 2-serrate; flowers all hermaphrodite; fruit a samara

1. Ulmus

1 Bark not fissured; leaves simply serrate; flowers male and hermaphrodite; fruit a drupe
2 Bark scaling; perianth-segments connate; drupe dry 2. Zelkova
2 Bark not scaling; perianth-segments free; drupe fleshy 3. Celtis

## 1. Ulmus L. ${ }^{2}$

Bark fissured. Flowers all hermaphrodite, appearing before the leaves on the previous year's growth. Perianth-segments connate. Anthers purplish-red. Fruit a samara, winged all round but the wing emarginate at the apex.

There is considerable intraspecific variation in habit and leafshape which, combined with frequent vegetative propagation in $U$. minor and $U$. procera, often gives rise to more or less distinctive local populations, such as the taxa known as $U$. angustifolia (Weston) Weston, U. coritana Melville, and U. plotii Druce. Some of these have been given specific rank but intermediates between them, presumably due to hybridization, occur freely. In addition, trees presumed to be hybrids between U. minor and U. glabra are commonly found. Species and putative hybrids, both often represented by selected clones, are frequently planted as ornamental trees.
1 Pedicels 3-6 times as long as flowers; fruits ciliate, pendulous on long pedicels
5. laevis

1 Pedicels shorter than flowers; fruits not ciliate, subsessile
2 Base of longer side of leaf forming a rounded lobe $\pm$ overlapping and concealing the short petiole; upper surface of lamina scabrid; seed central in the fruit

1. glabra

2 Base of longer side of leaf not overlapping or concealing the petiole; seed distinctly above the middle of the fruit
3 Leaves suborbicular, scabrid to glabrescent above, with base of long side rounded; fruit orbicular 2. procera
3 Leaves obovate to oblanceolate, usually smooth above, with base of long side making a $90^{\circ}$ turn into the petiole; fruit narrowly to broadly obovate
4 Young twigs glabrous or sparsely pubescent; leaves $\pm$ glabrous beneath, serrate $\quad$ 3. minor
4 Young twigs densely white-pubescent; leaves densely greyish-pubescent beneath, crenate-serrate 4. canescens

1. U. glabra Hudson, Fl. Angl. 95 (1762) (U. montana With., U. scabra Miller). Tree up to c. 40 m , without suckers. Twigs stout, hispid when young. Leaves suborbicular or broadly obovate to elliptic; lateral veins $12-18$ pairs. Fruit $15-20 \mathrm{~mm}$; seed central. $2 n=28$. Most of Europe. Al Au Be Br Bu Cz Da Fe Ga Ge Gr Hb He Ho Hs Hu It Ju No Po Rm Rs (N, B, C, W, K, E) Su .
U. elliptica C. Koch, Linnaea 22: 599 (1849) is like 1 but has broader, ciliate leaves, ferrugineous hairs on the bud-scales and

[^34]${ }^{2}$ By T. G. Tutin.
the fruit pubescent in the middle. It is native in Krym, and is planted elsewhere.
2. U. procera Salisb., Prodr. Stirp. 391 (1796). Tree up to c. 30 m , suckering. Twigs rather stout, persistently pubescent. Leaves suborbicular to ovate; lateral veins $10-12$ pairs. Fruit $10-17 \mathrm{~mm}$; seed above the middle. - W. \& S. Europe (distribution imperfectly known). Br Bu Ga Gr Hs Hu Ju Rm [Hb].
3. U. minor Miller, Gard. Dict. ed. 8, no. 6 (1768) ( $U$. carpinifolia G. Suckow, U. campestris auct., non L., U. foliacea sensu Hayek, U. glabra Miller, non Hudson). Tree up to $c$. 30 m , suckering. Twigs usually slender, glabrous. Leaves obovate, ovate or oblanceolate, serrate; lateral veins 7-12 pairs. Fruit 7-17 mm ; seed above the middle. $2 n=28$. Most of Europe, from England, Estonia and C. Ural southwards. Al Au Be Bl Br Bu Co $\mathrm{Cr} \mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(B}, \mathrm{C}$, W, K, E) Su Tu.
4. U. canescens Melville, Kew Bull. 1957: 499 (1958). Like 3 but the twigs in the first year densely and softly white-pubescent; leaves ovate-elliptic, crenate-serrate, densely greyish-pubescent; lateral veins $12-16(-18)$ pairs. C. \& E. Mediterranean region. Gr It Ju Si [?Al Cr Rm].
5. U. laevis Pallas, Fl. Ross. 1 (1): 75 (1784) (U. effusa Willd.). Tree up to 35 m . Twigs softly pubescent or glabrous. Leaves suborbicular to ovate, glabrous or softly pubescent beneath; lateral veins $12-19$ pairs. Fruit $10-12 \mathrm{~mm}$; seed central. $2 n=28$. C., E. \& S.E. Europe, extending to Belgium and S. Sweden (Öland). Al Au Be Bu Cz Fe Ga Ge Gr He Hu Ju Po Rm Rs (N, B, C, W, E) Su . [It.]

## 2. Zelkova Spach ${ }^{2}$

Bark smooth, scaling. Flowers male and hermaphrodite, appearing with the leaves on the young growth. Perianth-segments connate. Anthers yellow. Drupe dry.

1. Z. abelicea (Lam.) Boiss., Fl. Or. 4: 1159 (1879) (Z. cretica (Sm.) Spach). Shrub 3-5 m. Twigs slender, hispid. Leaves up to c. 2.5 cm , subsessile, ovate, obtuse, coarsely 7 - or 9 -dentate. Flowers white, scented. Drupe pubescent. Rocky mountain slopes. Kriti. Cr.

## 3. Celtis L. ${ }^{2}$

Bark smooth, not scaling. Flowers male and hermaphrodite, appearing with the leaves on the young growth. Perianth-segments free. Anthers yellow. Drupe fleshy.

> 1 Leaves entirely glabrous, even when young; endocarp weakly reticulate
> 3. glabrata

1 Leaves pubescent beneath, at least when young
2 Leaves crenate or with broad, subobtuse teeth; endocarp with 4 ridges
4. tournefortii

2 Leaves sharply serrate; endocarp reticulate
3 Leaves rounded or cordate at base; endocarp strongly reticulate-rugose

1. australis

3 Leaves cuneate at base; endocarp weakly reticulate.
2. caucasica

1. C. australis L., Sp. Pl. 1043 (1753). Tree up to 25 m , with grey bark. Leaves $4-15 \times 1.5-6 \mathrm{~cm}$, lanceolate to ovate-lanceolate, serrate, long-acuminate, rounded or cordate at base, scabrid above, pubescent beneath. Peduncle up to 3.5 cm . Drupe 9-12 mm in diameter, globose, glabrous, brownish-black when ripe; endocarp strongly reticulate-rugose. S. Europe. Al Bu Co Cr Ga He Hs It Ju Lu Rm Sa Si.
2. C. caucasica Willd., Sp. Pl. 4 (2): 994 (1806). Tree, usually smaller than 1. Leaves rhombic-ovate, acuminate, serrate, cuneate at base, smooth above, pubescent beneath. Peduncle up to 1.7 cm . Drupe globose, reddish-brown when ripe; endocarp weakly reticulate. E. Bulgaria; ?Macedonia. Bu. (W. Asia.)
3. C. glabrata Steven ex Planchon, Ann. Sci. Nat. ser. 3, 10: 285 (1848). Small tree or shrub 3-4 m. Leaves 4-6×c. 4 cm ,
rhombic-ovate, cuspidate, serrate, cuneate at base, entirely glabrous, yellowish-green. Drupe globose; endocarp weakly reticulate. S. Krym. Rs (K).
4. C. tournefortii Lam., Encycl. Méth. Bot. 4: 138 (1797) (incl. C. aspera (Ledeb.) Steven). Shrub or small tree 1-6 m. Leaves $5-7 \times 2.5-4 \mathrm{~cm}$, ovate, crenate or with broad subobtuse teeth, subcordate at base, scabrid to almost smooth on the upper surface, pubescent beneath, dark green. Drupe obovoid, brownish-yellow when ripe; endocarp with 4 ridges. Sicilia, Balkan peninsula, Krym. Bu Gr Ju Rs (K) Si.

Two other species, which seem to represent local populations, have been recognized. C. aspera (Ledeb.) Steven, from Krym, has crenate, scabrid leaves and C. aetnensis Strobl, from Sicilia (Etna) has serrate-crenate, almost smooth leaves.

## XXXVIII. MORACEAE ${ }^{1}$

Trees or shrubs with latex. Monoecious or dioecious. Leaves alternate (rarely opposite); stipules caducous. Flowers usually densely spicate, capitate or enclosed in a fleshy, urceolate receptacle (fig). Male flowers with 3- to 4-partite perianth, and 3-4 stamens opposite the perianth-segments. Female flowers with 3- to 4-partite perianth; ovary 1- or 2-locular, superior; styles 2 (1). Ovule anatropous or campylotropous. Fruit a druplet often surrounded by the fleshy perianth; druplets often crowded into syncarps.
$\begin{array}{lll}1 & \text { Leaves entire; branches spiny } & \text { 3. Maclura } \\ 1 & \text { Leaves dentate or lobed; branches not spiny } & \end{array}$
2 Stipule-scar encircling the stem; stamens straight in bud; fruits borne on the inside of a fleshy pyriform structure
4. Ficus

2 Stipule-scar not encircling the stem; stamens inflexed in bud; fruits borne on a short axis
3 Buds with 3-6 scales; syncarp cylindrical or ovoid 2. Morus
3 Buds with 2 or 3 scales; syncarp globose 1. Broussonetia

## 1. Broussonetia L'Hér. ex Vent. ${ }^{2}$

Not spiny; leaves toothed or lobed; buds with 2 or 3 scales. Dioecious. Male flowers in catkin-like inflorescences; perianth 4-partite; stamens 4, inflexed in bud. Female flowers in dense, globose, tomentose heads; perianth denticulate, with 4 very small teeth, forming a layer of pulp in fruit.

1. B. papyrifera (L.) Vent., Tabl. Régn. Végét. 3: 548 (1799). Small tree; young twigs villous. Leaves $7-20 \mathrm{~cm}$, ovate, serrate, sometimes lobed, scabrid above, grey-tomentose beneath. Syncarps $c .2 \mathrm{~cm}$ in diameter, orange, with red fruits. Planted in S. Europe and sometimes naturalized. [Ga It Rm Si.] ( $E$. Asia.)

## 2. Morus L. ${ }^{2}$

Not spiny; leaves dentate or lobed; buds with 3-6 scales. Monoecious or dioecious. Flowers of both sexes in short dense spikes. Perianth of male flowers 4-partite; stamens 4, inflexed in bud. Perianth of female flowers with 4 almost or quite free segments, becoming fleshy in fruit.

[^35]${ }^{2}$ By T. G. Tutin.

Leaves pubescent beneath; syncarp subsessile 1. nigra Leaves almost glabrous beneath; peduncle about as long as syncarp
2. alba

1. M. nigra L., Sp. Pl. 986 (1753). Tree, with stout rough branches. Leaves $6-20 \mathrm{~cm}$, broadly ovate-cordate, dentate or lobed, scabrid above, pubescent beneath. Syncarp $2-2.5 \mathrm{~cm}$, dark purple, very acid until completely ripe. Widely cultivated for its fruit and locally naturalized in S. Europe. [Al Bu Cr Gr Hs It Rm.] (C. Asia.)
2. M. alba L., loc. cit. (1753). Tree, with slender smooth branches. Leaves $6-18 \mathrm{~cm}$, ovate, rounded or obliquely cordate at base, dentate or lobed, usually smooth above, glabrous, or pubescent on the veins only beneath. Syncarp $1-2.5 \mathrm{~cm}$, white, pinkish or purplish, edible long before it is ripe. Cultivated throughout $S$. Europe as food for silkworms and as a roadside tree and frequently naturalized in S.E. Europe and occasionally elsewhere. [ $\mathrm{Al} \mathrm{Au} \mathrm{Bu} \mathrm{Cr} \mathrm{Gr} \mathrm{Rm} \mathrm{Rs} \mathrm{(W}, \mathrm{K}, \mathrm{E)} \mathrm{Tu]}. \mathrm{(China)}$.

## 3. Maclura Nutt. ${ }^{2}$

Spiny; leaves entire. Dioecious. Perianth 4-partite. Male flowers pedicellate, cymose-paniculate; stamens 4, inflexed in bud. Female flowers in subglobose or somewhat elongated heads.

1. M. pomifera (Rafin.) C. K. Schneider, Illustr. Handb. Laubholzk. 1: 806 (1906). Tree. Leaves 5-12 cm, ovate, acuminate. Syncarp $10-14 \mathrm{~cm}$ in diameter, subglobose, orange. Cultivated as a hedge plant and for ornament, and locally naturalized in $S$. Europe. [It Rm Rs (K).] (North America.)

## 4. Ficus L. ${ }^{1}$

Not spiny; leaves usually lobed; buds enclosed in the connate stipules. Stipules caducous, leaving a circular scar. Monoecious. Flowers enclosed within a fleshy urceolate structure. Stamens 4, straight in bud.

Literature: I. J. Condit \& J. Enderud, Hilgardia 25: 1-663 (1956).

1. F. carica L., Sp. Pl. 1059 (1753). Spreading, deciduous shrub or small tree. Leaves $10-20 \mathrm{~cm}$ long and wide, usually palmately lobed, usually cordate at base, scabrid, sparsely hispid beneath. Syncarp $5-8 \mathrm{~cm}$, pyriform, greenish- or brownishviolet. Extensively cultivated and widely naturalized in S. Europe; perhaps native in the southern parts of the Iberian peninsula, Italy, the Balkan peninsula and U.S.S.R. *Co *Cr *Gr *Hs *It
*Lu *Rs (K) *Sa *Si [Al Au Az Bl Cz Ga He Hu Ju Tu]. (S.W. Asia.)

Many cultivars exist and the wild plant (var. caprificus Risso) also shows considerable variability. The syncarps are eaten both fresh and dried.
F. elastica Roxb., Hort. Beng. 65 (1814), with entire, glossy, evergreen leaves, is commonly grown as a house-plant.

## XXXIX. CANNABACEAE ${ }^{1}$

Herbs without latex. Usually dioecious. Male flowers pedicellate; perianth 5-partite; stamens erect in bud. Female flowers sessile, perianth undivided; fruit an achene enclosed in the persistent perianth.

Climber; female inflorescence cone-like Erect herb; female inflorescence not cone-like

1. Humulus
2. Canuabis

## 1. Humulus L. ${ }^{2}$

Climbers. Inflorescences pendent, glandular; the male muchbranched; the female cone-like.

1. H. lupulus L., Sp. Pl. 1028 (1753). Stems up to 6 m , rough with deflexed hairs. Leaves opposite, broadly ovate-cordate, usually deeply 3 - to 5 -lobed and coarsely dentate; lobes acuminate. Male flowers $c .5 \mathrm{~mm}$ in diameter. Female inflorescence $15-20 \mathrm{~mm}$; flowers subtended by persistent ovate, acute, pale green bracts. Cone-like infructescence c. $30 \mathrm{~mm} .2 n=20$. Most of Europe. All except Az Bl Cr Fa Is Sb .

The infructescence is widely used in brewing and the plant is consequently cultivated and often naturalized, so that its natural distribution is now obscured.

## 2. Cannabis L. ${ }^{2}$

Erect herb. Inflorescences erect, glandular; the male muchbranched; the female racemose.

1. C. sativa L., $S p$. Pl. 1027 (1753). Stems up to $2 \cdot 5$ m. Leaves usually alternate, except the lower, 3 - to 9 -palmatisect; lobes lanceolate, acute, serrate. Nut smooth, not articulated at the base. $2 n=20$. Native on alluvial sands in S.E. Russia; widely cultivated for its fibre, oil and narcotic resin, and naturalized in a large part of Europe; a frequent casual elsewhere. Rs (E) [Au Be $\mathrm{Bu} \mathrm{CoCzGaGe} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs]}. \mathrm{(S} .\mathrm{\&} \mathrm{W}. \mathrm{Asia)}$.
C. ruderalis Janisch., Učenye Zap. Gos. Sar. Univ. 2 (2): 14 (1924), which is found as a weed of cultivated fields in S.E. Russia (and in C. Asia), is said to differ in its smaller size, and its nut with a marbled surface, distinctly articulated at the base and easily detached.

## XL. URTICACEAE ${ }^{3}$

Herbs, small shrubs or rarely climbers, without latex. Leaves opposite or alternate, simple, usually stipulate. Flowers usually unisexual. Perianth 4 - to 5 -merous, often persistent. Male flowers with (1-)4-5 stamens opposite the perianth-segments and inflexed in bud, often with rudimentary ovary. Female flowers often with small staminodes; ovary superior, 1-locular, sometimes adnate to perianth; style simple; ovule 1, orthotropous. Fruit an achene. Seeds usually with endosperm; embryo straight.

Boehmeria nivea (L.) Gaud.-Beaup. in Freyc., Voy. Bot. 499 (1830), from China, a herb or shrub $50-200 \mathrm{~cm}$, with leaves $6-30 \mathrm{~cm}$, alternate, white-tomentose beneath and stipulate, is cultivated in S. Europe for fibre and for ornament, and is perhaps locally naturalized.

1 Leaves densely white-pubescent beneath; female flowers without perianth; male flowers with 1 stamen and 3 - to 5 -toothed cylindrical perianth
5. Forsskalea

1 Leaves green beneath; female flowers with perianth enclosing the achene; male flowers with 4 stamens and deeply lobed perianth
2 Leaves opposite, variously toothed or lobed, rarely entire
3 Leaves 10 mm or more, usually with stinging hairs 1. Urtica
3 Leaves up to 5 mm , without stinging hairs
2. Pilea

[^36]2 Leaves alternate, entire
4 Flowers solitary; stems very slender, creeping and rooting at the nodes
4. Soleirolia

4 Flowers clustered; stems not creeping or rooting at the nodes
3. Parietaria

## 1. Urtica L. ${ }^{4}$

Annual or perennial herbs, usually with stinging hairs. Leaves opposite, usually deeply lobed or variously toothed; stipules free. Inflorescence axillary, spike-like, with clustered cymes. Flowers unisexual. Perianth 4-merous. Female flowers with more or less unequal perianth-segments, the 2 larger enclosing the achene.

1 Leaves 3- to 5-lobed; lobes serrate
4. cannabina

1 Leaves entire to serrate, but not lobed
2 Female flowers in long-pedunculate, globose heads 8. pilulifera
2 All flowers in spike-like racemes
3 Stipules 2 at each node; upper racemes usually male, with the flowers usually inserted unilaterally on inflated peduncles 7. dubia
3 Stipules 4 at each node; peduncles of the upper racemes not inflated
4 Plants with male and female flowers in the same raceme; petiole of lower leaves at least $\frac{2}{3}$ as long as the lamina
5 Perennial; racemes $1-6 \mathrm{~cm}$; perianth-segments of the female flowers subequal in fruit

1. atrovirens

5 Annual; racemes not more than $1.5(-2) \mathrm{cm}$; outer perianthsegments of the female flowers shorter than the two inner in fruit
6. urens

4 Plants usually dioecious, or with male and female flowers in separate racemes; petiole of lower leaves not more than $\frac{1}{2}$ as long as the lamina
6 Lower racemes female, shorter than petiole of subtending leaf; upper usually male, erecto-patent; perianth glabrous in fruit; leaves cuneate to subtruncate at the base
5. rupestris

6 All racemes similar, pendent or patent, longer than petiole; perianth hispid in fruit; leaves truncate to subcordate at base
7 Fruit with the 2 outer perianth-segments not more than $\frac{1}{2}$ as long as the 2 inner; stem usually pubescent 2. dioica
7 Fruit with the 2 outer perianth-segments $\frac{1}{2}-\frac{2}{3}$ as long as the 2 inner; stem glabrescent
3. kioviensis

1. U. atrovirens Req. ex Loisel., Mém. Soc. Linn. Paris 6: 432 (1827). Perennial $30-100 \mathrm{~cm}$, dull green; monoecious. Leaves $2-7 \mathrm{~cm}$, lanceolate, ovate or suborbicular, cordate or cuneate at base, serrate; petiole about as long as lamina; stipules 4 at each node. Racemes longer than petiole, with both male and female flowers, patent or pendent in fruit. Female flowers with perianthsegments subequal, pubescent. $2 n=26$. W. Mediterranean region. Bl Co It Sa.
2. U. dioica L., Sp. Pl. 984 (1753) (incl. U. pubescens Ledeb.). Perennial 30-150( -250 ) cm, dull green; usually dioecious. Leaves (1-)3-12(-15) cm, ovate, rarely lanceolate, acuminate, more or less cordate at base, serrate; petiole not more than $\frac{1}{2}$ as long as lamina; stipules 4 at each node. Racemes up to 10 cm , usually exceeding the subtending petiole, patent or pendent in fruit. Female flowers with outer perianth-segments less than $\frac{1}{2}$ as long as inner, pubescent or hispid. $2 n=48,52$. Throughout Europe, but only as an introduced weed in some districts. All except Bl Cr Sb .

Very variable and probably containing a number of subspecies.
3. U. kioviensis Rogow., Bull. Soc. Nat. Moscou 16: 324 (1843). Like 2 but monoecious; stem up to 200 cm , bright green, glabrescent, the lower nodes hollow and rooting; upper stipules connate at base; perianth of female flowers more or less glabrous, the 2 outer segments $\frac{1}{2}-\frac{2}{3}$ as long as the 2 inner. $2 n=$ 22. E.C. Europe from E. Austria to C. Ukraine. Au Cz Hu Rm Rs (C, W).
4. U. cannabina L., Sp. Pl. 984 (1753). Like 2 but the stem up to 200 cm , with stinging hairs confined to the inflorescence; leaves 3- to 5 -lobed, with serrate lobes; racemes erecto-patent. Naturalized in U.S.S.R., sometimes planted elsewhere. [Rs (W, E).] (C. \& N. Asia.)
5. U. rupestris Guss., Cat. Pl. Boccad. 83 (1821). Perennial $30-100 \mathrm{~cm}$; usually dioecious. Leaves $2-10 \mathrm{~cm}$, ovate-acuminate, cuneate or truncate at base, serrate; petiole not more than $\frac{1}{2}$ as long as lamina; stipules 4 at each node. Racemes unisexual; female not more than 2 cm , shorter than the subtending petiole, patent or pendent in fruit; male $2-8 \mathrm{~cm}$, erecto-patent. Female flowers with subglabrous perianth-segments. Sicilia. Si.
6. U. urens L., Sp. Pl. 984 (1753). Annual 10-60(-80) cm, clear green; monoecious. Leaves $1-4(-6) \mathrm{cm}$, ovate, cordate to cuneate at base, deeply serrate; petiole $c . \frac{2}{3}$ as long as lamina; stipules 4 at each node. Racemes not more than $1 \cdot 5(-2) \mathrm{cm}$, with

[^37]numerous female and few male flowers, erecto-patent in fruit. Perianth-segments of female flowers ciliate on the margin, glabrous or sparsely hispid on the back. $2 n=24,26,52$. Throughout Europe except the extreme north. All except Sb .
7. U. dubia Forskål, Fl. Aegypt. cxxi (1775) (U. caudata Vahl, non Burm. fil., $U$. membranacea Poiret). Annual $15-80 \mathrm{~cm}$; monoecious. Leaves $2-6(-10) \mathrm{cm}$, ovate, subcordate at base, serrate; petiole almost as long as the lamina; stipules 2 at each node. Racemes unisexual; the lower female, shorter than petiole; the upper male, longer than petiole, erecto-patent, the flowers inserted unilaterally on an inflated axis. Mediterranean region, Portugal, Açores. Al Az Bl Co Cr Ga Gr Ho It Ju Lu Sa Si Tu.
8. U. pilulifera L., Sp. Pl. 983 (1753). Annual $30-100 \mathrm{~cm}$; monoecious. Leaves $2-6 \mathrm{~cm}$, ovate, truncate to subcordate at base, serrate or entire; petiole almost as long as lamina; stipules 4 at each node. Racemes unisexual; female long-pedunculate with flowers in globose heads; male spicate. Female flowers with inflated perianth. S. Europe; often naturalized or casual elsewhere. Al Bl Bu Co Cr Ga Gr Hs It Ju Lu Rs (K) Sa Si Tu [Au $\mathrm{Be} \mathrm{BrCz} \mathrm{Ge} \mathrm{He} \mathrm{Hu]}$.

## 2. Pilea Lindley ${ }^{1}$

Annual herbs without stinging hairs. Leaves opposite, entire, fleshy; stipules apparently absent. Inflorescence axillary, globose. Flowers uni- or bi-sexual; female flowers with 3-lobed perianth, one lobe larger, cucullate, enclosing the achene.

1. P. microphylla (L.) Liebm., Danske Vid. Selsk. ser. 5, 2: 296 (1851). Procumbent, fleshy, branched. Leaves 1•5-5 mm , obovate to elliptical, obtuse. Inflorescence contracted, globose. Naturalized in the Balkan peninsula. [Gr Ju.] (Tropical America.)

## 3. Parietaria L. ${ }^{1}$

Annual or perennial herbs, sometimes woody at the base, without stinging hairs. Leaves alternate, entire; stipules absent. Flowers hermaphrodite or unisexual, in axillary, bracteate, 3- to manyflowered cymes, one or more in each leaf-axil. Perianth green, cylindrical and 4-toothed in female flowers, 4-partite in hermaphrodite and male flowers. Achenes enclosed in perianth and sometimes in the bracts.

1 Bracts becoming brown, hard and connate, forming a 5 -lobed involucre around the achene; leaves rarely more than 1 cm
6. cretica

1 Bracts remaining herbaceous, free or slightly connate at the base; leaves often more than 1 cm
2 Bracts shorter than the perianth in fruit
3 Annual; stem sparsely pubescent; petiole of lower leaves usually equalling or longer than lamina; achenes brown or olive 3. mauritani
3 Perennial; stem usually densely pubescent; petiole of lower leaves shorter than lamina; achenes black
4 Erect, usually more than 30 cm ; leaves $3-12 \mathrm{~cm}$; bracts completely free 1. officinal
4 Procumbent or ascending, rarely more than 40 cm ; leaves not more than 5 cm ; bracts shortly connate at base
2. diffusa

2 Bracts equalling or exceeding the perianth in fruit
5 Perianth-lobes incurved and connivent at the apex in fruit; achenes symmetrical at the apex 4. lusitanica
5 Perianth-lobes $\pm$ patent and not connivent in fruit; achenes asymmetrically apiculate
5. debilis

1. P. officinalis L., Sp. Pl. 1052 (1753) (P. erecta Mert. \& Koch). Perennial; stem $30-100 \mathrm{~cm}$, erect, simple or slightly branched, densely pubescent. Leaves $3-12 \mathrm{~cm}$, ovate-lanceolate or elliptical, long-acuminate; petiole shorter than lamina. Bracteoles free, shorter than perianth. Achenes black. C. \& S. Europe, but absent from the west. Al Au Bu Co Cr CzGaGe Gr He Hu It Ju Rm Rs (W, K) Sa Si Tu [Be Da Ho Po].
2. P. diffusa Mert. \& Koch in Röhling, Deutschl. Fl. ed. 3, 1 : 827 (1823) (P. officinalis auct., non L., P. ramiflora auct.). Like 1 but the stem not more than 40 cm , procumbent or ascending, much-branched; leaves up to 5 cm , ovate-acuminate; bracteoles shortly connate at base. S. \& W. Europe, extending to Switzerland and W. Germany. Al Az Bl Br Bu Co Cr Ga Ge Gr Hb He Ho Hs It Ju Lu Rm Rs (K) Sa Si Tu [Au Be Hu].
3. P. mauritanica Durieu in Duchartre, Rev. Bot. 2: 427 (1847). Annual, erect or diffuse; stem $5-40 \mathrm{~cm}$, sparsely pubescent. Leaves up to 5 cm , ovate-acuminate; petioles of the lower leaves usually equalling or longer than the lamina. Bracteoles shorter than perianth; perianth $2-3 \mathrm{~mm}$ in fruit. Achenes brown or olive. S. half of Iberian peninsula. Hs Lu. (N.W. Africa.)
4. P. lusitanica L., Sp. Pl. 1052 (1753). Slender, diffuse annual $5-30 \mathrm{~cm}$. Leaves up to 4 cm , broadly ovate-acuminate to ovateorbicular. Bracteoles equalling or longer than perianth; perianth not more than 1.5 mm , the lobes incurved at the apex and connivent in fruit. Achenes brown or olive, the apex symmetrical. $S . \& S . E$. Europe. Bl Bu Co Cr Ga Gr Hs Hu It Ju Lu Rm Rs (W, K, E) Sa Si.
(a) Subsp. lusitanica: Leaves not more than 2 cm ; petiole shorter than the lamina. S. Europe, eastwards to c. $25^{\circ} \mathrm{E}$.
(b) Subsp. serbica (Pančić) P. W. Ball, Feddes Repert. 68: 186 (1963) (P. serbica Pančić, P. chersonensis (A. F. Láng \& Szov.) Dörfler): Leaves (1-)2-4 cm ; petiole about as long as the lamina. S.E. Europe, westwards to Srbija.
5. P. debilis Forster fil., Fl. Ins. Austral. Prodr. 73 (1786) (P. micrantha Ledeb.). Very like 4 but stem up to 50 cm , usually stouter; leaves up to 6 cm ; perianth $1-2 \mathrm{~mm}$ in fruit, the lobes patent, not connivent; achenes asymmetrically apiculate. Ural;

Açores. Az Rs (C). (Widespread in the S. Hemisphere and in parts of Asia, N. Africa and C. America.)
6. P. cretica L., Sp. Pl. 1052 (1753). A diffuse or ascending annual or perennial up to 50 cm . Leaves up to 1 cm , ovate or elliptical. Bracteoles of each cyme becoming brown and connate, forming a 5 -lobed involucre around the fruit. Achenes brown. Greece and Aegean region; also on small islands off Sicilia. Cr Gr Si.

## 4. Soleirolia Gaud.-Beaup. ${ }^{1}$

Like Parietaria but creeping and rooting at the nodes; flowers solitary, surrounded by an involucre of 1 bract and 2 bracteoles; achene enclosed by the perianth and involucre (Helxine Req., non L.).

1. S. soleirolii (Req.) Dandy, Feddes Repert. 70: 1 (1964) (Helxine soleirolii Req.). Pubescent, very slender perennial 5-20 cm . Leaves $2-6 \mathrm{~mm}$, suborbicular, 3 -veined. Flowers unisexual, the lower female, the upper male. $2 n=20$. $\quad$ Islands of $W$. Mediterranean region; often cultivated and naturalized elsewhere in Europe, particularly in the west and south-west. Bl Co It $\mathrm{Sa}[\mathrm{Br}$ $\mathrm{Ga} \mathrm{Hb} \mathrm{Ho]}$.

## 5. Forsskalea L. ${ }^{1}$

Perennial herbs, woody at the base. Leaves alternate, crenatedentate; stipules free. Inflorescence axillary, cymose, bracteate. Flowers unisexual. Male flowers with tubular, 3- to 5-toothed perianth; stamen 1. Female flowers without perianth; ovary woolly.

1. F. tenacissima L., Opobalsam. Decl. 18 (1764) (F. cossoniana Webb). Hispid, ascending or diffuse, up to 60 cm . Leaves up to 15 mm , obovate to obovate-orbicular, crenate-dentate, cuneate at the base, densely white-pubescent beneath; stipules persistent, scarious. Cymes 1 - to 5 -flowered; bracts (2-)3(-4), up to 10 mm , longer than the cymes and forming an involucre, densely covered with long, silky hairs. S. Spain. Hs. (N. Africa and Asia Minor.)

## PROTEALES

## XLI. PROTEACEAE ${ }^{2}$

Leaves simple, exstipulate. Flowers hermaphrodite, usually in bracteate racemes, spikes or clusters. Perianth 4 -merous, in a single petaloid whorl; segments united in bud, separating wholly or partly at anthesis. Stamens 4, opposite the perianth-segments, with which their filaments are usually connate. Ovary superior, unilocular; style and stigma 1. Seeds without endosperm.

A large family, predominantly of the southern hemisphere; not native to Europe, but including many species cultivated in gardens.

## 1. Hakea Schrader ${ }^{1}$

Shrubs or small trees. Flowers zygomorphic, pedicellate, in dense axillary racemes or clusters; bracts deciduous. Perianth coiled in bud, partly straightening after anthesis; segments eventually free proximally but sometimes remaining connate distally, each consisting of a narrow claw and an orbicular-spathulate, concave

[^38]${ }^{2}$ Edit. D. A. Webb.
limb, on the inner side of which is an apparently sessile anther. Stigma large, oblique. Fruit woody, 2-valved, tardily dehiscent; seeds 2, winged.
Leaves $c .1 \mathrm{~mm}$ in diameter, terete, pungent 1. sericea Leaves $5-20 \mathrm{~mm}$ wide, flat, not pungent

> 2. salicifolia

1. H. sericea Schrader, Sert. Hannov. 27 (1795) (H. acicularis (Sm. ex Vent.) Knight). Shrub up to $2-3 \mathrm{~m}$. Leaves up to $7 \mathrm{~cm} \times c .1 \mathrm{~mm}$, terete, pungent, glabrous when mature. Flowers in axillary clusters; perianth $4-5 \mathrm{~mm}$, white or pale pink. Planted for reclamation of arid land in Spain and Portugal and locally naturalized. [Hs Lu.] (E. Australia.)
2. H. salicifolia (Vent.) B. L. Burtt, Kew Bull. 1941: 33 (1942). Like 1 but leaves 6-18 mm wide, flat, narrowly elliptical or lanceolate to linear-oblong. Perianth white. Planted for reclamation of arid land in Spain and Portugal and locally naturalized. [Hs Lu.] (S.E. Australia, Tasmania.)

## SANTALALES

## XLII. SANTALACEAE ${ }^{1}$

Herbaceous or woody plants. Leaves alternate, simple, linear, oblong or lanceolate, exstipulate, deciduous or evergreen. Flowers small, hermaphrodite or unisexual. Perianth 3- to 5lobed or -partite, tubular to campanulate-rotate. Stamens 3-5, opposite lobes of the perianth. Ovary inferior, 1-celled. Style 1; stigma capitate or lobed. Fruit a small green nut or a drupe. Seed solitary, with abundant endosperm. Hemiparasites, growing on the roots of herbs or shrubs.

1 Herbs; perianth-segments united; fruit a small green nut
3. Thesium

1 Woody plants; perianth-segments free; fruit a drupe
2 Plant with a woody rhizome; stigma capitate; perianth 4- to 5 -partite; flowers hermaphrodite 1. Comandra
2 Shrubs, without a rhizome; stigma 3- to 4-lobed; perianth 3to 4-partite; dioecious
2. Osyris

## 1. Comandra Nutt. ${ }^{2}$

Rhizome woody. Flowers hermaphrodite, with a solitary bract. Perianth 4 - to 5 -partite, campanulate. Stamens 4 or 5. Stigma capitate. Fruit a globose drupe surmounted by the persistent dry perianth.

1. C. elegans (Rochel ex Reichenb.) Reichenb. fil., Icon. Fl. Germ. 11: 11 (1849) (Thesium elegans Rochel ex Reichenb.). Plant with a persistent woody rhizome; stems erect, simple or branched. Leaves oblong. Inflorescence cymose, terminal, fewflowered; flowers cream-coloured or greenish. Balkan peninsula; Romania. Al Bu Gr Ju Rm.

## 2. Osyris L. ${ }^{2}$

Dioecious; shrubs, without a rhizome. Leaves lanceolate to linear-lanceolate, evergreen. Perianth 3- to 4-partite. Male flowers in lateral few-flowered cymes; stamens 3-4. Female fiowers solitary and terminal on short branches; stigma 3-lobed. Fruit a globose drupe.
Bracts foliaceous, persistent; drupe $5-7 \mathrm{~mm}$
Bracts small, caducous; drupe $7-10 \mathrm{~mm}$
2. quadripartita

1. O. alba L. $S p$. Pl. 1022 (1753). Stems up to 120 cm , with many slender spreading branches. Leaves coriaceous, linearlanceolate, with a single mid-vein; lateral veins obscure or absent. Bracts similar to upper cauline leaves, persistent. Perianth 3partite. Drupe 5-7 mm, red. S. Europe. Al Bl Bu Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.
2. O. quadripartita Salzm. ex Decne, Ann. Sci. Nat. ser. 2, 6: 65 (1836) (O. lanceolata Steudel \& Hochst. ex A.DC). Like 1, but stems up to 240 cm ; leaves very coriaceous, with pinnate venation; bracts small, caducous; perianth 3- to 4-partite; drupe $7-10 \mathrm{~mm}$. S. half of Iberian peninsula; 1slas Baleares. Bl Hs Lu.

## 3. Thesium L. ${ }^{2}$

Perennials, rarely annuals, without a rhizome, but often with a woody stock and sometimes producing slender stolons; stems

[^39]${ }^{2}$ By R. Hendrych.
procumbent to erect, simple or branched. Leaves alternate, linear to lanceolate, mostly entire, 1 - to 5 -veined, green or yellowishgreen. Inflorescence a panicle with few-flowered branches, or a raceme. Flowers small, hermaphrodite, on short branches, with a bract and usually with 2 bracteoles. Perianth tubular to campanulate-rotate, 4 - to 5 -lobed, usually white inside and yellowish-green or green outside. Stamens 4 or 5. Stigma capitate. Fruit a small green nut surmounted by the persistent dry perianth.
1 Bracteoles absent
2 Stock slender, stoloniferous; persistent perianth shorter than fruit
3. ebracteatum

2 Stock thick, woody, not stoloniferous; persistent perianth 2-3 times as long as fruit
4. rostratum

12 bracteoles present
3 Persistent perianth equalling or longer than nut
4 Persistent perianth usually 4-lobed, 2-3 times as long as nut; inflorescence usually secund 1. alpinum
4 Persistent perianth usually 5-lobed, usually $\pm$ equalling nut; inflorescence not secund
2. pyrenaicum

3 Persistent perianth much shorter than nut
5 Small but prominent extra lobes of the disc present between persistent perianth-lobes
6 Stoloniferous; inflorescence $2-3 \mathrm{~cm}$, few-flowered, racemose; leaves usually 2 cm or less; stems mostly up to 15 cm 5. kerneranu
6 Not stoloniferous; inflorescence 5 cm or more, manyflowered, paniculate; leaves $3 \cdot 5-5 \mathrm{~cm}$; stems up to $25-$ 30 cm 6. auriculatu
5 Small but prominent extra lobes of the disc not present between persistent perianth-lobes
7 Nut reticulately veined (sometimes indistinctly so)
8 Annual; stems ascending to erect, densely covered with nuts 16. humile
8 Perennial; stems procumbent to ascending, sparsely covered with nuts
9 Perianth $\pm$ infundibuliform; nut distinctly reticulately veined 15. bergeri
9 Perianth campanulate-rotate; nut indistinctly reticulately veined
17. procumbens

7 Nut only longitudinally veined
10 Stoloniferous
11 Stems robust, rigid; inflorescence usually a panicle; leaves mostly 3 -veined
12. linophyllon

11 Stems slender and rather weak; inflorescence a raceme; leaves 1 -veined
12 Flowers subsessile; stems mostly $5-10 \mathrm{~cm}$
12 Flowers shortly stalked; stems mostly $10-20 \mathrm{~cm}$
9. italicum

10 Not stoloniferous
13 Leaves lanceolate, distinctly 3- to 5 -veined
11. bavarum

13 Leaves linear-oblong to linear, 1-veined (rarely 3veined)
14 Inflorescence a raceme; branches 1-flowered
15 Fruiting pedicel not thickened
10. dollineri

15 Fruiting pedicel thickened 18. brachyphyllum
14 Inflorescence variously paniculate; branches severalto many-flowered at least in lower part of the inflorescence
16 Bract usually 3-4 times as long as bracteoles; perianth infundibuliform; panicle branches racemose
7. arvense

16 Bract usually $\pm$ equalling bracteoles; perianth broadly campanulate; panicle branches often paniculate
17 Stems usually more than 20 cm , ascending to erect, robust, rigid; bract, bracteoles and ultimate branches not scabrid 13. divaricatum
17 Stems usually up to $15-20 \mathrm{~cm}$, decumbent to longascending, slender, weak; bract, bracteoles and ultimate branches distinctly scabrid
14. humifusum

1. T. alpinum L., Sp. Pl. 207 (1753) (incl. T. tenuifolium Sauter ex Koch). Perennial. Stems $10-20(-30) \mathrm{cm}$, ascending to erect, simple or slightly branched. Leaves linear to linear-oblong, 1 -veined. Inflorescence racemose, rarely paniculate; flowers often subsessile, usually more or less secund. Bract at least 2-3 times as long as flower or fruit; bracteoles equalling flower or fruit. Perianth subtubular, 4(-5)-lobed. Persistent perianth 2-3 times as long as the subglobose nut. $2 n=12$. C. \& S. Europe, mainly on mountains in the south; S. Sweden. Al Au Bu Co Cz Ga Ge He Hs It Ju Po Rm Rs (C, W) Su.
2. T. pyrenaicum Pourret, Mém. Acad. Toul. 3: 331 (1788) (T.pratense Ehrh. ex Schrader). Perennial. Stems $10-20(-30) \mathrm{cm}$, ascending to erect, simple or branched. Leaves more or less linear, 1 -veined. Inflorescence racemose or paniculate; flowers not secund. Bract usually at least twice as long as flower or fruit; bracteoles equalling flower or fruit. Perianth tubular-campanulate. Nut ovoid-ellipsoidal or ellipsoidal. - W. \& C. Europe; N. Italy. Au Be Cz Ga Ge He $\dagger$ Ho Hs It Ju Lu Po.
(a) Subsp. pyrenaicum: Perianth $3-4 \mathrm{~mm}$, mostly 5 -lobed (rarely 4-lobed in isolated flowers); persistent perianth equalling nut. Throughout the range of the species.
(b) Subsp. alpestre O. Schwarz, Mitt. Thür. Bot. Ges. 1: 96 (1949): Perianth at least 5 mm , mostly 5 -lobed, but often 4-lobed; persistent perianth about twice as long as nut. E. Alps and mountains of N. Jugoslavia.
3. T. ebracteatum Hayne in Schrader, Jour. für die Bot. 1800 (1): 33 (1800). Perennial; stock slender, stoloniferous. Stems $10-$ $15(-25) \mathrm{cm}$, ascending to erect, simple or rarely with a single branch below the inflorescence. Leaves linear-oblong, 1 -veined. Inflorescence racemose. Bract about 3 times as long as flower or fruit; bracteoles absent. Perianth broadly campanulate, 5 -lobed. Nut ellipsoidal, twice as long as persistent perianth. E. \& E.C. Europe, extending to N.W. Germany and E. Denmark. Au Cz Da Ge Po Rm Rs (B, C, E).
4. T. rostratum Mert. \& Koch in Röhling, Deutschl. Fl. ed. 3, 2: 287 (1826). Perennial; stock stout, woody, not stoloniferous. Stems $10-30 \mathrm{~cm}$, ascending to erect, with some non-flowering branches. Leaves linear, 1 -veined. Inflorescence racemose. Bract up to 4 times as long as flower or fruit; bracteoles absent. Perianth tubular, 5 -lobed. Persistent perianth $2(-3)$ times as long as the ovoid-globose fruit. $2 n=26$. C. Europe. Au Cz Ge He It ? Rm.
5. T. kerneranum Simonkai, Enum. Fl. Transsilv. 478 (1886). Perennial; stoloniferous. Stems up to $10-15 \mathrm{~cm}$, ascending, simple. Leaves up to 1.5 cm , linear-oblong, 1 -veined. Inflorescence short, few-flowered, subspicate. Bracts at least twice as long as flower or fruit; bracteoles shorter than flower or fruit. Perianth campanulate. Nut ellipsoidal, 4-5 times as long as persistent perianth, which has small but prominent extra lobes of the disc between the 5 lobes. - S. Carpathians. Rm.
6. T. auriculatum Vandas, Sitz.-Ber. Böhm. Ges. Wiss. 1890/1891: 279 (1890). Perennial; not stoloniferous. Stems
c. $25-30 \mathrm{~cm}$, ascending to erect, simple, or branched above. Leaves narrowly linear, 1 -veined. Inflorescence paniculate with long racemose or subspicate branches; flowers often subsessile and often more or less secund. Bract and bracteoles equalling flowers; bract enlarging in fruit to 6 or more times as long as fruit. Perianth broadly campanulate, 5 -lobed. Nut and perianthlobes as in 5. - Mountains of W. Jugoslavia and Albania. AI Ju.
7. T. arvense Horvátovszky, Fl. Tyrnav. 27 (1774) (T. ramosum Hayne; incl. T. bulgaricum Velen.). Perennial; not stoloniferous. Stems (10)-15-25(-30) cm, ascending to erect. Leaves linearoblong to linear, $1(-3)$-veined, often subsecund. Inflorescence usually a panicle with long racemose branches. Bract 3-4 times as long as flower or fruit; bracteoles equalling flower or fruit. Perianth infundibuliform, 5(-4)-lobed. Nut ellipsoidal, 3 times as long as the persistent perianth. E. \& E.C. Europe. Al Au Bu Cz Gr Hu It Ju Rm Rs (C, W, E).
8. T. parnassi A.DC. in DC., Prodr. 14: 643 (1857). Perennial; stoloniferous. Stems $5-10(-15) \mathrm{cm}$, ascending to erect, simple, weak, slender. Leaves $c .1 \mathrm{~cm}$, oblong-linear to linear, 1 -veined. Inflorescence a short, rather few-flowered raceme, often with subsessile flowers. Bract usually twice as long as flower or fruit; bracteoles almost equalling flower or fruit. Perianth infundibuliform, 5 -lobed. Nut subglobose, 4 times as long as persistent perianth. - Mountains of W. part of Balkan peninsula, C. \& S. Italy, and Sicilia. Al Gr It Ju Si.
9. T. italicum A.DC. in DC., Prodr. 14: 644 (1857). Perennial; stoloniferous. Stems $10-20 \mathrm{~cm}$, ascending to erect, simple or slightly branched. Leaves $c .3 \mathrm{~cm}$, linear, 1-veined. Inflorescence a long raceme. Bract 5-6 times as long as flower or fruit; bracteoles only slightly longer than flower or fruit. Perianth infundibuliform, 5 -lobed. Nut more or less ovoid, 3 times as long as persistent perianth. Corse, Sardegna. Co Sa.
10. T. dollineri Murb., Lunds Univ. Arsskr. 27: 43 (1891) sensu lato (T. humile auct. eur. med., non Vahl). Annual to perennial; notstoloniferous. Stems 6-15cm, decumbent, ascending or erect, simple or branched. Leaves linear to oblong-linear, 1 -veined, sometimes secund. Inflorescence few- or many-flowered, flowers often subsessile. Perianth infundibuliform, 5 -lobed. Nut more or less ovoid-globose, 4 times as long as persistent perianth. - E.C. Europe and Balkan peninsula, southwards to Macedonia. $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Hu} \mathrm{Ju} \mathrm{Rm}$.
(a) Subsp. dollineri: Annual. Stem single, horizontally branched from near middle. Bract and bracteoles more or less equalling flower or fruit. Throughout the range of the species.
(b) Subsp. simplex (Velen.) Stoj. \& Stefanov, Fl. Bǎlg, ed. 2, 312 (1933) (incl. T. moesiacum Velen.). Perennial. Stems several, unbranched. Bract and bracteoles much longer than flower or fruit. Throughout the range of the species.
11. T. bavarum Schrank, Baier. Reise 129 (1786) (T. montanum Ehrh. ex Hoffm.). Perennial; not stoloniferous. Stems c. 2560 cm , erect, usually simple. Leaves lanceolate, distinctly 3- to 5 -veined, always flaccid and dark green. Inflorescence lax, paniculate. Bract more or less equalling to twice as long as flower or fruit; bracteoles shorter than flower or fruit. Nut 4-5 times as long as persistent perianth. $2 n=24$. Alps, C. Europe, Balkan peninsula, Italy. Au $\mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm}$.
12. T. linophyllon L., Sp. Pl. 207 (1753) (T. linifolium Schrank, T. intermedium Schrader). Perennial; usually stoloniferous. Stems $10-30 \mathrm{~cm}$, ascending to erect, usually simple. Leaves
narrowly elliptical, 1- to 3-veined, often rather stiff and yellowishgreen. Inflorescence, bract and bracteoles more or less as in 11. Nut ellipsoidal, 4-6 times as long as persistent perianth. $2 n=14$. From E. France eastwards to the Volga and southwards to S. Italy and Greece. $\mathrm{Al} \mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{GeGr} \mathrm{He} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{RmRs} \mathrm{(C}, \mathrm{W)}$.
13. T. divaricatum Jan ex Mert. \& Koch in Röhling, Deutschl. Fl. ed. 3, 2: 285 (1826) (incl. T. nevadense Willk.). Perennial; not stoloniferous. Stems $15-25(-35) \mathrm{cm}$, ascending to erect, robust, rigid, much-branched. Leaves narrowly linear, 1 -veined. Inflorescence paniculate. Bract and bracteoles usually shorter than flower or fruit. Perianth broadly campanulate, 5 -lobed. Nut ovoid to subglobose, 5 times as long as persistent perianth. S. Europe, extending northwards to C. France and the Alps. Al Bu CoCrGa Gr Hs It Ju Lu Rm Tu.
14. T. humifusum DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 366 (1815). Perennial; not stoloniferous. Stems $10-20 \mathrm{~cm}$, decumbent or long-ascending, slender, weak, branched. Leaves linear, 1 -veined. Inflorescence paniculate. Bract usually equalling flower or fruit; bracteoles shorter, distinctly scabrid. Perianth broadly campanulate, 5 -lobed. Nut almost subglobose, 4-5 times as long as persistent perianth. - W. Europe. Be Br GaHoHs .
15. T. bergeri Zucc., Abh. Bayer. Akad. Wiss. 2: 324 (1837). Perennial. Stems $5-15 \mathrm{~cm}$, decumbent, procumbent or ascending, simple or branched. Leaves linear to oblong-linear, not fleshy, entire, 1-veined. Inflorescence a raceme; flowers often subsessile. Bract 4 or more times as long as flower or fruit; bracteoles more or less equalling flower or fruit. Perianth more or less
infundibuliform, 5-lobed. Nut subglobose, distinctly reticulately veined, 5 times as long as persistent perianth. S. part of Balkan peninsula; Aegean region. $\mathrm{Al} \mathrm{Cr} \mathrm{Gr} \mathrm{Tu}$.
16. T. humile Vahl, Symb. Bot. 3: 43 (1794). Annual. Stems $5-20 \mathrm{~cm}$, ascending to erect, usually branched from base with long simple branches. Leaves linear or narrowly linear, rather fleshy, denticulate, 1 -veined. Inflorescence often subspicate, sometimes paniculate. Bract 2-5 times as long as flower or fruit; bracteoles usually equalling flower or fruit. Perianth infundibuliform, 5-lobed. Nut subglobose, reticulately veined, 5-6 times as long as persistent perianth. Mediterranean region; Portugal. Bl Co Cr ? Ga Gr Hs It Ju Lu Sa Si.
17. T. procumbens C. A. Meyer, Verz. Pf. Cauc. 40 (1831). Perennial. Stems $10-25 \mathrm{~cm}$, more or less procumbent, usually simple. Leaves linear, 1 -veined. Bract longer than flower or fruit; bracteoles more or less equalling flower or fruit. Perianth campanulate-rotate, 5 -lobed. Nut ovoid, indistinctly reticulately veined, 3-4 times as long as persistent perianth. N.E. Ukraine and S.C. Russia. Rs (C, W, E).
18. T. brachyphyllum Boiss., Diagn. Pl. Or. Nov. 1 (5): 48 (1844). Perennial; not stoloniferous. Stems $5-15 \mathrm{~cm}$, decumbent to ascending, simple. Leaves $c .1 \mathrm{~cm}$, linear-oblong, 1 -veined. Inflorescence a raceme with subsessile or shortly stalked flowers. Bract 5-8 times as long as flower or fruit; bracteoles more or less equalling flower or fruit. Perianth broadly campanulate, 5 -lobed. Nut ellipsoidal, only longitudinally, not reticulately, veined, 5-6 times as long as persistent perianth. Krym (Sinferopol). Rs (K). (Asia Minor and Caucasus.)

## XLIII. LORANTHACEAE ${ }^{1}$

Small shrubs, hemiparasitic on Gymnosperms and woody Angiosperms. Leaves opposite or whorled, entire, sometimes scalelike. Flowers actinomorphic, unisexual (in European species), usually 4 -merous; perianth in 1 or 2 whorls, the inner more or less petaloid, with the parts free or connate. Stamens epipetalous, opposite the petals. Ovary inferior; ovules usually not differentiated from the placenta; style simple or 0 . Fruit a berry, rarely dry and dehiscent. Seed solitary, without testa; embryos 1-3.

2. Viscum

## 1. Loranthus L. ${ }^{2}$

Leaves opposite, pinnate- or slightly parallel-veined, coriaceous. Inflorescence racemose or spicate. Perianth in 2 whorls. Calyxteeth small; petals 4-6. Stamens inserted at the base of the petals; anthers dehiscing longitudinally. Fruit a yellowish, viscid berry.
A predominantly tropical and subtropical genus with only one species in Europe.

1. L. curopaeus Jacq., Enum. Stirp. Vindob. 55 (1762). Stem up to 50 cm , dull brown. Leaves $1-5 \mathrm{~cm}$, obovate-oblong, obtuse, dull green. Berry up to 10 mm , pyriform-globose, yellow.
[^40]On members of the Fagaceae. S.E. Europe, extending westwards to Italy and northwards to $51^{\circ} \mathrm{N}$. in E. Germany (? and Poland). $\mathrm{Al} \mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ge} \mathrm{Gr} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{?Po} \mathrm{RmRs} \mathrm{(W}, \mathrm{K)} \mathrm{Si} \mathrm{Tu}$

## 2. Viscum L. ${ }^{2}$

Leaves opposite or whorled, with 3-7 parallel veins, coriaceous. Inflorescence cymose, the flowers crowded. Perianth in 2 whorls. Calyx 4-toothed in female flowers, absent in male flowers. Petals usually 4. Stamens almost completely connate with the petals; anthers opening by pores. Fruit a white, yellow or red, viscid berry.

Literature: K. F. von Tubeuf, Monographie der Mistel. München. 1923.

Inflorescence shortly pedunculate; berry red

1. cruciatum Inflorescence sessile; berry white or yellow 2. album
2. V. cruciatum Sieber ex Boiss., Voy. Bot. Midi Esp. 2: 274 (1839). Stem up to 60 cm , yellowish-green. Leaves 2-4 cm, often whorled, obovate-oblong, obtuse, yellowish-green. Cymes shortly pedunculate. Berry $6-10 \mathrm{~mm}$, red. On various dicotyledonous trees and shrubs. S.W. Spain, just extending to S. Portugal. Hs Lu. (N. Africa, Asia Minor.)
3. V. album L., Sp. Pl. 1023 (1753). Stem up to 100 cm , yellowish-green. Leaves $2-8 \mathrm{~cm}$, opposite, rarely whorled, obovate-oblong, obtuse, yellowish-green. Cymes sessile. Berry $6-10 \mathrm{~mm}$, globose or pyriform, white or occasionally yellow. On various trees. Most of Europe except the N. and E. margins;
exterminated in some regions. All except Az Fa Fe Hb Is Rs (N, E) Sa Sb .

The following subspecies are variously treated as forms, varieties, subspecies or species in modern Floras, and there is no general agreement as to their status and relationships.
1 Edges of the seed straight; embryos usually 2-3 (on Dicotyledons)
(a) subsp. album

1 Edges of the seed convex; embryos $1(-2)$ (on Conifers)
2 Leaves up to 8 cm , not more than 3 times as long as wide
(b) subsp. abietis

2 Leaves not more than 4(-6) cm, up to 5 times as long as wide
(c) subsp. austriacum
(a) Subsp. album: Leaves variable. Berry usually white, globose; edges of the seed straight; embryos 2-3. On dicotyledonous trees. Throughout the range of the species.
(b) Subsp. abietis (Wiesb.) Abromeit in Wünsche, Pfl. Deutschl. ed. 12, 182 (1924) (V. laxum var. abietis (Wiesb.) Hayek): Leaves up to 8 cm , not more than 3 times as long as broad. Berry usually white, pyriform; edges of the seed convex; embrycs $1(-2)$. On Abies spp. C. \& S. Europe.
(c) Subsp. austriacum (Wiesb.) Vollmann, Fl. Bayern 212 (1914) (V. laxum var. pini (Wiesb.) Hayek): Like (b) but leaves $2-4(-6) \mathrm{cm}$, up to 6 times as long as wide; berry usually yellow. On Pinus and Larix spp. C. \& S. Europe northwards to $c .54^{\circ} N$.

## 3. Arceuthobium Bieb. ${ }^{1}$

Leaves opposite, scale-like, connate in pairs, forming a sheath around the stem. Perianth in 1 whorl. Male flowers solitary, sessile. Perianth 2- to 5 -lobed. Stamens sessile; anthers dehiscing transversely. Female flowers solitary or in pairs, pedicellate; perianth of 2 short teeth. Fruit green, dry, dehiscing explosively. (Razoumofskya Hoffm.)

1. A. oxycedri (DC.) Bieb., Fl. Taur.-Cauc. 3: 629 (1819) (Razoumofskya oxycedri (DC.) F. W. Schultz). Yellowish-green, articulate, up to 20 cm . Leaves up to 5 mm , triangular. Male flowers on short terminal branches; female flowers terminal and axillary. Fruit ovate-oblong, shortly pedicellate. Usually on Juniperus spp. S. Europe; very local. Al Az Bu Ga Gr Hs Ju ?It ?Lu Rs (K) Tu.

# ARISTOLOCHIALES 

## XLIV. ARISTOLOCHIACEAE ${ }^{2}$

Herbs or woody climbers. Leaves alternate, entire, exstipulate. Flowers solitary or in axillary clusters, hermaphrodite, actinomorphic or zygomorphic, usually 3-merous. Perianth in 1 whorl, more or less petaloid, forming a tube, 3-lobed at the apex or with a single unilateral lobe; stamens 6 or 12 , in 1 or 2 whorls, free or connate with the stylar column. Ovary inferior, 6-locular; placentation axillary; styles usually 6 , free or connate to form a column with a 6-lobed stigma; ovules numerous. Fruit a capsule.
Perianth actinomorphic, with short tube, persisting in fruit; flowers terminal

1. Asarum Perianth zygomorphic, with long tube, deciduous; flowers axillary
2. Aristolochia

## 1. Asarum L. ${ }^{1}$

Herbs with creeping rhizome. Flowers solitary and terminal. Perianth actinomorphic, 3-lobed, persistent in fruit. Stamens 12, in 2 whorls, free or almost so; filaments short. Fruit subglobose, dehiscing irregularly.

1. A. europaeum L., Sp. Pl. 442 (1753). Stems $2-10 \mathrm{~cm}$, pubescent, with 2-5 leaves and brown ovate scales $1-2 \mathrm{~cm}$. Leaves $2.5-10 \mathrm{~cm}$, wider than long, reniform, cordate; petiole longer than lamina. Perianth c. 15 mm , brownish; lobes more or less deltate, acuminate. $2 n=26,40$. From S. Fennoscandia southwards to S. France, C. Italy and Macedonia. Al Au Be Bl *Br Bu Cz Ge He Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Su [ Da Ho ].
A. ibericum Steven ex Woronow, Sched. Herb. Fl. Ross. 6: 70 (1908) (A. europaeum var. intermedium C. A. Meyer, A. europaeum var. caucasicum Duchartre) with leaves more or less acute and at least as long as wide, appears to be restricted to C. and E. Europe and is perhaps a subspecies of 1.

[^41]${ }^{2}$ Edit. V. H. Heywood.

## 2. Aristolochia L. ${ }^{1}$

Perennial herbs or woody climbers. Flowers axillary. Perianth zygomorphic, deciduous, the base swollen (utricle), the upper part narrower, more or less cylindrical (tube); limb unilateral and entire, rarely absent or 3-lobed. Stamens usually 6 , in 1 whorl, connate with stylar column. Fruit a septicidal capsule.
A. durior Hill, Veg. Syst. 21: 57 (1772) (A. sipho L'Hér.) from North America is commonly cultivated for ornament, and may sometimes occur partly naturalized. It is a woody climber with leaves up to 30 cm and the perianth brownish with a 3-lobed limb.

Literature: P. H. Davis \& M. S. Khan, Notes Roy. Bot. Gard. Edinb. 23: 515-46 (1961).
Flowers 2 or more together in the axil of a leaf 6. clematitisFlowers solitary
2 Stem usually climbing, woody; leaves evergreen, coriaceous
3 Ovary and pedicels pubescent 1. sempervirens
3 Ovary and pedicels glabrous 2. baetica2 Stem not climbing, herbaceous; leaves not coriaceous4 Perianth without conspicuous unilateral limb, the apexclavate, with a small pore 13. microstom
4 Perianth with large conspicuous unilateral limb at least $\frac{1}{5}$ as long as tube
5 Perianth-tube strongly curved, $10-20 \mathrm{~mm}$ in diameter; utricle oblong-cylindrical
6 Leaves not more than $5.5 \times 6 \mathrm{~cm}$; limb of perianth with auricles $2-5 \mathrm{~mm}$ long at base 3. cretica
6 Leaves up to $16 \times 15 \mathrm{~cm}$; limb of perianth with auricles up to 20 mm long at base
7 Leaves ovate-orbicular, cordate to reniform, about as long as wide 4. pontica 7 Leaves $\pm$ deltate to ovate-cordate, distinctly longer than wide 5. bodamae
5 Perianth-tube $\pm$ straight, less than 5 mm in diameter; utricle $\pm$ globose


1. A. sempervirens L., Sp. Pl. 961 (1753) (incl. A. altissima Desf.). Evergreen; stems up to 5 m , climbing or rarely procumbent. Leaves up to $10 \times 6 \mathrm{~cm}$, triangular-ovate, cordate, glabrous, coriaceous, the basal sinus shallow, the lobes not more than $\frac{1}{7}$ th the length of the leaf. Flowers $2-5 \mathrm{~cm}$, yellow, striped with purple, limb purple or dull brownish-purple, tube strongly curved; ovary and pedicels shortly pubescent. Capsule 1-4 cm. S. Greece, Kriti; S. Italy, Sicilia. Cr Gr It Si [Ga].
2. A. baetica L., Sp. Pl. 961 (1753). Like 1 but leaves glaucous, the basal sinus deep and narrow, the lobes up to $\frac{1}{4}$ the length of the leaf; flowers brownish- or blackish-purple; ovary and pedicels glabrous. S. \& E. Spain; S. Portugal. Hs Lu.
3. A. cretica Lam., Encycl. Méth. Bot. 1: 255 (1783). Erect or decumbent, pubescent, $30-60 \mathrm{~cm}$. Leaves $2-5 \cdot 5 \times 2-6 \mathrm{~cm}$, reniform to triangular-ovate, about as long as wide; petioles not more than 3 cm . Flowers $5-12 \mathrm{~cm}$, dull purple; utricle oblong, strongly inflated; tube $10-20 \mathrm{~mm}$ in diameter, strongly curved; limb with 2 broad obtuse auricles 2-5 mm long at base. Capsule 3-6 cm, ovate-oblong. Kriti and Karpathos. Cr.
4. A. pontica Lam., Encycl. Méth. Bot. 1: 255 (1783) (?A. bodamae var. cordifolia Dingler). Like 3 but the leaves up to $16 \times 12 \mathrm{~cm}$, glabrescent, ovate-orbicular to reniform; flowers greenish-purple, the limb with auricles $10-20 \mathrm{~mm}$ long. ? N.E. Greece (N. of Alexandroupolis). ?Gr. (Caucasus, N. Anatolia.)
5. A. bodamae Dingler, Flora (Regensb.) 66: 301 (1883). Like 3 but the leaves up to $12-14 \times 8-12 \mathrm{~cm}$, longer than wide, subdeltate to ovate; petiole up to $3-5 \mathrm{~cm}$; flowers blackish-purple, the limb paler towards the apex. Thrace. Gr Tu.
6. A. clematitis L., Sp. Pl. 962 (1753). Subsimple, glabrous, up to 100 cm ; stock creeping, much divided. Leaves $3-15 \mathrm{~cm}$, broadly ovate, obtuse; petiole $1 \cdot 5-5 \mathrm{~cm}$. Flowers $2-3 \mathrm{~cm}, 2-8$ together in the axils of the leaves, yellow, the limb brownish; pedicels very short. Capsule $2-5 \mathrm{~cm}$, ovoid to pyriform. Formerly cultivated as a medicinal herb throughout most of Europe and widely naturalized from c. $55^{\circ} \mathrm{N}$. southwards; probably native in the east and south-east. Al Au Be ? Bl Br Bu Co Cr Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs (B, C, W, K, E) Tu.
7. A. pistolochia L., Sp. Pl. 962 (1753). Simple or branched, pubescent, $20-80 \mathrm{~cm}$; stock of numerous, fibrous, cylindrical, fasciculate tubers. Leaves $1-3(-5) \mathrm{cm}$, ovate-triangular, the margin and lower surface with cartilaginous teeth or papillae; petiole $1-5 \mathrm{~mm}$. Flowers $2-5 \mathrm{~cm}$, brownish, the limb dark purple. Capsule 2-3 cm, globose to pyriform. - S.W. Europe. Co Ga Hs LuSa.
8. A. rotunda L., Sp. Pl. 962 (1753). Simple or branched, glabrescent, $15-60 \mathrm{~cm}$; tuber globose or ovoid. Leaves 2-7(-9) cm , ovate-orbicular, amplexicaul; petiole not more than 0.5 cm . Flowers (2-)3-5 cm, yellow, limb dark brown. Capsule $1-2 \mathrm{~cm}$, globose. S. Europe. Al Bl Bu Co Cr Ga Gr He Hs It Ju Lu Sa Si Tu.
9. A. pallida Willd., Sp. Pl. 4 (1): 162 (1805). Simple or branched, glabrescent, $15-50 \mathrm{~cm}$; tuber globose. Leaves $2-7 \mathrm{~cm}$, ovate-reniform; petiole up to $1 \cdot 5(-2 \cdot 5) \mathrm{cm}$. Flowers $3-6 \mathrm{~cm}$, green, yellow or pale brown, with brownish or purplish stripes, the limb often darker. Capsule $c .2 \mathrm{~cm}$, ovoid-oblong. S. Europe, except the west. Al Bu Co Cr Ga Gr It Ju Rm Sa Si Tu.
The following two little-known taxa are probably subspecies or varieties of 9 .
A. macedonica Bornm., Bot. Jahrb. 61(4): 106(1928) (A.melanoglossa Bornm.,non Speg.). Like 9 but the tuber sometimes shortly cylindrical; leaves triangular-ovate; flowers $5-6 \mathrm{~cm}$, brown, with pale purple stripes, limb dark purple, deeply emarginate. - Macedonia and Albania. Al Bu Ju.
A. croatica Horvatić, Prir. Istraž. Kral. Jug. 18: 195 (1933). Like 9 but said to differ in the stem being rigid; internodes short (c. 2 cm ); lower leaves up to 6 cm , decreasing rapidly above, the upper not more than 1 cm , triangular-ovate, thick, rigid; flowers pale purple-brown with greenish veins, limb greenish-yellow. - N.W. Jugoslavia (island of Pag). Ju.
10. A. sicula Tineo in Guss., Fl. Sic. Syn. 2: 878 (1845). Like 9 but the stem 20-100 cm; leaves 4-12 cm, ovate-triangular, acute to acuminate; petiole $2 \cdot 5-6 \mathrm{~cm}$; flowers pale yellow, with brownish stripes. - Sicilia. Si.

Perhaps only a subspecies of 9 .
11. A. longa L., Sp. Pl. 961 (1753). Usually branched, glabrescent, $20-80 \mathrm{~cm}$; tuber cylindrical. Leaves $2-6(-9) \mathrm{cm}$, ovatetriangular; petioles up to $1(-1 \cdot 5) \mathrm{cm}$. Flowers $3-5(-6) \mathrm{cm}$, brownish or yellowish-green, limb brownish-purple; pedicels about equalling petioles. Capsule $1 \cdot 5-3 \mathrm{~cm}$, globose to pyriform. Mediterranean region, but rare in the east; Portugal. Al Bl Bu Co Cr Ga Gr Hs It Lu Sa Si.
12. A. bianorii Sennen \& Pau, Butll. Inst. Catalana Hist. Nat. 1911: 19 (1912). Branched, glabrous, $10-30 \mathrm{~cm}$; tuber cylindrical or ovoid. Leaves $0 \cdot 5-2(-3) \times 0 \cdot 5-1(-1 \cdot 5) \mathrm{cm}$, ovate-oblong to ovate-triangular, deeply cordate; petiole $0 \cdot 1-0 \cdot 4 \mathrm{~cm}$. Flowers $1-3 \mathrm{~cm}$, brownish-yellow, with brownish stripes, limb reddish; pedicels equalling or longer than petioles. Capsule $5-10 \mathrm{~mm}$, globose. Islas Baleares (Mallorca). Bl.
13. A. microstoma Boiss. \& Spruner in Boiss., Diagn. Pl. Or. Nov. 1 (5): 50 (1844). Simple or branched, pubescent, 10-40 cm; tuber cylindrical. Leaves $1-3 \mathrm{~cm}$, ovate-oblong, cordate; petiole $0 \cdot 2-1 \cdot 5 \mathrm{~cm}$. Flowers $1 \cdot 5-3 \mathrm{~cm}$, brownish, clavate, with apical pore, limb very small or absent. Capsule $1-2 \mathrm{~cm}$, globose. - S. Greece and Kikladhes. Gr.

## XLV. RAFFLESIACEAE (CYTINACEAE) ${ }^{1}$

Perennial herbs without chlorophyll, parasitic on the roots of other plants. Flowers unisexual. Perianth consisting of a single, more or less petaloid whorl. Ovary inferior; fruit a berry.

## 1. Cytinus L. ${ }^{2}$

Parasitic (in Europe) on members of the Cistaceae. Stem simple, stout, with fleshy scale-leaves. Flowers subsessile, in a dense spike, the lower female the upper male. Perianth tubular, with 4 spreading lobes. Stamens 8 , united into a column. Style single; stigma capitate. Seeds numerous, embedded in a sweet, viscid pulp.
Perianth bright yellow

1. hypocistis
2. ruber
3. C. hypocistis (L.) L., Syst. Nat. ed. 12, 2: 602 (1767). Stem $3-7 \mathrm{~cm}$, rarely longer. Scale-leaves densely imbricate, ovateoblong, ciliate, yellow, orange or scarlet. Flowers 5-10, each subtended by 2 usually pubescent bracteoles of the same colour as the leaves; perianth usually pubescent, bright yellow. $S . \& W$. parts of Mediterranean region; S.W. Europe, northwards to c. $46^{\circ} \mathrm{N}$. in W. France. Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.

Three subspecies, differing in colour, flower-size and hostplant, can be recognized in Europe:
1 Perianth c. 12 mm , scarcely exceeding the bracteoles
(a) subsp. hypocistis

1 Perianth at least 16 mm , obviously exceeding the bracteoles
2 Scale-leaves usually yellow or orange; flowers often more than 20 mm
(b) subsp. macranthus

2 Scale-leaves usually red; flowers c. $18 \mathrm{~mm} \quad$ (c) subsp. orientalis
(a) Subsp. hypocistis: On white-flowered species of Cistus; perhaps also on Halimium spp. From W. France to Jugoslavia and Sicilia.
(b) Subsp. macranthus Wettst., Ber. Deutsch. Bot. Ges. 35: 95 (1910): On Halimium spp. Portugal; ?Spain. (N. Africa.)
(c) Subsp. orientalis Wettst., op. cit. 97 (1910): On Cistus parviflorus. Kriti and Gavdhos. (E. Mediterranean.)
2. C. ruber (Fourr.) Komarov, Fl. URSS 5: 442 (1936) (C. hypocistis subsp. kermesinus Guss.). Like 1, but with stem up to 12 cm ; scale-leaves and bracteoles crimson or carmine; and perianth $c .12-15 \mathrm{~mm}$ (slightly exceeding the bracteoles) ivorywhite or pale pink. On pink-flowered species of Cistus. Mediterranean region, Portugal. Bl Co Ga Gr Hs It Ju Lu Sa Si.

## BALANOPHORALES

## XLVI. BALANOPHORACEAE ${ }^{1}$

Herbs without chlorophyll, parasitic on the roots of other plants. Flowers usually unisexual, in dense, spicate or capitate inflorescences. Fruit a small, 1 -seeded nut; seed with abundant endosperm and minute embryo.

## 1. Cynomorium L. ${ }^{2}$

Perennial. Male, female and hermaphrodite flowers present. Perianth of $1-5$ linear to cuneate or oblanceolate segments, partly fused to the ovary in female and hermaphrodite flowers. Stamen 1, epigynous. Style and stigma 1.

1 C. coccineum L., Sp. Pl. 970 (1753). Plant dark red to purplish-black. Stems $15-30 \mathrm{~cm}$, erect, stout, fleshy, arising from a branched underground rhizome, bearing numerous triangularlanceolate scale-leaves. Inflorescence $6 \mathbf{- 1 2 \times 2 - 4 ~ c m}$, terminal, cylindrical-clavate, with a stout, fleshy axis on which are numerous dense, subcapitate cymes subtended by triangular-peltate, deciduous bracts. Parasitic on various plants, usually in saline habitats. Mediterranean region, S. Portugal; very local. ?Cr Hs It Lu Sa Si. (N. Africa, S.W. Asia.)

## POLYGONALES

## XLVII. POLYGONACEAE ${ }^{3}$

Herbs, shrubs or climbers without latex. Leaves nearly always alternate; stipules often united in a membranous sheath (ochrea). Flowers hermaphrodite or unisexual; perianth 3- to 6-merous, herbaceous, often enlarging and becoming membranous in fruit. Stamens usually 6-9. Ovary superior, unilocular; styles 2-4; ovule solitary, basal. Fruit a trigonous or lenticular nut.

[^42]11. Calligonum

[^43]2 Stamens 6-8
1 Herbs, dwarf shrubs or woody climbers
3 Perianth-segments 3 or 4
4 Perianth-segments 4 ; stamens 6
6. Oxyria

4 Perianth-segments 3 ; stamens 3

1. Koenigia

3 Perianth-segments 5 or 6
5 Woody climbers
6 Leaves $3-6 \mathrm{~cm}$ wide, cordate
3. Bilderdykia

6 Leaves less than 2.5 cm wide, not cordate 10. Muehlenbeckia
5 Herbs or dwarf shrubs
7 Outer fruiting perianth-segments with 3 stout spines 9. Emex
7 Outer fruiting perianth-segments not spiny
12. Atraphaxis
8 Leaves palmately lobed; stamens 9
8 Leaves not palmately lobed; stamens 8 or fewer
9 Perianth-segments 6 , the inner much larger than the outer in fruit
9 Perianth-segments 5, equal in fruit or the outer larger 10 Outer perianth-segments winged or keeled in fruit 11 Erect, rhizomatous perennials; stigmas fimbriate; styles fairly long 11 Twining annuals; stigmas compact, subsessile tria
3. Bilderdykia
10 Outer perianth-segments not winged or keeled in fruit
12 Leaves deltate-cordate, about as wide as long; fruit at least twice as long as perianth
5. Fagopyrum
12 Leaves distinctly longer than wide, never deltate and rarely cordate; fruit included in the perianth or protruding for less than half its length 2. Polygonum

## 1. Koenigia L. ${ }^{1}$

Annual herb. Leaves usually sub-opposite. Perianth-segments 3, sepaloid. Stamens 3, alternating with 3 gland-like staminodes. Styles 2.

1. K. islandica L., Mantissa 35 (1767). Stems $1-6 \mathrm{~cm}$, erect, reddish. Leaves $3-5 \mathrm{~mm}$, broadly elliptical; petiole c. 1 mm ; stipules hyaline. Flowers in terminal and axillary clusters; perianth-segments $c .1 \mathrm{~mm}$, pale green. $2 n=28$. Open habitats. Arctic Europe, extending southwards in the mountains to $53^{\circ} 30^{\prime} N$. in Scotland. Br Fa Fe Is No Rs (N) Sb Su.

## 2. Polygonum L. ${ }^{2}$

Herbs or dwarf shrubs. Leaves variously shaped, always distinctly longer than wide. Perianth-segments usually more or less equal, free or united at the base, petaloid at least in part, not winged or keeled. Stamens 8, rarely fewer. Stigmas 2 or 3. Nut lenticular or trigonous, not winged, enclosed in the persistent perianth or protruding from it for less than half its length.

The sections set out below are often elevated to generic rank, by reason mainly of constant differences in the structure of the pollen. Differences in habit, ochrea, inflorescence, style and stigma, and chromosome number show some correlation with the differences in pollen-structure, but not with sufficient constancy to provide satisfactory generic diagnoses.

A number of hybrids have been reported, especially in Sect. Persicaria; none appears to be widespread. Some, at least, of these supposed hybrids are referable either to one of the parents or to a third species, but it appears that hybrids occur at any rate between P. persicaria and P. mite, and between P. persicaria and $P$. lapathifolium; they are intermediate in appearance between the parents.
In addition to the species described below, several others are cultivated in gardens. Among these P. campanulatum Hooker fil., an erect perennial $c .1 \mathrm{~m}$ high, easily distinguished by the pale pinkish-brown tomentum on the under surface of the leaves and the bright pink, campanulate flowers, crowded in compact panicles, is perhaps becoming naturalized.
1 Flowers in wide, diffuse panicles (Sect. Aconogonon)
2 Leaves $1-3 \mathrm{~cm}$ wide, cuneate at the base; ochreae hyaline, soon disappearing
35. alpinum

2 Leaves $3-8 \mathrm{~cm}$ wide, $\pm$ truncate at the base; ochreae brown, persistent
36. polystachyum

1 Flowers in spikes or axillary clusters
${ }^{1}$ By T. G. Tutin. $\quad{ }^{2}$ By D. A. Webb and A. O. Chater.

3 Leaves broadly ovate, obtuse, turning blue on drying
31. tinctorium

3 Leaves not turning blue on drying
4 Ochreae white or silvery and hyaline, at least in distal part, eventually deeply lacerate; flowers in small, subsessile axillary clusters, or in lax, slender, often leafy spikes (Sect. Polygonum)
5 Perennial; stems woody at the base
6 Ochreae in inflorescence longer than internodes, those in the middle part of the stem at least half as long as internodes
7 Stock forming a dense, woody mat; stems $3-6 \mathrm{~cm}$ (mountains of Aegean region) 6. idaeum
7 Stock sparingly branched; stems usually more than 10 cm (lowland)
8 Ochreae with $8-12$ strong, branched veins 5. maritimum
8 Ochreae with fewer, faint veins
9 Leaves less than 5 mm wide
4. romanum

9 Leaves more than 5 mm wide
7. cognatum

6 Ochreae shorter than all internodes (except on unexpanded young stems) and much shorter than those in middle of stem
10 At least the upper bracts scarious and shorter than the flowers

1. scoparium

10 Bracts all leaf-like, at least as long as the flowers and usually longer
11 Bracts much shorter than the lower leaves; nut glossy
12 Stem 30-100 cm; leaves $2-4 \mathrm{~cm}$
2. equisetiforme

12 Stem 10-20 cm; leaves $c .1 \mathrm{~cm}$
3. icaricum

11 Bracts scarcely shorter than the lower leaves
13 Leaves more than 6 mm wide
13. oxyspermum

13 Leaves less than 6 mm wide
4. romanum

5 Annual; stems scarcely woody at the base
14 Perianth-segments shorter than the tube; leaves narrowly linear
15 Stems erect; nut dull
9. salsugineum

15 Stems procumbent; nut glossy
10. aschersonianum

14 Perianth-segments longer than the tube
16 At least the upper bracts scarious and shorter than the flowers
17 Stems procumbent or decumbent 12. arenarium
17 Stem erect
18 Flowers in clusters of 1-3, subsessile, greenish
11. patulum

18 Flowers in clusters of 5-10, distinctly pedicellate, pink
8. floribundum

16 Bracts all leaf-like, longer than the flowers
19 Nut glossy, exceeding the perianth
20 Leaves very glaucous and minutely papillose; sap acid to the taste 19. acetosum
20 Leaves green or slightly glaucous, not papillose; sap not acid to the taste
21 Leaves less than 2 mm wide; nut less than 3 mm
14. graminiolium

21 Leaves more than 2 mm wide; nut more than 3 mm
13. oxyspermum

19 Nut punctulate, dull, enclosed in perianth or only very slightly exceeding it
22 Perianth-tube at least half as long as segments; leaves $\pm$ uniform in size
18. arenastrum

22 Perianth-tube very short; leaves on main stem much larger than those on branches
23 Larger leaves $1-4 \mathrm{~mm}$ wide, perianth-segments narrow, not overlapping 17. rurivagum
23 Larger leaves $5-18 \mathrm{~mm}$ wide; perianth-segments wide, overlapping
24 Larger leaves ovate-lanceolate; petiole very short, included in ochrea; nut c. 3 mm 15. aviculare
24 Larger leaves obovate, with obvious petioles partly exserted from the ochrea; nut c. 4 mm 16. boreale
4 Ochreae brown, usually opaque, entire or fimbriate but scarcely lacerate; flowers usually in dense spikes, rarely in lax, leafless spikes

25 Rhizomatous perennial
26 Rhizome short, stout; styles 3, free (Sect. Bistorta)
27 Leaf-margin revolute; lower flowers of spike usually replaced by bulbils
34. viviparum

27 Leaf-margin plane; bulbils not present
28 Petiole of lower leaves winged; upper leaves not amplexicaul
32. bistorta

28 Petiole of lower leaves not winged; upper leaves amplexicaul
33. amplexicaule

26 Rhizome extensively creeping; styles 2 , rarely 3 , united in lower part (Sect. Persicaria)
29 Ochreae ciliate; spikes slender, rather lax
28. hydropiperoides 27. amphibium

25 Ochreae not ciliate; spikes stout, dense 27 . amphil stolons (Sect. Persicaria)
30 Stem furnished, at least in lower part, with recurved prickles
30. sagittatum

30 Stem without prickles
31 Ochreae and petioles densely hairy; upper margins of ochreae green and leaf-like, at least in part
29. orientale

31 Ochreae and petioles glabrous or sparsely hairy; ochreae entirely scarious
32 Spikes lax and slender, with each flower distinctly visible
33 Perianth furnished with brownish glands 23. hydropiper 33 Perianth without glands
34 Ochreae with a few short cilia or none 21. foliosum
34 Ochreae conspicuously ciliate
35 Usually perennial, with epigeal stolons or rooting, decumbent branches; larger leaves usually 10 cm or more
24. salicifolium

35 Annual; leaves seldom more than 8 cm
36 Leaves lanceolate, usually more than 10 mm wide; nut $3-4 \mathrm{~mm}$ 22. mite
36 Leaves linear-lanceolate to linear-oblong, seldom more than 8 mm wide; nut $2-3 \mathrm{~mm} \quad$ 20. minus
32 Spikes dense and stout, with the flowers crowded and overlapping
37 Peduncles bearing numerous subsessile yellow glands
26. lapathifolium

37 Peduncles without glands
25. persicaria

Sect. Polygonum. Herbs or dwarf shrubs. Leaves small; ochreae silvery- or whitish-hyaline, at least in upper part, eventually lacerate. Flowers axillary, solitary or in small clusters, forming very lax spikes. Perianth petaloid or mainly sepaloid; stamens 3-8; styles 3 (rarely 2), usually short; nut trigonous.

1. P. scoparium Req. ex Loisel., Mém. Soc. Linn. Paris 6: 410 (1827). Perennial, with a branched, woody stock. Stems 50120 cm , erect, sparingly branched. Leaves caducous. Ochreae much shorter than internodes, reddish-brown except for a short hyaline apex. Flowers pink, solitary or in pairs, in very lax terminal spikes; bracts scarious, shorter than flowers. Nut glossy, scarcely exceeding the perianth. $2 n=20$. Damp roadsides and waste places. Corse; Sardegna. Co Sa.
2. P. equisetiforme Sibth. \& Sm., Fl. Graec. Prodr. 1: 269 (1809). Perennial with a branched, woody stock. Stems 30100 cm , procumbent or suberect, usually branched. Leaves $2-4 \mathrm{~cm}$, oblong to linear, acute, often caducous. Ochreae hyaline, brownish towards the base, much shorter than the internodes. Flowers pink or white, in axillary clusters of 2-3, forming long, lax, terminal spikes; bracts herbaceous, equalling or slightly exceeding the flowers but much smaller than the lower leaves. Styles often 2; nut c. 2.5 mm , glossy. Chiefly ruderal. Mediterranean region and S. Bulgaria; local. Bu Cr Gr Hs It Sa Si Tu.
3. P. icaricum Rech. fil., Magyar Bot. Lapok 33: 8 (1934).

Like 2 but smaller and more condensed; stock stouter, and with very numerous crowded, erect, slender stems $10-20 \mathrm{~cm}$; leaves c. 1 cm , persistent; flowers solitary or in pairs in much shorter spikes. Rock-crevices. E. Aegean region (Samothraki). Gr.

## Recorded elsewhere only from Ikaria.

4. P.romanum Jacq., Obs. Bot. 3:8(1768). Perennial with woody stock. Stems $40-100 \mathrm{~cm}$, procumbent, densely leafy above, often less leafy near the base. Leaves linear to linear-lanceolate, acute, somewhat glaucous; margins plane. Ochreae hyaline, with rather faint veins, much shorter than internodes in middle of stem, but usually longer than internodes towards the base and in the inflorescence. Flowers whitish, in numerous, short, dense, leafy axillary spikes; bracts leaf-like. Nut $2-3 \mathrm{~mm}$, finely striate, dull. - W. Mediterranean region. Bl ?Ga Hs It Sa.
P. longipes Halácsy \& Charrel, Österr. Bot. Zeitschr. 40: 164 (1890) from the Aegean region, Albania and Turkey, is like 4 but usually has shorter and less acute leaves, fewer lateral inflorescences, and a slightly glossy nut. It is not clear from the material available whether it deserves specific status.

Plants from Sicilia (? and S. Italy) which have often been referred to $P$. herniarioides Delile, a species of N. Africa and S.W. Asia, somewhat resemble small specimens of $P$. longipes but are perhaps annual; if this is so, they would be hard to distinguish from $P$. arenastrum. They lack the very obtuse leaves, gradually tapered from near the apex to the base, characteristic of $P$. herniarioides. They may perhaps, if perennial, merit specific status as P. gussonii Tod. ex Cesati, Passer. \& Gibelli, Comp. Fl. Ital. 262 (1869).
5. P. maritimum L., Sp. Pl. 361 (1753). Perennial, with stout, woody stock. Stems $10-50 \mathrm{~cm}$, procumbent, branched, stout. Leaves $5-25 \mathrm{~mm}$, narrowly elliptical, acute, glaucous, usually blackening on drying; margins revolute. Ochreae reddish-brown at the base, with 8-12 conspicuous, branched veins, silvery-hyaline above, longer than most of the internodes. Flowers pink or whitish, solitary, or in axillary clusters of 2-4; bracts leaf-like. Nut $3.5-5 \mathrm{~mm}$, equalling or slightly exceeding the perianth, glossy. Maritime sand and shingle. $2 n=20$. Shores of Atlantic, Mediterranean and Black Sea, northwards to the Channel Islands. $\mathrm{Al} \mathrm{Az} \mathrm{Bl} \dagger \mathrm{Br} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs}$ It Ju Lu Rm Rs (W, K) Sa Si Tu.
6. P. idaeum Hayek, Prodr. Fl. Penins. Balcan. 1: 110 (1924). Like 5 but much condensed; stock forming a dense, woody mat; stems $3-6 \mathrm{~cm}$; internodes very short (c. 5 mm ); leaves ovate, obtuse. Mountain rocks. Kriti; ?Evvoia. Cr ?Gr.
7. P. cognatum Meissner, Monogr. Gen. Polyg. Prodr. 91 (1826) ( $P$. alpestre C. A. Meyer). Perennial, with a branched woody stock. Stems $5-30 \mathrm{~cm}$, procumbent. Leaves $10-20 \times 5-9 \mathrm{~mm}$, oblong, subacute or mucronate. Ochreae hyaline, usually longer than internodes. Flowers solitary or in axillary clusters of 2-5; bracts as large as lower leaves. Perianth pinkish; tube at least as long as the segments, becoming hard in fruit. Nut 3 mm , glossy, included in perianth. Locally naturalized as a ruderal. $[\mathrm{Br} \mathrm{Bu}$ Ga.] (S.W. Asia.)
8. P. floribundum Schlecht. ex Sprengel, Syst. Veg. 2: 257 (1825). Annual (? or perennial). Stems long, stout, freely branched Leaves $7-25 \mathrm{~mm}$, oblong or ovate, subacute. Flowers in axillary clusters of $3-10$, most of them aggregated into numerous, fairly dense, stout spike-like racemes at the ends of the branches; lower bracts leaf-like, upper ones shorter than the flowers. Pedicels slender, longer than the perianth; perianth 2 mm , pink,
enclosing the nut. Saline semi-deserts. Lower Volga. Rs (E). (W. Asia.)

A very distinct but imperfectly known species whose affinities are uncertain.
9. P. salsugineum Bieb., Beschr. Länd. Terek Kasp. 169 (1800). Erect, bushy annual with very slender branched stems $5-20 \mathrm{~cm}$. Leaves $c .3 \mathrm{~mm}$, narrowly linear, almost subulate, very few. Flowers subsessile, solitary in the axils of minute scarious bracts. Perianth pink or yellowish; segments shorter than the tube. Nut long and narrow, exceeding the perianth, dull. Saline habitats. S.E. Russia and Krym. Rs (K, E).
P. samarense H. Gross, Bot. Jahrb. 49: 340 (1913) is reported as an endemic in S.E. Russia. It is like 9 in habit, but has taller stems, longer leaves ( $10-15 \times 1-1.5 \mathrm{~mm}$ ), distinct pedicels, perianth-tube shorter than the segments, and a glossy nut.
10. P. aschersonianum H. Gross, Bot. Jahrb. 49: 341 (1913). Like 9 but with procumbent stems, somewhat longer leaves ( $4-7 \mathrm{~mm}$ ), and a slightly wider, somewhat glossy nut. - Saline regions of S.E. Russia. Rs (E).
11. P. patulum Bieb., Fl. Taur.-Cauc. 1: 304 (1808) (P. bellardii auct., non All., P. gracilius auct. ross.; incl. P. kitaibelianum Sadler \& P. novoascanicum Klokov). Annual. Stem $20-100 \mathrm{~cm}$, erect, usually much-branched. Leaves $25-45 \mathrm{~mm}$, linear-lanceolate to oblong-elliptic, often caducous. Flowers solitary or in axillary clusters of $2-3$, subsessile, forming lax or moderately dense spikes; lower bracts leaf-like, upper ones scarious and shorter than the flowers. Perianth $c .3 \mathrm{~mm}$, divided almost to the base; segments greenish, erect. Nut glossy, enclosed in the perianth. $2 n=20$. C., S. \& S.E. Europe, northwards to c. $55^{\circ} \mathrm{N}$. in Russia. ?Al Au Bl Bu Co Cz Ga Ge Gr Hs Hu It Ju Po Rm Rs (C, W, K, E) Sa Si Tu.
12. P. arenarium Waldst. \& Kit., Pl. Rar. Hung. 1: 69 (1801). Annual. Stems $20-50 \mathrm{~cm}$, diffusely branched from the base, procumbent or ascending. Leaves linear-lanceolate, acute, usually caducous. Bracts minute, scarious. Perianth pink and white, conspicuous, with patent segments. Nut 2 mm. S. \& E.C. Europe. Al Bu Cz Ga Gr Hu It Ju Lu Rm Rs (W, K, E) Tu.
(a) Subsp. arenarium (incl. P. pseudoarenarium Klokov, $P$. janatae Klokov, \& P. venantianum G. C. Clementi): Flowers rather distant, solitary or in pairs on the main branches; clustered and forming short, condensed terminal spikes on the lateral branches. Nut glossy. E.C. \& S.E. Europe.
(b) Subsp. pulchellum (Loisel.) D. A. Webb \& Chater, Feddes Repert. 68: 188 (1963): Flowers solitary or in pairs, forming lax spikes throughout the inflorescence. Nut dull or scarcely glossy. $2 n=20$. Mediterranean region; Portugal.
P. albanicum Jáv., Bot. Közl. 19: 18 (1920) from N.E. Albania is like 12 (b) but is said to have narrower, veinless leaves and a slightly glossier and longer nut.
13. P. oxyspermum Meyer \& Bunge ex Ledeb., Ind. Sem. Hort. Acad. Dorpat., suppl. 2, 5 (1824). Annual to perennial. Stems $10-100 \mathrm{~cm}$, procumbent, rather stout and sometimes woody at the base. Leaves $15-30 \mathrm{~mm}$, elliptical to linear-lanceolate; margins scarcely revolute. Ochreae much shorter than internodes, mostly hyaline, with 4-6 simple veins. Flowers in axillary clusters of 2-6, rarely solitary; bracts leaf-like. Nut glossy, exceeding the perianth. Sandy and gravelly sea-shores. Coasts of most of Europe, but absent from the E. Mediterranean. Br Bu Da Fe Ga Ge Hb It No Po Rm Rs (N, B, W, K) Sa Su Tu.
(a) Subsp. oxyspermum: Annual or biennial, green. Leaves linear-lanceolate. Perianth-segments with deep red margins; nut $5-6.5 \mathrm{~mm}$, pale or greenish-brown, distinctly exceeding the perianth. $2 n=40$. Coasts of the Baltic; Kattegat; $S$. Norway.
(b) Subsp. raii (Bab.) D. A. Webb \& Chater, Feddes Repert. 68:188 (1963) (P. raii Bab., P. robertii auct., ? an Loisel.): Annual to perennial, green or somewhat glaucous. Leaves usually elliptical, very variable in width. Perianth-segments with white or pale pink margins; nut $2 \cdot 5-5 \cdot 5 \mathrm{~mm}$, dark brown, slightly or considerably exceeding the perianth. $2 n=40$. Shores of N.W. Europe, from N.W. France to arctic Russia; also locally in $W$. Mediterranean region.
P. norvegicum Sam. ex Lid, Norsk Flora 250 (1952) from Fennoscandia is considered a distinct species or subspecies by some authors but it does not, however, seem possible at present to distinguish it satisfactorily from variants occurring in S. \& S.E. Europe.

The plants from the Mediterranean probably correspond to P. robertii Loisel., Mém. Soc. Linn. Paris 6: 409 (1827), but the name is of uncertain application. They differ from those of the Atlantic coasts only in their smaller nut and a greater tendency towards a perennial habit.

The plants from the Black Sea coast (Turkey to Krym), which have been called P. mesembricum Chrtek, Preslia 32: (1960) may perhaps constitute a third subspecies, but their range of variation cannot yet be adequately assessed. They appear to be annual or biennial, with greyish-green or silvery leaves, ochreae with $6-8$ veins, and white margins to the perianth. The nut is said to be generally similar to that of (b), but in some cultivated specimens can approach that of (a).
14. P. graminifolium Wierzb. ex Heuffel, Verh. Zool.-Bot. Ges. Wien 8: 190 (1858). Annual. Stems 10-30 cm, branched, slender, decumbent. Leaves $10-20 \times 1-1.5 \mathrm{~mm}$, linear, subacute. Ochreae brownish, caducous, with c. 6 veins. Flowers solitary or in axillary clusters of 2-3 near the ends of the branches, subsessile. Perianth $1.5-2 \mathrm{~mm}$; segments longer than tube. Nut 2-2.5 mm, exceeding the perianth, glossy. Lower and middle Danube valley. ? Bu Hu Ju Rm [Au].
15. P. aviculare L., Sp. Pl. 362 (1753) (P. heterophyllum Lindman, $P$. littorale auct., pro parte). Annual; stems erect or procumbent. Leaves $20-50 \times 5-15 \mathrm{~mm}$, lanceolate to ovate, subacute, those on the main stem much larger than those on the branches. Ochreae silvery-hyaline, with few, faint veins, usually less than half as long as the internodes; petioles very short, included in ochreae. Flowers solitary or in axillary clusters of 2-6; bracts leaf-like. Perianth-tube very short; segments greenish with pink or white margins, wide and overlapping. Nut $2 \cdot 5$ 3.5 mm , included in perianth, punctulate, dull. $2 n=60$. Probably throughout Europe, but only as an alien in the extreme north. ?All territories.
16. P. boreale (Lange) Small, Bull. Torrey Club 21: 479 (1894). Like 15 but leaves obovate, those on the main stems $30-50 \times 5$ 18 mm ; those on the branches much smaller; petioles well exserted from ochreae; perianth-segments with conspicuous, bright pink margins; nut $3 \cdot 5-4 \cdot 5 \mathrm{~mm}$. $2 n=40$ Northern part of N.W. Europe from Zetland northwards. Br Fa Fe Is No Su.
17. P. rurivagum Jordan ex Boreau, Fl. Centr. Fr. ed. 3, 2: 560 (1857). Like 15 but smaller; leaves linear or linear-lanceolate, acute or acuminate; those of the main stem $15-35 \times 1-4 \mathrm{~mm}$,
those on the branches much smaller; ochreae longer (up to 1 cm ), brownish below; flowers few; perianth-segments narrow, scarcely overlapping; nut $2 \cdot 5-3.5 \mathrm{~mm}$, slightly exserted from perianth. $2 n=60$. Usually a weed in fields. Distribution uncertain; mainly in W. \& S.C. Europe, but extending north-eastwards to Sweden.
P. neglectum Besser, Enum. Pl. Volhyn. 45 (1821), originally described from Lithuania, is said to differ in its more or less uniformly sized leaves, its frequently procumbent habit, and its smaller nut. Plants from U.S.S.R. and from C. Europe have been referred here, but the status of the taxon is not clear. P. scythicum Klokov in Kotov, Fl. RSS Ucr. 4: 650 (1952) from the S. Ukraine is very similar.
18. P. arenastrum Boreau, Fl. Centr. Fr. ed. 3, 2: 559 (1857) ( $P$. aequale Lindman, P. littorale auct., pro parte, P. aviculare auct. ross.). Annual. Stems usually less than 30 cm , procumbent, freely branched, forming a mat. Leaves $5-20 \times 2 \cdot 5-5 \mathrm{~mm}$, elliptical or lanceolate, more or less uniform in size. Ochreae silvery-hyaline with few, faint veins, less than half as long as internodes. Flowers solitary or in few-flowered axillary clusters. Perianth-tube at least half as long as segments. Nut $1 \cdot 5-2 \cdot 5 \mathrm{~mm}$, included in perianth, dull, often with one side much narrower than the other two. $2 n=40$. Probably throughout most of Europe, except the extreme north; distribution imperfectly known.
P. calcatum Lindman, Bot. Not. 1904: 139 (1904) is like 18 but is often more slender and even more closely appressed to the ground. The leaves are smaller, the perianth-tube half as long as the segments, and the nut glossy and smooth (more rarely punctulate). It is recorded in N. Europe, southwards to Britain, Germany, Romania and C. Russia, but does not seem to merit recognition as a distinct species. P. acetosellum Klokov, Jour. Agr. Bot. (Kharkov) 1 (3): 171 (1927), described from E. Ukraine, and P. propinquum Ledeb., Fl. Ross. 3: 532 (1850) from N. Ukraine and S.E. Russia, are very similar.
19. P. acetosum Bieb., Fl. Taur.-Cauc. 1: 304 (1808). Annual. Stems procumbent or ascending, branched; sap acid to the taste. Ochreae silvery-hyaline, with very faint veins. Leaves $2-3 \mathrm{~cm}$, linear-oblong, obtuse, rarely acute, somewhat fleshy, veinless, covered with minute white tubercles and appearing glaucous. Flowers in clusters of 3-7. Perianth bluish-green; segments with white margins. Nut $1 \cdot 7-3 \mathrm{~mm}$, slightly glossy. S.E. Russia (near Astrakhan), ?coast of Bulgaria. ?Bu Rs (E). (S.W. Asia.)

Sect. Persicaria (Miller) DC. Herbs. Ochreae brownish, entire or ciliate but not lacerate. Flowers in spikes; bracts few and inconspicuous. Perianth usually petaloid; stamens 5-8; styles 2, rarely 3, united below. Nut lenticular, rarely trigonous.
20. P. minus Hudson, Fl. Angl. 148 (1762). A glabrous annual. Stems $10-40 \mathrm{~cm}$, slender, decumbent or ascending. Ochreae with long, coarse cilia. Leaves $25-75 \times 4-9 \mathrm{~mm}$, usually $6-9$ times as long as wide, narrowly oblong-lanceolate, subsessile. Spikes slender, lax, often interrupted below, erect. Perianth $2-2.5 \mathrm{~mm}$, deep pink (rarely white). Nut $1 \cdot 5-3 \mathrm{~mm}$, black, glossy, usually lenticular. Damp places. Europe except the south and extreme north; from N. Spain to $63^{\circ}$ N. in Russia. Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Su .
21. P. foliosum H. Lindb., Meddel. Soc. Faun. Fl. Fenn. 23: 3 (1900). Like 20 but ochreae with short cilia or none; leaves linear (c. 10 times as long as wide); inflorescence sparser and more leafy; perianth and nut $1 \cdot 5-2 \mathrm{~mm} .2 n=20$. Fennoscandia; Estonia; N.W. Russia. Fe No Rs (N, B) Su.
22. P. mite Schrank, Baier. Fl. 1: 668 (1789). A glabrous annual. Stems $10-60 \mathrm{~cm}$, slender, erect. Ochreae with long, coarse cilia. Leaves $3-10 \times 0.5-2 \mathrm{~cm}$, usually less than 6 times as long as wide, elliptic-lanceolate, subsessile. Inflorescence lax, slender, interrupted, often branched. Perianth $2 \cdot 5-4 \cdot 5 \mathrm{~mm}$, pink (rarely white). Nut $3-4.5 \mathrm{~mm}$, black, glossy, lenticular or trigonous. $2 n=40$. Most of Europe except the north. Al Au Be Br Bu Co Cz Ga Ge Gr Hb He Ho Hu Hs It Ju Po Rm Rs (C, W, E) Sa Si ?Tu.

Like 23 in general habit and leaf-shape, but easily distinguished by the glossy nut and the absence of glands on the perianth. It is usually distinguishable from 20 by the habit, by the dimensions of the leaves, and by the size of the nut, but a few plants are difficult to assign to either species and many of the records are ambiguous.
23. P. hydropiper L., Sp. Pl. 361 (1753). A glabrous, acrid annual. Stems $20-80 \mathrm{~cm}$, more or less erect. Ochreae fringed with a few short cilia. Leaves $5-12 \times 1-2.5 \mathrm{~cm}$, lanceolate, acute or acuminate, subsessile. Flowers in numerous very lax, slender, nodding spikes; a cleistogamous flower is also present in each leaf-axil. Perianth 3-5 mm, pink or greenish-white, covered with brownish glands. Nut c. 3 mm , punctulate, dull. $2 n=20$. Damp places; calcifuge and somewhat nitrophile. Europe, except the north and some islands. All except Az Bl Cr Fa Is Sa Sb .
24. P. salicifolium Brouss. ex Willd., Enum. Pl. Hort. Berol. 1: 428 (1809) ( $P$. serrulatum Lag.). Perennial, with rooting procumbent or decumbent branches. Stems $30-70 \mathrm{~cm}$, ascending, rather stout. Ochreae strongly ciliate. Leaves $7-15 \mathrm{~cm}$, linearlanceolate, glabrous except for strong hairs on the margins and the veins beneath. Flowers pink, in long, lax, very slender spikes. Nut 2-2.5 mm, black, glossy, usually trigonous. Wet places and river-banks. S. Europe. Al Az Bl Bu Cr Ga Gr Hs It Lu Sa Si.
P. serrulatoides H. Lindb., from N. Africa, which has been doubtfully recorded from some Mediterranean localities in Europe, differs constantly only in the shorter cilia on the ochreae. It does not appear to be specifically distinct.
25. P. persicaria L., Sp. Pl. 361 (1753). Annual. Stems 2080 cm , erect or ascending. Ochreae shortly ciliate. Leaves up to $15 \times 3.5 \mathrm{~cm}$, lanceolate, often with a large blackish spot, glabrous or occasionally tomentose beneath. Spikes cylindrical, dense, usually stout. Perianth bright or pale pink. Nut black, glossy, usually lenticular. $2 n=44$. Ruderal, and as a weed. Throughout Europe. All except Az Cr Sb.
26. P. lapathifolium L., Sp. Pl. 360 (1753) (incl. P. nodosum Pers., P. scabrum Moench and P. linicola Sutulov). Annual. Stems up to 80 cm , procumbent or erect, simple or branched, sometimes spotted with red. Ochreae entire or very shortly ciliate. Leaves ovate to linear-lanceolate, acute or obtuse, sometimes with a large blackish spot, glabrous or densely tomentose beneath, with pellucid, often yellow glands visible from lower surface. Spikes stout and usually dense; peduncles, and sometimes also pedicels and perianth, bearing yellow subsessile glands. Perianth dull pink or greenish-white. Nut black, glossy, usually lenticular. $2 n=22$. Throughout Europe. All except Az Cr Sb.

Extremely variable, especially in habit, colour of foliar glands and of perianth, and in indumentum. The normally autogamous reproduction tends to the production of pure lines, many of which are locally constant and have therefore been named as species or subspecies; but its widespread dissemination as a weed has destroyed any geographical pattern which may have existed, and
there is scarcely any correlation of these characters that remains constant over a wide area. Furthermore, it is known that some of the characters, especially of habit and tomentum, which are partly determined genetically are also very plastic phenotypically.

The only variant which is known both to retain its characteristics in cultivation and to show a well-defined geographical distribution is P. brittingeri Opiz, Natural. 8: 74 (1824) ( $P$. danubiale Kerner) which grows on river-alluvia in the basins of the upper Danube and Rhine. It has procumbent much-branched stems with very short internodes, and broadly elliptical or ovate leaves, densely tomentose beneath and with colourless glands. It probably merits recognition either as a species or as subsp. brittingeri (Opiz) Jáv.
P. nodosum Pers., Syn. Pl. 1: 440 (1805) is a commonly recurring variant with glabrous leaves, yellow foliar glands, red-spotted stems, and pink flowers in a rather lax spike; it is characteristic of river-gravels in some regions. Similarly, P. tomentosum Schrank, Baier. Fl. 1: 669 (1789) (P. pallidum With.), with a low habit, densely tomentose leaves and greenish-white flowers, is often seen on drying mud or as a weed in fields. In both cases, however, it is possible to find plants with some of these characteristics perfectly developed and others not at all, and it seems doubtful whether anything is gained by giving them taxonomic rank.
27. P. amphibium L., Sp. Pl. 361 (1753). Perennial, with slender, far-creeping rhizome. Stems erect, ascending or floating, usually much-branched. Leaves of aquatic plants floating, longstalked, oblong-ovate, truncate or subcordate at base, glabrous; those of terrestrial plants oblong-lanceolate, rounded at the base, pubescent or appressed-hispid. Ochreae not ciliate. Spikes $2.5 \times 1 \mathrm{~cm}$, terminal, obtuse; flowers deep pink. Styles 2, long; nut lenticular, glossy. Europe except the extreme south. $2 n=66$. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Cr} \mathrm{Sb}$.
28. P. hydropiperoides Michx, Fl. Bor. Amer. 1: 239 (1803). Perennial, with slender, far-creeping rhizome. Stems $20-40 \mathrm{~cm}$, decumbent or ascending; ochreae fringed with long cilia. Leaves $5-20 \mathrm{~mm}$ wide, linear-lanceolate, cuneate, glabrous. Flowers pink, in slender, lax, usually branched spikes. Nut trigonous, glossy. Damp places. Açores. Az. (North and South America.)
29. P. orientale L., Sp. Pl. 362 (1753). Annual, densely pubescent throughout. Stem $50-100 \mathrm{~cm}$, erect, stout. Leaves up to 20 cm , ovate-acuminate, stalked, sometimes slightly cordate. Ochreae with green, leaf-like lobes on their distal margin. Flowers pink, in long, slender, moderately dense, branched spikes. Nut 3 mm , glossy, lenticular. Cultivated in gardens and locally naturalized, mainly in C. \& S. Europe. [ Au Cz Ga Ge He Ho It $\mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W}, \mathrm{K}, \mathrm{E)]}. \mathrm{(E} .\mathrm{\&} \mathrm{S.E}. \mathrm{Asia)}$.
30. P. sagittatum L., Sp. Pl. 363 (1753). Annual. Stems 50 100 cm , weak, scrambling by numerous hooked prickles. Leaves $3-6 \mathrm{~cm}$, oblong-sagittate, glabrous. Flowers whitish, in small, long-stalked, subcapitate spikes. Nut glossy, trigonous. Naturalized by unknown means in S.W. Ireland (Kerry). [Hb.] (E. Asia and North America.)
31. P. tinctorium Aiton, Hort. Kew. 2: 31 (1789). Annual. Stems $30-80 \mathrm{~cm}$, erect, usually simple, reddish. Ochreae more or less hyaline, ciliate. Leaves $c .8 \times 6 \mathrm{~cm}$, broadly ovate, glabrous, petiolate, turning dark blue-green on drying. Flowers pink, in short, rather dense spikes, forming a terminal leafy panicle. Nut trigonous, glossy. Formerly cultivated in several countries as a

[^44]dye-plant, and reported as naturalized in Ukraine. [Rs (W).] (China.)

Sect. Bistorta (Miller) DC. Perennial herbs with short, stout rhizomes. Ochreae brown, not lacerate. Flowers in fairly dense terminal spikes. Perianth petaloid; stamens 6-8; styles 3, long and slender; nut trigonous.
32. P. bistorta L., Sp. Pl. 360 (1753). Rhizome stout, contorted. Stems $20-100 \mathrm{~cm}$, erect, simple. Lower leaves $5-15 \mathrm{~cm}$, ovate, obtuse, truncate at base; petioles long, broadly winged in upper part. Upper leaves triangular-lanceolate, acute or acuminate. Flowers bright pink, in a terminal, dense cylindrical spike $20-70 \times 10-15 \mathrm{~mm} .2 n=44$. Damp, grassy places. Throughout a large part of Europe, but absent as a native from most of Fennoscandia, and only on mountains in the south. Al Au Be Br Bu Cz ?Fe Ga Ge He Ho Hs Hu It Ju Lu Po Rm Rs (N, B, C, W, K, E) [Da Hb No Su].
33. P. amplexicaule D. Don, Prod. Fl. Nepal. 70 (1825). Stems $60-100 \mathrm{~cm}$, erect. Leaves large, ovate-acuminate, cordate; the lower petiolate, the upper sessile-amplexicaul. Flowers deep red, in dense but rather slender cylindrical spikes. Cultivated for ornament, and naturalized in Ireland. [Hb.] (Himalaya.)
34. P. viviparum L., Sp. PI. 360 (1753). Rhizome not contorted. Stems $5-40 \mathrm{~cm}$, erect, simple. Leaves up to 10 cm but usually less, oblong- to linear-lanceolate, tapered at both ends; margins revolute. Flowers pale pink or white, in a slender, moderately dense, terminal spike $20-60 \times 5-10 \mathrm{~mm}$, in the lower part of which the flowers are usually replaced by brown or deep purple bulbils. Nut rarely produced. $2 n=c .100, c .132$. N. Europe, and on mountains in C. and parts of S. Europe. $\mathrm{Au} \mathrm{Br} \mathrm{Bu} \mathrm{Cz} \dagger \mathrm{Da} \mathrm{Fa}$ Fe Ga Ge Hb He Hs Is It Ju No Po Rm Rs (N, B, C, W, E) Sb Su .

Sect. Aconogonon Meissner. Perennial herbs. Flowers in diffuse, terminal panicles. Perianth petaloid. Stamens 8. Styles 3 ; nut trigonous.
35. P. alpinum All., Mélang. Philos. Math. Soc. Roy. Turin (Misc. Taur.) 5: 94 (1774). Stems 30-80 cm, erect, arising from a shortly creeping underground rhizome. Leaves $1-3 \mathrm{~cm}$ wide, oblong-lanceolate, tapered at both ends. Ochreae mainly hyaline, soon disappearing. Flowers white or pale pink, in a diffuse panicle. Perianth-segments subequal. Styles very short, with large capitate stigmas. Nut $4-5 \mathrm{~mm}$, exceeding the perianth, trigonous, pale brown, glossy. S., C. \& E. Europe, mainly in the mountains; local. Al Au Bu Co Ga Gr He Hs It Ju Rm Rs (C, W, E) [Da].
36. P. polystachyum Wall. ex Meissner in Wall., Pl. Asiat. Rar. 3: 61 (1832). Stems $60-120 \mathrm{~cm}$, stout, erect, arising from a creeping underground rhizome. Leaves $10-20 \times 3-8 \mathrm{~cm}$, oblonglanceolate, acuminate, truncate or shortly cuneate at the base, glabrous or hairy beneath, usually with red veins. Ochreae brown, thick, persistent, entire. Flowers white, in lax, somewhat leafy panicles with a red axis. Inner perianth-segments broadly obovate to orbicular; outer ones smaller, elliptical. Styles long and slender; stigmas small. Nut rarely produced in Europe. Cultivated in gardens and naturalized in C. \& N.W. Europe. [ Au Be Br $\mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho]}. \mathrm{(Himalaya)}$.

## 3. Bilderdykia Dumort. ${ }^{1}$

Stem twining or procumbent; leaves deltate or cordate-sagittate, petiolate. Ochreae truncate. Flowers in lax, spike-like or paniculate terminal and lateral inflorescences. Perianth-segments
$5(-6)$; the outer 3 larger, keeled or winged. Stamens 8. Stigmas capitate, subsessile. Nut triquetrous, not exceeding the perianth.

1 Woody perennial; inflorescence paniculate
1 Annual; inflorescence narrow, scarcely branched
2 Fruiting pedicels $1-3 \mathrm{~mm}$; nut finely granular
2 Fruiting pedicels $5-8 \mathrm{~mm}$; nut smooth and glossy

1. convolvulus
2. dumetorum
3. B. convolvulus (L.) Dumort., Fl. Belg. 18 (1827) (Polygonum convolvulus L.). Puberulent or slightly mealy. Stem up to 1 m , angular, twining or spreading. Leaves $2-6 \mathrm{~cm}$, acuminate. Flowers in narrow, spike-like inflorescences. Pedicels not more than 3 mm , even in fruit, articulated above the middle. Perianthsegments greenish-white, accrescent, the outer ones keeled or slightly winged in fruit (rarely with broad wings as in 2). Nut $4-5 \mathrm{~mm}$, finely granular, dull black. $2 n=40$. Cultivated ground and waste places. Throughout Europe, certainly introduced in the extreme north and perhaps elsewhere. All except Sb .
4. B. dumetorum (L.) Dumort., loc. cit. (1827) (Polygonum dumetorum L.). Like 1, but often taller; pedicels articulated at or below the middle, attaining $5-8 \mathrm{~mm}$ in fruit and usually deflexed; outer perianth-segments broadly winged in fruit, the wings decurrent on the pedicel; and nut $2 \cdot 5-3 \mathrm{~mm}$, smooth and glossy. $2 n=20$. Usually in hedges or among native vegetation. Most of Europe except the extreme north. Al Au Be Br Bu Co Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Si Su.
5. B. aubertii (Louis Henry) Moldenke, Revista Sudamer. Bot. 6: 29 (1939) (Polygonum baldschuanicum auct., non Regel). A vigorous woody climber, up to 5 m or more. Leaves $3-8 \mathrm{~cm}$, cordate, obtuse to acuminate. Flowers in diffuse, axillary and terminal panicles with somewhat scabrid axis. Perianth-segments white or pale green, becoming pink in fruit; the outer ones with decurrent wings. Nut black, glossy. Cultivated for ornament and occasionally naturalized. [ Au BrCz Hs Rm .] (W. China and Tibet.)
B. baldschuanica (Regel) D. A. Webb, Feddes Repert. 68: 188 (1963) (Polygonum baldschuanicum Regel) from Tadzhikistan, is less frequently cultivated; it is perhaps naturalized in a few places, but most of the records refer to 3. It differs in its bright pink flowers and almost smooth axis to the inflorescence.

## 4. Reynoutria Houtt. ${ }^{1}$

Perennials with extensive subterranean rhizomes and stout, erect annual stems. Functionally dioecious, but with conspicuous rudiments of stamens in the female and of gynaeceum in the male flowers. Flowers in relatively small axillary panicles. Perianth accrescent; segments 5 , the outer 3 keeled, eventually winged. Stamens 8. Styles 3, distinct; stigmas fimbriate.
Leaves seldom more than 12 cm , acuminate-cuspidate; flowers white

1. japonica Leaves usually more than 15 cm , acute or somewhat acuminate; flowers greenish
2. sachalinensis
3. R. japonica Houtt., Nat. Hist. 2 (8): 640 (1777) (Polygonum cuspidatum Siebold \& Zucc.). Stems 1-2 m, numerous, glaucous, often reddish, branched above, forming a dense thicket. Leaves $5-12 \mathrm{~cm}$, broadly ovate-triangular, acuminate-cuspidate, truncate at base, petiolate. Flowers white, in clusters of 2-4, arranged in axillary panicles $8-12 \mathrm{~cm}$ long, with slender, rather lax branches.

[^45]${ }^{2}$ By T. G. Tutin.

Nut 4 mm , glossy. Extensively naturalized from gardens in $N . \&$ C. Europe. [Au Be Br Cz Fe Ga Ge Hb He Ho Hu Lu No Po Rm Rs (N).] (Japan.)
2. R. sachalinensis (Friedrich Schmidt Petrop.) Nakai in Mori, Enum. Pl. Corea 135 (1922) (Polygonum sachalinense Friedrich Schmidt Petrop.). Like 1 but with stouter stems, often more than 3 m ; leaves $15-30 \mathrm{~cm}$, acute or slightly acuminate, usually somewhat cordate; and shorter panicles with stouter, denser branches, the flowers usually in clusters of 4-7. Naturalized from gardens as $\mathbf{1}$, but much less frequently. [ Be Br Cz Fe Ga Hb Ho Hu Po Rs (N).] (E. Asia.)

## 5. Fagopyrum Miller ${ }^{1}$

Erect annuals with hollow stems. Leaves triangular-sagittate, cordate. Ochreae short, truncate, entire. Flowers heterostylous, andromonoecious, in narrow, terminal and axillary, raceme-like panicles; pedicels equalling the perianth, articulated above the middle. Perianth campanulate, with 5 segments, not accrescent. Stamens 8, alternating with yellow nectaries on the disc. Styles 3, long and slender; stigmas capitate, small. Nut triquetrous, greatly exceeding the perianth.

Perianth $3-4 \mathrm{~mm}$; nut with smooth faces and angles 1. esculentum Perianth 2 mm ; nut with rugose faces and sinuate-dentate angles
2. tataricum

1. F. esculentum Moench, Meth. 290 (1794) (F. vulgare T. Nees, F. sagittatum Gilib., Polygonum fagopyrum L.). $15-60 \mathrm{~cm}$, glabrous or puberulent, tinged with red at maturity. Leaves up to $7 \times 6 \mathrm{~cm}$, usually slightly longer than wide, entire or sinuate, dark green, the lower stalked, the upper sessile. Axillary panicles short and compact, on long peduncles. Perianth-segments 34 mm , greenish-white, tipped with pink. Nut $5-6 \mathrm{~mm}$, dark brown, dull at maturity, with smooth faces and acute, entire angles. $2 n=16$. Cultivated as a grain crop in most of Europe except Fennoscandia, and naturalized as an occasional ruderal almost throughout Europe. [Probably all except Cr Fa Gr Hb Is Sb Tu.] (E.C. Asia.)
2. F. tataricum (L.) Gaertner, Fruct. \& Sem. Pl. 2: 182 (1790). Like 1, but often taller, glabrous, seldom tinged with red; leaves usually wider than long, lighter green; panicles longer and laxer; perianth-segments 2 mm , usually entirely green; and nut irregularly rugose with obtuse, sinuate-dentate angles. $2 n=16$. Cultivated in much of Europe, though less often than 1, and widely distributed as a ruderal, and as a weed in cultures of 1. [ Be DaFe $\mathrm{Ga} \mathrm{He} \mathrm{Ho} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{W}, \mathrm{C}, \mathrm{E)} \mathrm{Su;} \mathrm{casual} \mathrm{elsewhere]}$.

## 6. Oxyria Hill ${ }^{2}$

Perennial herb. Perianth-segments in 2 whorls of 2, the inner accrescent in fruit but not tubercled. Stamens 6. Stigmas 2. Fruit lenticular, broadly winged.

1. O. digyna (L.) Hill, Hort. Kew. 158 (1768). Glabrous, up to 30 cm . Leaves $1-3 \mathrm{~cm}$, almost all basal, reniform, petiolate. Inflorescence branched, leafless. Pedicels slender, jointed about the middle, thickened towards the top. Outer perianth-segments spreading or deflexed, inner appressed. $2 n=14$. Arctic Europe, and on all the principal mountain-ranges southwards to C. Spain, Corse and Bulgaria. Au Br Bu Co Cz Ga Ge Hb He Hs Is It Ju No Po Rm Rs (N, W) Sb Su.

## 7. Rheum L. ${ }^{1}$

Robust perennial herbs with a woody rhizome. Leaves large, palmately veined. Ochreae loose, persistent, not ciliate. Flowers hermaphrodite, in a panicle. Perianth-segments 6 , free, equal, not accrescent. Stamens 9. Stigmas 3, subsessile. Fruit with 3 membranous wings.

Several species from temperate Asia are occasionally cultivated in gardens for their decorative foliage. R. palmatum L., Syst. Nat. ed. $10,1010(1759)$ from W. China, was formerly much cultivated as a purgative; and R. rhabarbarum L., Sp. Pl. 372 (1753), from Mongolia and neighbouring territories, is cultivated extensively in Britain and occasionally elsewhere in N.W. Europe for its edible petioles.
Stem with a single leaf; inflorescence compact, subglobose

1. tataricum Stem with several leaves; inflorescence diffuse, pyramidal
2. rhaponticum
3. R. tataricum L. fil., Suppl. 229 (1781). Leaves mostly basal, up to 50 cm wide, ovate to orbicular, cordate, entire, glabrous above, finely tuberculate on lower surface and petiole. Stems stout, inclined, each bearing a single leaf. Inflorescence condensed, subglobose. Perianth-segments 3 mm , yellowish, with brown veins. Fruit c. $11 \times 9 \mathrm{~mm}$, dark brown, with rather narrow wings. Dry, open places. S.E. Russia. Rs (E). (C. Asia.)
4. R. rhaponticum L., Sp. Pl. 371 (1753). Like 1 in general habit, but leaves glabrous throughout and with undulate margin; stem with several leaves; panicle pyramidal, diffuse, somewhat leafy; and fruit much smaller. Wet mountain rocks. S.W. Bulgaria (Rila Planina). Bu.

Closely related plants, which have often been considered conspecific, are found in Siberia and C. Asia; they are sometimes cultivated and one is reported as naturalized in N. Germany.

## 8. Rumex L. ${ }^{2}$

Herbs, rarely shrubs, usually with long, stout roots, sometimes rhizomatous. Leaves alternate; ochreae tubular. Flowers hermaphrodite or unisexual, arranged in whorls on simple or branched inflorescences, anemophilous. Perianth-segments in two whorls of 3 , the outer remaining small and thin, the inner becoming enlarged and often hardened in fruit. Valves (fruiting inner perianthsegments) sometimes developing marginal teeth or dorsal tubercles as they mature. Stamens in two whorls of 3; anthers basifixed. Fruit a trigonous nut.

Literature: K. H. Rechinger, Beih. Bot. Centr. 49 (2): 1-132 (1932). Feddes Repert. 31: 225-83 (1933). Candollea 12: 9-152 (1949).

1 Shrub; leaves ovate-spathulate, often wider than long 5. lunaria
1 Herbs, sometimes woody at the base; leaves usually longer than wide
2 Leaves usually hastate or sagittate and tasting acid; flowers usually unisexual
3 Valves scarcely exceeding nut (rarely up to twice as long)
4 Valves not or scarcely exceeding nut; basal lobes of leaves usually distinct (1-3). acetosella group
4 Valves distinctly exceeding nut (up to twice as long); basal lobes of leaves very small or absent
4. graminifolius

3 Valves several times as long as nut
5 Annual; valves 12-18(-23) mm wide
20. vesicarius

5 Perennial; valves not more than 13 mm wide
${ }^{2}$ By K. H. Rechinger.

6 Outer perianth-segments free, appressed to the base of the inner ones
7 Valves at least $9 \times 10 \mathrm{~mm}$; ochreae of inflorescence large, persistent; leaves often undulate, sometimes dissected
6. tingitanus

7 Valves less than $9 \times 10 \mathrm{~mm}$; ochreae evanescent; leaves not undulate or dissected
8 Stems woody below; leaves narrowly linear
7. suffruticosus

8 Stems herbaceous (sometimes woody at the extreme base); leaves scutate or hastate
8. scutatus

6 Outer perianth-segments united at the base, deflexed
9 Roots tuberous (cf. 19)
9. tuberosus

9 Roots not tuberous
10 Inflorescence lax, with simple branches
11 Ochreae $\pm$ entire
12 Stem 20 cm or less, with at most 2 small leaves; valves 3 mm in diameter 10. nivalis
12 Stem ( $10-$ ) $50-120 \mathrm{~cm}$; cauline leaves numerous, large; valves (3-) $3 \cdot 5-4 \cdot 5 \mathrm{~mm}$ in diameter
11. arifolius

11 Ochreae fimbriate
13 Cauline leaves few, 8-12 times as long as wide, with long basal lobes; inflorescence with few, very short branches; valves $2.5-3 \mathrm{~mm}$
13. gussonei

13 Cauline leaves numerous, 3-6 times as long as wide, with short basal lobes; inflorescence with several flexuous branches; valves $3-3.5 \mathrm{~mm}$
14. acetosa

10 Branches of inflorescence repeatedly branched
14 Valves broadly emarginate at apex, c. 9 mm wide; 14 inflorescence very compact $\begin{aligned} & \text { 19. thyrsoides } \\ & \text { Valves rounded at apex, less than } 6 \mathrm{~mm} \text { wide }\end{aligned}$
15 Leaves papillose
17. papillaris

15 Leaves smooth
16 Upper cauline leaves 2-3 times as long as wide
17 Leaves often undulate; ochreae not fimbriate; panicle dense, with most of the branches repeatedly branched 16. rugosus
17 Leaves flat; ochreae fimbriate; panicle lax, only the lower branches branched again 12. amplexicaulis
16 At least the upper cauline leaves more than 4 times as long as wide
18 Valves 3-4 mm in diameter; lower leaves narrowly linear; basal lobes divergent 18. intermedius
18 Valves $2 \cdot 5-3.2 \mathrm{~mm}$ in diameter; lower leaves broader than the upper ones; basal lobes deflexed 15. thyrsiflorus
2 Leaves cordate, rounded or cuneate at base, never hastate or sagittate; most flowers hermaphrodite (except in 4)
19 Stem with axillary shoots flowering later than main stem
20 Stem erect; leaves thin, lanceolate; valves $3.5 \times 2.5 \mathrm{~mm}$
21. triangulivalvis

20 Stem creeping; leaves thick, obovate; valves $4 \times 3 \mathrm{~mm}$
22. frutescens

19 Stem without axillary, late-flowering shoots
21 Valves all without tubercles
22 Leaves narrowly linear, at least 10 times as long as wide; valves not more than twice as long as the nut.
4. graminifolius

22 Leaves not narrowly linear; valves more than twice as long as the nut
23 Lower surface of leaves and petioles densely papillose; valves distinctly denticulate
29. cantabricus

23 Leaves not papillose
24 Basal and lower cauline leaves all deeply cordate, usually about as long as wide (rarely up to $1 \frac{1}{2}$ times as long as wide), rounded at apex 23. alpin
24 Basal and lower cauline leaves rounded or cuneate at base, acute at apex (or if cordate at base, then at least $1 \frac{1}{2}$ times as long as wide)
25 Basal and lower cauline leaves widest near the usually cordate base
26 Valves entire, with subacute apex $\quad$ 24. aquaticus

26 Valves denticulate, with very acute apex 25 . azoricus
25 Basal and lower cauline leaves widest near or below the middle, usually rounded or cuneate at base
27 Basal leaves $1 \frac{1}{2}-2$ times as long as wide; petiole shorter than lamina
27. balcanicus

27 Basal leaves more than twice as long as wide; petiole at least as long as lamina
28 Infiorescence simple or with very few short branches, lax; basal leaves usually 6-12 cm; stem 40 cm or less
26. arcticus

28 Inflorescence always branched; basal leaves more than 12 cm ; stem normally more than 60 cm
29 All leaves narrowly linear-lanceolate; lower cauline leaves up to 8 times as long as wide; valves $3 \cdot 5$ 5 mm long, less than 5 mm wide
28. pseudonatronatus

29 Lower cauline leaves not more than 4 times as long as wide; valves $4.5-6 \mathrm{~mm}$ long, more than 5 mm wide
30. longifolius

21 At least one valve with a distinct tubercle
30 Valves entire, or with very small or indistinct teeth or crenulations not more than 1.5 mm long
31 Pedicels thick, persistent, articulated near the middle but scarcely deciduous, about as long as the valves 42. pulcher

31 Pedicels slender, thin, articulated below the middle, deciduous, longer than the valves
32 Basal and lower cauline leaves almost as wide as long, deeply cordate
31. confertus

32 Basal and lower cauline leaves rounded, truncate or cuneate at base (or, if cordate, at least twice as long as wide)
33 Valves usually $5-8 \mathrm{~mm}$, broadly rounded-cordate or rounded-triangular; tubercles much narrower than the width of the valves; most whorls of infructescence crowded
34 Aquatic; basal leaves usually 50 cm or more; tubercles of the $\pm$ triangular valves $2-3$ times as long as wide
32. hydrolapathum

34 Terrestrial; basal leaves much smaller; tubercles of the $\pm$ cordate valves hardly longer than wide
35 Basal leaves about 3 times as long as wide, pale green; petiole flat above; tubercles small, developing late, long remaining soft
36 Lateral veins of leaves making an angle of $45-60^{\circ}$ with the midrib; valves entire 35. patientia
36 Lateral veins of leaves making an angle of $60-90^{\circ}$ with the midrib; valves $\pm$ toothed
37 Valves 6-8 6-7 mm, red-brown, with numerous irregular teeth c. 1 mm .
33. cristatus

37 Valves $5 \times 6 \mathrm{~mm}$, dark brown, with very small indistinct teeth near the base
34. kerneri

35 Basal leaves usually more than 3 times as long as wide, fresh or dark green; petiole canaliculate above; tubercles of valves large, developing and hardening early
38 Valves $\pm$ entire
36. crispus

38 Valves with small but distinct teeth 37. stenophyllus
33 Valves usually 3-4 mm, lingulate; tubercles occupying nearly the whole width of the valves; all whorls of infructescence remote
39 Leaves glaucous; valves c. 4 mm , all with prominent tubercles $\frac{2}{3}-\frac{3}{4}$ their length
40. rupestris

39 Leaves not glaucous; valves not more than 3 mm
40 Pedicels about as long as the valves or only slightly longer; all valves with tubercles; usually all whorls of flowers subtended by leaves 38. conglomeratus
40 Pedicels always distinctly longer than the valves; only one valve with a tubercle; only the lower whorls of flowers subtended by leaves 39. sanguineus
30 Valves with distinct teeth more than 1 mm long
41 Perennial
42 Teeth of valves hooked at the apex
41. nepalensis

42 Teeth of valves straight or curved
43 Pedicels thick, persistent, about as long as the valves, articulated near the middle, but scarcely deciduous; leaves $c .10 \mathrm{~cm}$, thick 42. pulcher
43 Pedicels slender, easily disarticulating, the largest at least twice as long as the valves; articulated near the base and easily deciduous when ripe; leaves $c .20 \mathrm{~cm}$, thin
43. obtusifolius

41 Annual or biennial
44 Whorls with 2-4 flowers; basal leaves $1-2 \mathrm{~cm}$
50. bucephalophorus

44 Whorls many-flowered; basal leaves more than 2 cm
45 Valves $4-5 \mathrm{~mm}$, with stout, subulate teeth 44. dentatus
45 Valves not more than $3 \cdot 5(4) \mathrm{mm}$; with slender, setaceous teeth
46 Middle cauline leaves cuneate at base; petiole short
47 Valves 3-3•5(-4) mm ; tubercle with obtuse apex
45. palustris

47 Valves $2 \cdot 5-3 \mathrm{~mm}$; tubercle with acute apex
48 Most pedicels longer than the valves; teeth longer than the length of the valves; tubercles much narrower than the valve 46. maritimu
48 Most pedicels shorter than the valves; teeth shorter than the length of valves; tubercle covering almost the whole surface of the valve 47. rossicus
46 Middle cauline leaves truncate or shortly cuneate at base, often panduriform; petiole long
49 Only the anterior valve with a distinct tubercle; valves with a long, subulate apex 48. marschallianus
49 All valves with nearly equal tubercles; valves with acute apex
49. ucranicus

Subgen. Acetosella. Dioecious (very rarely polygamous). Slender perennials. Valves seldom much longer than the nut, without tubercles. Leaves hastate or sagittate, acid-tasting.
(1-3). R. acetosella group. Members of this group may be recognized by the hastate or sagittate leaves with distinct basal lobes, and the valves of the fruit about the same size as the nut. The species are critical and have only recently been recognized as distinct, and their distribution is still imperfectly known. There is much variation in leaf-shape, and 1 and 3 sometimes have the basal lobes of the leaves divided.
1 Valves not separable from the nut

1. angiocarpus

1 Valves separable from the nut
2 Stem procumbent or ascending, with upright branches; inflorescence branching from below the middle; leaves often narrowly linear, the basal ones up to 10 times as long as wide
2. tenuifolius

2 Stem erect; inflorescence branching from or above the middle; leaves lanceolate or linear-lanceolate
3. acetosella

1. R. angiocarpus Murb., Lunds Univ. Arsskr. 27 (5): 46 (1891) ( $R$. acetosella subsp. angiocarpus Murb.). Leaves varying in outline, hastate; central lobe lanceolate; basal lobes entire or sometimes divided. Flowering stems more or less erect, branching at or above the middle. Valves adhering to the nut. Nut as wide as or somewhat wider than long. $2 n=14$. C. \& W. Europe; W. Mediterranean region.
2. R. tenuifolius (Wallr.) Á. Löve, Bot. Not. 1941: 99 (1941) ( R. acetosella var. tenuifolius Wallr.). Leaves narrowly linear, up to 10 times as long as wide, the cauline rarely more than 2 mm wide; margin often deflexed; basal lobes narrow, diverging at right angles or directed somewhat distally. Flowering stems ascending, or procumbent with erect branches, branched from below the middle. Valves separating from the nut. Nut 0.91.3 mm , longer than wide. $2 n=28$. N. \& E. Europe.
3. R. acetosella L., Sp. Pl. 338 (1753) sensu stricto, emend. Á. Löve, op. cit. 160 (1941). Leaves hastate, variable in outline;
central lobe lanceolate; basal lobes entire or sometimes divided. Flowering stems more or less erect, branching from the middle or above it. Valves readily separating from the nut. Nut $1 \cdot 3-1 \cdot 5 \mathrm{~mm}$, longer than wide. $2 n=42$. Throughout Europe.
4. R. graminifolius Rudolph ex Lamb., Trans. Linn. Soc. Londo n 10: 264 (1811) (R. angustissimus Ledeb.). Stem usually procumbent. Leaves small, narrowly linear; basal lobes indistinct or absent. Valves from slightly longer than to nearly twice as long as the nut. Nut $c .1 .8 \mathrm{~mm}$, longer than wide. $2 n=56$. Arctic. FeRs (N).

Subgen. Acetosa. Dioecious or polygamous, rarely monoecious. Valves considerably longer than the nut, with or without tubercles. Leaves usually hastate or sagittate, often acid-tasting.

This subgenus is badly in need of revision; the following treatment is therefore tentative.
5. R. lunaria L., Sp. Pl. 336 (1753). Shrub with flexuous branches. Leaves $2.5-5 \times 2.5-6 \mathrm{~cm}$, often wider than long, broadly ovate-spathulate, truncate at the base, rounded at the apex. Inflorescence a compound panicle. Outer perianth-segments 2 mm , lanceolate, deflexed. Valves $5 \times 7 \mathrm{~mm}$, reniformorbicular, narrowly cordate at base, rounded or truncate at apex, with a small, flat, quadrangular tubercle near the base; margin entire. Nut $3 \times 1.3 \mathrm{~mm}$, widest a little below the middle. Naturalized in Sicilia and Sardegna. [Sa Si.] (Canarias.)
6. R. tingitanus L., Syst. Nat. ed. 10, 2: 991 (1759). Rhizome emitting long stolons. Leaves ovate- to lanceolate-triangular, truncate or broadly sinuate at the base, gradually attenuate at the apex, crispate to lobate (or sometimes pinnatipartite, var. lacerus Boiss., non R. lacerus Balbis). Ochreae of inflorescence large, persistent. Outer perianth-segments c. 4 mm , free, obovate, deflexed. Valves $9-11 \times 10-13 \mathrm{~mm}$, thin, pale, often purplish towards the margin, entire, with tubercles. Nut $3 \cdot 5-4 \cdot 2 \times 1 \cdot 5$ 2 mm , reddish, broadest below the middle. Maritime sands. $W$. Mediterranean region, Portugal. Ga It Hs Lu.
7. R. suffruticosus Gay ex Meissner in DC., Prodr. 14: 72 (1856). Stems densely branched, dark and woody at the base; flowering branches herbaceous, erect. Leaves narrowly linear, hastate, with long, narrow basal lobes diverging at right angles. Outer perianth-segments free, appressed to the margins of the valves. Inflorescence small, narrow, usually lax; branches simple. Valves c. $3 \times 3 \mathrm{~mm}$, dark brown. Mountains of $N . \& C$. Spain. Hs ?Lu.
8. R. scutatus L., Sp. Pl. 337 (1753) (incl. R. aetnensis C. Presl). Suffrutescent, with subterranean shoots, branching from the base. Leaves scutate, variable in outline, about as long as wide, green or glaucous. Inflorescence very lax, with few, erect branches. Pedicels shorter than the valves. Flowers polygamous. Valves $4 \cdot 5-6 \times 5 \mathrm{~mm}$, pale, cordate, without tubercles. Nut $3-3.5 \mathrm{~mm}$, yellowish-grey. $2 n=20$. Screes. Mountains of C. \& S. Europe; cultivated elsewhere and sometimes escaping. Al Au Be Bu Co Cz $\mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(K)} \mathrm{Sa} \mathrm{[Br} \mathrm{Ho} \mathrm{Su]}$.
R. induratus Boiss. \& Reuter, Pugillus 107 (1852), from dry habitats in Portugal and C. \& S. Spain, is like 8 but with nearly leafless stems and flowering branches indurate in fruit, forming an intricate, globose mass. It probably deserves specific status.
9. R. tuberosus L., $S p$. Pl. ed. 2, 481 (1762). At least some of the roots tuberous. Stems $20-60 \mathrm{~cm}$. Valves $5-8 \times 5-8 \mathrm{~mm}$. Mediterranean region; Romania and S.E. Russia. Bu Co Ga Gr It Ju Rm Rs (E) Sa Tu.

A polymorphic species, comprising several geographical races and in need of further study (vide K. H. Rechinger, Candollea 12: 29 ff. (1949)).
(a) Subsp. tuberosus: Stems up to 60 cm , erect, solitary or few. Leaves acute. Inflorescence long, usually lax. Valves $c .5 \times 5 \mathrm{~mm}$. Throughout most of the range of the species.
(b) Subsp. creticus (Boiss.) Rech. fil., Candollea 12: 30 (1949): Stems several, low, arcuate-ascending. Basal leaves more or less obtuse. Inflorescence short, contracted; valves up to $8 \times 8 \mathrm{~mm}$. S.E. part of Mediterranean region.
10. R. nivalis Hegetschw. Fl. Schweiz 345 (1840). Stems $7-$ 20 cm , several from a thick stock, leafless or with 1-2 cauline leaves. Leaves small; outermost (or sometimes all) basal leaves rounded at the apex, slightly cordate at the base, without basal lobes; cauline leaves (if present) and sometimes inner basal leaves more or less hastate. Inflorescence lax, usually simple, rarely with $1-2$ short branches. Valves c. 3 mm . Nut pale.
 2750 m. E. Alps; Crna Gora. Al Au He It Ju.
11. R. arifolius All., Mélang. Philos. Math. Soc. Roy. Turin (Misc. Taur.) 5: 94 (1774) (R. montanus Desf.). Stems (10-) $50-120 \mathrm{~cm}$, with numerous cauline leaves. Basal leaves ovate, about twice as long as wide, cordate at the base, with short, truncate, rounded or acuminate basal lobes. Ochreae more or less entire. Panicle lax, with flexuous branches, the lower sometimes branched. Valves $3 \cdot 3-4 \cdot 5 \mathrm{~mm}$ long and wide. Nut $2 \cdot 5-3 \mathrm{~mm}$, usually yellowishgrey (rarely brown), dull. $2 n=14$ (尔), 15 ( ${ }^{7}$ ). Meadows, mainly in the mountains. From Iceland to Poland and the Balkan peninsula. Au Bu Co $\mathrm{Cz} \mathrm{Fa} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{?Lu} \mathrm{?No} \mathrm{Po}$ Rm ?Rs (N) ?Sa ?Su.

Very distinct in C. Europe from 14 and other related species, but much less so in the north and south.

The plant described as R. acetosa subsp. lapponicus Hiitonen, Suomen Kasvio 298 (1933) appears to be related to 11 and to replace it in Fennoscandia. It is of more slender habit, with fewer nodes, often smaller and more rounded leaves, and a very lax panicle.
R. fontano-paludosus Kalela, Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo 14 (2): 11 (1940), which grows in wet places in E. Finland and Russia, is like 11 but with a long, slender vertical stock; slender, very slightly furrowed stem; small, thick leaves with short basal lobes; inflorescence with few branches; and valves up to 6 mm . It may, perhaps, be an eastern ecotype of $R$. acetosa subsp. lapponicus Hiitonen.
12. R. amplexicaulis Lapeyr., Hist. Abr. Pyr. 200 (1813). Tall perennial. Ochreae persistent till the fruit is ripe, long, with long marginal cilia. Leaves broadly rounded, with semi-amplexicaul base. Panicle very large and lax; lower branches compound. Flowers larger than in 11. Woods and river-banks in the mountains. France, Spain, Italy. Ga Hs It.

Related to 11, and perhaps replacing it in the mountains of S. Europe.
13. R. gussonei Arcangeli, Comp. Fl. Ital. 586 (1882). (R. triangularis sensu Guss., non DC., ?R. nebroides Campd., ?R. acetosa var. alpinus Boiss.) Stems $10-30(-50) \mathrm{cm}$, sometimes more or less caespitose. Basal leaves about twice as long as wide, sagittate, acute, with acute, deflexed basal lobes; cauline leaves few, very narrow. Inflorescence narrow, with few, short branches. Valves $2 \cdot 5-3 \mathrm{~mm}$, pale, membranous, with a small, deflexed tubercle near the base. Nut c. $2.2 \times 1.5 \mathrm{~mm}$, dark brown, widest
below the middle. Screes and rock-crevices on limestone. Mountains of Balkan peninsula; Appennini. Al Gr It Ju ?Si.

Somewhat similar plants occur rarely in the S.W. Alps and E. Pyrences.
14. R. acetosa L., Sp. Pl. 337 (1753). Ochreae fimbriate. Basal leaves 2-4 times as long as wide, with long, narrow, deflexed basal lobes. Branches of inflorescence simple. Valves 3-3.5 mm, suborbicular, with a small tubercle near the base. Nut 1.8$2 \cdot 2 \mathrm{~mm}$, blackish, shining. $2 n=14$ ( (), 15 ( ${ }^{\text {( })}$. Mainly in meadows. Most of Europe, but rare in much of the south. Al Au Be Br Bu $\mathrm{Co} \mathrm{Cz} \mathrm{Da} \mathrm{Fa} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{?Lu} \mathrm{No} \mathrm{Po} \mathrm{Rm}$ Rs (N, B, C, W, E) ?Sa Su [Is].

Polymorphic; several variants have been given specific rank. Of these the most distinct are:
R. vinealis Timb.-Lagr. \& Jeanb., Bull. Soc. Bot. Fr. 11: lxxii (1864). Whole plant purplish; without acid taste. Stems numerous, from a thick stock, branched from below the middle. Basal leaves ovate, slightly sagittate. Inflorescence long, narrow. Valves nearly 4 mm wide. Vineyards in S.W. France (near Toulouse).
R. hibernicus Rech. fil., Watsonia 5: 65 (1961). Stems 10-15 cm, several, arcuate-ascending, from a thin, straggling stock. Basal leaves $10-15 \times 5-10 \mathrm{~mm}$, with short, acute, slightly divergent basal lobes; cauline leaves few, the upper up to 8 times as long as wide. Inflorescence dense, with very few, short branches. Valves up to $4 \times 4.5 \mathrm{~mm}$. Dunes in W. Scotland and W. Ireland.
15. R. thyrsiflorus Fingerh., Linnaea 4: 380 (1829) (incl. R. nemorivagus Timb.-Lagr.). Basal leaves 3-4 times as long as wide; cauline leaves becoming progressively narrower upwards, up to 14 times as long as wide; basal lobes divergent, sometimes divided. Panicle dense, with branches repeatedly branched. Valves $2 \cdot 5-3(-5) \mathrm{mm}$, cordate-reniform, sometimes wider than long, with a small deflexed tubercle near the base. Nut $1 \cdot 8-2 \cdot 2 \mathrm{~mm}$, dark brown. $2 n=14$. Dry, open habitats. E. \& C. Europe, extending to Denmark and the Netherlands; recently spreading as an alien into W. Europe. Al Au Cz Da Fe Ge Gr Ho Hu Ju Po Rm Rs (N, B, C, W, K, E) Su [Ga He ?It No].

Flowers 2-6 weeks later than 14 in places where both grow together.
16. R. rugosus Campd., Monogr. Rumex 113 (1819) (R. ambiguus Gren.). Stems up to 120 cm , pale green. Leaves large, pale green, somewhat fleshy when alive, very thin when dry, 2-4 times as long as wide, rounded at the apex, with deflexed basal lobes; cauline leaves decreasing slightly upwards; the uppermost sessile, with a broadly cordate base, tapering towards the apex. Panicle dense, with branches repeatedly branched. Valves $3(-4) \mathrm{mm}$ long and wide. Nut up to 2 mm , dark brown. Origin unknown; cultivated as a vegetable and established here and there as an escape.
17. R. papillaris Boiss. \& Reuter, Pugillus 107 (1852). Like 15, but plant more slender; leaves papillose-pubescent, wider, with less divergent lobes; valves smaller. Spain and Portugal. Hs Lu.

Not yet well understood, but probably related to 15 . The papillose leaf-surface seems to be correlated with other characters, though this still needs confirmation. Plants of 14 and 15 with slightly papillose stems and leaves, but without the other characters, are occasionally found.
18. R. intermedius DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 369 (1815). Stems up to 60 cm , often several. Basal leaves $10 \times 1$ 1.5 cm , rarely wider, linear, with narrow, divergent lobes; cauline
leaves narrowly linear with sagittate base; all leaves often crispate at the margin. Valves $3-4 \mathrm{~mm}$, as wide as long, not or scarcely cordate at base. Nut $2 \times 1 \mathrm{~mm}$, dark brown. W. Mediterranean region. Bl Ga Hs ?It.
19. R. thyrsoides Desf., Fl. Atl. 1: 321 (1798). Roots tuberous. Stems 30-50 cm. Basal leaves thick, c. 2-3 times as long as wide, often constricted above the base, with short, acute, deflexed basal lobes; cauline leaves progressively smaller and narrower, the uppermost sometimes linear; all leaves often crispate at margin. Valves $6 \times 9 \mathrm{~mm}$, subcordate at base. Nut $3 \times 1.5 \mathrm{~mm}$, dark purplish-brown. W. Mediterranean region. Ga Hs It Sa Si.
20. R. vesicarius L., Sp. Pl. 336 (1753). Glaucous annual. Leaves triangular-hastate. Pedicels solitary in the axils of the small ochreae, usually bearing 2 flowers, a primary and a secondary. Valves of the primary flowers $12-18(-23) \mathrm{mm}$ long and wide, membranous, finely and densely reticulate, 2 valves of each flower with tubercles, all with margins bent outwards so as to hide the tubercles and also the smaller secondary flower. Nut of primary flowers $3 \cdot 5-4 \cdot 7(-5 \cdot 2) \mathrm{mm}$, greyish-brown; of secondary flower $2 \cdot 8-4(-4 \cdot 5) \mathrm{mm}$, somewhat darker. Once recorded from S.E. Greece (near Navplion). ?Gr. (N. Africa, S.W. Asia.)

Subgen. Rumex (Subgen. Lapathum). All or most flowers hermaphrodite. Valve several times as wide as the nut, with or without tubercles. Basal and lower cauline leaves never hastate or sagittate.

Many species of Subgen. Rumex hybridize freely. Most hybrids are highly sterile, the pollen grains being of irregular size or remaining clumped together in the anthers. Hybrids may be recognized by the lax and untidy habit, the stems often taller than their parents, the mostly sterile flowers shed prematurely from the primary inflorescence, the occurrence of secondary flowering branches below the primary inflorescence, the valves of different shape and sizes on the same plant, and the nuts empty or failing to develop.
21. R. triangulivalvis (Danser) Rech. fil., Feddes Repert. 40: 297 (1936). Perennial. Stem $30-50(-100) \mathrm{cm}$, rarely flexuous and decumbent at the base. Leaves $c .5$ times as long as wide, linearlanceolate, acute, pale green; petiole short. Pedicels filiform, jointed near the base, up to $1 \frac{1}{2}$ times as long as valves. Valves $(1-) 3(-4) \times 2 \cdot 5-3 \mathrm{~mm}$, triangular, entire, without tubercles. Nut $2 \times 1.3 \mathrm{~mm}$. Naturalized in N., W. \& C. Europe. [Au Be Br Cz Da Ge Ho Is No Su.] (North America.)
22. R. frutescens Thouars, Mélang. Bot. 1 (5): 38 (1811) (R. cuneifolius Campd.). Rhizome long, creeping, jointed, branched, with short, erect leafy and flowering stems. Leaves $c .1 \frac{1}{2}$ times as long as wide, obovate, thick; petiole short. Inflorescence small, crowded, leafless. Valves $4 \times 3 \mathrm{~mm}$, longer than pedicels, ovatetriangular, entire, coriaceous, each with a fusiform tubercle. Nut $2.5 \times 2 \mathrm{~mm}$, broadest in the middle. Naturalized on dunes in England and Denmark; casual elsewhere. [Br Da.] (South America.)
23. R. alpinus L., Sp. Pl. 334 (1753). Rhizome creeping; stems $50-100 \mathrm{~cm}$, erect. Basal leaves about as long as wide, deeply cordate, rounded at apex; petiole longer than lamina. Panicle crowded; branches fasciculate, repeatedly branched; pedicels filiform, up to 3 times as long as valves. Valves $4 \cdot 5-5(-6) \times 3 \cdot 5-$ 5 mm , entire, without tubercles. $2 n=20$. Strongly nitrophile. Mountains of C. \& S. Europe. Al Au Bu Cz Ga Ge Gr He Hs It Ju Po Rm Rs (W) [Br].
24. R. aquaticus L., Sp. Pl. 336 (1753). Perennial. Stem (50-) $100-200 \mathrm{~cm}$, erect. Basal leaves triangular, acute, deeply cordate at base, $1 \frac{1}{2}-2 \frac{1}{2}$ times as long as wide; petiole at least as long as lamina. Panicle large, dense; pedicels filiform, up to $2 \frac{1}{2}$ times as long as the valves. Valves ( $\left.5-\right) 6-8.5 \mathrm{~mm}$, ovatetriangular, more or less acute, longer than wide, margins entire. $2 n=c$. 200. Wet places. N., C. \& E. Europe. Au Be Br Cz Da Fe Ga Ge He Ho Hu Ju No Po Rm Rs (N, B, W, E) Su.
Many records for S. Europe are erroneous. The hybrid with $R$. hydrolapathum (described under that species) is frequent and fairly fertile. The hybrid with $R$. longifolius is frequent, especially in N. Sweden.
25. R. azoricus Rech. fil., Candollea 11: 229 (1948). Like 24 but with very acute valves, the margins minutely but distinctly denticulate. Açores (Faial, São Jorge). Az.
R. caldeirarum Rech. fil., Candollea 11: 235 (1948), which is possibly a hybrid between $R$. azoricus and $R$. obtusifolius subsp. obtusifolius, has been found once, on Sao Miguel.
26. R. arcticus Trautv. in Middenddorff, Reise Nord. Östen Sibir. 1 (2) 1: 29 (1856). Like 24 but stem short, slender, more or less simple; basal leaves small, more than twice as long as wide, rounded or cuneate (rarely indistinctly cordate) at base; valves $4-5 \times 3-4 \mathrm{~mm} .2 n=c .200$. Marshes. N. Russia. Rs (N) (Arcticcircumpolar).
27. R. balcanicus Rech. fil., Magyar Bot. Lapok 33: 5 (1934). Rhizome creeping. Leaves elliptical, $1 \frac{1}{2}-2$ times as long as wide, equally tapered at both ends; lateral veins making an acute angle with the midrib. Inflorescence leafless, diffuse. Valves 2-2.5x 1.5 mm . Beside mountain streams. - Jugoslavia. Ju.
28. R. pseudonatronatus Borbás, Értek. Term. Köreb. Magyar Tud. Acad. 11 (18): 21 (1880) (R. fennicus (Murb.) Murb.). Root perennial, fusiform. Stem $80-150 \mathrm{~cm}$, stiffly erect, slender. Leaves $8-15$ times as long as wide, narrowly lanceolate, undulate. Inflorescence long, narrow, crowded, nearly leafless. Pedicels up to twice as long as valves, filiform. Valves $3 \cdot 5-5 \times 3 \cdot 2-4 \cdot 8 \mathrm{~mm}$, slightly cordate at base, rounded at apex, entire, without tubercles. Nut $2-3 \times 1 \cdot 0-1 \cdot 5 \mathrm{~mm} .2 n=40$. Riversides and seashores; more or less halophilous. E. Europe, extending to E. Sweden and E. Austria. Au Fe Hu Rs (N, B, C, W, E) Su.
29. R. cantabricus Rech. fil., Österr. Bot. Zeitschr. 107: 439 (1960). Petioles and leaves densely papillose. Petiole of basal and lower cauline leaves about as long as the lamina; lamina distinctly cordate, widest below the middle, about as long as wide; lateral veins forming an angle of $50-60^{\circ}$ with the midrib. Valves $6(-8) \times$ $8(-10) \mathrm{mm}$, slightly cordate at base, without tubercles; margin with many small teeth. - N. Spain (Picos de Europa). Hs.
30. R. longifolius DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 368 (1815) ( R. domesticus Hartman). Stout perennial $60-120 \mathrm{~cm}$. Leaves broadly lanceolate, 3-4 times as long as wide. Pedicels c. $1 \frac{1}{2}$ times as long as the valves, filiform. Valves $4 \cdot 5-5 \cdot 5 \times 5 \cdot 5-6.5 \mathrm{~mm}$, slightly cordate at base, rounded at apex, entire, without tubercles. $2 n=60$. Ruderal. N. Europe; U.S.S.R.; Pyrenees. Br DaFaFe Ga Ge Hs Is No Rs (N, B, C, W) Su [Cz Is].

Frequently recorded elsewhere in error for other species. Hybridizes freely with $R$. crispus and $R$. obtusifolius.
31. R. confertus Willd., Enum. Pl. Hort. Berol. 397 (1809). Perennial, papillose-pubescent. Basal leaves deeply cordatetriangular, scarcely longer than wide, basal lobes and apex rounded; petiole often longer than lamina. Axis of panicle
flexuous; branches arcuate at the base. Pedicels filiform, up to twice as long as the valves. Valves $c .6 \times 8 \mathrm{~mm}$, broadly reniformscutate, with small, irregular indistinct teeth near the base, one with a small tubercle. $2 n=40$. Mainly ruderal. E. \& E.C. Europe. $\mathrm{CzHu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs}(\mathrm{B}, \mathrm{C}, \mathrm{W}, \mathrm{K}, \mathrm{E})[\mathrm{Au} \mathrm{Br} \mathrm{Fe}]$.

## Hybridizes freely with $R$. crispus and $R$. obtusifolius.

32. R. hydrolapathum Hudson, Fl. Angl. ed. 2, 154 (1778). Perennial up to 200 cm . Leaves flat, rigid, broadly lanceolate, tapering equally at both ends, lateral veins at a right angle with the midrib; basal leaves 4-5 times as long as wide. Pedicels stiff, c. $1 \frac{1}{2}$ times as long as the valves. Valves triangular, each with a distinct fusiform tubercle. Nut $4.5-5 \mathrm{~mm} .2 n=200$. Marshes. Europe, except the south and extreme north; Makedonija. Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju No Po Rm Rs (B, C, W, K, E) Su.

The hybrid with R. aquaticus (R. heterophyllus C. F. Schultz, $R$. maximus Schreber, non C. C. Gmelin) is frequent in N.C. Europe and S. Scandinavia. It is similar in habit to $R$. hydrolapathum but has wider and shorter leaves, rounded or slightly cordate at the base, and valves of somewhat irregular development, in part larger and wider than in pure $R$. hydrolapathum. The hybrid with $R$. obtusifolius is rarer, but not infrequent in England and the Netherlands; it is easily distinguished by the distinct teeth near the base of the valves and by their rather long apex. All $R$. hydrolapathum hybrids are similar in habit to $R$. hydrolapathum.
33. R. cristatus DC., Cat. Pl. Hort. Monsp. 139 (1813) ( $R$. graecus Boiss. \& Heldr.). Perennial $60-120 \mathrm{~cm}$. Basal leaves $20-30 \times 10-15 \mathrm{~cm}$, ovate-lanceolate, with a cordate base, acute at apex; petiole $\frac{1}{2}$ as long as lamina. Pedicels $1 \frac{1}{2}-2$ times as long as the valve, slender. Valves $6-8 \times 6-7 \mathrm{~mm}$, reddish-brown when ripe, cordate, with very small irregular acute teeth up to 1 mm ; all with unequal tubercles. Nut $3-3.2 \mathrm{~mm}$, widest slightly below the middle. Ruderal. Greece; Sicilia; doubtfully recorded from S. Italy. Gr ?It Si [ Au Br He ].
34. R. kerneri Borbás, Temes Megye Veg. 60 (1884) (R. confertoides Bihari). Like 33 but leaves minutely papillose-scabrid beneath; panicle lax, with lower whorls remote; valves $5 \times 6 \mathrm{~mm}$, blackish-brown; teeth even smaller, sometimes indistinct. - From Hungary and Romania to C. Greece. Al Bu Gr Hu Ju Rm [Au].

## Hybridizes frequently with R. obtusifolius.

35. R. patientia L., Sp. Pl. 333 (1753). Perennial $80-200 \mathrm{~cm}$. Leaves pale green, 3-4 times as long as wide, ovate- or oblonglanceolate, acute, truncate or broadly cuneate (rarely subcordate) at the base. Valves $4-8 \times 4-10 \mathrm{~mm}$, variable in outline. Nut 3-4 mm. Mainly ruderal. From E. Austria and S. Czechoslovakia to S.E. Russia; formerly cultivated elsewhere as a vegetable and locally naturalized. Al Au Bu Cz Gr Hu Ju Rm Rs (W, K, E).
1 Valves 6-8×8-10 mm
(b) subsp. orientalis
1 Valves less than 8 mm wide

2 Valves longer than wide, acute, truncate or subcordate at base
(c) subsp. recurvatus

2 Valves about as long as wide, obtuse, distinctly cordate at

$$
\text { base } \quad \text { (a) subsp. patientia }
$$

(a) Subsp. patientia: $2 n=60 . \mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Gr} \mathrm{Hu} \mathrm{Rm}$.
(b) Subsp. orientalis (Bernh.) Danser, Nederl. Kruidk. Arch. 1923: 281 (1924): $2 n=60$. Bu Cz Hu Ju Rm Rs (W, K, E).
(c) Subsp. recurvatus (Rech.) Rech. fil., Feddes Repert. 31: 252 (1933): $2 n=60$. Bu Cz Rm.

This species hybridizes freely with R.crispus and R.obtusifolius. $R$. patientia $\times$ crispus is rather like $R$. patientia with undulate leaves and unequally sized, nearly entire valves, broadly rounded at the apex. $R$. patientia $\times$ obtusifolius has valves distinctly toothed at the base, with a rather long apex.
36. R. crispus L., Sp. Pl. 335 (1753). Perennial $30-150 \mathrm{~cm}$. Basal leaves 4-5 times as long as wide, narrowly lanceolate, acute, usually cuneate at the base; margins undulate; petiole usually shorter than lamina. Branches of inflorescence erect or ascending, solitary; lower whorls usually remote. Pedicels 2-2 $\frac{1}{2}$ times as long as valves. Valves $3-5 \cdot 5(-6 \cdot 5) \mathrm{mm}$ long and wide, cordate, variable in outline and in development of tubercles, more or less entire. $2 n=60$. Sea-shores, river-gravels, and very commonly as a ruderal. Almost throughout Europe. All except CrSb , but only as a naturalized alien in Az Is.

The hybrid with $R$. obtusifolius is the commonest in the genus, and was originally described as a species ( $R$. pratensis Mert. \& Koch). It is found wherever the parents grow together, and can always be recognized by the different size and outline of the valves on the same plant, some of the flowers falling off before the valves have reached their normal size. The valves are toothed, but often as wide as in $R$. crispus; the leaves are intermediate, subcuneate to cordate at the base, but always longer and more distinctly undulate than in R. obtusifolius.
37. R. stenophyllus Ledeb., Fl. Altaica 2: 58 (1830). Like 36 but $20-60(-180) \mathrm{cm}$, leaves usually less undulate; pedicels $1 \frac{1}{2}-2$ times as long as the valves; valves $(3 \cdot 5-) 4(-5) \mathrm{mm}$ long and wide, cordate-triangular, with numerous small but distinct teeth $0 \cdot 5(-1) \mathrm{mm}$, entire at the broadly triangular apex. $2 n=60$. Halophilous. C. \& E. Europe. Au Bu Cz Ge Hu Ju Rm Rs (W, E) $[\mathrm{Br} \mathrm{Da} \mathrm{Su}]$.
38. R. conglomeratus Murray, Prodr. Stirp. Gotting. 52 (1770). Perennial $30-80(-120) \mathrm{cm}$. Panicle lax; whorls all remote and usually subtended by a leaf. Pedicels about as long as the valves, jointed near the middle. Valves $2.5-3.2 \times 1.1 .7 \mathrm{~mm}$, oblongovate, entire, all tuberculate; tubercles often covering nearly the whole valve. $2 n=20$. Riversides and waste places. Europe, from Scotland, S. Sweden and C. Russia southwards. All except Fa Is Rs (N, B, E) Sb, but only as an alien in Az Fe No.

Subsp. nevadensis H. Lindb., Act. Soc. Sci. Fenn. nov. ser. B, 1 (2): 41 (1932), from S. Spain (Sierra Nevada), is said to be like the typical plant but with thicker, longer, narrower leaves, larger flowers, longer and flatter tubercles and whorls of branches without subtending leaves.
39. R. sanguineus L., Sp. Pl. 334 (1753). Like 38 but more slender and erect; panicle less leafy; pedicels longer than the valves, jointed below the middle; only one valve with a tubercle; tubercle much shorter than the valve. $2 n=20$. Damp and shady places. Most of Europe from c. $60^{\circ} \mathrm{N}$. southwards, except E. Russia, but rare in the Mediterranean region. Al Au Be Br Bu Co Cz Da Ge Hb He Ho Hs Hu It Ju No Po Rm Rs (B, C, W, K) Sa Si Su.

Fertile intermediates between $R$. conglomeratus and $R$. sanguineus, of presumed hybrid origin, occur commonly in Britain.
40. R. rupestris Le Gall, Congr. Sci. France 16 (1): 143 (1850). Like 38 but branches strict; leaves oblong, narrowed at base, obtuse, glaucous, lamina usually much longer than petiole; usually only the lowest whorl on each branch subtended by a leaf; valves $c .4 \mathrm{~mm}$, oblong, obtuse, with oblong tubercles $2 \cdot 5-3 \mathrm{~mm}$. Coasts of W. Europe. Br Ga Hs.
41. R. nepalensis Sprengel, Syst. Veg. 2: 159 (1825). Perennial $60-170 \mathrm{~cm}$. Basal leaves $1 \frac{1}{2}-2 \frac{1}{2}$ times as long as wide, oblongovate, papillose beneath, cordate at base, rounded or broadly acuminate at apex. Panicle open, branches solitary, arcuatedivaricate. Valves $5-7 \times 3 \cdot 5-4 \mathrm{~mm}$, ovate-triangular, with numerous hooked teeth developing early. $2 n=60$. Clearings in mountain woods. Italy and Balkan peninsula. Al Gr It ?Ju. (S.W China westwards to Anatolia.)
42. R. pulcher L., Sp. Pl. 336 (1753). Perennial $20-60 \mathrm{~cm}$. Plant often papillose. Basal leaves small, fleshy, about twice as long as wide, cordate at base. Panicle open; branches flexuous, often entangled or arcuate; whorls all remote and subtended by a leaf. Pedicels thick, shorter than to as long as the valve, jointed near or slightly below the middle, scarcely deciduous. Valves thick, coarsely foveolate-rugose, very variable in size and outline. Mainly ruderal. S. \& W. Europe, extending to Hungary and N. Romania. Al Az Bl Br Bu Co Cr CzGaGr He Hs Hu It Ju Lu Rm Rs (K) Sa Si Tu [Au Da Hb He Su].
1 Valves entire, or with teeth up to 0.5 mm near the base; branches arcuate-divaricate; leaves seldom panduriform
(c) subsp. anodontus

1 Valves with several teeth on each side; teeth more than 0.5 mm
2 Valves suborbicular or ovate-triangular, broadly acuminate at apex; teeth short, up to 8 on each side; usually 3 meshes of venation on each side of the tubercle; branches arcuatedivaricate; leaves seldom panduriform (b) subsp. divaricatus
2 Valves narrowly ovate or oblong with lingulate apex; teeth oblong, few on each side near the base; one or two meshes of venation on each side of the tubercle; branches angular-flexuous, often intricate; leaves usually panduriform
3 Valves 4.5-5 mm; teeth 1-2 mm, 4 on each side
(a) subsp. pulcher

3 Valves 6 mm ; teeth 3-4 mm, 5-6 on each side
(d) subsp. raulinii
(a) Subsp. pulcher: $2 n=20$. Throughout the range of the species.
(b) Subsp. divaricatus (L.) Murb., Lunds Univ. Arsskr. 27: 45 (1891): $2 n=20$. $S$. Europe.
(c) Subsp. anodontus (Hausskn.) Rech. fil., Beih. Bot. Centr. 49 (2): 34 (1932). Kriti.
(d) Subsp. raulinii (Boiss.) Rech. fil., op. cit. 39 (1932): Greece and Aegean region.

Hybrids with R. crispus, R. conglomeratus and R. obtusifolius are known. They usually show something of the divaricate branching, remote whorls, short pedicels and thick venation of the valves characteristic of R.pulcher.
43. R. obtusifolius L., Sp. Pl. 335 (1753). Perennial $60-120 \mathrm{~cm}$. Basal leaves large, twice as long as wide, thin, obtuse or subacute, cordate at the base; petiole slightly longer than lamina. Panicle open; branches arcuate; whorls mostly remote, the lower ones subtended by a leaf. Pedicels slender, up to $2 \frac{1}{2}$ times as long as the valves, jointed near the base, readily deciduous. Valves variable in size, outline and tubercles. Europe except the extreme north and south. All except Cr Sb , but only as an alien in Az Is and perhaps elsewhere.

1 Valves entire or with a few short or indistinct teeth near the base, all with tubercles
(d) subsp. sylvestris

1 Valves with several distinct, often long teeth
2 All valves with tubercles; tubercles often unequal
(c) subsp. transiens

2 One valve with a tubercle, the other two without
3 Valves 6 mm , ovate or ovate-triangular, obtuse; leaves papillose beneath
(a) subsp. obtusifolius

3 Valves 5 mm , narrowly triangular or lingulate, acute; $\begin{array}{ll}\text { leaves usually not papillose } & \text { (b) subsp. subalpinus }\end{array}$
(a) Subsp. obtusifolius (subsp. agrestis (Fries) Čelak.): $2 n=40$. Mainly ruderal. Native in W. Europe, but widely naturalized elsewhere.
(b) Subsp. subalpinus (Schur) Čelak., Prodr. Fl. Böhm. 159 (1873): Streamsides and woodland-margins. Carpathians and mountains of Balkan peninsula.
(c) Subsp. transiens (Simonkai) Rech. fil., Beih. Bot. Centr. 49 (2): 52 (1932): Mainly ruderal. C. Europe, Balkan peninsula, S. Scandinavia.
(d) Subsp. sylvestris (Wallr.) Rech., Österr. Bot. Zeitschr. 42: 51 (1892); $2 n=40$. Riversides, and as a ruderal. Europe from Italy and Sweden eastwards.

This species forms hybrids rather frequently; the commonest is with R. crispus and is described under that species. Most hybrids of $R$. obtusifolius inherit something of its cordate basal leaves and toothed and acuminate valves.
44. R. dentatus L., Mantissa Altera 226 (1771). Annual 20 70 cm . Basal leaves small, 2-3 times as long as wide, truncate or subcordate at the base; petiole equalling or shorter than lamina. Pedicels somewhat longer than valves. Valves $4-6 \times 2-3 \mathrm{~mm}$, all or only one with tubercle; teeth $3-6 \mathrm{~mm} .2 n=40$. Wet places. S.E. Europe. Al Gr Rm Rs (W, E) [Hu ?Ju].
(a) Subsp. halacsyi (Rech.) Rech. fil., Beih. Bot. Centralbl. 49 (2): 16 (1932): Valves $4 \times 2 \mathrm{~mm}$, all with tubercles; teeth as long as width of valves. Romania to Greece ; occasionally naturalized further west.
(b) Subsp. reticulatus (Besser) Rech. fil., op. cit. 18 (1932): Valves $5-6 \times 3 \mathrm{~mm}$, only one with a tubercle; teeth longer than width of valves. Ukraine (near Odessa); S.E. Russia (Volga delta). (S.W. Asia.)

Subsp. dentatus is not recorded for Europe.
R. obovatus Danser, Nederl. Kruidk. Arch. 1920: 241 (1921), from South America, which is recorded as introduced in several places in N. Europe and is perhaps becoming naturalized, is like $R$. dentatus but with the lower leaves all widest above the middle.
45. R. palustris Sm., Fl. Brit. 1: 394 (1800). Annual or biennial $30-60 \mathrm{~cm}$; whole plant eventually brown. Basal leaves about 6 times as long as wide, lanceolate, acute, cuneate at the base; margin undulate. Branches of panicle arcuate; whorls remote, all subtended by leaves. Pedicels $1-1 \frac{1}{2}$ times as long as valves. Valves $3-3 \cdot 5(-4) \times 1 \cdot 2-1 \cdot 5 \mathrm{~mm}$ (excluding teeth), narrowly lingulate; teeth 2-3 on each side, about as long as the width of the valve. $2 n=40$. Marshes and riversides. C. \& S. Europe, extending to England, the Netherlands, S. Sweden and Latvia. Au Be Br Bu Da Ga Ge Gr He Ho Hs Hu It Ju No Po Rm Rs (B) Su.

Erroneously interpreted by some authors as a hybrid ( $R$. conglomeratus $\times$ maritimus); consequently all hybrids in which $R$. palustris took part have been interpreted as triple hybrids.
46. R. maritimus L., Sp. Pl. 335 (1753). Annual $10-50(-70) \mathrm{cm}$; plant golden-yellow when fruit is ripe. Basal leaves narrowly elliptical, tapering nearly equally at both ends. Branches of panicle arcuate; all whorls except the lower ones confluent when ripe. Pedicels very slender, somewhat longer than the valves. Valves $2 \cdot 5-3 \times 1 \cdot 5-2 \mathrm{~mm}$ (excluding teeth), ovate-triangular, with a narrow, triangular apex; teeth usually 2 on each side, setiform, longer than the width of the valve. Nut $1 \cdot 3-1 \cdot 5(-1 \cdot 8) \mathrm{mm}$. $2 n=40$. Sea-shores and other wet places. Most of Europe except the south and the extreme north. Au Be BrCzDaFe GaGe Hb He Ho ?Hs Hu It Ju No Po Rm Rs (B, C, W, K, E) Su.

In localities where both R. palustris and R. maritimus are found it is not always easy to decide which was involved in forming a
particular hybrid, except for the evidence provided by the larger valves of R. palustris, with relatively shorter teeth. Hybrids in which either of these species takes part tend to have long branches, remote whorls, all subtended by leaves, and strongly toothed valves. The most frequent of such hybrids is $R$. crisplis $\times$ palustris.
47. R. rossicus Murb., Bot. Not. 1913: 221 (1913). Like 46 but pedicels mostly shorter than the valves; no visible veins at the side of the tubercle; teeth 1-2 on each side, shorter than the length of the valve; nut $1 \cdot 1-1 \cdot 3 \mathrm{~mm} .2 n=40$. Riversides. $N . \& C$. Russia. Rs (C, N).
48. R. marschallianus Reichenb., Pl. Crit. 4: 58 (1826). Slender annual $5-25 \mathrm{~cm}$, often with decumbent branches from the base. All leaves with comparatively long petioles, linear-lanceolate; lower ones with cordate or truncate base. Lower whorls remote; upper confluent. Valves $2 \cdot 5-3 \mathrm{~mm}$, excluding the long subulate apex, which is as long as the rest of the valve, unequal, the larger one with a narrow tubercle; teeth up to 5 mm , several times as long as the width of the valves. Riversides. S. Russia, Ukraine. Rs (C, W, E).
49. R. ucranicus Besser ex Sprengel, Novi Provent. 36 (1819). Slender, purplish annual $8-15 \mathrm{~cm}$, branched from the base. Basal leaves small, obovate. Cauline leaves linear-lanceolate, 3-4 times as long as wide; margin often undulate; petiole longer than width of lamina. Petiole of leaves of inflorescence longer than the diameter of the whorl it subtends. Valves $2(-2 \cdot 5) \times 1 \mathrm{~mm}$ (excluding teeth), narrowly triangular, very acute, each with a large orange tubercle; teeth c. 3 on each side, at least as long as the width of the valve. $2 n=40$. Riversides. U.S.S.R., from c. $57^{\circ} \mathrm{N}$. southwards, extending to E. Poland and N.E. Romania. Po Rm Rs (B, C, W, E).

Subgen. Platypodium. Usually annual. Stems short, slender. Basal leaves small, ovate or spathulate. Flowers in clusters of 4 or fewer. Flowers, fruits and pedicels often dimorphic; valves very small, usually with teeth and small tubercles.
50. R. bucephalophorus L., Sp. PI. 336 (1753). Annual, or rarely perennial, with one or several slender stems; very variable in habit and size. Leaves very small. Flowers usually in clusters of 2 or 3. Pedicels usually dimorphic; some slender and very short, others long, broad and flat. Valves small, variable in size and shape. Sandy and rocky places, usually near the sea. Mediterranean region and S.W. Europe. Al Az Bl Co Cr Ga Gr Hs It Ju LuSaSi ?Tu.

Very variable. The following treatment is a summary of that given by K. H. Rechinger, Bot. Not. 1939: 485-504 (1939).
1 Pedicels nearly all short and slender; valves all similar, 3$3 \cdot 5(-4) \mathrm{mm}$, with 3(-4) broad-based teeth on each side; nut c. 2 mm
(c) subsp. graecus

1 Pedicels dimorphic, some long, broad and flat; valves usually of two kinds, but all with narrow-based teeth.
2 Stems $3-10 \mathrm{~cm}$, numerous, arcuate-ascending; flowers dimorphic, a cluster of larger ones always present at the base of the plant, with short, not articulate pedicels; valves of upper flowers 2 mm , with 3 short teeth on each side; nut $1.3-1.7 \mathrm{~mm}$
(d) subsp. aegaeus

2 Stems $10-40 \mathrm{~cm}$, solitary or few, $\pm$ erect, without a cluster of larger flowers at the base; nut $1 \cdot 8-2 \mathrm{~mm}$
3 Valves usually with 3 straight teeth on each side; nut 1.8 mm
(a) subsp. bucephalophorus

3 Valves usually with 4 hooked teeth on each side; nut up to 2 mm
(b) subsp. hispanicus
(a) Subsp. bucephalophorus (subsp. gallicus (Steinh.) Rech. fil.): $2 n=16$. Throughout the range of the species.
(b) Subsp. hispanicus (Steinh.) Rech. fil., Bot. Not. 1939: 500 (1939): S.W. Europe.
(c) Subsp. graecus (Steinh.) Rech. fil., op. cit. 492 (1939): Mediterranean region, from Spain to Greece.
(d) Subsp. aegaeus Rech. fil., op. cit. 495 (1939): Aegean region.

## 9. Emex Campd. ${ }^{1}$

Annual herbs; monoecious. Ochreae not ciliate, soon lacerate. Female flowers at base of infiorescence; perianth-segments 6, free in male flowers, connate in female flowers, the outer 3 spinescent and indurated in fruit. Stamens 4-6. Stigmas 3. Nut triquetrous, included in perianth.

1. E. spinosa (L.) Campd., Monogr. Rumex 58 (1819). Glabrous, stems 30 cm or more, erect or ascending. Leaves ovate, truncate or subcordate at base, petiolate. Male flowers in terminal and axillary pedunculate clusters; female axillary, sessile. Fruit enclosed in perianth; outer segments ending in patent spines; inner erect, tubercled. Sandy shores and disturbed ground. Mediterranean region, extending to N.W. Spain and Açores. $\mathrm{Az} \mathrm{Bl} \mathrm{Co} \mathrm{Cr} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.

## 10. Muehlenbeckia Meissner ${ }^{2}$

Woody plants, usually climbers. Ochreae not ciliate, soon lacerate and vanishing. Flowers dioecious or polygamous. Perianthsegments 5 , sepaloid, united at the base, accrescent and fleshy in fruit. Stamens 8, represented by staminodes in female flowers. Stigmas 3, subsessile; nut triquetrous, partly fused with the accrescent perianth.

1. M. sagittifolia (Ortega) Meissner, Pl. Vasc. Gen. 2: 227 (1841). Glabrous, woody climber with slender, twining branches. Leaves $c .5 \mathrm{~cm}$, lanceolate, acuminate or mucronate; base truncate, often slightly hastate. Flowers greenish, in short axillary racemes. Fruiting perianth berry-like, first red, later whitish. Naturalized from gardens near Lisboa and in the Açores. [Az Lu.] (Temperate South America.)

## 11. Calligonum L. ${ }^{2}$

Erect shrubs. Leaves small, caducous. Ochreae short, without veins. Flowers hermaphrodite, in axillary clusters. Perianthsegments 5 or 6, more or less petaloid, free, persistent but deflexed in fruit. Stamens c. 15. Stigmas 4 ; fruit furnished with wings or bristles.

1. C. aphyllum (Pallas) Gürke in Richter \& Gürke, Pl. Eur. 2: 111 (1897). Up to 2 m ; twigs numerous, slender, dark green, arising in bunches of 2-6 from each node. Leaves $2-3 \mathrm{~mm}$, more or less subulate, caducous. Flowers usually in pairs, stalked.

Outer perianth-segments 3 mm , broadly ovate, green with white margins; inner ones smaller, white with pink mid-vein. Fruit with 4 flat, membranous wings decurrent on the pedicel. Sandy places. S.E. Russia. Rs (E). (W. \& C. Asia.)

## 12. Atraphaxis L. ${ }^{2}$

Erect, small-leaved shrubs. Ochreae brown proximally, hyaline distally, bifid, 2 -veined. Flowers hermaphrodite, in short racemes. Perianth-segments 4 or 5 , the inner 2 or 3 accrescent and surrounding the fruit. Stamens 6 or 8 , united into a ring at the base. Stigmas 2 or 3; nut not winged.
1 Perianth-segments 4 ; stamens 6
2 Branches mostly leafless and spiny towards the apex; fruiting perianth $5-6 \mathrm{~mm}$ wide 1. spinosa
2 Branches mostly leafy to the apex, not spiny; fruiting perianth $8-9 \mathrm{~mm}$ wide
2. replicata

1 Perianth-segments 5; stamens 8
3 Inner perianth-segments scarcely exceeding the nut
3. frutescens

3 Inner perianth-segments about twice as long as the nut
4. billardieri

1. A. spinosa L., $S p$. Pl. 333 (1753). $30-80 \mathrm{~cm}$, with numerous slender, divaricate branches, many of them leafless towards the apex and more or less spiny. Leaves $7-11 \mathrm{~mm}$, ovate or elliptical, mucronate, very shortly petiolate. Flowers in short-stalked, axillary racemes. Perianth bright pink, with white margins; segments 4 , the two inner $4-5 \times 5-6 \mathrm{~mm}$ in fruit. Nut broadly ovate, flattened, pale greenish-brown. Steppes and semi-deserts. S.E. Russia, W. Kazakhstan. Rs (E). (W. \& C. Asia.)
2. A. replicata Lam., Encycl. Méth. Bot. 1: 329 (1783). Very like 1, but with branches seldom spine-tipped and usually leafy to the apex; leaves $3-8 \mathrm{~mm}$, sometimes almost orbicular; and fruiting perianth-segments $7-8 \times 8-9 \mathrm{~mm}$. S.E. Russia westwards to Krym. Rs (?W, K, E). (W. \& C. Asia.)
3. A. frutescens (L.) C. Koch, Dendrologie 2 (1): 360 (1872). $20-$ 70 cm , branches usually leafy, rarely spine-tipped. Leaves 12 $17 \times 2-8 \mathrm{~mm}$, fleshy, glaucous, linear-lanceolate to oblongobovate, entire or bluntly toothed, with a short, white, apical mucro. Flowers in short, lax, terminal racemes. Perianthsegments 5, pinkish- or greenish-white, the two inner $4-5 \times 5-6 \mathrm{~mm}$, semicircular, equalling or slightly exceeding the dark brown, glossy, acutely trigonous nut. Steppes and semi-deserts. S. \& S.E. Russia. Rs (W, E). (W. \&. C. Asia.)
4. A. billardieri Jaub. \& Spach, Ill. Pl. Or. 2: 14 (1844). Like 3, but with ovate or oblong leaves, obtuse to acute but not mucronate; and pink perianth-segments, up to $6 \times 8 \mathrm{~mm}$ in fruit and nearly twice as long as the nut. Dry mountain rocks. C. Greece and Kriti; very local. Cr Gr. (S.W. Asia.)

## CENTROSPERMAE

## XLVIII. CHENOPODIACEAE ${ }^{1}$

Herbs, shrubs or rarely small trees, often succulent; glabrous, pubescent or farinose with vesicular hairs. Leaves alternate or opposite, exstipulate. Flowers hermaphrodite or unisexual, often bracteolate, solitary or in dense cymose clusters in a spicate or paniculate inflorescence. Perianth absent or 1 - to 5 -merous, often accrescent in fruit; segments usually more or less connate. Stamens 1-5, opposite the perianth-segments. Ovary superior, rarely semi-inferior, unilocular; ovules solitary, basal; stigmas (1-)2-3(-5). Fruit usually an achene. Seeds horizontal (compressed in the vertical plane) or vertical (compressed in the horizontal plane).

The majority of the species are halophytes or ruderals. The family is particularly predominant in maritime habitats, and in the steppe and semi-desert regions of S.E. Europe.

The interpretation of the structure of the segmented genera in this family ( $18-22,29,30$ ) is a matter of considerable controversy. For recent accounts of the two interpretations see: A. Fahn \& T. Arzee, Amer. Jour. Bot. 46: 330-8 (1959); F. F. Leysle, Bot. Z̆ur. 34: 253-66 (1949). The latter interpretation is that accepted here.

1 Plant with spinose branches
2 Annual herb; inflorescence of numerous dichasial cymes
3. Chenopodium

2 Small shrubs; flowers solitary
3 Leaves up to 50 mm , semi-cylindrical, obtuse 26. Noaea
3 Leaves not more than 8 mm , filiform or scale-like, mucronate
25. Salsola

1 Plant without spinose branches, sometimes with spine-tipped leaves and bracts
4 Leaves flat, the largest usually at least 5 mm wide, frequently toothed, lobed or pinnatipartite
5 Plant with yellow or brownish glands or glandular hairs
3. Chenopodium

5 Plant eglandular
6 Leaves and bracts spinose-acuminate 15. Agriophyllum
6 Leaves and bracts not spinose
7 Flowers all unisexual; female flowers mostly without perianth, but with 2 bracteoles which become enlarged and enclose the fruit
8 Plant pubescent
9 Bracteoles with a long patent subulate appendage
9. Ceratocarpus

9 Bracteoles without a subulate appendage
8. Krascheninnikovia 8. Plant glabrous or farinose
$\begin{array}{lll}10 & \text { Bracteoles free, at least in the upper half } & \text { 6. Atriplex } \\ 10 & \text { Bracteoles connate almost to the apex } & \end{array}$
10 Bracteoles connate almost to the apex
11 Plant silvery-farinose; stigmas 2-3
7. Halimione

11 Plant green; stigmas 4-5
5. Spinacia

7 Flowers mostly hermaphrodite, rarely all unisexual and then the female with 3 or more perianth-segments
12 Perianth-segments in fruit with a tubercle, spine or horizontal wing or keel on the back
13 Perianth-segments with a spine in fruit
12. Bassia

13 Perianth-segments with a wing, keel or tubercle in fruit 14 Plant glabrous or farinose
23. Suaeda

14 Plant pubescent at least in the upper parts
15 Wings of the perianth connate and completely encircling the fruit; leaves dentate to sinuatepinnatifid
4. Cycloloma

15 Wings of the perianth free; leaves entire 13. Kochia 12 Perianth-segments without appendages, rarely vertically keeled or winged
16 Ovary semi-inferior, connate with the swollen receptacle in fruit
16 Ovary superior
17 Achenes strongly compressed, encircled by a distinct wing or margin, usually emarginate at the apex
14. Corispermum

17 Achenes not winged or margined, rarely with a 2 -
lobed wing at apex
18 Plant pubescent
19 Perianth-segments mostly solitary, not enclosing the achene
14. Corispermum

19 Perianth-segments 3 or more, enclosing the achene
20 Leaves up to $9 \times 3 \mathrm{~cm}$, broadly lanceolate; flowers unisexual
10. Axyris

20 Leaves not more than 1.5 cm , linear or linearlanceolate; flowers hermaphrodite, sometimes some female
11. Camphorosma

18 Plant glabrous or farinose
21 Flowers usually unisexual, the male in terminal spicate inflorescences, the female axillary
5. Spinacia

21 Flowers hermaphrodite, sometimes some female
22 Perianth-segments equal; lower leaves elliptical to ovate or triangular
3. Chenopodium

22 Two lateral perianth-segments larger than the rest; lower leaves linear to linear-oblong
11. Camphorosma

4 Leaves filiform, semi-cylindrical, scale-like or apparently absent
23 Stems segmented, with opposite branches; leaves opposite, rudimentary
24 Stamens (3-)5; perianth-segments in fruit usually with a transverse wing on the back; embryo spiral
25 Staminodes absent; stigmas 4; seeds horizontal
25 Staminodes present; stigmas 2; seeds vertical
30. Haloxylon

24 Stamens 1-2. 29. Anabasis
24 Stamens 1-2; perianth-segments not winged; embryo annular or conduplicate
26 Annual; all branches terminated by an inflorescence
27 Flowers and perianth obvious, fleshy; seeds with soft green or brown testa
21. Salicornia

27 Flowers minute, $\pm$ hidden by the bracts; perianth thin, membranous; seeds with black, crustaceous, granular testa
22. Microcnemum

26 Perennial, usually shrubs or small trees, with many nonflowering branches
28 Opposite pairs of bracts connate to form a segment
20. Arthrocnemum

28 Opposite pairs of bracts free, reniform or orbicular
29 Shrub or small tree up to 350 cm , without subglobular axillary branches; bracts $\pm$ orbicular 18. Halostachys
29 Small shrub not more than 50 cm , with numerous subglobular axillary branches; bracts reniformorbicular
19. Halocnemum

23 Stems not segmented, branches opposite or alternate; leaves obvious, sometimes small but then alternate
30 Perianth-segments in fruit with a wing, keel or spine on the back
31 Perianth-segments with one unbranched spine on the back
12. Bassia

31 Perianth-segments winged or keeled, rarely with 2 spines on the back, one of which is often branched

32 Leaves mostly opposite
33 Leaves broadly triangular or ovate, with a spinose apex
28. Girgensohnia

33 Leaves semi-cylindrical or oblong; apex obtuse or mucronulate
25. Salsola

32 Leaves all alternate
34 Perianth with 3 outer large segments and 2 inner very small segments (rarely 0); stamen 1 27. Ofaiston
34 Perianth-segments $\pm$ equal; stamens usually 3-5
35 Flowers (at least the outer ones in each cyme) with 2 conspicuous bracteoles
36 All flowers with bracteoles
25. Salsola

36 Outer flowers of each cyme with bracteoles, the inner flowers ebracteolate
34. Halogeton

35 Flowers ebracteolate or with minute bracteoles
37 Plant pubescent, sometimes sparsely so 13. Kochia
37 Plant glabrous or papillose
38 Perianth-segments of the lower flowers keeled, the upper narrowly winged in fruit, the wings free
23. Suaeda

38 Perianth-segments broadly winged in fruit, the wings connate
24. Bienertia

30 Perianth without appendages
39 Bracteoles 2, connate in fruit, each with a long, terminal, patent, subulate appendage; flowers all unisexual
9. Ceratocarpus

39 Bracteoles absent or present but without a terminal subulate appendage; flowers hermaphrodite and female
40 Perianth-segments up to 10 mm in fruit, pale yellowish, shining; pulvinate shrub 31. Nanophyton
40 Perianth-segments smaller, not conspicuously shining; not pulvinate
41 Leaves with spinose apex
42 Flowers with 2 conspicuous bracteoles

1. Polyenemum

42 Flowers with minute bracteoles
23. Suaeda

41 Leaves not spinose
43 Cymes mostly 3 -flowered, immersed in the axis of a spike-like inflorescence; lamina of leaves not more than 6 mm
44 Annual; seeds $0.5-1 \mathrm{~mm}$
17. Halopeplis

44 Small shrubs; seeds $1-1.5 \mathrm{~mm}$ 16. Kalidium

43 Cymes with a variable number of flowers, not immersed in the axis of the inflorescence; leaves usually larger
45 Achenes strongly compressed, conspicuously margined or winged
45 Achenes not winged or margined
46 Perianth-segments solitary
46 Perianth-segments 2-5
47 Flowers with 2 conspicuous bracteoles; perianthsegments becoming hard in fruit (see also 27. Ofaiston)

48 Seeds compressed in the plane at right angles to the axis
33. Halimocnemis

48 Seeds compressed in the plane parallel to the axis 32. Petrosimonia
47 Flowers ebracteate or with minute bracteoles; perianth-segments fleshy or membranous
49 Perianth fleshy, the segments all $\pm$ equal; embryo spiral; plant glabrous or farinose 23. Suaeda
49 Perianth membranous, 2 segments larger than the rest; embryo annular; plant pubescent, rarely glabrous
11. Camphorosma

## 1. Polycnemum L. ${ }^{1}$

Glabrous or pubescent annuals. Leaves subulate, rigid, spinetipped. Flowers hermaphrodite, solitary in the axils of leaf-like bracts; bracteoles 2 ; perianth-segments 5 ; stamens usually 3 ; stigmas 2. Seeds vertical.

1 Leaves not more than 0.3 mm in diameter, filiform, often glandular-pubescent
4. heuffelii

1 Leaves at least 0.5 mm in diameter, triquetrous, usually glabrous
2 Lower leaves $10-20 \mathrm{~mm}$; bracteoles up to twice as long as the perianth; seeds $1 \cdot 5-2 \mathrm{~mm}$ 1. majus
2 Lower leaves $3-10(-12) \mathrm{mm}$; bracteoles as long as the perianth; seeds $1-1.5 \mathrm{~mm}$
3 Uppermost bracts at least 3 times as long as the perianth
2. arvense

3 Uppermost bracts not more than 2-3 times as long as the perianth
3. verrucosum

1. P. majus A. Braun, Flora (Regensb.) $24: 151$ (1841). Procumbent or erect, $5-30 \mathrm{~cm}$, glabrous, not verrucose. Leaves (6-)1020 mm , spine-tipped. Bracts at least twice as long as the perianth; bracteoles 1-2 times as long as the perianth. Seeds $1 \cdot 5-2 \mathrm{~mm}$. Dry places, often as a ruderal. C. \& S. Europe, extending to Belgium and to c. $40^{\circ}$ E. in Russia. Al Au Be Bu Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs (C, W, K, E).
2. P. arvense L., Sp. Pl. 35 (1753). Procumbent or erect, with spirally twisted branches, up to 50 cm , usually verrucose. Leaves $3-8(-12) \mathrm{mm}$, softly spine-tipped. Bracts at least 3 times as long as the perianth, bracteoles about equalling perianth. Seeds $1-$ 1.5 mm . Sandy soils, often a weed. C. \& S. Europe, extending to C. France and C. \& S. Russia. Au Bu Co Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs (B, C, W, K, E) Sa Tu.
3. P. verrucosum A. F. Láng, Syll. Pl. Nov. Ratisbon (Königl. Baier. Bot. Ges.) 1: 179 (1824). Like 2 but branches stiffly erect at apex; leaves glaucous; uppermost bracts not more than 2-3 times as long as the perianth. Dry, sandy places. Danube basin, Ukraine, S.E. Russia. Au Cz Ge Hu Rm Rs (W, E).

Possibly not specifically distinct from 2.
4. P. heuffelii A. F. Láng, op. cit. 2: 219 (1828). Procumbent, $5-30 \mathrm{~cm}$. Leaves $5-12 \times 0 \cdot 1-0 \cdot 3 \mathrm{~mm}$, filiform, recurved, densely glandular-pilose to subglabrous. Bracts at least twice as long as perianth; bracteoles $1-2$ times as long as perianth. Seeds 11.3 mm . - S.E. \& E.C. Europe from S.W. Poland and N.E. Ukraine to C. Greece. Bu Cz Gr Hu Ju Po Rm Rs (C, W).

## 2. Beta L. ${ }^{1}$

Glabrous herbs. Leaves flat, more or less entire. Flowers hermaphrodite, solitary or in few-flowered cymes arranged in a spicate inflorescence. Perianth-segments and stamens 5 ; ovary semiinferior, connate with the receptacle in fruit; stigmas usually 2-3. Fruits often adhering together by the swollen perianth and receptacle. Seeds horizontal.
1 Stems not more than 10 cm , procumbent, leafless except for bracts subtending solitary flowers; leaves all basal 5. nana
1 Stems normally much more than 10 cm , leafy; cymes 1 - to several-flowered
2 Perianth whitish-yellow 4. trigyna
2 Perianth green to purplish, sometimes with a scarious margin
3 Inflorescence ebracteate or bracteate only at the base

1. vulgaris

3 Inflorescence bracteate $\pm$ to the apex
4 Perianth-segments up to 5 mm in fruit; bracts much smaller than cauline leaves 2. macrocarpa
4 Perianth-segments $1-1.5 \mathrm{~mm}$ in fruit; lower bracts similar to the cauline leaves
3. patellaris

1. B. vulgaris L., Sp. Pl. 222 (1753). Annual to perennial up to 200 cm . Basal leaves ovate-cordate to rhombic-cuneate;
cauline rhombic to lanceolate. Inflorescence dense, becoming interrupted towards the base in fruit, ebracteate at least in the upper half. Receptacle pelviform; segments not more than 3 mm in fruit, incurved. Stigmas usually 2. Coasts of S. \& W. Europe northwards to c. $59^{\circ} \mathrm{N}$. in W. Sweden; cultivated throughout most of Europe and occasionally naturalized. Al Az Be Bl Br Bu Co $\mathrm{Cr} \mathrm{Da} \mathrm{Ga} \mathrm{*Ge} \mathrm{Gr} \mathrm{Hb} \mathrm{Ho} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{?Rs} \mathrm{(W)} \mathrm{Sa} \mathrm{Si} \mathrm{Su} \mathrm{Tu}$.
(a) Subsp. vulgaris. Stem up to 200 cm , erect; root swollen; leaves up to 20 cm ; cymes 2 - to 8 -flowered. $2 n=18$. Widely cultivated, some cultivars for sugar, others for the edible hypocotyl and root, others for fodder; often persisting as a casual and occasionally naturalized.

Many cultivars of this subspecies have been described and are sometimes given subspecific or varietal rank.
(b) Subsp. maritima (L.) Arcangeli, Comp. Fl. Ital. 593 (1882) (B. maritima L., B. perennis (L.) Freyn). Stem up to 80 cm , procumbent to erect, root usually not swollen; leaves up to 10 cm ; cymes 1 - to 3 -flowered. $2 n=18$. Coasts of $S . \& W$. Europe northwards to c. $59^{\circ} \mathrm{N}$. in W. Sweden.

Polymorphic and probably divisible into a number of subspecies.
2. B. macrocarpa Guss., Fl. Sic. Prodr. 1: 302 (1827) (B. bourgaei Cosson). Annual $15-40 \mathrm{~cm}$, procumbent or ascending. Basal leaves oblong-spathulate to triangular-ovate, sometimes subcordate; cauline obovate to lanceolate or rhombic. Inflorescence lax, bracteate to the apex. Cymes 2- to 3(-5)-flowered. Receptacle pelviform and hard in fruit; segments up to 5 mm , erect, often incurved at the apex; stigmas 2-3. S. part of Mediterranean region (very local); one station in S. Portugal. Gr Hs It Lu Si [Ga]. (N. Africa, Atlantic Islands.)
3. B. patellaris Moq. in DC., Prodr. 13 (2): 57 (1849) (incl. B. diffusa Cosson). Annual up to 60 cm , procumbent. Leaves broadly triangular-ovate, usually cordate. Inflorescence very lax, with leaf-like bracts almost to the apex. Cymes 1 - to 3 -flowered, usually developing 1 fruit. Receptacle hemispherical in fruit; segments $1-1.5 \mathrm{~mm}$, incurved or erect; stigmas 2. Maritime rocks. S.E. Spain (near Almeria). Hs. (N.W. Africa, Atlantic Islands.)
4. B. trigyna Waldst. \& Kit., Pl. Rar. Hung. 1: 34 (1800). Perennial up to 100 cm , erect. Basal leaves up to 20 cm , broadly ovate; cauline ovate to lanceolate, often cordate. Inflorescence usually dense in the upper part, the bracts small or absent. Cymes 1- to 3-flowered. Receptacle pelviform; perianth whitishyellow; segments erect in fruit; stigmas 3. S.E. Europe, from E. Jugoslavia to Krym; occasionally naturalized elsewhere. Bu $\mathrm{Ju} \mathrm{Rm} \mathrm{Rs}(\mathrm{W}, \mathrm{K})[\mathrm{Cz} \mathrm{Ga} \mathrm{It}]$.
5. B. nana Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 1 (7): 82 (1846-7). Decumbent perennial with stout cylindrical root and the leaves all basal. Leaves $15-20 \times 8-10 \mathrm{~mm}$, ovate-oblong. Flowering stems $5-10 \mathrm{~cm}$, leafless but with a lax bracteate inflorescence. Flowers solitary. Receptacle hemispherical, strongly ridged; segments incurved in fruit; stigmas 2. Snow patches. - Mountains of S. Greece (Parnassos, Taiyetos). Gr.

## 3. Chenopodium L. ${ }^{1}$

Annual, rarely perennial herbs, glabrous, pubescent, glandular or farinose. Leaves alternate, flat. Flowers hermaphrodite and female, usually in cymes, variously arranged. Bracteoles absent.

[^46]Perianth-segments $2-5$, more or less unaltered in fruit, rarely becoming fleshy; stamens $1-5$; stigmas $2(-5)$. Seeds usually horizontal.

Most species grow in man-made habitats and it is often impossible to decide whether they fall into the category of casual, established alien or native in any particular country.

To see the markings on the testa, which are taxonomically important, the skin-like pericarp which closely invests the ripe seed must be removed; a magnification of $\times 40$ is required.

Literature: P. Aellen in Hegi, Ill. Fl. Mitteleur. ed. 2, 3 (2): 569 et seq. (1960). P. Guinet, Jour. Agr. Trop. Bot. Appl. 6: 241-66 (1959) (seeds). T. Kowal, Polsk. Towarz. Bot. (Monogr. Bot.) 1: 87-163 (1954).

1 Ultimate branches of the axillary cymes ending in bare, subulate, spinescent points; leaves linear-oblanceolate, entire to slightly dentate
1 Ultimate branches of the inflorescence neither bare and subulate nor spinescent; leaves various
2 Plant pubescent, with yellow or amber-coloured glands or glandular hairs, aromatic, not farinose
3 Inflorescence usually composed of distinct though sometimes small dichasial cymes in the axils of leaves or bracts
4 Glands on lower surface of leaves and outside of sepals very shortly stalked; sepals rounded on the back 1. botrys
4 Glands on lower surface of leaves and outside of sepals sessile; sepals each with a conspicuous longitudinal keel down the back
2. schraderanum

3 Inflorescence composed of small sessile clusters of flowers in the axils of leaves or bracts; flowers not in dichasial cymes
5 Sepals in fruit free to at least half-way down, the calyx neither saccate nor net-veined outside; inflorescence distinctly paniculate
4. ambrosioides

5 Sepals in fruit connate to near apex, the calyx saccate and net-veined outside; inflorescence not paniculate
5. multifidum

2 Plant glabrous or farinose (at least on the young parts), eglandular, not aromatic
6 Perennial with triangular-hastate or -sagittate leaves; stigmas $0.8-1.5 \mathrm{~mm}$; seeds vertical except in terminal flowers
6. bonus-henricus

6 Annual; leaves variable but not hastate or sagittate (except 7 and 8); stigmas up to $c .0 .5 \mathrm{~mm}$; seeds vertical or horizontal
7 Seeds vertical except sometimes in the terminal flowers of the partial inflorescence; inflorescence glabrous
8 Leaves densely glaucous-farinose beneath
9. glaucum

8 Leaves green (or reddish) and glabrous beneath
9 Flowers in dense, globose, sessile axillary cymes along the main stems; perianth becoming fleshy and red in fruit
10 Cymes all conspicuously bracteate
7. foliosum

10 Upper cymes ebracteate 8. capitatum
9 Cymes usually in branched axillary and terminal panicles; perianth not becoming markedly fleshy and red in fruit
11 Sepals of lateral flowers of partial inflorescence scarcely ridged on back, usually free to half-way down or more 10. rubrum 11 Sepals of lateral flowers distinctly ridged or keeled on back (at least when young), connate almost to apex, forming a sac closely investing the fruit 11. botryodes
7 Seeds usually all horizontal; inflorescence sometimes glabrous, but more often farinose
12 Larger cauline leaves $\pm$ cordate to subtruncate at base, coarsely dentate; seeds $1.75-2 \mathrm{~mm}$ in diameter, with coarsely pitted testa
12. hybridum

12 Larger cauline leaves not cordate, $\pm$ cuneate; seeds less than 1.75 mm in diameter
13 Inflorescence-axes and outside of sepals glabrous (rarely sparsely farinose in 15)

14 Leaves entire, or rarely with a single, inconspicuous tooth on each side, ovate-elliptic, cuneate at base; stems 4-angled
13. polyspermum

14 Leaves $\pm$ dentate, the larger ones deltate; stems not 4-angled
15. urbicum

13 Inflorescence-axes and outside of sepals $\pm$ conspicuously farinose, at least when young
15 Plant smelling strongly of decaying fish; leaves entire or with a single angle on one or both sides towards base
14. vulvaria

15 Plant not evil-smelling; leaves often $\pm$ dentate or lobed
16 Seeds with acute margins; testa with minute, very close, rounded pits; leaves often strongly dentate, not at all 3-lobed
16. murale

16 Seeds with obtuse margins; testa smooth, furrowed, or with much larger pits than 16 ; leaves variable
17 Testa strongly pitted; leaves conspicuously 3-lobed
18 Middle lobe of leaves $\pm$ oblong and parallel-sided, slightly lobed to subentire; pits on testa close and radially elongate; plant not turning red
17. ficifolium

18 Middle lobe of leaves $\pm$ triangular and acute, with a few irregular teeth; pits less deep and regular; plant soon turning red
18. acerifolium

17 Testa not strongly pitted, usually $\pm$ smooth or furrowed; leaves 3-lobed or not
19 Leaves up to $11 \times 13 \mathrm{~cm}$; young parts of plant conspicuously tinged with reddish-purple
23. giganteum

19 Leaves rarely more than 6 cm ; young shoots not conspicuously reddish-purple
20 Stems $5-30 \mathrm{~cm}$, normally procumbent; leaves 3lobed (arctic Russia)
19. jenissejense

20 Stems normally erect or ascending; leaves variable (not arctic)
21 Leaves (at least middle and lower cauline) almost or quite as wide as long; inflorescence very grey-farinose 20 . opulifolium
21 Leaves (except the most juvenile) at least $1 \frac{1}{2}$ times as long as wide; inflorescence usually not very grey-farinose
22 Plant usually deep green (though often $\pm$ masked by grey); stems often reddish; leaves usually ovate-lanceolate, dentate or entire; testa with shallow, widely spaced, radial furrows 21. album
22 Plant usually rather bright glaucescent green; stems not red; larger cauline leaves always ovate-rhombic, with acute, forwardly directed teeth; testa with more numerous closer and deeper furrows than in 21
22. suecicum

1. C. botrys L., Sp. Pl. 219 (1753). Annual (4-) $15-70 \mathrm{~cm}$, aromatic, clothed all over with short, glandular hairs. Leaves pinnatifid, with up to $4(-6)$ lobes on each side. Inflorescence narrow, elongate, of many axillary cymes, the upper equalling or exceeding the bracts. Sepals not keeled on back. Seed $0 \cdot 5-0.8 \mathrm{~mm}$ in diameter. S. Europe extending northwards to C. France, Poland and the middle Volga. Al Au Bu? CoCzGaGeHe Hs Hu It Ju Lu Po Rm Rs (C, W, K, E) Sa Si Tu.
2. C. schraderanum Schultes in Roemer \& Schultes, Syst. Veg. 6: 260 (1820). Very like 1, but up to 130 cm ; smell unpleasant; glands on the lower side of the leaf and outside of sepals sessile; sepals each with a prominent, dentate keel outside from near apex to base; seeds $0.7-0.8 \mathrm{~mm}$ in diameter. $2 n=18$. E.C. \& $E$. Europe. [Ge Hu Po Rm Rs (C, W).] (E. Africa.)
3. C. aristatum L., $S p . P l .221$ (1753). Annual $3-30 \mathrm{~cm}$, bushy, much-branched, glabrous or sparsely glandular. Leaves up to $7 \times 0.7 \mathrm{~cm}$, linear-oblanceolate, entire or feebly dentate. Inflorescence of numerous axillary, dichasial cymes, whose ultimate
branches are bare, subulate, and spinescent. Sepals free to near the base, slightly keeled on back. Seeds $0.5-0.7 \mathrm{~mm}$ in diameter. C. Ural; naturalized in E. Ukraine and Hungary. Rs (C) [Hu Rs (E)]. (N. \& C. Asia, N. America.)
4. C. ambrosioides L., Sp. Pl. 219 (1753). Annual, rarely shortlived perennial, up to $1 \cdot 2 \mathrm{~m}$, strongly aromatic, pubescent (rarely with longer hairs), with many sessile glands. Leaves usually lanceolate, entire, dentate or rarely laciniate. Inflorescence paniculate; cymes sessile along the ultimate branches, usually bracteate. Calyx not saccate or net-veined; sepals free to at least half-way down, rounded on back. Seeds $0.5-0.8 \mathrm{~mm}$ in diameter. $2 n=32$. Cultivated as a vermifuge and naturalized throughout much of C. \& S. Europe. [Au Az Bl Co Cr Cz Ga Ge Gr Hs Hu It Ju Lu Po Rm Rs (W) Sa Si.] (Tropical America.)
5. C. multifidum L., Sp. Pl. 220 (1753). Perennial up to 1 m , procumbent to erect, much-branched, pubescent and with sessile glands. Leaves mostly pinnatifid, with narrow lobes. Flowers sessile or almost so, in sessile axillary clusters. Fruiting calyx enlarged and saccate; sepals connate to near apex, net-veined outside. Seeds $0 \cdot 9-1.5 \mathrm{~mm}$ in diameter. S. Europe, but doubtfully native. *Co *Ga *Hs *It *Lu *Sa *Si. (? South America.)
6. C. bonus-henricus L., Sp. Pl. 218 (1753). Perennial $5-80 \mathrm{~cm}$, erect or ascending, sparsely farinose. Leaves more or less triangular, hastate to sagittate, usually subentire except for basal lobes. Infiorescence mostly terminal, narrow, tapering, leafless above. Sepals not or scarcely keeled. Stigmas $0 \cdot 8-1 \cdot 5 \mathrm{~mm}$. Seeds $1.5-2.2 \mathrm{~mm}$ in diameter, vertical except in terminal flowers. $2 n=36$. Most of Europe, except the east and parts of the south. All except Az Bl Cr Fa Is Lu Rs (N, K, E) Sb Tu.
7. C. foliosum Ascherson, Fl. Brandenb. 1: 572 (1864). Annual (7-)25-100 cm, erect, glabrous or almost so. Lower leaves deltate, coarsely dentate-serrate; upper (bracts) linearlanceolate, with a projecting lobe on either side near base. Inflorescence of many sessile, conspicuously bracteate cymes along main stems. Calyx red and fleshy in fruit. Seeds $1-1.3 \mathrm{~mm}$ in diameter, mostly vertical, reddish-brown, not acutely keeled. Scattered through much of Europe, but native only in the Alps and on mountains in the Iberian peninsula. $\mathrm{Au} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{[Al}$ $\mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Gr} \mathrm{?Ho} \mathrm{Po} \mathrm{RmRs} \mathrm{(B}, \mathrm{C}, \mathrm{W}, \mathrm{K}, \mathrm{E)} \mathrm{Su]}$.
8. C. capitatum (L.) Ascherson, Fl. Brandenb. 1: 572 (1864). Like 7 but lower leaves usually less toothed; upper leaves rhombic-hastate to lanceolate; cymes fewer and larger ( $5-10 \mathrm{~mm}$ in diameter), the upper ebracteate; seeds acutely keeled. $2 n=18$. Scattered localities in Europe, but not native, and possibly not truly naturalized. [Au Br Da Ga Ge Hb He Ho ?Hu Po Rm Rs (C, W, E).] (Origin uncertain.)
9. C. glaucum L., Sp. Pl. 220 (1753). Annual 2-40(-120) cm, procumbent or erect, much-branched, glabrous or almost so, except for the leaves beneath. Leaves elliptical, lanceolate, or rarely linear-elliptic, usually coarsely sinuate-serrate to sinuate, rarely subentire or entire, green above, densely glaucous-farinose beneath. Inflorescence axillary and terminal; cymes usually arranged in spikes or more or less paniculate. Flowers and seeds as in 10. $2 n=18$. Most of Europe except the extreme north and the islands. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Co} \mathrm{Cr} \mathrm{Fa} \mathrm{Hb} \mathrm{Is} \mathrm{Lu} \mathrm{Sa} \mathrm{Sb} \mathrm{Si}$.
C. wolffii Simonkai, Termész. Füzetek 3: 164 (1879), recorded from Romania (Transsylvania) is very like 9 but the leaves are mostly linear and entire or only slightly dentate; it is probably a mutant of 9 .
10. C. rubrum L., Sp. Pl. 218 (1753). Annual (0.5-)4-90 cm, procumbent to erect, usually much-branched, glabrous or almost so. Leaves ovate-rhombic to lanceolate, coarsely serrate-lobed to subentire. Cymes in variable, often pyramidal and leafy inflorescences. Sepals of lateral flowers 2-4, free to the middle or below, not or scarcely keeled. Seeds of lateral flowers 0.6 $1 \cdot 1 \mathrm{~mm}$ in diameter, vertical, reddish-brown. $2 n=36$. Most of Europe, but rare in the Mediterranean region. All except Al Az Bl Cr Fa Is Sa Sb Si Tu.
11. C. botryodes Sm. in Sowerby, Engl. Bot. 32: t. 2247 (1811). Like 10 but stems more often spreading or decumbent; leaves deltate to rhombic, subentire or slightly dentate, except for basal angles; sepals of lateral flowers more or less distinctly ridged or keeled, connate almost to apex and forming a sac closely investing the fruit. Saline habitats. C. \& S. Europe, extending to Ireland, Denmark and S.E. Russia, but absent from the C. \& E. Mediterranean region. Au Be Br Co Cz Da Ga Ge Hb He Hs Hu Lu Po Rm Rs (W, K, E).
12. C. hybridum L., Sp. Pl. 219 (1753). Annual $10-100 \mathrm{~cm}$, sparsely farinose to subglabrous. Leaves ovate in outline, usually acuminate at apex, more or less cordate to subtruncate at base, with $1-5$ coarse, angular teeth on each margin. Inflorescence cymose, often lax; ultimate branches divaricate. Sepals not keeled on back. Seeds $1.75-2 \mathrm{~mm}$ in diameter, horizontal; testa black, coarsely pitted. $2 n=18$. Most of Europe, but rare in the Mediterranean region. All except Az Bl Co Cr Fa Hb Is Lu Sa Sb ; introduced in Fe .
13. C. polyspermum L., Sp. Pl. 220 (1753). Annual (5-)15100 cm , erect or procumbent, glabrous. Leaves up to $8 \times 5 \mathrm{~cm}$, ovate-elliptic, entire or rarely with a single slight tooth just above the base on each side, cuneate at base. Inflorescence long, lax, tapering, of many axillary mostly divaricately branched cymes. Sepals 5, not keeled. Seeds $0.8-1.25 \mathrm{~mm}$ in diameter, horizontal. $2 n=18$. Most of Europe, but rare in the Mediterranean region. All except Al Az Bl Fa Is Sb .
14. C. vulvaria L., Sp. Pl. 220 (1753). Annual (4-)10-65 cm, procumbent, much-branched, grey-farinose, smelling of decaying fish. Leaves up to $2 \cdot 5(-3) \times 2 \cdot 3(-2 \cdot 7) \mathrm{cm}$, rhombic to ovate, entire or with an acute angle on each margin at broadest part, more or less densely grey-farinose beneath. Inflorescences terminal and axillary, small, leafy. Sepals 5, not keeled. Seeds $1-1.5 \mathrm{~mm}$ in diameter, brownish-black, obtusely keeled. $2 n=18$. Most of Europe. All except Az Fa Hb Is No Rs (N) Sb.
15. C. urbicum L., Sp. Pl. 218 (1753). Annual (4-)15-100 cm, erect, glabrous or very sparingly farinose. Lower leaves up to $14 \times 11 \mathrm{~cm}$, deltate to ovate, attenuate into the petiole; margins shallowly dentate to coarsely dentate-lobate above the basal lobes. Panicles with crowded suberect branches. Sepals 5, not keeled. Seeds 0.9-1.3 mm in diameter, horizontal, black, obtusely keeled. $2 n=36$. Most of Europe. All except Az Bl Cr Fa Hb He Ho Is Lu Rs ( N ) Sa Sb .
16. C. murale L., $S p$. Pl. 219 (1753). Annual up to 90 cm , erect or spreading, usually much-branched, more or less farinose. Leaves usually rhombic-ovate and coarsely dentate, not 3-lobed. Inflorescences terminal and axillary, divaricately branched, leafy. Sepals 5, bluntly keeled above. Seeds $1 \cdot 2-1 \cdot 5 \mathrm{~mm}$ in diameter, black, horizontal, acutely margined; pericarp adherent; testa closely and minutely pitted. $2 n=18$. Most of Europe. All except Fa Hb Is No Rs (N, E) Sb Tu.
17. C. ficifolium Sm., Fl. Brit. 1: 276 (1800). Annual 3090 cm , usually erect, more or less farinose, green. Leaves up to c. $7 \times 4 \mathrm{~cm}$, lanceolate to linear-oblong, usually with a single prominent divergent lobe on either side near base; middle lobe oblong, more or less parallel-sided, slightly lobed to subentire. Inflorescence much-branched; branches usually slender. Sepals 5, keeled. Seeds $1-1.15 \mathrm{~mm}$ in diameter, obtusely keeled; testa with close, radially elongate pits. $2 n=18$. Most of Europe. Au Be Br Bu Cz Da Fe Gr He Ho ?Hs It Ju No Po Rm Rs (N, B, C, W, K, E) Sa Si Su Tu.
18. C. acerifolium Andrz., Univ. Izv. (Kiev) 7-8: 132 (1862). Like 17 but with more prominent lateral lobes to leaves, and the middle lobe more or less triangular and acute, with few irregular teeth; pits on testa of seeds less deep and regular. Whole plant soon becoming red, and finally yellow. Poland and U.S.S.R. Po Rs (N, C, W, E).
19. C. jenissejense Aellen \& Iljin in Komarov, Fl. URSS 6: 873 (1936). Annual $5-30 \mathrm{~cm}$, procumbent, rarely suberect. Leaves up to $4 \times 2.5 \mathrm{~cm}$, oblong- or elliptic-deltate, more or less 3-lobed, with tooth-like lateral lobes at middle of leaf, and with 1-2 teeth above, green. Inflorescence dense, spicate. Sepals slightly keeled and farinose. Seeds $1-1.25 \mathrm{~mm}$ in diameter, black, without clear pattern on testa. N.E. Russia. Rs (N). (Siberia.)
20. C. opulifolium Schrader ex Koch \& Ziz, Fl. Palat. 6 (1814). Annual $60-150 \mathrm{~cm}$, erect, much-branched, green to almost white, rarely red-tinged, more or less grey-farinose. Leaves (at least middle and lower) rhombic-ovate, almost as wide as long, usually with a short, prominent lobe on each side, otherwise entire or with several teeth. Inflorescence a very greyfarinose panicle. Sepals 5 , keeled. Seeds $1 \cdot 1-1.5 \mathrm{~mm}$ in diameter, black, obtusely keeled; testa not pitted. $2 n=54$. Most of Europe, but only as a casual in the north. All except Az Fa Fe Hb Ho Is $\mathrm{No} \mathbf{S b} \mathrm{Tu}$.
21. C. album L., Sp. Pl. 219 (1753). Annual $10-150 \mathrm{~cm}$, usually erect, green or red-tinged (especially on stem), more or less greyfarinose. Leaves $1.2-8.2 \times 0.3-5.5 \mathrm{~cm}$, very variable, rhombicovate to lanceolate, mostly at least $1 \frac{1}{2}$ times as long as wide, entire, or shallowly dentate, sometimes more or less 3-lobed. Inflorescence a spicate or cymosely branched panicle. Sepals 5, keeled outside. Seeds $1 \cdot 2-1 \cdot 6(-1 \cdot 85) \mathrm{mm}$ in diameter, black, obtusely margined, usually marked with faint radial furrows, otherwise almost smooth. Most of Europe. All except Sb ; introduced in Fa and Is.

A very variable and complex species, divisible into at least two subspecies.
(a) Subsp. album: Leaves rhombic-ovate to lanceolate, often acute; margins not obviously parallel; stems green or red. $2 n=18,54$. Throughout the range of the species.
(b) Subsp. striatum (Krašan.) J. Murr in Urban \& Graebner, Festschr. Ascherson 222 (1904): Leaves oblong, obtuse; margins almost parallel, not or scarcely dentate; stems red-striped. C. \& E. Europe, extending westwards to Belgium; introduced in Spain.

It is possible that further subspecies should be recognized in Europe, and even that $\mathbf{2 2}$ and 23 might be better so treated.
C. reticulatum Aellen, Bot. Not. 1928: 205 (1928) has the testa of the seeds covered with distinct raised lines, forming a close, more or less quadrate reticulum, the surface between the ridges being minutely dotted; it is probably best considered a variant.
C. zerovii Iljin in Kotov, Fl. RSS Ucr. 4: 650 (1952), from the C. \& S. Ukraine, is like 21 but has elongate, horizontally spreading and arcuate-decumbent lower branches and rather thick leaves, very whitish-farinose beneath, ovate in outline, subobtuse at the apex, and held upright. The status of this plant requires further investigation.
22. C. suecicum J. Murr, Magyar Bot. Lapok 1: 341 (1902). Like 21 but usually a rather bright glaucescent green, somewhat farinose when young; stems not tinged with red; cauline leaves larger, ovate-rhombic, with sharp ascending teeth; cymes rather lax; testa with more numerous, closer and deeper furrows. $2 n=18$. N., C. \& E. Europe, occasionally naturalized elsewhere. Da Fe No Po Rm Rs (N, B, C, W, E) $\mathrm{Su}[\mathrm{Au} \mathrm{Br} \mathrm{Cz} \mathrm{Hb]}$.
23. C. giganteum D. Don, Prodr. Fl. Nepal. 75 (1825). Like 21 but $200-300 \mathrm{~cm}$, with young parts of plant conspicuously tinged with vivid reddish-purple, and with large rhombic-deltate leaves up to $c .14 \mathrm{~cm}$ long and wide. Naturalized in S. France (near Marseille). [Ga.] (N. India.)

## 4. Cycloloma Moq. ${ }^{1}$

Like Chenopodium but pubescent and eglandular; perianthsegments in fruit with a transverse wing on the back, the wings connate and completely encircling the fruit.

1. C. atriplicifolia (Sprengel) Coulter, Mem. Torrey Bot. Club 5: 143 (1894). Erect or ascending pubescent annual up to 80 cm . Leaves $3-6 \mathrm{~cm}$, oblong-ovate or lanceolate, sinuatepinnatifid or dentate. Perianth c. 2 mm in diameter in fruit; wing $c .0 .5 \mathrm{~mm}$ wide. Naturalized in N. Italy, S. France and Czechoslovakia. [Cz Ga It.] (C. \& W. North America.)

## 5. Spinacia L. ${ }^{1}$

Annual or biennial glabrous herb. Leaves flat. Flowers unisexual. Male flowers 4 - to 5 -merous, in a dense spicate inflorescence. Female flowers axillary, without perianth but with $2(-4)$ persistent bracteoles which become enlarged, connate and hardened in fruit; stigmas 4-5. Seeds vertical.

1. S. oleracea L., Sp. Pl. 1027 (1753). Stems up to 1 m or more, erect. Leaves ovate to triangular-hastate, entire or dentate. Bracteoles in fruit orbicular-obovate, usually wider than long, often with a divergent spine at the apex. A widely cultivated vegetable, occurring throughout most of Europe as an escape from cultivation, but rarely persisting. (Origin unknown?W. Asia.)

## 6. Atriplex L. ${ }^{2}$

Annuals or small shrubs; glabrous or farinose. Leaves flat. Flowers usually unisexual. Male flowers with 5 perianth-segments and 5 stamens. Female flowers without perianth but with 2 large persistent bracteoles, free or connate up to the middle; rarely some female flowers with 4 - to 5 -lobed perianth; stigmas 2 . Seeds vertical, often dimorphic, rarely some horizontal.
1 Shrubby perennial
2 Bracteoles reniform to orbicular or orbicular-ovate, not lobed; plant $100-250 \mathrm{~cm}$, stout, erect

1. halimus

2 Bracteoles ovate-rhombic to ovate-deltate, often 3-lobed; plant $20-50 \mathrm{~cm}$, procumbent at the base

[^47]3 Bracteoles $4-5 \mathrm{~mm}$, not or only slightly 3-lobed, with numerous filiform appendages on the back 2. glauca
3 Bracteoles 2-4 mm, 3-lobed, with 0-2 tubercles on the back
3. cana

## 1 Annual

4 Female flowers dimorphic, some with horizontal seeds and 4to 5 -lobed perianth, the rest with vertical seeds and 2 bracteoles
5 Leaves green or purple-brown, glabrous, sometimes the uppermost slightly farinose
4. hortensis

5 Leaves grey- to white-farinose, at least beneath
6 Stem cylindrical or obtusely angled; leaves thin, grey beneath, mostly broadly triangular-cordate 5. nitens
6 Stem 4- to 5-angled; leaves thick, white beneath, narrowly triangular-cordate
6. aucheri

4 Female flowers monomorphic, all with vertical seeds and 2 bracteoles
7 Bracteoles elliptical or orbicular-cordate, smooth and usually entire
8 Leaves mostly lanceolate to narrowly hastate 7. oblongifolia
8 Leaves broadly triangular-hastate 8. heterosperma
7 Bracteoles rhombic to rhombic-ovate, usually with teeth or appendages on the back
9 Bracteoles becoming hard in fruit; stems terete or angled
10 Cymes in terminal, leafless, often long panicles
12. tatarica

10 Cymes axillary or in leafy panicles
11 Bracteoles broadly rhombic, usually wider than long, 3 -lobed with quadrangular lateral lobes and entire middle lobe, smooth or muricate on the back
11. laciniata

11 Bracteoles rhombic or triangular-rhombic, acute and irregularly toothed in the upper part, usually with large appendages on the back
12 Stem and branches almost glabrous; flowers not more than 3 in each cyme; seeds with flat sides
9. sphaeromorpha

12 Stem and branches densely farinose; flowers $5-10$ in a cyme; seeds with convex sides
10. rosea

9 Bracteoles not becoming hard; stems strongly ridged
13 Bracteoles serrate or laciniate
16. calotheca

13 Bracteoles entire or dentate
14 At least some bracteoles stalked at the base
17-19. hastata group
14 Bracteoles sessile, sometimes cuneate at base
15 Lower leaves truncate at base 17-19. hastata group
15 Lower leaves cuneate or attenuate at base
16 Bracteoles ovate-rhombic with long-acuminate apex; lower leaves linear or linear-lanceolate 13. littoralis
16 Bracteoles rhombic or orbicular-rhombic; lower leaves rhombic-hastate to elliptic-lanceolate
17 Lower leaves at least 4 times as long as wide
17 Lower leaves 3-4 times as long as wide
14. patens
15. patula

1. A. halimus L., Sp. Pl. 1052 (1753). Erect stout shrubby perennial up to 250 cm , silvery-white. Leaves up to 4 cm , ovaterhombic or deltate, almost coriaceous, entire or rarely dentate. Cymes remote, in a paniculate inflorescence. Bracteoles orbicularovate to orbicular or reniform, entire or dentate, usually without appendages on the back. $2 n=18$. Halophilous. S. Europe. Bl Bu Co Cr Ga Gr Hs It Lu SaSi [Be].
2. A. glauca L., Sp. Pl. ed. 2, 1493 (1763). Dwarf shrub up to 50 cm , grey-green to silvery. Leaves up to $1(-3) \times 0 \cdot 5(-1) \mathrm{cm}$, oblong-lanceolate to orbicular, entire or dentate, slightly fleshy, silvery, sometimes grey-green on the upper surface. Cymes in long spicate inflorescences. Bracteoles $4-5 \mathrm{~mm}$, ovate-rhombic to ovate-deltate, entire or dentate, sometimes almost 3-lobed, with numerous large appendages on the back. C., E. \& S. Spain, S. Portugal. Hs Lu.
3. A. cana Ledeb., Icon. Pl. Ross. 1: 11 (1829). Shrub up to 50 cm , much-branched from the base. Leaves $0 \cdot 5-3 \mathrm{~cm} \times 2$ 7 mm , oblong-spathulate to linear-lanceolate, usually entire, thick, coriaceous, grey. Inflorescence paniculate, lax, shortly branched. Bracteoles up to $4 \times 3 \mathrm{~mm}$, fleshy, 3-lobed, campanulate to orbicular-deltate, entire, with or without appendages on the back. Steppes. S.E. Russia and Krym. Rs (K, E).
A. mollis Desf., Fl. Atl. 2: 391 (1799) is like 3 but has leaves $10-20 \times 4 \mathrm{~mm}$, lanceolate, silvery; bracteoles thin, orbicular. Recorded from Malta but not seen for many years and possibly only introduced. ?Si. (E. Mediterranean and N. Africa.)
4. A. hortensis L., Sp. Pl. 1053 (1753). Erect annual up to 250 cm . Leaves usually more than 10 cm , cordate- or hastatetriangular, slightly dentate or almost entire, the uppermost triangular or oblong-lanceolate, slightly farinose when young, more or less glabrous when mature, often purple-brown. Inflorescence terminal, spicate. Female flowers dimorphic. Bracteoles $5-15 \mathrm{~mm}$, orbicular-cordate. Seeds horizontal and vertical. Cultivated throughout most of Europe as a vegetable and naturalized in the centre and south. $\left[\mathrm{Al} \mathrm{Au} \mathrm{Bu} \mathrm{Cr}{ }_{4} \mathrm{Ge} \mathrm{Gr} \mathrm{He}\right.$ Ho Hs Hu It Ju Lu Po Rm Rs (C, W, K, E).]
5. A. nitens Schkuhr, Handb. 3: 541 (1803). Like 4 but the leaves white beneath; bracteoles oblong-cordate, conspicuously reticulate-veined. Roadsides and waste places. C. \& E. Europe. $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ge} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)}. \mathrm{(W} .\mathrm{\&} \mathrm{C}$. Asia.)
6. A. aucheri Moq., Chenop. Monogr. 51 (1840) (A. amblyostegia Turcz.). Like 4 but smaller (up to 150 cm ), the stem 4- to 5 -angled; leaves smaller, thick, distinctly bicolourous, the lower surface white, the upper green but often infolded. E. Ukraine; S.E. Russia. Rs (W, K, E).
7. A. oblongifolia Waldst. \& Kit., Pl. Rar. Hung. 3: 278 (1812). Erect annual up to 120 cm . Lower leaves ovate-lanceolate, often hastate, usually sinuate-dentate, the upper lanceolate. Cymes few-flowered, axillary, or in long, terminal, interrupted spicate inflorescences. Bracteoles up to 13 mm , triangular-ovate to rhombic-ovate, usually entire, smooth on the back. Ruderal. C., E. \& S.E. Europe, extending westwards to E. France. Au Bu $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)}$.
8. A. heterosperma Bunge, Mém. Sav. Étr. Pétersb. 7: 448 (1854). Like 7 but the lower leaves up to 15 cm , sagittate, entire or irregularly dentate, the upper narrow, hastate; inflorescence lax, spicate; bracteoles up to 6 mm , orbicular or cordate, somewhat farinose. Ruderal. S.E. Russia, E. Ukraine; naturalized or casual elsewhere. Rs (E) [?Au Ga Ge Po ?Rm]. Often confused with 5.
9. A. sphaeromorpha Iljin, Bull. Jard. Bot. URSS 26: 414 (1927). Much-branched annual up to 80 cm . Leaves up to $3 \times 2 \mathrm{~cm}$, triangular-ovate or deltate, broadly cuneate, obtuse, crenate-serrate, grey-green. Female flowers few, axillary; male terminal, in short, leafless, spicate inflorescences. Bracteoles c. 6 mm , rhombic, irregularly dentate, ventricose, becoming hardened towards the base. S. Russia and Ukraine. Rs (W, E).
10. A. rosea L., Sp. Pl. ed. 2, 1493 (1763). Erect or ascending annual up to 100 cm , much-branched, stems smooth or angled. Leaves up to $6 \times 3 \mathrm{~cm}$, ovate-rhombic or rhombic-triangular, sinuate-dentate, white. Cymes axillary, except the uppermost. Bracteoles up to 12 mm , rhombic, dentate, becoming hard in the lower half, usually with large appendages on the back. Ruderal. $S$. \& C. Europe. Al Au Bl Bu Co Cr Cz Ga Ge Gr Hs Hu It Ju Lu Po Rm Sa Si Tu [Be Br He Ho].
11. A. laciniata L., Sp. Pl. 1053 (1753) (A. sabulosa Rouy). Procumbent much-branched silvery annual up to 30 cm ; stem smooth or angled. Leaves $1 \cdot 5-2 \mathrm{~cm}$, rhombic to ovate, sinuatedentate. Cymes axillary. Bracteoles $6-7 \mathrm{~mm}$, broadly rhombic, rounded or toothed on the lateral angles, becoming hard in the lower half. $2 n=18$. Maritime. W. \& N.W. Europe. Be Br Da Ga Ge Hb Ho Hs No Su.
12. A. tatarica L., Sp. Pl. 1053 (1753) (A. laciniata sensu Coste; incl. A. tornabenii Tineo). Procumbent to erect, muchbranched whitish annual up to 150 cm ; stem smooth or angled. Leaves up to $10 \times 7 \mathrm{~cm}$, silvery, triangular-rhombic to triangular hastate, irregularly sinuate-lobed, the lowest lobe largest. Inflorescence terminal, paniculate or spicate. Bracteoles up to 7 mm , orbicular to oblong-rhombic, reticulate-veined, becoming hard in the lower half, with or without appendages on the back. $2 n=18 . C . \& S$. Europe, casual in the north. Al Au Bu Co Cz Ge Gr Hs Hu It Ju Po Rm Sa Si Tu [Be].

Polymorphic and probably composed of a number of subspecies.
13. A. littoralis L., Sp. Pl. 1054 (1753). Erect, usually muchbranched annual up to 100 cm ; stems strongly ridged. Leaves linear to oblong-linear, entire or dentate, the lower shortly petiolate, the upper sessile. Inflorescence long, spicate, leafy only at the base. Bracteoles rhombic-ovate, dentate or entire, muricate on the back; apex acuminate or lingulate. $2 n=18$. Maritime, and saline places inland. C., W. \& S. Europe extending northwards to c. $69^{\circ} \mathrm{N}$. in Norway. Au Be Br Co Cz Da Fe Ga Ge Gr Hb Ho Hs Hu It Ju No Po Rm Sa Su.
14. A. patens (Litv.) Iljin, Bull. Jard. Bot. URSS 26: 415 (1927). Erect annual $15-70 \mathrm{~cm}$. Lower and middle leaves up to $8 \times 2 \mathrm{~cm}$, narrowly oblong-hastate to elliptic-lanceolate, crenate-serrate, the upper linear-lanceolate, entire. Cymes small, in leafless, terminal, spicate, inflorescences. Bracteoles orbiculardeltate, acuminate, entire or dentate, farinose, smooth or muricate on the back. S. Russia, Ukraine. Rs (W, E).
15. A. patula L., Sp. Pl. 1053 (1753). Much-branched annual up to 150 cm , slightly farinose; stem strongly ridged. Lower leaves $3-14 \times 1-6 \mathrm{~cm}$, rhombic-hastate with cuneate base, the upper lanceolate to linear, entire. Cymes axillary or in long spicate inflorescences. Bracteoles up to $5(-10) \mathrm{mm}$, broadly rhombic, entire or denticulate, smooth or tuberculate on the back. $2 n=36$. Weed and ruderal. Throughout Europe northwards to c. $71^{\circ} N$. All except Al Az Cr Sb.
16. A. calotheca (Rafn) Fries, Nov. Fl. Suec. ed. 2, Mant. 3: 164 (1842). More or less glabrous annual $30-100 \mathrm{~cm}$. Leaves triangular-hastate, irregularly sinuate-dentate. Inflorescence spicate, acute. Bracteoles up to 25 mm , hastate or cordatetriangular, laciniate, without appendages on the back. $2 n=18$. Coasts of the Baltic extending to S. Norway and N.W. Germany. Da Fe Ge No Po Rs (B, C) Su.
(17-19.) A. hastata group. Erect or procumbent annuals up to 100 cm , farinose when young; stem strongly ridged. Lower leaves up to $10 \times 7 \mathrm{~cm}$. Inflorescence paniculate or spicate. Bracteoles smooth or tuberculate on the back.

The seeds in this group are dimorphic, the 'small' seeds are $1-2 \mathrm{~mm}$, black, smooth, the 'large' seeds are $2-3 \mathrm{~mm}$, brown, reticulate-rugose.

A difficult group not yet properly understood. The evidence available indicates that all the species within the group are inter-
fertile, and many populations are made up of plants variously intermediate between two or more of the species. It is, therefore, often impossible to identify individuals with any certainty.
1 At least some bracteoles distinctly stalked
19. longipes
1 Bracteoles sessile, sometimes cuneate at base
2 Bracteoles thin, not inflated; plant up to 100 cm , usually erect
17. hastata
2 Bracteoles thick, inflated; plant usually not more than 20 cm , procumbent
18. glabriuscula
17. A. hastata L., Sp. Pl. 1053 (1753). Erect or procumbent, up to 100 cm , usually green. Lower leaves hastate, the base subcordate. Bracteoles not more than 5 mm , triangular-rhombic to elliptic-rhombic, dentate. Seeds nearly all small. $2 n=18$. Ruderal, usually near the coast. Throughout Europe northwards to $c .71^{\circ} \mathrm{N}$. in Norway. All except Cr Fa Is Sb .
Very variable; one of the more distinct variants is subsp. polonicum (Zapał.) Aellen, Feddes Repert. 69: 144 (1964) from S.E. Poland, E. Czechoslovakia and W. Ukraine. It has the lower leaves almost sagittate-hastate, deeply sinuate-dentate; bracteoles rhombic with acute appendages on the back.
Another distinct variant, from maritime habitats in England, and probably elsewhere in W. Europe, is usually red or purple, has the lower leaves truncate at base, bracteoles up to $5-10 \mathrm{~mm}$, thin, distinctly reticulate-veined, and numerous large seeds.
18. A. glabriuscula Edmondston, Fl. Shetl. 39 (1845). Procumbent, up to 20 cm , often red. Leaves hastate, base truncate. Bracteoles up to 8 mm , rhombic to rhombic-orbicular, inflated, thick, entire or dentate. Large seeds numerous. $2 n=18$. Maritime. Coasts of W. \& N.W. Europe. Be Br Da Fa Ga Ge Hb Ho ?Hs Is No Po Su.
19. A. longipes Drejer, Fl. Excurs. Hafn. 107 (1838). Procumbent to erect, colour variable. Lower leaves triangular-hastate and somewhat cuneate at base, to oblong. Bracteoles up to $5-20 \mathrm{~mm}$, at least some distinctly stalked, triangular to rhombic, usually entire, smooth or muricate on the back. Large seeds usually numerous. $2 n=18$. Maritime. Coasts of the Baltic and arctic Russia; recently found to be widespread in the British Isles, and probably also occurring elsewhere in W. \& N.W. Europe. Br Da Fe Po Rs (N) Su [No].
Often confused with $\mathbf{1 7}$ and 18. In Britain it has commonly been called $A$. patula var. bracteosa.
In the Baltic and arctic Russia many subspecies of, or species related to 19 have been described. Most of these are sympatric and are probably more correctly treated as variants of this species or as intermediates between 19 and other taxa in this group. Those generally recognized in recent floras are:
A. longipes Drejer sensu stricto. Inflorescence leafless; bracteoles $5-20 \mathrm{~mm}$, nearly all with stalk up to 30 mm long.
A. longipes subsp. kattegatensis Turesson, Lunds Univ. Arsskr. nov. ser. (2), 21: 4 (1925). Inflorescence leafy almost to apex; bracteoles $5-20 \mathrm{~mm}$ with stalk $3-10 \mathrm{~mm}$ long.
A. praecox Hülphers in Lindman, Svensk Fanerogamfl. 228 (1918). Leaves oblong-ovate or lanceolate-elliptical, entire or with small basal teeth; bracteoles $3-6 \mathrm{~mm}$, entire, 1 -veined, at least some distinctly stalked.
A. nudicaulis Boguslaw., Lešn. Žur. 1: 30 (1846). Leaves oblong-deltate, dentate; bracteoles $3-6 \mathrm{~mm}$, entire, 3 -veined with a reticulum of secondary veins, at least some distinctly stalked.

[^48]A. lapponica Pojark., Fl. Murmansk. Obl. 3: 365 (1956). Lower leaves lanceolate to hastate, somewhat cuneate at base; inflorescence leafless, the cymes dense, remote, almost forming whorls; bracteoles ( $5-$ ) $7-8(-20) \mathrm{mm}$, dentate, at least some stalked.
A. kuzenevae N. Semen. in Pojark., Fl. Murmansk. Obl. 3: 366 (1956). Lower leaves ovate-hastate, somewhat cuneate at base; inflorescence leafy; bracteoles $4 \cdot 5-8 \mathrm{~mm}$, sinuate-dentate, rarely almost entire, distinctly 1 -veined, red-violet on the margin, at least some stalked.

## 7. Halimione Aellen ${ }^{1}$

Like Atriplex but the bracteoles connate almost to the apex in fruit.
1 Annual; fruit with pedicel up to 12 mm
3. pedunculata
1 Small shrub; fruit $\pm$ sessile
2 Bracteoles $2.5-5 \mathrm{~mm}$ in fruit, obdeltate, usually 3-lobed distally 1. portulacoides
2 Bracteoles $c .2 \mathrm{~mm}$ in fruit, suborbicular, obtuse with dentate margin
2. verrucifera

1. H. portulacoides (L.) Aellen, Verhandl. Naturf. Gesell. Basel 49: 126 (1938) (Atriplex portulacoides L., Obione portulacoides (L.) Moq.). Decumbent small shrub $20-80(-150) \mathrm{cm}$, silveryfarinose, stems often rooting. Lower leaves opposite, oblong, elliptical or obovate, entire, thick and fleshy. Fruit sessile. Bracteoles $2 \cdot 5-5 \mathrm{~mm}$, obdeltate, usually 3-lobed at the apex. $2 n=36$. Salt-marshes, particularly at the edges of channels and pools. Shores of the Mediterranean, Atlantic and North Sea, northwards to Denmark; S.W. shore of the Black Sea. Al Be Bl Br Bu Co Da Ga Ge Gr Hb Ho Hs It Ju Lu Sa Si Tu.
2. H. verrucifera (Bieb.) Aellen, op. cit. 129 (1938) (Atriplex verrucifera Bieb.). Like 1 but bracteoles c. 2 mm , suborbicular, obtuse, dentate, verrucose. Salt-marshes; occasionally on saline soils inland. S.E. Europe from the W. shores of the Black Sea to c. $52^{\circ} N$. in Russia. Rm Rs (W, K, E).
3. H. pedunculata (L.) Aellen, op. cit. 123 (1938) (Atriplex pedunculata L., Obione pedunculata (L.) Moq.). Erect annual up to 50 cm , silvery-farinose. Leaves alternate, oblong to elliptical or obovate, entire. Fruiting pedicels up to 12 mm . Bracteoles $2-3 \mathrm{~mm}$, obdeltate, 3 -lobed, the middle lobe very small, the lateral lobes large and spreading. $2 n=18$. Saline soils. Shores of N.W. \& N. Europe from N. France to Estonia and of the Black Sea, and in saline places inland. $\mathrm{Be} \dagger \mathrm{Br} \mathrm{Bu} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Ho}$ Po Rm Rs (B, W, K, E) Su.

Rare and possibly extinct in many of its localities in N.W. Europe.

## 8. Krascheninnikovia Gueldenst. ${ }^{1}$

Perennial herbs or small shrubs with stellate hairs. Leaves alternate, flat, entire. Flowers unisexual. Male flowers in a dense spicate inflorescence; perianth-segments 4; stamens 4. Female flowers axillary, without perianth but with 2 persistent bracteoles; stigmas 2. Seeds vertical. (Eurotia auct.)

1. K. ceratoides (L.) Gueldenst., Nov. Comment. Acad. Sci. Petrop. 16: 555 (1772) (Eurotia ceratoides (L.) C. A. Meyer). Erect, $30-100 \mathrm{~cm}$; tomentose or lanate, with grey or reddishbrown hairs. Leaves $12-40 \mathrm{~mm}$, linear-oblong or lanceolate, attenuate at base into a short petiole. Flowers densely tomentose or lanate. Bracteoles c. 3 mm in fruit, obovate, pubescent. Dry places. U.S.S.R. from C. Ukraine to W. Kazakhstan and E. Russia; also very locally in Romania, C. Europe and E. \& S. Spain. Au ?Cz Hs Hu Rm Rs (C, W, K, E).

## 9. Ceratocarpus L. ${ }^{1}$

Annual herbs with stellate hairs. Leaves entire, spine-tipped. Flowers unisexual. Male flowers solitary or in short axillary cymes; perianth-segments 2 ; stamens $1(-3)$. Female flowers solitary, without perianth but with 2 persistent bracteoles; stigmas 2. Seeds vertical.

1. C. arenarius L., Sp. Pl. 969 (1753). Much-branched herb up to 30 cm with grey or reddish-brown tomentum. Leaves $1-4 \mathrm{~cm}$, linear or linear-filiform, the lower opposite, the upper alternate. Bracteoles $5-7 \mathrm{~mm}$ in fruit, connate, forming a tri-angular-cuneate involucre; apex of bracteoles with a patent subulate appendage. Sandy ground, and as a weed. E. Europe from N.E. Bulgaria to E. Russia. Bu Rm Rs (C, W, K, E).

## 10. Axyris L. ${ }^{1}$

Stellate-pubescent annual herb. Leaves alternate, flat. Flowers unisexual; the male in dense cymes forming a spicate inflorescence; the female 2-bracteate, solitary or forming a cyme with the male flowers. Perianth-segments 3(-5); stamens 2-5; stigmas 2. Fruit usually with a short wing at the apex. Seeds vertical.

1. A. amaranthoides L., Sp. Pl. 979 (1753). Stems $15-80 \mathrm{~cm}$. Leaves up to $9 \times 3 \mathrm{~cm}$, lanceolate, densely pubescent. Achenes $2-3 \mathrm{~mm}$, often with 2 -lobed wing at apex. Cultivated ground and waste places. C., S. \& E. Russia; W. Kazakhstan; rarely as a casual elsewhere. Rs (C, E) [Cz]. (Temperate Asia.)

## 11. Camphorosma L. ${ }^{1}$

Annual or perennial herbs or small shrubs, usually pubescent. Leaves alternate, linear or subulate. Flowers hermaphrodite or female, solitary or in dense ovoid cymes. Perianth-segments 4(5) with the 2 lateral segments larger; stamens 4-5; stigmas 2(-3). Seeds vertical.

## 1 Dwarf shrubs

2 Perianth glabrous at least at the base; plant smelling of camphor 1. monspeliaca
2 Perianth densely villous-tomentose; plant not smelling of camphor
2. lessingii

1 Annual herbs
3 Perianth $\pm$ glabrous, with divergent lateral segments 3. annua
3 Perianth densely pubescent, with incurved lateral segments
4. songorica

1. C. monspeliaca L., $S p$. Pl. 122 (1753). Caespitose perennial with short, woody, leafy branches at the base, and flowering stems $10-60 \mathrm{~cm}$; smelling of camphor. Leaves $2-10 \mathrm{~mm}$, linear, stiff, often fasciculate. Perianth $2-3.5 \mathrm{~mm}$, glabrous or pubescent at the apex of the segments. Saline soils and dry waste places. S. Europe extending northwards to c. $53^{\circ}$ N. in E.C. Russia. Al $\mathrm{Bu} \mathrm{Co} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)} \mathrm{Sa} \mathrm{Si}$.
2. C. lessingii Litv., Trav. Mus. Bot. Acad. Pétersb. 2: 96 (1905) (C. ruthenica auct., non Bieb.). Very like 1 but flowering stems $15-80 \mathrm{~cm}$; plant not smelling of camphor; leaves $2-6 \mathrm{~mm}$; perianth $2-2.5 \mathrm{~mm}$, villous-tomentose. W. Kazakhstan and adjacent parts of S.E. Russia. Rs (E). (C. \& S.W. Asia.)
C. nestensis Turrill, Kew Bull. 1935: 142 (1935), described from N.E. Greece (near Xanthi), is doubtfully distinct from 2. It is said to have the flowers gynomonoecious, the female flowers with

[^49]perianth $1 \cdot 5-2.5 \mathrm{~mm}$, the hermaphrodite flowers with perianth c. 4 mm .
3. C.annua Pallas, Reise 3: 603 (1776) (C.ovata Waldst. \& Kit.). Glabrous or sparsely pubescent annual or biennial $5-40 \mathrm{~cm}$. Leaves $5-15 \mathrm{~mm}$, linear. Perianth $2 \cdot 5-4 \mathrm{~mm}$, glabrous; lateral perianth-segments divergent at the apex. Saline habitats. - E.C. Europe extending to Bulgaria and C. Ukraine. Au Bu Cz Hu Ju Rm Rs (W).
4. C. songorica Bunge, Act. Horti Petrop. 6: 415 (1880). Like 3 but lanate; perianth pubescent, apex of lateral segments incurved, usually villous. Salt-marshes. S. \& E. Russia, E. Ukraine. Rs (W, K, E). (C. \& W. Asia.)

## 12. Bassia All. ${ }^{1}$

Pubescent herbs. Leaves linear, flat or cylindrical, entire. Flowers hermaphrodite or female, solitary or in cymes arranged in a panicle. Perianth-segments 5, becoming enlarged in fruit and developing a spine on the back; stamens 5; stigmas 2-3. Seeds horizontal. (Echinopsilon Moq.)

1 Leaves linear-lanceolate, flat, attenuate towards the base; spines of the perianth $1-1.5 \mathrm{~mm}$

1. hyssopifolia

1 Leaves semicylindrical or filiform, rarely the lowest $\pm$ flat; spines of the perianth usually not more than 1 mm
2 Spines of perianth pubescent; stem usually procumbent or ascending
2. hirsuta

2 Spines of perianth glabrous in the upper part; stem erect
3. sedoides

1. B. hyssopifolia (Pallas) Volk. in Engler \& Prantl, Natürl. Pflanzenfam. 3 (1a): 70 (1893) (Kochia hyssopifolia (Pallas) Schrader). Erect, white, hirsute or villous annual $10-100 \mathrm{~cm}$; branches erect. Leaves up to $35 \times 4 \mathrm{~mm}$, linear-lanceolate, flat, attenuate at base. Perianth villous-lanate; spines $1-1.5 \mathrm{~mm}$, subulate, curved, glabrous. Saline soils and cultivated ground. From Moldavia to W. Kazakhstan; N.E. \& S.E. Spain. Hs Rs (W, K, E) [Ga].
2. B. hirsuta (L.) Ascherson in Schweinf., Beitr. Fl. Aethiop. 187 (1867) (Echinopsilon hirsutum (L.) Moq., Kochia hirsuta (L.) Nolte). Procumbent or ascending, villous or glabrescent annual $10-60 \mathrm{~cm}$; branches flexuous. Leaves up to 15 mm , linear, fleshy, semicylindrical, rarely the lower spathulate and more or less flat. Perianth hirsute; spines $c .1 \mathrm{~mm}$, conical or hooked, pubescent. $2 n=18$. Maritime sands and saline soils. Coasts of Caspian and Black Sea, C. Mediterranean region and of Denmark, N. Germany and the Netherlands. ?Be Bu Co Da Ga Ge Ho It Ju Rm Rs (W, K, E) Sa Su .
3. B. sedoides (Pallas) Ascherson in Schweinf., loc. cit. (1867) (Kochia sedoides (Pallas) Schrader). Erect, lanate annual 10100 cm ; branches erect. Leaves up to 12 mm , filiform, fleshy. Perianth villous; spines $c .1 \mathrm{~mm}$, conical, usually straight, glabrous in the upper part. Saline habitats. E. Europe, extending westwards to Czechoslovakia and Hungary. Bu Cz Hu Rm Rs (C, W, K, E).

## 13. Kochia Roth ${ }^{1}$

Like Bassia but the perianth-segments developing a transverse wing (rarely a tubercle) on the back in fruit.
1 Leaves flat, lanceolate or linear-lanceolate, 3-veined; fruiting perianth-segments with very short wing sometimes reduced to a tubercle
4. scoparia

1 Leaves semicylindrical, linear-subulate, obscurely veined or 1 -veined; fruiting perianth-segments with distinct scarious wing
2 Annual; fruiting perianth-segments with oblong or obovate wing not more than 1 mm wide
3. laniflora

2 Small shrub; fruiting perianth-segments with suborbicular or triangular-orbicular wing usually at least 2 mm wide
3 Leaves up to 12 mm , acute or mucronate, not fleshy; peri-anth-segments ovate, obtuse, densely pubescent 1. prostrata
3 Leaves up to 30 mm , obtuse, fleshy; perianth-segments orbicular, glabrous or sparsely pubescent
2. saxicola

1. K. prostrata (L.) Schrader, Neues Jour. Bot. 3 (3 and 4): 85 (1809). Small shrub with procumbent stems up to 80 cm . Leaves up to 12 mm , linear-subulate, stiff, spine-tipped. Fruiting perianth $3-4.5 \mathrm{~mm}$, pubescent; segments ovate, obtuse; wing semicircular, erose. Dry places. S. Europe, extending northwards to Austria and S.C. Russia. Al Au Bu Cz Ga Hs Hu It Ju Rm Rs (C, W, K, E).
2. K. saxicola Guss., Enum. Pl. Inar. 275 (1854). Small shrub up to 30 cm . Leaves up to 30 mm , cylindrical, fleshy, obtuse. Fruiting perianth c. 4 mm , glabrous or sparsely pubescent; segments suborbicular, very obtuse; wing cuneate-obovate, apex obtuse or retuse. Maritime rocks and cliffs. Islands of Ischia, Capri and Stromboli. It.
3. K. laniflora (S. G. Gmelin) Borbás, Balaton Tav. Part. 340 (1900) (K. arenaria (Gaertner, Meyer \& Scherber) Roth). Erect annual up to 80 cm . Leaves up to 25 mm , filiform, soft. Fruiting perianth $4-6 \mathrm{~mm}$, perianth-segments ovate; wing not more than 1 mm wide, oblong-obtuse or obovate. Dry, sandy places. S. \& C. Europe; U.S.S.R. northwards to c. $53^{\circ}$ N. Au Bu $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)} \mathrm{[He]}$.
4. K. scoparia (L.) Schrader, Neues Jour. Bot. 3 (3 and 4): 85 (1809). Erect annual $20-150 \mathrm{~cm}$. Leaves up to 50 mm , flat, lanceolate or linear-lanceolate, 3-veined. Fruiting perianth 3-4 mm , pubescent, with ovate-obtuse segments; wing very short or reduced to a tubercle. Naturalized in C., E. \& S. Europe, possibly native in S. and E. Russia. Rs ( $\left.{ }^{*} \mathrm{C},{ }^{*} \mathrm{~K},{ }^{*} \mathrm{E}\right)[\mathrm{Al} \mathrm{Au} \mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Ge}$ He Ho Hs Hu It Ju Lu Po Rm Rs (W) Tu]. (Temperate Asia.)

Cultivated for its ornamental foliage.

## 14. Corispermum L. ${ }^{1}$

Annual herbs, often pubescent with stellate hairs. Leaves alternate, linear or lanceolate, flat or semicylindrical. Flowers hermaphrodite, solitary in the axils of bracts, in spikes arranged in a branched inflorescence. Perianth-segments $0-3(-5)$. Stamens $1-5$. Stigmas 2. Achene strongly compressed, usually with a marginal wing. Seeds vertical.

All species occur on shingle or in sandy habitats.
Literature: M. Iljin, Bull. Jard. Bot. URSS 28: 637-54 (1929). M. Klokov, Not. Syst. (Leningrad) 20: 90-136 (1960).
Base of style curved outwards

1. uralense
1 Base of style straight
2 Achene not winged 12. orientale
2 Achene winged, wing sometimes narrow
3 Wing membranous
4 Flowers in long lax spikes
2. canescens
4 Flowers in short dense spikes
5 Apex of wing distinctly emarginate
5 Apex of wing not emarginate
3. marschallii 3. algidum

3 Wing thick, or membranous only at margin, often very narrow
6 Perianth-segments absent from most flowers 10. intermedium
6 Perianth-segments obvious in all flowers
7 Achene with triangular-acuminate apex
7 Achene with emarginate or obtuse apex
8 Achene with emarginate apex
8 Achene with obtuse apex
9 Leaves filiform or semicylindrical
10 Achene $4-5 \mathrm{~mm}$
7. filifolium

10 Achene $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$
6. nitidum

9 Leaves flat
11 Wing not more than $\frac{1}{10}$ as wide as achene
11 Wing $c . \frac{1}{5}$ as wide as achene
9. hyssopifolium
11. leptopterum

1. C. uralense (Iljin) Aellen, Feddes Repert. 69: 144 (1964). (C. squarrosum auct.) Plant $5-40 \mathrm{~cm}$, often reddish, pubescent becoming glabrous; branches long. Leaves oblong-linear to linear. Spikes cylindrical, dense. Bracts ovate or oblong-ovate, pubescent. Perianth-segments $0-1$. Achene $2 \cdot 3-3 \cdot 3 \times 2-2 \cdot 6 \mathrm{~mm}$, ovate; base of the style curved outwards; wing very small, membranous, undulate. S.E. Russia. Rs (E).
2. C. marschallii Steven, Mém. Soc. Nat. Moscou 5: 336 (1814). Plant $30-40 \mathrm{~cm}$, densely pubescent, becoming glabrous; branches long. Leaves narrowly lanceolate to linear. Spikes usually short, dense. Bracts broadly ovate, acute, longer but narrower than the achene, margin membranous. Perianth-segments $0(-2)$. Achene $4-5 \times 3-4 \mathrm{~mm}$, ovate to orbicular; wing broad $\left(\frac{1}{2} \frac{1}{3}\right.$ as wide as achene), cordate at base, membranous, erose, emarginate; style included in the notch. E. \& E.C. Europe. Cz Ge Po Rm Rs (C, W, E) [It ?Si].
3. C. algidum Iljin, Bull. Jard. Bot. URSS 28: 642 (1929). Like 2 but the plant $3-15 \mathrm{~cm}$, pubescent; leaves oblong or linear-oblong; spikes usually ovoid, bracts oblong or ovate; achene $3-4 \times 2 \cdot 2-3 \mathrm{~mm}$, ovate, or ovate-orbicular, obtuse; wing $\frac{1}{4}-\frac{1}{8}$ as wide as achene, almost entire, or dentate towards the apex, scarcely emarginate. - N. Russia. Rs (N).
4. C. canescens Kit. in Schultes, Oestreichs Fl. ed. 2, 1: 7 (1814). Plant $30-70 \mathrm{~cm}$, simple or with long branches, usually pubescent. Leaves linear. Spikes long, lax. Bracts ovate, acute, broadly membranous-margined, covering the fruit. Perianthsegments $0-5$. Achene $3 \cdot 5-4 \times 2 \cdot 5-3 \cdot 25 \mathrm{~mm}$, ovate or orbicular; wing broad ( $\frac{1}{4}-\frac{1}{8}$ as wide as achene), translucent, erose. C. \& E. Europe. $\mathrm{Cz} \mathrm{Hu} \mathrm{Rm} \mathrm{Rs}(\mathrm{C}, \mathrm{W}, \mathrm{E})$.
C. ucrainicum Iljin, Not. Syst. (Leningrad) 9: 262 (1946), C. stenopterum Klokov, op. cit. 20: 93 (1960), C. volgicum Klokov, op. cit. 100 (1960) and C. borysthenicum Andrz., Univ. Izv. (Kiev) 7-8: 134 (1862) should probably be included here.
5. C. aralocaspicum Iljin, Bull. Jard. Bot. URSS 28: 637 (1929). Plant $10-60 \mathrm{~cm}$, with long branches from the base, more or less glabrous. Leaves linear, flat. Spikes short, dense at the base. Bracts oblong-ovate, shorter than the fruit. Perianthsegments $1(-3)$. Achene $3 \cdot 5-3.75 \times 3 \cdot 3-3.5 \mathrm{~mm}$, almost orbicular, apex rounded, almost truncate; wing broad ( $\frac{1}{2}-\frac{1}{4}$ as wide as achene) towards the apex, undulate. S.E. Russia, W. Kazakhstan. Rs (E).
6. C. nitidum Kit. in Schultes, Oestreichs Fl. ed. 2, 1: 7 (1814). Plant $10-50 \mathrm{~cm}$, branches procumbent, sparsely pubescent or glabrous, often reddish. Leaves linear, slightly fleshy. Spikes long, slender, lax. Upper bracts broadly ovate to orbicular, shortly acuminate, broadly membranous-margined.

Perianth-segments 3. Achene $2.5-3.5 \times 2-2.75 \mathrm{~mm}$, ovate or almost orbicular, apex truncate and shortly bidentate; wing very narrow, thick, entire. C. and E. Europe. Au Bu Cz Gr Hu Ju Rm Rs (C, W, K, E).
C. nitidulum Klokov, op. cit. 105 (1960) and C. calvum Klokov, op. cit. 112 (1960) are probably only variants of 6 .
7. C. filifolium C. A. Meyer, Bull. Soc. Nat. Moscou 2: 455 (1854). Like 6 but leaves filiform; achene $4-5 \times 3-4 \mathrm{~mm}$, ovate, obtuse, the wing with a gap at the style-base. S.E. Russia. Rs (E) [Ge].
8. C. declinatum Stephan ex Steven, Mém. Soc. Nat. Mosc. 5: 384 (1817). Plant $15-50 \mathrm{~cm}$, long- and much-branched from the base, glabrous or subglabrous. Leaves linear or linear-lanceolate. Spikes long and lax. Bracts oblong, long-acuminate, broadly membranous at the base. Perianth-segments rudimentary. Achene $3-4 \times 1.3-2.5 \mathrm{~mm}$, oblong-obovate, almost parallelmargined; wing very narrow, thick, slightly erose, with a triangular apex. S.E. Russia. Rs (E).
9. C. hyssopifolium L., Sp. Pl. 4 (1753). Plant $15-60 \mathrm{~cm}$, branched from the base. Leaves linear. Spikes long, narrow, more or less lax. Lower bracts longer than the achene, upper shorter and narrower. Perianth-segments 1(-3). Achene $4-5 x$ 3-4 mm, ovate; wing very narrow, thin, sometimes absent, apex rounded, entire. E. Europe. Po Rm Rs (W, K, E).
C. hybridum Besser ex Andrz., Univ. Izv. (Kiev) 7-8: 135 (1862), C. glabratum Klokov, op. cit. 122 (1960), C. czernjaevii Klokov, op. cit. 120 (1960), and C. insulare Klokov, op. cit. 124 (1960) are probably not specifically distinct from 9.
10. C. intermedium Schweigger, Königsb. Arch. Naturw. 1: 211 (1812). Plant $10-30 \mathrm{~cm}$, with long branches, pubescent when young. Leaves lanceolate to linear. Spikes short, thick and dense, or elongate and lax. Bracts broadly ovate-lanceolate, narrower but slightly longer than the fruit. Perianth-segments $O(-3)$. Achene $3-4.5 \times 3 \mathrm{~mm}$, elliptic-ovate to suborbicular; wing $\frac{1}{3}-\frac{1}{4}$ as wide as the achene, thick, membranous only at the margin, more or less entire, apex rounded, projecting slightly at the base of the style. C. Europe. Ge Po.
11. C. leptopterum (Ascherson) Iljin, Bull. Jard. Bot. URSS 28: 653 (1929) (C. hyssopifolium auct. eur. centr., non L.). Plant $10-60 \mathrm{~cm}$, branched from the base, usually glabrous. Leaves linear-lanceolate to lanceolate, flat. Spikes short or long, usually dense. Lower bracts lanceolate, completely covering the fruit. Perianth-segment 1 . Achene $3 \cdot 3-4 \cdot 3 \times 2-3 \cdot 5 \mathrm{~mm}$, obovate or obovate-oblong, apex rounded, truncate or triangular. Wing narrow and thick, or broad and membranous ( $\frac{1}{4} \frac{1}{8}$ as wide as achene), entire or undulate. S. France, Italy, Sicilia; casual elsewhere and locally naturalized. Ga It $\mathrm{Si}[\mathrm{Be} \mathrm{Ge} \mathrm{Ho}]$.
12. C. orientale Lam., Encycl. Méth. Bot. 2: 111 (1786). Plant $5-60 \mathrm{~cm}$, with patent branches, more or less pubescent. Leaves oblong to linear. Spikes short, dense. Bracts ovate, acuminate, membranous-margined, slightly longer than the fruit. Perianth-segment 1 . Achene $2-3 \times 1 \cdot 5-2 \mathrm{~mm}$, elliptic-ovate, bidentate at the apex; wing practically absent. S.E. Russia. Rs (E).

## 15. Agriophyllum Bieb. ex C. A. Meyer ${ }^{1}$

Stellate-pubescent annual herb. Leaves alternate, flat, spinetipped. Flowers hermaphrodite, in axillary cymes. Perianthsegments ( $0-$ )1-3; stamens $2-3$; stigmas 2. Achene compressed,

[^50]narrowly winged, with the persistent stigmas forming a 2 -lobed beak. Seeds vertical.

1. A. squarrosum (L.) Moq. in DC., Prodr. 13 (2): 139 (1849) (A. arenarium Bieb. ex C. A. Meyer). Leaves up to 8 cm , lanceolate or linear-lanceolate, acuminate, with spinose apex and with 5-15 more or less parallel veins. Bracts ovate, with spinose apex; cymes $c .1 \mathrm{~cm}$, ovoid. Achene $3-6 \mathrm{~mm}$. Mobile sands. S.E. Russia; W. Kazakhstan. Rs (E). (W. \& C. Asia.)

## 16. Kalidium Moq. ${ }^{1}$

Small fleshy shrubs, not articulate. Leaves alternate, fleshy, small, decurrent. Flowers hermaphrodite or female, in usually 3flowered cymes immersed in the fleshy axis of a spicate inflorescence. Perianth-segments 5; stamens 2; stigmas 2.

Lamina of leaves 2-6 mm, patent or recurved

1. foliatum

Lamina of leaves reduced to a small tubercle at the apex of the
decurrent-amplexicaul base
2. caspicum

1. K. foliatum (Pallas) Moq. in DC., Prodr. 13 (2): 147 (1849). Stems $10-75 \mathrm{~cm}$, branches not fragile when dry; lamina of leaves 2-6 mm, linear to ovate, semi-terete, patent or recurved; base semi-amplexicaul. Terminal spikes $20-30 \mathrm{~mm}$. Achene $c .1 \mathrm{~mm}$. Saline habitats. S.E. Russia, W. Kazakhstan; S.E. Spain. Hs Rs (E). (W. \& C. Asia.)
2. K. caspicum (L.) Ung.-Sternb., Atti Congr. Bot. Firenze 317 (1876). Stems $15-25 \mathrm{~cm}$, branches fragile when dry; lamina of leaves a small tubercle, convex below, flattened above; base amplexicaul-obovate. Terminal spikes $6-12 \mathrm{~mm}$. Achene $1 \cdot 2-$ 1.5 mm . Saline habitats. S.E. Russia (Astrakhan region). Rs (E). (S.W. \& C. Asia.)

## 17. Halopeplis Bunge ex Ung.-Sternb. ${ }^{1}$

Annual herbs. Leaves alternate, subglobose and amplexicaul with rudimentary lamina. Inflorescence spicate, with a 3 -flowered cyme in the axil of each bract. Flowers hermaphrodite or female, more or less connate with each other and with the surrounding bracts; perianth-segments 3 ; stamens 1-2; stigmas 2 .

Leaves distant, the internodes longer than the leaves (W. Mediterranean region, S. Portugal)

1. amplexicaulis Leaves crowded, the internodes shorter than the leaves (shores of the Caspian Sea)
2. pygmaea
3. H. amplexicaulis (Vahl) Ung.-Sternb. ex Cesati, Passer. \& Gibelli, Comp. Fl. Ital. 271 (1869) (Halostachys perfoliata sensu Willk.). Stem erect, $5-30 \mathrm{~cm}$, glaucous, with stout base. Leaves distant; lamina c. 2 mm . Spikes $5-15 \mathrm{~mm}$; bracts ovate-orbicular. Seeds c. 0.5 mm , with cylindrical papillae. Salt-marshes. W. Mediterranean region (eastwards to Taranto) and S. Portugal. Hs It Lu Sa Si. (N. Africa.)
4. H. pygmaea (Pallas) Bunge ex Ung.-Sternb., Syst. Salicorn. 105 (1866). Like 1 but $3-20 \mathrm{~cm}$, slender; leaves crowded, the internodes shorter than the leaves. N.W. shores of the Caspian Sea. Rs (E). (C. Asia.)

## 18. Halostachys C. A. Meyer ${ }^{1}$

Shrubs or small trees. Leaves opposite, connate, with a rudimentary lamina. Inflorescence spicate, with 3-flowered cymes in the axils of opposite, free, bracts. Flowers free, hermaphrodite; perianth-segments 3; stamen 1; stigmas 2-3.

1. H. belangerana (Moq.) Botsch., Not. Syst.(Leningrad) 16: 84 (1954) (H. caspia C. A. Meyer, H. caspica auct.). Shrub or small tree up to 3.5 m with erect branched trunk; ultimate branches articulated. Spikes $1-3 \mathrm{~cm}$; bracts more or less orbicular, slightly cordate. Seeds $0 \cdot 5-1 \mathrm{~mm}$. Salt-marshes. S.E. Russia, W. Kazakhstan. Rs (E). (S.W. \& C. Asia.)

## 19. Halocnemum Bieb. ${ }^{1}$

Small fleshy shrubs with opposite and decussate leaves. Flowers hermaphrodite, in 2- to 3 -flowered axillary cymes arranged in a spicate, articulate inflorescence. Perianth-segments 3; stamen 1; stigmas 2-3.

1. H. strobilaceum (Pallas) Bieb., Fl. Taur.-Cauc. 3: 3 (1819). Stem up to 50 cm , becoming woody. Leaves connate at base and enclosing the stem so that it is apparently articulate; free part of leaves $c .1 \mathrm{~mm}$, broadly obovate, obtuse; leaves subtending short globose branches. Bracts free, reniform-orbicular; cymes globose to cylindrical-globose. Seeds $0.5-0.8 \mathrm{~mm}$. Shores of the Mediterranean, Black and Caspian Seas. Al Gr Hs Rm Rs (W, K, E) Sa Si Tu.

## 20. Arthrocnemum Moq. ${ }^{1}$

Articulate, glabrous, dwarf shrubs. Leaves opposite, scale-like, the bases of each pair amplexicaul, fused to form a segment. Inflorescence spicate, segmented; each fertile segment composed of two 3 -flowered cymes immersed in the pair of bracts arising from the node above; the flowers of each cyme more or less equal in size, the central distinctly separating the laterals. Perianthsegments usually 4 ; stamens 2 .

The delimitation of this genus from Salicornia is that proposed by C. E. Moss, Jour. S. African Bot. 20: 1-22 (1954), but there is much disagreement as to the limits of these genera.

All species occur mainly in salt-marshes.
1 Flowers of each cyme falling to leave an undivided hollow in the segment; seeds black; testa hard, tuberculate 3. glaucum
1 Flowers of each cyme falling to leave a tripartite hollow in the segment; seeds greenish-brown to greyish; testa thin, membranous, covered with short conical or curved hairs
2 Usually with creeping, subterranean stems; green, often becoming red or brown; seeds covered with curved or hooked hairs

1. perenne

2 Always without creeping subterranean stems; usually glaucous; seeds covered with $\pm$ conical hairs
2. fruticosum

1. A. perenne (Miller) Moss, Jour. S. Afr. Bot. 14: 40 (1948) (Salicornia perennis Miller, S. radicans Sm.). Small shrub with creeping, subterranean stems forming mats up to 1 m in diameter; also with short erect non-flowering and flowering stems, which are green, becoming red or brownish. Cymes completely immersed in and connate with the fertile segments, falling to leave a tripartite hollow in the segment; flowers almost reaching the upper edge of the segment. Seeds greenish-brown or greyish; testa thin, membranous, covered with curved or hooked hairs; endosperm almost absent. $2 n=18$. Coasts of $S . \& W$. Europe, northwards to $c .53^{\circ} N$. in Britain. Al Bl Br Co Cr Ga Gr Hb Hs It Ju Lu Sa Si.

Much confused with procumbent plants of 2.
2. A. fruticosum (L.) Moq., Chenop. Enum. 111 (1840) (Salicornia fruticosa (L.) L.). Like 1 but the stems up to 1 m , erect or procumbent, usually stout and not rooting, glaucous; cymes

[^51]clearly not reaching the upper edge of the fertile segment; testa covered with short conical hairs. $2 n=54$. Coasts of $S$. Europe extending northwards to $47^{\circ} 15^{\prime} N$. in W. France. Al Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.
3. A. glaucum (Delile) Ung.-Sternb., Atti Congr. Bot. Firenze 283 (1876) (Salicornia macrostachya Moric.). More or less erect shrub up to 1 m , glaucous, becoming yellowish-green or reddish. Cymes protruding, free, falling to leave one hollow in the segment; flowers extending to not more than $\frac{1}{3}$ of the length of the segment. Seeds black; testa hard, tuberculate; endosperm abundant. $2 n=36$. Coasts of $S$. Europe. Al Bl Co Cr Ga Gr Hs It Ju Lu SaSi .

## 21. Salicornia L. ${ }^{1}$

Annual, articulate herbs. Leaves and inflorescence like those of Arthrocnemum. Cymes (1-)3-flowered, connate with and completely immersed in the bract of the segment, the flowers arranged in a triangle, the laterals usually meeting below the central flower. Perianth 3- to 4-lobed; stamens 1-2. Seeds with thin membranous testa; endosperm very sparse.

All species occur in saline habitats, and it is possible that immersion in salt water is essential for the growth of some species.

It is usually impossible to identify dried specimens with any reasonable degree of accuracy. As a result most Floras recognize only one species (S. europaea L. or S. herbacea (L.) L.), although there can be little doubt that several occur in Europe. In recent years several accounts of the genus based on living material, but covering relatively small areas, have been published, but these cannot be satisfactorily correlated either taxonomically or nomenclaturally, even in N.W. Europe.

Literature: P. W. Ball \& T. G. Tutin, Watsonia 4: 193-205 (1959). D. König, Mitt. Fl.-Soziol. Arbeitsgemeinschaft n.s. 8: 5-58 (1960). J. Nannfeldt, Svensk Bot. Tidskr. 49: 97-109 (1955). R. de Soó, Acta Bot. Acad. Sci. Hung. 6: 397-403 (1960).

1 Cymes 1-flowered; infructescence disarticulating
4. pusilla

1 Cymes 3-flowered; infructescence not disarticulating
2 Anthers $0 \cdot 2-0.5 \mathrm{~mm}$, often not exserted; fertile segments with convex sides; lateral flowers smaller than the central
(1-3). europaea group
2 Anthers ( $0 \cdot 5-$ ) $0.6-1 \mathrm{~mm}$, always exserted; fertile segments $\pm$ cylindrical, sometimes with slightly concave sides; lateral flowers almost equalling the central (5-7). procumbens group
(1-3). S. europaea group. Plants usually red or purple in fruit; the uppermost primary branches straight, making an acute angle (usually less than $45^{\circ}$ ) with the main stem; terminal spike with 3-12(-22) fertile segments; fertile segments with convex sides, the lateral flowers of each cyme commonly appearing much smaller than the central flower; flowers often cleistogamous; stamens usually 1 , rarely 0 or 2 ; anthers $0.2-0.5 \mathrm{~mm}$, usually dehiscing before exsertion, or not exserted and persisting in the perianth; seeds $1-1.7 \mathrm{~mm}$.

The specific limits within this group are obscure, and the genetic situation is not yet fully understood. Inbreeding is probably predominant, and this may account for a great deal of the local variation which occurs. The following appear to be the more distinct taxa:
1 Lower fertile segments of the terminal spike 3-5 mm wide at the narrowest point; upper edge with an inconspicuous scarious margin (not more than 0.1 mm wide)

1. europaea

1 Lower fertile segments of the terminal spike 2-3.5(-4) mm wide (or less) at the narrowest point; upper edge with a conspicuous scarious margin (c. $0 \cdot 1-0 \cdot 2 \mathrm{~mm}$ wide)

2 Lower fertile segments of the terminal spike $2 \cdot 5-4 \mathrm{~mm}$ wide at the narrowest point and $3-5 \cdot 3 \mathrm{~mm}$ wide at the widest (W. \& N.W. Europe)
2. ramosissima

2 Lower fertile segments of the terminal spike 2-2.5 mm wide at the narrowest point, and $2.5-3 \mathrm{~mm}$ wide at the widest (E.C. \& E. Europe)
3. prostrata

1. S. curopaea L., Sp. Pl. 3 (1753) (S. herbacea (L.) L.). Plant $10-40 \mathrm{~cm}$, simple to much-branched; glaucous or grass-green, sometimes becoming yellow-green, usually with red or pinkishred colour appearing diffusely in the fertile segments. Terminal spikes $10-50 \mathrm{~mm}$; lower fertile segments $2 \cdot 5-4 \cdot 5 \mathrm{~mm}, 3-5 \mathrm{~mm}$ wide at the narrowest point and $3 \cdot 5-6 \mathrm{~mm}$ wide at the widest; upper edge with an inconspicuous, narrow (c. 0.1 mm ) scarious margin. $2 n=18$. N.W. Europe; possibly this or closely related spp. throughout Europe in suitable habitats. All except Au Az Fa He Is Sb .

Very variable. S. stricta Dumort., Bull. Soc. Bot. Belg. 7: 334 (1868), S. patula Duval-Jouve, Bull. Soc. Bot. Fr. 15: 175 (1868), S. obscura P. W. Ball \& Tutin, Watsonia 4: 204 (1959), S. brachystachya (G. F. W. Meyer) D. König, Mitt. Fl.-Soziol. Arbeitsgemeinschaft n.s. 8: 11 (1960), pro parte, S. simonkaiana (Soó) Soó, Acta Bot. Acad. Sci. Hung. 6: 401 (1960) are probably variants of this species.
2. S. ramosissima J. Woods, Bot. Gaz. (London) 3: 29 (1851). Erect or procumbent up to 40 cm , typically much-branched but sometimes forming pure stands of small simple plants; dark green, sometimes becoming yellow-green, with dark purplish-red first appearing round the flowers and along the upper edge of the fertile segments and sometimes eventually colouring the whole segment. Terminal spike $5-30(-40) \mathrm{mm}$; lower fertile segments $1 \cdot 9-3 \cdot 5 \mathrm{~mm}, 2 \cdot 5-4 \mathrm{~mm}$ wide at the narrowest point and $3-5 \cdot 3 \mathrm{~mm}$ wide at the widest; upper edge with a conspicuous, scarious margin $0 \cdot 1-0 \cdot 2 \mathrm{~mm}$ wide. $2 n=18$. N.W. Europe and ?W. Mediterranean region. $\mathrm{Be} \mathrm{Br} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} ? \mathrm{Hb} \mathrm{Ho}$ ?It ?Sa ?Si.
3. S. prostrata Pallas, Ill. Pl. 3 (1803) (S. ramosissima auct. eur. orient., non J. Woods). Like 2 but more slender; lower fertile segments of the terminal spike $2-2.5 \mathrm{~mm}$ wide at the narrowest point and $2 \cdot 5-3 \mathrm{~mm}$ wide at the widest. $2 n=18$. E. \& E.C. Europe. Au Hu Rm Rs (W, E).
4. S. pusilla J. Woods, Bot. Gaz. (London) 3: 30 (1851). Plants up to 25 cm , erect or procumbent, usually much-branched, yellowish-green becoming brownish- or pinkish-yellow. Terminal spike up to $6(-15) \mathrm{mm}$, disarticulating in fruit; fertile segments 2-4(-12), with convex sides. Cymes 1 -flowered. Flowers almost orbicular; stamens usually one. $2 n=18$. Uppermost parts of saltmarshes and shores of estuaries. - C. \& S. Britain, S. Ireland, N.W. France; very probably elsewhere in W. Europe. Br Ga Hb .

Intermediates, presumably of hybrid origin, between this sp . and 2 occur sometimes when the two species grow together.
(5-7). S. procumbens group. Plants usually not pink or purple; uppermost primary branches curving upwards; terminal spike with (4-)6-30 fertile segments; fertile segments usually more or less cylindrical, the lateral flowers of each cyme almost as large as the central flower; flowers chasmogamous; stamens 1-2; anthers $0.6-1 \mathrm{~mm}$, dehiscing after exsertion; seeds $1.4-2.2 \mathrm{~mm}$.
S. procumbens Sm. in Sowerby, Engl. Bot. t. 2475 (1813) must be identical with either 6 or 7 but information at present available does not permit of a decision.

[^52]1 Lower fertile segments of the terminal spike with a minimum diameter $2-3.5 \mathrm{~mm}$; plant usually becoming light brownishor orange-purple 5. nitens

1 Lower fertile segments of the terminal spike with a minimum diameter usually exceeding 3.5 mm ; plant usually without purple coloration, rarely pale red or purple
2 Terminal spikes with 6-15(-22) fertile segments, $\pm$ cylindrical; spikes of the primary lateral branches cylindrical; plant dull green to yellowish-green, often becoming bright yellow in fruit
6. fragilis

2 Terminal spikes with 12-30 fertile segments, distinctly tapering towards the apex; spike of the primary lateral branches tapering; plant dark, dull green becoming paler or dull yellow in fruit
7. dolichostachya
5. S. nitens P. W. Ball \& Tutin, Watsonia 4: 204 (1959). Erect, $5-25 \mathrm{~cm}$, usually with the primary branches less than $\frac{1}{2}$ the length of the main stem; green to yellowish-green, usually soon becoming light brownish- or orange-purple. Terminal spike $1-4 \mathrm{~cm}$, cylindrical, with 4-9 fertile segments. Lower fertile segments $2-3.5 \times 2-3.5 \mathrm{~mm}$ at the narrowest point and $2 \cdot 3-4.0 \mathrm{~mm}$ wide at the widest. $2 n=36$. Mud in upper part of salt-marshes. England, S. Ireland; probably elsewhere in W. and S. Europe. Br Hb.
6. S. fragilis P. W. Ball \& Tutin, Watsonia 4: 204 (1959) (S. strictaauct., proparte, non Dumort.). Erect (10-)15-30(-40) cm, usually much-branched; green to yellowish-green usually becoming bright yellow. Terminal spike $(1 \cdot 5-) 2 \cdot 5-8 \mathrm{~cm}$, cylindrical, with 6-15(-22) fertile segments. Lower fertile segments $3-5 \times$ $3 \cdot 5-6 \mathrm{~mm}$, cylindrical. $2 n=36$. Often colonizing open sandy soils, but occurring in a wide range of habitats. - Known certainly only from C. \& S. England and Ireland but probably widespread throughout W. \& S. Europe. Br Hb.
S. emerici Duval-Jouve, Bull. Soc. Bot. Fr. 15: 176 (1868), S. lutescens P. W. Ball \& Tutin, Watsonia 4: 203 (1959), ?S. stricta subsp. decumbens Aellen in Hegi, Ill. Fl. Mitteleur. ed. 2, 3 (2): 730 (1961), pro parte (S. stricta subsp. procumbens sensu D. König, pro parte) are probably variants of this species.
7. S. dolichostachya Moss, New Phytol. 11: 409 (1912) (S. stricta sensu D. König, pro max. parte, non Dumort.). Erect 10-$40(-45) \mathrm{cm}$, much-branched, straggling to fastigiate, dark green becoming paler or dull yellow and finally brownish. Terminal spikes (2.5-)5-12(-20) cm, tapering, with $12-30$ fertile segments. Lower fertile segments $3-6 \times 3-6 \mathrm{~mm}$, cylindrical. $2 n=36$. Mud and sand at relatively low tidal levels. N.W. Europe. Be Br Da Ga Ge Hb Ho No Rs (N) Su.

This species is said to differ from all others in the absence of spirally thickened or striated cells in the fertile segments. Some variants of 6 are, however, often almost without these cells, so the taxonomic value of this character is doubtful.
(a) Subsp. dolichostachya: Straggling to fastigiate; uppermost branches arising at an angle of $c .60-90^{\circ}$ with the axis and curving upwards. Throughout the range of the species, except the Baltic region.
(b) Subsp. strictissima (K. Gram) P. W. Ball, Feddes Repert. 69: 7 (1964). Erect, fastigiate; uppermost branches arising at an angle of $45^{\circ}$ or less with the axis, straight. Baltic region and possibly parts of the North Sea coasts.
S. oliveri Moss, Jour. Bot. (London) 49: 183 (1911), described from N.W. France, is possibly a dwarf variant of (a).

## 22. Microcnemum Ung.-Sternb. ${ }^{1}$

Like Salicornia but flowers free, minute, with thin membranous perianth; central flower in each cyme hermaphrodite, laterals
usually female; stamen 1 ; seeds with black, crustaceous, granular testa.

1. M. coralloides (Loscos \& Pardo) Font Quer, Butll. Inst. Catal. Hist. Nat. 5: 98 (1925). Erect, usually much-branched annual $5-10 \mathrm{~cm}$. Terminal spikes up to 4 cm , with up to 16 fertile segments. Fertile segments $2-3 \mathrm{~mm}$, with broad membranous upper margin; flowers more or less concealed. Saline soils. E. \& E.C. Spain. Hs. (C. \& S. Anatolia.)

In Europe represented only by the endemic subsp. coralloides, with tuberculate, not papillose, seeds.

## 23. Suaeda Forskål ex Scop. ${ }^{1}$

Annual or perennial herbs or small shrubs, glabrous or farinose. Leaves usually alternate, semicylindrical or flat. Flowers hermaphrodite and female, solitary or in few-flowered cymes; bracteoles 2, minute. Perianth-segments 5 , fleshy, sometimes with a small tubercle, or horns, or a narrow transverse wing on the back in fruit; stamens 5; stigmas 2-3(-5). Seeds vertical or horizontal.

Several species can produce dimorphic seeds. The first-formed are black, shining, smooth or with a fine pattern on the testa; the later-formed are larger, light brown or olive, dull, with a distinct coarse reticulum on the testa. The seeds referred to in this account are always the first-formed seeds.

## All the species occur in saline habitats.

1 Fruiting perianth of the upper flowers transversely winged, that of the lower flowers usually keeled
2 Leaves linear-semicylindrical, not more than 1.5 mm in diameter; bracts ovate, acute, much shorter than the leaves

## 13. heterophylla

2 Leaves and bracts similar, flat, ovate to oblong, up to 5 mm wide, obtuse
14. kossinskyi

1 Fruiting perianth not transversely winged
3 Fruiting perianth with 1 or 2 horns on the back, the upper often almost stellate 8. corniculata
3 Fruiting perianth not horned (occasionally with tubercles)
4 Peduncle of the cyme connate with the bract
5 Small shrub; leaves $3-16 \mathrm{~mm}$
4. dendroides

5 Annual herb; leaves $12-30 \mathrm{~mm}$
6 Leaves c. 0.5 mm in diameter, cylindrical 10. altissima
6 Leaves $1-3 \mathrm{~mm}$ wide, flat
7 Fruiting perianth with a slight tubercle on the back; seeds granular
11. linifolia

7 Fruiting perianth with a transverse keel on the back; seeds smooth
12. eltonica

4 Peduncle of the cyme not connate with the bract
8 Seeds with a distinct fine pattern on the testa
9 Small shrub; perianth inflated in fruit
3. physophora

9 Annual herb, sometimes $\pm$ woody at the base; perianth not inflated
7. maritima

8 Seeds smooth or very indistinctly patterned
10 Leaves with a slender caducous apex (up to 1 mm ); fruiting perianth rugose 9. splendens
10 Leaves obtuse, acute or shortly acuminate, but without a caducous apex; fruiting perianth smooth 11 Perianth-segments very inflated, red in fruit
6. baccifera 11 Perianth-segments not inflated in fruit, usually green 12 Annual, sometimes woody at base; longest leaves usually more than 20 mm ; stigmas $2(-3)$
13 Leaves acute to mucronate; seeds completely smooth
5. confusa

13 Leaves obtuse or subacute; seeds faintly reticulate
7. maritima

12 Small shrub; longest leaves usually less than 15 mm ; stigmas 3

14 Stigmas usually flat, oblong-ovate, lobed or capitate; leaves $5-18 \times(0.8-) 1-1.5 \mathrm{~mm}$; bracts mostly much longer than the cymes 1. vera
14 Stigmas subulate or filiform; leaves $2-5(-6) \times c$. 0.5 mm ; bracts shorter than or equalling the cymes
2. pruinosa

1. S. vera J. F. Gmelin in L., Syst. Nat. ed. 13, $2(1): 503$ (1791) (S. fruticosa auct.). Small shrub up to 120 cm . Leaves $5-18 \times(0.8-) 1-1.5 \mathrm{~mm}$, semicylindrical, obtuse or shortly apicuate, sessile, glaucous. Cymes dense, shorter than the bracts. Stigmas usually flat, oblong-ovate, lobed or capitate. Fruiting perianth usually green, not inflated. Seeds smooth, usually vertical. S. \& W. Europe northwards to c. $53^{\circ}$ N. in England. Al Bl Br Co Cr Ga Gr Hs It Ju Lu Sa Si.
2. S. pruinosa Lange, Vid. Meddel. Dansk Naturh. Foren. Kjobenhavn 1861: 45 (1861) (S. fruticosa var. brevifolia Moq., pro parte). Like 1 but the leaves $2-5(-6) \times c .0 .5 \mathrm{~mm}$, more or less cylindrical; bracts not exceeding the cymes; stigmas filiform or subulate. E. Spain, Sicilia. Hs Si. (N. Africa.)
3. S. physophora Pallas, Ill. Pl. 51 (1803). Small shrub up to 120 cm . Leaves $20-40 \times 1-2 \mathrm{~mm}$, filiform, obtuse or subacute. Cymes very lax. Fruiting perianth spongy-inflated, reddish. Seeds punctate, mostly horizontal. S.E. Russia, W. Kazakhstan. Rs (E). (C. Asia.)
4. S. dendroides (C. A. Meyer) Moq., Chenop. Monogr. Enum. 126 (1840). Small shrub up to 60 cm . Leaves $5-16 \times 1-2 \mathrm{~mm}$, semicylindrical, obtuse, attenuate at base. Cymes dense; peduncle connate with the base of the bract. Fruiting perianth inflated, green. Seeds more or less smooth, mostly horizontal. S.E. Russia, W. Kazakhstan. Rs (E). (Caspian region.)
5. S. confusa Iljin, Acta Horti Petrop. 26: 284 (1930). Annual up to 50 cm , often woody at base. Leaves $10-25 \times c .1 \mathrm{~mm}$, semicylindrical, acute, or acuminate. Cymes dense. Fruiting perianth not inflated, green. Seeds smooth, mostly horizontal. S. Russia, S. Ukraine, ?Moldavia. Rs (W, K, E).
6. S. baccifera Pallas, Ill. Pl. 48 (1803). Annual up to 50 cm , often woody at base. Leaves $12-25 \times 0.6-1 \mathrm{~mm}$, semicylindrical, mostly obtuse. Cymes dense. Fruiting perianth much enlarged, baccate, red. Seeds smooth, mostly horizontal. S. Russia; one locality in E. Ukraine. Rs (W, E).
7. S. maritima (L.) Dumort., Fl. Belg. 22 (1827). Annual up to $50(-100) \mathrm{cm}$, of very variable habit and colour. Leaves $10-$ $50 \times c .1 \mathrm{~mm}$, semicylindrical, acute or subobtuse. Cymes dense. Fruiting perianth not inflated, green or red. Seeds finely reticulate, usually horizontal. In suitable habitats throughout most of Europe except the north-east and extreme north. All except Az Fa He Is Rs (N) Sb.

Very variable in habit, leaf-shape and colour. Very little of the variation is correlated with distribution. The following subspecies appear to be the most distinct.
$\begin{array}{ll}1 & \text { Perianth-segments with a membranous margin, with a keel and } \\ \text { small tubercle on the back } & \text { (c) subsp. pannonica }\end{array}$
(b) subsp. salsa
(a) Subsp. maritima (incl. S. prostrata Pallas): $2 n=36$. Recorded throughout the range of the species, but many of the records for E.C. \& E. Europe may be referable to (b).
(b) Subsp. salsa (L.) Soó in Soó \& Jáv., Magyar Növ. Kéz. 785 (1951) (S. salsa (L.) Pallas): $2 n=36$. E.C. \& E. Europe.
(c) Subsp. pannonica (G. Beck) Soó ex P. W. Ball, Feddes Repert. 69: 44 (1964) (S. pannonica G. Beck): E. Austria, Hungary, N.W. Romania.
8. S. corniculata (C. A. Meyer) Bunge, Acta Horti Petrop. 6 : 429 (1880). Annual up to 50 cm . Leaves $12-20 \times 1-1.5 \mathrm{~mm}$, semicylindrical, more or less acute. Cymes dense, occurring in the axils of most leaves. Fruiting perianth with 1 or 2 horns on the back, the upper horn almost stellate, the lower much smaller and dentate, or absent. Seeds reticulate-punctate, usually horizontal. S.E. Russia, W. Kazakhstan. Rs (E). (W. \& C. Asia.)
9. S. splendens (Pourret) Gren. \& Godron, Fl. Fr. 3: 30 (1855). Diffuse annual up to 50 cm . Leaves $8-20 \times 1-2 \mathrm{~mm}$, semicylindrical, semitranslucent, acuminate or mucronate, usually with a fine caducous apex up to 1 mm . Cymes dense. Fruiting perianth very inflated, rugose. Seeds smooth, usually horizontal. $2 n=18$. Mediterranean region, extending to C. Portugal. Al Co Ga Gr Hs It Lu ? Rm Sa Tu .
10. S. altissima (L.) Pallas, Ill. Pl. 49 (1803). Erect annual up to 150 cm . Leaves $12-30 \times 0.5 \mathrm{~mm}$, filiform, acute or subobtuse. Cymes lax or dense, usually shortly pedunculate, the peduncle connate with the base of the bracts. Fruiting perianth not inflated, rounded on the back. Seeds almost smooth, vertical or horizontal. S.E. Europe from E. Greece to W. Kazakhstan; S. \& E. Spain. Bu Gr Hs Rs (W, K, E).
11. S. linifolia Pallas, Ill. Pl. 43 (1803). Erect annual up to 75 cm . Leaves $12-30 \times 1-3 \mathrm{~mm}$, linear, acute, flat. Cymes usually lax, very shortly pedunculate, the peduncle connate with the base of the bracts. Fruiting perianth not inflated, with a slight tubercle on the back. Seeds granular, vertical or horizontal. S.E. Russia, W. Kazakhstan. Rs (E). (W. Asia.)
12. S. eltonica Iljin, Bull. Jard. Bot. URSS. 26: 415 (1927). Like 11 but plant up to 150 cm ; leaves $20-40 \mathrm{~mm}$; cymes dense; fruiting perianth transversely keeled on the back; seeds smooth. S.E. Russia. Rs (E).
13. S. heterophylla (Kar. \& Kir.) Bunge ex Boiss., Fl. Or. 4:943 (1879). Erect annual up to 80 cm . Leaves $10-16 \times 1-1.5 \mathrm{~mm}$, semicylindrical, acute. Cymes free, dense. Fruiting perianth of the upper flowers with a narrow transverse wing, of the lower flowers with a transverse keel. Seeds finely punctate-reticulate, mostly horizontal. S.E. Russia, W. Kazakhstan. Rs (E).
14. S. kossinskyi Iljin, Bull. Jard. Bot. URSS. 26: 115 (1927). Like 14 but $5-15 \mathrm{~cm}$, branched at base; leaves up to 5 mm wide, oblong to obovate, obtuse, with cymes in the axils of almost all the leaves. S.E. Russia, W. Kazakhstan. Rs (E).

## 24. Bienertia Bunge ex Boiss. ${ }^{2}$

Like Suaeda but the fruiting perianth with transverse wings on the back, the wings connate and encircling the perianth.

1. B. cycloptera Bunge ex Boiss., Fl. Or. 4: 945 (1879). Annual $10-40 \mathrm{~cm}$. Leaves $10-20 \mathrm{~mm}$, linear to oblong, semi-terete,

[^53]fleshy. Inflorescence a narrow panicle with short branches bearing 6 - to 10 -flowered cymes. Fruiting perianth $5-7 \mathrm{~mm}$ in diameter (including wing), lenticular; apices of the segments verrucose. Gypsaceous and saline habitats. S.E. Russia (near Volgograd), W. Kazakhstan. Rs (E). (S.W. Asia.)

## 25. Salsola L. ${ }^{1}$

Annuals or dwarf shrubs; glabrous or pubescent. Leaves filiform or semicylindrical, alternate or opposite. Flowers hermaphrodite, with 2 conspicuous bracteoles. Perianth-segments 5 ( 3 outer and 2 inner), usually developing a transverse wing on the back in fruit; stamens 5 ; stigmas 2(-3). Seeds usually horizontal.

Most species are restricted to more or less saline, sandy habitats, either maritime or in arid regions inland. A large proportion is essentially Asiatic, and occur only on the extreme S.E. margin of Europe.

Measurements of the perianth in fruit include the wings.
Horaninovia minor Fischer \& Meyer, Enum. Pl. Nov. 1: 10 (1841) occurs at the mouth of the Ural river in W. Kazakhstan, and has also been doubtfully recorded from S.E. Russia (Astrakhan). It has the leaves and bracts opposite, spinose; the flowers solitary, axillary and in distant, subglobose spinose heads at the apices of the branches; perianth-segments with a large suborbicular appendage on the back in fruit.
1 Annual herbs
2 Upper leaves clavate; perianth in fruit spongy, inflated 1. foliosa
2 Leaves not clavate; perianth in fruit not spongy and inflated
3 Leaves spine-tipped or mucronate
4 Perianth-segments rigid, mucronulate; mid-vein distinct
5 Plant densely covered with brittle bristles 8. kali 5 Plant glabrous or papillose
6 Leaves coriaceous, erect, yellowish, contrasting sharply with the purple or reddish stem 3. paulsenii 6 Leaves soft, dark green, the lower usually deflexed; stem green 4. pellucida 4 Perianth-segments flaccid; mid-vein weak or absent 7 Leaves opposite, pubescent 2. brachiata 7 Leaves alternate, or sometimes opposite but then glabrous 8 Perianth tubular in fruit; lower leaves mostly opposite 9 Lower leaves $20-70 \mathrm{~mm}$; uppermost bracts equalling flowers
5. soda 9 Lower leaves $10-20(-30) \mathrm{mm}$; uppermost bracts shorter than flowers
6. acutifolia

8 Perianth pelviform in fruit; lower leaves alternate or at most 1-3 pairs opposite
10 Bracteoles mucronulate 7. tamariscina 10 Bracteoles cuspidate
11 Bracts $\pm$ appressed
9. collina

11 Bracts $\pm$ patent
8. kali

3 Leaves obtuse, neither spine-tipped nor mucronate
12 Leaves not decurrent; perianth $5-10 \mathrm{~mm}$ in diameter in fruit
13 Lower leaves 5-8 mm; bracts shorter than or equalling bracteoles
13. nitraria

13 Lower leaves $8-16 \mathrm{~mm}$; bracts exceeding bracteoles
14. affinis

12 Leaves shortly decurrent; perianth $10-20 \mathrm{~mm}$ in diameter in fruit
14 Plant lanate in the upper part; stigmas shorter than style
10. lanata

14 Plant pubescent or glabrous; stigmas equalling or longer than style
15 Stigmas at least 3 times as long as style; plant glaucous; hairs short, straight
11. turcomanica

15 Stigma usually less than 3 times as long as style; plant grey or white; hairs long, crispate
12. crassa

## 1 Shrubs

16 Anther-appendage lanceolate or elliptic-oblong, acute
17 Leaves 2-3 mm; bracteoles reniform, shorter than flower
15. nodulosa

17 Leaves $5-13 \mathrm{~mm}$; bracteoles elliptical, about equalling the flower
16. carpatha

16 Anther-appendage short, obtuse
18 Leaves constricted above the enlarged base
17. arbuscula

18 Leaves not constricted just above the base
19 First- and second-year stems with numerous longitudinal ridges; leaves fugacious
18. genistoides

19 First- and second-year stems terete or with c. 4 angles or ridges; leaves usually more persistent
20 Perianth-segments obtuse, fimbriate; leaves nearly all opposite 20. verticillata
20 Perianth-segments acute, not fimbriate; leaves alternate or some opposite
21 Leaves $1-3 \mathrm{~mm}$ in diameter (S.E. Spain) 21. papillosa
21 Leaves less than 1 mm in diameter (sometimes deciduous)
22 Leaves $10-25 \mathrm{~mm}$; plant glabrous except for tufts of hairs in the axils of the leaves (S. Spain) 19. webbii
22 Leaves $2-10(-15) \mathrm{mm}$; stems and often the leaves pubescent
23 Leaves $2-5 \mathrm{~mm}$, glabrous 24. dendroides
23 Leaves $5-10(-15) \mathrm{mm}$, usually pubescent, sometimes very sparsely so
24 Primary branches of the inflorescence up to 20 40 cm , with the secondary branches regularly arranged (W. Mediterranean region and Portugal)
22. vermiculata

24 Primary branches of the inflorescence not more than 10 cm , irregularly branched
25 Plant not more than 30 cm ; branches divaricate
23. aegaea

25 Plant up to 70 cm ; branches erect
25. laricina

1. S. foliosa (L.) Schrader in Roemer \& Schultes, Syst. Veg. 6: 804 (1820). Simple or virgate annual $15-80 \mathrm{~cm}$, glabrous, blueblack when dry. Leaves $10-20 \mathrm{~mm}$, semicylindrical, at least the upper clavate, obtuse, mucronulate. Perianth spongy, inflated in fruit, the segments ovate, the part above the wing short, triangular or rounded, brownish; wings reniform or orbicular, yellow, finely veined, the lower one larger than the rest. S.E. Russia, W. Kazakhstan. Rs (E). (C. Asia.)
2. S. brachiata Pallas, Ill. Pl. 30 (1803). Virgate annual $10-$ 30 cm , usually pubescent; branches mostly opposite. Leaves $15-$ 20 mm , semicylindrical, semi-amplexicaul, acute, mucronate, opposite. Lower bracts acuminate. Perianth-segments small, with sparse appressed hairs; wings unequal, reniform or obovate, densely dark-striate. Stigma sessile. Seeds vertical. S.E. Russia, W. Kazakhstan, Krym. Rs (K, E). (C. asia.)
3. S. paulsenii Litv., Bull. Turkestan Sect. Russ. Geogr. Soc. 4 (5): 28 (1905). Annual $10-40 \mathrm{~cm}$, glabrous or sparsely papillose; stem red. Leaves $15-30 \mathrm{~mm}$, semicylindrical, mucronate, coriaceous, yellow, contrasting sharply with the stems. Bracts ovate at base, with a linear, spinose apex; bracteoles partly connate with the solitary flowers. Perianth with a short tube and small, acute, incurved segments; wings membranous, with broad veins. Style short. S.E. Russia. Rs (E). (C. Asia.)
4. S. pellucida Litv., Sched. Herb. Fl. Ross. 8: 16 (1922). Like 3 but up to 60 cm , sparsely but distinctly papillose; stem green; leaves dark green, the lower opposite; bracts and bracteoles linear, sometimes with a triangular base; perianth with short broad tube, the segments long, narrow, acute, softly spine-tipped; wing flabellate. S.E. Russia. Rs (E). (C. Asia.)
5. S. soda L., Sp. Pl. 223 (1753). Erect glabrous annual up to 70 cm . Leaves $20-70 \mathrm{~mm}$, semicylindrical, ovate at base, with long linear mucronulate apex; the lower opposite. Upper bracts equalling the flowers; bracteoles ovate, with short acumen. Perianth-segments ovate, becoming hardened in fruit, the margin pectinate-ciliate, transversely keeled or with a small wing (c. 1 mm ) on the back. Stigma longer than styles. Seeds $3-4 \mathrm{~mm}$, vertical, oblique or horizontal. S. Europe. Al Bl Bu Ga Gr Hs Hu It Ju Lu Rm Rs (W, E, K) Tu.
6. S. acutifolia (Bunge) Botsch., Not. Syst. (Leningrad) 22: 29 (1963) (S. mutica C. A. Meyer). Like 5 but not more than 50 cm ; leaves $10-20(-30) \mathrm{mm}$, semi-cylindrical becoming slightly wider at base, acuminate; uppermost bracts shorter than the perianth; bracteoles orbicular; perianth-segments ovate-elliptical, with a transverse appendage on the back; seeds always vertical. S.E. Russia, S.E. Ukraine, W. Kazakhstan. Rs (E).
7. S. tamariscina Pallas, Reise 3: 604 (1776). Erect, virgate, papillose-scabrid annual $10-50 \mathrm{~cm}$. Leaves $5-15 \mathrm{~mm}$, semicylindrical, wider at the base and membranous-margined, mucronate. Bracts acuminate, not or only slightly longer than the flowers; bracteoles ovate-lanceolate, acuminate, mucronate, equalling the flowers. Perianth-segments ovate, with long, narrow, triangular apex; wing suborbicular. Stigmas longer than style. S.E. Russia and E. Ukraine. Rs (W, K, E).
8. S. kali L., Sp. Pl. 222 (1753). Erect or diffuse, glabrous or hispid annual up to 100 cm . Leaves $10-40 \mathrm{~mm}$, linear-subulate, acuminate. Bracts patent; bracteoles ovate-triangular, with long spine-like apex, longer than the flowers. Perianth-segments ovate, acuminate, usually with ovate to reniform wing. Stigmas longer than style. Often on non-saline sands, or as a ruderal. Throughout most of Europe northwards to $63^{\circ} 30^{\prime} N$., but almost exclusively coastal in the north. All except Fa Is Sb .
A polymorphic species, comprising many subspecies and varieties. At least 3 subspecies can be recognized in Europe.
1 Perianth-segments stiff, $\pm$ spinose, with distinct mid-vein; plant usually hispid
(a) subsp. kali

1 Perianth-segments soft, with obscure mid-vein
2 Plant yellowish, glabrous; bracteoles swollen and $\pm$ connate at base; perianth-segments not winged (b) subsp. tragus
2 Plant grey-green, glabrous or shortly hispid; bracteoles not swollen, free; perianth-segments usually winged.
(c) subsp. ruthenica
(a) Subsp. kali: Coasts of Europe, northwards to $63^{\circ} 30^{\prime} N$.
(b) Subsp. tragus (L.) Nyman, Consp. 631 (1881) (S. tragus L.): Coasts of S. Europe.
(c) Subsp. ruthenica (Iljin) Soó in Soó \& Jáv., Magyar Növ. Kéz. 2: 786 (1951) (S. ruthenica Iljin; incl. S. pestifer A. Nelson): Throughout the range of the species, but often only casual in the north.
9. S. collina Pallas, Ill. Pl. 34 (1803). Like 8 (c) but leaves semi-amplexicaul; bracts appressed, imbricate, exceeding the bracteoles; perianth-segments often connate with the bracteoles; wing small, with erose margin, or absent. E. Russia. Rs (C, E). (Temperate Asia.)
10. S. lanata Pallas, Reise 2:736(1773). Erect annual 10-60 cm, lanate with long and short hairs. Leaves $10-25 \times 1-2 \mathrm{~mm}$, semicylindrical, obtuse, semi-amplexicaul, decurrent. Bracts oblongtriangular, somewhat deflexed; bracteoles triangular-ovate, broadly membranous-margined in the lower part. Perianth $10-$ 20 mm in diameter in fruit, glabrous in the lower part, segments
triangular, with lingulate apex; wing broadly reniform, brown, with numerous fine veins. Style c. 2 mm ; stigmas much shorter than style. S.E. Russia, W. Kazakhstan. Rs (E). (C. \& S.W. Asia.)
11. S. turcomanica Litv., Sched. Herb. FI. Ross. 2: 10 (1900). Like 10 but glaucous, pubescent, with very short patent hairs; bracts broadly ovate at base, membranous-margined, narrowed to a semicylindrical, sulcate apex; perianth pubescent, the segments long, acute, with incurved or patent apex; stigmas at least 3 times as long as style. S.E. Russia (N.W. shore of Caspian Sea). Rs (E). (C. \& S.W. Asia.)
12. S. crassa Bieb., Mém. Soc. Nat. Moscou 1: 100 (1806). Like 10 but upper parts grey- or white-pubescent with long, crispate hairs, or glabrous; perianth-segments acute; style short; stigmas $3-4 \mathrm{~mm}$, but usually less than 3 times as long as style. S.E. Russia, W. Kazakhstan. Rs (E). (S.W. Asia.)
13. S. nitraria Pallas, Ill. Pl. 23 (1803). Erect, much-branched annual $5-40 \mathrm{~cm}$; upper parts villous. Leaves $5-8 \times 1-2 \mathrm{~mm}$, linear, semicylindrical, somewhat enlarged at base. Bracts broadly cordate, spurred, glabrous, shorter than or equalling bracteoles; bracteoles orbicular-elliptical. Perianth $7-10 \mathrm{~mm}$ in diameter in fruit, glabrous, the segments triangular, acute, incurved; wing blackish-brown. Stigmas about as long as the style. S.E. Russia, W. Kazakhstan. Rs (E). (C. \& S.W. Asia.)
14. S. affinis C. A. Meyer, Bull. Phys.-Math. Acad. (Pétersb.) 1: 360 (1843). Erect annual up to $25(-40) \mathrm{cm}$, pubescent or subglabrous. Leaves $8-16 \times 1 \cdot 5-2 \mathrm{~mm}$, semicylindrical, obtuse. Bracts elliptical or elliptic-orbicular, longer than the bracteoles; bracteoles oblong or lanceolate. Perianth $7-10 \mathrm{~mm}$ in diameter in fruit, the segments lanceolate, acute, glabrescent; wing reniform. Stigmas shorter than style. S.E. Russia (Astrakhan), W. Kazakhstan. Rs (E).
15. S. nodulosa (Moq.) Iljin, Acta Horti Petrop. 43 (4): 222 (1930). Shrub $10-40 \mathrm{~cm}$, grey-pubescent. Leaves $2-3 \times 0.5 \mathrm{~mm}$, narrowly triangular, obtuse, semi-amplexicaul. Bracts resembling the leaves but shorter and broader; bracteoles reniform, shortly acuminate, shorter than the flower. Perianth c. 10 mm in diameter in fruit, the segments oblong, with triangular apex, sparsely pubescent; wing brownish. Filaments with a lanceolate or elliptic-oblong, acute appendage. Doubtfully recorded from S.E. Russia (near Astrakhan). ?Rs (E). (W. Caucasus.)
16. S. carpatha P. H. Davis, Notes Roy. Bot. Gard. Edinb. 21 : 139 (1953). Erect grey-pubescent shrub $30-40 \mathrm{~cm}$. Leaves $5-13 \mathrm{~mm}$, oblong-linear, acute. Bracts narrowly oblong-elliptical; bracteoles similar, about equalling or shorter than the flower. Perianth-segments ovate-lanceolate, grey-pubescent. Filaments with lanceolate appendage $c .1 .5 \mathrm{~mm}$. Fruit not known. Calcareous maritime rocks. Karpathos. Cr.
17. S. arbuscula Pallas, Reise 1: 488 (1771). Glabrous shrub $20-100 \mathrm{~cm}$. Leaves $5-35 \mathrm{~mm}$, linear to oblong-linear, much enlarged at the base, with a distinct constriction above it. Bracts orbicular-ovate, becoming very hard in fruit; bracteoles linear, attenuate at the base, longer than the flower. Perianth $8-12 \mathrm{~mm}$ in diameter, becoming hard in fruit; segments broadly lanceolateoblong, incurved, pale yellow or greenish-yellow; wing brown. Style shorter than stigmas. S.E. Russia. Rs (E). (C. Asia.)
18. S. genistoides Juss. ex Poiret in Lam., Encycl. Méth. Bot. 7: 294 (1806) (S. tamariscifolia Lag. pro parte). Glabrous, glaucous
virgate shrub $30-50 \mathrm{~cm}$; first- and second-year stems with numerous longitudinal ridges. Leaves up to 8 mm , fugacious, linear-filiform, mucronate, the uppermost scale-like. Bracts ovate-orbicular, acute, keeled, floccose on the upper surface. Perianth $10-15 \mathrm{~mm}$ in diameter in fruit, the segments elliptical, obtuse, the apex deflexed, 1 -veined; wing reddish. - S.Spain.Hs.
19. S. webbii Moq., Chenop. Enum. 139 (1840). Erect shrub up to 200 cm , glabrous except for tufts of hairs in axils of leaves. Leaves $10-25 \times c . \quad 0.5 \mathrm{~mm}$, filiform, mucronate, pale bluishgreen, semi-amplexicaul, decurrent. Bracts ovate, subacute, shorter than the flowers; bracteoles orbicular-ovate, keeled, obtuse or shortly acuminate, about equalling the perianth. Perianth c. 13 mm in diameter in fruit, the segments lanceolate; wing brownish. S. Spain. Hs. (N.W. Africa.)
20. S. verticillata Schousboe, Vextr. Marokko 123 (1800) (S. longifolia sensu Willk). Glabrous shrub $50-100 \mathrm{~cm}$. Leaves up to 30 mm , nearly all opposite, linear or linear-oblong, attenuate towards the base and scarcely amplexicaul. Bracts linear-oblong, keeled, usually longer than the flowers; bracteoles oblongelliptical. Perianth $12-20 \mathrm{~mm}$ in diameter in fruit, the segments obtuse, almost entirely membranous, fimbriate; wing orbicularobovate, reniform. S. Spain, Sicilia. Hs Si.
21. S. papillosa (Cosson) Willk., Strand-steppengeb. Iber. Halbins. 146(1852). Divaricately branched often procumbent shrub
 cylindrical, obtuse, enlarged at base, glabrous, pale bluish-green, whitish when dry. Bracts like the leaves; bracteoles oblonglanceolate, obtuse, hyaline at the base. Perianth-segments oblonglanceolate. Rocky calcareous hills. - S.E. Spain (Almería). Hs.
22. S. vermiculata L., Sp. Pl. 323 (1753). Pubescent virgate shrub up to 100 cm . Leaves $5-10 \times 0 \cdot 5-1 \mathrm{~mm}$, semicylindrical to filiform, expanding into an ovate base, semi-amplexicaul, obtuse, usually pubescent. Primary branches of the inflorescence up to $20-40 \mathrm{~cm}$, with regularly arranged secondary branches. Bracts ovate with filiform apex; bracteoles ovate, keeled, fimbriate, shorter than the perianth. Perianth $6-12 \mathrm{~mm}$ in diameter in fruit, the segments oblong-ovate, acute, sparsely pubescent; wing obovate, finely veined. Stigmas shorter than the style, subulate, longpapillose. W. Mediterranean region and S. Portugal. Bl Hs Lu Sa Si.
23. S. aegaea Rech. fil., Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 105 (2): 67 (1943) (S. vermiculata auct. balcan., non L.). Like 22 but not more than 30 cm , with much shorter, divaricate branches; lower leaves $5(-10) \mathrm{mm}$, oblong, glabrescent; upper leaves and bracts shortly triangular, usually pubescent; bracteoles orbicular to rhombic. Calcareous maritime rocks. Aegean region. Cr Gr.
24. S. dendroides Pallas, III. Pl. 22 (1803). Virgate shrub 75150 cm . Lower leaves 2-5 mm, semicylindrical, obtuse, broader at the base, glabrous, deciduous. Primary branches of the inflorescence $5-10 \mathrm{~cm}$. Bracts like the leaves but shorter; bracteoles orbicular, glabrous. Perianth $7-9 \mathrm{~mm}$ in diameter in fruit, the segments narrowly triangular-ovate, acute, almost entirely membranous, glabrous, incurved. Stigmas lingulate. S.E. Russia (N.W. shore of Caspian Sea). Rs (E). (C. \& S.W. Asia.)
25. S. laricina Pallas, Ill. Pl. 21 (1803). Erect shrub $20-70 \mathrm{~cm}$. Leaves $5-12 \mathrm{~mm}$, semicylindrical or filiform, slightly broader at base, glaucous, sparsely pubescent, persistent. Primary branches of the inflorescence $5-10 \mathrm{~cm}$, the secondary branches irregular. Bracts like the leaves; bracteoles ovate-orbicular, keeled, apex
cucullate, glabrous. Perianth $5-7 \mathrm{~mm}$ in diameter in fruit, the segments orbicular to oblong, acute, almost entirely membranous. Stigmas lorate. S.E. Russia, S. Ukraine, W. Kazakhstan. Rs (W, K, E).

## 26. Noaea Moq. ${ }^{1}$

Spiny, glabrous shrub. Leaves alternate, filiform. Flowers hermaphrodite, solitary, axillary. Perianth-segments 5 ( 3 outer and 2 inner) all developing a transverse wing on the back in fruit; stamens 5; stigmas 2. Seeds vertical, compressed parallel to the axis.

1. N. mucronata (Forskål) Ascherson \& Schweinf., Mém. Inst. Égypt. 2: 131 (1889). Stem $20-75 \mathrm{~cm}$, much-branched, with the branches spine-tipped. Leaves up to 5 cm , filiform, obtuse. Perianth c. 4 mm , the wings $3-6 \mathrm{~mm}$, obovate or obovateorbicular with erose margin. Aegean region; ?Istanbul. Gr ?Tu. (C. \& S.W. Asia; N. Africa.)

## 27. Ofaiston Rafin. ${ }^{1}$

Annual glabrous herbs; leaves alternate, nearly all basal. Flowers hermaphrodite, solitary, enclosed by 2 bracteoles. Perianthsegments 3 or 5, the 3 outer larger, developing a short transverse wing on the back in fruit, the 2 inner very small or absent; stamen 1 ; stigmas 2 . Seeds vertical, compressed at right angles to the axis.

1. O. monandrum (Pallas) Moq. in DC., Prodr. 13 (2): 203 (1849). More or less erect, fiexuous, up to 40 cm . Leaves 10 20 mm , fleshy, filiform. Bracts $2-3 \mathrm{~mm}$, ovoid-triquetrous, acute, with broad membranous margin; bracteoles ovate, becoming cartilaginous and keeled, enclosing the fruit. Perianth-segments membranous, with oblong or orbicular-ovate wing. Saltmarshes. S.E. Russia, W. Kazakhstan. Rs (E). (W. Asia.)

## 28. Girgensohnia Bunge ${ }^{1}$

Annual glabrous herb. Leaves opposite. Flowers hermaphrodite. Perianth-segments 5 ( 3 outer and 2 inner), 2 or 3 segments developing a transverse wing on the back in fruit; stamens 5, alternating with 5 short staminodes; stigmas 2. Seeds vertical, compressed parallel to the axis.

1. G. oppositifolia (Pallas) Fenzl in Ledeb., Fl. Ross. 3: 835 (1851). Stems $10-50 \mathrm{~cm}$, more or less segmented, glaucous or reddish. Leaves up to 15 mm , broadly triangular or ovate, spinetipped. Flowers solitary or in short spicate inflorescences in the axils of broadly ovate bracts. Wing of perianth suborbicular, reddish. Seeds $1-2 \mathrm{~mm}$. Saline semi-deserts. S.E. Russia (near Astrakhan). Rs (E). (C. \& S.W. Asia.)

## 29. Anabasis L. ${ }^{1}$

Articulate fleshy small shrubs. Leaves opposite, connate and amplexicaul, forming a segment. Flowers hermaphrodite and female, 1 or several in the axils of the upper leaves. Perianthsegments 5 , usually developing a transverse wing on the back in fruit; stamens 5 , alternating with 5 staminodes; stigmas 2 . Seeds vertical, compressed parallel to the axis.
1 Perianth-segments not winged in fruit; anthers apiculate 1. salsa 1 Perianth-segments developing a conspicuous wing in fruit; anthers not apiculate

2 Plant caespitose, with simple, deciduous flowering stems not more than 10 cm 3. cretace
2 Plant with branched, persistent stems usually more than 10 cm
3 Flowers with only 3 perianth-segments winged 2. aphylla
3 Flowers with all 5 perianth-segments winged
4. articulata

1. A. salsa (C. A. Meyer) Paulsen, Vid. Meddel. Dansk Naturh. Foren. Kjobenhavn 1903: 202 (1903). 5-25cm, procumbent, woody at base, with numerous erect, more or less simple, deciduous branches; upper segments up to $40 \times 2-3 \mathrm{~mm}$. Leaves $1-5 \mathrm{~mm}$, subcylindrical, with deciduous apical seta. Perianth-segments not winged, becoming hard in the upper part in fruit; staminodes fimbriate. Saline soils. S.E. Russia. Rs (E). (W. \& C. Asia.)
2. A. aphylla L., Sp. Pl. 223 (1753). Stems $25-75 \mathrm{~cm}$, persistent, branched, woody below; upper segments up to $20 \times 1 \mathrm{~mm}$. Leaves $c .1 \mathrm{~mm}$, each pair forming a short truncate cupule. Three perianth-segments winged; wings up to 4 mm , orbicular-ovate; staminodes ciliolate. Saline soils. S.E. Russia, W. Kazakhstan. Rs (E).
3. A. cretacea Pallas, Reise 1: 442 (1771). Caespitose, with simple deciduous flowering stems up to 10 cm ; upper segments of flowering stems $c .10 \times 1 \mathrm{~mm}$. Leaves $c .3 \mathrm{~mm}$, triangular-ovate, often patent. Three perianth-segments with an orbicular-ovate wing and 2 without a wing or with a smaller narrower wing; staminodes fimbriate. Calcareous soils. S.E. Russia, W. Kazakhstan. Rs (E). (W.C. Asia.)
4. A. articulata (Forskål) Moq. in DC., Prodr. 13 (2): 212 (1849). Stems $10-30 \mathrm{~cm}$, persistent, branched, woody below; upper segments up to $8 \times 2 \mathrm{~mm}$. Leaves $1-2 \mathrm{~mm}$. Five perianthsegments winged; wings up to $4 \times 7 \mathrm{~mm}$, reniform-orbicular; staminodes villose. Saline soils. S. Spain (near Almeria). Hs. (N. Africa, W. Asia.)

## 30. Haloxylon Bunge ${ }^{1}$

Small shrubs with articulate stems. Leaves opposite, connate and amplexicaul forming segments; lamina rudimentary. Inflorescence spicate, usually interrupted; flowers usually solitary. Perianthsegments 5 , developing a transverse wing on the back in fruit; stamens usually 5 , connate; stigmas 4 . Seeds horizontal.

1. H. articulatum (Moq.) Bunge, Mém. Sav. Étr. Pétersb. 7: 469 (1854). Erect, $10-60 \mathrm{~cm}$, caespitose, glaucous; segments of main branches $c .1 \mathrm{~cm}$. Leaves with lamina up to 3 mm , tri-angular-subulate. Perianth-segments c. 1 mm , elliptic, obtuse; wings up to $3 \times 4 \mathrm{~mm}$, reniform-orbicular to orbicular-ovate, pinkish. Dry saline soils. S.E. Spain. Hs. (N. Africa, Mediterranean region.)

## 31. Nanophyton Less. ${ }^{1}$

Glabrous small shrub. Leaves alternate, triangular-subulate. Flowers hermaphrodite, in groups of 1-7 at the apices of the branches; bracteoles 2. Perianth-segments 5, very enlarged and inflated in fruit; stamens 5; stigmas 2. Seeds vertical, compressed parallel to the axis.

1. N. erinaceum (Pallas) Bunge, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 7, 4 (11): 51 (1862). $5-15 \mathrm{~cm}$, pulvinate, with procumbent tortuous woody stems. Leaves $3-7 \mathrm{~mm}$, semiamplexicaul, spine-tipped. Perianth-segments up to 10 mm in fruit, pale yellowish-green, shining. Achenes c. 3 mm . Dry saline places. S.E. Russia. Rs (E). (W. \& C. Asia.)

## 32. Petrosimonia Bunge ${ }^{1}$

Annual, usually pubescent herbs. Leaves alternate or opposite, cylindrical or semicylindrical. Inflorescence a panicle, the flowers hermaphrodite, solitary, axillary; bracteoles 2, becoming hard and enclosing the fruit. Perianth-segments $2-5$; stamens 1-5; stigmas 2. Seeds vertical, compressed parallel to the axis.

All species occur in saline habitats.
1 Leaves all opposite; perianth-segments 5 1. brachiata
1 Middle and upper leaves alternate; perianth-segments almost always 2-3
2 Leaves $c .1 \mathrm{~mm}$ in diameter or less; stamens $1-3$
3 Perianth-segments 3-4, all pubescent on the back; stamens 1-2 4. monandra
3 Perianth-segments 2-3, glabrous (rarely 1 pubescent on the back); stamens 2-3
4 Perianth-segments and stamens 3 ; lower leaves up to 50 mm 2. triandra

4 Perianth-segments and stamens mostly 2; lower leaves usually not more than 10 mm 3. litwinowii
2 Leaves (at least the lower) $2-3 \mathrm{~mm}$ in diameter; stamens 5
5 Apex of bracteoles deflexed, attenuate
7. glaucescens

5 Apex of bracteoles erect, not attenuate
6 Perianth-segments glabrous or shortly pubescent, becoming cartilaginous in fruit
5. oppositifolia

6 Perianth-segments long-ciliate, at least at the apex, not becoming cartilaginous in fruit
6. brachyphylla

1. P. brachiata (Pallas) Bunge, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 7, 4 (11): 59 (1862). 5-40 cm, erect, branched from base, pubescent. Leaves up to $30 \times 2 \mathrm{~mm}$, all opposite. Perianth-segments and stamens 5. S.E. Europe from S.E. Greece to W. Kazakhstan; very local. Bu Gr Rs (W, K, E).
2. P. triandra (Pallas) Simonkai, Enum. Fl. Transs. 466 (1886). $5-35 \mathrm{~cm}$, procumbent or diffuse, pubescent or glabrous. Leaves up to $50 \times 1 \mathrm{~mm}$, the middle and upper alternate. Panicle lax in fruit. Perianth-segments 3, glabrous; stamens 3. S.E. Europe. Rm Rs (W, K, E).
3. P. litwinowii Korsh., Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 8, 7(1):358(1898).5-30 cm, green, erect or procumbent, glabrous or pubescent. Leaves usually not more than $10 \times 1 \mathrm{~mm}$, alternate. Panicle lax in fruit. Perianth-segments 2, glabrous; stamens 2. S.E. Russia, W. Kazakhstan. Rs (E).
4. P. monandra (Pallas) Bunge, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 7, 4 (11): 53 (1862). $5-30 \mathrm{~cm}$, erect or procumbent, often densely pubescent. Leaves up to $10 \times 1 \mathrm{~mm}$, crowded, alternate. Panicle dense in fruit. Perianth-segments 3(-5), pubescent on the back. Stamens 1-2. S.E. Russia, W. Kazakhstan. Rs (E). (W. \& C. Asia.)
5. P. oppositifolia (Pallas) Litv., Sched. Herb. Fl. Ross. 7: 13 (1911) (P. crassifolia auct.). Stems 5-40 cm, erect or procumbent, glabrous or pubescent. Leaves up to $40 \times 3 \mathrm{~mm}$, very fleshy, obtuse, the upper alternate. Bracteoles obtuse, not deflexed. Perianth-segments 2 , glabrous or shortly pubescent, becoming cartilaginous in fruit; stamens 5. S.E. Europe. Al Bu Rm Rs (W, K, E).
6. P. brachyphylla (Bunge) Iljin, Acta Hort. Petrop. 43: 234 (1930). Like 5 but the perianth-segments long-ciliate at least towards the apex, not becoming cartilaginous in fruit. S.E. Russia, W. Kazakhstan. Rs (E). (W. \& C. Asia.)
7. P. glaucescens (Bunge) Iljin, Acta Hort. Petrop. 43: 233 (1930). Like 5 but plant densely pubescent; bracteoles acute, apex deflexed; perianth-segments hirsute on the back, not becoming cartilaginous in fruit. S.E. Russia, W. Kazakhstan. Rs (E). (W. \& C. Asia.)

## 33. Halimocnemis C. A. Meyer ${ }^{1}$

Like Petrosimonia but the seeds compressed at right angles to the axis.

1. H. sclerosperma (Pallas) C. A. Meyer in Ledeb., Fl. Altaica 1: 384 (1829). Stem $5-30 \mathrm{~cm}$, thick and flexuous. Leaves 1525 mm , linear or oblong, mucronate. Bracts ovate, acuminate. Perianth-segments $3(-5)$, the two outer segments becoming $7-8 \mathrm{~mm}$ and hard in fruit. Saline soils. S.E. Russia (Ozero El'ton). Rs (E). (W.C. Asia.)

## 34. Halogeton C. A. Meyer ${ }^{1}$

Annual glabrous or papillose herbs. Leaves alternate, fleshy, more or less cylindrical. Flowers hermaphrodite or female, in dense cymes in the axils of leaf-like bracts; the outer in each cyme 2-bracteolate, the inner ebracteolate. Perianth-segments 5, developing a transverse wing in fruit. Stamens 3-5. Stigmas 2. Seeds vertical or horizontal.

1. H. sativus (L.) Moq., Chenop. Monogr. Enum. 158 (1840). Stems $15-80 \mathrm{~cm}$. Leaves $5-16 \times 1-1.5 \mathrm{~mm}$, usually mucronate. Stamens 5. Perianth-wing up to $3 \times 4 \mathrm{~mm}$, reniform-orbicular to ovate, unequal, often pinkish. Seeds $c .1 .5 \mathrm{~mm}$. Saline habitats, mainly maritime. S.E. Spain. Hs [It]. (N.W. Africa.)

Cultivated in the Mediterranean region where it is burnt for the production of base-rich ash.
H. glomeratus (Bieb.) C. A. Meyer in Ledeb., Fl. Altaica 1:378 (1829) from S.E. Russia and W. Kazakhstan, is very doubtfully distinct from 1. It is less robust (stems $3-40 \mathrm{~cm}$ ), with the leaves up to $12 \times 2 \mathrm{~mm}$ and $1-3(-5)$ stamens.

## XLIX. AMARANTHACEAE ${ }^{2}$

Herbs or rarely small shrubs. Leaves opposite or alternate, entire, exstipulate. Flowers usually hermaphrodite, often in spicate or capitate, usually bracteate inflorescences; bracteoles $2-5$. Perianth almost always dry and scarious, usually 4 - to 5 -merous; segments free or connate at base. Stamens $1-5$, opposite the perianth-segments and usually not exserted. Ovary

[^54]${ }^{2}$ Edit. T. G. Tutin.
superior, unilocular; ovules amphitropous. Fruit with a membranous, rarely fleshy, wall, dehiscing irregularly, or circumscissile.

## 1 Leaves opposite

2 Inflorescence long, lax; fruits deflexed
3. Achyranthes

2 Inflorescence dense, capitate; fruits not deflexed 4. Alternanthera 1 Leaves alternate

Filaments connate below into a tube; fruit with numerous
$\begin{aligned} & \text { seeds } \\ & \text { s. Celosia }\end{aligned}$
3 Filaments free; fruit with 1 seed 2. Amaranthus

## 1. Celosia L. ${ }^{1}$

Leaves alternate. Bracteoles 3. Perianth-segments 5, oblong, acute or obtuse. Stamens 5, alternating with 5 teeth; filaments connate below into a membranous tube. Style long, filiform. Fruit circumscissile; seeds numerous.

1. C. argentea L., Sp. Pl. 205 (1753). Glabrous branched annual $15-50 \mathrm{~cm}$. Leaves lanceolate to linear; petioles short. Inflorescences pedunculate, spicate, usually cylindrical. Flowers sessile; perianth much longer than bracteoles, red or white. Widely cultivated for ornament and frequently occurring as a casual in S. Europe. (Tropics.)
C. argentea var. cristata (L.) O. Kuntze (C. cristata L.) is also cultivated for ornament and occurs as a casual in S. Europe. It has rather wider leaves, nearly sessile inflorescences and flowers which are usually shining purple, less frequently yellow or white.

## 2. Amaranthus L. ${ }^{2}$

Annual, rarely perennial herbs; monoecious or dioecious. Leaves usually alternate. Bracteoles 3-5, small and herbaceous or membranous and spinescent. Perianth-segments $0-5$, linear or lanceolate to spathulate. Styles and stigmas 2-3. Fruit dry, membranous, indehiscent or dehiscing transversely. Seeds vertically compressed.

In the following descriptions characters of the perianth refer to female flowers.

All the species are ruderals or weeds. Most of them have been introduced into Europe and are usually casual in the north and centre. This account includes only those species that occur frequently or are known to be naturalized.
A. caudatus L., Sp. Pl. 990 (1753), perhaps native in S. America, with long pendent red or rarely green inflorescences is commonly cultivated for ornament and sometimes occurs as a casual.

Literature: A. Thellung in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 225-356 (1914). A. W. Kloos in Robyns, Fl. Gén. Belg. (Spermat.) 1: 306-35 (1953). S. Priszter, Ann. Sect. Horti- Viticult. Univ. Sci. Agr. (Budapest) 2: 121-262 (1953). P. Aellen in Hegi, Ill. Fl. Mitteleur. ed. 2, 3 (2): 465-516 (1959). J. P. M. Brenan, Watsonia 4: 261-80 (1961).

1 Perianth-segments (4-)5
2 Inflorescence a terminal panicle, the apical part leafless and often spicate
3 Fruit dehiscing transversely
4 Perianth-segments enlarged in the upper part, $\pm$ spathulate, obtuse or truncate 4. retroflexu
4 Perianth-segments lanceolate or narrowly ovate or elliptic, acute
5 Longest bracteoles of the female flowers usually twice as long as the perianth

1. hybridus

5 Longest bracteoles of the female flowers 1-1 $\frac{1}{2}$ times as long as the perianth
2. cruentus

3 Fruit indehiscent
6 Bracteoles longer than the perianth, spinescent; leaves 25 cm wide, ovate or ovate-oblong
3. bouchonii

6 Bracteoles shorter than the perianth, not spinescent; leaves not more than 1 cm wide, linear-lanceolate 5. muricatus
${ }^{1}$ By T. G. Tutin.
${ }^{2}$ By P. Aellen.

2 Inflorescence composed entirely of axillary cymose clusters, leafy to the apex
7 Fruit dehiscing transversely
6. blitoides

7 Fruit indehiscent
8 Perianth-segments narrowly spathulate, erect, appressed to the fruit; leaves undulate-crenate 7. crispus
8 Perianth-segments clawed; claw erect, limb patent; leaves entire
8. standleyanus

1 Perianth-segments (2-)3
9 Fruit dehiscing transversely
10 Bracteoles twice as long as the perianth, spinescent 9. albus
10 Bracteoles not longer than the perianth, not spinescent
10. graecizans

9 Fruit indehiscent
11 Leaves acute; stems puberulent above; fruit inflated
11. deflexus

11 Leaves $\pm$ emarginate; stems glabrous; fruit not inflated
12. lividus

1. A. hybridus L., Sp. Pl. 990 (1753) (A. chlorostachys Willd.). Stems $20-100 \mathrm{~cm}$, erect, glabrous or sparsely pubescent above. Leaves rhombic-ovate. Inflorescence elongate-spicate, often compound, with long branches. Bracteoles (2-)4-6 mm, ovate, with a very long mucro, about twice as long as the perianth. Perianth-segments narrowly ovate, usually acute, about as long as the fruit. Fruit dehiscing transversely. $2 n=32$. Commonly introduced and naturalized in many parts of Europe. [ Al Au Az $\mathrm{Cr} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{Sm} \mathrm{Si]}. \mathrm{(Tropical} \mathrm{and}$ subtropical America.)
2. A. cruentus L., Syst. Nat. ed. 10, 2: 1269 (1759) (A. patulus Bertol.). Like 1 but the terminal inflorescence usually dense and with short branches at the base; bracteoles $2-4 \mathrm{~mm}$, with short mucro, c. $1 \frac{1}{2}$ times as long as the perianth. $2 n=34$. Commonly introduced and naturalized, mainly in S. Europe. [ Al Au Az Bu $\mathrm{Cr} \mathrm{Ga} \mathrm{Ge} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{RmRs}(\mathrm{C}, \mathrm{W}, \mathrm{K}, \mathrm{E}) \mathrm{Sa}$ Si.] (Tropical and subtropical America.)
A. paniculatus L., Sp. Pl. ed. 2, 1406 (1763). Very like 2 but the inflorescence red, rarely yellow or green; bracteoles $1-1 \frac{1}{2}$ times as long as the perianth. Commonly cultivated and sometimes occurring as a casual. Probably originated in cultivation.
3. A. bouchonii Thell., Le Monde des Plantes 27 (nos. 45-160): 4 (1926). Very like 1 but the bracteoles linear-lanceolate, longspinescent; perianth-segments elliptic-lanceolate to linear; fruit indehiscent. Naturalized in France and occurring as a casual elsewhere. [ Ga Ge He .] (Origin uncertain.)
4. A. retroflexus L., Sp. Pl. 991 (1753). Stems $15-100 \mathrm{~cm}$, erect, lanate in the upper part. Leaves rhombic-ovate. Inflorescences spicate, usually short and dense. Bracteoles $3-6 \mathrm{~mm}$, stout and spinescent, $1 \frac{1}{3}-2$ times as long as the perianth. Perianthsegments $2-3 \mathrm{~mm}$, linear-cuneate, truncate or obtuse, with short mucro. Fruit dehiscing transversely, feebly muricate. Introduced and naturalized throughout most of Europe. [ Al Au Be Bl Br Bu Cr Da Ga Ge Gr Ho Hs Hu It Ju Po Rm Rs (B, C, E) Sa Si Su Tu.] (North America.)
A. quitensis Kunth in Humb., Bonpl. \& Kunth, Nov. Gen. Sp. 2: 194 (1818). Very like 4 but glabrous or puberulent; inflorescence with numerous distinct lateral branches; perianth-segments with green excurrent midrib. A rare casual recorded from several countries. (South America.)
5. A. muricatus (Moq.) Gillies ex Hicken, Apunt. Hist. Nat. (Buenos Aires) 2: 92 (1910). Decumbent perennial up to 60 cm , usually glabrous. Leaves $2-5 \mathrm{~cm}$, linear to lanceolate or narrowly ovate-lanceolate, long-petiolate. Inflorescence a long panicle,
branched at the base. Bracteoles half as long as the perianth, ovate, acute. Perianth-segments $5, c .2 \times 0.5-0.7 \mathrm{~mm}$, spathulate. Fruit indehiscent, strongly muricate. Naturalized in Spain, and Portugal; rarely casual elsewhere. [Hs Lu.] (Temperate South America.)
6. A. blitoides S. Watson, Proc. Amer. Acad. Arts Sci. 12: 273 (1877). Stems $15-50 \mathrm{~cm}$, procumbent, whitish, glabrous or pubescent in the upper part. Leaves $1.5-3 \mathrm{~cm}$, oblong-lanceolate to obovatespathulate, obtuse, with distinct membranous margin. Inflorescence of short axillary cymose clusters. Bracteoles shorter than the perianth, lanceolate. Perianth-segments $4-5$, unequal, resembling the bracteoles; the largest $2-2.5 \mathrm{~mm}$, with short acumen. Fruit dehiscing transversely. Naturalized in C. \& S. Europe ; casual throughout most of Europe. [ Au Br Da Ga Ge Hs Hu It Lu Po Rm Rs (E).] (C. \& W. North America.)
7. A. crispus (Lesp. \& Thév.) N. Terracc., Rendic. Accad. Sci. Fis. Mat. (Napoli) 4: 188(1890). Stems up to 40 cm , procumbent or ascending, much-branched, densely puberulent. Leaves mostly $0.5-1.5 \mathrm{~cm}$, ovate-rhombic or lanceolate-rhombic, obtuse, mucronate; margin undulate-crenate. Inflorescence of ovoid or spherical, axillary cymose clusters. Bracteoles half as long as the perianth, ovate, acute. Perianth-segments $5,0.6 \mathrm{~mm}$ wide at the apex, obovate to spathulate, obtuse. Fruit muricate, indehiscent. Naturalized in S. and parts of C. Europe; casual elsewhere. [Au Bu Hu It Rm.] (Argentina.)
8. A. standleyanus Parodi ex Covas, Darwiniana 5: 339 (1941). Stems up to 70 cm , procumbent or erect, sparsely pubescent. Leaves mostly $3-5 \mathrm{~cm}$, rhombic-ovate to lanceolate, flat. Inflorescence usually of short axillary cymose clusters, sometimes with a dense spicate inflorescence at the apex. Bracteoles $\frac{1}{2}-\frac{2}{3}$ as long as the perianth, ovate-lanceolate to ensiform. Perianthsegments $5, c .2 \mathrm{~mm}$, distinctly spathulate. Fruit indehiscent, densely muricate, but the apex almost smooth. Naturalized in Spain, a casual elsewhere in Europe. [Hs.] (Argentina.)
9. A. albus L., Syst. Nat. ed. 10, 2: 1268 (1759). Stems $10-50 \mathrm{~cm}$, erect or procumbent, much-branched, glabrous or sparsely puberulent. Leaves oblong or spathulate, cuneate, obtuse and slightly emarginate, mucronate; margin undulate. Inflorescence of short axillary cymose clusters. Bracteoles twice as long as the perianth, ensiform with long spinescent apex. Perianth-segments 3, narrowly elliptic. Fruit c. 1.5 mm , scarcely muricate, dehiscing transversely. Naturalized or a casual in most of Europe. [ Au Bl Br Bu Co Da Ga Ge Gr Ho Hs Hu It Po Rm Rs (C, W, E) Sa Si.] (S. North America.)
10. A. graecizans L., Sp. Pl. 990 (1753) (A. angustifolius Lam., A. sylvestris Vill.). Stems up to 70 cm , usually erect, usually glabrous. Leaves $2-4 \times 1-2 \mathrm{~cm}$, ovate or elliptic-rhombic, usually acute. Inflorescence of axillary cymose clusters. Bracteoles $\frac{3}{5}-\frac{3}{4}$ as long as perianth, ovate, mucronulate. Perianth-segments 3, $1 \cdot 3-2 \mathrm{~mm}$, ovate-lanceolate, acute. Fruit longer than the perianth, somewhat muricate, dehiscing transversely, with green longitudinal veins when young. S. Europe, introduced throughout most of Europe and sometimes naturalized. Al Bl Bu Cr Ga Hs It Ju Lu Sa Si Tu [Au Ge Hu Po Rm].
11. A. deflexus L., Mantissa Altera 295 (1771). Procumbent perennial up to 40 cm , densely puberulent in the upper part. Leaves $3-5 \mathrm{~cm}$, rhombic-ovate, obtuse; margin finely undulate. Inflorescence usually dense, terminal, spicate, becoming interrupted and leafy towards the base. Bracteoles $\frac{1}{3} \frac{1}{2}$ as long as the

[^55]perianth, ovate, wide at the base, mucronate. Perianth-segments $2-3,1 \cdot 2-1 \cdot 5 \mathrm{~mm}$, linear to oblong-spathulate. Fruit $2 \cdot 5-3 \mathrm{~mm}$, oblong-ovate, inflated-membranous, smooth, with 3 dull green longitudinal veins, not dehiscing transversely. Seeds much smaller than the fruit. Naturalized in S. Europe; casual elsewhere. [Al Au Az Bl Bu Ga Gr Hs Hu It Ju Rm Rs (W, K, E) Sa Si Tu.]
12. A. lividus L., Sp. Pl. 990 (1753) (A. blitum L.). Stems up to 80 cm , procumbent to erect, glabrous. Leaves rhombic- to orbicular-ovate, with light or dark spots on the upper surface, sub-truncate or emarginate, the margin often undulate. Inflorescence of axillary cymose clusters, forming a dense, more or less leafless spike towards the apex. Bracteoles $\frac{1}{3}-\frac{1}{2}$ as long as the perianth, ovate with wide base, acute. Perianth-segments $3(-5)$, oblong-linear to spathulate. Fruit feebly rugose, without green veins, indehiscent or dehiscing irregularly. Seeds almost as large as fruit. S. Europe, introduced and sometimes naturalized elsewhere. Al Az Bu Cr Ga Gr Hs It Ju Lu Sa Si Tu [Au Be Da Fe Ge Ho Hu Po Rm Rs (B, C, W, K, E) Su].

## 3. Achyranthes L. ${ }^{1}$

Leaves opposite. Inflorescence long, lax, spicate. Flowers erect, becoming deflexed. Perianth-segments $4-5$, narrowly lanceolate, becoming indurated and ribbed. Stamens (2-4)5 alternating with teeth; filaments connate below into a tube. Fruits deflexed.
Stem densely pubescent; leaves green beneath 1. aspera
Stem almost glabrous; leaves silvery beneath
2. sicula

1. A. aspera L., Sp. Pl. 204 (1753). Pubescent perennial, woody below. Leaves broadly ovate or broadly rhombic, shortly acuminate, green on both surfaces. Flowers pedicellate, somewhat shining, green. Bracteoles glabrous, awned. Perianth about twice as long as bracteoles. Teeth alternating with the stamens fimbriate at apex. More or less naturalized in S. Europe. (Tropics.)
2. A. sicula (L.) All., Mélang. Philos. Math. Soc. Roy. Turin (Misc. Taur.) 5: 93 (1774). Like 1 but the stem nearly glabrous; leaves ovate to ovate-oblong, densely silvery-sericeous beneath; teeth alternating with stamens entire at apex. S. part of $W$. Mediterranean region. Hs It Sa Si. ( $N$. Africa.)

## 4. Alternanthera Forskål ${ }^{1}$

Leaves opposite. Inflorescence capitate, terminal or axillary. Perianth-segments 5, free. Stamens 2-5; filaments connate below into a tube. Fruits not deflexed.
A number of species, beside the following, occur as casuals.
Literature: P. Aellen in Hegi, Ill. Fl. Mitteleur. ed. 2, 3 (2): 523-8 (1959). S. J. van Ooststroom \& Th. J. Reichgelt, Gorteria 1: 2-6 (1961).
1 Annual; leaves linear; bracteoles and outer perianth-segments not pungent
1 Perennial; leaves ovate or obovate; bracteoles and outer perianth-segments pungent
2 Two of the outer perianth-segments with points $c . \frac{1}{3}$ as long as the whole; filament about as long as anther 1. pungens
2 Two of the outer perianth-segments with points not more than $\frac{1}{10}$ as long as the whole; filament about twice as long as anther
2. peploides

1. A. pungens Kunth in Humb., Bonpl. \& Kunth, Nov. Gen. Sp. 2: 206 (1818). Perennial. Stems somewhat woody at base, pubescent. Leaves ovate or obovate, shortly petiolate. Inflorescences sessile, 2-3 together, ovoid. Flowers subtended by 2 boat-shaped,
pungent bracteoles. Three outer perianth-segments longer than the 2 inner 2 with points $c . \frac{1}{3}$ as long as the whole, the other and the inner ones with short slender points; all with small tufts of short retrorsely barbed hairs. Filaments and the teeth between them about as long as the anthers. Perhaps naturalized in S.W. Europe, but uncertain owing to confusion with 2, to which all specimens seen belong. (Temperate South America.)
2. A. peploides (Humb. \& Bonpl.) Urban, Feddes Repert. 15: 168 (1918). Like 1 but points of outer perianth-segments not more than $\frac{1}{10}$ as long as the whole; perianth-segments with more
numerous, longer retrorsely barbed hairs; filaments and the teeth between them about twice as long as the anthers. A common weed in the Accores; perhaps naturalized in S. Spain. [Az ?Hs.] (W. Indies, C. America.)
3. A. nodiflora R.Br., Prodr. Fl. Nov. Holl. 1: 417 (1810). Annual. Stems glabrous or slightly hairy at nodes, but with 2 lines of hairs when young. Leaves linear, sessile. Inflorescence sessile, axillary, globose. Bracteoles not spinose. Perianthsegments c. 3 mm , white. Naturalized in S. Spain; casual elsewhere. [Hs.] (Australia, India, Africa.)

## L. NYCTAGINACEAE ${ }^{1}$

Herbs, shrubs or woody climbers, often with swollen nodes. Leaves simple, entire, exstipulate. Flowers solitary or in small terminal umbels (rarely in whorls), subtended by bracts which often simulate a perianth. Perianth petaloid, tubular, with a short, 5-lobed limb; lower part of tube persistent and concrescent with the fruit to form an achene-like anthocarp. Stamens usually $3-5$. Ovary superior, 1 -celled, containing a single ovule.
Various cultivars and hybrids of Bougainvillea, woody climbers with alternate leaves and an involucre of 3 conspicuous, brightly coloured bracts, are extensively planted for ornament in parts of the Mediterranean region, but are not reported as naturalized.
1 Bracts few and inconspicuous; flowers in umbels of c. 10

1. Commicarpus

1 Bracts conspicuous, united around the base of each flower or umbel to form a calyx-like involucre; flowers solitary or in umbels of 3-5
2 Perianth c. 8 mm in diameter; involucre broadly conical, accrescent, membranous in fruit, subtending several flowers
3. Oxybaphus

2 Perianth c. 25 mm in diameter; involucre tubular, not accrescent, or membranous, subtending only 1 flower 2. Mirabilis

## 1. Commicarpus Standley ${ }^{2}$

Shrubs or somewhat woody herbs with opposite leaves. Flowers small, in whorls or umbels. Bracts few and inconspicuous. Perianth-tube contracted above the ovary and surmounted by a spreading, 5 -lobed limb. Stamens usually 3. Anthocarp somewhat viscid and with hooked hairs.

1. C. plumbagineus (Cav.) Standley, Contr. U.S. Nat. Herb. 18: 101 (1916) (Boerhavia plumbaginea Cav.). Stems up to 70 cm , woody, geniculate, straggling or procumbent, with long internodes. Leaves c. $3 \times 2 \mathrm{~cm}$, deltate to ovate, stalked, puberulent beneath. Flowers in small, long-pedunculate, axillary umbels, sometimes with a whorl of flowers on the peduncle. Bracts 1 or 2, very small. Perianth c. $13 \times 6 \mathrm{~mm}$, pubescent, sharply differentiated into a lower blackish portion surrounding the ovary, and an upper portion, white or pale pink, narrowly tubular below and gradually expanded into a flat limb with 5 emarginate lobes; at the junction of the two portions are 5 black tubercles. Stamens and style exserted. Anthocarp 8 mm , obconical, striate, glandular-tuberculate. Rocky and stony places. S.E. Spain (hills near Orihuela). Hs. (S.W. Asia and tropical Africa.)

[^56]${ }^{2}$ By D. A. Webb.

## 2. Mirabilis L. ${ }^{2}$

Perennial herbs with opposite leaves. Flowers in axillary cymes, each flower surrounded by a tubular or narrowly campanulate, calyx-like involucre of 5 bracts. Perianth infundibuliform, with a long tube, contracted above the ovary, and a spreading, plicate, slightly 5-lobed limb. Stamens 5. Anthocarp coriaceous.

Perianth-tube not more than 35 mm , glabrous
Perianth-tube $60-105 \mathrm{~mm}$, glandular-pubescent

1. jalapa
2. longiflora
3. M. jalapa L., Sp. Pl. 177 (1753). Glabrous or slightly pubescent. Stems $50-100 \mathrm{~cm}$, erect. Leaves ovate, acuminate. Flowers in crowded terminal cymes, opening in the afternoon. Perianth red, yellow, white or parti-coloured; limb c. 25 mm in diameter; tube $25-35 \mathrm{~mm}$. Cultivated for ornament; naturalized in France and probably elsewhere. [Ga.] (Tropical America.)

Plants with scented flowers and the anthocarp more strongly ridged and verrucose than usual are sometimes distinguished as M. odorata L., Cent. Pl. 1: 7 (1755) (M. dichotoma L.), but are probably best regarded as a variety of 1.
2. M. longiflora L., Kung. Svenska Vet. Akad. Handl. 1755: 176 (1755). Like 1 in habit but glandular-pubescent and viscid throughout; perianth-tube $60-105 \mathrm{~mm}$, very slender; limb white to pink or lilac. Cultivated for ornament and occasionally naturalized. [Cz Ga.] (Mexico.)

## 3. Oxybaphus L'Hér. ex Willd. ${ }^{2}$

Like Mirabilis, but with involucre subtending several flowers and strongly accrescent, becoming membranous in fruit; stamens exserted, sometimes less than 5.

1. O. nyctagineus (Michx) Sweet, Hort. Brit. 334 (1826) (Mirabilis nyctaginea (Michx) McMillan). Stems erect, angular, dichotomously branched. Leaves $5-10 \mathrm{~cm}$, broadly ovate, petiolate. Flowers in axillary and terminal cymes. Peduncles and pedicels hairy. Involucre up to 2 cm in diameter in fruit, very broadly conical, 5 -lobed, membranous, with conspicuous veins, subtending 3-5 flowers. Perianth c. $12 \times 8 \mathrm{~mm}$, campanulate, red. Stamens 3-5, exserted. Anthocarp ribbed, hairy. Established as a weed and ruderal in parts of C. \& E. Europe. [Cz Hu Rm Rs (C, W).] (North America.)

## LI. PHYTOLACCACEAE ${ }^{1}$

Herbs, shrubs or trees with alternate, entire leaves. Flowers in racemes. Perianth-segments 5, free, persistent. Stamens hypogynous. Carpels united at least at the base, each containing a single ovule.

## 1. Phytolacca L. ${ }^{2}$

Herbs, shrubs or trees. Racemes usually opposite the leaves. Perianth-segments small, between sepaloid and petaloid in colour and texture. Stamens 10 or more; carpels 10 or fewer. Fruit a berry.

Literature: H. Walter in Engler, Pflanzenreich 39 (IV, 83): 36-63 (1909).

Herb, somewhat woody at the base; flowers hermaphrodite;
racemes erect
Dioecious tree; racemes drooping

1. americana 2. dioica
2. P. americana L., Sp. Pl. 441 (1753) (P. decandra L.). A glabrous, perennial herb, somewhat woody at the base. Stems $1-3 \mathrm{~m}$, subdichotomously branched, often red, with decurrent ridges from the leaf-bases. Leaves $12-25 \times 5-10 \mathrm{~cm}$, ovate-
lanceolate, petiolate. Racemes c. 10 cm , more or less erect. Flowers hermaphrodite. Perianth-segments 2.5 mm , broadly ovate, greenish-white, turning reddish in fruit. Stamens 10. Carpels 10, united except for the styles. Fruit 10 mm in diameter, depressed-globose, purplish-black. Waste places. Cultivated for ornament and for dye from the berries; widely naturalized in $S$. Europe, and locally or as a casual in C. Europe. [Al Au Az Bl Bu Co Cr Cz Ga Gr He Ho Hs Hu It Ju Lu Rm Rs (K) Sa Si Tu.] (United States.)
P. esculenta Van Houtte, Fl. Serres Jard. Eur. 4: 398 (1848), from E. Asia, is reported as more or less naturalized locally in Romania. It is like 1 but has $c .8$ stamens and the same number of free carpels.
3. P. dioica L., Sp. Pl. ed. 2, 632 (1762). Dioecious small tree with stout branches. Leaves $6-12 \times 2.5-6 \mathrm{~cm}$, evergreen, ovate to lanceolate, petiolate, glabrous. Racemes drooping. Perianth-segments 3.5 mm , oblong, green, spotted with white. Stamens c. 25, exceeding the perianth. Carpels 7-10, united only in lower part. Fruit subglobose, purplish-black. Planted for ornament and shade in the Mediterranean region and locally naturalized. [Ga Gr Hs It Si.] (Temperate and subtropical South America.)

## LII. AIZOACEAE ${ }^{3}$

Herbs or shrubs. Leaves usually opposite and fleshy. Calyx tubular or turbinate with often fleshy lobes. Petals usually numerous. Ovary usually inferior. Fruit woody and opening on moistening, or fleshy and indehiscent.

1 Petals absent; ovary superior
2 Capsule opening by valves; leaves usually alternate
2 Capsule circumscissile; leaves opposite
1 Petals present; ovary inferior
3 Stigmas 8-20; fruit fleshy; seeds embedded in mucilage
3. Carpobrotus

3 Stigmas 5 or fewer; fruit a woody capsule; seeds not embedded in mucilage
4 At least the lower leaves petiolate
5 Leaves cordate at base, finely papillose
5. Aptenia

5 Leaves not cordate at base, covered with hyaline vesicles
4. Mesembryanthemum

4 All leaves sessile
6 Flowers purplish-pink
6. Disphyma

6 Flowers white to yellow
7 Leaves pruinose; flowers bright yellow 7. Lampranthus
7 Leaves green; flowers white or yellowish-white
4. Mesembryanthemum

## 1. Aizoon L. ${ }^{4}$

Annual. Leaves usually alternate. Flowers subsessile. Petals absent. Stamens c. 20, connate in 5 bundles. Ovary superior; stigmas 5 . Capsule opening by 5 valves at the apex; seeds numerous.

1. A. hispanicum L., Sp. Pl. 488 (1753). Densely papillose annual $5-15 \mathrm{~cm}$. Leaves oblong-lanceolate, obtuse. Flowers

[^57]solitary, usually in the dichotomies of the stem. Perianth-tube shortly obconical or hemispherical; lobes lanceolate, acute, yellowish above. S. part of Mediterranean region. ?Bl Cr Hs [It].

## 2. Sesuvium L. ${ }^{2}$

Like Aizoon, but with circumscissile capsule, and leaves always opposite.

1. S. portulacastrum L., Syst. Nat. ed. 10, 2: 1058 (1759). Glabrous perennial, with procumbent branches up to 30 cm . Leaves oblong-spathulate, petiolate, somewhat fleshy. Flowers axillary, subsessile, 5 -merous; anthers pink; seeds black, smooth. Naturalized on maritime sands near Lisboa. [Lu.] (Tropical Africa and America.)

## 3. Carpobrotus N.E. Br. ${ }^{4}$

Procumbent woody perennials. Leaves opposite, 3 -angled, very fleshy. Flowers solitary, peduncled. Petals numerous. Stigmas 8-20. Ovary inferior; fruit fleshy, indehiscent; seeds embedded in mucilage.
1 Flowers $2.5-5 \mathrm{~cm}$ in diameter $\quad$ 3. chilensis
1 Flowers $8-12 \mathrm{~cm}$ in diameter
2 Leaves glaucous, broadest at or above the middle; stamens purple 1. acinaciformis
2 Leaves not glaucous, not broadening above the base; stamens yellow
2. edulis

1. C. acinaciformis (L.) L. Bolus, Fl. Pl. S. Afr. 7: sub t. 247 (1927) (Mesembryanthemum acinaciforme L.). Stems up to 2 m . Leaves glaucous, broadest at or above the middle, abruptly contracted to the acute apex; dorsal angle horny. Flowers c. 12 cm
in diameter, purple; stamens purple. Naturalized on the coasts of S. \& S. W. Europe. [Ga Gr Hs It Lu Sa, probably elsewhere.] (S. Africa.)
2. C. edulis (L.) N.E. Br. in Phillips, Gen. S. Afr. Fl. Pl. 249 (1926). Stems up to several metres. Leaves not glaucous, not broadening above the middle, tapering gradually to the acute apex; dorsal angle serrulate. Flowers $c .9 \mathrm{~cm}$ in diameter, yellow or purple; stamens yellow. $2 n=18$. Naturalized on the coasts of S. and S.W. Europe, northwards to Ireland. [ Az Be Br Ga Hb Hs It Lu; probably elsewhere.] (S. Africa.)
3. C. chilensis (Molina) N.E. Br., Jour. Bot. (London) 66: 324 (1928). Like 2 but smaller; leaves smooth on the dorsal angle; flowers $2.5-5 \mathrm{~cm}$ in diameter, purple. Naturalized in many places round the coast of Spain andperhaps elsewhere. [Hs.] (W. America.)

## 4. Mesembryanthemum L. ${ }^{1}$

Herbs. Leaves fleshy, flat or subterete, alternate or opposite. Flowers solitary or in cymes. Petals numerous. Stigmas 5. Ovary inferior; capsule with 5 valves, winged on the angles. (Cryophytum N.E. Br., Gasoul Adanson.)
Leaves narrowly oblong, subterete

1. nodiflorum Leaves spathulate to broadly ovate, flat 2. crystallinum
2. M. nodiflorum L., Sp. Pl. 480 (1753) (Gasoul nodiflorum (L.) Rothm.). More or less procumbent annual up to $c .20 \mathrm{~cm}$. Leaves narrowly oblong, subterete, obtuse, glaucous and slightly crystalline-papillose. Flowers terminal and axillary, solitary, subsessile. Petals shorter than sepals, yellowish or white. Maritime sands and salt-marshes. Mediterranean region extending to C. Portugal. Bl Co Cr Ga Gr Hs It Ju Lu Sa Si [Az].
3. M. crystallinum L., Sp. Pl. 480 (1753) (Cryophytum crystallinum (L.) N.E. Br.). Like 1 but whole plant densely crystallinepapillose; leaves spathulate to broadly ovate, flat; petals longer than sepals. Maritime sands and salt-marshes. Mediterranean region extending to Portugal. Bl Co Cr Ga Gr Hs It Ju Lu Sa Si [Az].

A species of Drosanthemum (a genus very closely related to Mesembryanthemum), D. candens (Haw.) Schwantes, Zeitschr. Sukkulentenk. 3: 30 (1927), with procumbent stems, not rooting freely at the nodes, almost cylindrical leaves $c .1 \mathrm{~cm}$ long, covered
with papillae, and pure white petals that are longer than the sepals, is naturalized locally in Portugal, S.W. England and the Açores.

## 5. Aptenia N.E. Br. ${ }^{1}$

Like Mesembryanthemum but with 4 stigmas and a 4-locular capsule; valves without wings.

1. A. cordifolia (L. fil.) N.E. Br., Jour. Bot. (London) 66: 139 (1928). Procumbent perennial. Leaves opposite, ovate-cordate, finely papillose, flat, not glaucous. Flowers axillary and terminal, pedunculate. Petals purple. Naturalized in S. Europe. [Az Ga Hs It Lu.] (S. Africa.)

## 6. Disphyma N.E. Br. ${ }^{2}$

Like Mesembryanthemum, but glabrous, not papillose; wings on capsule widely separated at the base; apical tubercles of capsule bifid.

1. D. crassifolium (L.) L. Bolus, Fl. Pl. S. Africa 7: 276 (1927). Perennial; stems c. 20 cm , woody at the base, procumbent, rooting. Leaves up to $25 \times 6 \mathrm{~mm}$, oblanceolate, flat above, rounded or somewhat keeled beneath. Flowers axillary, pedunculate; petals $10-15 \mathrm{~mm}$, pinkish-purple. Naturalized on maritime sands and rocks near Lisboa. [Lu.] (S. Africa.)

## 7. Lampranthus N.E. Br. ${ }^{2}$

Like Mesembryanthemum, but erect shrubs; stigmas large, conspicuous, surrounded by a raised ring on the disc. (No satisfactory generic diagnosis has yet been published.)

1. L. glaucus (L.) N.E. Br., Gard. Chron. ser. 3, 87: 212 (1930). Shrub $15-25 \mathrm{~cm}$, with ascending, tortuous branches. Leaves $8-20 \mathrm{~mm}$, opposite, slightly connate, lincar-oblong, trigonous, obtuse, pruinose, somewhat crystalline-papillose. Flowers terminal; petals $12-15 \mathrm{~mm}$, bright yellow. Naturalized on maritime sands and rocks near Lisboa. [Lu.] (S. Africa.)

The description applies to var. tortuosus (Haw.) Schwantes. The type variety, which is also cultivated, is taller, with stiffly erect branches and larger leaves.

## LIII. MOLLUGINACEAE ${ }^{3}$

Annual herbs. Leaves not fleshy. Perianth of 5 free sepals. Petals absent. Petaloid staminodes 0-20. Stamens 3-20. Ovary superior. Fruit a membranous, loculicidal capsule, opening to the base by 3-5 valves on drying.

> Petaloid staminodes absent; plant $\pm$ glabrous Petaloid staminodes present; plant stellate-tomentose 1. Mollugo 2. Glinus

## 1. Mollugo L. ${ }^{1}$

Flowers in cymes or axillary fascicles. Petaloid staminodes absent. Stamens 5. Stigmas 3. Capsule opening by 3 valves; seeds without a strophiole.

[^58]Flowers in axillary fascicles; leaves obovate-lanceolate to spathu-
late 1. verticillata Flowers in axillary, pedunculate, umbellate cymes; leaves linear

> 2. cerviana

1. M. verticillata L., Sp. Pl. 89 (1753). Procumbent or ascending, branched, glabrous annual $5-10(-40) \mathrm{cm}$. Leaves 3-5, pseudoverticillate, obovate-lanceolate to spathulate. Flowers small, pedicellate, in axillary fascicles. Perianth-segments acute, with scarious margins. Naturalized locally in S. Europe. [It Lu.] (Tropical America.)
2. M. cerviana (L.) Ser. in DC., Prodr. 1: 392 (1824). Like 1 but rather taller; leaves 3-10, pseudoverticillate, linear; flowers in pedunculate umbellate cymes; perianth-segments obtuse. Sandy and gravelly places. S. Europe extending northwards to c. $52^{\circ}$ N. in C. Russia. Bu Gr Hs It Lu Rm Rs (C, W, K, E).

## 2. Glinus L. ${ }^{1}$

Flowers in subsessile axillary fascicles. Petaloid staminodes numerous. Stamens 12. Stigmas 5. Capsule opening by 5 valves; seeds with a large strophiole.

1. G. lotoides L., Sp. Pl. 463 (1753). A softly stellate-tomentose, procumbent annual $10-40 \mathrm{~cm}$. Leaves obovate or oblongspathulate, often fascicled. Sepals yellow above; staminodes white. S. Europe. Al Cr Gr Hs It $\mathrm{Ju} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.

## LIV. TETRAGONIACEAE ${ }^{2}$

Perianth of 4-5 sepaloid segments. Stamens 3-15, inserted in the perianth-tube. Ovary inferior; stigmas 3-8. Fruit an indehiscent drupe.

## 1. Tetragonia L. ${ }^{1}$

Leaves ovate-rhombic. Flowers subsessile, solitary. Stamens usually $c .15$.

1. T. tetragonoides (Pallas) O. Kuntze, Rev. Gen. 1: 264 (1891) ( $T$. expansa Murray). A densely papillose, somewhat fleshy, procumbent or ascending annual. Leaves often hastate. Sepals yellow above. Fruit with large tubercles near the top. $2 n=32$. Commonly cultivated as a vegetable, naturalized in S.W. Europe. [Az Lu.] (Australia, New Zealand.)

## LV. PORTULACACEAE ${ }^{3}$

Annual or perennial herbs, usually glabrous and fleshy. Leaves simple, entire. Flowers solitary or in cymes, hermaphrodite. Sepals ('bracteoles') 2; petals ('perianth-segments') 4-6, free or joined below; stamens 3 to many. Ovary unilocular, with 1 to many campylotropous ovules on a basal placenta. Fruit a capsule; seeds with curved embryo.

Several species from America are grown in gardens. Species of Calandrinia in particular are occasionally recorded as naturalized, but none seems to be at all widely established.
Stamens numerous; ovary semi-inferior

1. Portulaca

Stamens 5 or 3; ovary superior
2. Montia

## 1. Portulaca L. ${ }^{4}$

Glabrous fleshy herbs with alternate or opposite leaves and small setaceous stipules. Flowers often terminal. Petals fugacious; stamens numerous; ovary semi-inferior. Capsule unilocular, with thin wall, dehiscing with a transverse lid. Seeds numerous, reniform.

Literature: K. von Poellnitz, Feddes Repert. 37: 240-320 (1934).

1. P. oleracea L., Sp. Pl. 445 (1753). Annual with branched stems up to 50 cm . Leaves mostly scattered and alternate, but subopposite and crowded below flowers, oblong-obovate, sessile with a cuneate base, shining. Flowers solitary or two or three together, often terminal. Sepals c. 4 mm , keeled, joined into a short tube at base; petals $5,6-8 \mathrm{~mm}$, yellow, obovate, slightly joined; stamens 7-12. Capsule 3-9 mm, obovoid; seeds c. 0.5 mm , black. Cultivated as a vegetable; also a weed of cultivation. Mainly in $S . \&$. Europe. Al Au Az Be Bl Br Bu Co Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs (C, W, K, E) Sa Si Tu.
(a) Subsp. oleracea: Procumbent or decumbent. $2 n=54$. Widespread weed of cultivation in S. \& C. Europe, rare and casual in N. Europe; native range unknown.
(b) Subsp. sativa (Haw.) Čelak., Prodr. Fl. Böhm. 484 (1875). Robust, erect, and larger in all its parts than (a). $2 n=54$. Cultivated as a vegetable in S. \& S.E. Europe and occasionally occurring as an escape.

[^59]P. grandiflora Hooker, Bot. Mag. 56: t. 2885 (1829), with large $(4-5 \mathrm{~cm})$ reddish or orange flowers, usually flore pleno, is a native of South America commonly grown in gardens. It is occasionally established on roadsides and in waste places in S. \& S.C. Europe.

## 2. Montia L. ${ }^{4}$

Glabrous, somewhat fleshy herbs with opposite, exstipulate cauline leaves. Flowers in terminal cymes. Stamens 5 or 3. Ovary superior. Fruit a globose capsule dehiscing with three valves. Seeds few, black, broadly reniform.

Includes American species often placed in Claytonia L.; the generic boundary here adopted follows F. Pax \& K. Hoffmann in Engler \& Prantl, Natürl. Pflanzenfam. ed. 2, 16c: 257 (1934).
1 No basal leaf-rosette; cauline leaves numerous; corolla very small, zygomorphic, gamopetalous 1. fontana
1 Basal leaf-rosette and a single pair of cauline leaves present; corolla obvious, actinomorphic, of 5 free petals
2 Cauline leaves broadly connate; petals $2-3 \mathrm{~mm}$, white 2. perfoliata
2 Cauline leaves not connate; petals $8-10 \mathrm{~mm}$, usually pink
3. sibirica

1. M. fontana L., Sp. Pl. 87 (1753) (M. minor C. C. Gmelin, M. rivularis C.C. Gmelin, M. verna Necker). Annual or perennial, with weak branching stems up to 50 cm or more in water, but short and erect, more or less caespitose, on land. Leaves $3-20 \mathrm{~mm}$, usually narrowly spathulate. Flowers c. 2 mm , very inconspicuous, in small terminal cymes often overtopped by non-flowering branches. Capsule $1 \cdot 5-2 \mathrm{~mm}$; seeds usually 3 . $2 n=18$, 20. In water, or on mud or seasonally wet open ground, usually calcifuge. Most of Europe, except the south-east. All except Al Az Bl Cr Rs (W, K, E) Tu.

A very variable species, in which the seed characters show correlation with geographical distribution and, less satisfactorily, with habit and habitat differences. Four subspecies can be recognized:
1 Ripe seeds smooth, shining
(a) subsp. fontana

1 Ripe seeds dull or somewhat shining, with at least some low tubercles on keel
2 Ripe seeds dull, entirely covered with broad obtuse tubercles; usually annual, with erect caespitose stems, on damp sandy ground
(d) subsp. chondrosperma

2 Ripe seeds somewhat shining, tubercles confined to keel; annual or perennial, of varied habit
3 Ripe seeds with 3-4 rows of long acute tubercles on keel
(c) subsp. amporitana

3 Ripe seeds with variably developed broad low tubercles on keel
(b) subsp. variabilis
(a) Subsp. fontana (M. lamprosperma Cham., M. rivularis auct.): $2 n=18,20$. N. \& C. Europe; mountains of S. Europe.
(b) Subsp. variabilis Walters, Watsonia 3: 5 (1953) (M. rivularis auct.): W. \& C. Europe; detailed distribution not yet known.
(c) Subsp. amporitana Sennen, Bull. Géogr. Bot. (Le Mans) 21 : 110 (1911) (M. lusitanica Samp., M. rivularis auct.): W. \& S.W. Europe; apparently rare in C. Europe, but detailed distribution not yet known.
(d) Subsp. chondrosperma (Fenzl) Walters, Watsonia 3: 4 (1953) (M. verna auct., M. minor auct.): $2 n=18,20$. In drier
places than (a) to (c), often on sandy ground. Europe, northwards to Scotland and S. Sweden.
2. M. perfoliata (Donn ex Willd.) Howell, Erythea 1: 38 (1893). Annual up to 30 cm . Basal leaves in a rosette, elliptical to rhombic-ovate, fleshy; cauline leaves broadly connate beneath the few-flowered inflorescence. Petals $2-3 \mathrm{~mm}$, white, entire to emarginate, slightly longer than sepals. Capsule shorter than persistent sepals. $2 n=36$. On rather dry sandy soils, sometimes locally abundant. Naturalized, mainly in W. Europe. [ Be Br Da $\mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{Lu]}. \mathrm{(W} .\mathrm{North} \mathrm{America)}$.
3. M. sibirica (L.) Howell, Erythea 1: 39 (1893). Like 2 but basal leaves ovate, acuminate; cauline leaves not connate; petals $8-10 \mathrm{~mm}$, pink or more rarely white, bifid. In damp shady places on acid sandy soils. A frequent casual in $N . W$. Europe, naturalized in Britain. [Br.] (W. North America.)

## LVI. BASELLACEAE ${ }^{1}$

Glabrous, perennial, twining herbs, usually fleshy. Leaves alternate, usually ovate with a more or less cordate base, entire. Flowers in spikes, racemes or racemose panicles, hermaphrodite. Sepals ('bracteoles') 2; petals ('perianth-segments') 5; stamens 5 , opposite petals. Ovary unilocular, with 3 styles and a single basal ovule. Fruit indehiscent, fleshy, surrounded by persistent sepals and petals.

A small family, mainly in America, and not native in Europe.

Basella alba L., Sp. Pl. 390 (1753), a very fleshy perennial herb with flowers in spikes, probably native of tropical Asia, is widely cultivated as a vegetable in S. Europe and occasionally escapes, but does not seem to be naturalized.

## 1. Boussingaultia Humb., Bonpl. \& Kunth ${ }^{2}$

Filaments curved outwards in bud; sepals not winged in fruit.
Literature: E. Ulbrich in Engler \& Prantl, Natürl. Pflanzenfam. ed. 2, 16c: 263-71 (1934).

1. B. cordifolia Ten., Ann. Sci. Nat. ser. 3, 19: 355 (1853) (B. baselloides auct., non Humb., Bonpl. \& Kunth). Tall slender twining plant with numerous potato-like tubers on the rhizomes. Leaves $2-7 \mathrm{~cm}$. Inflorescence $5-15 \mathrm{~cm}$, more or less compound, axillary; flowers $c .2 \mathrm{~mm}$, whitish. Naturalized on roadsides and in waste places in S. \& S.E. Europe. [Az Ga Hs Lu Rs (W, E).] (Subtropical South America.)

Grown in gardens in S. Europe, mainly for its drought-resistant summer-green foliage, but also cultivated as a vegetable.

## LVII. CARYOPHYLLACEAE ${ }^{1}$

Herbs, more rarely small shrubs. Leaves usually opposite and decussate, more rarely alternate or verticillate, simple, entire, with or without scarious stipules. Flowers actinomorphic, usually hermaphrodite, often in bracteate dichasia. Sepals 4-5, free, or fused and often united by scarious strips of tissue (commissures) alternating with the calyx-teeth. Petals (0)4-5, free. Stamens usually $8-10$, obdiplostemonous. Ovary superior, unilocular at least above, with 1 to numerous campylotropous ovules on a basal or free-central placenta; stigmas (1)2-5. Fruit usually a capsule, dehiscing with teeth equalling the styles in number or twice as many; more rarely fruit a berry or achene.

[^60]4 Fruit not as above
5 Stigmas 1 or 2
6 Bracts conspicuous, longer than flowers
6 Bracts inconspicuous, shorter than flowers 7 Leaves aristate; plant erect
15. Paronychia

7 Leaves not aristate; plant procumbent
8 Sepals conspicuously white and spongy
8 Sepals not white and spongy
5 Stigmas 3 or 5
9 Sepals with a single large tooth on each side
9 Sepals entire
10 Leaves obovate or orbicular
. - .

10 Leaves subulate, linear or linear-lanceolate
11 Petals 0; style 1
Ortegia
11 Petals 5; styles 3 or 5
12 Styles 3; stipules connate
12 Styles 5; stipules not connate
23. Spergularia
22. Spergula

1 Stipules absent
13 Sepals free, or joined only at base (Subfam. Alsinoideae)
14 Styles 2
15 Petals absent; fruit indehiscent
13. Scleranthus

15 Petals present; fruit a dehiscent capsule
16 Capsule dehiscing with 4 equal teeth; seeds with strophiole
2. Moehringia

16 Capsule dehiscing with 2 entire or bifid teeth; seeds without strophiole
17 Basal leaves setaceous; capsule with entire teeth 5. Bufonia
17 Basal leaves linear-spathulate; capsule with bifid teeth

1. Arenaria

## 14 Styles 3-5

18 Capsule-teeth as many as styles
19 Fleshy maritime plant; seeds $3-4.5 \mathrm{~mm}$
19 Plant not fleshy; seeds less than 3 mm
20 Styles fewer than sepals
20 Styles as many as sepals
21 Capsule-teeth entire; leaves subulate
21 Capsule-teeth shallowly bifid; leaves ovate
18 Capsule-teeth twice as many as styles
22 Petals absent
23 Styles 3
23 Styles 5
22 Petals present
24 Petals bifid to at least half-way
24 Petals bifid to less than half-way or entire
25 Plant with napiform tubers on rhizome
7. Pseudostellaria

25 Plant without napiform tubers
26 Petals irregularly toothed
8. Holosteum

26 Petals entire, emarginate or bifid
27 Styles 4 or 5
28 Glabrous, glaucous annuals; petals 4(5), entire or emarginate
10. Moenchia

28 Annuals or perennials, usually hairy; petals 5(4), distinctly bifid
9. Cerastium

27 Styles 3 on at least some flowers
29 Petals bifid to c. $\frac{1}{3}$
9. Cerastium

29 Petals emarginate (to less than $\frac{1}{4}$ ) or entire
30 Seeds with persistent strophiole $\quad$ 2. Moehringia
30 Seeds without strophiole

1. Arenaria

13 Sepals joined to form a distinct calyx-tube (Subfam. Silenoideae)
31 Calyx-tube with commissural veins alternating with the mid-veins of the sepals; styles 3-5
32 Fruit a berry
29. Cucubalus

32 Fruit a capsule
33 Capsule dehiscing with a lid
30. Drypis

33 Capsule dehiscing with teeth
34 Capsule-teeth twice as many as styles, or teeth bifid
28. Silene

34 Capsule-teeth as many as styles, entire
35 Annual; calyx-teeth foliaceous
26. Agrostemma

35 Perennial; calyx-teeth not foliaceous
36 Seeds with a hair-tuft at hilum; petals imbricate in bud
27. Petrocoptis

36 Seeds glabrous; petals contorted in bud
25. Lychnis

31 Calyx-tube without commissural veins; styles 2 or 3
37 Calyx-tube with 5 wings
34. Vaccaria

37 Calyx-tube without wings
38 Calyx-tube with scarious commissures
39 Seeds scutate, with facial hilum
35. Petrorhagia

39 Seeds reniform or comma-shaped, with lateral hilum
40 Calyx tubular; petal-limb abruptly contracted into claw
32. Bolanthus

40 Calyx campanulate; petal-limb gradually narrowed into claw
31. Gypsophila

38 Calyx-tube without scarious commissures
41 Epicalyx present
36. Dianthus

41 Epicalyx absent
42 Seeds scutate, with facial hilum
37. Velezia

42 Seeds reniform, with lateral hilum
33. Saponaria

## Subfam. Alsinoideae

Leaves opposite; stipules absent. Petals usually well developed; sepals free or joined only at base.

[^61]
## 1. Arenaria L. ${ }^{1}$

Annual, biennial or perennial herbs. Leaves opposite, entire, very variable in shape from orbicular to subulate. Flowers usually in few-flowered cymes, sometimes solitary, 5 -merous (rarely 4-merous). Sepals free; petals usually entire, white (or very rarely pink); stamens (8)10; styles 3(-5). Capsule conical to cylindrical, dehiscing with twice as many teeth as styles; teeth narrow, acute. Seeds several, reniform (globose in 1 species), usually dark brown, smooth, tuberculate. (Incl. Gouffeia Robill. \& Cast. ex DC.)

Literature: J. McNeill, Notes Roy. Bot. Gard. Edinb. 24: 79-155 (1962).

1 Perennial, with leafy vegetative stems
2 Leaves usually more than 30 mm , linear, erect
3 Sepals acute or acuminate
4 Pedicels usually longer than sepals; petals 2-3 times as long as sepals
3. gypsophiloides

4 Pedicels usually equalling or shorter than sepals; petals equalling or slightly exceeding sepals
5 Basal leaves $20-120 \times 0.5-0.75 \mathrm{~mm}$; inflorescence $\pm$ elongate; bracts $5-7 \mathrm{~mm}$ 1. rigida
5 Basal leaves $100-400 \times 1-1.3 \mathrm{~mm}$; inflorescence a compact hemispherical head; bracts $c .15 \mathrm{~mm} \quad$ 2. cephalotes
3 Sepals obtuse
6 Sepals $2-3 \mathrm{~mm}$, with a prominent keel 5. Iongifolia
6 Sepals $2.5-5 \mathrm{~mm}$, not keeled 4. procera
2 Leaves usually less than 30 mm , usually patent or recurved
7 Leaves $15-30 \mathrm{~mm}$, linear-subulate, very stiff and spiny
12. pungens

7 Leaves not stiff or spiny
8 Flowers sessile or subsessile
9 Leaves thick or subcoriaceous, with thickened margins 10 Leaves acute and mucronate 11. aggregata 10 Leaves obtuse
11 Flowers not more than half-exserted from the very hard, compact cushion; sepals $c .2 .5 \mathrm{~mm}$. 7. lithops
11 Flowers completely exserted from the foliage, or clustered on long peduncles
12 Plant $\pm$ densely covered with very short white hairs, forming compact, silvery cushions $5-10 \mathrm{~cm}$ in diameter; sepals keeled for $c .1 \mathrm{~mm}$ at base, otherwise very obscurely veined
9. tomentosa

12 Plant not silvery; sepals with strong, raised veins
13 Flowers solitary and terminal 8. tetraquetra
13 Flowers (2-)4-12 in dense terminal clusters
10. armerina

9 Leaves thin, without raised margins
14 Petals slightly exceeding sepals (S.W. Bulgaria)
14 Petals not exceeding sepals
15 Petals equalling sepals; leaves glabrous 20. humifusa
15 Petals distinctly shorter than sepals; leaves scabridpuberulent vide 34. leptoclados
8 Flowers pedicellate; pedicels usually equalling or longer than sepals
16 Stems procumbent, rooting at the nodes 19. biflora
16 Stems not rooting at the nodes
17 Sepals glabrous on surface, though often ciliate
18 Plant with slender, yellowish stolons; stems very slender
lant without stolons
20. humifusa

18 Plant without stolons
19 Capsule very long-exserted from calyx, cylindrical, shining 6. purpurascen
19 Capsule slightly exserted, ovoid to globose
20 Leaves usually linear, with revolute margins
13. valentina

20 Leaves broader, flat
21 Leaves finely denticulate, never ciliate 24 . gracilis
21 Leaves entire, usually ciliate at least at base

22 Leaves somewhat fleshy, obscurely 1 -veined; not more than the lower $\frac{1}{3}$ of the margin ciliate
21. norvegica

## 22 Leaves not fleshy, distinctly 1 -veined; the lower $\frac{1}{4}-\frac{2}{3}$ of the margin ciliate <br> 22. ciliata

17 Sepals hairy on surface
23 Leaves linear-lanceolate, with prominent keel-like midrib beneath and a long arista
14. grandiflora

23 Leaves without keel-like midrib and arista
24 Plant with $\pm$ filiform, procumbent stems forming dense mats; leaves broadly ovate or orbicular; sepals not more than 3 mm
18. balearica

24 Plant with stouter stems, not forming dense mats; leaves narrower; sepals usually more than 3 mm
25 Leaves linear-subulate (or rarely linear-lanceolate), not more than 1 mm wide
32. hispida

25 Leaves more than 1 mm wide
26 Pedicels not longer than sepals (S.W. Bulgaria)
vide 25. filicaulis
26 Pedicels usually longer than sepals
27 Sepals usually more than 5 mm
28 Petals less than $1 \frac{1}{2}$ times as long as sepals
28. ligericina

28 Petals more than $1 \frac{1}{2}$ times as long as sepals
29 Leaves ovate 15. bertolonii
29 Leaves oblanceolate or oblong to linear
30 Caespitose; leaves usually not more than 10 mm long, widest above the middle 16. huteri
30 Not caespitose; leaves usually more than 10 mm long, widest at or below the middle (rarely a few in middle of stem widest above the middle)
17. montana

27 Sepals not more than 5 mm
31 Sepals eglandular
32 Pedicels more than 3 times as long as sepals
31. cinerea

32 Pedicels not more than 3 times as long as sepals
22. ciliata

31 Sepals glandular-pubescent
33 Petals about twice as long as sepals
34 Sepals obtuse or subacute; capsule slightly exceeding sepals 29. cretica
34 Sepals acute; capsule slightly shorter than sepals
25. filicaulis

33 Petals not more than $1 \frac{1}{2}$ times as long as sepals
35 Dwarf caespitose plant with stems $2-5 \mathrm{~cm}$; pedicels 1-2 times as long as sepals; flowers solitary or paired
30. halacsyi

35 Large plants with long pedicels; inflorescence with more than 2 flowers
36 Leaves broadly elliptical to obovate; petals very slightly exceeding sepals
37 Plant pubescent; stems, branches and pedicels slender and long 26. deflexa
37 Plant puberulent; stems, branches and pedicels stout and short 27. fragillima
36 Leaves elliptical, lanceolate or oblanceolate; petals $1 \frac{1}{3}-1 \frac{1}{2}$ times as long as sepals
38 Seeds with low obtuse tubercles or ridges; leaves without prominent midrib
28. ligericina

38 Seeds with acute tubercles; leaves with prominent midrib
25. filicaulis

1 Annual or biennial, lacking leafy vegetative stems at time of flowering
39 Lower leaves lanceolate or wider, usually with 3 or more veins
40 Petals equalling or exceeding sepals
41 Pedicels $\pm$ glabrous
36. serpentini

41 Pedicels pubescent or puberulent
42 Seeds globose and smooth; sepals often black-tipped
41. cerastioides

42 Seeds reniform and tuberculate, sepals never blacktipped
43 Seeds with acute tubercles
44 Sepals ovate-oblong, obtuse
44. conimbricensis

44 Sepals lanceolate or ovate-lanceolate, acute or acuminate
45 Petals $1 \frac{1}{2}-2$ times as long as sepals 49. retusa
45 Petals scarcely exceeding sepals
38. muralis

43 Seeds with low, obtuse tubercles
46 Petals about twice as long as sepals; pedicels 4-6 times as long as sepals
31. cinerea

46 Petals not more than $1 \frac{1}{3}$ times as long as sepals; pedicels less than 4 times as long as sepals
47 Leaves $\pm$ densely pubescent
35. conferta

47 Leaves glabrous, though usually ciliate
48 Leaves more than 3 times as long as wide
21. norvegica

48 Leaves less than 3 times as long as wide
23. gothica

40 Petals shorter than sepals
49 Bracts forming an involucre around the inflorescence; stems less than 3 cm
39. saponarioides

49 Bracts not forming an involucre; stems usually more than 3 cm
50 Sepals with patent or recurved apices 40. guicciardii
50 Sepals straight
51 Sepals $4 \cdot 5-6 \mathrm{~mm}$, lanceolate, long-attenuate above, but obtuse or subacute at apex
37. nevadensis

51 Sepals 2-5 mm, ovate or ovate-lanceolate, acute
52 Capsule cylindrical to cylindrical-subovoid, not or scarcely swollen at base, usually twice as long as wide; seeds $0.3-0.6 \mathrm{~mm}$ 34. leptoclados
52 Capsule ovoid or ovoid-conical, distinctly swollen at base, less than twice as long as wide
53 Petals $\frac{1}{2}-\frac{2}{3}$ as long as sepals; seeds $0.45-0.7 \mathrm{~mm}$
33. serpyllifolia

53 Petals almost equalling sepals; seeds $0.7-1 \mathrm{~mm}$
35. conferta

39 All leaves linear-lanceolate or linear, usually 1 -veined (S.W. Europe)

54 Pedicels glabrous or subglabrous
55 Petals $1 \frac{1}{2}-2$ times as long as sepals; sepals ovate, obtuse
45. obtusiflora

55 Petals $\pm$ equalling sepals; sepals lanceolate, acute
$\begin{array}{ll}56 & \text { Sepals } 2.5 \mathrm{~mm} \text {; capsule with } 6 \text { teeth } \\ 56 & \text { Sepals } 3-4 \mathrm{~mm} \text {; capsule with } 2 \text { bifid teeth } \\ \text { 51. provillipes }\end{array}$
54 Pedicels pubescent or puberulent
57 Petals pink, truncate-emarginate, $\pm$ equalling sepals
42. emarginata

57 Petals white
58 Petals emarginate, 2-3 times as long as sepals
43. algarbiensis

58 Petals entire, not more than twice as long as sepals
59 Petals shorter than sepals
60 Inflorescence many-flowered; pedicels 2-5 times as long as sepals; sepals usually very finely acute 48. modesta
60 Inflorescence few-, often 3 -flowered; pedicels $1 \frac{1}{2}-2$ times as long as sepals; sepals subacute 47. conica
59 Petals equalling or exceeding sepals
61 Sepals obtuse
62 Capsule $1 \frac{1}{2}-2$ times as long as sepals, long-exserted; pedicels minutely scabrid-puberulent 45. obtusiflora Capsule included in, or scarcely exserted from sepals; pedicels with patent glandular hairs
44. conimbricensis

61 Sepals acute
63 Plant eglandular; pedicels with minute deflexed hairs; leaves subtrigonous
46. controversa

63 Plant glandular-pubescent; pedicels usually with patent glandular hairs; leaves thin, flat
64 Sepals usually very finely acute, very obscurely veined; leaves linear or linear-lanceolate
48. modesta

64 Sepals acute, with 3 raised veins; leaves usually oblanceolate or wider
49. retusa

Subgen. Eremogone (Fenzl) Fenzl. Perennials, woody at base, with linear leaves more than 30 mm . Styles 3(-5).

1. A. rigida Bieb., Fl. Taur.-Cauc. 1: 346 (1808). Glabrous perennial with woody, branched stock; stems $7-40 \mathrm{~cm}$, erect, slender, rigid, simple. Basal leaves $30-120 \times 0.5-0.75 \mathrm{~mm}$, linear, acuminate; cauline shorter and wider, merging into lanceolate, acuminate bracts $5-7 \mathrm{~mm}$. Inflorescence a several- to manyflowered, more or less strict, compact, oblong panicle; pedicels mostly equalling or shorter than sepals. Sepals 4-6 mm, lanceolate, acuminate, with very obtuse keel; petals equalling or slightly exceeding sepals. Dry, usually sandy ground. ? S. Ukraine and Black Sea coast. Bu Rm Rs (W, E).
2. A. cephalotes Bieb., Fl. Taur.-Cauc. 1: 346 (1808). Like 1 but stems $20-50 \mathrm{~cm}$, stout; basal leaves $100-400 \times 1-1 \cdot 3 \mathrm{~mm}$; inflorescence a dense, terminal, hemispherical head; bracts c. 15 mm , coriaceous and conspicuous; pedicels shorter than sepals and flowers often subsessile; sepals $5 \cdot 5-7 \mathrm{~mm}$, lanceolate, acute. Dry open slopes. - S. Ukraine and Moldavia. Rs (W).
3. A. gypsophiloides L., Mantissa 71 (1767). Like 1 but stems stout; basal leaves $c .1 \mathrm{~mm}$ wide; inflorescence a lax, elongate panicle; pedicels $1-2$ times as long as sepals; sepals $4-5 \mathrm{~mm}$, ovate, acute or acuminate; petals 2-3 times as long as sepals. S. \& E. Bulgaria. Bu. (S.W. Asia.)

The typical plant, with glandular-pubescent inflorescence, is recorded only from Aitos. Var. rhodopaea Velen., recorded from limestone rocks in two valleys in the Rodopi Planina, has larger flowers and glabrous inflorescences.
4. A. procera Sprengel, Hist. Rei Herb. 2: 153 (1808). Perennial with branched woody stock; stems (10-)20-40 cm, erect, rigid, rather stout, simple, glabrous below, sometimes pubescent above. Basal leaves $30-120 \times c .1 \mathrm{~mm}$, linear, acuminate; cauline shorter and wider. Inflorescence usually a very lax subcorymbose panicle, sometimes elongate or fasciculate; pedicels usually $2-4$ times as long as sepals. Sepals $2 \cdot 5-5 \mathrm{~mm}$, ovate, very obtuse, not keeled; petals about twice as long as sepals. C. \& E. Europe. Au Cz Ge Hu Po Rm Rs (N, B, C, W, E).
(a) Subsp. procera (A.graminifolia auct., non Ard., nec Schrader, A. biebersteinii Schlecht.; incl. A. pineticola Klokov): Leafsheaths at base of stem c. 2 mm , often purplish. Branches of inflorescence and pedicels glandular-pubescent. Ukraine and S. Russia.
(b) Subsp. glabra (F. N. Williams) J. Holub, Preslia 28: 94 (1956) (A. graminifolia Schrader, non Ard., A. biebersteinii auct., non Schlecht., A. micradenia Smirnov; incl. A. koriniana Fischer, A. ucrainica Sprengel ex Steudel, A. stenophylla Ledeb., A. syreistschikowii Smirnov and A. polaris Schischkin): Leaf-sheaths at base of stem c. 2.5-4 mm, often purplish. Inflorescence-branches and pedicels glabrous, eglandular. Throughout the range of the species.

This subspecies is very variable. Plants from Siberia, which possibly just reach Europe in N.E. Russia, with stems $10-15 \mathrm{~cm}$, basal leaves $30-70 \mathrm{~mm}$, and violet-tinged sepals have been called A. polaris Schischkin in Komarov, Fl. URSS 6: 887 (1936), and may merit subspecific rank.
5. A. longifolia Bieb., Fl. Taur.-Cauc. 1: 345 (1808). Glabrous perennial with branched, slightly woody stock; stems $20-40 \mathrm{~cm}$, erect, fairly stout, simple. Basal leaves $100-200 \times$ c. 0.75 mm , linear, acuminate; cauline shorter but scarcely wider. Inflorescence many-flowered, subcorymbose; pedicels usually 1-3 times as long as sepals. Sepals $2-3 \mathrm{~mm}$, ovate, obtuse, with a promi-
nent, blunt keel; petals about twice as long as sepals. C., S. \& E. Russia; E. Ukraine. Rs (C, W, E).

Subgen. Porphyrantha (Fenzl) McNeill. Perennial with lanceolate leaves. Styles 3. Capsule cylindrical, long-exserted, shiny.
6. A. purpurascens Ramond ex DC. in Lam. \& DC., Fl. Fr. ed. 3, 4: 785 (1805). Perennial; stems 4-10 cm, diffuse, ascending, glabrous with distinct scale-leaves towards base; puberulent with deflexed hairs, branched and leafy in upper part. Leaves $5-10 \mathrm{~mm}$, elliptic-lanceolate or lanceolate, acute, strongly 1 -veined, glabrous, ciliate at base. Flowers 2-4 in rather dense clusters, rarely solitary; pedicels usually equalling sepals, pubescent, erect in fruit. Sepals $4.5-6.5 \mathrm{~mm}$, lanceolate, acute, 3- to 5 -veined, glabrous; petals $1 \frac{1}{2}-2$ times as long as sepals, oblong, palepurplish or white. Capsule $1 \frac{3}{4}-2$ times as long as sepals, cylindrical. Damp rocky places on mountains. - Pyrenees; Cordillera Cantábrica. Ga Hs.

Subgen. Arenaria. Annuals to perennials, of various habit; leaves less than 30 mm . Styles 3(-5). Capsule more or less ovoid.
7. A. lithops Heywood ex McNeill, Notes Roy. Bot. Gard. Edinb. 24: 113 (1962) (A. pulvinata Huter, non Edgew.). Perennial, sparsely covered with very short crisped hairs, forming very compact, hard cushions $5-80 \mathrm{~cm}$ in diameter which show growthrings inside; stems usually completely covered by the densely imbricate leaves. Leaves $1-1.5 \mathrm{~mm}$, ovate-deltate, obtuse, recurved. Flowers 4-merous, solitary, terminal, sessile, not more than half-exserted from the cushion. Sepals c. 2.5 mm , ovatelanceolate, obtuse; petals $c$. $1 \frac{1}{2}$ times as long as sepals. Rocky mountain slopes. S.E. Spain. Hs.
8. A. tetraquetra L., Sp. Pl. 423 (1753). Perennial, usually forming dense cushions $5-25 \mathrm{~cm}$ in diameter, not showing growth rings, subglabrous; stems more or less densely covered with imbricate leaves. Leaves $1-4 \mathrm{~mm}$, ovate, obtuse, recurved, glabrous, ciliate at base. Flowers 4-merous or 5-merous, solitary and terminal, completely exserted from the foliage, on slightly (up to $c .1 \mathrm{~cm}$ ) protruding stems; bracts ovate-lanceolate. Sepals $4-6 \mathrm{~mm}$, lanceolate, gradually narrowed to obtuse apex, with prominent raised veins; petals slightly exceeding or up to $1 \frac{1}{2}$ times as long as sepals. Dry places on mountains. - C. \& E. Pyrenees and mountains of E. \& S.E. Spain. Ga Hs.

Plants from the Pyrenees usually have 4-merous flowers. Plants from E. and S. Spain usually have 5 -merous flowers and are often more densely caespitose (var. granatensis Boiss.).
9. A. tomentosa Willk., Linnaea 25: 15 (1852). Perennial, forming compact silvery cushions $5-10 \mathrm{~cm}$ in diameter, more or less densely covered with very short, crisped, white hairs; stems densely covered with imbricate leaves. Leaves $1-1.5 \mathrm{~mm}$, ovate, obtuse, recurved. Flowers 5 -merous, terminal and completely exserted from the cushion, or 2-3 in a terminal cluster with 1-2 axillary flowers just below. Sepals 4-5 mm, lanceolate, gradually narrowed to an obtuse apex, keeled for $c .1 \mathrm{~mm}$ at base, otherwise very obscurely veined; petals slightly exceeding sepals. - S.E. Spain. Hs.
10. A. armerina Bory, Ann. Gén. Sci.Phys. (Bruxelles) 3:5 (1820) (A. armeriastrum Boiss.). Usually laxly caespitose perennial, with flowering stems protruding from the lax vegetative cushion; stems $5-20 \mathrm{~cm}$, usually puberulent. Leaves $1-4 \mathrm{~mm}$, linearlanceolate to ovate, obtuse, recurved, usually folded, rarely imbricate, puberulent or subglabrous. Flowers (2-)4-12 in dense
terminal heads surrounded by linear-lanceolate bracts, sometimes with $1-3$ axillary flowers below. Sepals $5-8 \mathrm{~mm}$, linear-lanceolate, acute, with very prominent raised veins, subglabrous to sublanate; petals slightly exceeding or up to $1 \frac{1}{2}$ times as long as sepals. S. Spain. Hs.

Densely puberulent plants with sublanate sepals are best given varietal status as var. caesia (Boiss.) Pau.
11. A. aggregata (L.) Loisel., Dict. Sci. Nat. 46: 513 (1827). Caespitose perennial. Leaves $1-4 \mathrm{~mm}$, lanceolate, acute and mucronate, recurved and folded, glabrous or sparsely puberulent. Flowers 4- to 5-merous. Sepals lanceolate or linear-lanceolate, acuminate, with strong raised veins; petals equalling or slightly exceeding sepals. S.W. Europe. Ga Hs It Lu.

Very variable; at least two subspecies may be recognized:
(a) Subsp. aggregata (A. capitata Lam.; incl. A. pseudarmeriastrum Boiss.): Plant forming a lax cushion with stems $2-5 \mathrm{~cm}$, covered with more or less imbricate leaves. Flowering stems protruding usually 3 cm or more above the cushion, unbranched, with dense, terminal 3 - to 15 -flowered heads. Sepals $6-7.5 \mathrm{~mm}$. Iberian peninsula; S. France; N.W. Italy (Alpi Marittime).
(b) Subsp. erinacea (Boiss.) Font Quer, Arx. Secc. Ci. Inst. Est. Catalans 15: 35 (1948) (A. erinacea Boiss.): Plant forming a dense cushion $5-10 \mathrm{~cm}$ in diameter, with stems covered with densely imbricate leaves. Flowers solitary and terminal, rarely 2 or 3 together, on the surface of the cushion, not on protruding stems. Sepals $4-6 \mathrm{~mm}$. E. Spain; S.E. France (Mont Ventoux); N. Portugal (Serra da Estrêla).

Intermediates between these two subspecies occur on Mont Ventoux.
A. racemosa Willk., Bot. Zeit. 5: 239 (1847), from S. Spain, is laxly caespitose, has acute, mucronate, more or less distant and not imbricate leaves, and 2-5 flowers in lax racemes (or rarely solitary flowers). The sepals are $4-6 \mathrm{~mm}$ long, ovate-lanceolate, acute and strongly veined. It may merit subspecific status under 11.
12. A. pungens Clemente ex Lag., Gen. Sp. Nov. 15 (1816). Perennial, forming dense spiny cushions; stems $10-20 \mathrm{~cm}$, branched, viscid-puberulent at least above. Leaves $c .15-30 \mathrm{~mm}$, linear-subulate, subtriquetrous, very stiff and spiny, patent, at least the upper puberulent. Stems 1(-3)-flowered; pedicels c. 2-3 times as long as sepals, viscid-puberulent. Sepals $6-13 \mathrm{~mm}$, linear-lanceolate, acuminate, stiff, spiny, viscid-puberulent; petals shorter than sepals, white, oblong-obovate. Capsule shorter than sepals, ovoid. Dry screes from c. 1900 to 3000 m. S. Spain (Sierra Nevada). Hs. (Morocco.)
13. A. valentina Boiss., Diagn. Pl. Or. Nov. 3 (1): 90 (1853). Perennial, sometimes laxly caespitose; stems $5-20 \mathrm{~cm}$, slender, straggling, branched at right angles, bearing minute deflexed hairs. Leaves $3-10 \times 0.5-1.5 \mathrm{~mm}$, linear or linear-lanceolate, flat but often appearing subulate because the margins are revolute, rather rigid but not spiny, usually fasciculate. Branches $1(-3)-$ flowered; pedicels $3-5$ times as long as sepals. Sepals $2 \cdot 5-5 \mathrm{~mm}$, ovate, subacute to acuminate, with a distinct mid-vein, glabrous, often ciliate at base; petals about twice as long as sepals, oblongspathulate, white. Capsule slightly exceeding sepals, ovoidglobose. Calcareous rocks. - S.E. Spain. Hs.
14. A. grandiflora L., Syst. Nat. ed. 10, 2: 1034 (1759). Laxly caespitose perennial; stems $5-15 \mathrm{~cm}$; the vegetative stems with short deflexed hairs; the flowering with patent glandular hairs. Leaves $5-10 \times 0.75-1(-1.5) \mathrm{mm}$, linear-lanceolate, acuminate,
green, with a long arista; midrib and margins prominent beneath and coriaceous. Stems 1 - to $3(-6)$-flowered; pedicels $2-6$ times as long as sepals, glandular-pubescent. Sepals $3-5 \cdot 5 \mathrm{~mm}$, ovate, acute or acuminate, sparsely glandular-pubescent, often keeled, mid-vein always prominent; petals $1 \frac{1}{2}-2 \frac{1}{2}$ times as long as sepals, oblong-obovate, white. Capsule $1 \frac{1}{4}(-2)$ times as long as sepals, ovoid. $2 n=44$. Dry rocky and stony places, mostly on mountains. C. \&. S. Europe, but rare or absent in the east. Au Bl Cz Ga He Hs It Ju Lu Si.

Var. incrassata (Lange) Cosson occurs in S.W. Europe. It differs from the typical plant in forming dense, more leafy tussocks; in having tetragonous, not terete, stems, and in having broader, elliptical and densely fasciculate leaves. It may merit subspecific status.
15. A. bertolonii Fiori in Fiori \& Paol., Fl. Anal. Ital. 1: 346 (1898). Laxly caespitose perennial; stems $5-12 \mathrm{~cm}$, branched, pubescent, or glabrous. Leaves $5-13 \mathrm{~mm}$, ovate, acute or subobtuse, pubescent; the lower shortly petiolate, the upper sessile. Flowers solitary or in 2 - to 3 -flowered cymes; pedicels 2-4 times as long as sepals, slender. Sepals (4-)5-6.5 mm, ovate-lanceolate, obtuse or subacute, veinless, sparsely glandular-pubescent; petals 2-3 times as long as sepals, usually emarginate, white. Capsule equalling or slightly exceeding sepals, ovoid. $2 n=30$. Rocks. - C. Mediterranean region. Co It Sa Si.
16. A. huteri Kerner, Österr. Bot. Zeitschr. 22: 368 (1872). Like 15 but usually more caespitose; leaves oblanceolate, subobtuse; pedicels $3-5$ times as long as sepals; sepals oblonglanceolate; petals $1 \frac{3}{4}-2$ times as long as sepals, entire; capsule shorter than sepals. Crevices of dolomitic rocks. - N.E. Italy (Alpi Carniche). It.
17. A. montana L., Cent. PI. 1: 12 (1755). Robust, greyishgreen, crisply and shortly pubescent perennial; stems $10-30 \mathrm{~cm}$, spreading or erect. Leaves $10-20(-40) \times 2-4 \mathrm{~mm}$, oblonglanceolate to linear, acute, 1 -veined. Flowers solitary or in 2- to 11 -flowered cymes; pedicels 2-6 times as long as sepals. Sepals (5-)6-9 mm, ovate-lanceolate to ovate, acute or subacute, 1 -veined; petals twice as long as sepals, white. Capsule shorter than or equalling sepals. S.W. Europe, extending northwards to C. \& N.W. France. Ga Hs Lu.
(a) Subsp. montana: Stems $10-30 \mathrm{~cm}$, spreading or erect. Leaves $10-20(-40) \times 2-4 \mathrm{~mm}$, oblong- or linear-lanceolate. Pedicels usually eglandular. Sepals lanceolate to ovate, acute or subacute, usually with scarious margins. $2 n=28$. Throughout the range of the species.
(b) Subsp. intricata (Dufour) Pau, Act. Soc. Esp. Hist. Nat. 27: 199 (1898): Stems $10-40 \mathrm{~cm}$, straggling. Leaves $10-40 \times 1-2 \mathrm{~mm}$, linear. Pedicels usually glandular. Sepals ovate, acute or subobtuse, usually without scarious margins. S. Spain.
18. A. balearica L., Syst. Nat. ed. 12, 3: 230 (1768). Perennial with slender, almost filiform, procumbent, branched stems forming dense mats. Leaves 2-4 mm, broadly ovate or orbicular, obtuse, shortly pubescent; petioles equalling lamina. Flowering stems up to 6 cm , ascending, glabrous or scabrid; flowers solitary; pedicels $5-10$ times as long as sepals, filiform. Sepals $2 \cdot 5-3 \mathrm{~mm}$, ovate, subobtuse, distinctly 1 -veined, shortly and sparsely pubescent; petals twice as long as sepals. Capsule slightly exserted. Shaded rocky places, up to 1450 m. Islands of W. Mediterranean, from Mallorca to Montecristo; naturalized from gardens in Britain. Bl Co It Sa [Br].
19. A. biflora L., Mantissa 71 (1767). Perennial; stems up to 20 cm , procumbent, slender, rooting at the nodes, glabrous or
rarely puberulent. Leaves 3-4 $\times 1 \cdot 5-2 \cdot 5 \mathrm{~mm}$, obovate to orbicular, obtuse, distinctly 1 -veined, abruptly contracted into a ciliate petiole. Flowering branches $2-3 \mathrm{~cm}$; flowers solitary or 2 together; pedicels 1-2 times as long as sepals. Sepals $3 \cdot 5-4 \cdot 5 \mathrm{~mm}$, ovate, obtuse or subacute, rarely acute, usually glabrous, often ciliate near base, $1(-3)$-veined; petals slightly exceeding sepals. Capsule more or less equalling sepals. $2 n=22$. Damp places at over 1700 m , often in snow-patches. Principal mountain-ranges of Europe, from Pyrenees to E. Carpathians and Bulgaria. Al Au Bu Ga Ge Gr He It Ju Rm Rs (W).

Plants from Romania and the N. part of the Balkan peninsula with lanceolate, acute sepals, often more-flowered branches, and petals slightly shorter than the sepals, are usually called $\mathbf{A}$. rotundifolia Bieb., Fl. Taur.-Cauc. 1: 343 (1808), but there appears to be no satisfactory basis for specific separation. A chromosome number of $2 n=44$ has been recorded for this plant.
20. A. humifusa Wahlenb., Fl. Lapp. 129 (1812). Small, matforming perennial up to 3 cm , with procumbent, glabrous stems and slender, elongate stolons at or just above ground-level. Leaves $3-4 \times 1-1.75 \mathrm{~mm}$, elliptical to narrowly obovate, glabrous or very slightly ciliate at the base. Flowers solitary or rarely two together; pedicels much shorter than or equalling sepals, slightly scabrid. Sepals $3-4 \mathrm{~mm}$, ovate, usually glabrous, obscurely 3 -veined, with narrow scarious margin; petals slightly exceeding sepals; anthers pale purple. Capsule exserted, cylindrical. Seeds $0.7-0.75 \mathrm{~mm}$, reddish-brown. $2 n=40$. Moist, open habitats on basic soil in mountains. Arctic Europe and subarctic Norway (very rare). No Rs (N) Sb Su. (Arctic and montane North America.)
21. A. norvegica Gunnerus, Fl. Norvegica 2: 144 (1772). Annual to perennial herb forming lax tufts 3-7 cm high. Leaves oblanceolate, glabrous, often slightly ciliate below, obscurely veined. Cymes 1 - to 2(-4)-flowered; pedicels $1-3$ times as long as sepals, slightly scabrid. Sepals 3-4 mm, ovate, glabrous, often with a few basal cilia, 3 -veined, the lateral veins often obscure; petals $4-5.5 \mathrm{~mm}$, exceeding the sepals; anthers white. Capsule equalling or slightly exceeding sepals, conical. Seeds $0.8-1 \mathrm{~mm}$, black, dull, with low broad tubercles. N.W. Europe, extending to W. Sweden. Br Hb Is No Su .
(a) Subsp. norvegica: Perennial. Leaves $3-4 \cdot 5(-6) \mathrm{mm}$, somewhat fleshy, dark green. Sepals usually not ciliate; petals 4 $4.5 \mathrm{~mm} .2 n=80$. Open habitats on basic soils in the mountains. - Scotland, W. Ireland, Iceland, Norway, Sweden.
(b) Subsp. anglica Halliday, Watsonia 4: 209 (1960) (A. gothica auct. angl., non Fries): Annual or biennial and of a laxer habit than (a). Leaves $4 \cdot 5-5(-6) \mathrm{mm}$, lighter green. Sepals usually with a few basal cilia; petals $5-5.5 \mathrm{~mm} .2 n=80$. Damp, bare depressions on limestone pavement. - N. England (W. Yorkshire).
22. A. ciliata L., Sp. Pl. 425 (1753). Low-growing perennial with scabrid stems up to 7 cm . Leaves broadly elliptical, oblanceolate or spathulate, midrib prominent below, usually ciliate at least in lower half. Cymes 1- to 7 -flowered; pedicels scabrid. Sepals ovate-lanceolate, usually ciliate at base; petals exceeding sepals; anthers white. Capsule swollen below. Seeds $0.85-1.05 \mathrm{~mm}$, black, dull, with low broad tubercles. Open habitats on basic soil. Mountains of C. Europe, southwards to C. Spain and N. Italy; locally in N. Europe. Au Cz Fe Ga Ge Hb He Hs It Ju No Po Rm Rs (N) Sb.

The following is a very simplified treatment of the various geographical and chromosome variants of this very polymorphic species.
(a) Subsp. ciliata (subsp. tenella (Kit.) Br.-B1.): Leaves 3-4 times as long as wide, scarcely to entirely ciliate. Flowers solitary
or 2 (rarely 3) together. Sepals $3 \cdot 5-5 \mathrm{~mm}$; petals $5-7.5 \mathrm{~mm}$. $2 n=80,120,240$. C. \& E. Alps, Carpathians.

As defined here, this subspecies includes subsp. pseudofrigida Ostenf. \& O. C. Dahl $(2 n=40)$ from Finland, N. Norway, arctic Russia and Svalbard, and subsp. hibernica Ostenf. \& O. C. Dahl from N.W. Ireland.
(b) Subsp. moehringioides (J. Murr) Br.- Bl., Sched. Fl. Raet. Exsicc. 279 (1927)(incl. subsp. polycurpoides Br .-Bl.): Leaves 2-3 times as long as wide, ciliate for the basal $\frac{1}{3}-\frac{2}{3}$. Cymes usually 2 - to $5-$ flowered. Sepals $3 \cdot 5-4 \mathrm{~mm}$; petals $4-5 \mathrm{~mm} .2 n=40$. © C. \& $N$. Spain, Pyrenees, Jura, Alps eastwards to Vorarlberg, N. Appennini.
23. A. gothica Fries, Nov. Fl. Suec. ed. 2, Mant. 2, 33 (1839). Annual or biennial with ascending, rather robust, scabrid stems up to $12(-15) \mathrm{cm}$. Leaves $4-6 \mathrm{~mm}$, broadiy elliptical to obovate, less than 3 times as long as wide, margin strongly ciliate at least in the lower half. Cymes (1-)2- to $6(-8)$-flowered; pedicels strongly scabrid. Sepals $3-4 \mathrm{~mm}$, ovate-lanceolate, ciliate below and often also on keel, 3-veined; petals $4-5.5 \mathrm{~mm}$, slightly exceeding sepals. Seeds $0.8-0.9 \mathrm{~mm}$, black, dull, with low broad tubercles. $2 n=100$. Dry limestone pavement and lake-shores. - S. Sweden (Gotland; one station in Västergötland); Jura (Lac de Joux). He Su.

This description applies to plants from Sweden. The plants from Switzerland are taller, less ciliate, and have larger cymes than those from Sweden. Although their chromosome number is the same, it is quite possible that they are of different origin.
24. A. gracilis Waldst. \& Kit., Pl. Rar. Hung. 3: 305 (1812). Laxly (rarely densely) caespitose perennial; stem $2-8 \mathrm{~cm}$, ascending or erect, slender, papillose-scabrid below, glabrous above. Leaves $3-8 \mathrm{~mm}$, lanceolate to elliptic-lanceolate, rarely narrower, acute, 1 -veined, usually glabrous, denticulate. Flowers $1-2(-3)$; pedicels $2-5$ times as long as sepals, glabrous. Sepals $3.5-5 \cdot 5 \mathrm{~mm}$, ovate, obtuse or acute, often strongly keeled below, obscurely 1 - to 3 -veined, glabrous; petals about twice as long as sepals, white. Capsule slightly exceeding sepals, ovoid. Mountain rocks. S. \& W. Jugoslavia. Ju.
25. A. filicaulis Fenzl in Griseb., Spicil. Fl. Rumel. 1: 203 (1843). Glandular-pubescent caespitose perennial; stems 515 cm , slender, fragile. Leaves acute, 1 -veined, light green, the lower shortly petiolate, the upper sessile; midrib prominent beneath. Flowers $3-10$ in a lax, leafy inflorescence with slender, patent branches; pedicels $2-5(-10)$ times as long as sepals. Sepals $3.5-4.5 \mathrm{~mm}$; petals oblong-cuneate, white. Seeds $0.7-$ 1 mm , with acute tubercles. Mountain rocks. Balkan peninsula, southwards from $41^{\circ} 30^{\prime} N$. Bu Gr Ju.
(a) Subsp. filicaulis: Plant moderately hairy with rather short, slender hairs. Leaves $3-8 \mathrm{~mm}$, elliptic-lanceolate or oblanceolate. Sepals ovate-lanceolate, acuminate. Petals c. $1 \frac{1}{2}$ times as long as sepals. Capsule slightly exceeding sepals. Macedonia and $S$. Bulgaria.
(b) Subsp. graeca (Boiss.) McNeill, Notes Roy. Bot. Gard. Edinb. 24: 270 (1963) (A. graeca (Boiss.) Halácsy): Plant usually more densely hairy with longer, stouter hairs. Leaves $5-10 \mathrm{~mm}$, elliptical, ovate or ovate-lanceolate. Sepals ovate, acute. Petals almost twice as long as sepals. Capsule slightly shorter than sepals. - C. \& S. Greece.

Plants growing on marble at $2300-2400 \mathrm{~m}$ in S.W. Bulgaria (Pirin Planina) with obtuse, subsessile leaves, very short pedicels, petals $1 \frac{1}{4}-1 \frac{1}{3}$ as long as the sepals and capsules slightly shorter than the sepals have been called A. pirinica Stoj., Bull. Inst. Roy. Hist. Nat. (Sofia) 14: 158 (1941). Their status is uncertain.

Plants from N.E. Greece (Pangaion) are very like (b) but have the lowest pair of bracts cordate or truncate (not cuneate) at the base; they have been called A. teddii Turrill, Kew Bull. 1936: 100 (1936), but are perhaps best included in (b).
26. A. deflexa Decne, Ann. Sci. Nat. ser. 2, 3: 227 (1834) (A. graveolens auct. balcan., non Schreber; incl. A. orbicularis Vis.). Like 25 (a) but whole plant more densely glandularpubescent; leaves thicker and wider, broadly elliptical or obovate; all leaves, including the upper, narrowed at base and more or less petiolate; sepals lanceolate, acuminate; petals only slightly exceeding sepals; seeds $0.4-0.6 \mathrm{~mm} .2 n=44$. N.W. Jugoslavia (Velebit); S.E. Aegean region (Karpathos). Cr Ju. (E. Aegean islands.)
27. A. fragillima Rech. fil., Feddes Repert. 47: 49 (1939) (A. pamphylica sensu Hayek). Like 25 (a) but plant less densely caespitose, grey-green, and covered with very short hairs; flowering stems, peduncles and pedicels shorter and stouter; leaves thicker, and shorter than in 26, all more or less petiolate; sepals $4-5 \mathrm{~mm}$, lanceolate, acuminate; petals only slightly exceeding sepals. Dry stony places. Kriti and Karpathos. Cr.
28. A. ligericina Lecoq \& Lamotte, Cat. Pl. Centr. Fr. 104 (1847) (A. lesurina Loret). Like 25 (a) but stems 7-40 cm, usually stouter; leaves with midrib obscure beneath; sepals $3.5-5 \cdot 5 \mathrm{~mm}$, more or less distinctly 1 -veined, lacking or having obscure lateral veins; petals $c .1 \frac{1}{3}$ as long as sepals; seeds with low, obtuse tubercles or ridges. Calcareous rocks and sands. - S. France (district between Millau and Florac); E. Pyrenees (Sierra del Cadi). Ga Hs.
29. A. cretica Sprengel, Syst. Veg. 2: 396 (1825). Densely caespitose perennial; stems $2-10 \mathrm{~cm}$, slender, fragile, usually glandular-pubescent only in inflorescence. Leaves $3-10 \mathrm{~mm}$, crowded, oblong-elliptic or oblanceolate, rather obtuse, glabrous (or sometimes glandular-pubescent, var. stygia (Boiss. \& Heldr.) Boiss.), 1-veined. Inflorescence 1- to 5 -flowered, usually corymbose; pedicels $1-3$ times as long as sepals. Sepals $2 \cdot 5-4 \cdot 5 \mathrm{~mm}$, oblong or oblong-lanceolate, obtuse or subacute, veinless, keeled at base, glandular-pubescent; petals 2 or more times as long as sepals, white. Capsule slightly exceeding sepals, ovoid. Mountain rocks. S. Albania, C. \& S. Greece, Kriti. Al Cr Gr.
30. A. halacsyi Bald., Malpighia 5: 65 (1891). Dwarf caespitose perennial; stems $2-5 \mathrm{~cm}$, slender, eglandular, with short white deflexed hairs especially above. Leaves $2-4 \mathrm{~mm}$, ovate, lanceolate or obovate, shortly petiolate, 1 -veined, subglabrous, strongly ciliate at base, crowded on vegetative stems. Flowers solitary or paired; pedicels $1-2$ times as long as sepals. Sepals 3-4 mm, oblong-lanceolate, obtuse or subacute, glandularhairy; petals scarcely exceeding sepals, broadly spathulate, white. Capsule slightly exceeding sepals, ovoid. Rock-crevices. - Crna Gora (Kom Kučki, S.W. of Andrijevica). Ju.
31. A. cinerea DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 611 (1815). Perennial, suffruticose at base, with many ascending flowering stems $10-20 \mathrm{~cm}$, and with very few and inconspicuous vegetative leafy stems at time of flowering; stems with short deflexed hairs. Leaves 3-5 mm, 1 -veined, the lower oblong-lanceolate, acute, the upper linear-lanceolate. Inflorescence lax, 3- to 10 -flowered, eglandular; pedicels 4-6 times as long as sepals, rigid, erect, with short deflexed hairs. Sepals $4-5 \mathrm{~mm}$, ovate-lanceolate, acute, distinctly 1 -veined, developing a strongly ciliate keel after flowering; petals about twice as long as sepals. Capsule slightly exceeding sepals, ovoid-globose. Seeds with low flattened
tubercles. Dry and rocky places. - S.E. France (district between Nice and Digne). Ga.

Sometimes with the appearance of an annual. The eglandular inflorescence, the erect pedicels, the strongly ciliate keel of the sepals, and the low flattened tubercles of the seeds distinguish it from 49 and the shape of the leaves distinguishes it from 46.
32. A. hispida L., Sp. Pl. 608 (1753). Pubescent perennial; stems $7-25 \mathrm{~cm}$, many, ascending. Leaves $5-10 \times 0 \cdot 5(-1) \mathrm{mm}$, subulate, rarely linear-lanceolate and acuminate, not narrowed at base, 1 -veined. Inflorescence lax, 3 - to 10 -flowered, glandularpubescent. Sepals $3-4.5 \mathrm{~mm}$, lanceolate, acuminate, 3- to 5 veined, with the mid-vein prominent; petals $c .1 \frac{1}{3}$ times as long as sepals. Capsule slightly shorter than or equalling sepals, ovoid. Seeds with acute tubercles. $2 n=40$. Calcareous, often dolomitic rocks. - S. France, N.E. Spain. Ga Hs.
33. A. serpyllifolia L., Sp. Pl. 423 (1753). A relatively robust, scabrid-puberulent, usually eglandular annual, rarely biennial; stems $3-30 \mathrm{~cm}$, usually profusely branched at base, ascending or erect. Leaves $2 \cdot 5-8 \mathrm{~mm}$, broadly ovate to ovate-lanceolate, acute or acuminate, 3 - to 5 -veined, the lower petiolate, the upper sessile. Flowers in diffuse dichasia; pedicels usually longer than sepals. Sepals 3-4.5 mm, ovate-lanceolate or ovate, acute, 3- to 5 -veined; the inner with a scarious margin, the central green part being $\frac{1}{2}-\frac{1}{3}$ the width of the sepal; petals $\frac{1}{2}-\frac{2}{3}$ as long as sepals, white. Capsule slightly exceeding sepals, less than twice as long as wide, broadly ovoid-conic, distinctly swollen at base. Seeds 0.45$0.7 \mathrm{~mm} .2 n=40$. Dry, usually sandy places. Almost throughout Europe. All except Az Fa Is Sb .

Plants from dunes on the Atlantic coast of Europe with very dense inflorescences and pedicels shorter than the sepals are var. macrocarpa Lloyd.
34. A. leptoclados (Reichenb.) Guss., Fl. Sic. Syn. 2: 824 (1845). Like 33 but plant more delicate in all its parts; sepals usually less than 3 mm ; capsule usually equalling or shorter than sepals, usually twice as long as wide, cylindric-subovoid, scarcely swollen at base; seeds $0.3-0.6 \mathrm{~mm} .2 n=20$. $S$., W. \& C. Europe, extending locally northwards to $59^{\circ} \mathrm{N}$. in Norway and eastwards to S.W. Ukraine. All except Az Fa Fe Is Po Rs (N, B, C, K, E) Sb .
A. marschlinsii Koch, Flora (Regensb.) 24: 509 (1841), with the same chromosome number, occurring at above 1900 m in the Alps, perhaps deserves specific status. It is often perennial, with fewerflowered, dense inflorescences, and narrower scarious margins to the inner sepals (the central green part being half the width of the sepal).
35. A. conferta Boiss., Diagn. Pl. Or. Nov. 1 (1): 51 (1843). Like 33 but plant usually with a short, greyish pubescence; inflorescence dense, branches more or less strict, usually with pedicels shorter than sepals (rarely some pedicels up to 3 times as long as sepals); sepals more sharply acute; petals more or less equalling sepals; capsule slightly shorter than sepals. Stony places on mountains. Balkan peninsula from $39^{\circ} 30^{\prime} N$. northwards, mainly in the west. $\mathrm{Al} \mathrm{Gr} \mathrm{Ju}$.

Very variable in habit, but probably always distinguishable from 33 by the longer petals and shorter capsules.
36. A. serpentini A. K. Jackson, Hook. Ic. 34: t. 3326 (1937). Like 33 but stems more slender and rigid, puberulent only at base with minute deflexed hairs; upper parts of stems, branches and pedicels glabrous or subglabrous; inflorescence very
lax, pedicels all $2-5$ times as long as sepals; seeds $0 \cdot 8-0 \cdot 9 \mathrm{~mm}$. Serpentine rocks. - S. Albania (Moskopolë). Al.
37. A. nevadensis Boiss. \& Reuter in Boiss., Diagn. Pl. Or. Nov. 3 (1): 90 (1853). Glandular-puberulent annual, usually purplish at base; stems $5-8 \mathrm{~cm}$, branched. Leaves $4-7 \mathrm{~mm}$, mostly 3 -veined, the lower ovate and patent, the upper linear-lanceolate and erect. Flowers clustered in more or less dense corymbs; pedicels equalling or up to twice as long as sepals, always erect and strict. Sepals $4 \cdot 5-6 \mathrm{~mm}$, lanceolate, long-pointed, obtuse or subacute; petals $c . \frac{3}{4}$ as long as sepals, oblong, white. Capsule shorter than sepals, oblong-ovoid. - S. Spain (Sierra Nevada). Hs.
38. A. muralis (Link) Sieber ex Sprengel, Syst. Veg. 2: 397 (1825) (A. oxypetala auct., vix Sibth. \& Sm.). Glandularpubescent annual; stems $7-15 \mathrm{~cm}$, ascending or erect, slender, diffusely branched. Leaves $5-15 \mathrm{~mm}$, obovate, acute, 1 -veined, narrowed into a distinct petiole. Inflorescence lax, 5 - to 20 flowered; pedicels (2-)3-4 times as long as sepals, slender, rigid, patent or deflexed in fruit. Sepals $2 \cdot 5-4 \mathrm{~mm}$, lanceolate, acute, with obscure veins; petals scarcely exceeding sepals, linearlanceolate. Capsule slightly exceeding sepals, oblong. Seeds $0.4-0.6 \mathrm{~mm}$ with very acute tubercles. Mountain rocks. Kriti. Cr. (W. Asia.)
A. oxypetala Sibth. \& Sm., Fl. Graec. Prodr. 1: 303 (1809) from Ilia and Attiki in Greece has acuminate sepals and petals; it is extremely like 38, and further investigation may indicate that it should be included, along with several W. Asiatic species, under a common name (possibly A. graveolensSchreber, Nova Acta Acad. Leop.-Carol. 3: 478 (1767)).
26 can often be distinguished from 38 only by its perennial habit.
39. A. saponarioides Boiss. \& Balansa, Diagn. Pl. Or. Nov. 2 (6): 35 (1859) (A. nana Boiss. \& Heldr., non Willd.). Glandular-pubescent dwarf annual; stems not more than 3 cm , solitary or 2-3 together. Leaves oblong-ovate, narrowed into petiole, obtuse, 3- to 7veined, the upper forming an involucre around the inflorescence. Flowers 1-5; pedicels shorter than sepals. Sepals lanceolate, acute, with $3-5$ prominent veins, elongating in fruit; petals $\frac{1}{3}$ as long as sepals, ovate. Capsule shorter than sepals, ovoid. Stony places on mountains. E. Kriti (Kametta). Cr. (Cyprus, Asia Minor.)

The plant from Kriti is referable to subsp. boissieri (Pax) McNeill, Notes Roy. Bot. Gard. Edinb. 24: 289 (1963), which also occurs on Cyprus. The typical subspecies is known only from Asia Minor, and has linear-lanceolate sepals and narrower petals.
40. A. guicciardii Heldr. ex Boiss., Diagn. Pl. Or. Nov. 3 (5): 60 (1856). Scabrid-puberulent, slightly glandular annual; stems $3-20 \mathrm{~cm}$, usually many, ascending or erect, rather densely leafy. Leaves $3-5 \mathrm{~mm}$, ovate or ovate-oblong, acute or acuminate, subsessile or petiolate, 3- to 5 -veined. Flowers $5-20$ in dense clusters; pedicels usually not more than half as long as sepals, rather stout. Sepals $4-6 \mathrm{~mm}$, lanceolate, long-acuminate with usually patent or recurved apex, 3 - to 5 -veined with thickened, prominent veins; petals $\frac{1}{3}$ as long as sepals. Capsule more or less equalling sepals, narrowly cylindrical. Dry stony places. S. Greece. Gr.
41. A. cerastioides Poiret, Voy. Barb. 2: 166 (1789) (A. spathulata Desf.). Robust pubescent and glandular annual. Stems $10-25 \mathrm{~cm}$, usually branched from base. Leaves $10-20 \mathrm{~mm}$, broadly spathulate to obovate-oblanceolate, subacute to acumi-
nate, 1 -veined, the lower long-petiolate. Inflorescence 4- to many-flowered, lax; pedicels 3-5 times as long as sepals. Sepals $4-5.5 \mathrm{~mm}$, ovate, obtuse or subacute, usually black-tipped; petals twice as long as sepals, slightly emarginate, white; anthers blue. Capsule $\frac{3}{4}-1 \frac{1}{3}$ as long as sepals. Seeds $0.6-0.8 \mathrm{~mm}$, globose, black, almost smooth. Disturbed ground. S.W. Spain, from $37^{\circ} 45^{\prime} N$. southwards. Hs. (N.W. Africa.)
42. A. emarginata Brot., Fl. Lusit. 2: 202 (1804). Glandularpubescent annual; stems $5-10 \mathrm{~cm}$, erect, branched. Leaves $5-15 \mathrm{~mm}$, linear or linear-subulate, obtuse, 1 -veined, patent; the lower and middle equalling or exceeding the internodes; the upper shorter. Flowers in a usually dense inflorescence; pedicels scarcely equalling or up to twice as long as sepals, patent in fruit. Sepals $3-5 \mathrm{~mm}$, lanceolate, subobtuse, 1 -veined; petals more or less equalling sepals, oblong, truncate-emarginate, pinkish. Capsule shorter than sepals, ovoid-oblong. Dry sandy places. S. Portugal; S.W. Spain. Hs Lu. (N. Africa.)
43. A. algarbiensis Welw. ex Willk., Icon. Descr. Sp. Pl. Nov. 1 (9): 93 (1855). Glandular, puberulent or shortly pubescent annual; stems $5-10 \mathrm{~cm}$, ascending or erect, slender. Leaves $2-5 \mathrm{~mm}$, linear-lanceolate, all shorter than internodes. Inflorescence lax, several- to many-flowered; pedicels 3-5 times as long as sepals. Sepals $3-4 \mathrm{~mm}$, ovate or ovate-lanceolate, obtuse or subacute, with $3-5$ prominent veins; petals $2-3$ times as long as sepals, deeply emarginate, white. Capsule slightly shorter than sepals, ovoid-oblong. - S. Portugal; S.W. Spain. Hs Lu.
44. A. conimbricensis Brot., Fl. Lusit. 2: 200 (1804) (incl. A. loscosii Texidor). Glandular, puberulent or pubescent annual; stems $5-15 \mathrm{~cm}$, branched. Leaves $5-15 \mathrm{~mm}$, linear to linearoblanceolate, flat, obtuse and subapiculate, ciliate at base. Inflorescence lax, several- to many-flowered; pedicels 3-5 times as long as sepals, very slender but scarcely capillary, patent in fruit, covered with patent glandular hairs. Sepals $1 \cdot 5-3 \cdot 5 \mathrm{~mm}$, ovate, obtuse, obscurely 1 -veined, or veinless; petals $1 \frac{1}{2}-2$ times as long as sepals, obovate, entire, white; anthers vinous-red. Capsule about equalling sepals, ovoid-oblong. Seeds $c .0 .6 \mathrm{~mm}$, reniform, with obtuse or acute tubercles. $2 n=22$. ©., E. \& S. Spain; C. \& S. Portugal. Hs Lu.
45. A. obtusiflora G. Kunze, Flora (Regensb.) 29: 632 (1846). Eglandular annual; stems $5-15 \mathrm{~cm}$. Leaves 3-10 mm, linear-oblanceolate, acute, 1 -veined, flat. Inflorescence glabrous or puberulent. Sepals $2-3.5 \mathrm{~mm}$, ovate, obtuse, often apiculate; petals $1 \frac{1}{2}-2$ times as long as sepals; anthers vinous-red. Seeds $0 \cdot 5$ 0.8 mm . Calcareous mountain screes. - E. \& C. Spain. Hs.
(a) Subsp. obtusiflora: Stems usually simple and with short deflexed hairs below, branched and glabrous or subglabrous above. Inflorescence glabrous or subglabrous; pedicels 3-6 times as long as sepals, filiform, patent in fruit. Sepals $2-3 \mathrm{~mm}$. Capsule more or less equalling sepals, ovoid. Seeds with acute tubercles. E., C. \& S.E. Spain.
(b) Subsp. ciliaris (Loscos) Font Quer, Collect. Bot. (Barcelona) 3: 348 (1953) (A. ciliaris Loscos): Usually smaller and more bushy than (a); stems usually much-branched from the base, with short deflexed hairs throughout. Inflorescence-branches puberulent; pedicels 2-3 times as long as sepals, always erect, subglabrous or with minute deflexed hairs. Sepals $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$, subglabrous or puberulent. Capsule $1 \frac{1}{2}-2$ times as long as sepals, globose-conic. Seeds with obtuse tubercles. E., C. \& N.E. Spain.
46. A. controversa Boiss., Voy. Bot. Midi Esp. 2: 100 (1839). Like 45 but stems, branches and pedicels covered with minute deflexed hairs; leaves linear, trigonous; pedicels 2-3 times as long
as sepals; sepals $2-4.5 \mathrm{~mm}$, ovate-lanceolate, acute or subacute; capsule slightly exceeding sepals. - C. \& W. France; Spain (perhaps extinct). Ga ?Hs.
47. A. conica Boiss., Voy. Bot. Midi Esp. 2: 98 (1839). Annual; whole plant glandular-puberulent; stems $2 \cdot 5-5 \mathrm{~cm}$, branched. Leaves $5-15 \mathrm{~mm}$, linear-subulate, obtuse. Inflorescence usually 3 -flowered; pedicels $1 \frac{1}{2}-2$ times as long as sepals, erect or slightly patent. Sepals $3 \cdot 5-4 \mathrm{~mm}$, ovate-lanceolate, subacute, 3 -veined; petals $c . \frac{2}{3}$ as long as sepals, oblong, white. Capsule slightly exceeding sepals, ovoid. Seeds $0.5-0.6 \mathrm{~mm}$, with obtuse tubercles. - S. Spain. Hs.
48. A. modesta Dufour, Ann. Gén. Sci. Phys. (Bruxelles) 7:291 (1821). Annual; stems $5-15 \mathrm{~cm}$, often branched from the base, glan-dular-pubescent. Leaves $3-10 \mathrm{~mm}$, linear or linear-oblanceolate, acute, 1 -veined. Inflorescence usually many-flowered, lax; pedicels 2-5 times as long as sepals, erect or patent in fruit, with patent glandular and minute deflexed eglandular hairs, rarely more or less eglandular. Sepals $3-4(-5) \mathrm{mm}$, ovate-lanceolate, acute with a very fine, sharp point, obscurely 3 -veined, glandular-pubescent; petals more or less equalling sepals, oblong, obtuse, white. Capsule slightly exceeding sepals, ovoid-conic. Seeds $c .0 .5 \mathrm{~mm}$, reniform, with usually obtuse tubercles. $2 n=26$. Dry places. E. \& S. Spain; S. France. Ga Hs.

Var. purpurascens Cuatrec. from S.E. Spain may merit subspecific status; it has the sepals less finely acute and the seeds $(0.6-) 0.7-0.8 \mathrm{~mm}$, with acute tubercles. In these respects it approaches 49, but is quite distinct from it in the shape of its leaves.
49. A. retusa Boiss., Voy. Bot. Midi Esp. 2: 99 (1839). Like 48 but leaves oblanceolate to obovate-oblanceolate, acuminate; sepals less finely acute, with more prominent veins; petals truncate; seeds $c .0 .7 \mathrm{~mm}$, with acute tubercles. Stony and rocky places. - S.W. Spain. Hs.
50. A. capillipes Boiss., Voy. Bot. Midi Esp. 2: 98 (1839). Very slender annual; stems c. 5 cm , branched, capillary, glabrous above, scabrid with minute hairs below; internodes much longer than leaves. Leaves $2-4 \mathrm{~mm}$, linear-lanceolate, acute, veinless. Inflorescence several- to many-flowered, very lax; pedicels 3-6 times as long as sepals, capillary, glabrous. Sepals 2.5 mm , lanceolate, acute, 3 -veined; petals more or less equalling sepals. Capsule ovoid-globose. Shady, sandy places at c. 1300 m . - S.W. Spain (Sierra Bermeja, near Estepona). Hs.

## Subgen. Arenariastrum F. N. Williams. Annual. Styles 2.

51. A. provincialis Chater \& Halliday Feddes Repert. 69: 50 (1964) (Gouffeia arenarioides Robill. \& Cast. ex DC.). Glabrous; stems $10-20 \mathrm{~cm}$, many, slender, branched, ascending. Basal leaves linear-spathulate, obtuse; cauline linear-lanceolate, acute, subconnate at base; all leaves ciliate at base, obscurely 3 -veined. Flowers in a lax cyme, rarely solitary and terminal; bracts herbaceous; pedicels mostly longer than sepals, capillary. Sepals $3-4 \mathrm{~mm}$, lanceolate, acute, 3 - to 5 -veined; petals equalling sepals, oblong, denticulate, white. Capsule 2-3 mm, oblong-ovoid, with 2 bifid teeth. $2 n=40$. Rocky and sandy places. - S.E. France (near Marseille and Toulon). Ga.

## 2. Moehringia L. ${ }^{1}$

Annual or perennial herbs, usually with weak, straggling stems. Leaves ovate to linear. Inflorescence a lax, few-flowered cyme;
flowers usually 5 -merous, a few species 4 -merous. Petals white, entire; stamens 10 or 8 (rarely 5); styles 3 or 2 . Capsule more or less equalling sepals, globose, dehiscing with 6 or 4 teeth. Seeds few, reniform, reddish-black, smooth; strophiole persistent.

Differs from Arenaria in possessing a strophiole and in its basic chromosome number, $x=12$. The strophiole is often of great diagnostic value but it can only be reliably observed on ripe seeds. Most of the European species are very local endemics requiring further taxonomic study.

1 Petals absent or up to $\frac{2}{3}$ as long as sepals
2 Sepals $4-5 \mathrm{~mm}$; petals $\frac{1}{2}-\frac{2}{3}$ as long as sepals

1. trinervia

2 Sepals $1-4 \mathrm{~mm}$; petals absent or rudimentary
3 Stems glabrous; sepals $1-1.5 \mathrm{~mm}$
4. minutiflora

3 Stems pubescent; sepals $2-4 \mathrm{~mm}$
2. pentandra

1 Petals $\pm$ equalling or exceeding sepals
4 Stems pubescent, at least near base, sometimes sparsely so
5 Upper leaves broadly elliptical or orbicular
6 Stems erect; leaves broadly elliptical 3. lateriflora
6 Stems procumbent; leaves orbicular
6. fontqueri

5 Upper leaves linear or narrowly elliptical
7 Leaves distinctly 3 -veined, the lateral veins marginal
9. pendula

7 Leaves 1 -veined, or appearing veinless
8 Upper leaves not more than 1 mm wide; cymes 3 - to severalflowered
12. grisebachii

8 Upper leaves more than 1 mm wide
9 Stems glabrous above; leaves distinctly petiolate; cymes 3 - to several-flowered 11. jankae
9 Stems pubescent above; leaves sessile; cymes 1- to 3flowered
10. villosa

4 Stems glabrous
10 At least the lower leaves ovate or distinctly spathulate
11 Upper leaves linear-oblong, narrower than the lower
8. diversifolia

11 All leaves similar
12 Leaves sessile or very shortly petiolate, up to twice as long as wide
7. tejedensis

12 Leaves distinctly petiolate, more than twice as long as wide
5. intricata

10 Leaves all linear, linear-lanceolate or narrowly spathulate 13 Flowers 4-merous
14 Leaves usually less than 10 mm , fleshy 18. sedifolia
14 Leaves usually more than 10 mm , scarcely fleshy
15 Leaves linear, rarely more than 1.2 mm wide
16 Leaves widest in upper half; flowers usually solitary; strophiole prominent, laciniate 16. markgrafii
16 Leaves not widest in upper half; cymes 2- to 6flowered; strophiole small, almost entire 20. muscosa 15 Leaves linear-spathulate, usually more than 1.2 mm wide
17 Sepals with wide scarious margins; petals slightly exceeding sepals 15. tommasinit
17 Sepals with narrow scarious margins; petals about twice as long as sepals
14. papulosa

13 Flowers 5-merous
18 Leaves narrowly spathulate to linear-lanceolate
19 Leaves not more than $11 \times 1.5 \mathrm{~mm}$; strophiole entire
13. dielsiana

19 At least some leaves more than $11 \times 1.5 \mathrm{~mm}$; strophiole lobed or finely laciniate
20 Plant green, slender; pedicels deflexed after flowering
10. villosa

20 Plant distinctly glaucous, not slender; pedicels erect after flowering
14. papulosa 18 Leaves linear
21 Plant glaucous; strophiole large, laciniate
22 Stems very fragile and slender; leaves $0.3-0.6 \mathrm{~mm}$ wide
19. glaucovirens

22 Stems more robust; leaves more than 0.6 mm wide

## 21 Plant green; strophiole small

23 Stems weak; leaves usually more than 10 mm , glabrous; sepals 1 -veined
20. muscosa

23 Stems more robust; leaves usually less than 10 mm , usually shortly and sparsely ciliate at base; sepals 3 -veined 21. ciliata

1. M. trinervia (L.) Clairv., Man. Herb. 150 (1811) (Arenaria trinervia L.). Annual or short-lived perennial with procumbent or ascending, pubescent stems up to 40 cm . Leaves 25 mm , ovate, acute, 3- to 5-veined, ciliate; the lower leaves petiolate, the upper subsessile. Flowers 5 -merous, solitary and axillary or in fewflowered cymes; pedicels slender, pubescent. Sepals $4-5 \mathrm{~mm}$, lanceolate, 3 -veined, with wide, scarious, ciliate margins; petals $\frac{1}{2}-\frac{2}{3}$ as long as sepals. Capsule included. Seeds reddish-black, with a small, laciniate strophiole. $2 n=24$. Woods and shady places. Almost throughout Europe. All except Az Bl Fa Is Sb.
2. M. pentandra Gay, Ann. Sci. Nat. ser. 1, 26: 230 (1832). Like 1 but more delicate; lamina of leaves not ciliate (but petiole ciliate); sepals $2-4 \mathrm{~mm}$, with a wider scarious margin and indistinct lateral veins; petals absent or rudimentary. Stamens $5(-8) .2 n=48$. In drier habitats than 1. Mediterranean region. Bl Co Ga Gr Hs It Ju Lu ?Sa Si.
M. thasia Stoj. \& Kitanov, Ann. Univ. Sofia Phys.-Math. 3 (Sci. Nat.) 41: 293 (1945), from Thasos, is probably a variant of $\mathbf{2}$ with the lamina of the leaves ciliate.
3. M. lateriflora (L.) Fenzl, Vers. Darstell. Alsin. tab. ad 18, 38 (1833). Rhizomatous perennial with erect, pubescent stems up to 20 cm . Leaves up to $25 \times 8 \mathrm{~mm}$, elliptic-lanceolate, obtuse, ciliate on margin and hairy on veins at least at the base, 1- to 3-veined. Flowers axillary and solitary or in 2- to 4 -flowered cymes, 5 -merous; pedicels slender, puberulent. Sepals $2-2.5 \mathrm{~mm}$, elliptical, obtuse, margin scarious, glabrous; petals and capsule twice as long as sepals. Strophiole small. Woods. Fennoscandia and U.S.S.R. Fe No Rs (N, B, C, W, E) Su.
4. M. minutiflora Bornm., Feddes Repert. 16: 183 (1919). Glabrous and extremely slender annual or perennial; stems spreading and profusely branched. Leaves ovate-oblong, 3- to 5 -veined, abruptly contracted into a petiole as long as the lamina. Flowers 5-merous, solitary, axillary; pedicels filiform. Sepals $1-1.5 \mathrm{~mm}$, with a wide scarious margin; petals absent. Seeds very small; strophiole minute. Rock-fissures. Makedonija (near Prilep). Ju.
5. M. intricata Willk., Linnaea 25: 14 (1852). Glabrous perennial with caespitose, profusely branched stems up to 20 cm , fragile, woody below. Leaves usually broadly spathulate, at least twice as long as wide, distinctly petiolate, 1-veined; older leaves somewhat fleshy and glaucous; petioles short. Cymes lax, manyflowered; flowers 5 -merous; pedicels $3-8$ times as long as the sepals, slender, erect. Sepals $2 \cdot 5-3 \mathrm{~mm}$, oblong-lanceolate, with wide scarious margins, obscurely 3 -veined; petals twice as long as sepals, obovate-cuneate. Seeds somewhat rugose. Limestone crevices and caves. - S.E. Spain. Hs.
6. M. fontqueri Pau, Cavanillesia 2: 163 (1930). Pubescent perennial with procumbent stems. Leaves orbicular to broadly oblong, sessile, ciliate. Cymes 1- to 2-flowered. Sepals ovate, obtuse; petals twice as long as sepals. - S.E. Spain (Almeria). Hs.
7. M. tejedensis Huter, Porta \& Rigo ex Willk., Suppl. Prodr. Fl. Hisp. 275 (1893). Caespitose, glabrous perennial with slender rhizome and filiform ascending stems. Leaves 4-11 $\times 2 \cdot 5-$
5.5 mm , shorter than the internodes, ovate-elliptical, very shortly petiolate or sessile, seldom more than twice as long as wide, fleshy, crowded below, remote above. Flowers in 1- to 3-flowered cymes, 5 -merous. Sepals $2 \cdot 5-3.5 \mathrm{~mm}$, ovate-oblong, 1 -veined, with narrow scarious margins; petals twice as long as sepals, cuneate, ciliolate. Rock crevices at 1600-1700 m. S. Spain (Sierra Tejeda, S.W. of Granada). Hs. (Morocco.)
8. M. diversifolia Dollinerex Koch,Flora (Regensb.) 22:2(1839). Perennial with weak, glabrous stems up to 30 cm . Leaves glabrous, 1 -veined; lower leaves ovate and abruptly contracted into a long flaccid petiole; upper leaves narrowly spathulate to linear-lanceolate, longer than the petiole. Flowers 5-merous, in 1 - to 5 -flowered cymes; pedicels long, usually pubescent. Sepals $1 \cdot 5-2 \mathrm{~mm}$, broadly ovate, 1 -veined, with a broad, scarious margin; petals equalling sepals. Seeds with a conspicuous, laciniate strophiole. $2 n=24$. Rock crevices and screes; calcifuge. - S.E. Austria, W. \& C. Jugoslavia. Au Ju.
9. M. pendula (Waldst. \& Kit.) Fenzl, Vers. Darstell. Alsin. tab. ad 46 (1833). Creeping, often pendent perennial with filiform stems $15-90 \mathrm{~cm}$. Leaves $10-40 \times 1-4 \mathrm{~mm}$, linear, acuminate, distinctly 3 -veined, glabrous, or ciliate only at the base. Flowering stems pubescent; flowers 5 -merous, solitary or in 2- to 3 -flowered cymes. Sepals $3-4 \mathrm{~mm}$, lanceolate; petals $1 \frac{1}{2}-2$ times as long as sepals. Cliffs and screes. - S. \& E. Jugoslavia, Bulgaria, S.W. \& C. Romania. Bu Ju Rm.
10. M. villosa (Wulfen) Fenzl, Vers. Darstell. Alsin. tab. ad 46 (1833). Pubescent, rarely glabrous, perennial, with weak, often procumbent stems up to 15 cm . Leaves obscurely 1 -veined, rather densely covered with short patent hairs; lower leaves shorter than internodes, narrowly ovate; upper leaves equalling internodes, linear to linear-spathulate. Flowers 5 -merous, solitary or in fewflowered cymes; pedicels slender, pubescent. Sepals $3-4 \mathrm{~mm}$, lanceolate, obscurely 1 -veined; petals $1 \frac{1}{2}-2$ times as long as sepals. Strophiole prominent, white, broadly lobed. Crevices of limestone cliffs up to 1600 m . Mountains of N. \& W. Slovenija. ?It Ju.
11. M. jankae Griseb. ex Janka, Österr. Bot. Zeitschr. 23: 195 (1873). Perennial with erect, rather rigid stems, pubescent towards the base. Lower leaves narrowly ovate to ovate-oblong, acute, distinctly petiolate; upper leaves linear-lanceolate, more than 1 mm wide. Cymes few-flowered; flowers 5 -merous. Sepals $2-3 \mathrm{~mm}$; petals slightly shorter than sepals. Seeds dull, somewhat rugose. - E. Bulgaria and E. Romania. Bu Rm.

Similar in habit to 10, but distinguished by the petiolate leaves, several-flowered cymes and smaller sepals.
12. M. grisebachii Janka, Österr. Bot. Zeitschr. 23: 194 (1873). Like 11 but stems pubescent throughout; leaves somewhat fleshy, linear to linear-oblong, the upper not more than 1 mm wide, sessile; cymes usually 3 - to 6 -flowered; petals equalling sepals. - E. Bulgaria and E. Romania. Bu Rm.
13. M. dielsiana Mattf., Ber. Deutsch. Bot. Ges. 43: 509 (1925). Glabrous, fragile and somewhat fleshy perennial. Upper leaves $5-10 \times 1-1.5 \mathrm{~mm}$, narrowly oblong or spathulate, acute, glaucous, $\frac{1}{2}$-terete. Cymes $1(-3)$-flowered; flowers 5 -merous; pedicels $10-15 \mathrm{~mm}$, slender. Sepals 3.5 mm , 1 -veined; outer sepals with narrow scarious margin; petals exceeding sepals but shorter than in 10. Seeds $1.5-1.8 \mathrm{~mm}$, smooth, reniform, $2-4$ per capsule; strophiole white when fresh, becoming brown, conical, entire. Cliffs, 1300-1400 m. - N. Italy (Alpi Bergamasche). It.
14. M. papulosa Bertol., Fl. Ital. 4: 363 (1841). Glabrous and often glaucous perennial with often pendent stems up to 20 cm . Leaves up to $25 \times 4 \mathrm{~mm}$, narrowly elliptical to spathulate, obscurely veined, sometimes slightly fleshy. Flowers 4- or 5 -merous, in 1- to 5 -flowered cymes; pedicels $2-6 \mathrm{~cm}$, slender. Sepals 2-3 mm, ovate-lanceolate, concave, with narrow scarious margins; petals twice as long as sepals. Strophiole prominent, finely laciniate. Rock-fissures. - Maritime Alps; S. \& C. Appennini. Ga It.

Plants from the Maritime Alps have 5-merous flowers; those from the Appennini have 4-merous flowers.
15. M. tommasinii Marchesetti, Boll. Soc. Adr. Sci. Nat. Trieste 5: 327 (1880). Like 14 but leaves narrower; sepals with wide scarious margins; flowers 4-merous; petals slightly exceeding sepals. Calcareous rocks. - N.W. Jugoslavia (Istra); just extending into Italy near Trieste. It Ju.
16. M. markgrafii Merxm. \& Guterm., Phyton (Austria) 7: 1 (1957). Perennial with sparingly branched stems up to 10 cm , woody below. Leaves $15-20 \times 1 \mathrm{~mm}$, linear to narrowly spathulate, somewhat fleshy. Flowers 4-merous, usually solitary; pedicels $10-12 \mathrm{~mm}$, slender. Sepals 3 mm , ovate, 1 -veined; petals scarcely exceeding sepals. Seeds $1-1.2 \mathrm{~mm}$, black, shiny, $2-5$ per capsule; strophiole prominent, white, laciniate. Limestone rocks, c. 300 m . - N. Italy (Alpi Bresciane). It.
17. M. bavarica (L.) Gren., Mém. Soc. Émul. Doubs 1 (2): 37 (1841). Glaucous and glabrous perennial with spreading or erect stems up to 20 cm . Leaves up to 20 mm , linear, $1-1.5 \mathrm{~mm}$ thick, fleshy, usually appearing veinless. Flowers 5 -merous, solitary or in few-flowered cymes. Sepals $3-4 \mathrm{~mm}$, ovate-lanceolate, distinctly veined, with wide scarious margins. Seeds $1 \cdot 2$ 1.5 mm , reddish-black, shiny; strophiole prominent, white, laciniate. - S.E. Alps and W. part of Balkan peninsula. Al Au It Ju.

A variable species. At least two subspecies may be recognized: (a) Subsp. bavarica ( $M$. ponae (Reichenb.) Fenzl; incl. $M$. malyi Hayek): Stems glaucous, but not strongly so, and not jointed. Lower leaves usually $5-15 \mathrm{~mm}$. Petals $1 \frac{1}{2}-2$ times as long as sepals. $2 n=24$. Calcareous rocks. Almost throughout the range of the species (westwards to Monte Baldo).
(b) Subsp. insubrica (Degen) Sauer, Phyton (Austria) 8: 279 (1959): Stems very glaucous, jointed. Lower leaves seldom more than 5 mm . Petals scarcely exceeding sepals. N. Italy (Alpi Bresciane).
18. M. sedifolia Willd., Ges. Nat. Freunde Berlin Mag. 2: 101 (1808) ( $M$. dasyphylla Bruno ex Gren. \& Godron.). Glabrous, glaucous perennial with weak stems, laxly caespitose trailing up to 25 cm . Leaves usually $5-10 \mathrm{~mm}$, linear, or or somewhat fleshy, veinless. Flowers 4-merous, solitary in few-flowered cymes; pedicels 3-6 times as long as sepals, slender. Sepals ovate-lanceolate, acute or sub-obtuse, obscurely 3 -veined; petals usually exceeding sepals. Strophiole prominent, laciniate. Rock fissures. - S.E. France, N.W. Italy. Ga It.

Very variable, particularly in habit, colour, succulence and length of leaves; but, while some variants approach 20, the two species are readily distinguished by the relative prominence of their strophioles.

Although it has been confused with 15, M. sedifolia is distinguished from it by its more robust habit and fleshy leaves.
${ }^{1}$ By G. Halliday.
19. M. glaucovirens Bertol., Fl. Ital. 6: 626 (1847). Glabrous, glaucous perennial forming dense tufts up to 15 cm . Leaves $10-15 \times 0 \cdot 3-0 \cdot 6 \mathrm{~mm}$, patent, narrowly linear to filiform, distinctly 1 -veined, somewhat fleshy. Flowers 5 -merous, solitary or in 2to 3 -flowered cymes; pedicels slender. Sepals $2 \cdot 5-3 \mathrm{~mm}$, ovatelanceolate, distinctly 1 -veined; petals slightly exceeding sepals. Seeds black; strophiole broadly 4-lobed. Shady limestone rocks. - S. Alps from c. $10^{\circ} 30^{\prime}$ to c. $12^{\circ} 15^{\prime}$ E. It.
20. M. muscosa L., Sp. Pl. 359 (1753). Glabrous perennial with weak, often procumbent stems, but very variable in habit. Leaves up to $30(-50) \times 0.5-1.2 \mathrm{~mm}$, narrowly linear to filiform, acute, 1 - to 3 -veined. Flowers usually 4 -merous, in (2-)3- to 6 -flowered cymes; pedicels 3-6 times as long as sepals, slender. Sepals 2.5-3.5 mm, lanceolate, acute, 1 -veined, with wide scarious margins; petals $1 \frac{1}{2}$ times as long as sepals; stamens 8. Capsule with 4 valves. Seeds reddish-black; strophiole small, almost entire. $2 n=24$. - Mountains of $S . \& C$. Europe northwards to $c$. $50^{\circ} N$. Al Au Bu Cz Ga Ge He Hs Hu It Ju Po Rm Rs (W) Si.
M. pichleri Huter, Österr. Bot. Zeitschr. 54: 449 (1904), endemic in S. Bulgaria (Rodopi Planina), may be related to 20. It has a very slender habit, 5 -merous flowers and seeds with a large strophiole.
21. M. ciliata (Scop.) Dalla Torre in Hartinger, Atlas Alpenft. (Text) 78 (1882) (M. polygonoides (Wulfen) Mert. \& Koch). Creeping, laxly caespitose perennial with usually glabrous stems up to 20 cm . Leaves $3-10 \times 0.6-1 \mathrm{~mm}$, linear to linear-lanceolate, somewhat fleshy, obscurely 1 - to 3 -veined, glabrous except for a few cilia at the base. Flowers 5 -merous, solitary or in 2- to 3 -flowered cymes; pedicels $10-15 \mathrm{~mm}$. Sepals $3-4 \mathrm{~mm}$, ovate, 1 - to 3 -veined; petals slightly exceeding sepals. Seeds $1-1 \cdot 2 \mathrm{~mm}$, black, shiny; strophiole small, finely laciniate. $2 n=24$. - Calcareous screes. Alps; N.W. part of Balkan peninsula; E. Pyrenees. $\mathrm{Al} \mathrm{Au} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju}$.

Dwarf plants with petals nearly twice as long as the sepals occur at high altitudes in the Alps. They have been called subsp. nana (St. Lager) Schinz \& R. Keller, but their status requires investigation.

## 3. Minuartia L. ${ }^{1}$

Like Arenaria but leaves usually narrowly lanceolate, setaceous or subulate; capsule dehiscing with as many teeth as styles; capsule-teeth wide and obtuse; seeds 1 to many, smooth, tuberculate or fimbriate. (Incl. Alsine auct., Cherleria L., Queria L.)

Literature: J. Mattfeld, Feddes Repert. (Beih.) 15: 1-228 (1922). J. McNeill, Notes Roy. Bot. Gard. Edinb. 24: 79-155 (1962).

1 Annual or biennial, lacking vegetative stems at time of flowering
2 Sepals 1-veined
3 Stems and sepals glandular-pubescent; pedicels less than half as long as sepals
4 Glandular hairs short and crisped; fascicles of flowers sessile
12. campestris

4 Glandular hairs patent; fascicles of flowers pedunculate
14. glomerata

3 Stems and sepals usually glabrous or sparsely pubescent; pedicels about equalling sepals
5 Stems erect; cymes in small, dense fascicles 15. rubra
5 Stems ascending; cymes elongate, corymbose
16. funkii

2 Sepals 3-veined
6 Stems slender; cymes usually lax; scarious margin of sepals usually narrow
7 Leaves linear-spathulate 1. thymifolia

7 Leaves linear-subulate
8 Leaves ciliolate at base; sepals with a broad scarious margin
8. regeliana

8 Leaves not ciliolate; sepals with a narrow scarious margin
9 Pedicels not longer than sepals; cymes crowded
7. mediterranea

9 Pedicels usually longer than sepals; cymes lax
10 Petals at least as long as sepals
11 Stems decumbent
2. mesogitana

11 Stems erect
4. bilykiana

10 Petals shorter than sepals
12 Anthers purplish; seeds 1 mm
6. velenovskyi

12 Anthers yellow; seeds 0.6 mm or less
13 Capsule shorter than sepals; seeds $0 \cdot 3-0.4 \mathrm{~mm}$; sepals $2-3(-3 \cdot 25) \mathrm{mm}$ 3. viscosa
13 Capsule 1-1 $\frac{1}{2}$ times as long as sepals; seeds (0.3-) $0.4-0.6 \mathrm{~mm}$; sepals ( $2-$ ) $3-4 \mathrm{~mm}$
5. hybrida

6 Stems robust; cymes condensed into dense fascicles; scarious margin of sepals extending half-way to mid-vein
14 Bracts elongate, strongly curved; capsule with 1 seed
9. hamata

14 Bracts neither elongate nor strongly curved; capsule with 5 or more seeds
15 Plant densely glandular-pubescent; pedicels half as long as sepals
13. globulosa

15 Plant with crisped, eglandular hairs; flowers subsessile
16 Fascicles of flowers forming a dense, wide, terminal capitulum; stamens 3
10. dichotoma

16 Fascicles of flowers axillary and terminal; stamens 10
11. montana

1 Perennial; vegetative shoots usually present at time of flowering
17 Sepals appearing veinless, densely glandular-pubescent; petals usually pale pink
57. geniculata

17 Sepals distinctly veined; petals white
18 Sepals obtuse, oblong
19 Petals shorter than sepals, or absent; flowers solitary
56. sedoides

19 Petals equalling or exceeding sepals; cymes usually 3 - to many-flowered
20 Leaves at least 1 mm wide (coast of W. France)
55. olonensis

20 Leaves rarely more than 0.5 mm wide
21 Leaves prominently ciliate; seeds fringed with long tubercles
52. macrocarpa

21 Leaves not prominently ciliate; seeds smooth or with low tubercles
22 Plant glabrous
46. wettsteinii

22 Plant pubescent, at least above
23 Cymes 3- to many-flowered
24 Pedicels and sepals eglandular 51. laricifolia
24 Pedicels and sepals glandular-pubescent
25 Plant with woody rhizomes; leaves very acute, often falcate
26 Rhizomes long; sepals $4-7 \times 1-1.5 \mathrm{~mm}$; petals $2-2 \frac{1}{2}$ times as long as sepals 48. baldaccii
26 Rhizomes short; sepals $3-5 \times 0.5-1 \mathrm{~mm}$; petals $1-1 \frac{1}{2}$ times as long as sepals 49. garckeana
25 Plant usually without woody rhizomes; leaves not acute or falcate 27 Leaves $10-20 \mathrm{~mm}$; sepals $5-7 \mathrm{~mm}$ 47. capillacea 27 Leaves $5-12 \mathrm{~mm}$; sepals $4-5.5 \mathrm{~mm}$
51. laricifolia

23 Cymes 1- to 3-flowered
28 Flowering stems $0.5-1 \mathrm{~cm}$, scarcely exserted from tuft; petals scarcely exceeding sepals $\mathbf{5 0}$. handelii 28 Flowering stems $5-10 \mathrm{~cm}$
29 Flowers solitary; petals twice as long as sepals
53. arctica

29 Flowers 1-3; petals 1-1 $\frac{1}{2}$ times as long as sepals
54. biffora

18 Sepals acute, ovate to linear-lanceolate
30 Sepals 1 -veined; scarious margin extending nearly to vein

31 Pedicels and sepals glandular-pubescent
32 Sepals $2-4 \mathrm{~mm}$; vegetative fascicles of leaves short, ovoid, compact
22. anatolica

32 Sepals $4-6 \mathrm{~mm}$; vegetative fascicles of leaves long
33 Petals equalling or slightly exceeding sepals (Krym)
21. adenotricha

33 Petals $\frac{2}{3}$ as long as sepals
14. glomerata

31 Pedicels and sepals glabrous
34 Petals less than half as long as sepals; stems procumbent
23. trichocalycina

34 Petals more than half as long as sepals; stems erect
35 Cymes 1- to 4 -flowered
20. krascheninnikovii

35 Cymes usually many-flowered
36 Petals slightly exceeding sepals
18. setacea

36 Petals not exceeding sepals
37 Sepals $3.5-5.5 \mathrm{~mm}$, linear-lanceolate $\quad$ 17. mutabilis
37 Sepals $3-4 \mathrm{~mm}$, ovate-lanceolate
19. bosniaca

30 Sepals 3 - to 7 -veined; scarious margin extending at most to lateral veins
38 Leaves linear-setaceous to linear-subulate
39 Sepals 3-veined
40 Leaves 1 -veined; plant glabrous
41 Stems densely caespitose; flowers solitary, rarely present; pedicels $5-15 \mathrm{~mm}$
45. rossii

41 Stems laxly caespitose; cymes 1 - to 4 -flowered; pedicels $15-20 \mathrm{~mm}$
44. stricta

40 Leaves 3 -veined; stems usually glandular-pubescent, at least above
42 Sepals erect at anthesis; petals at least $1 \frac{1}{2}$ times as long as sepals
43 Veins of leaf all equally prominent; pedicels patent to erecto-patent
41. pichleri

43 Midrib of leaf more prominent than the lateral veins; pedicels erect to erecto-patent
44 Leaves rigid, somewhat fleshy
45 Leaves $5-10 \mathrm{~mm}$ (Krym)
39. taurica

45 Leaves $15-25 \mathrm{~mm}$ (Greece)
40. juniperina

44 Leaves not rigid, not fleshy
46 Leaves glabrous
47 Flowers usually in pairs; capsule $1 \frac{1}{2}$ times as long as sepals 36. austriaca
47 Cymes 3- or more-flowered; capsule and sepals $\pm$ equal
48 Sepals $2-3 \mathrm{~mm}$
34. grignensis

48 Sepals $3 \cdot 5-5 \mathrm{~mm}$
38. villarii

46 Leaves glandular-pubescent
49 Flowers solitary or in pairs
37. helmii

49 Cymes usually 3- to 4-flowered
38. villarii

42 Sepals patent at anthesis; petals not more than $1 \frac{1}{2}$ times as long as sepals
50 Leaves usually secund; stems black below 26. recurva
50 Leaves somewhat recurved but never secund; stems not black below
51 Petals equalling or exceeding sepals 42. verna
51 Petals shorter than sepals
52 Petals obovate, obtuse 43. rubella
52 Petals ovate, acute
42. verna

39 Sepals 5 - to 7 -veined at least near the base
53 Stems laxly caespitose
54 Sepals with narrow scarious margin; petals clawed
24. hirsuta

54 Sepals with broad scarious margin; petals truncate at base, not clawed
25. eurytanica

53 Stems densely caespitose; plant often pulvinate
55 Cymes many-flowered, dense; pedicels not longer than sepals
27. bulgarica

55 Cymes 1 - to 5(-8)-flowered, lax; pedicels 1-3 times as long as sepals
26. recurva

38 Leaves linear-lanceolate, lanceolate or oblong-elliptic
56 Leaves oblong-elliptic, cucullate above; flowers 4merous
35. cherlerioides

56 Leaves linear-lanceolate to lanceolate, flat; flowers 5 -merous

57 Leaves usually narrowly linear, 3 -veined; plant glabrous 34. grignensis
57 Leaves lanceolate or linear-lanceolate, 5 -veined; stems glandular-pubescent above
58 Sepals 1- to 3-veined in upper half
59 Petals and capsule $1 \frac{1}{2}$ times as long as sepals; pedicels longer than sepals
31. cerastiifolia

59 Petals and capsule equalling sepals
60 Flowering stems $1-3 \mathrm{~cm}$; flowers usually solitary; pedicels $1-4 \mathrm{~mm}$ 32. rupestris
60 Flowering stems $5-7 \mathrm{~cm}$; flowers usually 2(3); pedicels $5-15 \mathrm{~mm}$
33. lanceolata

58 Sepals 5 - to 7 -veined in upper half
61 Leaves not rigid; outer veins of sepals curving outwards
28. saxifraga

61 Leaves rigid; outer veins of sepals parallel
62 Flowering stems $1-2 \mathrm{~cm}$; flowers usually solitary
30. stellata

62 Flowering stems $4-14 \mathrm{~cm}$; cymes 2 - to 7 -flowered
29. graminifolia

Subgen. Minuartia. Annual or perennial. Flowers usually white. Radicle incumbent.

Sect. Sabulina (Reichenb.) Graebner. Annual. Leaves linear, rarely linear-spathulate, 3-veined at least at base. Sepals 3 -veined, patent at anthesis, not becoming indurated; scarious margin narrow. Petals seldom exceeding sepals; stamens 3-10.

1. M. thymifolia (Sibth. \& Sm.) Bornm., Beih. Bot. Centr. 31 (2): 193 (1914). Annual, stems up to 6 cm , often branched at the base, sparsely glandular-pubescent above. Leaves 3-6x 1 mm , linear-spathulate, somewhat fleshy. Cymes more than 10 -flowered, dense; pedicels up to $1 \frac{1}{2}$ times as long as sepals. Sepals $2.5-3.5 \mathrm{~mm}$, ovate-oblong; petals and capsule slightly longer than sepals. Seeds 0.4 mm , smooth. Maritime sands. Once recorded from Kriti, locality not specified. ?Cr. (E. Mediterranean.)
2. M. mesogitana (Boiss.) Hand.-Mazz., Ann. Naturh. Mus. (Wien) 26: 148 (1912). Annual; stems up to 12 cm , decumbent, branched at the base. Leaves linear, somewhat fleshy. Cymes lax; pedicels patent. Sepals $2.25-3.5 \mathrm{~mm}$, ovate-lanceolate; petals and capsule $1-1 \frac{1}{2}$ times as long as sepals. Dry places.S. \& E. Bulgaria; S.E. Romania; Samothraki. Bu Gr Rm. (S.W. Asia.)
3. M. viscosa (Schreber) Schinz \& Thell., Bull. Herb. Boiss. ser. 2, 7: 404 (1907) (Alsine viscosa Schreber). Annual with rather slender, erect stems branched usually from above the middle; branches usually erect, more rarely erecto-patent; plant glandularpubescent, often densely so, rarely glabrous. Leaves 4-9(-12) mm, linear-subulate. Cymes lax; pedicels $3-8 \mathrm{~mm}$, slender. Sepals 2-3(-3.25) mm, lanceolate; petals distinctly shorter than sepals. Capsule shorter than sepals. Seeds $0 \cdot 3-0.4 \mathrm{~mm}$, almost smooth. $2 n=46$. Dry sandy places. Widely distributed, but local, from E. France to C. Russia, and from S. Sweden to Makedonija. Au $\mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{?Gr} \mathrm{He} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{E)} \mathrm{Su} \mathrm{Tu}$.
4. M. bilykiana Klokov in Kotov, Fl. RSS Ucr. 4: 654 (1952). Like 3 but stems somewhat fleshy; branches often patent; sepals $2.25-3 \mathrm{~mm}$; petals and capsule slightly exceeding sepals; seeds $0.5-0.6 \mathrm{~mm}$, acutely tuberculate. - S.W. Ukraine (near Izmail). Rs (W).
The relationship between this species and $\mathbf{2}$ requires investigation.
5. M. hybrida (Vill.) Schischkin in Komarov, Fl. URSS. 6: 488 (1936) (M. tenuifolia (L.) Hiern, non Nees ex C. F. P. Mart., Alsine
tenuifolia (L.) Crantz). Annual, but more robust than 3, with erect stems 3-12(-20) cm, branched at the base and from above the middle; plant usually glandular-pubescent, at least above, rarely glabrous. Leaves up to 12 mm . Cymes lax, many-flowered; pedicels $5-20 \mathrm{~mm}$. Sepals $2-4 \mathrm{~mm}$, linear to ovate-lanceolate; petals slightly shorter than sepals; anthers yellow. Capsule $1-1 \frac{1}{2}$ times as long as sepals. Seeds ( $0 \cdot 3-$ ) $0 \cdot 4-0.6 \mathrm{~mm}$, minutely tuberculate, reddish-brown. Dry sandy places. S. \& W. Europe, extending northwards to England, C. Germany and S. Ukraine; occasionally naturalized elsewhere. Be Bl Br Bu Co Cr Ga Ge Gr He Ho Hs It Ju Lu Rm Rs (C, W, K) Sa Si Tu [Au Da Hb].

A very variable species, particularly in height, pubescence and size and shape of sepals.
(a) Subsp. hybrida (incl. M. tenuifolia subsp. vaillantiana (DC.) Mattf., M. tenuifolia subsp. hybrida (Vill.) Mattf., Alsine tenuifolia var. hybrida (Vill.) Willk.): Stems $3-10 \mathrm{~cm}$. Sepals 3-4× $0.8-1 \mathrm{~mm}$, linear to ovate-lanceolate, glandular-pubescent, rarely glabrous. $2 n=46,70$. Throughout the range of the species.

Plants with glabrous, ovate-lanceolate sepals occurring from Italy to the Netherlands have been called M. tenuifolia subsp. vaillantiana, but the sepal-shape is inconstant and glabrous plants occur throughout the range of subsp. (a).
(b) Subsp. lydia (Boiss.) Rech. fil., Bot. Jahrb. 80: 315 (1961) (M. tenuifolia subsp. lydia (Boiss.) Mattf.): Stems up to 17 cm , more slender than in (a), glandular-pubescent. Sepals $2-2.5 \mathrm{~mm}$; petals and capsule about equalling sepals. E. Greece (Evvoia); ?Kriti. ?Cr Gr.
This subspecies shows similarities to 2 : further investigation is required.
6. M. velenovskyi (Rohlena) Hayek, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 94: 135 (1917). Like 5 but sepals 2.5-3 mm, ovate-lanceolate; anthers purplish; capsule exceeding sepals; seeds 1 mm , shortly and bluntly tuberculate. Jugoslavia (Crna Gora), N. Albania. Al Ju.
7. M. mediterranea (Link) K. Maly, Glasn. Muz. Bosni Herceg. 20: 563 (1908). Like 5 in habit; stems $4-12 \mathrm{~cm}$, glabrous or glabrescent. Cymes dense; pedicels usually shorter than sepals. Sepals 3-5 $\times 0.5-0.7 \mathrm{~mm}$, narrowly linear-lanceolate; petals $\frac{1}{3}-\frac{1}{2}$ as long as sepals, sometimes absent. Capsule usually included. Seeds 0.4 mm , smooth. $2 n=24$. Mediterranean region; N.W. France ( $W$. Coast of Normandie). Al Bl Co Cr Ga Gr Hs It Ju Lu ? Sa Si Tu.
8. M. regeliana (Trautv.) Mattf., Bot. Jahrb. 57 Beibl. 126: 29 (1921). Glabrous annual; stems $5-15 \mathrm{~cm}$, branched from the base. Leaves $2-10 \mathrm{~mm}$, narrowly linear, often ciliolate at base. Pedicels $3-17 \mathrm{~mm}$, filiform. Sepals $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$ ovate-lanceolate, 3 -veined in lower half; scarious margin broad. Capsule usually exserted. Seeds 0.5 mm , finely tuberculate. Salt steppe and desert soils. Borders of W. Kazakhstan and S.E. Russia. Rs (E). (Caucasus, C. Asia.)

Sect. Minuartia. Annual or perennial. Leaves linear to linearlanceolate. Cymes lax (perennials) or in dense fascicles (annuals). Sepals 3-veined, with scarious margin extending to lateral veins, or 1 -veined with margin extending almost to centre; sepals becoming indurated; stamens 3-10.
9. M. hamata (Hausskn.) Mattf., Bot. Jahrb. 57 Beibl. 126: 29 (1921) (Queria hispanica L., non M. hispanica sensu Mattf.). Annual, sparsely covered with crisped hairs; stems $3-7 \mathrm{~cm}$, usually branched from the base. Leaves $10-20 \mathrm{~mm}$, linear-setaceous. Bracts 3 -veined, shorter than leaves, abruptly narrowed
from a very broad sheathing base, hamate, incurved above with broad scarious margin; fascicles of cymes in capitula which are deciduous at maturity; flowers sessile, the terminal rudimentary. Sepals c. 4 mm , lanceolate, becoming indurated, 3 -veined; scarious margin broad; petals minute, subulate; stamens usually 10. Capsule with 1 seed. Dry places. Iberian peninsula; Balkan peninsula; Krym. Al Bu Gr Hs Ju Lu Rs (K).
10. M. dichotoma L., Sp. Pl. 89 (1753) (M. hispanica sensu Mattf., Alsine dichotoma (L.) Fenzl). Annual, covered with crispate hairs; stems $2-8 \mathrm{~cm}$, erect, occasionally branched from the base; stems branched above to give a congested capitulum of fascicles of flowers. Leaves $8-15 \mathrm{~mm}$, erecto-patent, much longer than internodes. Bracts scarious, exceeding the flowers, curved above. Sepals 3 -veined, sparsely hairy; petals absent or rudimentary; stamens usually 3 . Seeds $0.5-0.8 \mathrm{~mm}, 6-12$, almost smooth. Dry, sandy places. C. \& E. Spain; ?Portugal. Hs ?Lu.
11. M. montana L., Sp. Pl. 90 (1753) (Alsine montana (L.) Fenzl; incl. M. wiesneri (Stapf) Schischkin). Like 10 but more robust; stems often branched from the base; leaves $15-20 \mathrm{~mm}$, squarrose, sometimes recurved; fascicles of flowers terminal and axillary, shorter than the bracts; petals rudimentary; stamens 10 ; seeds $0.6-0.8 \mathrm{~mm}$, minutely tuberculate. Dry sandy places. C., E. \& S. Spain; S.W. Bulgaria; Krym. Bu Hs Rs (K) [Ga].
12. M. campestris L., Sp. Pl. 89 (1753) (Alsine campestris (L.) Fenzl). Glandular-pubescent annual; stems $2-10 \mathrm{~cm}$. Leaves up to 15 mm , erect. Bracts and fascicles of flowers almost equal and scarcely exceeding internodes; at maturity fascicles present at most nodes. Sepals 1 -veined; petals rudimentary; stamens usually 5 . Seeds $0.4-0.6 \mathrm{~mm}, 7-10$, minutely tuberculate. Dry places. C., E. \& S. Spain. Hs. (N. Africa.)
13. M. globulosa (Labill.) Schinz \& Thell., Bull. Herb. Boiss. ser. 2, 7: 403 (1907). Densely glandular-pubescent annual with erect stems up to 13 cm . Leaves linear-lanceolate. Bracts scarcely exceeding pedicels; cymes axillary and terminal; pedicels $\frac{1}{2}$ as long as sepals, erecto-patent. Sepals lanceolate; petals $\frac{1}{3}$ as long as sepals. Capsule included. Seeds $0.6-0.8 \mathrm{~mm}$, tuberculate on back. Dry cultivated places. S. \& W. parts of Balkan peninsula. Cr GrJu .
14. M. glomerata (Bieb.) Degen, Mitt. Naturw. Ver. Steierm. 46: 319 (1910). Glandular-pubescent biennial or perennial with erect stems up to 20 cm . Leaves linear-setaceous, 3 -veined at the base. Fascicles of flowers terminal and axillary; pedicels up to $2(-3) \mathrm{mm}$. Sepals $4-6 \mathrm{~mm}$, narrowly lanceolate, long-acuminate; petals $\frac{1}{3}-\frac{2}{3}$ as long as sepals. $2 n=28$. S.E. Europe, extending northwards to S.E. Czechoslovakia and N. Ukraine. Bu Cz Gr Hu Ju Rm Rs (W, K) Tu.
(a) Subsp. glomerata: Biennial. Leaves erect, appressed. Cymes dense, many-flowered. Petals half as long as sepals. Throughout the range of the species, except perhaps in Greece.
(b) Subsp. velutina (Boiss. \& Orph.) Mattf., Feddes Repert. (Beih.) 15: 85 (1922): Perennial. Leaves often falcate. Cymes lax, few-flowered. Petals as long as sepals. - N. Greece; $S$. Bulgaria.
15. M. rubra (Scop.) McNeill, Feddes Repert. 68: 173 (1963) (M. fastigiata (Sm.) Reichenb., M. fasciculata auct., non (L.) Hiern, Alsine fasciculata auct., non (L.) Wahlenb., A. jacquinii Koch). Biennial with erect stems up to 30 cm ; branches erect, glabrous or sparsely hairy above, very rarely glandular-pubescent. Leaves 3 -veined at base, linear-setaceous. Flowers in
dense axillary and terminal fascicles; pedicels and sepals almost equal. Sepals 4-6 mm, linear, glabrous or sparsely hairy; petals $\frac{1}{3}$ as long as sepals; stamens 5. Capsule included. Seeds $0 \cdot 7-$ 0.8 mm , distinctly but shortly tuberculate on back. $2 n=30$. Dry sandy places. - S. Europe, and locally in C. Europe, northwards to C. Germany and eastwards to $24^{\circ}$ E. in Romania. Au Cz Ga Ge ? Gr He Hs Hu It Ju Rm.
16. M. funkii (Jordan) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 714 (1918) (Alsine funkii Jordan). Like 15 but with ascending stems and corymbose cymes. S. \& E. Spain; S. France. Ga Hs.
17. M. mutabilis Schinz \& Thell. ex Becherer, Ber. Schweiz. Bot. Ges. 48: 296 (1938) (M. rostrata (Pers.) Reichenb., Alsine mucronata auct., non L., A. rostrata (Pers.) Fenzl). Laxly caespitose, usually glabrous perennial with numerous erect flowering stems $10-20 \mathrm{~cm}$, branched above. Leaves erect to erecto-patent. Terminal cymes usually many-flowered; pedicels usually equalling sepals. Sepals $3 \cdot 5-5 \cdot 5 \mathrm{~mm}$, narrowly lanceolate; petals slightly shorter than sepals. Capsule about equalling sepals. Seeds $0.7-0.8 \mathrm{~mm}$, distinctly but shortly tuberculate on back. $2 n=28$. Dry places. Mountains of S.W. \& S.C. Europe, from N.E. Spain to Corse and Switzerland and to $11^{\circ}$ E. in N. Italy. Co GaHeHs It.
18. M. setacea (Thuill.) Hayek, Fl. Steierm. 1: 271 (1908) (Alsine setacea (Thuill.) Mert. \& Koch). Caespitose perennial with numerous erect flowering stems up to 20 cm , with crispate hairs below, glabrous above. Leaves $8-15 \times 0.2 \mathrm{~mm}$, setaceousfiliform, 3 -veined at base, usually erect, rarely patent or falcate, scabrid. Cymes 3- to many-flowered, lax (dense in var. parviflora (Velen.) Prodan); pedicels usually 2-4 times as long as sepals. Sepals 2-5 mm, ovate-lanceolate to lanceolate; petals and capsule slightly exceeding sepals. Seeds $0.5-0.7 \mathrm{~mm}$, with low, rounded tubercles. $2 n=30$. From C. France to c. $37^{\circ}$ E. in Russia, northwards to $51^{\circ}$ N. in Ukraine and southwards to C. Greece. Al Au $\mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{Hu} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)}$.

Many variants of this very polymorphic species have been given taxonomic recognition but, pending a detailed study of the European material, only two subspecies will be recognized here.
(a) Subsp. setacea: Cymes 3- to many-flowered. Sepals 23.5 mm , ovate-lanceolate. Throughout the range of the species.
(b) Subsp. banatica (Reichenb.) Prodan in Savul., Fl. Rep. Pop. Române 2: 80 (1953): Cymes 3- to 5-flowered. Sepals 3•5-5 mm , linear-lanceolate. - From C. Austria and C. Czechoslovakia to Bulgaria. Au Bu Cz Ju Rm.

The distribution of this subspecies is imperfectly known.
19. M. bosniaca (G. Beck) K. Maly, Glasn. Muz. Bosni Herceg. 20: 563 (1908). Like 18 but sepals 3-4 mm; petals and sepals subequal; glands at base of outer stamens elongate and bipartite; seeds 0.8 mm , acutely tuberculate. - Jugoslavia, N. Albania. Al Ju.
20. M. krascheninnikovii Schischkin, Acta Inst. Bot. Acad. Sci. URSS. ser. 1, 3: 170 (1937). Like 18 but leaves $0 \cdot 2-0.5 \mathrm{~mm}$ wide; cymes 1 - to 4 -flowered; pedicels usually less than twice as long as sepals; sepals $3-4 \mathrm{~mm}$; petals $1-1 \frac{1}{2}$ times as long as sepals; seeds $0.75-1 \mathrm{~mm}$, acutely tuberculate. - S. Ural (near Kyshtym). Rs (C).

It is not certain that this species occurs within the boundary of Europe.
21. M. adenotricha Schischkin, Acta Inst. Bot. Acad. Sci. URSS. ser. 1,3: 169 (1937). Like 18 but leaves 0.3 mm wide; cymes

1- to 6 -flowered; pedicels $2-6 \mathrm{~mm}$; pedicels and sepals sparsely pubescent; sepals $4-5 \mathrm{~mm}$; petals scarcely exceeding sepals; seeds c. 0.75 mm , with low, rounded tubercles. Mountainrocks. - Krym. Rs (K).
22. M. anatolica (Boiss.) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 717 (1918). Densely pubescent, laxly caespitose perennial; flowering stems with compact, ovoid, axillary vegetative fascicles, often covered with arachnoid indumentum; fascicular leaves appressed. Cymes crowded, many-flowered; pedicels seldom longer than sepals. Sepals $3-4 \mathrm{~mm}$, equalling or slightly exceeding petals. N. Aegean region (Samothraki). Gr. (Anatolia.)

The closely related M.erythrosepala (Boiss.) Hand.-Mazz., Ann. Naturh. Mus. (Wien) 23: 152 (1909), has been reported from Samothraki, but the records are probably referable to 22.
23. M. trichocalycina (Ten. \& Guss.) Grande, Boll. Soc. Bot. Ital. 1912: 179 (1912) (M. confusa (Heldr. \& Sart.) Maire \& Petitmengin). Perennial with sparse, crispate hairs and procumbent stems. Leaves linear-subulate. Cymes dense; pedicels shorter than sepals. Sepals $3 \cdot 5-6 \mathrm{~mm}$, linear-lanceolate; petals less than half as long as sepals. Capsule included. - Mountains of S. Greece and C. Italy (Abruzzi). Gr It.

Sect. Plurinerviae McNeill (Tryphane sensu Mattf.). Perennial. Leaves linear-subulate to linear-setaceous, 3 - to 5 -veined towards the base. Sepals usually 5 - to 7 -veined, patent at anthesis; petals $1-1 \frac{1}{2}$ times as long as sepals, usually oblong-obovate, narrowed towards the base.
24. M. hirsuta (Bieb.) Hand.-Mazz., Ann. Naturh. Mus. (Wien) 23: 152 (1909). Laxly caespitose, usually glandularpubescent perennial; flowering stems erect, up to 20 cm . Cymes lax, 3- to many-flowered; pedicels longer than sepals. Sepals ovate-lanceolate, 5 - to 7 -veined; margin scarious. E.C. \& S.E. Europe. $\mathrm{Bu} \mathrm{Cz} \mathrm{Gr} \mathrm{Hu} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(K)}$.

A variable species. Some authorities regard it as a subspecies of $\mathbf{2 6}$, whilst others give the following subspecies specific rank.
1 Leaves $20-30 \mathrm{~mm}$, slender, erect, glabrous; pedicels and sepals glandular-pubescent
(c) subsp. frutescens

1 Leaves $5-15 \mathrm{~mm}$, somewhat rigid, often falcate
2 Plant densely glandular-pubescent; leaves $0.5-1 \mathrm{~mm}$ wide; seeds acutely tuberculate on back (a) subsp. hirsuta
2 Leaves up to 0.3 mm wide; pedicels and sepals sparsely glandular-pubescent; seeds obscurely tuberculate
(b) subsp. falcata
(a) Subsp. hirsuta (M. hirsuta subsp. falcata sensu Mattf. pro parte): Krym.
(b) Subsp. falcata (Griseb.) Mattf., Bot. Jahrb. 57 Beibl. 126: 130 (1921): Balkan peninsula.
(c) Subsp. frutescens (Kit.) Hand.-Mazz., Ann. Naturh. Mus. (Wien) 23: 152 (1909): $2 n=30,32$. - N. Hungary; Carpathians; Bulgaria.

Plants from S.W. Romania having pedicels more than 3 times as long as the sepals and sepals $7-8 \mathrm{~mm}$, have been called M. cataractarum Janka, Math. Term. Közl. 12: 165 (1874).
25. M. eurytanica (Boiss. \& Heldr.) Hand.-Mazz., Ann. Naturh. Mus. (Wien) 23: 153 (1909). Glabrous perennial, rarely sparsely glandular-pubescent. Leaves falcate, rather wide. Pedicels equalling sepals. Sepals 6 mm , lanceolate; margin broadly scarious; petals linear-lanceolate, truncate at the base, equalling sepals. Mountain rocks. - C. Greece. Gr.
26. M. recurva (All.) Schinz \& Thell., Bull. Herb. Boiss. ser. 2, 7: 404 (1907) (Alsine recurva (All.) Wahlenb.). Densely caespitose perennial; stems woody and often black below; flowering stems usually up to 12 cm ; plant sparsely glandular-pubescent, at least above. Leaves $4-10 \mathrm{~mm}, 3$-veined, falcate. Cymes 1 - to 8 flowered; pedicels up to 3 times as long as sepals. Sepals 3.25$5 \cdot 5(-6) \mathrm{mm}$, ovate-lanceolate, 5 - to 7 -veined; petals and capsule slightly exceeding sepals. Seeds 1.2 mm , weakly tuberculate. Usually calcifuge. Mountains of S. \& S.C. Europe from Portugal to the S. Carpathians. Al Au Bu Ga Gr He Hs It Ju Lu Rm Si.
(a) Subsp. recurva: Cymes 1- to $3(-5)$-flowered; bracts 3 - to 5 -veined. Outer sepals $3 \cdot 25-4 \cdot 25 \mathrm{~mm}, 5$-veined. $2 n=30$. Throughout the range of the species, but absent from Sicilia.
(b) Subsp. juressi (Willd. ex Schlecht.) Mattf., Bot. Jahrb. 57 Beibl. 126: 31 (1921) (incl. M. engleri Mattf.): More robust than (a); flowering stems up to 15 cm . Cymes 3 - to 8 -flowered; bracts 5 to 7 -veined. Outer sepals $4-5.5(-6) \mathrm{mm}, 7$-veined. Sicilia; S. \& C. Italy; W. part of Balkan peninsula. Al Gr It Ju Si.

Although this subspecies appears fairly distinct, and has often been accorded specific rank, plants intermediate between the two subspecies occur in the Iberian peninsula, S. France and the S.E. Alps.
27. M. bulgarica (Velen.) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 727 (1918). Like 26 but cymes compact, many-flowered; pedicels not longer than sepals; sepals $3-4 \mathrm{~mm}$, 5 - to 9 -veined, slightly shorter than petals. Mountain rocks and screes. - C. \& S. Bulgaria. Bu.

Sect. Lanceolatae (Fenzl) Graebner. Perennial. Leaves lanceolate to linear-lanceolate. Sepals 5 - to 7 -veined (often obscurely so), erect or suberect at anthesis.
28. M. saxifraga (Friv.) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 756 (1918). Densely caespitose perennial with erect, densely glandular-pubescent flowering stems. Leaves lanceolate to ovate-lanceolate, not rigid. Flowers in compact, many-flowered cymes. Sepals lanceolate, densely glandularpubescent; veins 5-7, the outer curved towards the margin; petals obovate, exceeding the sepals. Mountain rocks, 1200-1800 m. Bulgaria. Bu. (Anatolia.)
29. M. graminifolia (Ard.) Jáv., Sched. Fl. Hung. Exsicc. 2: 22 (1914). Densely pulvinate perennial with unbranched flowering stems $4-14 \mathrm{~cm}$. Leaves $10-40 \mathrm{~mm}$, linear-lanceolate, rigid. Cymes 2- to 7 -flowered. Sepals $5-10 \mathrm{~mm}$, lanceolate, 5- to $7-$ veined; petals exceeding sepals. Capsule included. Mountain rocks. - S. Europe from c. $11^{\circ}$ to c. $22^{\circ}$ E. Al It Ju Rm Si.
(a) Subsp. graminifolia (incl. subsp. hungarica Jáv.): Whole plant glandular-pubescent, often densely so. Leaves of nonflowering stems $20-40 \mathrm{~mm}$, those of the flowering stems at least half as long as internodes. N. \& C. Italy; S.W. Romania.
(b) Subsp. clandestina (Portenschl.) Mattf., Bot. Jahrb. 57 Beibl. 126: 31 (1921): Stems and leaves glabrous. Leaves of nonflowering stems $10-30 \mathrm{~mm}$; those of the flowering stems rarely more than $\frac{1}{3}$ as long as internodes. Pedicels and sepals glabrous or sparsely glandular-pubescent. C. \& S. Italy; Sicilia; Albania; C. \& S. Jugoslavia.
30. M. stellata (E. D. Clarke) Maire \& Petitmengin, Mat. Étude Fl. Géogr. Bot. Orient 4: 48 (1908). Densely pulvinate perennial with columnar stems. Leaves up to 10 mm , deltatelanceolate to lanceolate, in rosettes. Flowering stems and sepals glandular-pubescent; cymes 1 - to 4 -flowered. Sepals 6 mm , lanceolate, 5 -veined; petals $1 \frac{1}{2}$ times as long as sepals. Capsule equalling sepals. Rocks at high altitudes. Mountains of Greece and S. Albania. Al Gr.
(a) Subsp. stellata: Stems glandular-pubescent. Leaves glabrous. Flowers solitary, rarely in pairs. Throughout the range of the species.
(b) Subsp. pseudosaxifraga Mattf., Feddes Repert. (Beih.) 15: 136 (1922): Whole plant densely glandular-pubescent. Flowers (1-)2-4(-5). N. Greece (Pindhos).
31. M. cerastiifolia (Lam. \& DC) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 754 (1918) (Alsine cerastiifolia (Ramond) Fenzl). Glandular-pubescent, caespitose perennial with stems up to 8 cm . Leaves $3-10 \mathrm{~mm}$, lanceolate to lanceolateelliptic; midrib very prominent beneath. Flowers 1(2); pedicels usually twice as long as sepals. Sepals $3-4 \mathrm{~mm}$, ovate-lanceolate; petals $1 \frac{1}{2}$ times as long as sepals. Capsule exserted. Seeds $1-$ 1.4 mm , reddish-brown. Screes and rocks above 1800 m . - C. Pyrenees. Ga Hs.
32. M. rupestris (Scop.) Schinz \& Thell., Bull. Herb. Boiss. ser. 2, 7: 403 (1907) (M. lanceolata (All.) Matt., subsp. rupestris (Scop.) Mattf., Alsine rupestris (Scop.) Fenzl. Laxly caespitose or creeping perennial; stems rooting intermittently at the nodes, glandular-pubescent above. Leaves 2-4 mm, lanceolate, shortly ciliate. Flowering stems $1-3 \mathrm{~cm}$; flowers usually solitary! pedicels $1-4 \mathrm{~mm}$. Sepals $3 \cdot 5-5 \mathrm{~mm}$, lanceolate; usually glandularpubescent; petals and sepals about equal. Capsule included. Seeds $1-1 \cdot 2 \mathrm{~mm} .2 n=c .72$. Screes and rocks above 1900 m . - Alps. Au Ga Ge He It Ju.
33. M. lanceolata (All.) Mattf., Bot. Jahrb. 57 Bejbl. 126: 31 (1921) (M. lanceolata subsp. clementei (Huter) Mattf.). Like 32 but more robust; leaves up to 15 mm ; flowering stems $5-7 \mathrm{~cm}$; flowers 2(3); pedicels $5-15 \mathrm{~mm} .2 n=36$. - S.W. Alps (Cottian Alps). Ga It.
34. M. grignensis (Reichenb.) Mattf., Feddes Repert. (Beih.) 15: 141 (1922) (Alsine villarii var. grignensis (Reichenb.) Tanfani). Glabrous perennial with very crowded lower internodes and elongate flowering stems up to 10 cm . Leaves $5-15 \mathrm{~mm}$, linear, erect or erecto-patent, 3 -veined. Cymes 5 - to 12 -flowered; pedicels $8-15 \mathrm{~mm}$, slender. Sepals $2-3 \mathrm{~mm}$, ovate, acute, 3 -veined; petals and capsule slightly exceeding sepals. Seeds $1-1 \cdot 2 \mathrm{~mm}$, fimbriate. $2 n=36$. Limestone and dolomite cliffs, 1300-1900 m. - N. Italy (Alpi Bergamasche). It.

A very distinct species, intermediate between Sect. Lanceolatae and Sect. Acutiflorae.

Sect. Aretioideae Mattf. Perennial. Leaves oblong-elliptical. Flowers 4 -merous. Sepals erect at anthesis. Seeds fimbriate.
35. M. cherlerioides (Hoppe) Becherer, Denkschr. Schweiz. Naturf. Ges. 81: 167 (1956) (M. aretioides (Sommerauer) Schinz \& Thell., Alsine octandra (Sieber) Kerner). Densely caespitose perennial $2-5 \mathrm{~cm}$; stems usually richly branched. Leaves $1 \cdot 5-3 \times 1 \mathrm{~mm}$, oblong-elliptic, obtuse, somewhat fleshy; apex cucullate; veins 3 , distinct and persistent. Flowers solitary; pedicels shorter than sepals. Sepals $2-4 \mathrm{~mm}$, lanceolate, acute, 3-veined; petals slightly shorter than sepals, sometimes absent; styles usually 3. Capsule exserted. Seeds $0 \cdot 9-1 \cdot 2 \mathrm{~mm}$. Rocks and screes above 2000 m . © C. \& E. Alps. Au Ge He It Ju.
(a) Subsp. cherlerioides: Leaves glabrous. Calcicole. E. Alps, westwards to c. $9^{\circ} 30^{\prime} E$.
(b) Subsp. rionii (Gremli) Friedrich, Feddes Repert. 70: 2 (1964) (M. aretioides subsp. rionii (Gremli) Schinz \& Thell.): Leaves ciliolate. Calcifuge. C. Alps, eastwards to c. $10^{\circ} 30^{\prime}$ E.

Sect. Acutiflorae (Fenzl) Hayek. Perennial. Leaves linear,

3 -veined. Bracts herbaceous. Sepals erect at anthesis; petals exceeding sepals. Seeds rugose, or shortly tuberculate.
36. M. austriaca (Jacq.) Hayek, Fl. Steierm. 1: 274 (1908) (Alsine austriaca (Jacq.) Wahlenb.). Laxly caespitose perennial with glabrous or sparsely glandular-pubescent stems $8-20 \mathrm{~cm}$. Leaves $10-20 \times 0.5-1 \mathrm{~mm}$, glabrous. Flowers $1-2(3)$; pedicels more than 4 times as long as sepals. Sepals $4-6 \mathrm{~mm}$, ovatelanceolate; petals slightly emarginate; petals and capsule $1 \frac{1}{2}-2$ times as long as sepals. Seeds $1-1.5 \mathrm{~mm}$, prominently tuberculate on back. $2 n=26$. Calcareous rocks and screes. - E. Alps, westwards to Alpi Bergamasche. Au Ge It Ju.
37. M. helmii (Ser.) Schischkin, Jour. Governm. Bot. Gard. Nikita 10 (2): 38 (1928). Like 36 but stems densely caespitose; plant densely glandular-pubescent; sepals obscurely veined; capsule only slightly exceeding sepals. $2 n=26$. - C. Ural. Rs (C).
38. M. villarii (Balbis) Chenevard, Annu. Cons. Jard. Bot. Gèneve 18 \& 19: 144 (1914) (M. flaccida sensu Schinz. \& Thell., Alsine villarii (Balbis) Mert. \& Koch). Like 36 in habit. Leaves $0.7-2 \mathrm{~mm}$ wide. Cymes 2 - to $4(-7)$-flowered; pedicels $1-5(-7)$ times as long as sepals. Sepals $3 \cdot 5-5 \mathrm{~mm}$; petals $1-1 \frac{1}{2}$ times as long as sepals. Capsule slightly exceeding calyx. $2 n=26$. Rocks and screes. - Mountains of S.W. Europe from Spain to S.W. Alps. Ga Hs It.
The pubescence is very variable. Completely glabrous plants are not uncommon, whilst plants with densely glandularpubescent leaves occur in the S.W. Alps.
39. M. taurica (Steven) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 758 (1918). Glandular-pubescent perennial. Leaves $5-10 \times 1 \mathrm{~mm}$. Cymes 1 - to 5 -flowered; pedicels 2-4 times as long as sepals. Sepals $4 \cdot 5-5 \mathrm{~mm}$, ovate; petals twice as long as sepals. Capsule usually included. Seeds $c .0 .75 \mathrm{~mm}$, slightly tuberculate on back. Mountain rocks. - Krym. Rs (K).
40. M. juniperina (L.) Maire \& Petitmengin, Mat. Étude Fl. Géogr. Bot. Orient 4: 48 (1908). Glandular-pubescent or glabrous, caespitose perennial; stems rigid, nodes thickened. Leaves 15-25 mm , rigid, almost spiny, usually patent, terete, with fascicles of small leaves in their axils. Cymes 4 - to many-flowered. Sepals 4-5 mm, lanceolate; petals and capsule $1 \frac{1}{2}$ times as long as sepals. Alpine and subalpine rocks. S. \& W. Greece. Gr. (S.W. Asia.)
41. M. pichleri (Boiss.) Maire \& Petitmengin, Mat. Étude Fl. Géogr. Bot. Orient 4: 48 (1908). Densely caespitose, glandularpubescent perennial. Leaves 3 -veined, somewhat falcate. Cymes 3- to 6-flowered; pedicels 3-5 times as long as sepals. Sepals ovate-lanceolate; petals $1 \frac{1}{2}$ times as long as sepals. Capsule slightly exserted. Seeds acutely tuberculate on back. Mountain rocks above 1200 m . - S. Greece (Akhaia; Lakonia). Gr.

Although very similar in appearance to 42 it is readily distinguished by the dense pubescence, herbaceous bracts and longer petals.

Sect. Tryphane (Fenzl) Hayek. Perennial. Leaves linearsubulate to setaceous; veins 3, persistent. Sepals prominently 3 -veined, patent at anthesis. Seeds rugose.
42. M. verna (L.) Hiern, Jour. Bot. (London) 37: 320 (1899) (Alsine verna (L.) Wahlenb.). Laxly caespitose perennial; stems usually glandular-pubescent above. Leaves up to 20 mm , linearlanceolate, setaceous or subulate, glabrous or glandular-pubescent, very rarely scabrid. Cymes lax, few- to many-flowered; pedicels longer than sepals. Sepals ovate-lanceolate, usually
glandular-pubescent; petals $\frac{1}{2}-1 \frac{1}{2}$ times as long as sepals. Capsule equalling or slightly exceeding sepals. Seeds $0.5-1 \mathrm{~mm}$, brown, varying from almost smooth to acutely tuberculate. Protandrous. S., W. \& C. Europe ; N. Russia. Al Au Be Br Bu Co CrCzGa Ge Gr Hb He Hs Hu It Ju Po Rm Rs (N, W) Si Tu.

Very polymorphic. The following is a conservative treatment and several of the taxa probably deserve specific rank. Further information is required on two other subspecies recognized by Hayek, subsp. grandiflora (Presl) Hayek, Österr. Bot. Zeitschr. 71:112 (1922) (Sicilia) and subsp. leptophylla (Reichenb.) Hayek, Österr. Bot. Zeitschr. 71: 112 (1922) (Balkan peninsula).
1 Petals obtuse, widest at or above the middle
2 Stems woody below; leaves linear-lanceolate, stiffly patent, margin scabrid; cymes usually more than 7-flowered
(c) subsp. valentina

2 Stems not woody below; leaves linear-subulate to setaceous, not stiffly patent, margin entire
3 Axillary vegetative fascicles of leaves present on flowering stems; cymes 6 - to many-flowered; petals equalling sepals; anthers yellow
(b) subsp. collina

3 Axillary fascicles absent; cymes 1- to 7-flowered; petals usually exceeding sepals; anthers purplish (a) subsp. verna
1 Petals acute, widest below the middle
4 Plant green, not woody below; leaves up to 11 mm ; cymes 1- to 5 -flowered; sepals $2.2-3 \mathrm{~mm}$; petals distinctly shorter than sepals
(d) subsp. oxypetala

4 Plant glaucous, woody below
5 Petals distinctly shorter than sepals; leaves up to 5 mm ; cymes 1 - to 5 -flowered; sepals $2-3.5 \mathrm{~mm} \quad$ (f) subsp. idaea
5 Petals about equalling sepals; leaves up to 10 mm ; cymes (1-)3- to 15 -flowered; sepals $3 \cdot 2-5 \mathrm{~mm}$
(e) subsp. attica
(a) Subsp. verna (M. verna subsp. gerardi (Willd.) Graebner): $2 n=24$. Throughout the range of the species but only on mountains in the south.
(b) Subsp. collina (Neilr.) Halliday, Feddes Repert. 69: 13 (1964) (M. verna subsp. montana (Fenzl) Hayek): $2 n=48$. S. \& C. Europe, from Italy and Czechoslovakia eastwards.
(c) Subsp. valentina (Pau) Font Quer, Feddes Repert. 69:13
(1964). (Alsine paui Willk.): E. Spain (Serra Espadada, north of Valencia).
(d) Subsp. oxypetala (Wołoszczak) Halliday, Feddes Repert. 69: 13 (1964): E. Carpathians.
(e) Subsp. attica (Boiss. \& Spruner) Hayek, Österr. Bot. Zeitschr. 71: 112 (1922): Kriti, Greece; perhaps also in Sicilia and S. Italy.
(f) Subsp. idaea (Halácsy) Hayek, Österr. Bot. Zeitschr. 71: 115 (1922): Kriti; N. Greece (Olimbos).
43. M. rubella (Wahlenb.) Hiern, Jour. Bot. (London) 37: 320 (1899). Like small high montane variants of 42 (a), but usually even smaller; leaves 4-8 mm, glabrous or glandular-pubescent; cymes 1 - to $2(-3)$-flowered; petals usually $\frac{2}{3}$ as long as sepals, obtuse; capsule-teeth $3-4$; seeds $0.55-0.7 \mathrm{~mm}$. Homogamous. $2 n=24,26$. Open montane habitats on basic, mineral soil. Arctic and subarctic Europe southwards to $56^{\circ} 30^{\prime} N$. in Scotland. Br Fa Fe Is No Rs (N) Sb Su.

Sect. Alsinanthe (Fenzl) Graebner. Perennial. Plant glabrous. Leaves 1 -veined, linear to subulate. Sepals erect at anthesis; petals shorter than the sepals.
44. M. stricta (Swartz) Hiern, Jour. Bot. (London) 37: 320 (1899) (Alsine stricta (Swartz) Wahlenb.). Laxly caespitose perennial; flowering stems up to 10 cm , erect. Leaves $6-12 \mathrm{~mm}$, obscurely 1 -veined. Cymes 1 - to $3(-4)$-flowered; pedicels $15-50 \mathrm{~mm}$.

Sepals 2.5-4 mm, ovate, acute, 3-veined when dry; petals slightly shorter than sepals. Capsule equalling or slightly exceeding sepals, dehiscing almost to the base with patent teeth. Seeds $0.65-0.85 \mathrm{~mm}$, reddish-brown, smooth. $2 n=22,26$. Arctic and subarctic Europe southwards to $60^{\circ} \mathrm{N}$. in Norway and Ural; N. England. Probably extinct in S.W. Germany and the French and Swiss Jura. Br Fe $\dagger \mathrm{Ga} \dagger \mathrm{Ge} \dagger \mathrm{He}$ Is No Rs (N) Sb Su.
45. M. rossii (R. Br.) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 772 (1918). Low, densely caespitose perennial with spreading flowering stems. Leaves $2-5 \mathrm{~mm}$, subulate; vegetative propagation by short detachable shoots in axils of upper leaves. Flowers solitary, rarely produced; pedicels $5-15 \mathrm{~mm}$. Sepals $1 \cdot 5-2.5 \mathrm{~mm}$, ovate-deltate; petals and capsule slightly shorter than sepals. Seeds $0.6-0.7 \mathrm{~mm}$. Spitsbergen. Sb. (Arctic and montane N. America, Greenland.)

The plants from Spitsbergen belong to the high-arctic subsp. rossii.

Sect. Spectabiles (Fenzl) Hayek. Sepals linear-oblong, obtuse, erect at anthesis. Petals usually exceeding sepals. Capsule cylindrical.
46. M. wettsteinii Mattf., Bot. Jahrb. 57 Beibl. 127: 62 (1922). Caespitose, glabrous perennial. Leaves linear, obtuse, glaucous. Cymes few-flowered. Sepals $4-5 \mathrm{~mm}, 5$-veined, somewhat fleshy; petals just exceeding sepals; glands at base of outer stamens swollen, hairy. Rocks at c. 1400 m. E. Kriti (Afendi Kavusi, N.E. of Ierapetra). Cr.
47. M. capillacea (All.) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 767 (1918) (Alsine liniflora (L.) Hegetschw.). Laxly caespitose perennial with woody stock; stems $8-30 \mathrm{~cm}$, densely glandular-pubescent above. Leaves $10-20 \times$ 0.5 mm , linear-setaceous, rigid, 1 - to 3 -veined, obtuse, ciliolate. Cymes 1 - to 6 -flowered; pedicels and sepals densely glandularpubescent. Sepals $5-7 \mathrm{~mm}$, ovate-oblong; veins 3, the outer pair disappearing in upper half; petals and capsule $1 \frac{1}{2}-2$ times as long as sepals. Seeds $1 \cdot 5-2 \mathrm{~mm}$, prominently tuberculate to almost fimbriate on back; face rugose. $2 n=26$. Calcareous rocks and screes. - Mountains of S. \& S.C. Europe from France to Jugoslavia. Ga He It Ju.
48. M. baldaccii (Halácsy) Mattf. in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 940 (1919). Perennial with thick, woody rhizomes up to 20 cm ; stems relatively short, with crowded internodes; flowering stems glandular-pubescent above. Leaves $5-15 \mathrm{~mm}$, linear-subulate, acute, often secund, ciliolate, 1 -veined. Cymes 1- to 7 -flowered. Sepals $4-7 \times 1.5 \mathrm{~mm}$, oblong, 3 -veined to apex; petals broadly obovate, $2-2 \frac{1}{2}$ times as long as sepals. Capsule equalling sepals. -W. Balkan peninsula. Al Gr Ju.
1 Leaves $5-10 \mathrm{~mm}$, densely glandular-pubescent
(c) subsp. skutariensis

1 Leaves $5-15 \mathrm{~mm}$, glabrous
2 Leaves $5-9 \mathrm{~mm}$, green; flowering stems $4-6 \mathrm{~cm}$; cymes 1 - to 3 -flowered; sepals $4-5 \mathrm{~mm}$; petals $11-12 \mathrm{~mm}$
(b) subsp. doerfleri

2 Leaves 8-15 mm, glaucous; flowering stems up to 12 cm ; cymes 1 - to 5 -flowered; sepals $5-7 \mathrm{~mm}$; petals $16-18 \mathrm{~mm}$
(a) subsp. baldaccii
(a) Subsp. baldaccii: Albania; S. Jugoslavia; N.W. Greece.
(b) Subsp. doerfleri (Hayek) Hayek, Prodr. Fl. Penins. Balcan.

1: 193 (1924): Albania; S.W. Jugoslavia.
(c) Subsp. skutariensis Hayek, Prodr. Fl. Penins. Balcan. 1: 193 (1924): N.W. Albania.
49. M. garckeana (Ascherson \& Sint.) Mattf., Feddes Repert. (Beih). 15: 192 (1922). Like 48 but stems densely caespitose, shortly rhizomatous; flowering stems up to 12 cm ; leaves somewhat fleshy; sepals $3-5 \times 0.5-1 \mathrm{~mm}$; petals 6 mm , slightly exceeding sepals. Balkan peninsula, from E. Albania and Ipiros to E. Bulgaria. Al Bu Gr Ju.
50. M. handelii Mattf., Feddes Repert. 19: 193 (1923). Like 48 but flowering stems only $0.5-1 \mathrm{~cm}$; flowers solitary; petals 5 mm , scarcely exceeding sepals. Mountain rocks. - Hercegovina (Čvrsnica). Ju.
51. M. laricifolia (L.) Schinz \& Thell., Bull. Herb. Boiss. ser. 2, 7: 403 (1907) (M. striata (L.) Mattf., Alsine laricifolia (L.) Crantz, A. striata (L.) Gren.). Perennial with stems $8-30 \mathrm{~cm}$, laxly caespitose, woody below, but less robust than 47. Leaves linear-setaceous, rigid, acute, somewhat falcate, obscurely 1 veined, glabrous, ciliolate at base. Cymes 1 - to 6 -flowered; pedicels and sepals with crispate hairs, rarely glandular-pubescent. Sepals 4-7 mm, linear-oblong, 3-veined to apex, margin usually red; petals $1 \frac{1}{2}-2$ times as long as sepals. Mountain rocks and screes. - Mountains of S. \& C. Europe from C. Spain to the Carpathians. Au Cz Ga He Hs It Po Rm.
(a) Subsp. laricifolia (incl. subsp. diomedis (Br.-Bl.) Mattf.): Sepals $4-5 \cdot 5 \mathrm{~mm}$, sometimes glandular. Capsule $1-1 \frac{1}{2}$ times as long as sepals; seeds $0.8-1 \mathrm{~mm}$, rugose on back. Calcifuge. From Spain to N. Appennini and to c. $12^{\circ} 30^{\prime}$ E. in Austria.
(b) Subsp. kitaibelii (Nyman) Mattf., Feddes Repert. (Beih.) 15: 190 (1922). More robust than (a). Sepals $5-7 \mathrm{~mm}$, eglandular; petals and capsule $1 \frac{1}{2}-2$ times as long as sepals. Seeds $1 \cdot 2-1.5 \mathrm{~mm}$, tuberculate on back. $2 n=26$. Calcicole. E. Austrian Alps; Carpathians.

Often regarded as a species.
52. M. macrocarpa (Pursh) Ostenf., Meddel. Gronl. 37: 226 (1920). Caespitose perennial; flowering stems 2-6 cm, glandularpubescent. Leaves $5-12 \mathrm{~mm}$, linear-oblong, obtuse, distinctly ciliate. Flowers solitary; pedicels $5-13 \mathrm{~mm}$. Sepals $5-7 \mathrm{~mm}$, linear-oblong, glandular-pubescent; petals usually $1 \frac{1}{2}-2$ times as long as sepals. Capsule $2-2 \frac{1}{2}$ times as long as sepals. Seeds $2-2.5 \mathrm{~mm}$, fringed on back with very long fine tubercles. N. Ural (mouth of Kara river). Rs (N). (Siberia.)
53. M. arctica (Ser.) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 772 (1918). Densely caespitose perennial; flowering stems $5-9 \mathrm{~cm}$, glandular-pubescent. Leaves 616 mm , narrowly linear, cilia usually absent; leaves of flowering stems shorter and wider. Flowers solitary, rarely in pairs. Sepals $5-7 \mathrm{~mm}$, linear-oblong, glandular-pubescent; petals twice as long as sepals. Capsule $1 \frac{1}{2}-2$ times as long as sepals. Seeds $1-1.5 \mathrm{~mm}$, bluntly tuberculate on back. N. Ural (mouth of Kara river). Rs (N). (Siberia.)
54. M. biflora (L.) Schinz \& Thell., Bull. Herb. Boiss. ser. 2, 7: 404 (1907) (Alsine biflora (L.) Wahlenb.). Slender, caespitose perennial with flowering stems up to 10 cm . Leaves up to 10 mm , linear, obtuse, 1 -veined. Flowers $1-3$; pedicels and sepals sparsely pubescent. Sepals (3-)3.5-4.5(-5) mm, ovate-oblong, cucullate, 3 -veined; petals 0.5 mm wide, $1-1 \frac{1}{2}$ times as long as sepals, occasionally pale lilac. Capsule $1 \frac{1}{2}$ times as long as sepals. Seeds 0.7 mm , smooth on back. Damp open habitats in the mountains, often in snow-patches. N. Europe, southwards to $59^{\circ} \mathrm{N}$. in Norway and Ural; C. \& E. Alps. Au Fe He Is It No Rs (N) Sb Su.
55. M. olonensis (Bonnier) P. Fourn., Quatre Fl. Fr. 309

[^62](1936). Perennial; stems $3-10 \mathrm{~cm}$. Leaves crowded below, more than 1 mm wide. Flowers $1-3$. Sepals obtuse; scarious margin narrow. Petals $1 \frac{1}{2}$ times as long as sepals. Maritime rocks and sands. - W. France (Vendée). Ga.

The existence of this species is doubtful.
Sect. Cherleria (L.) Mattf. Perennial. Leaves somewhat fleshy. Sepals obtuse; petals absent or rudimentary; glands of outer stamens prominent, deeply divided.
56. M. sedoides (L.) Hiern, Jour. Bot. (London) 37: 321 (1899) (Alsine sedoides (L.) Kittel, A. cherleri Fenzl). Glabrous, densely pulvinate perennial. Leaves $3 \cdot 5-6 \mathrm{~mm}$, densely imbricate, linear-lanceolate, 3 -veined, furrowed above; margins scabrid. Flowers solitary; scarcely exserted from cushion; pedicels up to $3(-5) \mathrm{mm}$. Sepals $2-5 \mathrm{~mm}$, linear; either the stamens or the ovary may abort. Capsule $1 \frac{1}{2}-2$ times as long as sepals. Seeds $0 \cdot 8-$ 1 mm , smooth. $2 n=26,51-52$. Rock-ledges, exposed ridges, moraines. Pyrenees; Alps; Carpathians; Scotland. Au Br $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm}$.

Subgen. Rhodalsine (Gay) Graebner. Perennial. Flowers usually pale pink. Radicle of embryo accumbent.
57. M. geniculata (Poiret) Thell., Fl. Adv. Montpellier 232 (1912) (Rhodalsine geniculata (Poiret) F. N. Williams; incl. M. procumbens (Vahl) Graebner). Glandular-pubescent perennial; stems up to 30 cm , woody at base, procumbent and ascending, geniculate, much-branched. Leaves (4-)6-10(-12) $\times(0.5-) 1-$ $2(-2 \cdot 5) \mathrm{mm}$, elliptical to linear, with one prominent vein beneath. Flowers axillary and in terminal cymes; pedicels $1 \frac{1}{2}-6$ times as long as sepals. Sepals $3-4 \mathrm{~mm}$, oblong-ovate, usually obtuse, appearing veinless, with a wide scarious margin; petals and capsule about equalling sepals. Seeds $0.5-0.8 \mathrm{~mm}$, margin slightly rugose. Dry sandy places, often by the sea. Mediterranean region; Portugal. Bl Gr Hs It Lu Sa Si.

Very variable, particularly in leaf-shape and pubescence.

## 4. Honkenya Ehrh. ${ }^{1}$

Like Minuartia but succulent; capsule globose; seeds more than 3 mm , pyriform. (Ammadenia Rupr.)

1. H. peploides (L.) Ehrh., Beitr. Naturk. 2: 181 (1788) (Ammadenia peploides (L.) Rupr.). Glabrous, hermaphrodite or dioecious perennial with trailing, succulent stems rooting at the nodes. Leaves $5-20 \times 5-10 \mathrm{~mm}$, ovate to oblong, 1 -veined, acute. Flowers axillary and solitary, and in 1- to 6 -flowered terminal cymes; pedicels usually $2-6 \mathrm{~mm}$. Sepals $3-5 \mathrm{~mm}$, ovate, 1 -veined; petals greenish-white, equalling sepals in male flowers, shorter than sepals in female flowers. Capsule (4-)6-10 mm wide, globose, twice as long as sepals. Seeds $3-4(-4 \cdot 5) \mathrm{mm}$, usually 3-8, dark reddishbrown, shiny, almost smooth. $2 n=66,68-70$. Maritime sands and shingle, very rarely inland. Coasts of $N . \& W$. Europe; Ural. Be Br Da Fa Fe Ga Ge Hb Ho Hs Is Lu No Po Rs (N, B, C) SbSu.

Plants from Iceland and arctic Europe have similar chromosome number, but usually have a more diffuse growth, pedicels $4-15 \mathrm{~mm}$, and capsules with usually $4-12$ seeds. They have been given specific rank, but are here treated as var. diffusa (Hornem.) Ostenf.

## 5. Bufonia L. ${ }^{1}$

Annual or perennial herbs; rarely biennial; stems usually branched from the base; flowering stems erect. Leaves linear-
setaceous, appressed, those of the flowering stems shorter than the internodes. Inflorescence a cymose panicle; pedicels short; flowers self-pollinated. Sepals 4, the two outer being shortest, lanceolate, with a hyaline margin; petals 4 , equalling or shorter than the sepals, white; stamens 2-8; styles 2. Capsule included, dehiscing with 2 teeth. Seeds 1-2, oblong, compressed, tuberculate.

All species occur in dry, sandy or rocky habitats.
1 Annual, or rarely biennial, without vegetative stems at time of flowering
2 Sepals with 5 veins, 3 of which continue into the upper half; seeds usually more than 1.5 mm , with prominent, obtuse tubercles

1. paniculata

2 Sepals 3 -veined; veins confluent in upper half; seeds $1-1.5 \mathrm{~mm}$, with small, acute tubercles
2. tenuifolia

1 Perennial, with vegetative stems at time of flowering
3 Flowering stems usually unbranched, arcuate
7. stricta

3 Flowering stems branched above, straight
4 Petals exceeding outer sepals
4. macropetala

4 Petals not exceeding outer sepals
5 Inflorescence dense; branches strict; flowers overlapping
3. tuberculata

5 Inflorescence lax; branches usually divergent; flowers not overlapping
6 Outer sepals $2-2.5 \mathrm{~mm}$; seeds $1-1.3 \mathrm{~mm}$
6 Outer sepals 3-3.5 mm; seeds $1.5-2 \mathrm{~mm}$
5. willkommiana
6. perennis

1. B. paniculata F. Dubois in Delarbre, Fl. Auvergne ed. 2, 300 (1800) (B. macrosperma Gay ex Mutel). Annual up to 20 cm , usually richly and divaricately branched. Sepals lanceolate, acute; veins 5 , distinct, 3 continuing almost to the apex; petals almost equalling outer sepals. Capsule $2-3 \mathrm{~mm}$. Seeds $1 \cdot 5-$ 2.25 mm , oblong-elliptic; margin with prominent obtuse tubercles; faces rugose. S. Europe, extending northwards to C. France and Switzerland. Ga Gr He Hs It Ju Sa.
2. B. tenuifolia L., Sp. Pl. 123 (1753) (B. parvifora Griseb.). Like 1 but usually less robust and smaller in all its parts. Sepals strongly acuminate; veins 3 , confluent in upper half; petals half as long as outer sepals; stamens 2-3. Capsule 1.5 mm . Seeds $1-1.5 \mathrm{~mm}$; margin with small acute tubercles; faces almost smooth. S. Europe, extending north-eastwards to Ukraine. Bu Ga Gr Hs It Ju Rm Rs (W, K).
The plants from Ukraine include specimens intermediate between 1 and 2.
3. B. tuberculata Loscos, Trat. Pl. Arag. 3, Suppl. 8: 104 (1886). Erect perennial. Leaves setaceous, serrulate, glaucous. Inflorescence dense; branches strict; flowers usually overlapping. Sepals lanceolate, the outer $3.5-4.5 \mathrm{~mm}$; veins usually 5 ; petals and capsule slightly shorter than outer sepals. Seeds $1 \cdot 75-2 \mathrm{~mm}$, 1-2 per capsule; margin with prominent oblong-cylindrical tubercles. - E. Spain (mountains N.W. of Valencia). Hs.

The available descriptions of this species are inadequate, and it may prove to be only a perennial variant of 1 .
4. B. macropetala Willk., Flora (Regensb.) 34: 604 (1851). Perennial with glabrous, erect stems branched above. Leaves linear-subulate; margins ciliolate. Sepals lanceolate, the outer $3.5-4.5 \mathrm{~mm}$; veins 5 , the outer often obscure; petals oblong, about equalling inner sepals. Capsule often 1 -seeded. Seeds tuberculate on margin. - C. Spain. Hs.
5. B. willkommiana Boiss., Diagn. Pl. Or. Nov. 3 (1): 83 (1853). Perennial with robust erect stems, woody below, shortly branched

[^63]above. Leaves linear-setaceous; margins ciliolate. Inflorescence lax; cymes 1 - to $3(4)$-flowered; branches patent. Sepals ovatelanceolate, the outer $2-2.5 \mathrm{~mm}$; veins $3-5$; petals and capsule equalling outer sepals. Seeds $1-1.3 \mathrm{~mm}, 1-2$ per capsule; margin with low tubercles. - S. Spain and Portugal. Hs Lu.
6. B. perennis Pourret, Mém. Acad. Toulouse 3: 309 (1788). Perennial with robust stems up to 30 cm . Leaves rigid, erect, linear-setaceous, the basal $1-2 \mathrm{~cm}$; margins serrulate. Inflorescence lax; cymes 1- to 2 -flowered; branches patent. Sepals lanceolate-acuminate, the outer $3-3 \cdot 5 \mathrm{~mm}, 5$-veined below; petals about equalling outer sepals; stamens 8 . Seeds $1 \cdot 5-2 \mathrm{~mm}, 1-2$ per capsule, with prominent tubercles on margin; faces rugose. - S. France. Ga.
7. B. stricta (Sibth. \& Sm.) Gürke in K. Richter, Pl. Eur. 2: 247 (1899). Perennial with erect, arcuate, slender, usually unbranched flowering stems, woody below. Leaves of flowering stems short, subulate, often closely appressed. Flowers few, often 1. Outer sepals $3.5-4 \mathrm{~mm}$; veins 5 ; petals equalling outer sepals. Seeds small; margins tuberculate; faces smooth. - S. Greece (Imittos); Kriti. Cr Gr.

The flowering stems bear a striking, superficial resemblance to those of Parapholis strigosa (Gramineae).

## 6. Stellaria L. ${ }^{1}$

Annual or perennial herbs. Inflorescence usually a dichasium; flowers rarely solitary or 2 together; bracts scarious or herbaceous. Sepals 5 ; petals 5 or fewer, or absent, white, rarely greenish, usually deeply bifid; stamens 10(11) or fewer or absent; nectaries usually present; styles 3 . Fruit a globose to cylindrical capsule, dehiscing with 6 teeth usually to about the middle.
1 At least the lower leaves distinctly petiolate; leaves never linear-lanceolate or linear
2 Stems hairy all round
3 Petals equalling or slightly exceeding sepals (3-5). media group
3 Petals about twice as long as sepals
4 Sepals broadly ovate, pubescent beneath all over, margins narrowly scarious; ripe capsule equalling or only slightly exceeding sepals
2. bungeana

4 Sepals lanceolate, pubescent only at base, margins broadly scarious; ripe capsule $1 \frac{1}{2}-2$ times as long as sepals

1. nemorum

2 Stems with a single line of hairs down each internode, rarely with 2 lines or glabrous
5 Stems quadrangular; bracts scarious 7. alsine
5 Stems terete; bracts herbaceous (3-5). media group
1 All leaves sessile
6 Bracts herbaceous
7 Petals bifid to about half-way or less
8 Leaves $30-80 \mathrm{~mm}$
6. holostea

8 Leaves not more than 10 mm (11-13). longipes group
7 Petals bifid almost to the base
9 Bracts and leaves ciliate; largest leaves usually 15 mm or more 15. calycantha
9 Bracts and leaves not ciliate; leaves usually less than 15 mm
10 Leaves 2-8 mm; sepals $3.5-6 \mathrm{~mm}$, equalling ripe capsule; seeds $\pm$ smooth
17. humifusa

10 Leaves 6-15(-25) mm; sepals 2-3 mm, shorter than ripe capsule; seeds rugose
16. crassifolia

6 Bracts scarious, with green midrib, or entirely scarious
11 Angles of upper part of stems and margins of leaves rough with papillae
12 Sepals $5-7 \mathrm{~mm}$; petals equalling or up to twice as long as sepals
8. palustris

12 Sepals $2-4 \mathrm{~mm}$; petals equalling sepals
14. longifolia
11 Stems and margins of leaves smooth
13 Leaves elliptic, ovate or ovate-lanceolate, usually less than15 mm
14 Stems terete; leaves thick, rigid (11-13). longipes group
14 Stems quadrangular; leaves thin
15 Sepals not ciliate; ripe capsule pale brown (not Arctic)7. alsine
15 Sepals ciliate; ripe capsule dark brown or blackish(Arctic)(11-13). longipes group
13 Leaves attenuate-triangular to linear-lanceolate, usuallymore than 15 mm
16 Sepals pubescent beneath towards apex ..... 9. hebecalyx
16 Sepals glabrous (rarely puberulent) towards apex
17 Inflorescence usually 10 - to 60 -flowered; bracts usuallyciliate 10. graminea
17 Inflorescence usually 2- to 9-flowered; bracts not ciliate
18 Sepals lanceolate, acute; plant usually more than 25 cm
8. palustris
18 Sepals ovate-lanceolate, obtuse; plant usually less than 25 cm (Arctic) (11-13). longipes group

1. S. nemorum L., Sp. Pl. 421 (1753). Stoloniferous perennial herb; stems up to 65 cm , terete, hairy all round, usually branched only in the lax, many-flowered inflorescence. Lower leaves ovate, acute, with long petioles; upper usually sessile, acuminate. Sepals $6-7 \mathrm{~mm}$, lanceolate, glabrous, or pubescent only at the base, margins narrowly scarious; petals twice as long as sepals, bifid almost to base. Seeds $1-1.3 \mathrm{~mm}$. Most of Europe, except the extreme north and south. Al Au Be Br Bu Co Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju No Po Rm Rs (N, B, C, W, E) Su.
(a) Subsp. nemorum: Bracts decreasing gradually in size at each dichotomy, the second pair usually more than $\frac{1}{3}$ of length of first. Ripe seeds with rows of hemispherical tubercles on margins. Throughout the range of the species.
(b) Subsp. glochidisperma Murb., Lunds Univ. Arsskr. 27 (5): 156 (1892): Bracts decreasing abruptly in size after first dichotomy, second pair usually less than $\frac{1}{3}$ of length of first, third pair $1-2 \mathrm{~mm}$, scale-like. Ripe seeds with cylindrical papillae on margins. Mainly in W. \& C. Europe, extending from Britain (Wales) and C. Spain to S. Sweden, S.E. Austria and C. Jugoslavia.
2. S. bungeana Fenzl in Ledeb., Fl. Ross. 1: 376 (1842). Like 1 (a) but upper leaves acute to subacuminate; sepals $5-6 \mathrm{~mm}$, ovate, obtuse, pubescent beneath all over, margins narrowly scarious; seeds $1 \cdot 3-1 \cdot 5 \mathrm{~mm}$. Woods and shady ravines. $N . \& E$. Russia. Rs (N, C, E). (N. \& E. Asia.)
(3-5). S. media group. Annual; stems terete. At least the lower leaves petiolate. Petals bifid almost to the base.

The species of this group are extremely variable and almost all their characters show some overlap, though they can usually be readily distinguished when all the relevant characters are considered together. They are mostly autogamous, and so far as is known separated by sterility barriers.
1 Stems hairy all round
3. media

1 Stems with 1(2) lines of hairs, or rarely glabrous
2 Stamens (2-)10(11); seeds usually $1 \cdot 1-1.7 \mathrm{~mm}$; petals equalling or exceeding sepals 4. neglecta
2 Stamens (0-)3-5(-10); seeds usually less than 1.3 mm ; petals usually shorter than sepals, or absent
3 Sepals usually less than 3 mm ; seeds usually less than 0.8 mm , light yellowish-brown; petals absent (rarely minute)
5. pallida

3 Sepals usually more than 3 mm ; seeds usually more than 0.8 mm , dark reddish-brown; petals present (rarely minute or absent)
3. media
3. S. media (L.) Vill., Hist. Pl. Dauph. 3: 615 (1789). Stems up to 90 cm . Lower leaves ovate, acute or acuminate, with long petioles; upper more or less sessile. Inflorescence few- or manyflowered; pedicels patent or erect in fruit. Sepals $3-7 \mathrm{~mm}$; petals shorter than or slightly longer than sepals; stamens (0-)3-10. Seeds usually $0.8-1.4 \mathrm{~mm}$, usually dark reddish-brown. Mainly ruderal and as a weed of cultivation. Throughout Europe. Present in all territories, but probably only as an alien in the extreme north.

1 Upper part of stems with 1 (2) lines of hairs, or rarely glabrous
(a) subsp. media

1 Upper part of stems hairy all round
2 Lower part of stems with 1 line of hairs; petals equalling or shorter than sepals
(b) subsp. postii

2 Lower part of stems usually hairy all round; petals equalling or longer than sepals
(c) subsp. cupaniana
(a) Subsp. media: Stems up to 40 cm , with 1(2) lines of hairs, or rarely glabrous. Leaves usually glabrous. Inflorescence glandular, usually lax or dense. Sepals usually $3-5 \mathrm{~mm}$; petals equalling or slightly shorter than sepals; stamens (0-)3-5(-10). Seeds usually $0.8-1 \cdot 3 \mathrm{~mm}$, with rounded, rarely conical tubercles. $2 n=40,42,44$. Throughout the range of the species.

Var. apetala Gaudin, with sepals $3-4 \mathrm{~mm}$, petals minute or absent, and condensed inflorescences, has often been confused with 5.
(b) Subsp. postii Holmboe, Bergens Mus. Skr. 1 (2): 70 (1914): Stems up to 60 cm , with one line of hairs down each of the lower internodes, glandular-pubescent all round above. Leaves puberulent above. Inflorescence glandular-pubescent, dense. Sepals $4 \cdot 5-6.5 \mathrm{~mm}$; petals equalling or slightly shorter than sepals; stamens usually $5-10$. Seeds $1-1.3 \mathrm{~mm}$, with conical tubercles. S. Balkan peninsula and Aegean region.
(c) Subsp. cupaniana (Jordan \& Fourr.) Nyman, Consp. 111 (1878): Stems up to 90 cm , pubescent all round usually throughout, usually glandular. Leaves puberulent or pubescent, often glandular. Infiorescence densely glandular-pubescent, lax. Sepals usually $6-7 \mathrm{~mm}$; petals equalling or slightly longer than sepals; stamens usually 10 . Seeds usually $1.3-1.5 \mathrm{~mm}$, with conical tubercles. W. \& C. Mediterranean region.

Plants intermediate between subspp. (b) and (c) occur in the E. Mediterranean region. 3 (b) and (c) appear to be distinguishable from 4 by the pubescence of the stems and inflorescences, and intermediates between the species do not seem to occur; but their relationship requires further study.
4. S. neglecta Weihe in Bluff \& Fingerh., Comp. Fl. Germ. 1: 560 (1825). Stems up to 80 cm , with 1 line of hairs down each internode, eglandular. Lower leaves ovate, subcordate at base, acute or acuminate, more or less glabrous, petiolate; upper leaves usually sessile. Inflorescence few- or many-flowered; pedicels long, slender, usually deflexed in fruit. Sepals usually $5-6.5 \mathrm{~mm}$; petals equalling or slightly exceeding sepals; stamens (2-)10(11). Seeds usually more than 1.1 mm , often $1.3-1.6 \mathrm{~mm}$, usually dark reddish-brown, with conical tubercles. $2 n=22$. W., S. \& C. Europe, extending to $S$. Sweden and $S$. Ukraine. Al Au Be Br Co Cz Da Ge Hb He Ho Hs It Ju Po Rm Rs (W, K) Sa Si Su.
5. S. pallida (Dumort.) Piré, Bull. Soc. Bot. Belg. 2: 49 (1863) (S. apetala auct., non Ucria). Stems up to 30 cm , very slender, with 1 line of hairs down each internode, rarely glabrous. Leaves ovate, subacute, glabrous, usually all petiolate. Inflorescence few- or many-flowered; pedicels short, filiform, patent or erect in fruit. Sepals usually less than 3 mm , often grey-tomentose; petals absent (or minute); stamens $1-3$, very rarely 5 . Seeds usually less than 0.8 mm , pale yellowish-brown, rarely dark
brown, with rounded or conical tubercles. $2 n=22$. Usually on sandy soils. W., S. \& C. Europe, extending to S. Sweden, Latvia and Ukraine. Al Au Be Bl Br Bu Co Cr Cz Da Ga Ge Gr Hb He Ho Hs Hu It Ju Po Rm Rs (B, W, K) Sa Si Su.
6. S. holostea L., Sp. Pl. 422 (1753). Perennial; stems up to 60 cm , ascending, weak, diffuse, sharply quadrangular, usually rough. Leaves $30-80 \mathrm{~mm}$, lanceolate-acuminate, rough on margins and on midrib beneath. Inflorescence lax; flowers $15-30 \mathrm{~mm}$ in diameter. Sepals $6-9 \mathrm{~mm}$; petals up to twice as long as sepals, bifid to about half-way, rarely absent. $2 n=26$. Europe northwards to $63^{\circ} \mathrm{N}$. in Finland, but absent from many of the islands and much of S.E. Russia, and rare in the Mediterranean region. Au Be Br Bu Cz Da Fe Ga Ge Gr Hb He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, ?K, E) Su Tu.
7. S. alsine Grimm, Nova Acta Acad. Leop.-Carol. 3, app: 313 (1767) (S. uliginosa Murray). Creeping perennial; stems up to 40 cm , procumbent to ascending, quadrangular, glabrous, smooth. Leaves up to $15(-20) \mathrm{mm}$, elliptical to ovate-lanceolate, acute, sessile, or long-petiolate on overwintering vegetative shoots. Bracts scarious, with green midrib, not ciliate. Calyx infundibular at base; sepals $2.5-3.5 \mathrm{~mm}$, exceeding petals; stamens 10. $2 n=24$. Most of Europe, northwards to $67^{\circ} \mathrm{N}$. in Norway, but only on mountains in the south. Au Be Br Bu Co Cz Da Fa Fe Ga Ge Gr Hb He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W) Su .

Very variable in habit and in the size and shape of the leaves.
8. S. palustris Retz., Fl. Scand. Prodr. ed. 2, 106 (1795). Creeping perennial, entirely glabrous; stems up to 60 cm , erect, quadrangular, usually smooth. Leaves $15-20 \mathrm{~mm}$, linear-lanceolate, smooth, glaucous or green. Inflorescence lax, usually 2- to 9 -flowered; bracts scarious, with green midrib. Sepals $5-7 \mathrm{~mm}$ lanceolate, acute; petals equalling or up to twice as long as sepals, bifid almost to base. N.\& C. Europe, extending southwards to Corse, Bulgaria and Ukraine. Au Be Br Bu Co Cz Da Fe Ga Ge He Ho Hu It Ju No Po Rm Rs (N, B, C, W, E) Su.
S. fennica (Murb.) Perf., Bot. Žur. 2-3: 152 (1941) is like 8 but has the angles of the stems and the margins of the leaves rough with small papillae (as in 14), and has the sepals only $4-$ 5 mm long. In N . Fennoscandia intermediates are found between it and 8 , though further east it appears as a distinct species. More investigation is required before its appropriate taxonomic rank can be decided.
9. S. hebecalyx Fenzl in Rupr., Beitr. Pfl. Russ. Reich. 2: 26 (1845). Like 8 but leaves $8-25 \mathrm{~mm}$, triangular-lanceolate, narrowed evenly to subacute or obtuse apex; bracts sometimes ciliate towards apex; sepals $4-5 \cdot 5 \mathrm{~mm}$ ciliate, ovate-lanceolate, pubescent beneath towards apex. River-banks and ground subject to flooding. N. \& E. Russia. Rs (N, C, E). (Siberia.)

Very variable. In N. Russia it sometimes appears intermediate between 8 and $\mathbf{1 0}$; and in W. Siberia it sometimes resembles species of the S. longipes group. In Europe, however, it can always be distinguished from any other allied species by the pubescence on the back of the sepals.
10. S. graminea L., Sp. Pl. 422 (1753). Perennial; stems up to 90 cm , ascending, weak, diffuse, usually much-branched, quadrangular, smooth. Leaves up to 5 cm , linear- to elliptic-lanceolate, acute, smooth. Inflorescence lax, usually 10 - to 60 -flowered; bracts scarious, usually ciliate; flowers $5-12 \mathrm{~mm}$ in diameter, very variable. Sepals $3-7 \mathrm{~mm}$, usually ciliate, sometimes pubescent beneath but only near base, glabrous (rarely puberulent) in
upper half; petals shorter than or exceeding sepals. $2 n=26$. Europe, except the extreme south and many of the islands. All except Az Bl Cr Fa Sa Sb Si ?Tu.

The flowers are large in hermaphrodite plants, and small in partly or completely male-sterile plants.
(11-13). S. longipes group. Shortly creeping or caespitose perennials. Leaves ovate to linear-lanceolate, sessile.

This group has been reviewed by E. Hultén, Bot. Not. 1943: 251 (1943) and by T. W. Böcher, Bot. Tidsskr. 48: 401 (1951). The three species given below are morphologically quite distinct within Europe, but in other areas the situation is less clear, and a satisfactory interpretation of the group cannot be made without further investigation.

1 Sepals ciliate
13. ciliatisepala

1 Sepals not ciliate
2 Leaves ovate to ovate-lanceolate, thick, rigid; short, condensed non-flowering shoots usually present in axils of some upper leaves 12. crassip
2 Leaves linear-lanceolate, thin; short, condensed non-flowering shoots not present in axils of upper leaves
11. longipes
11. S. longipes Goldie, Edinb. Philos. Jour. 6: 327 (1822) (?S. peduncularis Bunge). Creeping or caespitose perennial; stems up to 25 cm , usually ascending, laxly branched, quadrangular; sometimes with non-flowering branches in axils of upper leaves, but never with the condensed shoots typical of 12. Leaves linear-lanceolate, thin, very acute. Inflorescence usually several-flowered. Sepals $3-7 \mathrm{~mm}$, ovate-lanceolate, obtuse, not ciliate, glabrous; petals exceeding sepals. Ripe capsule $1 \frac{1}{2}-2$ times as long as sepals, dark brown or blackish; teeth straight. Spitsbergen and Kolguev. Rs (N) Sb. (Arctic Asia and America.)
12. S. crassipes Hultén, Bot. Not. 1943: 261 (1943) (S. longipes auct.). Shortly creeping or caespitose perennial; stems $2-10 \mathrm{~cm}$, terete; short, condensed non-flowering shoots usually present in axils of some upper leaves. Leaves $3-15 \times 2-4 \mathrm{~mm}$, ovate to ovate-lanceolate, thick, rigid. Flowers usually solitary; pedicels short, stout. Sepals $3-4 \mathrm{~mm}$, shorter than petals. Ripe capsule shorter than calyx, light brown; teeth recurved. $2 n=104$. Spitsbergen, N.W. Fennoscandia and C. Norway (Dovrefjell). No Sb Su.
13. S. ciliatisepala Trautv. in Middendorff, Reise Nord. Östen Sibir. 1 (2) 1: 52 (1856) (S. longipes auct., S. edwardsii auct.). Very variable. Shortly creeping perennial; stems up to 20 cm , quadrangular, lacking condensed non-flowering shoots in axils of upper leaves. Leaves up to 10 mm , ovate to ovate-lanceolate. Inflorescence few-, rarely 1 -flowered; bracts scarious, ciliate. Sepals ciliate, sometimes pubescent beneath but only near base. Ripe capsule exceeding calyx, dark-brown or blackish. Spitsbergen, and E. part of arctic Russia. Rs (N) Sb. (Circumpolar.)
14. S. longifolia Muhl. ex Willd., Enum. Pl. Hort. Berol. 479 (1809). Creeping perennial; stems 5-25 cm, ascending, branched, quadrangular; angles of upper part of stem, margins of leaves and under side of midrib rough with small papillae. Leaves $5-40 \mathrm{~mm}$, linear-lanceolate to linear. Inflorescence many-flowered; bracts scarious, often with green midrib. Sepals $2-4 \mathrm{~mm}$, glabrous; petals equalling sepals. Ripe capsule slightly exceeding sepals. C. Europe ; Fennoscandia; C. \& N. Russia. Au Cz Fe Ge He It No Po Rm Rs (N, B, C, W, E) Su.

In the opinion of some authors the plants from Europe and Asia are distinct from S. longifolia from North America. They have been called S. diffusa Schlecht., Ges. Nat. Freunde Berlin

Mag. 7: 195 (1815), but the characters used for separating them are unreliable.
15. S. calycantha (Ledeb.) Bong., Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 6, 2: 127 (1832). Shortly creeping or caespitose perennial; stems $10-45 \mathrm{~cm}$, quadrangular, smooth or slightly rough. Leaves $10-30 \times 2-8 \mathrm{~mm}$, ovate- to linearlanceolate, usually pale yellowish-green, margins papillose and ciliate. Flowers few or solitary; bracts herbaceous, ciliate. Sepals $2-3.5 \mathrm{~mm}$; petals shorter than sepals, or absent. Ripe capsule nearly twice as long as sepals. $2 n=52$. Arctic and subarctic Europe, from Bjornoya to C. Ural. Fe Is No Rs (N, C) Sb Su.
16. S. crassifolia Ehrh., Hannover. Mag. 8: 116(1784). Creeping perennial; stems $3-45 \mathrm{~cm}$, usually ascending, laxly branched, quadrangular, glabrous, smooth. Leaves $6-25 \times 2-6 \mathrm{~mm}$, ovate to linear-lanceolate, acute, sessile, usually somewhat fleshy, margins smooth, not ciliate. Flowers solitary or in few-flowered leafy cymes; bracts herbaceous, not ciliate; flowers $5-8 \mathrm{~mm}$ in diameter. Sepals $2-3 \mathrm{~mm}$, linear-lanceolate, acute; petals exceeding sepals. Ripe capsule exceeding and up to twice as long as sepals. Seeds rugose. $2 n=26$. N. Europe, extending locally southwards to N. (formerly to S.) Germany and C. Ukraine. Da Fe Ge Is No Po Rs (N, B, C, W, E) Su.
17. S. humifusa Rottb., Kong. Danske Vid. Selsk. 10: 447 (1770). Like 16 but stems usually procumbent, matted; leaves $2-8 \times 1-4 \mathrm{~mm}$, usually crowded; plant often reproducing by vegetative buds in axils of leaves; flowers $8-16 \mathrm{~mm}$ in diameter; sepals $3 \cdot 5-6 \mathrm{~mm}$, ovate-lanceolate, subacute; ripe capsule usually equalling sepals; seeds almost smooth. $2 n=26$. Coasts of arctic and subarctic Europe, southwards to c. $64^{\circ}$ N. in N.W. Russia; one station at head of Gulf of Bothnia. Fe Is No Rs (N) Sb.

## 7. Pseudostellaria Pax ${ }^{1}$

Like Stellaria, but bearing small napiform tubers laterally on the rhizomes. (Krascheninnikowia Turcz., non Gueldenst.)

The other species in this genus are from Asia, and are further characterized by small, fertile cleistogamous flowers, without petals and with 4 sepals (the larger outer pair enclosing the smaller inner pair), which are borne on the lower parts of the plant. The European species rarely produces these cleistogamous flowers and, since its petaliferous flowers are probably always sterile, propagation is largely by the tubers.

1. P. europaea Schaeftlein, Phyton (Austria) 7: 190 (1957) (Stellaria bulbosa Wulfen, non Pseudostellaria bulbosa (Nakai) Ohwi). Perennial herb; stems $5-15 \mathrm{~cm}$, usually simple, terete, with 1 line of hairs. Leaves sessile, elliptical to lanceolate, acute. Flowers $1-3,9-13 \mathrm{~mm}$ in diameter. Sepals $4-7 \mathrm{~mm}$; petals equalling or exceeding sepals, bifid to less than half-way. $2 n=32$. Damp and shady places. - S.E. Austria and N. Jugoslavia; N.W. Italy (Vercelli prov.). Au It Ju.

## 8. Holosteum L. ${ }^{2}$

Annual. Inflorescence terminal, umbellate. Petals irregularly toothed; styles 3. Fruit a cylindrical capsule. Seeds asymmetrically reniform and laterally expanded.

1. H. umbellatum L., Sp. Pl. 88 (1753). Erect, simple or branched, up to $20(-35) \mathrm{cm}$, usually glaucous towards base, and

[^64]variably glandular-viscid. Basal leaves oblanceolate, narrowed into petiole; cauline elliptical, sessile; all leaves acute, entire. Flowers in simple umbels on slender pedicels of varying length; pedicels deflexed in young fruiting stage. Petals white or pale pink, about twice as long as sepals. Capsule cylindrical, somewhat narrowed above, twice as long as sepals. Seeds $0 \cdot 5-1 \mathrm{~mm}$, reddish-brown. On light often sandy soils, usually in disturbed habitats. Most of C., E. \& S. Europe, extending northwards to S. Sweden and England. Au Be Br Bu Cr Cz Da Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs (B, C, W, K, E) Sa Si Su Tu.

## Very variable in habit and indumentum.

(a) Subsp. umbeliatum: Glandular hairs more or less confined to middle part of stem and margin of leaves. Stamens usually 3-5. $2 n=20$. Throughout the range of the species.
(b) Subsp. glutinosum (Bieb.) Nyman, Consp. 112 (1878) (H. glutinosum (Bieb.) Fischer \& C. A. Meyer): Whole plant, except leaf-surfaces, more or less viscid with a dense glandular pubescence. Stamens usually 8-10. Mainly in S.E. Europe.

## 9. Cerastium L. ${ }^{3}$

Herbs, sometimes slightly woody at base, usually hairy. Flowers usually in cymose inflorescences, sometimes solitary. Sepals free; petals white, usually bifid or emarginate, sometimes absent; stamens 5-10, rarely fewer; nectaries present; styles usually 5 , opposite the sepals, sometimes 3,4 or 6 . Fruit a cylindrical or oblong capsule, often more or less curved, dehiscing with twice as many teeth as styles. Seeds numerous, spherical or reniform.
Literature: A. Buschmann, Feddes Repert. 43: 118-43 (1938). H. Gartner, Feddes Repert. (Beih.) 113: 1-96 (1939). E. Hultén, Svensk Bot. Tidskr. 50: 411-95 (1956). A. Lonsing, Feddes Repert. 46: 139-65 (1939). W. Möschl, Feddes Repert. 41: 15363 (1936). W. Möschl, Agron. Lusit. 13: 23-66 (1951).
1 Styles 3,4 , or 6: capsule-teeth 6,8 or 12
2 Petals shorter than sepals
49. diffusum

2 Petals $1 \frac{1}{3}-2$ times as long as sepals
3 Stem decumbent or ascending, glabrous except for a line of eglandular hairs down each internode

1. cerastoides

3 Stem erect, covered with minute viscid glands 2. dubium 1 Styles 5; capsule-teeth 10
4 Perennial, often with short non-flowering branches in the axils of leaves
5 Petals usually not more than $1 \frac{1}{2}$ times as long as sepals
6 Capsule conspicuously curved; at least the upper bracts usually with scarious margins
7 Lower cauline leaves petiolate 37. sylvaticum
$6^{7}$ Leaves sessile
6 Capsule straight; bracts without scarious margins
8 Leaves usually $50-80 \mathrm{~mm}$
4. dahuricum

8 Leaves usually not more than 20 mm
9 Petals ciliate at base; peduncles usually not more than 20 mm
30. pyrenaicum 9 Petals not ciliate; peduncles usually more than 20 mm 10 Sepals $5-7 \mathrm{~mm}$, with narrow scarious margins
32. pedunculatum 10 Sepals $7-8 \mathrm{~mm}$, with wide scarious margins

5 Petals at least twice as long as sepals
11 Plant with long, soft hairs (sometimes on stems and young leaves only)
12 Plant densely white- to yellow-tomentose to lanate
13 Ovary hairy; leaves $0.5-1.5 \mathrm{~mm}$ wide 8. grandiflorum
13 Ovary glabrous; leaves usually more than 1.5 mm wide 14 Plant with branched hairs 14 Plant without branched hairs 15 Capsule-teeth with revolute margins 11. tomentosum

## 15 Capsule-teeth with flat margins <br> 10. biebersteinii

12 Plant not densely tomentose, greyish or greenish
16 Leaves less than three times as long as wide
17 Plant tall, laxly caespitose, flowers many; bracts and sepals obtuse
12. moesiacum

17 Plant mat-forming; flowers 1-5; bracts and sepals acute
26. alpinum

16 Leaves at least three times as long as wide
18 Leaves of flowering stems sparsely ciliate at margins, surfaces glabrous or nearly so; midrib thin 15. lineare
18 Leaves tomentose and/or glandular, with soft hairs at least at margins; midrib strong and prominent beneath
19 Capsule twice as iong as sepals 16. gibraltaricum
19 Capsule as long as or slightly longer than sepals
20 Seeds $1-1.3 \mathrm{~mm}$, strongly tuberculate 13. decalvans
20 Seeds $1 \cdot 5-2 \mathrm{~mm}$, rugose
14. boissieri

11 Plant pubescent, glandular or glabrous, but never with long soft hairs
21 Flowering stems with non-flowering axillary shoots or conspicuous buds
22 Fruiting pedicel curved just beneath the calyx; capsule curved
23 Sepals $5-8 \mathrm{~mm}$; leaves mostly more than three times as long as wide
22. arvense

23 Sepals $3-5 \mathrm{~mm}$; leaves up to three times as long as wide
24 Petals up to $2 \frac{1}{2}$ times as long as sepals 23. alsinifolium
24 Petals not more than twice as long as sepals
24. jenisejense

22 Fruiting pedicel and capsule straight
25 Bracts ciliate from base to apex
26 Leaves usually at least 4 mm wide
20. scaranii

26 Leaves less than 4 mm wide
19. soleirolii

25 Bracts not ciliate or only ciliate at base
27 Young stems glabrous except for a line of small hairs down each internode; leaves pale green, somewhat fleshy

1. cerastoides

27 Young stems hairy all round, at least above; leaves dark to greyish-green, firm
28 Leaves $20-35 \times 6-10 \mathrm{~mm}$; seeds c. 0.6 mm (Açores)
21. vagans

28 Leaves linear to linear-lanceolate, up to 5 mm wide; seeds more than 1 mm
29 Bracts pubescent, with wide, scarious margins
17. banaticum

29 Bracts glabrous or nearly so, lowest herbaceous, upper with narrow scarious margins 18. julicum
21 No non-flowering axillary shoots or buds on flowering stems
30 Bracts leaf-like, without scarious margins
31 Glaucous-pruinose; stems up to 100 cm ; leaves usually $50-80 \mathrm{~mm}$ (N.E. Russia, lowland) 4. dahuricum
31 Not pruinose; stems up to 15 cm ; leaves up to 30 mm
32 Leaves of at least the non-flowering shoots obovate to spathulate, widest in the upper half, or suborbicular
33 Seeds $1-1.5 \mathrm{~mm}$, testa close
27. arcticum

33 Seeds $1 \cdot 5-2 \mathrm{~mm}$, testa loose
28. uniflorum

32 Leaves ovate to elliptical, widest in the middle or below the middle, acute
34 Seeds $1.3-1.7 \mathrm{~mm}$
34. carinthiacum

34 Seeds $1 \cdot 7-2 \cdot 5 \mathrm{~mm}$
29. Iatifolium

30 At least upper bracts sepal-like or minute, with scarious margins
35 Sepals $7-10 \mathrm{~mm}$
36 Plant glabrous; leaves up to 20 mm
26. alpinum

36 Plant pubescent; leaves $20-80 \mathrm{~mm}$
37 Inflorescence umbel-like; pedicels mostly shorter than sepals
3. maximum

37 Inflorescence a wide-spreading cyme; pedicels much longer than sepals
35. transsilvanicum

35 Sepals 2-6 mm
38 Leaves usually $30-70 \mathrm{~mm}$

39 Capsule-teeth revolute
39. pauciflorum

39 Capsule-teeth erect
40 Leaves sessile
36. subtriflorum

40 Lower cauline leaves petiolate
38 Leaves usually not more than 20 mm
41 Pulvinate, propagating by means of bulbil-like terminal buds (Arctic)
25. regelii

41 Bulbil-like terminal buds absent
42 Leafy stolons absent
43 Seeds squamose
33. dinaricum

43 Seeds with low tubercles
42 Leafy stolons present
44 All bracts with scarious margins
34. carinthiacum

44 Lowest bracts herbaceous
45 Leaves usually not more than 5 mm wide; seeds finely tuberculate $\quad \mathbf{2 3}$. alsinifoliu
45 Leaves usually more than 5 mm wide; seeds strongly tuberculate
36. subtriflorum

4 Annual, never with short non-flowering branches in the axils of leaves
46 Plant glabrous
47 Cauline leaves connate
6. perfoliatum

47 Cauline leaves not connate
47. semidecandrum

46 Plant hairy
48 Pedicels with deflexed-appressed eglandular hairs, without glandular hairs
49 Sepals with eglandular hairs protruding well beyond apex
40. illyricum

49 Sepals without eglandular hairs protruding beyond apex
50 Pedicels $8-15 \mathrm{~mm}$; petals $\pm$ equalling sepals 40 . illyricum
50 Pedicels $10-70 \mathrm{~mm}$; petals longer than sepals
51 Sepals $4-5.5 \mathrm{~mm}$
42. scaposum
51 Sepals $8-9.5 \mathrm{~mm}$
41. pedunculare

48 Pedicels without deflexed-appressed eglandular hairs, with or without glandular hairs
52 Sepals with eglandular hairs protruding well beyond apex
53 Pedicels shorter than sepals; flowers in dense clusters
44. glomeratum

53 Pedicels longer than sepals; flowers in open dichasia
54 Sepals $10-11 \mathrm{~mm}$
40. illyricum
54 Sepals $3-6.5 \mathrm{~mm}$ 43. brachypetalum

52 Sepals without eglandular hairs protruding beyond apex
55 Petals ciliate at base
56 Sepals with eglandular and glandular hairs 45. rectum
56 Sepals with eglandular hairs only 5. nemorale 55 Petals glabrous
57 Pedicels shorter than sepals; flowers clustered
58 Sepals with eglandular hairs
50. siculum
58 Sepals without eglandular hairs
59 Sepals $3 \cdot 5-9 \mathrm{~mm}$; capsule 15 mm or less 51. gracile

59 Sepals 9-12 mm; capsule more than 15 mm
7. dichotomum

57 Pedicels longer than sepals; flowers in open dichasia
60 Bracts with scarious margin
61 Upper bracts scarious at least in upper $\frac{1}{3}$
47. semidecandrum

61 Bracts scarious at most in upper $\frac{1}{5}$
62 Leaves $12-27 \mathrm{~mm}$; plant up to 22 cm ; petals at least $1 \frac{1}{2}$ times as long as sepals 46. ligusticu
62 Leaves 4-15 mm; plant not more than 14 cm ; petals not more than $1 \frac{1}{2}$ times as long as sepals.
48. pumilum

60 Bracts completely herbaceous
63 Sepals glandular-hairy, without eglandular hairs 64 Petals $1 \frac{1}{2}-2$ times as long as sepals 46. ligusticum 64 Petals shorter than to slightly longer than sepals 51. gracile
$\begin{array}{ll}63 \text { Sepals with eglandular as well as glandular hairs } \\ 65 & \text { Petals shorter than sepals } \\ 65 & \text { Petals longer than sepals }\end{array}$ 49. diffusum

1. C. cerastoides (L.) Britton, Mem. Torrey Club 5: 150 (1894)
(C. trigynum Vill.). Loosely matted perennial; usually glabrous
except for a line of small hairs down each internode; vegetative stems creeping; flowering stems $5-15 \mathrm{~cm}$, decumbent or ascending; all stems rooting. Leaves $6-20 \times 1-2.5 \mathrm{~mm}$, pale green, somewhat fleshy, linear to oblong, obtuse, usually curving to one side. Flowers $1-3$; pedicels up to 8 cm , slender, glandular; bracts herbaceous. Sepals $4-6 \mathrm{~mm}$; petals deeply bifid; styles usually 3. Capsule oblong, straight, up to twice as long as sepals; teeth patent. Seeds 0.5 mm , tuberculate. $2 n=38$ (36). Arctic and subarctic Europe, southwards to N. England, and on all the principal mountain ranges of Europe. Al Au Br Bu Cz Fa Fe Ga Ge Gr He Hs Is It Ju No Po Rm Rs (N, C, W) Sb Su.
2. C. dubium (Bast.) O. Schwarz, Mitt. Thür. Bot. Ges. 1 (1): 98 (1949) (C. anomalum Waldst. \& Kit.). Annual with numerous erect, minutely viscid-glandular stems up to 40 cm . Leaves $10-$ $30 \times 1-2 \mathrm{~mm}$, linear to linear-oblong, obtuse to subacute, glabrous or minutely viscid-glandular. Inflorescence of lax-flowered dichasia; pedicels up to 15 cm , slender, with numerous minute viscid glands; bracts herbaceous. Sepals $5-6 \mathrm{~mm}$, ovate-lanceolate, margin and apex scarious, minutely viscid-glandular; petals $1 \frac{1}{3}$ as long as sepals, bifid; styles 3. Capsule twice as long as sepals, oblong-ovoid; teeth patent. Seeds 0.6 mm , pale brown, tuberculate. $2 n=38$. Mainly in C. \& S.E. Europe, but extending to W. France, Sicilia, S. Poland and C. Russia. Au Bu Cz Ga Ge Gr Hu It Ju Po Rm Rs (C, W, K, E) Si Tu.
3. C. maximum L., Sp. Pl. 439 (1753). Robust, stoloniferous perennial $20-40 \mathrm{~cm}$, puberulent and glandular above. Leaves $40-80 \times 5-15 \mathrm{~mm}$, lanceolate to linear-lanceolate. Flowers 3-13, in dense umbel-like cymes, with minute bracteoles. Petals up to three times as long as calyx, obcordate, with crenate or dentate lobes. Capsule $17-22 \times 6-8 \mathrm{~mm}$, straight; teeth revolute. Seeds c. 1.8 mm , obtusely tuberculate. E. part of arctic Russia. Rs (N). (N. Asia and North America.)
4. C. dahuricum Fischer ex Sprengel, Pl. Min. Cog. Pug. 2: 65 (1815). Tall glaucous perennial $50-100 \mathrm{~cm}$. Leaves usually 50 $80 \times 15-30 \mathrm{~mm}$, ovate, subobtuse. Flowers 11-17, in a large spreading cyme; bracts herbaceous. Sepals $8-12 \mathrm{~mm}$; petals up to twice as long as calyx, ciliate. Capsule $10-15 \mathrm{~mm}$, straight. Seeds $c .1 .5 \mathrm{~mm}$, acutely tuberculate. N.E. Russia. Rs (N, C).
5. C. nemorale Bieb., Fl. Taur.-Cauc. 3: 317 (1819). Annual with weak ascending stems (8-) $15-60 \mathrm{~cm}$, hairy. Leaves $20-$ $70 \times 3-20 \mathrm{~mm}$; basal obovate-spathulate; cauline lanceolate, acute, weakly cordate at base; all more or less hairy. Inflorescence furcate, many-flowered; pedicels hairy, 1-4 times as long as sepals. Sepals $6-10 \mathrm{~mm}$, lanceolate, acute, narrowly scarious at apex, with dense eglandular hairs, without glandular hairs; petals bifid for $\frac{1}{3}$ of their length, equalling or a little shorter than sepals, with a ciliate claw; stamens hairy at base; styles 5. Capsule twice as long as sepals, more or less bent; teeth deflexed. Seeds 0.7 mm , rusty-brown, tuberculate. S. \& E. Ukraine; S. Russia. Rs (W, K, E).
6. C. perfoliatum L., Sp. Pl. 437 (1753). Glaucous, glabrous annual up to 50 cm . Leaves up to 40 mm , very narrowly elliptical to ovate-lanceolate, subacute, connate at base. Inflorescence furcate, with a dichasium of 2-7 flowers at the end of each branch; pedicels equalling or up to twice as long as sepals; bracts herbaceous. Sepals $9-11 \mathrm{~mm}$, lanceolate, acute, with a scarious margin at apex; petals shorter than sepals, bifid at apex. Capsule twice as long as sepals, bent near apex; teeth deflexed. Seeds $1 \cdot 2-$ 1.5 mm , acutely tuberculate. $2 n=c .37$. Black Sea region, from $E$. Bulgaria to near Rostov; S. \& E. Spain. Bu Hs Rs (W, K, E).
7. C. dichotomum L., $S p$. Pl. 438 (1753). Annual up to 18 cm ; stem densely viscid-glandular. Leaves up to 22 mm , more or less linear, upper sometimes ovate-lanceolate, densely viscid-glandular. Pedicels shorter than sepals; bracts herbaceous. Sepals 912 mm , more or less lanceolate, acute, densely viscid-glandular, without eglandular hairs; petals $c . \frac{1}{2}$ as long as sepals, shortly bifid; stamens 5 . Capsule $15-22 \mathrm{~mm}$. Seeds 1 mm , chestnutbrown, tuberculate. Spain; S. Greece. Gr Hs ?Lu. (N. Africa and S.W. Asia.)
8. C. grandiflorum Waldst. \& Kit., Pl. Rar. Hung. 2: 183 (1804) (C. nodosum Buschm.). Perennial $15-30 \mathrm{~cm}$, caespitose, white- to greyish-tomentose; uppermost internode up to 15 cm . Leaves $25-70 \times 0.5-1.5 \mathrm{~mm}$, narrowly linear, subacute, margins strongly revolute. Inflorescence a fastigiate cyme of 7-15 flowers; peduncles $1-4 \mathrm{~cm}$; bracts ovate to broadly lanceolate, with wide scarious margins and apices. Sepals $6-8 \mathrm{~mm}$, subobtuse, tomentose, with scarious margins; petals up to 18 mm , gradually tapering towards base; ovary and capsule tomentose, at least at base. Capsule straight, up to twice as long as calyx; teeth flat, patent. - W. part of Balkan peninsula. Al Ju.
9. C. candidissimum Correns., Österr. Bot. Zeitschr. 59: 171 (1909). Perennial $15-30 \mathrm{~cm}$, caespitose, white- to yellowish-lanate; uppermost internode not considerably longer than others. Leaves c. $20 \times 3 \mathrm{~mm}$, lanceolate to linear-lanceolate, subobtuse, straight to curved, margins revolute. Inflorescence a dense cyme with peduncles and pedicels not more than twice as long as sepals; bracts ovate, acute to subobtuse, with wide scarious margins. Sepals $5-6 \mathrm{~mm}$, obtuse, white-tomentose; petals up to 10 mm , truncate to auriculate; ovary glabrous. Capsule-teeth flat, recurved. Mountains of W. \& S. Greece. Gr.
10. C. biebersteinii DC., Mém. Soc. Phys. Genève 1: 436 (1822). Perennial $10-30 \mathrm{~cm}$, mat-forming, white-lanate; uppermost internode up to 10 cm , considerably longer than others. Leaves $20-$ $50 \times 3-8 \mathrm{~mm}$, linear-lanceolate to lanceolate, margins not or slightly revolute. Inflorescence an elongated cyme of 3-15 flowers, with pedicels more than twice as long as sepals; bracts lanceolate, tomentose, with scarious margins. Sepals $6-10 \mathrm{~mm}$, lanceolate, tomentose, subacute to obtuse, with broad scarious margins; petals about twice as long as sepals, gradually tapering towards base. Capsule-teeth erect, with flat margins. - Krym; commonly grown in gardens elsewhere. Rs (K).
11. C. tomentosum L., Sp. Pl. 440 (1753). Very like 10 but up to 45 cm ; leaves $10-30 \times 2-5 \mathrm{~mm}$, with slightly revolute margins; sepals $5-7 \mathrm{~mm}$; and capsule-teeth patent, with revolute margins. $2 n=c .108$. C. \& S. Appennini, Sicilia. Widely grown as a garden plant elsewhere and often escaping. It Si.

Very variable in habit, hairiness and leaf-shape.
Var. aetnaeum Janka from Sicilia (Etna) is said to be shorter, with narrower and shorter leaves which are sparingly tomentose to glabrescent beneath, and glabrescent sepals and shorter capsule. Further investigation is required.
12. C. moesiacum Friv., Flora (Regensb.) 19: 435 (1836). Perennial up to 40 cm , laxly caespitose, with creeping non-flowering basal shoots,tomentose; uppermost internode up to 10 cm , slightly longer than the others. Leaves up to $25 \times 10 \mathrm{~mm}$, elliptical to broadly lanceolate, those of non-flowering shoots obovate, obtuse. Flowers many, in an elongated cyme; bracts obtuse, with wide scarious margins, sparingly tomentose or sericeous. Sepals obtuse; petals
more than twice as long as sepals. Capsule $10-12 \mathrm{~mm}$, straight; teeth almost erect, with revolute margins. Seeds $1-1 \cdot 6 \mathrm{~mm}$, yellow-brown, rugose. - N.\&C. Balkan peninsula. Al Bu Gr Ju.
13. C. decalvans Schlosser \& Vuk., Fl. Croat. 360 (1869) (C. lanigerum G.C. Clementi, non Desv.). Perennial $7-40 \mathrm{~cm}$. Leaves usually $3-5 \mathrm{~mm}$ wide, lanceolate to elliptic-lanceolate, attenuate, acute, sparsely tomentose to pubescent, with prominent yellowish midrib. Bracts and sepals lanceolate, acute, with wide scarious margins. Sepals $6-8 \mathrm{~mm}$, pubescent and often glandular; petals patent. Capsule $7-9 \mathrm{~mm}$, straight, broadly cylindrical; teeth erect, with revolute margins. Seeds $1-1.3 \mathrm{~mm}$, strongly tuberculate. - Mourtains of Balkan peninsula. Al Bu Gr Ju.
C. orbelicum Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1890 (1): 42 (1890) (C. decalvans subsp. orbelicum (Velen.) Stoj. \& Stefanov) from S.W. Bulgaria, is tomentose and eglandular, with the flowering stems up to 40 cm , and leaves $40-50 \mathrm{~mm}$. It may merit sub-specific rank.
14. C. boissieri Gren., Mém. Soc. Émul. Doubs 1 (2): 37 (1841). Perennial $5-30 \mathrm{~cm}$, laxly caespitose, mat-forming, with nonflowering stems from subterranean basal branches; basal internodes of flowering stems almost as long as leaves, the uppermost much longer. Leaves usually $10-20 \times 1-5 \mathrm{~mm}$, lanceolate, stiff, patent, straight to recurved, narrowly acute or almost aristate, white- to greyish-tomentose; midrib strong. Flowers 1-7 in a lax cyme; upper internodes, peduncles, pedicels, bracts and sepals densely glandular. Sepals $6-8 \mathrm{~mm}$, lanceolate, with wide scarious margins; petals up to 15 mm . Capsule straight, broadly cylindrical, teeth erect, with slightly curved margins. Seeds $1 \cdot 5-2 \mathrm{~mm}$, yellowish-brown; testa loose. $2 n=72$. S. \& E. Spain; Corse, Sardegna. Co Hs Sa.
15. C. lineare All., Fl. Pedem. 2: 365 (1785). Perennial 520 cm , stoloniferous, fragile, lower internodes $1-2 \mathrm{~cm}$, uppermost longer, all sparsely villous to slightly hairy, often on only one side. Leaves of procumbent non-flowering stems rosulate, lanceolate to elliptical, soon decaying and sparsely villoustomentose; leaves of flowering stems $20-50 \times 2-4 \mathrm{~mm}$, linear, acute, surfaces glabrous or nearly so, sparsely ciliate, with slender midrib. Flowers $1-3$; peduncles and pedicels long, slender, villous especially distally, bracts lanceolate, connate at base. Sepals $5-7 \mathrm{~mm}$, lanceolate, acute, villous to slightly hairy, outer with narrow, inner with wide scarious margins. Capsule straight, cylindrical. Seeds $1 \cdot 2-1 \cdot 5 \mathrm{~mm}$, light yellowish-brown, strongly tuberculate. - S.W. Alps. ?Ga It.
16. C. gibraltaricum Boiss., Elenchus 24 (1838) (C. boissieri var. gibraltaricum (Boiss.) Gren.). Perennial $10-25 \mathrm{~cm}$; nonflowering stems procumbent; flowering stems ascending, with leafy axillary shoots, glandular-pubescent. Leaves up to $45 \times 8 \mathrm{~mm}$, linear-lanceolate, sub-aristate, often somewhat curved, glandular, margins ciliate with short and long hairs; midrib prominent beneath. Flowers $1-5$, on long peduncles; bracts glandular, with scarious margins, especially distally. Sepals $6-8 \mathrm{~mm}$, ovate-elliptic, glandular, with wide scarious margin at apex. Capsule twice as long as sepals; teeth short, straight, with somewhat revolute margins. Seeds $1-1.6 \mathrm{~mm}$, rugose, dark brown. S. Spain (Gibraltar). Hs. (N. Africa.)
17. C. banaticum (Rochel) Heuffel, Enum. Pl. Banat. 41 (1858). Perennial up to 40 cm ; stems, especially above, with deflexed hairs shorter than diameter of the stem, sometimes glandular, with somewhat swollen nodes; internodes about as long as leaves, uppermost long. Leaves linear to linear-lanceolate, often pilose, especially along the prominent rounded midrib, or glabrous,
ciliate at base. Flowers 3-7; bracts convex, subobtuse, pubescent beneath, with wide, scarious margins. Sepals $5-9 \mathrm{~mm}$, ovate to ovate-lanceolate, subobtuse, puberulent; margins scarious. Capsule $8-12 \mathrm{~mm}$; teeth erect, with revolute margins. Seeds $1 \cdot 2-1 \cdot 8 \mathrm{~mm}$, longer than wide, acutely tuberculate. C. \& N.E. Balkan peninsula, extending northwards to S.W. Romania. Al Bu Gr Ju Rm .
(a) Subsp. banaticum: Hairs of uppermost internode short, appressed. Leaves up to $55 \times 2.5 \mathrm{~mm}$, sparsely hairy to glabrous. Throughout the range of the species.
(b) Subsp. alpinum (Boiss.) Buschm., Feddes Repert. 43: 140 (1938) (C. speciosum Spruner ex Boiss.): Hairs of uppermost internode longer and more patent than in (a). Leaves up to $25 \times$ 5 mm , hairy to glabrescent. C. \& N.E. Balkan perinsula.
18. C. julicum Schellm., Carinthia II 48: 69 (1938) (C. rupestre Krašan, non Fischer). Densely caespitose perennial; upper part of stems glandular with patent hairs about as long as diameter of stem, basal part slightly hairy to glabrous; upper internode not or only slightly elongated. Leaves $10-30 \times$ $1-2.5 \mathrm{~mm}$, sparsely ciliate towards the base, otherwise glabrous, with keeled midrib and revolute margins. Flowers 1-3; bracts lanceolate, acute, glabrous or almost so, the lower herbaceous, the upper with narrow scarious margins. Sepals $5-8 \mathrm{~mm}$, acute, pubescent. Capsule up to twice as long as sepals, with thickened outer and inner cell-walls; teeth erect, with revolute margins. Seeds $1 \cdot 3-1 \cdot 8 \mathrm{~mm}$, verrucose. $2 n=36$. - S.E. Alps, westwards to $c .14^{\circ} 15^{\prime} E$. Au Ju.

Plants from C. Italy with leaves up to 4 mm wide, capsuleteeth erect, with revolute margins, and seeds $c .1 .2 \mathrm{~mm}$, have been described as $C$. arvense L. var. viscatum Montelucci. This seems to be closely related to 18 and 22a, and may be treated as a separate species, C. viscatum (Montelucci) Jalas, Arch. Soc. Zool.-Bot. Fenn. Vanamo 18 (1): 57 (1963).
19. C. soleirolii Ser. ex Duby, Bot. Gall. 1: 87 (1828) (incl. C. stenopetalum Fenzl, C. thomasii sensu Briq., non Ten.). Perennial $2.5-20 \mathrm{~cm}$, more or less caespitose; stems pubescent and glandular, at least above. Leaves $10-20 \times 1.5-4 \mathrm{~mm}$, linear to linear-lanceolate, pubescent to glabrous. Flowers 1-7; bracts glandular-pubescent, ciliate, scarious at apex. Sepals $7-9 \mathrm{~mm}$, lanceolate, acute, glandular-pubescent, with scarious margins; petals obovate. Capsule with thin cell-walls; teeth erect, with flat margins. Seeds $1 \cdot 5-1.8 \mathrm{~mm}$; testa loose. $2 n=72$. Rocks and screes above 1900 m . - Corse. Co.
20. C. scaranii Ten., Prodr. Fl. Nap. xxv.i (1811) (C. hirsutum auct. ital., non Crantz). Perennial $10-25 \mathrm{~cm}$; stems strongly pubescent and sometimes glandular. Leaves $15-55 \times 4-10 \mathrm{~mm}$, ovate-lanceolate to elliptical, usually densely pubescent on both sides. Bracts ciliate, with wide scarious margins. Sepals 6-8; petals obcordate. Capsule $c .10 \mathrm{~mm}$; teeth erect, with revolute margins. Seeds $0 \cdot 9-1 \cdot 3 \mathrm{~mm}$, rugose; testa usually close. - Italy, from Alpi Apuane southwards; Sicilia. It Si.
21. C. vagans Lowe, Trans. Camb. Philos. Soc. 6: 548 (1838) (incl. C. azoricum Hochst.). Perennial $20-40 \mathrm{~cm}$, with robust, ascending flowering stems; uppermost internodes not conspicuously longer than others. Leaves $20-35 \times 6-10 \mathrm{~mm}$, broadly lanceolate to elliptic-lanceolate, hirsute. Flowers 7-11; bracts ovate, acute, with scarious margins at apex. Sepals $5-7 \mathrm{~mm}$, hairy; outer ciliate in basal half, with scarious margins at apex; inner with scarious margins ( $0 \cdot 2-0 \cdot 3 \mathrm{~mm}$ wide) from base to apex; petals $9-10 \mathrm{~mm}$. Capsule $6-8 \mathrm{~mm}$; teeth erect to somewhat patent, with revolute margins. Seeds $0.6-0.9 \mathrm{~mm}$, acutely tuberculate especially along the edges. Açores. Az. (Madeira.)
22. C. arvense L., Sp. Pl. 438 (1753). Perennial $5-30 \mathrm{~cm}$, loosely matted to caespitose, with procumbent leafy stems freely rooting at lower internodes. Leaves linear-acicular to ellipticlanceolate. Bracts ciliate, with scarious margins; petals 2, rarely up to 3 , times as long as sepals. Seeds seldom more than 1 mm , tuberculate. Most of Europe except the extreme north. Al Au Be Br Bu Cz *Da Ga Ge Gr Hb He Ho Hs Hu It Ju Po Rm Rs (B, $\mathrm{C}, \mathrm{W}) * \mathrm{Su}\left[\mathrm{Fe} \mathrm{No}{ }^{* R s}(\mathrm{~N})\right]$.

The following grouping of subspecies is provisional and it seems possible that some of them may merit specific rank. Two different chromosome numbers have been recorded within the complex. Sufficient data on the correlation between cytological and morphological characteristics are, however lacking.
1 Lower leaves attenuate, shortly petiolate; seeds $1.1-1.7 \mathrm{~mm}$

2 Sepals lanceolate, subacute
(g) subsp. lerchenfeldianum

2 Sepals ovate-lanceolate, subobtuse
(h) subsp. glandulosum

1 Leaves sessile; seeds not more than 1 mm
3 Plants mostly loosely matted; non-flowering shoots nearly as long as flowering stems
(f) subsp. arvense

3 Plants $\pm$ caespitose; non-flowering shoots much shorter than flowering stems
4 Leaves subulate from a wide base, obtuse, imbricate
(a) subsp. thomasii

4 Leaves linear-acicular to lanceolate, acute, usually not imbricate
5 Seldom more than 10 cm ; capsule as long as or slightly longer than sepals $\quad$ (b) subsp. strictum
5 Usually $10-30 \mathrm{~cm}$; capsule up to twice as long as sepals
6 Non-flowering axillary shoots long; leaves up to 40 mm , linear-filiform
(d) subsp. suffruticosum

6 Non-flowering axillary shoots short; leaves seldom more than 20 mm , linear to lanceolate
7 Leaves linear-acicular, stiff $\quad$ (c) subsp. pallasii
7 At least the upper cauline leaves $2-4 \mathrm{~mm}$ wide, linearlanceolate to lanceolate
(e) subsp. ciliatum
(a) Subsp. thomasii (Ten.) Rouy \& Fouc., Fl. Fr. 3: 204 (1896): Stems usually $2-5 \mathrm{~cm}$. Leaves $4-10 \times 1-3 \mathrm{~mm}$, hairy. Flowers $1-3$. Sepals $5-6 \mathrm{~mm}$; petals $8-10 \mathrm{~mm}$. Capsule somewhat longer than sepals. © C. Italy.
(b) Subsp. strictum (Haenke) Gaudin, Fl. Helv. 3: 245 (1828): Plants $3-10 \mathrm{~cm}$, caespitose. Leaves $6-15 \times 1-4 \mathrm{~mm}$, lanceolate. Flowers usually $1-3$. Sepals $4-6 \mathrm{~mm}$; petals up to 12 mm . $2 n=36$. Alps \& S.W. Europe.
(c) Subsp.p allasii (Vest) Walters, Feddes Repert. 70: 2 (1964): Plant usually $10-20 \mathrm{~cm}$, matted, with weak stems. Leaves usually $1-2 \mathrm{~mm}$ wide, stiff, often curved. Bracts with narrow scarious margins. Sepals $5-7 \mathrm{~mm}$. W. Alps.
(d) Subsp. suffruticosum (L.) Hegi, Ill. Fl. Mitteleur. 3: 375 (1911): Like (c) but axillary stems and leaves longer and bracts with wide scarious margins. $2 n=36,72 . S$. Alps, Appennini.
(e) Subsp. ciliatum (Waldst. \& Kit.) Reichenb., Fl. Germ. Excurs. 798 (1832) (incl. subsp. matrense (Kit.) Jáv., subsp. calcicola (Schur) Borza): Plant densely matted and stiff. Bracts with wide, scarious margins. Sepals $5-8 \mathrm{~mm} .2 n=c .72$. E. (?W.) Alps; Balkan peninsula.
(f) Subsp. arvense: Stems usually $10-20 \mathrm{~cm}$. Leaves $10-$ $30 \times 1 \cdot 5-3 \mathrm{~mm}$, linear-lanceolate. Flowers 3-7. Sepals $5-7 \mathrm{~mm}$. $2 n=72$. Throughout the range of the species.
(g) Subsp. lerchenfeldianum (Schur) Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 611 (1917): Stems 10-30 cm. Lower leaves $10-20 \times 2-3 \mathrm{~mm}$, attenuate; upper leaves $10-20 \times 6 \mathrm{~mm}$, with rounded base, almost glabrous. Bracts scarious at apex. Sepals $5-7 \mathrm{~mm}$; petals twice as long as sepals. Capsule 8 mm ; teeth almost flat. - Carpathians, N.E. Jugoslavia.
(h) Subsp. glandulosum (Kit.) Soó, Acta Geobot. Hung. 2: 237 (1939) (C. tatrae Borbás): Like (g) but more densely caespitose
and with stems $8-15 \mathrm{~cm}$; bracts with narrow scarious margins; sepals wider and more obtuse; petals wider and up to three times as long as calyx; capsule up to twice as long as sepals.

- Tatra.

23. C. alsinifolium Tausch, Syll. Pl. Nov. Ratisbon. (Königl. Baier. Bot. Ges.) 2: 243 (1828). Caespitose perennial $5-25 \mathrm{~cm}$; non-flowering axillary shoots often lacking. Leaves of creeping basal stems $5-15 \times 1-6 \mathrm{~mm}$, elliptic-ovate, somewhat hairy to almost glabrous. Flowers few to many, in lax cymes; lowest bracts herbaceous. Sepals $3-4 \mathrm{~mm}$; petals up to $2 \frac{1}{2}$ times as long as sepals. Capsule up to $2 \frac{1}{2}$ times as long as sepals, slightly curved or almost straight. On serpentine. - W. Czechoslovakia (near Mariánske Lazne). Cz.
24. C. jenisejense Hultén, Svensk Bot. Tidskr. 50: 473 (1956) (C. beeringianum sensu Schischkin, non Cham. \& Schlecht.). Perennial $10-30 \mathrm{~cm}$; flowering stems slender, with long internodes, sparsely hairy with short patent hairs or subglabrous; basal branches stolon-like, leafy, axillary bulbils usually present. Leaves $10 \times 4 \mathrm{~mm}$, elliptical, acute, pubescent, at least marginally and along the veins. Flowers 3-7, in lax cymes; pedicels glan-dular-pubescent; upper bracts small, acute, with narrow scarious margins. Sepals $3-5 \mathrm{~mm}$, acute, with scarious margins; petals about twice as long as sepals. Capsule $8-12 \mathrm{~mm}$, curved; teeth erect or somewhat patent, with revolute margins. Seeds $c .1 \mathrm{~mm}$, strongly tuberculate. Subarctic Russia and N. Ural. Rs (N).
C. beeringianum Cham. \& Schlecht., Linnaea 1: 62 (1826) (C. bialynickii Tolm.) is like 24 but more compact and lowgrowing, with rigid erect flowering stems, lacking long runners and axillary bulbils, and having petals only slightly longer than the obtuse sepals. It has been recorded from Poluostrov Kanin but the identity of specimens available is not quite clear.
C. gorodkovianum Schischkin in Komarov, Fl. URSS 6: 883 (1936) from N . Ural seems also to be close to 24 but has petiolate lower cauline leaves, somewha larger sepals, and petals not very much longer than sepals.
25. C. regelii Ostenf., Skr. Vid.-Selsk. Christ. 1908 (8): 10 (1910). Densely caespitose, subglabrous perennial $1-5 \mathrm{~cm}$, often not flowering and propagating by means of thin, more or less subterranean runners with deciduous bulbil-like terminal buds. Leaves $3-7 \times 1 \cdot 5-3 \mathrm{~mm}$, roundish to broadly spathulate or elliptical, often distinctly connate at base, yellowish-green and somewhat fleshy, ciliate, otherwise glabrous and shiny. Flowers seldom produced, mostly solitary on short upright stems which are glandular in the upper part; bracts scarious at apex. Sepals $4-6 \mathrm{~mm}$, rounded at apex, glandular, $\frac{1}{3}$ as long as the deeply bifid petals. Ripe capsules and seeds unknown. $2 n=72$. Arctic Europe. Rs (N) Sb. (Arctic Siberia.)
26. C. alpinum L., Sp. Pl. 438 (1753). Perennial $5-20 \mathrm{~cm}$. Leaves $c .10 \times 5 \mathrm{~mm}$, obovate to elliptic-oblanceolate, acute to obtuse at apex; if hairy, then long soft hairs present, at least at apex of young leaves. Flowers $1-5$; peduncles $1-4 \mathrm{~cm}$; bracts acute, with scarious margins. Sepals $7-10 \mathrm{~mm}$, acute, truncate at base; petals about twice as long as sepals. Capsule $8-14 \mathrm{~mm}$, the upper half narrower and slightly curved. Seeds $1-1.4 \mathrm{~mm}$, acutely tuberculate. $2 n=c .54,72$ (144). Arctic and subarctic Europe, extending southwards to Britain and Estonia, and in most of the principal mountain ranges of Europe. Al Au Br Bu Cz Fe Ga Ge Gr He Hs Is It Ju No Po Rm Rs (N, B, W) Sb Su.

Very variable in habit, hairiness and leaf-shape.

## 1 Plant entirely glabrous

(d) subsp. glabratum

1 Plant with long soft hairs
2 Pedicels and peduncles densely hairy with patent glandular hairs
(a) subsp. squalidum

2 Pedicels and peduncles lanate, or with both glandular and long soft eglandular hairs
3 Plant greyish- to whitish-lanate; at least young leaves with a distal brush of lanate, entangled hairs $\quad$ (b) subsp. lanatum
Plant greyish-green; all leaves evenly hairy, not lanate
(c) subsp. alpinum
(a) Subsp. squalidum (Lam.) Hultén, Svensk Bot. Tidskr. 50: 434 (1956): Plant $5-10 \mathrm{~cm}$, mat-forming. Leaves up to $10 \times 5 \mathrm{~mm}$, elliptical to obovate, mostly rounded at apex, more or less lanate. Peduncles and pedicels densely glandular-hairy. Sepals $c .7 \mathrm{~mm}$. Capsule not much longer than sepals. - Pyrenees.

Another plant with glandular peduncles was described from mountains of N.E. Albania as C. hekuravense Jáv., Bot. Közl. 19: 18 (1921). According to the description it differs from (a) by its ovate, acute to acuminate leaves with short glandular hairs. Plants similar to (a) have also been recorded from the Alps and the Carpathians. Their taxonomic status needs further study.
(b) Subsp. lanatum (Lam.) Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 619 (1917): Mat-forming; whole plant, including peduncles and pedicels, lanate; glandular hairs absent. Throughout the range of the species.
(c) Subsp. alpinum: Plant mat-forming, greyish-green, not lanate but with long soft hairs and sometimes also glandular hairs. Almost throughout the range of the species, but absent from the extreme west.
(d) Subsp. glabratum (Hartman) Å. \& D. Löve, Acta Horti Gothob. 20: 141 (1956): Plant with slender subterranean runners and totally glabrous stems and leaves; habit suberect; upper internodes often somewhat elongated. Leaves up to 20 mm , narrow. Sepals somewhat saccate. N. Russia, Fennoscandia, Iceland.

A similar plant from E. Pyrenees was described as C. glaberrimum Lapeyr., Hist. Abr. Pyr. 265 (1813); according to the description, however, it has the petals not exceeding the sepals.
27. C. arcticum Lange, Fl. Dan. 50: 7 (1880). Perennial $2-15 \mathrm{~cm}$, with subterranean runners. Leaves usually $10-15 \times 4$ 5 mm , mostly narrower than in 26 (c). Flowers 1-3; bracts herbaceous. Sepals $6-9 \mathrm{~mm}$, ovate to ovate-lanceolate with wide scarious margins; petals 2 or more times as long as sepals, shallowly bifid. Capsule broadly cylindrical, with wide mouth, almost straight, up to twice as long as sepals. Seeds $1-1.5 \mathrm{~mm}$, rugose; testa close. N.W. Europe extending to Svalbard and N.W. Finland. Br Fa Fe Is No Sb Su .

Very variable in leaf-shape, hairiness, etc., especially in the Arctic. To some extent this variation may be due to hybridization with 25 and 26. At present it seems best to distinguish only the following two subspecies.
(a) Subsp. arcticum (C. edmondstonii auct. brit. et al., non (H. C. Watson) Murb. \& Ostenf.) : Leaves up to 15 mm , light or yellowish-green; margins with short few-celled cilia, otherwise glabrous to slightly pubescent. Sepals acute. $2 n=108$. Throughout the range of the species.
(b) Subsp. edmondstonii (H. C. Watson) Á. \& D. Löve, Acta Horti Gothob. 20: 110 (1956) (C. nigrescens Edmonston ex H. C. Watson): More compact. Leaves shorter, roundish, darker green, densely glandular like the pedicels. Sepals obtuse. $2 n=108$. On serpentine. Zetland (Unst).
28. C. uniflorum Clairv., Man. Herb. 147 (1811). Like 27 but $3-10 \mathrm{~cm}$ with leaves $10-18 \times 3-5 \mathrm{~mm}$, those of non-flowering shoots obovate to spathulate, subobtuse, attenuate, soft, bright green; flowers $1-3$; sepals $5-7 \mathrm{~mm}$; petals up to twice as long as sepals, bifid half-way to base; capsule narrower, twice as long as sepals; pedicel twice as long as the narrowly cylindrical curved
capsule; seeds $1 \cdot 5-2 \mathrm{~mm}$, smoother; testa loose. $2 n=36$. - Alps, W. Carpathians and mountains of C. Jugoslavia. Au Cz Ga He It Ju Po.
29. C. latifolium L., Sp. Pl. 439 (1753). Perennial $3-10 \mathrm{~cm}$, laxly caespitose, glandular-pubescent. Leaves $12-30 \times 5-10 \mathrm{~mm}$, ovate to ovate-elliptical, acute, sessile, rigid, bluish-green. Flowers $1-3$; bracts herbaceous. Sepals $5-7 \mathrm{~mm}$, with wide scarious margins; petals more than twice as long as sepals, shallowly bifid. Capsule often more than twice as long as sepals, broadly cylindrical, almost straight; pedicel not longer than the capsule. Seeds $1 \cdot 7-2.5 \mathrm{~mm}$, shallowly rugose; testa loose. $2 n=36$. Calcareous soils. Alps, N. Appennini. Au Ga Ge He It.
30. C. pyrenaicum Gay, Ann. Sci. Nat. ser. 1, 26: 231 (1832). Like 29 but petals ciliate at base, and only slightly exceeding sepals. E. Pyrenees. Ga Hs.
31. C. runemarkii Möschl \& Rech. fil., Anzeig. Akad. Wiss. (Wien) 1962: 231 (1962) (C. coronense Runemark, non Schur). Mat-forming or caespitose perennial $5-10 \mathrm{~cm}$; stems, peduncles, leaves and sepals covered with long, straight, eglandular hairs. Leaves $5-10 \times 2-4 \mathrm{~mm}$, elliptical to oblanceolate. Flowers solitary, terminal or in leaf-axils, without sepal-like bracts; peduncles $1 \cdot 5-3 \mathrm{~cm}$. Sepals $7-8 \mathrm{~mm}$, lanceolate, with wide scarious margins; petals $9-10 \mathrm{~mm}$. Capsule not much longer than sepals, scarcely curved. Seeds $0.7-0.8 \mathrm{~mm}$, minutely muricate. - Kikhlades (Naxos). Gr.
32. C. pedunculatum Gaudin, Fl. Helv. 3: 251 (1828). Perennial $3-10 \mathrm{~cm}$, laxly caespitose, sparsely pubescent or almost glabrous. Leaves $10-20 \times 3 \mathrm{~mm}$, lanceolate, stiff. Flowers campanulate, mostly solitary; pedicels up to 3 times as long as capsule. Sepals 5-7 mm, acute, with narrow scarious margins; petals glabrous, only slightly exceeding sepals, deeply bifid. Capsule up to twice as long as sepals; teeth revolute. Seeds c. 1 mm ; testa loose. $2 n=36$. C. \& E. Alps. Au Hs It.
33. C. dinaricum G. Beck \& Szysz., Rozpr. Acad. Um. (Mat. Przyr.) 19: 62 (1889). Like 32 but up to 15 cm ; upper bracts sepal-like, with scarious margins; sepals $3-5 \mathrm{~mm}$, acute, with broad scarious margins; capsule more than twice as long as sepals; seeds $c .1 .5 \mathrm{~mm}$. Mountains of W. Balkan peninsula. $\mathrm{Al} \mathrm{Gr} \mathrm{Ju}$.
34. C. carinthiacum Vest, Bot. Zeit. (Regensb.) 6: 120 (1807). Perennial up to 20 cm , loosely matted. Leaves $10-25 \times 3-8 \mathrm{~mm}$, ovate-elliptical to lanceolate, acute, often glabrous, shining. Flowers up to 7, in a spreading cyme. Sepals $5-6 \mathrm{~mm}$, subobtuse. Capsule at least twice as long as sepals, straight or slightly curved. Seeds $1 \cdot 3-1.7 \mathrm{~mm}$, with low tubercles; testa loose. - E. Alps and Carpathians. Au Cz He It Ju Po Rm.
(a) Subsp. carinthiacum: Often nearly glabrous. All except lowest bracts with wide scarious margins. $2 n=36$. N. and $C$. parts of E. Alps; Carpathians.
(b) Subsp. austroalpinum (H. Kunz) H. Kunz in Janchen, Cat. Fl. Austr. 1: 155 (1956): More densely glandular-hairy, especially above. Uppermost bracts herbaceous or with narrow scarious margins. $2 n=36$. S.E. Alps.
35. C. transsilvanicum Schur in Griseb. \& Schenk, Arch. Naturgesch. (Berlin) 1852: 305 (1852). Glandular-pubescent caespitose perennial with numerous flowering stems up to 40 cm , and short non-flowering shoots. Leaves of flowering stems $20-50 \times 4-7 \mathrm{~mm}$, elliptical to oblanceolate, acute, attenuate, sparsely pubescent to
glabrescent, often with longer, somewhat villous hairs at margins; leaves of non-flowering stems smaller, more densely hairy. Inflorescence a wide many-flowered cyme; bracts scarious, obtuse. Sepals acute, inner with wide scarious margins. Capsule up to twice as long as sepals, straight; teeth erect, obtuse. Seeds c. 2 mm , acutely tuberculate. - E. \& S. Carpathians. Rm.
36. C. subtriflorum (Reichenb.) Pacher, Jahrb. Naturh. Landesmus. Kärnten 18: 104 (1886) (incl. C. sonticum G. Beck). Perennial or biennial up to 40 cm , hirsute and glandular, with leafy stolons. Leaves elliptical to ovate-lanceolate, sessile. Inflorescence a 3 - to many-flowered cyme; lowest bracts herbaceous, upper small, with scarious margins. Sepals up to 5 mm , with scarious margins; petals up to 3 times as long as sepals. Capsule twice as long as sepals, straight; teeth erect. Seeds $0.7-1 \mathrm{~mm}$, tuberculate; testa close. $2 n=36$. $\quad$ N.W. Jugoslavia (Slovenija), just extending into Italy (Alpi Giulie). It Ju.
37. C. sylvaticum Waldst. \& Kit., Pl. Rar. Hung. 1: 100 (1802). Hirsute and glandular, perennial or biennial $15-70 \mathrm{~cm}$, with runner-like rooting leafy basal branches. Lower cauline leaves up to $50 \times 10 \mathrm{~mm}$, oblanceolate, petiolate; upper sessile, elliptical to elliptic-lanceolate; leaves of non-flowering shoots oblanceolate to rhombic-elliptic. At least the upper bracts usually with scarious margins. Sepals usually $3-6(-8) \mathrm{mm}$; petals and stamens ciliate or glabrous. Capsule up to 10 mm , conspicuously curved. Seeds $0.8-1 \cdot 3 \mathrm{~mm}$, densely tuberculate. $2 n=36$. - Mainly in E.C. Europe, extending from C. Italy, Albania and S.W. Ukraine northwards to the Baltic (Kaliningradskaja Oblast'). Al Au Cz Hu It Ju Po Rm Rs ( $\mathbf{B}, \mathrm{W}$ ).
38. C. fontanum Baumg., Enum. Stirp. Transs. 1: 425 (1816). Short-lived perennial up to 60 cm , with short basal non-flowering shoots. Leaves sessile. At least the upper bracts with scarious margins. Petals not or scarcely longer than sepals. Capsule curved. Seeds $0.4-1 \cdot 2 \mathrm{~mm}$, tuberculate. Almost throughout Europe. All territories, but only introduced in Sb .
Extremely variable. The following treatment is incomplete, as several taxa, especially from S. Europe, are too little known.
1 Sepals $3-7 \mathrm{~mm}$; seeds $0.4-0.8 \mathrm{~mm}$
2 Seed-tubercles low, 4-5 times as wide as high (mountains of Iberian peninsula)
(d) subsp. hispanicum

2 Seed-tubercles as wide as high (widespread)
(e) subsp. triviale

1 Sepals 6-9 mm; seeds $0.8-1 \cdot 2 \mathrm{~mm}$
3 Petals usuaily ciliate, shorter to slightly longer than sepals
(a) subsp. macrocarpum

3 Petals glabrous or with a few short hairs only, usually conspicuously longer than sepals
4 Usually sparsely viscid-pubescent, hairs c. 1 mm ; sepals with narrow scarious margins
(b) subsp. scandicum

4 Densely pubescent, hairs commonly more than 1 mm , very seldom glandular; sepals with wide scarious margins
(c) subsp. fontanum
(a) Subsp. macrocarpum (Schur) Jalas, Arch. Soc. Zool.-Bot. Fenn. Vanamo $18(\mathbf{1})$ : 62 (1963) (C. macrocarpum Schur): Flowering stems up to 60 cm , lax, with short non-flowering basal branches, glandular-hairy. Leaves usually $30-60 \times 12-$ 25 mm , thin, somewhat translucent, pure green. Capsule 1318 mm , nearly straight. $2 n=144$. Shady habitats. C. Europe.
Sometimes resembling 37 but sepals and capsule longer and petals shorter.
(b) Subsp. scandicum H. Gartner, Feddes Repert. (Beih.) 113:68 (1939) (C. caespitosum subsp. alpestre (Lindblom) Lindman): Flowering stems $10-30 \mathrm{~cm}$, sparsely pubescent to glabrescent, glandular or eglandular. Leaves $10-20 \times 5-15 \mathrm{~mm}$. Capsule 916 mm ; placenta $4-5 \mathrm{~mm}$. Seeds dark brown, with tubercles
twice as wide as high. $2 n=144 . N$. Europe. Fa Fe Is No Rs (N) Su.
(c) Subsp. fontanum (incl. subsp. alpicum H. Gartner; C. caespitosum subsp. fontanum (Baumg.); C. vulgatum subsp. fontanum (Baumg.) Schinz \& R. Keller): Flowering stems 2040 cm , robust, mostly densely hirsute, glandular hairs rare. Capsule usually $12-18 \mathrm{~mm}$; placenta $3-5 \mathrm{~mm}$. Seeds pale brown, with tubercles usually less than twice as wide as high. $2 n=144$. Mountains of C. Europe; ?Balkan peninsula.

It is questionable whether subsp. balcanicum H. Gartner, Feddes Repert. (Beih.) 113: 68 (1939) is really different from (c).
(d) Subsp. hispanicum H. Gartner, op. cit. 77 (1939) (incl. subsp. pyrenaeum H . Gartner). Like (c): but sepals $4-7 \mathrm{~mm}$; capsule commonly $10-14 \mathrm{~mm}$; placenta $2-4 \mathrm{~mm}$; seeds $c .0 .8 \mathrm{~mm}$ with tubercles 4-5 times as wide as high. S. Spain, Pyrenees.

The status and systematic position of subsp. pyrenaeum H. Gartner needs further study.
(e) Subsp. triviale (Link) Jalas, Arch. Soc. Zool.-Bot. Fenn. Vanamo 18 (1): 63 (1963) (C. vulgatum L. 1762, non 1755, C. holosteoides Fries, C. caespitosum Gilib., C. caespitosum subsp. triviale (Link) Hiitonen, C. vulgatum subsp. caespitosum (Gilib.) Dostál): Often laxly caespitose, $5-50 \mathrm{~cm}$, with leafy basal shoots, pubescent to glabrescent, with or without glandular hairs. Leaves usually $10-25 \times 3-10 \mathrm{~mm}$. Sepals $3-5 \mathrm{~mm}$; petals shorter to slightly longer than sepals. Capsule up to 12 mm ; placenta $1-4 \mathrm{~mm}$. Seeds $0 \cdot 4-0 \cdot 8 \mathrm{~mm}$, with tubercles as wide as high. $2 n=144$ (134-52). Widespread.
39. C. pauciflorum Steven ex Ser. in DC., Prodr. 1: 414 (1824). Perennial, $20-60 \mathrm{~cm}$, glandular-hairy, usually with single flowering stem, without runner-like leafy shoots. Leaves elliptic-lanceolate, all sessile or nearly so. Sepals 4-6 mm, obtuse; petals and capsule $2 \frac{1}{2}-3$ times as long as sepals. Capsule with revolute teeth. Seeds $0.7-0.8 \mathrm{~mm}$, strongly tuberculate. E. Russia (Baškirskaja A.S.S.R. and S. Ural). Rs (C). (N. \& C. Asia.)
40. C. illyricum Ard. Animadv. Bot. Spec. Alt. 26 (1763). Annual 1.5-20(-30) cm, very hairy throughout, the hairs of stems and pedicels often deflexed-appressed. Leaves up to 14 mm , the lower spathulate or obovate, the upper oblong to ovate or elliptical, more or less obtuse. Bracts herbaceous. Sepals oblonglanceolate to lanceolate, more or less acute; petals with a minute acute auricle at base, glabrous; stamens 5-10; styles 5. Seeds chestnut-brown, minutely tuberculate. Aegean region and $S$. Balkan peninsula; ?Corse. ?Co Cr Gr Tu.
1 Sepals $10-11 \mathrm{~mm}$; stamens ciliate at base; capsule 11-12 mm
(e) subsp. crinitum

1 Sepals 4-9 mm; stamens glabrous; capsule 6-7 mm
2 Sepals $8-9 \mathrm{~mm}$, with wide scarious margins; hairs not or scarcely extending beyond the apex
(d) subsp. illyricum

2 Sepals 4-8 mm, with narrow or no scarious margins; hairs extending well beyond the apex
3 Petals mostly only c. $\frac{1}{2}$ as long as sepals; style c. 1 mm
(a) subsp. comatum

3 Petals equalling or exceeding sepals; style $2-5 \mathrm{~mm}$
4 Plant $5-22 \mathrm{~cm}$; sepals $5.5-8 \mathrm{~mm}$; fruiting pedicels $10-50 \mathrm{~mm}$
(c) subsp. prolixum

4 Plant $2.5-10 \mathrm{~cm}$; sepals $5-5.5 \mathrm{~mm}$; fruiting pedicels $5-$ 13 mm
(b) subsp. decrescens
(a) Subsp. comatum (Desv.) P. D. Sell \& Whitehead, Feddes Repert. 69: 15 (1964) (C. comatum Desv., C. illyricum sensu Hayek, non Ard.): $1 \cdot 5-12 \mathrm{~cm}$. Fruiting pedicels 2- 20 mm , more or less erect, hairs mostly deflexed. Sepals $4-7.5 \mathrm{~mm}$, outer without or with only narrow scarious margins, hairs much exceeding the apex; petals usually only $\frac{1}{2}$ but sometimes up to $\frac{3}{4}$ as long as sepals; stamens glabrous; styles c. 1 mm . Capsule c. 7 mm . Seeds $0.5-0.8 \mathrm{~mm} .2 n=68$. Coastal regions and islands of E. Greece, Kriti, Turkey; ?Corse.
(b) Subsp. decrescens (Lonsing) P. D. Sell \& Whitehead, Feddes Repert. 69: 15 (1964) (C. pedunculare sensu Hayek, pro parte, non Bory \& Chaub.): $2 \cdot 5-10 \mathrm{~cm}$. Fruiting pedicels $5-13 \mathrm{~mm}$, more or less divaricate, hairs mainly deflexed-appressed. Sepals $5-5 \cdot 5 \mathrm{~mm}$, outer without or with only narrow scarious margins, hairs much exceeding the apex; petals equalling or a little longer than sepals; stamens glabrous; styles 2-3 mm. Capsule 6-7 mm. Seeds c. 0.6 mm . S. Greece (Argolis, Arkadhia and Kefallinia).
(c) Subsp. prolixum (Lonsing) P. D. Sell \& Whitehead, Feddes Repert. 69:15 (1964) (C. pedunculare sensu Hayek, pro parte, non Bory \& Chaub.): $5-22 \mathrm{~cm}$. Fruiting pedicels $10-50 \mathrm{~mm}$, erect or divaricate, hairs mostly deflexed-appressed. Sepals 5.58 mm , outer without or with only narrow scarious margins, hairs much exceeding the apex. Petals equalling or a little longer than sepals; stamens glabrous; styles $3-4 \mathrm{~mm}$. Capsule $6-7.5 \mathrm{~mm}$. Seeds c. 0.6 mm . - S. Greece (Peloponnisos; Zakinthos).
(d) Subsp. illyricum: 6-20 cm. Fruiting pedicels 8-15(-18) mm, erect, with appressed hairs. Sepals $8-9 \mathrm{~mm}$, with wide scarious margin and hairs not or scarcely exceeding the apex; petals about equalling sepals; stamens glabrous. Capsule c. 6 mm . $-W$. Greece (islands of Kefallinia, Kerkira and Levkas).
(e) Subsp. crinitum (Lonsing) P. D. Sell \& Whitehead, Feddes Repert. 69: 15 (1964): Up to 18 cm . Fruiting pedicels $8-15 \mathrm{~mm}$, erect, with long patent hairs. Sepals $10-11 \mathrm{~mm}$, outer without or with very narrow scarious margin, hairs much exceeding the apex; petals more or less equalling sepals; stamens ciliate at base; styles c. $3 \cdot 5 \mathrm{~mm}$. Capsule $11-12 \mathrm{~mm}$. Seeds $0 \cdot 6-1 \mathrm{~mm}$. $-W$. Greece (Akarnanika).
41. C. pedunculare Bory \& Chaub. in Bory, Expéd. Sci. Morée 3 (2): 130 (1832). Annual up to 20 cm ; stem with deflexed-appressed hairs and minute glands. Lower leaves spathulate, cauline up to 15 mm , ovate or elliptical, hairy. Inflorescence lax; pedicels $10-60 \mathrm{~mm}$, with deflexed-appressed hairs; bracts herbaceous. Sepals 8-9.5 mm, more or less lanceolate, subacute, margin and apex scarious, with long hairs not exceeding the apex; petals $1 \frac{1}{2}$ times as long again as sepals, bifid for $\frac{1}{5}$ of their length; stamens 10 ; styles 5 . Capsule c. 8 mm . Seeds $0.8-1 \mathrm{~mm}$, chestnut-brown, minutely tuberculate. S. Greece (Messinia). Gr. (Anatolia.)
42. C. scaposum Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 104 (1849). Annual up to 11 cm ; stem very short, stiffly hairy. Leaves 3-12 mm, ovate, obovate or elliptical, more or less obtuse, hairy. Flowers usually solitary on slender, appressedhairy pedicels $30-70 \mathrm{~mm}$. Sepals $4-5 \cdot 5 \mathrm{~mm}$, ovate-lanceolate to lanceolate, more or less obtuse, with wide scarious margins and apex and long appressed hairs not exceeding the apex; petals longer than sepals, bifid for c. $\frac{1}{5}$ of their length; stamens 10 ; styles 5. Capsule $6-8 \mathrm{~mm}$. Seeds $0.6-1 \mathrm{~mm}$, chestnut-brown, minutely tuberculate. Limestone rocks and screes. - Kriti. Cr.
43. C. brachypetalum Pers., Syn. Pl. 1:520 (1805). Annual up to 40 cm ; stem with long, deflexed, patent or ascending eglandular hairs, with or without glandular hairs. Leaves up to 20 mm , the lower spathulate or obovate, the upper ovate, elliptical or oblong, obtuse to acute, hairy. Inflorescence more or less lax; pedicels 3-27 mm, bent just below the flower, with patent or ascendingappressed eglandular hairs, with or without glandular hairs; bracts herbaceous. Sepals $3-6.5 \mathrm{~mm}$, lanceolate to oblonglanceolate, obtuse to acute, margin scarious, with long eglandular hairs exceeding the apex, with or without glandular hairs; petals shorter than or longer than sepals, bifid for up to $\frac{1}{3}$ of their length, with a small auricle at base; stamens up to 10 ; styles 5 . Capsule $6-9 \mathrm{~mm}$. Seeds $0 \cdot 4-1 \mathrm{~mm}$, minutely tuberculate. $S$., W. \& C.

Europe, extending northwards to S. Sweden and eastwards 10 Krym. All except Az Fa Fe Is Rs (N, C, E) Sa Sb.

1 Pedicels and sepals with long eglandular hairs, without glandular hairs
2 Pedicels with ascending-appressed eglandular hairs
(e) subsp. tenoreanum

2 Pedicels with patent deflexed or slightly ascending hairs
3 Hairs of pedicels patent or deflexed; hairs on sepals up to 2.5 mm ; capsule-teeth erect
(f) subsp. atheniense

3 Hairs of pedicels usually slightly ascending; hairs on sepals up to 1.5 mm ; capsule-teeth patent (d) subsp. brachypetalum
1 Pedicels and sepals with long glandular hairs mixed with the eglandular ones
4 Petals longer than sepals
5 Plant up to 7 cm , with numerous glandular and eglandular hairs; style $c .1 \mathrm{~mm}$; seeds $c .1 \mathrm{~mm} \quad$ (c) subsp. doerfleri
5 Plant $7-25 \mathrm{~cm}$, with numerous glandular and few eglandular hairs; styles $1.5-3 \mathrm{~mm}$; seeds $0.5-0.7 \mathrm{~mm}$
6 Stamens glabrous; styles $2-3 \mathrm{~mm}$ (a) subsp. pindigenum
6 Stamens ciliate; styles $1.5-2 \mathrm{~mm} \quad$ (b) subsp. corcyrense
4 Petals shorter than or almost equalling sepals
7 Sepals $4-5 \mathrm{~mm}$; seeds $0.5-0.6 \mathrm{~mm}$; glandular and eglandular hairs of pedicels and sepals usually more or less equally abundant and not dense
(g) subsp. tauricum

7 Sepals 4-6.5 mm; seeds $0.6-0.8 \mathrm{~mm}$; glandular hairs usually denser and eglandular hairs fewer
(h) subsp. roeseri
(a) Subsp. pindigenum (Lonsing) P. D. Sell \& Whitehead, Feddes Repert. 69: 18 (1964) (C. pindigenum Lonsing): 7-25 cm; stems with dense glandular and few eglandular hairs. Pedicels $4-20 \mathrm{~mm}$, clothed like the stem. Sepals $3-5 \mathrm{~mm}$, with numerous glandular hairs and a few eglandular hairs mostly near the apex; petals longer than sepals, cuneate at base, glabrous or with a few hairs; stamens glabrous; styles $2-3 \mathrm{~mm}$. Capsule 6-8 mm; teeth patent. Seeds 0.5-0.7 mm. - C. Greece (Pindhos, Aitolia).
(b) Subsp. corcyrense (Möschl) P. D. Sell \& Whitehead, Feddes Repert. 69: 18 (1964) (C. corcyrense Möschl): 7-12 cm; stems with dense glandular and few eglandular hairs. Pedicels 313 mm , clothed like the stem. Sepals 4-5 mm, with numerous glandular hairs, and few eglandular hairs especially near the apex; petals longer than sepals, obcordate, ciliate at base; stamens ciliate at base; styles $1.5-2 \mathrm{~mm}$. Capsule 7-9 mm; teeth patent. Seeds $0.5-0.7 \mathrm{~mm}$. - N.W. Greece (Kérkira).
(c) Subsp. doerfleri (Halácsy ex Hayek) P. D. Sell \& Whitehead, Feddes Repert. 69: 18 (1964) (C. doerfleri Halácsy ex Hayek): Up to 7 cm ; stems with eglandular and glandular hairs. Pedicels $3-11 \mathrm{~mm}$, clothed like the stem. Sepals $3.5-6 \mathrm{~mm}$, clothed like the stem; petals longer than sepals, glabrous; stamens glabrous; styles c. 1 mm . Capsule c. 8 mm ; teeth erect. Seeds c. 1 mm . Kriti.
(d) Subsp. brachypetalum: $5-40 \mathrm{~cm}$; stems with slightly ascending eglandular hairs up to 1.5 mm , without glandular hairs. Pedicels $5-18 \mathrm{~mm}$, clothed like the stem. Sepals $4-5.5 \mathrm{~mm}$, clothed like the stem; petals c. $\frac{3}{4}$ as long as sepals, glabrous or ciliate; stamens glabrous or ciliate; styles $0.75-1 \mathrm{~mm}$. Capsule $6-7.5 \mathrm{~mm}$; teeth patent. Seeds $c .0 .5 \mathrm{~mm} .2 n=c$. 90 . Mainly in C. Europe, but extending to Spain, N. Italy and Denmark. Be Br Co Da Ga Ge Hs Hu It Ju Rm.
(e) Subsp. tenoreanum (Ser.) Soó in Soó \& Jáv., Magy. Növ. Kéz. 2: 761 (1951): 5-18 cm; stems with ascending-appressed eglandular hairs, without glandular hairs. Pedicels $5-17 \mathrm{~mm}$, clothed like the stem. Sepals $4-5 \mathrm{~mm}$, with eglandular hairs up to 1.5 mm , without glandular hairs; petals $c . \frac{3}{4}$ as long as sepals, ciliate at base; stamens glabrous; styles $0 \cdot 75-1 \mathrm{~mm}$. Capsule $6.5-7.5 \mathrm{~mm}$; teeth patent. Seeds $0 \cdot 4-0.6 \mathrm{~mm} .2 n=c .52$. Mainly in C. \& S.E. Europe. Al Au Bu Cz Ga Gr He Hu Ju Rm.
(f) Subsp. atheniense (Lonsing) P. D. Sell \& Whitehead, Feddes Repert. 69: 19 (1964) (C. atheniense Lonsing): 15-25 cm; stems with long patent or deflexed eglandular hairs, without glandular hairs. Pedicels $5-25 \mathrm{~mm}$, clothed like the stem. Sepals 4-6 mm, with eglandular hairs up to 2.5 mm , without glandular hairs; petals $c . \frac{1}{2}$ as long as sepals, ciliate at base; stamens glabrous or slightly ciliate; styles $1 \cdot 2-1 \cdot 5 \mathrm{~mm}$. Capsule $6-9 \mathrm{~mm}$; teeth erect. Seeds $0.6-0.8 \mathrm{~mm}$. Greece (near Athinai).
(g) Subsp. tauricum (Sprengel) Murb., Lunds Univ. Arsskr. 27 (5): 159 (1892): $5-37 \mathrm{~cm}$; stems with long patent or slightly ascending eglandular hairs mixed with long glandular hairs. Pedicels $5-27 \mathrm{~mm}$, clothed like the stem. Sepals $4.5-5 \mathrm{~mm}$, clothed like the stem; petals c. $\frac{3}{4}$ as long as sepals, glabrous or ciliate; styles $c .0 .75 \mathrm{~mm}$. Capsule $6-8 \mathrm{~mm}$; teeth patent. Seeds $0.5-0.6 \mathrm{~mm} .2 n=c .90$. W. \& C. Europe extending to S. Sweden, Balkan peninsula and Krym. Al Au Be Bu Cz Da Ga Ge Hs Hu It Ju Po Rm Rs (K) Su.
(h) Subsp. roeseri (Boiss. \& Heldr.) Nyman, Consp. 109 (1878): $6-35 \mathrm{~cm}$; stems with dense long glandular and few eglandular hairs. Pedicels $3-10(-15) \mathrm{mm}$, clothed like the stem. Sepals 4-6.5 mm, clothed like the stem; petals nearly as long as sepals, glabrous; stamens glabrous; styles $0.75-1.5 \mathrm{~mm}$. Capsule 6-9 mm; teeth patent. Seeds $0 \cdot 6-0.8 \mathrm{~mm}$. S. Europe, from Balkan peninsula to Islas Baleares. Al Bl Bu Cr Gr It Ju Si Tu.
44. C. glomeratum Thuill., Fl. Paris ed. 2, 226 (1799) (C. viscosum auct. mult.). Annual up to $30(-45) \mathrm{cm}$; stem with eglandular and glandular hairs. Leaves $5-25 \mathrm{~mm}$, the lower oblanceolate to obovate, the cauline ovate or elliptic-ovate, obtuse, hairy. Flowers in compact cymose clusters; pedicels shorter than sepals; bracts herbaceous. Sepals 4-5 mm, lanceolate, acute, with a narrow scarious margin, with glandular hairs and eglandular hairs exceeding the apex; petals more or less equalling or shorter than sepals (rarely absent), bifid for up to $\frac{1}{4}$ of their length; stamens 10 ; styles 5 . Capsule $6-10 \mathrm{~mm}$. Seeds $0.4-0.5 \mathrm{~mm}$, pale brown, finely tuberculate. $2 n=72$. Throughout Europe except the north-east. All except $\mathrm{Fe} \mathrm{Rs}(\mathrm{N}) \mathrm{Sb}$.
45. C. rectum Friv., Flora (Regensb.) 19:435(1836). Annual 880 cm ; stem with glandular and short eglandular hairs. Leaves up to 60 mm , ovate, oblong-ovate or lanceolate, with more or less numerous eglandular and glandular hairs. Pedicels longer than sepals; bracts herbaceous or with a narrow scarious margin. Sepals 3-10 mm, lanceolate, acute, with numerous glandular and eglandular hairs not exceeding the apex, margin scarious; petals from $\frac{2}{3}$ as long to nearly $1 \frac{1}{3}$ as long as sepals, strongly ciliate at base; stamens $5-10$; styles 5 . Capsule up to twice as long as sepals. Seeds 0.6-1 mm. Balkan peninsula, Romania. Al Bu Gr Ju Rm.
(a) Subsp. rectum: $25-80 \mathrm{~cm}$. Leaves $25-60 \times 10-25 \mathrm{~mm}$, lanceolate. Inflorescence lax, many-flowered. Sepals 7-10 mm; stamens 10. Capsule $10-15 \mathrm{~mm}$. Seeds $c .1 \mathrm{~mm}$. Throughout the range of the species.
(b) Subsp. petricola (Pančić) H. Gartner, Feddes Repert. (Beih.) 113: 38 (1939) (C. petricola Pančić). $8-25 \mathrm{~cm}$. Leaves $5-25 \times 5-$ 10 mm , ovate or oblong-ovate, rarely lanceolate. Inflorescence less lax, and fewer flowered than in (a). Sepals $3-7 \mathrm{~mm}$; stamens 5-10. Capsule $7-10 \mathrm{~mm}$. Seeds c. 0.6 mm . Bulgaria, Greece; ?Jugoslavia.
46. C. ligusticum Viv., Elench. Pl. Horti. Bot. 15 (1802). Annual up to 30 cm ; stem with fine glandular and occasional eglandular hairs. Lower leaves spathulate, cauline elliptical or oblong, hairy. Pedicels much longer than sepals; bracts
herbaceous or scarious at most for $\frac{1}{5}$ of their length. Sepals $3-8 \mathrm{~mm}$, ovate-lanceolate, obtuse, margin scarious, with numerous glandular hairs, with or without eglandular hairs usually not exceeding the apex; petals $1 \frac{1}{2}-2$ times as long as sepals, bifid for up to $\frac{1}{3}$ of their length, glabrous; stamens 5-10; styles 5. Capsule $6-7 \mathrm{~mm}$. Seeds $0 \cdot 5-0.9 \mathrm{~mm}$, brown, sharply and minutely tuberculate. E. \& C. Mediterranean region. Al Co Cr It Ju Sa Si.
1 Bracts scarious for $\frac{1}{5}$ of their length $\quad$ (d) subsp. trichogynum
1 Bracts herbaceous or very slightly scarious
2 Sepals $7-8 \mathrm{~mm}$; seeds $0.7-0.9 \mathrm{~mm} \quad$ (c) subsp. granulatum
2 Sepals $3-6 \mathrm{~mm}$; seeds $0.5-0.65 \mathrm{~mm}$
3 Plant not more than 7 cm ; leaves not more than 6 mm ; sepals $3-4 \mathrm{~mm}$
(b) subsp. palustre

3 Plant up to 15 cm ; leaves up to 20 mm ; sepals $4-6 \mathrm{~mm}$
(a) subsp. ligusticum
(a) Subsp. ligusticum (C. campanulatum Viv.): Rarely more than 15 cm . Leaves up to 20 mm . Bracts herbaceous. Sepals $4-6 \mathrm{~mm}$; stamens 10 . Seeds $0 \cdot 5-0.65 \mathrm{~mm} .2 n=34$. Almost throughout the range of the species, but apparently absent from Sardegna.
(b) Subsp. palustre (Moris) P. D. Sell \& Whitehead, Feddes Repert. 69: 20 (1964) (C. palustre Moris): Up to 7 cm . Leaves up to 6 mm . Bracts herbaccous. Sepals $3-4 \mathrm{~mm}$; stamens 10 . Seeds 0.5-0.6 mm. - Sardegna.
(c) Subsp. granulatum (Huter, Porta \& Rigo) P. D. Sell \& Whitehead, Feddes Repert. 69: 21 (1964): Up to 30 cm . Leaves up to 30 mm . Bracts herbaceous. Sepals $7-8 \mathrm{~mm}$; stamens 10 . Seeds $0.7-0.9 \mathrm{~mm}$. S. Italy.
(d) Subsp. trichogynum (Möschl) P. D. Sell \& Whitehead, Feddes Repert 69: 21 (1964) (C. trichogynum Möschl): Up to 22 cm . Leaves $12-27 \mathrm{~mm}$. Bracts scarious at most for $\frac{1}{5}$ of their length. Sepals $4-5 \mathrm{~mm}$; stamens $5-10$. Seeds c. 0.7 mm . - Albania, Jugoslavia.
47. C. semidecandrum L., Sp. Pl. 438 (1753). Procumbent to erect annual up to 20 cm . Leaves up to 18 mm , the basal oblanceolate, the cauline ovate to broadly elliptical. Pedicels equalling or slightly longer than sepals; bracts sometimes almost entirely scarious, always scarious in upper $\frac{1}{3}$. Sepals $3-5 \mathrm{~mm}$, lanceolate, acute, with wide scarious margins; petals shorter than sepals, slightly notched. Capsule $4 \cdot 5-7 \mathrm{~mm}$. Seeds $0 \cdot 4-0.5 \mathrm{~mm}$, yellow-ish-brown, finely tuberculate. Throughout Europe except the extreme north. All except Az Fa Is Rs (N) Sb.
(a) Subsp. semidecandrum: Stem with eglandular and dense glandular hairs; pedicels and sepals with dense glandular and few eglandular hairs. $2 n=36$. Throughout the range of the species.
(b) Subsp. macilentum (Aspegren) Möschl, Feddes Repert. 93: 157 (1936). Whole plant glabrous. - S. Sweden.
48. C. pumilum Curtis, Fl. Lond. 2 (6) : t. 30 (1777). Annual up to 14 cm ; stem with numerous glandular and some eglandular hairs. Leaves 4-15 mm, the lower oblanceolate, the upper ovate or ovate-oblong, obtuse, hairy. Pedicels longer than sepals; bracts scarious for up to $\frac{1}{8}$ of their length. Sepals 4-5 mm, lanceolate to oblong-lanceolate, acute, scarious for up to $\frac{1}{4}$ their length, with glandular hairs, and eglandular hairs reaching near to but not exceeding the apex; petals sometimes purple-tinged, equalling or slightly longer than the sepals, bifid for up to $\frac{1}{4}$ of their length, with branched veins; stamens $5-10$; styles 5 . Capsule $6-8 \mathrm{~mm}$. Seeds $0.5-0.6 \mathrm{~mm}$, chestnut-brown, finely tuberculate. $2 n=90-$ 100. Most of Europe, but absent from large areas of the north and east. All except Az Fa No Rs (N, E).
1 Only upper bracts with a scarious margin; petals 3 times as long as wide; stamens 5
(a) subsp. pumilum

1 All bracts with a scarious margin; petals not more than $2 \frac{1}{2}$ times as long as wide; stamens (5-)6-10

2 Petals c. $2 \frac{1}{2}$ times as long as wide; stamens (5-)6-10; anthers $0.2-0.5 \mathrm{~mm}$
(b) subsp. pallens

2 Petals about twice as long as wide; stamens 10 ; anthers 0.4 1 mm
(c) subsp. litigiosum
(a) Subsp. pumilum (C. glutinosum auct., non Fries): Plant often suffused with red. Only upper bracts with a scarious margin. Petals narrow, c. 3 times as long as wide; stamens 5. W. Europe; S. Sweden; possibly also in parts of C. \& S. Europe.
(b) Subsp. pallens (F. W. Schultz) Schinz \& Thell., Bull. Herb. Boiss. ser. 2, 7: 402 (1907) (C. glutinosum Fries): Plant often pale green. All bracts with a scarious margin. Petals c. $2 \frac{1}{2}$ times as long as wide; stamens (5-)6-10; anthers $0 \cdot 2-0.5 \mathrm{~mm}$. Probably throughout the range of the species.
(c) Subsp. litigiosum (De Lens) P. D. Sell \& Whitehead, Feddes Repert. 69: 22 (1964) (C. litigiosum De Lens): All bracts with a scarious margin. Petals about twice as long as wide and exceeding the sepals by at least 1 mm ; stamens 10 ; anthers $0 \cdot 4-1 \mathrm{~mm}$. - C. Europe and N. Italy; Kriti.
49. C. diffusum Pers., Syn. Pl. 1: 520 (1805) (C. tetrandrum Curtis). Annual up to 30 cm ; stem with glandular and usually some eglandular hairs. Leaves $5-20 \mathrm{~mm}$, lower oblanceolate to spathulate, upper ovate to elliptical, hairy. Pedicels much longer than sepals; bracts usually herbaceous. Sepals $4-9 \mathrm{~mm}$, ovatelanceolate to lanceolate, acute or acuminate, with scarious margin at apex for up to $\frac{1}{10}$ their length, with glandular hairs, and some eglandular hairs not exceeding the apex. Petals shorter than sepals, bifid for $c$. $\frac{1}{5}$ of their length, with branched veins; stamens and styles $4-5$. Capsule $5-10 \mathrm{~mm}$. Seeds $0 \cdot 4-0 \cdot 7 \mathrm{~mm}$, yellowish to chestnut-brown, bluntly tuberculate. S., W. \& C. Europe, extending northwards to S. Sweden and eastwards to Ukraine. Au Be Br Co Cz Da Fa Ga Ge Gr Hb Ho Hs Hu It Ju Lu No Po Rs (W, K, ?E) Sa Si Su Tu.
1 Sepals $7-9 \mathrm{~mm}$; capsule $7-10 \mathrm{~mm} \quad$ (c) subsp. subtetrandrum 1 Sepals $4-7 \mathrm{~mm}$; capsule $5-7 \mathrm{~mm}$
2 Flowers 5-merous; petals 4 times as long as wide
(a) subsp. gussonei

2 Flowers 4(-5)-merous; petals 3 times as long as wide
(b) subsp. diffusum
(a) Subsp. gussonei (Tod. ex Lojac.) P. D. Sell \& Whitehead, Feddes Repert. 69: 23 (1964) (C. gussonei Tod. ex Lojac.): Flowers always 5 -merous. Sepals c. 4 mm ; petals 4 times as long as wide. Capsule $c .5 \mathrm{~mm}$. Seeds $c .0 .5 \mathrm{~mm}$. Sicilia.
(b) Subsp. diffusum (C. atrovirens Bab.; C. tetrandrum Curtis, nom. illegit.): Flowers 4(-5)-merous. Sepals $4-7 \mathrm{~mm}$; petals 3 times as long as wide. Capsule $5-7 \mathrm{~mm}$. Seeds $0 \cdot 5-0 \cdot 7 \mathrm{~mm}$. $2 n=36,72$. Mainly W. \& C. Europe.
(c) Subsp. subtetrandrum (Lange) P. D. Sell \& Whitehead, Feddes Repert. 69: 23 (1964) (C. subtetrandrum (Lange) Murb.): Flowers (4-)5-merous. Sepals $7-9 \mathrm{~mm}$; petals $2 \frac{1}{2}$ times as long as wide. Capsule $7-10 \mathrm{~mm}$. Seeds $c .0 \cdot 5 \mathrm{~mm} .2 n=72$. - E.C. Europe, extending to $S$. Sweden.
50. C. siculum Guss., Suppl. Fl. Sic. Prodr. 137 (1832). Annual up to 12 cm ; stems with minute glandular and a few eglandular hairs. Leaves $5-15 \mathrm{~mm}$, basal oblanceolate, cauline ovatelanceolate to broadly elliptical, obtuse or subacute, hairy. Inflorescence with a dense dichasium at the end of each branch; pedicels shorter than sepals; bracts herbaceous. Sepals $5-6 \mathrm{~mm}$, oblong or oblong-lanceolate, acute, scarious at apex, with dense glandular hairs, and a few eglandular hairs not exceeding the apex; petals $\frac{2}{3}$ as long as sepals, bifid for up to $\frac{1}{5}$ of their length.

[^65]Capsule 7-8 mm. Seed 0.4-0.5 mm, pale brown, finely tuberculate. W. Mediterranean region, Portugal. Co Ga Hs It Lu Si.
51. C. gracile Dufour, Ann. Gén. Sci. Phys. (Bruxelles) 7: 304 (1820) (C. bulgaricum Uechtr., C. gayanum Boiss., C. schmalhausenii Pacz., C. velenovskyi Hayek). Annual up to 22 cm ; stem, leaves, young capsule and petals sometimes suffused with purple; stems with numerous glandular and few eglandular hairs. Leaves $3-15 \mathrm{~mm}$, lower spathulate or obovate; cauline linearlanceolate to ovate-oblong, glandular and hairy. Inflorescence often much-branched; pedicels usually shorter, rarely longer, than sepals; bracts herbaceous. Sepals $2.5-7 \mathrm{~mm}$, ovate-lanceolate to ovate-oblong, obtuse to acute, the outer without or with very narrow scarious margin, the inner with a scarious margin, all glandular-hairy, the glands not exceeding the apex; petals shorter to slightly longer than sepals, emarginate or shallowly bifid. Capsule $4-14 \mathrm{~mm}$. Seeds $0.4-1 \mathrm{~mm}$, pale to chestnutbrown, finely tuberculate. $2 n=88-92$. S. Europe, northwards to c. $49^{\circ} \mathrm{N}$. in Ukraine. Bu Co Ga Gr Hs Lu Rm Rs (W, K, E).

Very variable, especially in size of sepals, petals, capsules and seeds; perhaps divisible into several subspecies.

## 10. Moenchia Ehrh. ${ }^{1}$

Glabrous, usually glaucous annuals. Leaves linear to oblonglanceolate. Flowers 4- or 5-merous, solitary or in few-flowered spreading cymes; bracts white-margined. Sepals lanceolate, acute, with broad white membranous margins; petals entire or slightly emarginate; stamens 4(5) or 8(10); styles (3)4(5), opposite the sepals. Fruit a straight capsule, dehiscing with twice as many short obtuse teeth as styles. Seeds numerous, reniform, papillose.
1 Petals exceeding the sepals; flowers 5-merous; capsule broadly ovoid
3. mantica

1 Petals shorter than or equalling the sepals; flowers 4- or 5merous; capsule cylindrical to narrowly ovoid
2 Leaves linear to linear-lanceolate; pedicels not thickened distally; flowers 4-merous

1. erecta

2 Leaves oblong-lanceolate; pedicels thickened distally; flowers 5-merous
2. graeca

1. M. erecta (L.) P. Gaertner, B. Meyer \& Scherb., Fl. Wett. 1: 219 (1799) (Cerastium erectum (L.) Cosson \& Germ.). Erect annual, usually with ascending basal branches. Basal leaves shortly petiolate, upper sessile, ascending; all linear or linear-lanceolate, rigid, acute, glaucous. Flowers $1-3(-5)$, c. 8 mm in diameter. Petals 4 (rarely 5 or absent), narrow, entire; stamens 4 (or 8 ); styles 4, short and recurved. Capsule equalling or somewhat exceeding the sepals, opening by 8 revolute teeth. $2 n=36 . W$., S. \& C. Europe, northwards to England \& eastwards to E. Germany \& Macedonia. Be Br Bu Co Cz Ga Ge Gr Ho Hs It Ju Lu Sa Si Tu.
(a) Subsp. erecta: Stem $2 \cdot 5-10 \mathrm{~cm}$. Flowers 1-3. Petals $\frac{2}{3}$ as long as the sepals; stamens 4. Capsule cylindrical, slightly exceeding the sepals. Throughout the range of the species.
(b) Subsp. octandra (Ziz) Coutinho, Fl. Port. 211 (1913) (M. octandra (Ziz) Gay): Stem $10-20 \mathrm{~cm}$. Flowers 2-5. Petals almost equalling the sepals; stamens 8. Capsule narrowly ovoid, scarcely equalling the sepals. W. Mediterranean region, Portugal.
2. M. graeca Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 91 (1853). Like 1 but usually smaller and more branched; leaves oblong-lanceolate, scarcely acute; flowers 5-merous; pedicels flexuous, thickened distally; sepals exceeding the petals; styles about as long as the ovary in flower; capsule $c . \frac{2}{3}$ as long as the sepals. W. \& S. parts of Balkan peninsula; Aegean islands. AlCrGrJu .
3. M. mantica (L.) Bartl., Cat. Sem. Horti. Gotting. 5 (1839). Like 1 but usually $15-30 \mathrm{~cm}$, and larger throughout; bracts very broadly white-margined; flowers 3-9 or more, 5-merous; petals equalling to much exceeding the sepals; stamens 10 ; styles 5 (rarely 3-4), at least as long as the ovary; capsule broadly ovoid, opening by 10 teeth. S.E. Europe, extending to Hungary and S. Switzerland. Al Au Bu Cr Gr He Hu It Ju Rm Tu [Cz Ge Po].
(a) Subsp. mantica: Petals white, up to twice as long as the sepals. Capsule about equalling the sepals. Throughout the range of the species.
(b) Subsp. caerulea (Boiss.) Clapham, Feddes Repert. 69: 49 (1964). (M. caerulea Boiss., M. mantica var. violascens Aznav.): Petals flax-blue, 2-3 times as long as the sepals. Capsule exceeding the sepals. Balkan peninsula; perhaps introduced elsewhere.

## 11. Myosoton Moench ${ }^{1}$

Perennial. Leaves ovate. Inflorescence a leafy dichasium; flowers 5 -merous. Petals white, deeply bifid; stamens 10 ; styles 5 , alternating with the sepals. Fruit an ovoid capsule, dehiscing to almost half-way with 5 shortly bifid, blunt teeth. Seeds numerous, reniform, tuberculate. (Malachium Fries.)

1. M. aquaticum (L.) Moench, Meth. 225 (1794) (Cerastium aquaticum L., Stellaria aquatica (L.) Scop., Malachium aquaticum (L.) Fries). Flowering stems $20-120 \mathrm{~cm}$, decumbent or ascending, weak, glandular-hairy above. Leaves $2-5(-8) \mathrm{cm}$, thin, ovate, acute to acuminate at apex, truncate or cordate at base, hairy or glabrous, shortly petiolate, or the upper sessile. Petals white, bifid to the base, exceeding the obtuse sepals. Ripe capsule exceeding the sepals, pendent from the patent pedicel. $2 n=28$. Europe, northwards to $65^{\circ} \mathrm{N}$. in Fennoscandia. All except Az Bl Fa Hb Is Sa Sb Tu .

Variable, especially in habit, hairiness and leaf-shape. Malachium calycinum Willk., Bot. Zeit. 5: 239 (1847) from S. Spain (Carratraca, N.W. of Málaga), with the stem having a single row of hairs and the petals only half as long as the sepals, may merit subspecific rank.

## 12. Sagina L. ${ }^{2}$

Small annual or perennial herbs, often caespitose, with slender procumbent or ascending flowering stems and subulate to linearlanceolate leaves in slightly connate pairs. Flowers 4- to 5merous, almost globose in bud, solitary or in few-flowered cymes. Sepals free; petals usually white, entire, often minute, sometimes 0 ; stamens as many or twice as many as the sepals; styles 4-5, alternating with the sepals. Fruit a capsule splitting to the base into 4 or 5 valves. Seeds numerous.
1 Annual, without vegetative stems at time of flowering; flowers 4-merous
2 Leaves with a well-marked arista; mean seed-size less than $0.4 \mathrm{~mm} \quad 12$. apetala
2 Leaves muticous or very shortly mucronate; mean seed-size more than 0.4 mm
13. maritima

1 Perennial, with vegetative stems at time of flowering, rarely annual; flowers usually 5 -merous, sometimes 4 -merous. (If annual, flowers 5 -merous)
3 Cauline leaves at the 2 uppermost nodes less than 2.5 mm , with short dense axillary leaf-fascicles

1. nodosa

3 Cauline leaves at the 2 uppermost nodes not distinctly shorter than those at the lower nodes
4 Leaves with a terminal arista $\frac{3}{4}-1 \frac{1}{2}$ times as long as the maximum leaf-width

[^66]
## 5 Petals $1 \frac{1}{2}-2$ times as long as sepals (Corse and Sardegna)

5. pilifera

5 Petals less than $1 \frac{1}{2}$ times as long as sepals 6. subulata
4 Leaves muticous or with an arista less than $\frac{3}{4}$ as long as the maximum leaf-width
6 Sepals and pedicels glandular (sometimes very sparsely so)
7 Petals more than $1 \frac{1}{2}$ times as long as sepals $\quad$ 4. glabra
7 Petals less than $1 \frac{1}{2}$ times as long as sepals
8 Plant more or less densely caespitose; flowers solitary
8. nevadensis

8 Plant not densely caespitose; inflorescence 2- to 5flowered
7. sabuletorum

6 Sepals and pedicels glabrous, or rarely pedicels minutely glandular
9 Plants forming small dense tufts; sepals usually with purple margins; fruiting pedicel not recurved during ripening
10 Flowers 4- to 5-merous, usually with fewer than 10 stamens; sepals longer than petals; fruiting pedicels curving outwards
2. intermedia

10 Flowers 5 -merous; stamens 10 ; petals longer than sepals; fruiting pedicels straight 3. caespit
9 Plants forming lax tufts or mats; sepals with white margins; fruiting pedicels recurved at some stage during ripening
11 Flowers usually 4-merous, occasionally 5-merous; petals often minute or absent, sometimes conspicuous; capsule less than 3 mm
11. procumbens

11 Flowers usually 5 -merous, occasionally 4 -merous; petals about equalling sepals; capsule 3 mm or more
12 Capsule more than 3.5 mm ; sepals more than 2.8 mm ; plant fully fertile 9. saginoides
12 Capsule less than 3.5 mm ; sepals less than 2.8 mm ; plant with reduced fertility
10. $\times$ normaniana

1. S. nodosa (L.) Fenzl, Vers. Darstell. Alsin. tab. ad 18 (1833). Perennial with short non-flowering main stem and many procumbent or ascending flowering stems $5-15(-35) \mathrm{cm}$, each with a basal rosette and with cauline leaves markedly diminishing upwards. Upper leaves shorter than the internodes and mostly with short dense axillary leaf-fascicles; all leaves narrowly linear, shortly mucronate. Flowers $1-3,5$-merous, $5-10 \mathrm{~mm}$ in diameter. Sepals 2-4 mm, ovate-oblong, obtuse; petals 2-3 times as long as the sepals; stamens 10 . Ripe capsule $1 \frac{1}{3}$ times as long as the appressed sepals. $2 n=22-24,44,56$. In damp places. Throughout Europe except most of the south-east and some islands. Au Be Br Co Cz Da Fa Fe Ga Ge Hb He Ho Hs Hu Is It Ju Lu No Po RmRs (N, B, C, W) Su.
Var. moniliformis (G. F. W. Meyer) Lange, procumbent and rarely flowering, but with numerous deciduous bulbil-like axillary fascicles, occurs in N. Europe and may merit subspecific rank.
2. S. intermedia Fenzl in Ledeb., Fl. Ross. 1: 339 (1842) (?S. nivalis (Lindblad) Fries). Perennial, forming small cushions $1.5-5 \mathrm{~cm}$ in diameter and $1-3 \mathrm{~cm}$ high. Basal leaf-rosette only present during the first season; cauline leaves $3-6 \mathrm{~mm}$, linear, usually shortly mucronate, glabrous. Flowers $3-6 \mathrm{~mm}$ in diameter, 4- to 5 -merous, solitary on pedicels $2-5 \mathrm{~mm}$. Sepals $1 \cdot 5-2 \mathrm{~mm}$, ovate, obtuse, with narrow, scarious, often violet margins; petals narrow, somewhat shorter than the sepals; stamens $8-10$, sometimes fewer. Ripe capsule $2 \cdot 5-3 \mathrm{~mm}$, greenish- or whitish-yellow, $1 \frac{1}{2}$ times as long as the appressed sepals; fruiting pedicels usually curving outwards. $2 n=88$. Arctic \& N.W. Europe, southwards to Scotland and S. Norway; ?Alps. ?Au Br Fa Fe ?He Is No Rs (N) Sb Su.
3. S. caespitosa (J. Vahl) Lange in Rink, Gronl. Geogr. Stat. Beskr.2(6): 133(1857). Perennial, forming small cushionslike those of 2 but with persistent dead leaves. Flowers usually 5-merous, 1 or 2 together on short peduncles which are scarcely exserted from
the cushions. Sepals $1 \cdot 8-3 \mathrm{~mm}$, with violet margin and often with conspicuous veins; petals up to 4 mm , longer than the sepals; stamens 10 . Ripe capsule $2-3.5 \mathrm{~mm}$, less than $1 \frac{1}{2}$ times as long as the appressed sepals; fruiting pedicels straight. $2 n=88$.
Mountains of Norway and N.W. Sweden; Iceland; Jan Mayen. Is No Sb Su .
4. S.glabra(Willd.) Fenz1, Vers. Darstell. Alsin. tab. ad 57(1833) (S. repens Burnat). Laxly caespitose perennial with procumbent or ascending rooting stems up to 2 cm . Upper leaves scarcely shorter than lower, about equalling the internodes and with elongating axillary shoots; all leaves narrowly linear, muticous or shortly mucronate. Flowers solitary, 5 -merous, $5-10 \mathrm{~mm}$ in diameter; pedicels $1-2 \mathrm{~cm}$ or more. Sepals ovate-oblong, obtuse; petals $1 \frac{1}{2}-2$ times as long as the sepals; stamens 10. Ripe capsule $1 \frac{1}{3}$ times as long as the appressed sepals. E. Pyrenees; Alps; Appennini. Au Ga He It Ju.
5. S. pilifera (DC.) Fenzl, Vers. Darstell. Alsin. tab. ad 57 (1833). Like 4 but more densely caespitose; leaves long-aristate; petals more than twice as long as the sepals. - Mountains of Corse and Sardegna. Co Sa.
6. S. subulata (Swartz) C. Presl, Fl. Sic. 158 (1826). Perennial, mat-forming, with short non-flowering main stem and numerous decumbent then erect or ascending flowering stems $2-7 \cdot 5(-12 \cdot 5) \mathrm{cm}$. All stems with basal rosettes of linear leaves $0.5-1.5 \mathrm{~cm}$; cauline leaves narrowed to an aristate apex, the arista $\frac{3}{4}-1 \frac{1}{2}$ times as long as the maximum leaf-width. Flowers usually solitary, 5 -merous; pedicels $2-4 \mathrm{~cm}$, filiform, glandularhairy at least above, rarely glabrous. Sepals broadly ovate, obtuse, usually glandular; petals about equalling the sepals; stamens 10 . Ripe capsule 3 mm , slightly exceeding the appressed sepals. $2 n=22$. Dry, sandy, gravelly or rocky places. W. \& C. Europe; S. Europe eastwards to S. Italy and C. Greece. Al Au Be Br CoCzDaFaGaGe Gr Hb He Ho Hs Hu Is It Ju Lu No Po Rm Sa Si Su.
Variable. Short-lived (?annual) dwarf variants, var. pygmaea Samp. (coast of Portugal) and var. gracilis Fouc. \& E. Simon primus (S. France and Corse), need further investigation. S. revelieri Jordan \& Fourr., Brev. Pl. Nov. 1: 11 (1866), from Corse, with petals up to $1 \frac{1}{2}$ times as long as the sepals, and basal leaves up to 2 cm , may merit subspecific rank.
7. S. sabuletorum (Gay) Lange, Descr. Icon. Ill. 3 (1864). Annual or perennial, robust, with a single non-flowering rosette from which many procumbent flowering stems radiate. Rosette-leaves $1.5-3 \mathrm{~cm}$; cauline $0.5-1.5 \mathrm{~cm}$, all shortly mucronate. Flowers 5 -merous, $2-4$ per stem, borne singly in the axils of uppermost leaves; pedicels and sepals densely glandular; pedicels not more than 1.5 cm . Fertile stamens only 5 . Capsule much longer than the sepals. Sandy and gravelly places at low altitudes. - Spain and Portugal. Hs Lu.
8. S. nevadensis Boiss. \& Reuter, Pugillus 22 (1852). Densely caespitose perennial $3-7 \mathrm{~cm}$; stems procumbent to erect, densely leafy, with short internodes. Leaves shortly mucronate. Flowers solitary; pedicels $2 \cdot 5-4 \mathrm{~cm}$, glandular-puberulent, often flexuous. Ripe capsule twice as long as the appressed sepals. Mountains. - Spain (Sierra Nevada, Sierra de Guadarrama). Hs.
9. S. saginoides (L.) Karsten, Deutsche. Fl. Pharm.-med. Bot. 539 (1882) (S. linnaei C. Presl). Perennial. Rosette leaves up to 2 cm ; cauline leaves $5-10 \mathrm{~mm}$; all leaves glabrous, sometimes ciliate, muticous to shortly mucronate. Flowers usually solitary, sometimes 2, on slender pedicels; pedicels glabrous, rarely
minutely glandular-puberulent. Sepals more than 2.8 mm , ovateoblong, obtuse, glabrous; petals about equalling the sepals; stamens 10 , rarely 5 . Ripe capsule ( $3 \cdot 5-4-5 \mathrm{~mm}$, pale strawcoloured, shining, about twice as long as the appressed sepals when dehisced. $2 n=22$. Arctic and subarctic Europe, and on the principal mountain ranges southwards to S. Spain and C. Greece. Al Au Br $\mathrm{Bu} \mathrm{Co} \mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N)} \mathrm{Su}$.
S. macrocarpa (Reichenb.) J. Maly, Enum. Pl. Austr. 293 (1848) with capsules up to 5 mm and $2 \frac{1}{2}$ times as long as the sepals, cannot be separated clearly from 9, though plants with larger capsules seem more frequent at lower levels in C. Europe.
10. S. $\times$ normaniana Lagerh., Kong. Norske Vid. Selsk. Skr. (Trondhjem) 1898 (1): 1 (1898) (S. procumbens $\times$ saginoides). Like 9 but with longer, more slender and rooting procumbent stems; rosette-leaves $0.5-3 \mathrm{~cm}$; sepals $2-2.5 \mathrm{~mm}$; fruiting pedicels 1.5 4 cm ; capsules $3-3.5 \mathrm{~mm}$, usually remaining undeveloped and setting no seed. Mountains of Scandinavia, Scotland and Austria. Au Br No Su.
Plants in cultivation often have some well-developed capsules with good seed.
11. S. procumbens L., Sp. Pl. 128 (1753). A mat-forming perennial with short non-flowering main stem bearing a dense central leaf-rosette, and numerous lateral stems up to 20 cm , ascending from procumbent rooting bases; usually glabrous, sometimes minutely ciliate. Leaves $5-12 \mathrm{~mm}$, linear-subulate, shortly aristate, glabrous or rarely ciliate. Flowers solitary, 4(-5)-merous; pedicels $5-20 \mathrm{~mm}$, glabrous. Sepals $1-2.5 \mathrm{~mm}$, ovate, obtuse; petals usually minute or absent, sometimes conspicuous and as long as the sepals; stamens $4(-5)$. Ripe capsule $2-3 \mathrm{~mm}$, longer than the usually patent sepals. $2 n=22$. Throughout Europe. All except Sb .

## Variable. The following treatment is conservative.

(a) Subsp. procumbens: Flowers usually 4 -merous. Sepals broadly ovate, usually patent in fruit; petals usually minute or absent. Throughout the range of the species.
(b) Subsp. muscosa (Jordan) Nyman, Consp. 121 (1878) (S. muscosa Jordan): Flowers commonly 5-merous. Sepals ovateelliptical, usually appressed in fruit; petals always conspicuous and sometimes as long as the sepals. Mountain rocks and ledges. - France (E. Cévennes, Auvergne, E. Pyrenees).
S. boydii Buchanan-White, Trans. Proc. Bot. Soc. Edinb. 17: 33 (1887), a densely caespitose perennial with short, erect, glabrous stems, crowded, imbricate, rigid, strongly recurved leaves and 4 - to 5 -merous flowers, is presumed to have been collected near Braemar, Scotland, in 1878 but has not been seen since, though still retained in cultivation. No ripe seeds are ever formed; the capsule remains enclosed in the tightly appressed sepals. $2 n=22$.
12. S. apetala Ard. Animadv. Bot. Spec. Alt. 2: 22 (1763). Annual; stem (1-)3-10(-20) cm, erect or ascending, with nonpersistent basal leaves in a lax cluster, simple or with decumbent (rarely quite procumbent) to ascending non-rooting branches. Leaves linear, long-mucronate to aristate, usually more or less ciliate towards the base. Flowers usually 4-merous, solitary; pedicels filiform, often glandular-hairy at least above. Sepals ovate to ovate-oblong, rounded to acute at the apex, often hooded; petals minute, often falling early, rarely absent. Ripe capsule equalling or exceeding the patent or appressed sepals. Mean seed-size less than $0.4 \mathrm{~mm} .2 n=12$. Europe northwards to Scotland, S. Sweden and Estonia. All except Fa Fe Is No Rs ( N, ? K) Sb .

This largely autogamous species is extremely variable, and all combinations of characters involving the ciliation of the leaves and the glandular-hairiness of the sepals and pedicels are to be found in local variants. The following is a very tentative treatment.
(a) Subsp. apetala (S. ciliata Fries): Fruiting sepals appressed or slightly patent, subacute; terminal capsule of well-grown plants c. $1 \frac{1}{4}$ times as long as sepals. Mean seed-size more than 0.34 mm . Throughout the range of the species.

Glabrous maritime variants with persistent basal leaves ( $S$. ambigua auct. non, Lloyd), occur in W. France and S. England.
S. melitensis Gulia ex Duthie, Jour. Bot. (London) 13: 37 (1875), often overwintering, with obtuse or subacute slightly patent sepals, occurs throughout the Mediterranean region, and may merit subspecific rank.
(b) Subsp. erecta (Hornem.) F. Hermann, Fl. Deutschl. Fennosk. 182 (1912) (S. apetala auct.). Fruiting sepals patent, subobtuse; terminal capsule of well-grown plants more than $1 \frac{1}{4}$ times as long as sepals. Mean seed-size less than 0.34 mm . Almost throughout the range of the species, but rare in the Mediterranean region.

A variant, smaller in all its parts (S. filicaulis auct., non Jordan, S. ciliata var. minor Rouy \& Fouc.), which occurs in C. \& N. France, Belgium and S. England, breeds true and may be worth subspecific rank.
13. S. maritima G. Don., Herb. Brit. fasc. 7, 155 (1806). Annual, usually glabrous, with or without a central rosette of leaves, main stem flowering, it and the numerous lateral branches varying from procumbent to erect; sometimes densely caespitose. Leaves linear-lanceolate, somewhat fleshy, obtuse or mucronulate but not aristate, rarely ciliate. Flowers usually 4-merous, solitary; peduncles erect, glabrous, filiform. Sepals ovate, obtuse, not mucronate, often with purplish margin; petals minute, or absent. Ripe capsule equalling or slightly shorter than the obliquely erect but not appressed sepals. Mean seed-size more than 0.4 mm . $2 n=22-24,28$. Coasts of Europe from Bulgaria and S.W. Finland westwards, and northwards to $68^{\circ} \mathrm{N}$. in Norway; occasionally inland, and on mountains up to $1,300 \mathrm{~m}$ in Scotland. Be Bl Br Bu Co Cr Da Fe Ga Gr Hb Ho Hs It Ju Lu No Po Rs (B) Sa Su.

Very variable, many local species and subspecies having been described. All combinations of characters may be found, and it is difficult to make useful subdivisions.

## 13. Scleranthus L. ${ }^{1}$

Annual, biennial or perennial herbs; stems diffusely branched, hairy on two sides. Leaves connate at base. Inflorescence of more or less dense terminal and axillary cymose clusters. Sepals usually 5 , inserted on the rim of the urceolate perigynous zone (the whole being called the 'fruit' in the following account); petals absent; stamens up to 10 ; styles 2. Fruit an indehiscent $1(-2)$-seeded nutlet enclosed by the hardened wall of the perigynous zone and the persistent sepals, which are shed with it. Seeds lenticular, smooth.

Measurements of the 'fruit' are from the apex of the sepal to the base of the perigynous zone and vary little between flowering and fruiting.

Literature: W. Rössler, Agronomia Lusitana 15: 97-138 (1953); Österr. Bot. Zeitschr. 102: 30-72 (1955).
1 Apex of sepals curved inwards and forming a hook

3. uncinatus

1 Apex of sepals patent, erect or slightly incurved, but not hooked
2 Sepals obtuse, scarious margin $0.3-0.5 \mathrm{~mm}$ 1. perennis
2 Sepals $\pm$ acute, scarious margin not more than 0.1 mm
2. annuus

1. S. perennis L., Sp. Pl. 406 (1753). Perennial herb often with woody stock and procumbent to erect stems up to 22 cm . Leaves linear to lanceolate, channelled, obtuse to acute, glabrous or with short cilia. Inflorescence of terminal clusters which are not usually exceeded by the bracts. Fruit $2-6.5 \mathrm{~mm}$; sepals lanceolate, obtuse, with a scarious margin $0.3-0.5 \mathrm{~mm}$ wide. Most of Europe except the extreme north. Al Au Be Br BuCoCzDaGa Ge Gr He Ho Hs Hu It Ju No Po Rm Rs (B, C, W, K, E) Sa Si Tu.

1 Fruit $4 \cdot 5-6.5 \mathrm{~mm}$
2 Stems procumbent, not dichotomously branched; fruit 4.55.5 mm (f) subsp. marginatus

2 Stems ascending, dichotomously branched; fruit $5-6.5 \mathrm{~mm}$
(g) subsp. dichotomus

1 Fruit 2-4.5 mm
3 Plant with procumbent or slightly ascending stems or forming a dense cushion; at least some of the inflorescences with more than 7 flowers in a cluster
4 Plant with long procumbent or slightly ascending stems; fruit $2-3(-3 \cdot 5) \mathrm{mm}$
(b) subsp. prostratus

4 Plant forming a dense cushion with stems up to 5 cm
5 Fruits $2-3 \mathrm{~mm}$ (Corse) $\quad$ (c) subsp. burnatii
5 Fruits $3.5-4.5 \mathrm{~mm}$ (Pyrenees) (d) subsp. polyenemoides
3 Plant with ascending to erect stems $3-22 \mathrm{~cm}$; inflorescences with not more than 7 flowers in a cluster
6 Stems up to 6 cm ; leaves lanceolate, obtuse; internodes $2-4 \mathrm{~mm}$
(e) subsp. vulcanicus

6 Stems up to 22 cm ; leaves linear, acute; internodes $6-10 \mathrm{~mm}$
(a) subsp. perennis
(a) Subsp. perennis: Stems up to 22 cm , ascending to erect; internodes $6-10 \mathrm{~mm}$. Leaves $5-9 \mathrm{~mm}$, linear, acute, shortly ciliate. Inflorescence with not more than 7 flowers in a cluster. Fruit (3-) $3 \cdot 5-4 \cdot 5 \mathrm{~mm}$; sepals erect or slightly incurved. $2 n=22$. Throughout the range of the species.
(b) Subsp. prostratus P. D. Sell, Feddes Repert. 68: 168 (1963): Stems long, procumbent to slightly ascending; internodes 2 -$3(-10) \mathrm{mm}$. Leaves $3-5(-7) \mathrm{mm}$, linear, acute, glabrous or slightly ciliate. Inflorescence often with more than 7 flowers in a cluster. Fruit $2-3(-3 \cdot 5) \mathrm{mm}$; sepals erect or slightly incurved. Sandy heaths. E. England.
(c) Subsp. burnatii (Briq.) P. D. Sell, Feddes Repert. 68: 168 (1963) (S. burnatii Briq.): Forming a more or less dense cushion; stems up to 5 cm , ascending; internodes $1-5 \mathrm{~mm}$. Leaves 4-6 mm, linear, more or less acute, ciliate. Inflorescence usually with more than 7 flowers in a cluster. Fruit $2-3 \mathrm{~mm}$; sepals slightly incurved. Mountains. Corse.
(d) Subsp. polyenemoides (Willk. \& Costa) Font Quer, Butll. Inst. Catalana Hist. Nat. 37: 51 (1949): Forming a dense cushion, with stems up to 3 cm ; internodes up to $4(-5) \mathrm{mm}$. Leaves 4-6 mm, linear acute, glabrous or slightly hairy. Inflorescence usually with more than 7 flowers in a cluster. Fruit $3.5-4.5 \mathrm{~mm}$; sepals erect or incurved. Pyrenees.
(e) Subsp. vulcanicus (Strobl) Béguinot in Fiori \& Béguinot, Nuovo Gior. Bot. Ital. nov. ser., 16: 464 (1909): Compact, with stems up to 6 cm ; internodes $2-4 \mathrm{~mm}$. Leaves $3-6(-8) \mathrm{mm}$, lanceolate, obtuse, shortly ciliate. Inflorescence with not more than 5 flowers in a cluster. Fruit $3-4.5 \mathrm{~mm}$; sepals more or less patent. Sicilia (Etna).
(f) Subsp. marginatus (Guss.) Arcangeli, Comp. Fl. Ital. 110 (1882): With numerous long, procumbent stems; internodes $5-10(-25) \mathrm{mm}$. Leaves $5-9 \mathrm{~mm}$, linear, obtuse, shortly ciliate.

Inflorescence with not more than 5 flowers in a cluster. Fruit $4.5-5.5 \mathrm{~mm}$; sepals more or less patent. - S. France, S. Italy, Sicilia, Romania and Balkan peninsula.
(g) Subsp. dichotomus (Schur) Stoj. \& Stefanov, Fl. Balg. ed. 3, 434 (1948): Like (f) but stems fewer, ascending, dichotomously branched; fruit 5-6.5 mm. Mountain rocks. - E. Alps to Carpathians; Balkan peninsula.
2. S. annuus L., Sp. Pl. 406 (1753). Annual or biennial herb with ascending stems up to 25 cm . Leaves linear, channelled, obtuse, ciliate at base. Inflorescence of axillary and terminal clusters, which are often exceeded by the bracts. Fruit 1.25.5 mm ; sepals lanceolate, more or less acute, with a scarious margin not more than 0.1 mm wide. $2 n=44$. Almost throughout Europe except the extreme north. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Fa} \mathrm{Is} \mathrm{Sb}$.

1 Fruit $3 \cdot 2-4 \cdot 5(-5 \cdot 5) \mathrm{mm}$; sepals patent
(a) subsp. annuus

1 Fruit $1 \cdot 2-3(-3 \cdot 8) \mathrm{mm}$; sepals erect or connivent
2 Sepals unequal, connivent
(c) subsp. verticillatus

2 Sepals equal, erect or connivent
3 Fruit $2 \cdot 2-3(-3 \cdot 8) \mathrm{mm}$; sepals erect or connivent
(b) subsp. polycarpos

3 Fruit $1 \cdot 2-1 \cdot 6(-2 \cdot 3) \mathrm{mm}$; sepals distinctly connivent
(d) subsp. ruscinonensis
(a) Subsp. annuus: Stems $2-24 \mathrm{~cm}$. Leaves $4-10(-20) \mathrm{mm}$. Fruit $3 \cdot 2-4 \cdot 5(5 \cdot 5) \mathrm{mm}$; sepals more or less equal, patent. Usually calcifuge. Throughout the range of the species.
(b) Subsp. polycarpos (L.) Thell. in Schinz \& R. Keller, Fl. Schweiz ed. 3, 2: 109 (1914): Stems 2-17 cm. Leaves 4-8 mm. Fruit $2 \cdot 2-3 \cdot 0(-3 \cdot 8) \mathrm{mm}$; sepals equal, erect or connivent. Usually calcifuge. Most of Europe, but probably absent from some parts of U.S.S.R.
(c) Subsp. verticillatus (Tausch) Arcangeli, Comp. Fl. Ital. 110 (1882): Stems $3-14 \mathrm{~cm}$. Leaves $4-6(-10) \mathrm{mm}$. Fruit $1 \cdot 5-$ $2 \cdot 2(-3 \cdot 0) \mathrm{mm}$; sepals unequal, connivent. Often on calcareous soils. S. \& S.C. Europe.
(d) Subsp. ruscinonensis (Gillot \& Coste) P. D. Sell, Feddes Repert. 68: 169 (1963) (S. ruscinonensis (Gillot \& Coste) Rössler): Usually less than 10 cm . Leaves $c .6 \mathrm{~mm}$. Fruit $1 \cdot 2-1 \cdot 6(-2 \cdot 3) \mathrm{mm}$; sepals of equal length, connivent at apex. - S.E. France; Corse; Spain; N. Portugal.

Hybrids between 1 and 2, which are more or less sterile, sometimes occur where the two species grow together.
3. S. uncinatus Schur, Verh. Siebenb. Ver. Naturw. 1: 107 (1850). Annual with ascending stems up to 12 cm . Leaves $7-10 \mathrm{~mm}$, linear, channelled, subacute, glabrous or slightly ciliate at base. Inflorescence of axillary and terminal clusters with 2-6 flowers in a cluster; bracts often exceeding clusters. Fruit $5-6 \mathrm{~mm}$; sepals linear-lanceolate, patent with an incurved hook at the apex, scarious margin not more than 0.1 mm wide. S. Europe ; Carpathians. Al Bu Cz Ga Gr Hs Ju ?Lu Rm Rs (W, ?K).

## Subfam. Paronychioideae

Leaves opposite, alternate or verticillate; stipules present. Petals often very small or absent; sepals free.

## 14. Corrigiola L. ${ }^{1}$

Glabrous herbs with more or less decumbent stems and alternate leaves. Inflorescence compound, cymose; flowers numerous, small, more or less aggregated, slightly perigynous. Sepals, petals
and stamens 5; stigmas 3. Fruit a trigonous achene enclosed in the persistent calyx.
Annual; inflorescence-branches bracteate

1. litoralis
Perennial; inflorescence-branches usually ebracteate
2. telephiifolia
3. C. litoralis L., Sp. Pl. 271 (1753). Annual, glaucous, with slender tap-root and decumbent stems up to 25 cm . Leaves linear-oblanceolate, obtuse, entire; stipules small, scarious. Inflorescence with leafy bracts at base of branches; flowers in dense terminal and axillary cymose clusters. Sepals $c .1 \mathrm{~mm}$, slightly longer than whitish petals. Fruit $1-1.5 \mathrm{~mm} .2 n=18$. On seasonally wet, sandy ground, often impermanent. W., C. \& S. Europe; occasional as a casual elsewhere. Au Be Br Bu Co Cr Cz *Da Ga Ge Gr He Ho Hs It Ju Lu Po Rs (W) Sa Si Tu.
4. C. telephiifolia Pourret, Mém. Acad. Toulouse 3: 316 (1788). Like 1 but perennial with thick woody tap-root; stems stouter, often ascending; basal leaves narrowly obovate and more or less fleshy; inflorescence-branches usually ebracteate; fruit 1.5$2.5 \mathrm{~mm} .2 n=18$. In similar situations to 1. W. Mediterranean region. ? Bl Co Ga Hs It Lu Sa [ Be Ge ].
C. imbricata Lapeyr., Hist. Abr. Pyr. 169 (1813), described from the E. Pyrenees, differs in its very short stems and more or less densely imbricate leaves. Its status is doubtful.

## 15. Paronychia Miller ${ }^{2}$

Herbs, sometimes woody at base, with erect to procumbent, usually much-branched stems. Leaves opposite (or sometimes apparently alternate), elliptical to linear; stipules usually conspicuous, scarious. Flowers small, slightly perigynous, in axillary, rarely terminal, spherical clusters; bracts scarious, usually silvery and often very conspicuous and concealing the flowers. Calyx very deeply 5 -lobed, lobes often cucullate and awned, and often with membranous margins; petals minute or absent; stamens 5; styles 2, or sometimes fused but bifid near apex or with bifid stigma (rarely conical and subentire). Fruit an achene with membranous pericarp.
1 Calyx-lobes entirely herbaceous, not cucullate or awned
2 Calyx-lobes very unequal in length
11. capitata

2 Calyx-lobes equal or subequal in length
3 Leaves c. 1.5 mm , imbricate, $\pm$ completely concealed by scarious stipules (E. \& S. Spain) 10. aretioides
3 Leaves usually more than 2 mm , not completely concealed by stipules
4 Calyx $2.5-4 \mathrm{~mm}$, about twice as long as ripe fruit; lobes linear-lanceolate, acute, not incurved at apex in fruit
9. cephalotes

4 Calyx $1 \cdot 5-3 \mathrm{~mm}$, not more than $1 \frac{1}{2}$ times as long as ripe fruit; lobes oblong to linear-oblong, subacute, $\pm$ incurved at apex in fruit
5 Flower-clusters 7-15 mm in diameter, dense; bracts 35 mm , orbicular to ovate, obtuse or subacute 7. kapela
5 Flower-clusters 17-21 mm in diameter, lax; bracts 711 mm , ovate-lanceolate, acute $\quad$ 8. taurica
Calyx-lobes with membranous margins, cucullate, awned on the back near the apex
6 Calyx-lobes very unequal, 3 outer enclosing 2 smaller, narrower inner ones; leaves less than 1 mm wide 1. cymosa
6 Calyx-lobes equal or subequal; leaves more than 1 mm wide
7 Bracts conspicuous, exceeding calyx; plant perennial
8 Flower-clusters usually more than 8 mm in diameter, welldefined; bracts $4-6 \mathrm{~mm}$, ovate, concealing the flowers

8 Flower-clusters usually less than 6 mm in diameter, indefinite; bracts $2-4 \mathrm{~mm}$, lanceolate, not concealing the flowers
6. polygonifolia

## 7 Bracts inconspicuous, shorter than calyx

9 Perennial; calyx without hooked hairs at base, and with awn less than 0.5 mm
4. suffruticosa

9 Annual; calyx with hooked hairs at base, and with awn c. 1 mm or more

10 Leaves ovate to oblong-ovate, reddish; awn on calyxlobes usually straight 2. echinulata
10 Leaves linear-oblong, green; awn on calyx-lobes curled or hooked at apex
3. rouyana

1. P. cymosa (L.) DC. in Lam., Encycl. Méth. Bot. 5: 26 (1804). Annual; stems 3-7(-15) cm, usually erect. Leaves linear, usually in apparent whorls of 4 . Flower-clusters $3-10 \mathrm{~mm}$ in diameter, globose, elongating up to 17 mm in fruit to form scorpioid cymes. Calyx $2-2.5 \mathrm{~mm}$, exceeding bracts; lobes unequal, the outer 3 broadly spathulate with alveolate hood, enclosing the 2 smaller inner lobes; awn stout, often hooked. S.W. Europe. Co Ga Hs Lu Sa.
2. P. echinulata Chater, Feddes Repert. 69: 52 (1964). ( $P$. echinata auct., non Lam.). Annual; stems $2-20 \mathrm{~cm}$, spreading or erect, usually much-branched. Leaves ovate to oblong-lanceolate, reddish, with pale membranous margin, shortly aristate. Flowerclusters $3-8 \mathrm{~mm}$ in diameter, not elongating in fruit. Calyx $2-$ 2.5 mm , equalling or exceeding bracts; lobes equal or subequal, spathulate, with crispate or hooked hairs at base; base and midvein reddish; margin and hood slightly alveolate; awn 1 mm or more, stout, patent, usually straight. Calcifuge. Dry, sandy or stony places. S. Europe. Bl Co Cr Ga Gr Hs It Lu Sa Si.
3. P. rouyana Coincy in Morot, Jour. Bot. (Paris) 8: 65 (1894). Like 2 but plant light green, only the lower parts reddish; leaves linear-oblong, more strongly aristate; calyx-lobes pale greenish, sometimes reddish towards apex, with apex of awn strongly curved or hooked. W. \& C. Spain. Hs.
4. P. suffruticosa (L.) Lam., Encycl. Méth. Bot. 5: 25 (1804) (Herniaria polygonoides Cav.). Perennial; stems $7-30 \mathrm{~cm}$, erect, branched, scabrid with short, stiff, deflexed hairs. Leaves 510 mm , elliptical to ovate-elliptic, acute, aristate, coriaceous, reddish, with a thickened pale margin. Flowers subsessile in small, dense clusters in a branched inflorescence; bracts $\frac{1}{3}-\frac{1}{2}$ as long as calyx, inconspicuous, ciliate, white. Calyx $1 \cdot 2-1 \cdot 6 \mathrm{~mm}$; lobes equal, glabrous, reddish, with scarious margins and hood; awn $c .0 .5 \mathrm{~mm}$, patent, straight. S. Spain. Hs.
5. P. argentea Lam., Fl. Fr. 3: 230 (1778). Perennial; stems $5-30 \mathrm{~cm}$, usually procumbent, much-branched, matted; internodes usually equalling or longer than leaves. Leaves 4-8 $(-20) \mathrm{mm}$, ovate to lanceolate. Flower-clusters usually more than 8 mm in diameter, well-defined; bracts $4-6 \mathrm{~mm}$, ovate, acute, silvery, concealing the flowers. Calyx $1.5-2.5 \mathrm{~mm}$; lobes equal, oblong, cucullate; awn smooth or scarcely spinulose; membranous margins equalling or wider than the brownish, usually smooth mid-vein. S. Europe. Bl Co $\mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.
6. P. polygonifolia (Vill.) DC. in Lam. \& DC., Fl. Fr. ed. 3, 3: 403 (1805). Like 5 but leaves $2-3(-10) \mathrm{mm}$, often subspathulate, crowded, usually longer than internodes; flower-clusters usually less than 6 mm in diameter, indefinite and inconspicuous; bracts ( $1.5-$ )2-4 mm, lanceolate, not concealing flowers; calyx $1-$ 1.75 mm ; lobes with spinulose awn; membranous margins narrower than the brownish, spinulose mid-vein. Calcifuge. Mountains of S. Europe. Co Ga Gr Hs It Lu ?Sa Si.
7. P. kapela (Hacq.) Kerner, Österr. Bot. Zeitschr. 19: 367 (1869) (P. capitata auct., non (L.) Lam.). Perennial; stems
$5-15 \mathrm{~cm}$, much-branched. Leaves crowded, often pubescent, ciliate; stipules linear-lanceolate, equalling or shorter than leaves. Flower-clusters $7-15 \mathrm{~mm}$ in diameter, very conspicuous; bracts $3-5 \mathrm{~mm}$, silvery. Calyx less than $1 \frac{1}{2}$ times as long as ripe fruit; lobes entirely herbaceous, equal or subequal in length, ovate to linear-oblong, usually obtuse, incurved at apex in fruit. S. Europe, extending northwards to Austria. Al Au Bu Cr Ga Gr Hs It Ju Rm.
1 Stems procumbent, mat-forming; leaves $1.5-3.5 \mathrm{~mm}$, elliptical to ovate, densely crowded, usually all flattened in one plane, strongly ciliate; calyx c. 1.5 mm ; lobes ovate
(b) subsp. serpyllifolia

1 Stems prostrate to ascending, not mat-forming; leaves ovatelanceolate, crowded, ciliate; calyx $1 \cdot 5-3 \mathrm{~mm}$; lobes ovate to linear-oblong
2 Leaves 4-8 mm, $\pm$ densely pubescent on both surfaces; calyx $2 \cdot 5-3 \mathrm{~mm}$
(c) subsp. chionaea

2 Leaves 3-5 mm, glabrous on both surfaces; calyx $1 \cdot 5-2 \cdot 5 \mathrm{~mm}$
(a) subsp. kapela
(a) Subsp. kapela: Throughout the range of the species, except Spain and the S. part of the Balkan peninsula.
(b) Subsp. serpyllifolia (Chaix) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 892 (1919): Spain and Pyrenees; Alps; Appennini.
(c) Subsp. chionaea (Boiss.) Borhidi, Feddes Repert. 69: 53 (1964) ( $P$. chionaea Boiss.): Balkan peninsula and Aegean region.
8. P. taurica Borhidi \& Sikura, Acta Bot. Acad. Sci. Hung. 7: 3 (1961). Like 7 (a) but stems ascending; flowering stems much longer than vegetative stems; flower-clusters $17-21 \mathrm{~mm}$ in diameter, laxer; bracts $7-11 \mathrm{~mm}$; calyx $2.5-3.5 \mathrm{~mm}$. Calcareous rocks. Mountains of N.E. Albania and Krym. Al Rs (K). (Asia Minor.)

This species requires further investigation; it is probably much more widespread than indicated above.
9. P. cephalotes (Bieb.) Besser, Enum. Horto Cremen. 4 (1830). Like 7 (a) but leaves oblong to linear-lanceolate; bracts $5-7 \mathrm{~mm}$; calyx $2 \cdot 5-4 \mathrm{~mm}$, twice as long as ripe fruit; lobes linear-lanceolate, acute, not incurved at apex in fruit. $2 n=36$. E., C. \& S.E. Europe. Al Bu Cz Gr Hu Ju Rm Rs (W, K) Tu.
10. P. aretioides DC., Prodr. 3: 371 (1828). Caespitose perennial, woody at base; stems up to 8 cm , much-branched, covered by densely imbricate leaves which are themselves more or less completely covered by cucullate, scarious stipules. Leaves c. 1.5 mm , oblong or linear-oblong, more or less obtuse. Flowerclusters very conspicuous; bracts $2 \cdot 5-3 \mathrm{~mm}$, orbicular or often wider than long, very obtuse. Calyx $1-1.75 \mathrm{~mm}$. Calcicole. - Mountains of E. \& S. Spain. Hs.
11. P. capitata (L.) Lam., Fl. Fr. 3: 229 (1778) (P. nivea DC., P. euboea Beauverd \& Top.). Laxly caespitose perennial; stems up to 15 cm , much-branched. Leaves $3-6 \mathrm{~mm}$, oblong-lanceolate to linear-lanceolate, acute, pubescent, ciliate, greyish-green. Flowerclusters $c .10 \mathrm{~mm}$, conspicuous; bracts $6-10 \mathrm{~mm}$, greatly exceeding and concealing the flowers. Calyx $2 \cdot 5-3.5 \mathrm{~mm}$; lobes very unequal, the shortest $\frac{2}{3}-\frac{3}{4}$ as long as the longest. S. Europe. Bl $\mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Sa} \mathrm{Si}$.
P. macrosepala Boiss., Diagn. Pl. Or. Nov. 1 (3): 11 (1843) is usually treated as a separate species but can scarcely be distinguished from 11, and requires further investigation. It appears to differ from 11 in the leaves being ovate or oblong, in the bracts being $5-7 \mathrm{~mm}$, not much exceeding and scarcely concealing the flowers, and in having slightly wider calyx-lobes. It occurs in the E. Mediterranean region and Sicilia.

## 16. Herniaria L. ${ }^{1}$

Like Paronychia, but flowers sometimes 4-merous; bracts inconspicuous; stigma notched or bifid, subsessile or rarely on a distinct style.

Literature: F. N. Williams, Bull. Herb. Boiss. ser. 2, 4: 556-70 (1896). F. Hermann, Feddes Repert. 42: 203-24 (1937).

1 Flowers 4-merous, with 2 outer sepals $\pm$ enclosing 2 smaller inner; upper stipules and bracts with conspicuous purplishblack coloration
2 Leaves $\pm$ flat, elliptical, not in dense clusters; flower-clusters distributed along most upper branches
14. fontanesii

2 Leaves ovoid to subglobose, in dense clusters; flower-clusters terminal or subterminal
15. fruticosa

1 Flowers 4- to 5 -merous, sepals $\pm$ equal; stipules and bracts usually without purplish-black coloration
3 Annual, without a woody stock
4 Flowers 5-merous
5 Leaves and sepals glabrous or ciliate
5. glabra

5 Leaves and sepals conspicuously hairy 11. hirsuta

4 Flowers 4-merous
6 Perigynous zone with patent, hooked hairs 12. polygama
6 Perigynous zone without patent, hooked hairs
13. nigrimontium

3 Perennial, with a $\pm$ woody stock
7 Sepals and leaves glabrous or ciliate
8 Sepals $c .0 .5 \mathrm{~mm}$; leaves usually entirely glabrous; flowerclusters usually contiguous on short lateral branches 5. glabra
8 Sepals $0.7-1 \mathrm{~mm}$; at least the younger leaves ciliate; flowerclusters usually not contiguous on short lateral branches
9 Plant usually compact; hairs on leaf-margins strongly curved forwards, appressed to leaf-margin (mountains of Greece and Kriti)
4. parnassica

9 Plant not compact; hairs on leaf-margins not appressed
6. ciliolata

7 Sepals densely hairy; leaves densely hairy or conspicuously ciliate
10 Plant compact, internodes seldom more than 5 mm ; flower-clusters terminal or subterminal
11 Leaves more than $2.5 \times 1.2 \mathrm{~mm}$, at least the older leaves glabrous on the surface

1. alpina

11 Leaves up to $2.5 \times 1.2 \mathrm{~mm}$, densely covered with appressed hairs
2. boissieri

10 Plant not compact, most internodes more than 5 mm , or if not then flower-clusters distributed along most of the younger branches
12 Leaves strongly ciliate, surface $\pm$ glabrous except for a line of hairs on the prominent midrib $\quad$ 3. latifolia
12 Leaves with hairs evenly distributed over the surface
13 Mature leaves mostly more than 6 mm , at least 3 times as long as wide; sepals with hairs about equalling the width of the sepals
10. incana

13 Leaves rarely more than 6 mm , less than three times as long as wide; sepals with hairs much shorter than the width of the sepals
14 Flower-clusters lax, up to 6 -flowered, mostly terminal or subterminal on the shorter branches; pubescence greyish-white
9. baetica

14 Flower-clusters dense, more than 6 -flowered, leafopposed or distributed along the shorter branches; pubescence usually yellowish
15 Older stems suffruticose, the younger hairy on one side only (maritime sands) 7. maritima
15 Stems usually not suffruticose, the younger hairy all round
8. scabrida

Subgen. Herniaria. Annual or perennial. Upper stipules and bracts usually without purplish-black coloration. Flowers 5merous, or 4 -merous in some annual species. Sepals more or less equal.
${ }^{1}$ By R. K. Brummitt and V. H. Heywood.

1. H. alpina Chaix in Vill., Hist. Pl. Dauph. 1: 379 (1786). Caespitose perennial; younger stems densely leafy, with internodes not more than 5 mm . Leaves not more than $4.5 \times 2 \mathrm{~mm}$, ellipticobovate, strongly ciliate, surface glabrous or rarely with few hairs. Flowers up to 2.5 mm , in few-flowered, lax, mostly terminal clusters, or solitary. Sepals with patent hairs. $2 n=18$. ? Alps; Appennini; E. Pyrenees. Au He Ga It.
H. olympica Gay in Duchartre, Rev. Bot. 2: 370 (1847), recorded from S.W. Bulgaria (Ali Botuš), appears to be very like 1, but has shorter hairs on the sepals and a short, broad bifid style.
2. H. boissieri Gay in Duchartre, Rev. Bot. 2: 370 (1847) ( $H$. frigida G. Kunze, nom. nud.). Like 1 but smaller in all parts; stem, leaves and flowers densely covered with minute, closely appressed, forwardly directed, silky white hairs; leaves up to $2.5 \times 1.2 \mathrm{~mm}$; flowers up to 1 mm , in fairly dense terminal or subterminal clusters of up to 12. Mountains of S. Spain (Sierra Nevada; ?Sierra de Cazorla). Hs. (N. Africa.)
3. H. latifolia Lapeyr., Hist. Abr. Pyr. 127 (1813). Perennial; internodes up to 15 mm , hairy on one side only. Leaves up to $9 \times 4 \mathrm{~mm}$, broadly elliptical, darkish green, conspicuously ciliate, surface glabrous or with hairs mainly on prominent midrib. Flowers 2 mm , in clusters which are leaf-opposed or contiguous on leafless lateral branches. Sepals with conspicuous patent hairs. - Pyrenees; mountains of N. \& C. Spain. Ga Hs.
4. H. parnassica Heldr. \& Sart. ex Boiss., Diagn. Pl. Or. Nov. 3 (1): 95 (1853). Perennial, usually rather compact. Leaves obovate to suborbicular, with minute, strongly curved hairs appressed to the margin, surfaces glabrous. Flowers 1.5 mm , clusters more or less distinct, not contiguous. Sepals $0.7-1 \mathrm{~mm}$, ciliate, rarely with few hairs on dorsal surface. Capsule slightly exceeding sepals. - Mountains of Albania, Greece and Kriti. AI Cr Gr.
5. H. glabra L., Sp. Pl. 218 (1753). Annual to perennial, rarely woody at base; stems subglabrous or with short hairs all round. Leaves up to $7 \times 3.5 \mathrm{~mm}$, elliptic-obovate, glabrous, or rarely more or less ciliate; upper stipules and bracts very rarely with purplish-black coloration. Flowers $c .1 \mathrm{~mm}$, clusters usually contiguous on short leafless branches. Sepals $c .5 \mathrm{~mm}$. Capsule usually distinctly exceeding sepals. $2 n=18$. Most of Europe except the extreme north. All except Az Bl Co Cr Fa Hb Is Rs (N) Sb.

Variable in duration, habit, presence of hairs on leaf-margins and sepals, size of flowers and length of fruit (vide Pugsley, Jour. Bot. (London) 68: 214-18 (1930)). Perennial, suffruticose plants with ciliate leaves have been distinguished as subsp. nebrodensis Jan ex Nyman, Consp. 3, in obs. post pag. 677 (1881) (H. microcarpa C. Presl). They occur on mountains of S. Europe and possibly elsewhere.
6. H. ciliolata Melderis, Watsonia 4: 42 (1957) (H. ciliata Bab., non Clairv.). Often woody at base; stems hairy on one side only. Leaves up to $6 \times 4 \mathrm{~mm}$, suborbicular to elliptical, at least the younger ones ciliate with patent hairs, surfaces glabrous. Flowers c. 1.5 mm , the clusters mostly not contiguous. Sepals $0.7-1 \mathrm{~mm}$, sometimes ciliate, usually with a single minute apical hair. Capsule equalling to slightly exceeding sepals. $2 n=72,108,126$. - W. coast of Europe, from Portugal (N. of Tagus) to N. France and S. England. Br Ga Hs Lu .
7. H. maritima Link in Schrader, Jour. für die Bot. 1799 (1): 57 (1799). Older stems woody at base, with prominent nodes;
younger stems hairy on one side only. Leaves 2-4(-6) mm, broadly elliptical to rhombic, yellowish-green, with dense appressed hairs on both surfaces, or the older sometimes only ciliate; upper stipules and bracts sometimes with purplish-black coloration. Flowers up to 2 mm ; clusters not contiguous. Sepals covered with more or less appressed hairs. Capsule about equalling sepals. Maritime sands. Portugal (S. of Tagus). Lu.
8. H. scabrida Boiss., Elenchus 42 (1838). Compact or elongate perennial. Leaves up to $6 \times 3 \mathrm{~mm}$, elliptical, yellowish-green, densely covered with appressed hairs; upper stipules and bracts often with some purplish-black coloration. Flowers c. 1.5 mm ; clusters often contiguous on short leafless branches. Sepals densely covered with usually very short hairs. Spain,Portugal. Hs Lu.

Very variable in habit, hairiness, and development of dark coloration on stipules and bracts. More elongate and less hairy plants, appearing intermediate between this species and 5, have been referred to H. scabrida var. glabrescens Boiss.
9. H. baetica Boiss. \& Reuter in Boiss., Diagn. Pl. Or. Nov. 3 (1): 95 (1853). Woody at base. Leaves broadly obovate to suborbicular, densely covered with whitish appressed hairs. Flowers $2-2.5 \mathrm{~mm}$ (including short pedicel); clusters few-flowered, mostly more or less contiguous towards ends of branches. Sepals densely covered with white patent hairs. - Mountains of $S$. Spain. Hs.
10. H. incana Lam., Encycl. Méth. Bot. 3: 124 (1789). Stock stout and woody. Leaves up to $12 \times 3 \mathrm{~mm}$, oblanceolate, at least 3 times as long as wide, densely covered with stiff white hairs; stipules usually hairy on their outer surface. Flowers $c .2 \mathrm{~mm}$ (including short pedicel); clusters mostly leaf-opposed. Sepals 5, covered with white patent hairs. E. \& S. Europe, extending northwards to Czechoslovakia and to $\mathrm{c} .51^{\circ} \mathrm{N}$. in Russia. Al ?Au ?Bl $\mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Gr} \mathrm{?Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)} \mathrm{Tu}$.
11. H. hirsuta L., Sp. Pl. 218 (1753). Annual; stems slender, usually with regularly alternating branches, with patent hairs. Leaves elliptical to oblanceolate, covered with stiff hairs, or the older sometimes only ciliate; stipules ciliate. Flowers $1-1.5 \mathrm{~mm}$, sessile, in dense clusters which are leaf-opposed or contiguous on short branches. Sepals densely hairy; perigynous zone subglabrous. $2 n=36$. C. \& S. Europe; sometimes casual elsewhere. $\mathrm{Al} \mathrm{Au}{ }^{*} \mathrm{Be} \mathrm{Bl} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{Rm}$ Rs (W) Sa Si Tu [Br Ho].

Plants with long stout hairs on the calyx, giving a greyish-white appearance, occur commonly in the Mediterranean region and are often distinguished as H. cinerea DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 375 (1815), but plants with shorter hairs occur throughout the range, and all intermediate conditions are found.
12. H. polygama Gay in Duchartre, Rev. Bot. 2: 371 (1847). Stems slender, with regularly alternating branches; hairs strongly recurved. Leaves glabrous or with few minute marginal hairs. Sepals glabrous towards apex but with patent hooked hairs at the base and on the perigynous zone. Style slender, exceeding the sepals. C. \& S. Russia, Ukraine, Romania. Rm Rs (C, W, E).
13. H. nigrimontium F. Hermann, Feddes Repert. 42: 223 (1937). Like 12 but sepals with hairs over outer surface and no patent hooked hairs at base. Balkan peninsula. Bu Gr Ju.

[^67]Subgen. Heterochiton (Graebner \& Mattf.) F. Hermann. Perennial, woody at base. Upper stipules and bracts with purplish-black coloration over most of their surface. Flowers tetramerous. 2 opposite sepals more or less enclosing the other 2.
14. H. fontanesii Gay in Duchartre, Rev. Bot. 2: 371 (1847). Leaves mostly $2-4 \mathrm{~mm}$, more or less flat, elliptical, mostly opposite and not clustered. Flowers $2-2.5 \mathrm{~mm}$, in clusters distributed along all the younger branches. Outer sepals divergent above. S.E. Spain; S. Sicilia. Hs Si. (N. Africa.)
(a) Subsp. fontanesii: Stems with strongly deflexed hairs. Leaves and sepals glabrous or rarely with short crisped hairs. Outer sepals without purplish-black patches. Maritime hills and dunes. Sicilia (near Porto Empedocle).
(b) Subsp. almeriana Brummitt \& Heywood, Feddes Repert. 69: 31 (1964): Stems with more or less patent hairs. Leaves and sepals with more or less silky hairs. Outer sepals with purplishblack patches on their lateral margins near the base. Hills of S.E. Spain.
15. H. fruticosa L., Cent. Pl. 1: 8 (1755). Leaves up to 2 mm , ovoid to subglobose, in dense clusters at each node, glabrous or minutely puberulent. Flowers c. 1.5 mm , in terminal or subterminal clusters. Outer sepals more or less erect, not divergent above, glabrous or subglabrous. - C., E. \& S. Spain. Hs.
(a) Subsp. fruticosa: Procumbent. Flowers in dense terminal clusters; purplish-black coloration, if present, restricted to small patches at base of sepals. Probably throughout the range of the species.
(b) Subsp. erecta (Willk.) Batt. in Batt. \& Trabut, Fl. Algér. (Dicot.) 168 (1888) excl. descr.: Suberect. Flowers in lax terminal and subterminal clusters. Outer sepals with purplish-black patches on margin near base; inner sepals purplish-black on most of their margins. S.E. Spain.

## 17. Illecebrum L. ${ }^{1}$

Like Paronychia, but annual; sepals white, spongy, persistent round the capsule; capsule 1 -seeded, dehiscing with $5(-10)$ valves which remain more or less joined above.

1. I. verticillatum L., Sp. Pl. 206 (1753). Glabrous; stems usually $5-30 \mathrm{~cm}$ (sometimes 1 cm in dry, or up to 70 cm in flooded habitats), branched or simple, decumbent, slender, quadrangular, often rooting near base. Leaves $2-5 \mathrm{~mm}$, opposite, linear-spathulate to obovate, obtuse; stipules small. Flowerclusters 2 at each node, 4 - to 6 -flowered, forming small, very white, usually crowded pseudo-whorls; bracteoles c. 1 mm , silvery. Sepals $1 \cdot 5-2 \cdot 5 \mathrm{~mm} .2 n=10$. In seasonally damp, sandy or gravelly places. W. \& C. Europe, extending locally to White Russia and S. Italy, with three isolated stations in the islands of Greece. Au $\mathrm{Az} \mathrm{Be} \mathrm{Br} \mathrm{Co} \mathrm{Cz} \dagger \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \dagger \mathrm{He}$ Ho Hs It Lu Po Rs (C) Sa.

## 18. Pteranthus Forskål ${ }^{2}$

Small annual. Flowers sessile, in groups of three. 'Fruit' complex, 1 -seeded, described below.

1. P. dichotomus Forskål, Fl. Aegypt. lxii \& 36 (1775). Fleshy annual herb; stems $10-20 \mathrm{~cm}$, procumbent to ascending, articulate at the nodes. Leaves linear, subverticillate; stipules minute, lanceolate. Flowers sessile, in groups of 3, situated at the apex of an oblanceolate, swollen, hollow, compressed peduncle, the two lateral flowers sterile; each flower situated between two minutely glandular bracts on which is spirally arranged a row of
curved spines. Petals absent; stamens 4 ; styles 2. Capsule indehiscent, 1 -seeded, enclosed in the spiny bracts and borne on the persistent compressed, inflated, wing-like peduncle, the whole 'fruit' $12-20 \mathrm{~mm}$. Malta (doubtfully native). *Si. (N. Africa, Cyprus, Asia Minor.)

## 19. Polycarpon Loeff. ex L. ${ }^{1}$

Small herbs; stems ascending or erect, usually branched, usually rough at angles. Leaves obovate to orbicular, more or less petiolate, opposite, often apparently verticillate. Flowers small, in cymose clusters with scarious bracts. Sepals 5 ; petals 5 , hyaline, shorter than sepals; stamens $1-5$, filaments more or less united at base; style short, 3 -lobed. Capsule dehiscing with 3 valves almost to base; valves twisting spirally into tubes. Seeds several.

The treatment accorded to this genus in the past has been very varied. The following account treats as species the four more or less discrete variants. Experimental investigation is needed.
1 Perennial, with a woody stock; stipules and bracts inconspicuous, greyish; petals entire; stamens 5; seeds tuberculate (coastal)
4. polycarpoides

1 Annual, rarely biennial or perennial, without a woody stock; stipules and bracts $\pm$ conspicuous and silvery; petals usually emarginate; seeds smooth or punctulate
2 Leaves not purplish-tinged; inflorescence lax, spreading, with many conspicuous branches; sepals mostly less than 2 mm (usually inland)

1. tetraphyllum

2 Leaves often purplish-tinged; inflorescence $\pm$ condensed, fewflowered, usually without conspicuous branches, sepals more than 2 mm (usually coastal)
3 Stems usually simple; leaves paired, very rarely whorled, always purplish-tinged at least near base of plant; stamens 1-3
2. diphyllum

3 Stems often branched; usually at least some leaves near middle of stem in whorls of 4 ; leaves not purplish-tinged; stamens 5
3. alsinifolium

1. P. tetraphyllum (L.) L., Syst. Nat. ed. 10, 2: 881 (1759). Annual, rarely biennial or perennial, without a woody stock; stems much-branched. Leaves green, mostly in whorls of 4. Inflorescence lax, spreading, much-branched. Sepals mostly less than 2 mm ; petals emarginate; stamens ( $1-$ )3-5. Seeds usually less than 0.5 mm , punctulate. Sandy or rocky places, usually inland. S. Europe, extending northwards in W. Europe to S.W. England; often casual elsewhere and locally naturalized. Al Az Bl ${ }^{*} \mathrm{Br} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Ga}{ }^{*} \mathrm{Ge} \mathrm{Gr} \mathrm{Hs}$ *Hu It Ju Lu Sa Si.
2. P. diphyllum Cav., Icon. Descr. 2: 40 (1793). Annual, without a woody stock; stems usually simple. Leaves always purplish-tinged at least near base of plant, paired, rarely verticillate. Inflorescence few-flowered, condensed. Sepals more than 2 mm ; petals entire or very slightly emarginate; stamens $1-3$. Seeds usually less than 0.5 mm , punctulate. Sandy places, usually coastal. S. \& W. Europe. ${ }^{* \mathrm{Br} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{Ju} \mathrm{Lu} \mathrm{Si.}}$
3. P. alsinifolium (Biv.) DC., Prodr. 3: 376 (1828) (incl. P. rotundifolium Rouy). Often biennial or perennial, without a woody stock; stems often branched. Leaves green, at least some in whorls of 4 ; stipules conspicuous, silvery. Inflorescence often branched but always rather condensed. Sepals more than 2 mm ; petals slightly emarginate; stamens always 5 . Seeds 0.5 mm or more, smooth. Sandy places, usually coastal. S. Europe. Bl Co $\mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.
4. P. polycarpoides (Biv.) Zodda, Nuovo Gior. Bot. Ital. nov. ser., 15: 347 (1908) (P. peploides DC.; incl. P. colomense Porta).
[^68]Perennial, with woody stock; stems branched. Leaves obovate to suborbicular, fleshy, usually paired, rarely verticillate; stipules small, greyish. Flowers few, in a lax inflorescence. Sepals $1 \cdot 5-2 \mathrm{~mm}$, obtuse or acute; petals entire; stamens 5 . Seeds 0.5 mm or more, tuberculate. Rocks, usually coastal. W. Mediterranean region. Bl Ga Hs It Si.

## 20. Ortegia L. ${ }^{1}$

Small herb with opposite leaves. Flowers small, shortly pedicellate in opposite, cymose clusters which are arranged in a panicle. Sepals 5, keeled, margins scarious; petals absent; stamens 3; style 1; stigma 3 -toothed or -lobed. Capsule dehiscing with 3 valves. Seeds numerous, minute, ovoid, acute.

1. O. hispanica L., Sp. Pl. 560 (1753). Annual to perennial herb; stems up to 40 cm , much-branched, with strict branches, angular, often very rough above. Leaves $5-18 \mathrm{~mm}$, opposite, linear or linear-lanceolate, obtuse or acute, much shorter than internodes, erect; stipules setiform, caducous, with blackish glands. Sepals $2-3 \mathrm{~mm}$, ovate-lanceolate, acute, keeled, green, with scarious margins. Spain and Portugal; formerly in Italy (Piemonte) but probably now extinct. Hs $\dagger$ It Lu.

## 21. Loeflingia L. ${ }^{2}$

Annuals. Flowers small, sessile, in compound dichasial or monochasial cymes, often spicate. Sepals free, unequal, the outer 3 longer and wider than the inner 2, all or only the outer with a setiform appendage on each side; petals 3 or 5 , very small; stamens 3 or 5 ; style 1 ; stigmas 3 , or 1 , more or less 3 -lobed. Fruit a capsule dehiscing with 3 valves. Seeds numerous.
1 Inflorescence-branches narrow, often secund; style deeply 3-partite 3. tavaresian
1 Inflorescence-branches $\pm$ condensed, not secund; style usually almost undivided or with 3 short stigma-lobes.
2 Sepals (2-)2•5-3 mm, all with setiform appendages; style shorter than capsule 1. hispanica
2 Sepals $1 \cdot 5-2 \mathrm{~mm}$, only 3 with setiform appendages; style as long as capsule
2. baetica

1. L. hispanica L., Sp. Pl. 35 (1753). Much-branched, glandu-lar-pubescent annual $2-10 \mathrm{~cm}$. Leaves linear, acute, connate at the base with the subulate stipules. Sepals (2-)2.5-3 mm, all with setiform appendages; stamens usually 3 ; style about half as long as capsule; stigma usually only shallowly lobed. Sandy soils. W. Mediterranean region. Ga Hs Lu Si.

Variable. L. pentandra Cav., Icon. Descr. 2: 39 (1793) from E. Spain (Valencia) has 5 stamens and sepals $2-2.5 \mathrm{~mm}$. It requires further investigation.
2. L. baetica Lag., Period. Soc. Med. Cádiz 4 (1824) (incl. L. gaditana Boiss. \& Reuter). Like 1 but sepals $1 \cdot 5-2 \mathrm{~mm}$, only 3 with setiform appendages; stamens 5 ; style as long as capsule. Maritime sands. - S. Spain; S. Portugal (Alentejo and Algarbe). Hs Lu.

Variable. L. micrantha Boiss. \& Reuter, Pugillus 23 (1852), has a slender inflorescence of shorter cymes, but occurs with typical plants of $\mathbf{2}$ in mixed populations.
3. L. tavaresiana Samp. in Nobre, Anais Ci. Nat. (Porto) 10: 25 (1906). Like 1 but much-branched from the base; inflorescencebranches narrow, often secund and sometimes obviously recurved; stamens 5; style obviously tripartite. Maritime sands. - S. Portugal (Alentejo, Baixas do Guadiana). Lu.

## 22. Spergula L. ${ }^{1}$

Annual (rarely perennial); stems ascending, often decumbent and much-branched at the base. Leaves linear, obtuse, decussate; stipules scarious, not united to surround the node; leaf-fascicles (short, leafy, lateral branches) borne on both sides at each node. Perianth 5 -merous; sepals free, green, with scarious margins; petals white, entire; stamens $5-10$; styles 5 . Capsule ovoid to subglobose, dehiscing with 5 valves. Seeds often winged.
1 Root thick and woody; plant densely glandular-hairy (mountains of Spain)
4. viscosa

1 Root $\pm$ slender, not woody; plant glandular-hairy or not
2 Seeds subglobose, keeled or with a narrow wing; leaves channelled beneath

1. arvensis

2 Seeds compressed, broadly winged; leaves not channelled beneath
3 Seed wider than its brownish wing; petals ovate, obtuse, contiguous
2. morisonii
3 Seed as wide as its transparent, shining wing; petals lanceolate. acute, not contiguous
3. pentandra

1. S. arvensis L., Sp. Pl. 440 (1753) (S. vulgaris Boenn., S. sativa Boenn., S. maxima Weihe, S. linicola Boreau). Annual $5-70 \mathrm{~cm}$, with ascending stems more or less branched at the base, moderately to densely glandular-hairy above. Leaves $1-3(-8) \mathrm{cm}$, linear, fleshy, channelled beneath. Sepals 4-5 mm, ovate; petals white, obovate, obtuse, slightly exceeding the sepals; stamens 510. Capsule 5 mm , somewhat exceeding the sepals. Seeds $1-$ 2 mm , subglobose, keeled or with a very narrow wing, greyblack, papillose or not. $2 n=18$. A weed of cornfields and other cultivated ground, especially on sandy soils; calcifuge. Throughout Europe. All except Al Bl Sb.

Very variable in habit, pubescence, size of seed, presence of seed-papillae, etc. S. chieusseana Pomel, Nouv. Mat. Fl. Atl. 206 (1874), may merit specific rank. It differs from 1, which it replaces in S. and C. Portugal, by having a sessile instead of a pedunculate terminal inflorescence.
2. S. morisonii Boreau in Duchartre, Rev. Bot. 2: 424 (1847) ( $S$. vernalis auct.). Annual with ascending stems $5-30 \mathrm{~cm}$, glabrous or sparsely pubescent. Leaves $1-2 \mathrm{~cm}$, linear, not channelled beneath; leaf-fascicles conspicuously shorter than the internodes. Sepals 4 mm , ovate, acuminate; petals about equalling the sepals, ovate, obtuse, overlapping at their margins; stamens $5-10$. Capsule 5 mm , slightly exceeding the sepals. Seeds $1-1.5 \mathrm{~mm}$ (including wing), laterally compressed, with a brownish striate wing narrower than the seed. $2 n=18$. C. Europe, extending southwards to the Iberian peninsula and N. Italy and northwards to C. Sweden. Au Be Bu Cz Da Fe Ga Ge Ho Hs Hu It Lu No Po Rm Rs (B, C) Su [Br].
3. S. pentandra L., Sp. Pl. 440 (1753). Like 2 but petals lanceolate, acute, not contiguous, somewhat exceeding the sepals; stamens usually 5 ; seeds with white, shining wing about as wide as the seed. S. \& C. Europe, extending northwards to Belgium. Be Bu Co Cz Ga Ge Gr Hs Hu It Ju Lu Po Rm Sa Si Tu.
4. S. viscosa Lag., Gen. Sp. Nov. 15 (1816). Apparently perennial with woody tap-root; stems many, ascending, densely glandular-hairy and viscid. Leaves densely fasciculate, channelled beneath. Petals much shorter than the sepals. Seeds laterally compressed, dark brown, surrounded by a brownish wing narrower than the seed. Sandy places on mountains. Spain. Hs.

[^69]
## 23. Spergularia (Pers.) J. \& C. Presl ${ }^{2}$

Herbs, sometimes woody at the base; stems erect, decumbent or procumbent, dilated at the nodes, somewhat flattened. Leaves linear, decussate, with pale, scarious stipules united to surround the node, forming more or less triangular structures on either side of the stem; leaf-fascicles (short leafy lateral branches) when present borne on only one side at each node. Perianth 5-merous; sepals free, green, with scarious margins; petals entire; stamens $1-10$; styles 3. Capsule dehiscing with 3 valves. Seeds often winged.

1 Robust, with thick woody stock; sepals usually more than 4 mm
2 Stipules 6-10 mm, with setaceous apex; leaves awned; wing of seed (if present) deeply laciniate-fimbriate 2. fimbriata
2 Stipules 2-6 mm, not setaceous; leaves mucronate or obtuse; wing of seed (if present) entire or somewhat toothed
3 Stipules wider than long; leaves flattened, widening above (Açores)

1. azorica

3 Stipules longer than wide; leaves semicylindrical, linear
4 All seeds unwinged; plant often densely glandular-hairy throughout
5 Petals much shorter than sepals, white or pinkish; capsule subglobose
4. macrorhiza

5 Petals about as long as sepals, pink; capsule ovoid 3. rupicola
4 Seeds with $\pm$ developed wing (exceptionally absent); plant glandular-hairy only in the inflorescence
6 Seeds black; leaves narrowed towards base; stipules silvery 5. australis
6 Seeds brown; leaves not narrowed towards base; stipules not silvery
7 Stipules on young stems connate for more than half their length; capsule more than 6 mm
6. media

7 Stipules on young stems connate for considerably less than half their length; capsule less than 6 mm
13. nicaeensis

1 Slender, with $\pm$ slender tap-root; sepals usually less than 4 mm
8 Stipules on young shoots connate for about half their length (forming a sheath); seeds light brown, often winged
9 Inflorescence little-branched; seeds smooth or tuberculate; petals 3 mm or more
7. marina

9 Inflorescence much-branched; seeds sparsely papillose; petals less than 3 mm
8. tangerina

8 Stipules on young shoots connate for considerably less than half their length; seeds $\pm$ dark brown, unwinged (or with vestigial wing)
10 Sepals mucronate, scarious except for a narrow green vein; seeds less than 0.4 mm 9. segeta
10 Sepals not or scarcely mucronate, green, with scarious margins; seeds more than 0.4 mm
11 Inflorescence ebracteate above; petals narrowly elliptical; capsule globose
10. diandra

11 Inflorescence bracteate (upper bracts often very short); petals ovate; capsule ovoid to subglobose
12 Petals much longer than sepals
11. purpurea

12 Petals about equalling or shorter than sepals
13 Seeds brown, tuberculate
14 Petals white, or pink above and white beneath; seeds pale greyish-brown
15. bocconii

14 Petals uniformly pink; seeds dark brown
15 Upper bracts almost as long as the leaves
12. rubra 15 Upper bracts much shorter than the leaves
16 Plant rather robust, not rooting at the nodes; stipules broadly triangular 13. nicaeensis
16 Plant slender, often rooting at the nodes; stipules lanceolate-acuminate
14. capillacea

13 Seeds black, smooth or densely spinulose
17 Stipules $\pm$ cordate; sepals acute to mucronulate; seeds $\pm$ smooth
16. heldreichii

17 Stipules triangular; sepals obtuse; seeds densely spinulose 17. echinosperma

1. S. azorica (Kindb.) Lebel, Mém. Soc. Nat. Sci. Cherbourg 14: 47 (1868). Perennial; stems $8-15 \mathrm{~cm}$, woody below, densely glandular-hairy. Leaves flat, widening towards the apex, mucronate; stipules wider than long, dull. Sepals and petals $3-5 \mathrm{~mm}$; stamens 10. Capsule subglobose, equalling or exceeding the sepals. Seeds brown, pyriform, hilum subapical, unwinged or with vestigial wing. Açores. Az.
2. S. fimbriata Boiss., Diagn. Pl. Or. Nov. 3 (1): 94 (1853). Perennial; stems $5-35 \mathrm{~cm}$, robust, often woody below, glandularhairy above. Leaves awned; stipules very long ( $6-10 \mathrm{~mm}$ ), with setaceous apices, silvery. Petals $4-6 \mathrm{~mm}$, lilac, equalling or longer than sepals; stamens 10 . Capsule $3 \cdot 5-5 \cdot 5 \mathrm{~mm}$. Seeds black, some unwinged, others usually with laciniate-fimbriate wing. Coasts of S.W. Spain and S. Portugal, from Gibraltar to Faro. Hs Lu. (Morocco, Canarias.)
3. S. rupicola Lebel ex Le Jolis, Mém. Soc. Nat. Sci. Cherbourg 7: 274 (1860) (S. lebeliana Rouy). Perennial; stems $5-35 \mathrm{~cm}$, robust, somewhat woody below, often glandular-hairy throughout. Leaves narrowly linear, mucronate; stipules ovate-triangular, acuminate, somewhat silvery. Sepals $4-4.5 \mathrm{~mm}$; petals uniformly pink, about equalling the sepals; stamens 10 . Capsule $4 \cdot 5-7 \mathrm{~mm}$, ovoid, equalling or somewhat exceeding the sepals. Seeds $0.5-0.7 \mathrm{~mm}$, dark brown, unwinged, regularly tuberculate. $2 n=36$. Rocky places by the sea. Atlantic coasts of Europe, northwards to c. $58^{\circ} \mathrm{N}$. in Scotland. Br Ga Hb Hs Lu.
4. S. macrorhiza (Req.) Heynh., Nomencl. Bot. 2: 689 (1846). Like 3 but with leaves broadly linear and very crowded; petals white or pinkish, shorter than the sepals; capsule subglobose, much shorter than the calyx. $2 n=36$. Rocky places by the sea. Corse; Sardegna; ?elsewhere. Co ?Gr ?It Sa.
5. S. australis Samp., Anais Ci. Acad. Polyt. Porto 21 (1904). Like $\mathbf{3}$ but leaves somewhat narrowed towards base; stipules very silvery; seeds with vestigial or well-developed wings, smooth or slightly tuberculate, black. $2 n=40$. Rocky places by the sea. Portugal; ?Spain. ?Hs Lu.
6. S. media (L.) C. Presl, Fl. Sic. 161 (1826) (S. marginata Kittel). Perennial; stems $5-40 \mathrm{~cm}$, glabrous throughout or glandular-hairy in the inflorescence. Leaves mucronate; stipules broadly triangular, not acuminate. Sepals $4-6 \mathrm{~mm}$; petals white or pink, equalling or somewhat exceeding the sepals; stamens 10 (rarely 7-9). Capsule $7-9 \mathrm{~mm}$, much exceeding the calyx. Seeds $0.7-1 \mathrm{~mm}$ (excluding wing), dark brown, smooth or tuberculate, usually winged; margin of wing entire or only slightly divided. $2 n=18,36$. Seashores, salt-marshes, and saline areas inland. Coasts of Europe (except the north-east) and inland saline areas. All except $\mathrm{Al} \mathrm{Az} \mathrm{Fa} \mathrm{Fe} \mathrm{He} \mathrm{Is} \mathrm{Rs} \mathrm{(N}, \mathrm{B)}$ Sb .

Populations of this species with completely unwinged seeds occur in Britain, Ireland, France and probably elsewhere, and have been given varietal status by a number of authors.
7. S. marina (L.) Griseb., Spicil. Fl. Rumel. 1: 213 (1843) (S. salina J. \& C. Presl). Annual, biennial or rarely perennial, with slender or slightly fleshy stock. Leaves fleshy, mucronate; stipules short, obtuse, forming a sheath. Sepals $2.5-4 \mathrm{~mm}$; petals pink above and white near base, rarely entirely white, not exceeding the sepals; stamens $1-5(-8)$. Capsule (3-)4-6 mm, usually exceeding the sepals. Seeds $0.6-0.7 \mathrm{~mm}$, light brown, smooth or densely tuberculate, unwinged or mixed winged and
unwinged; wing of seed when present erose to laciniate. $2 n=36$. In similar habitats to 6 . Coasts of Europe and inland saline areas. All except Az Fa He Sb.
8. S. tangerina P. Monnier, Feddes Repert. 69: 50 (1964). Like 7 but stems $5-10 \mathrm{~cm}$, very slender; inflorescence very condensed; petals and sepals $1 \cdot 5-3 \mathrm{~mm}$; capsule $2-3 \mathrm{~mm}$; seeds $0 \cdot 5-0.65 \mathrm{~mm}$, sparsely covered with long papillae. $2 n=18$. Saline soils. Iberian peninsula, S. France. Ga Hs ?Lu.
9. S. segetalis (L.) G. Don fil., Gen. Syst. 1: 425 (1831) (Alsine segetalis L., Delia segetalis (L.) Dumort.). Annual with slender tap-root; stems $3-15 \mathrm{~cm}$, ascending. Leaves awned; stipules long, silvery, much-divided at the apex. Inflorescence very slender, without upper bracts. Sepals $1 \cdot 5-2 \mathrm{~mm}$, acute, mucronate, with wide scarious margin and narrow green vein; petals white, shorter than the sepals. Capsule $1 \cdot 5-3 \mathrm{~mm}$, ovoid. Seeds 0.4 mm , black, ovoid, unwinged, tuberculate. $2 n=18$. Cornfields. W. and parts of C. \& S. Europe ; S.E. Russia. Be Ga Ge He Ho Hs It Lu Po Rs (E).
10. S. diandra (Guss.) Boiss., Fl. Or. 1: 733 (1867) (S. salsuginea Fenzl). Annual or biennial with slender tap-root; stems 3-30 cm, slender, ascending. Stipules short, triangular (rarely lanceolate). Inflorescence much-branched, very slender, without upper bracts. Sepals $2-3 \mathrm{~mm}$; petals lilac (rarely white), narrowly elliptical, equalling the sepals; stamens $2-3$. Capsule $1 \cdot 5-3 \mathrm{~mm}$, globose, about equalling the sepals; valves purple-black at maturity. Seeds $0 \cdot 6-0.7 \mathrm{~mm}$, unwinged, dark brown to black, rugulose or bristling with rigid papillae. $2 n=18$. Saline waste places. $S$. Europe; S.E. Russia. Al Co Cr Ga Gr Hs It Lu Sa Si Rs (E) Tu.
11. S. purpurea (Pers.) G. Don fil., Gen. Syst. 1: 425 (1831) (S. longipes Rouy). Annual or biennial with slender tap-root; stems $2-25 \mathrm{~cm}$, slender. Stipules lanceolate, acuminate, silvery. Inflorescence often slender, bracteate. Sepals $2 \cdot 5-4 \mathrm{~mm}$; petals $3-4.5 \mathrm{~mm}$, uniformly rose-purple, exceeding the sepals; stamens 10. Capsule $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$, shortly stipitate, equalling or somewhat exceeding the sepals. Seeds $0.45-0.6 \mathrm{~mm}$, unwinged, dark-brown or black, finely tuberculate. $2 n=18,36$. Sandy waste places (not halophilous). Iberian peninsula. ?Ga Hs ?It Lu.
12. S. rubra (L.) J. \& C. Presl, Fl. Čechica 94 (1819) (S. campestris (L.) Ascherson). Annual to perennial with slender to somewhat woody tap-root; stems $5-25 \mathrm{~cm}$, diffuse, decumbent or procumbent. Leaves very fasciculate; stipules lanceolate, acuminate, silvery. Bracts of the inflorescence almost as large as leaves. Sepals and petals $3-4 \mathrm{~mm}$; petals uniformly pink; stamens (5-)10. Capsule $4-5 \mathrm{~mm}$, about equalling the sepals. Seeds $0.45-0.55 \mathrm{~mm}$, unwinged, dark brown, subtrigonous. $2 n=36,54$. Sandy soils (not halophilous). Throughout Europe. All except Fa Is Sb .
13. S. nicaeensis Sarato ex Burnat, Fl. Alp. Marit. 1: 269 (1892). Like 12 but biennial with stout woody stock; stems $10-35 \mathrm{~cm}$, robust; stipules short, triangular; upper bracts very short; capsule slightly exceeding the sepals; seeds $0.5-0.65 \mathrm{~mm}$, dark brown, ovoid, often with vestigial wing near the micropyle. $2 n=36$. Saline soils and waste places; nitrophilous. Mediterranean region. Co Ga ?Gr Hs It Sa ?Si.
14. S. capillacea (Kindb. \& Lange) Willk. in Willk. \& Lange, Prodr. Fl. Hisp. 3: 163 (1874). Like 12 but stems $8-35 \mathrm{~cm}$, creeping, rooting at the nodes; inflorescence few-flowered, with very small bracts; seeds semicircular in outline. $2 n=18$. Granitic sands (not halophilous). Portugal and N.W. Spain. Hs Lu.
15. S. bocconii (Scheele) Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (1): 849 (1919) (S. atheniensis (Heldr. \& Sart.) Ascherson \& Schweinf.). Annual or biennial with slender taproot; stems $5-25 \mathrm{~cm}$, slender, densely glandular-hairy in the inflorescence. Leaves not fasciculate; stipules triangular, not acuminate. Upper bracts much reduced. Sepals $2-3.5 \mathrm{~mm}$; petals pink, with white base or entirely white, somewhat shorter than or equalling the sepals; stamens $(0-) 2-5(-8)$. Capsule $2-3.5 \mathrm{~mm}$, equalling or shorter than the sepals. Seeds $0 \cdot 35-$ 0.45 mm , unwinged, light grey-brown, finely tuberculate. $2 n=36$. Ruderal. S.W. Europe and Mediterranean region, mainly near the coast. Co Cr Ga Gr Hs It Lu Sa Si [ Br Ge Ho ].
16. S. heldreichii Fouc. ex E. Simon secundus \& P. Monnier, Bull. Soc. Bot. Fr. 105: 263 (1958). Annual with slender tap-root; stems $8-35 \mathrm{~cm}$, glandular-hairy only in inflorescence. Stipules more or less cordate, with short, often bifid, point. Sepals $2 \cdot 5-$ 3.5 mm , acute with nearly mucronate apex; petals pink to lilac, somewhat paler at the base, shorter than or equalling the sepals; stamens (2-)6-8(-10). Capsule $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$, about equalling the sepals. Seeds $0.5-0.6 \mathrm{~mm}$, unwinged, metallic black, smooth or slightly rugulose. $2 n=36$. Maritime sands. Mediterranean region and S.W. Europe. Ga Gr Hs It Lu.
17. S. echinosperma Čelak., Prodr. Fl. Böhm. 867 (1881). Annual (rarely perennial) with slender tap-root; stems $4-10 \mathrm{~cm}$, slender. Leaves slightly fasciculate; stipules triangular, often wider than long. Inflorescence few-flowered, with well-developed bracts. Sepals $2.5-3.5 \mathrm{~mm}$, curved in fruit; petals pale pink, equalling or somewhat shorter than the sepals; stamens (0-)2-5. Capsule subglobose, exceeding the sepals. Seeds $0 \cdot 45-0 \cdot 55 \mathrm{~mm}$, black, unwinged, densely spinulose. Margins of lakes and streams. C. \& W. Europe (distribution not fully known). Cz Ga Ge Po.

## 24. Telephium L. ${ }^{1}$

Procumbent perennial, woody at base. Flowers in terminal cymes, 5 -merous. Styles 3(4), free to base; ovary septate below, with many ovules. Capsule usually trigonous, dehiscing with $3(4)$ valves.

1. T. imperati L., Sp. Pl. 271 (1753). Glabrous dwarf shrub; rhizome very stout, woody; stems $15-40 \mathrm{~cm}$, rarely branched, procumbent to ascending, often rooting near base, terete. Leaves up to 15 mm , rather fleshy and glaucous, alternate, usually secund. Flowers shortly pedicellate, in 5 - to $20(-50)$-flowered terminal capitate cymes; bracts small. Sepals oblong-lanceolate, obtuse, green with white, scarious margins; petals white, slightly exceeding sepals. Capsule 15 - to 20 -seeded, exceeding sepals. S. Europe, extending northwards to the French Jura. Cr Ga Gr He Hs It.
(a) Subsp. imperati. Leaves obovate to obovate-subspathulate, obtuse. Sepals 4-7 mm. Capsule rather abruptly contracted into beak. Spain and S. France; very locally in N. Italy and S.W. Switzerland.
(b) Subsp. orientale (Boiss.) Nyman, Consp. 254 (1879): Like (a) but smaller and more slender in all its parts; leaves narrower, upper linear-lanceolate and rather acute; cymes fewer-flowered, denser; sepals $3-4.5 \mathrm{~mm}$; capsule more gradually narrowed into beak, and more exserted. C. \& S. Greece; Kriti.

## Subfam. Silenoideae

Leaves opposite; stipules absent. Epicalyx-scales (bracteoles) sometimes present. Sepals joined in a tubular or campanulate

[^70]calyx, sometimes with scarious commissures. Petals usually welldeveloped; stamens, petals and ovary often situated on a more or less elongated column which forms the carpophore in fruit.

## 25. Lychnis L. ${ }^{1}$

Erect perennials. Flowers 5 -merous; aestivation contorted. Epicalyx absent. Calyx-tube 10 -veined, with 5 short teeth. Limb of petal more or less distinct from claw; coronal scales present; stamens 10 ; styles usually 5 , opposite calyx-teeth. Fruit a capsule, dehiscing usually with 5 teeth; carpophore short or long. Seeds not bearded at hilum. (Incl. Coronaria Schaeffer, Polyschemone Schott and Viscaria Bernh.)

| Leaves and stems densely villous with white hairs |  |
| :---: | :---: |
|  | Inflorescence $\pm$ capitate; petals 2 -lobed 3. flos-jovis |
|  | Flowers long-stalked in a lax inflorescence; petals entire or emarginate <br> 2. coronaria |
| 1 Stems and leaves not villous |  |
|  | Petals deeply 4-lobed with linear, patent lobes; rarely broadly |
| 3 Petals entire, emarginate or 2-lobed with entire lobes |  |
| 4 Leaves and lower part of stems sparsely hispid or pubescent |  |
| 5 Calyx more than 10 mm ; leaves sparsely hispid |  |
| 5 Calyx less than 10 mm ; leaves pubescent with crispate hairs |  |
|  | Leaves glabrous or ciliate; lower part of stems glabrous sibirica |
|  | 6 Calyx less than 6 mm ; inflorescence $\pm$ capitate 7. alpina |
| 6 Calyx more than 6 mm ; inflorescence not capitate |  |
|  | 7 Inflorescence many-flowered 6. viscaria |
|  | 7 Inflorescence 1- to 3-flowered 8. nivalis |

1. L. chalcedonica L., $S p$. Pl. 436 (1753). Stems $30-45(-60) \mathrm{cm}$, erect, simple, stout, hispid. Leaves sparsely hispid, ovate, acute; cauline cordate-amplexicaul. Inflorescence 10 - to 50 -flowered, capitate. Calyx $14-17 \mathrm{~mm}$. Petal-limb bright scarlet, bifid for $\frac{1}{3}$ of its length. Carpophore $4-6 \mathrm{~mm}$. Woods and thickets. U.S.S.R. from c. $47^{\circ}$ to $55^{\circ} \mathrm{N}$. Rs (W, C, E).

Often cultivated for ornament.
2. L. coronaria (L.) Desr. in Lam., Encycl. Méth. Bot. 3: 643 (1792) (Coronaria coriacea Schischkin ex Gorschk.). Whole plant densely villous with white hairs; stems $30-100 \mathrm{~cm}$, erect, often branched. Leaves ovate to ovate-lanceolate, acute. Flowers longpedicillate in a few-flowered inflorescence. Calyx $15-20 \mathrm{~mm}$. Petal-limb purplish, rarely very pale or white, entire or emarginate. Carpophore c. 2 mm . S.E. Europe; cultivated elsewhere for ornament and locally naturalized. Al Bu Cz Gr Hu It Ju Rm Rs (W, K) Tu [Au Ga Ge He Hs Lu Po].
3. L. flos-jovis (L.) Desr. in Lam., Encycl. Méth. Bot. 3: 644 (1792). Less densely villous than 2 , stems $20-90 \mathrm{~cm}$, usually erect and little-branched. Basal leaves lanceolate-spathulate, acute; cauline lanceolate. Inflorescence 4- to 10 -flowered, more or less capitate. Calyx 11-13 mm. Limb of petal purplish or scarlet, rarely white, bifid with wide, often lobed, lobes. Capsule $c$. 14 mm ; carpophore c. 2 mm . Dry, sunny slopes, 1000-2000 m. - Alps, eastwards to c. $11^{\circ} 15^{\prime}$ E.; often cultivated for ornament and locally naturalized in C. Europe. Ga He It $[? \mathrm{Au} \mathrm{Cz}$ ].
4. L. flos-cuculi L., Sp. Pl. 436 (1753) (Coronaria flos-cuculi (L.) A. Braun). Stems $20-90 \mathrm{~cm}$, often branched, sparsely scabrid-puberulent. Basal leaves oblong-spathulate, petiolate, slightly scabrid, often ciliate at base; cauline linear-lanceolate, connate at base. Flowers in long-stalked dichasia. Calyx 6-

10 mm . Capsule 6-10 mm; carpophore very short or absent. Damp places. Most of Europe, but rare in the south. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Sb} \mathrm{Tu}$.
(a) Subsp. flos-cuculi: Petal-limb deeply 4-lobed with linear, patent lobes, usually pale purplish. $2 n=24$. Throughout the range of the species.
(b) Subsp. subintegra Hayek, Österr. Bot. Zeitschr. 70: 14 (1921): Petal-limb 2-lobed with oblong-obtuse lobes which are emarginate on their outer margins, usually white. Balkan peninsula.
5. L. sibirica L., Sp. Pl. 437 (1753). Whole plant pubescent with short crispate hairs. Stems $8-30 \mathrm{~cm}$, usually simple. Basal leaves crowded on woody stock, linear-lanceolate; cauline 3-8 pairs, remote. Inflorescence (1-) 3- to 4(-8)-flowered, lax; pedicels mostly longer than calyx. Calyx $5-6(-8) \mathrm{mm}$. Petal-limb pale yellow or white, bifid to about half-way; coronal scales lanceolate, acute. Capsule $6-8 \mathrm{~mm}$; carpophore very short. Arctic Russia (Pečora estuary). Rs (N). (N. Asia.)

The European plant is subsp. samojedorum Sambuk, Bull. Acad. Sci. URSS ser. 7, 22: 47 (1928) (L. samojedorum (Sambuk) Gorschk.). Subsp. sibirica occurs in Siberia and approaches close to the boundary of Europe N.E. of Sverdlovsk.
6. L. viscaria L., Sp. Pl. 436 (1753) (Viscaria viscosa Ascherson, V. vulgaris Bernh.). Stem $15-90 \mathrm{~cm}$, simple, or branched above, glabrous or slightly hairy above, viscid below the upper nodes. Leaves mostly basal, linear- to ovate-lanceolate, petiolate, glabrous, usually ciliate at base. Flowers usually in 3- to 6flowered, shortly stalked opposite dichasia which are arranged in a lax, spike-like panicle. Calyx 6-15 mm. Petals usually dark or pinkish-purple, rarely white, entire or emarginate. Capsule $7-10 \mathrm{~mm}$. Most of continental Europe, but rare in the south-west. Al Au Be Br Bu Cz Da Fa Fe Ga Ge Gr He Ho Hs Hu It Ju ?Lu No Po Rm Rs (N, B, C, W, K, E) Su Tu.

Very variable, the centre of variation being in Makedonija. To the north and west of this region, the plants have long carpophores, and in Greece only plants with short carpophores occur. The shape of the calyx is more or less correlated with the length of the carpophore, but the other variable characters are not. Two subspecies can be recognized.
(a) Subsp. viscaria: Calyx clavate. Carpophore more than 3 mm , at least half as long as the ripe capsule. $2 n=24$. Throughout the range of the species, except Greece.
(b) Subsp. atropurpurea (Griseb.) Chater, Feddes Repert. 69: 45 (1964) (L. atropurpurea (Griseb.) Nyman, Viscaria atropurpurea Griseb.; incl. V. sartorii Boiss.). Calyx tubular to campanulate, not clavate. Carpophore 2 mm or less, less than $\frac{1}{3}$ as long as ripe capsule. Balkan peninsula and Romania.
7. L. alpina L., Sp. Pl. 436 (1753) (Viscaria alpina (L.) G. Don fil.). Caespitose, glabrous, with ciliate leaf-bases; stems $5-15 \mathrm{~cm}$, simple, not viscid. Basal leaves crowded, linear-subspathulate to linear; cauline usually 2-3 pairs, often wider. Inflorescence (6-)10- to 20 -flowered, more or less capitate, rarely elongate. Calyx (3-)4-5 mm. Petal-limb pale purple, rarely white, bifid to about half-way. Capsule c. 4 mm ; carpophore 2 mm or less. Some flowers are large and hermaphrodite, some small and usually with abortive stamens. $2 n=24$. N. Europe, southwards to $56^{\circ} N$; Alps; Pyrenees; Appennini (one locality). Au Br Fe Ga He Hs Is It No Rs (C, N) Su.
8. L. nivalis Kit. in Schultes, Oestreichs Fl. ed. 2, 1: 698 (1814). Caespitose, glabrous, with ciliate or serrulate leaves. Stems

[^71]2 By W. Rothmaler.
$5-20 \mathrm{~cm}$, simple, not viscid. Radical leaves crowded, oblonglanceolate to subspathulate; cauline 1-2 pairs, often linear. Flowers 1-3; pedicels equalling or shorter than the calyx. Calyx 10-12 mm. Petal-limb pale purple or white, 2-lobed. Carpophore short. Damp, stony places, 1820-2290 m. - E. Carpathians (Muntii Rodnei). Rm.

## 26. Agrostemma L. ${ }^{1}$

Like Lychnis, but annuals; calyx with 5, long, linear, foliaceous teeth; styles 5 , alternating with calyx-teeth; carpophore absent.

1 Calyx-teeth equalling or shorter than tube; petals longer than calyx; limb with rows of black spots at base 3. gracilis
1 Calyx-teeth longer than tube; petals shorter than calyx; limb with greenish spots, or not spotted
2 Seeds usually 3 mm or more, with prominent acute tubercles

1. githago

2 Seeds usually less than 3 mm , with small obtuse tubercles or almost smooth
2. linicola

1. A. githago L., Sp. Pl. 435 (1753) (Lychnis githago (L.) Scop.). Plant covered with long, appressed, greyish hairs; stems $30-100 \mathrm{~cm}$. Leaves usually linear, slightly connate, acute, or the lower obtuse. Calyx $3-7 \mathrm{~cm}$, the ovoid or oblong tube usually much shorter than the often caducous teeth. Petals shorter than calyx; limb not spotted, dull purple, rarely white. Seeds mostly 3 mm or more, with prominent acute tubercles. $2 n=48$. Probably native in Europe only in the E. Mediterranean region; introduced as a weed of cultivation almost throughout Europe, but less abundant than formerly. All except Sb , but in Az Fa Is only as a rare casual.

Perhaps comparatively recently derived from 3.
2. A. linicola Terechov, Bull. Appl. Bot. Pl.-Breed. (Leningrad) 25 (4): 283 (1931). Like 1, but calyx-tube narrower and less hairy; petal-limb usually greenish-spotted; seeds mostly less than 3 mm , with smaller, obtuse tubercles, or almost smooth. Flax-fields. - U.S.S.R., from c. $54^{\circ}$ N. southwards. Rs (C, W, E).

Flowers and sets seed earlier than 1.
3. A. gracilis Boiss., Diagn. Pl. Or. Nov. 3 (1): 80 (1853). Like 1 but smaller, more slender and less hairy; calyx-tube narrower, equalling or longer than teeth; petals longer than calyx; limb pale purple, with lines of black spots at base. C. Greece (near Farsala). Gr. (Asia Minor.)

## 27. Petrocoptis A. Braun ${ }^{2}$

Perennials, woody at base. Inflorescence cymose, 1- to 10 flowered. Epicalyx absent. Calyx conical-campanulate, 10veined. Petals 5, imbricate, long-clawed; coronal scales present; stamens 10 ; styles 5 , opposite the sepals. Capsule dehiscing with 5 teeth opposite the calyx-teeth; carpophore present. Seeds reniform, black, with a conspicuous tuft of hairs $0 \cdot 5-1 \mathrm{~mm}$ long at the hilum.

All the species grow on calcareous rocks in the Pyrenees and mountains of Spain.

## Literature: W. Rothmaler, Bot. Jahrb. 72 (1): 117-30 (1941).

1 Plants with rosettes of leaves near the base of the flowering stems; flowers white, rarely pale purplish
2 Calyx 9-13 mm
6. crassifolia

2 Calyx 5-8 mm
3 Calyx glandular
2. viscosa

3 Calyx eglandular
4 Leaves thick, coriaceous, glaucous; petiole not ciliate; seeds 1.5 mm or more, dull
5. hispanica
4 Leaves thin, green; petiole ciliate; seeds 1 mm or less, shining

1. pyrenaica 1 Plant without rosettes of leaves on the flowering stems; flowers usually reddish or purplish
5 Calyx $7-9 \mathrm{~mm}$; bracts scarious
2. glaucifolia
5 Calyx 10-13 mm; bracts leaf-like
6 Leaves thick, coriaceous, glaucous, lanceolate; seeds 1.25 mm or more
3. pardoi
6 Leaves thin, green, ovate or broadly lanceolate; seeds 1 mm or less
4. grandiflora
5. P. pyrenaica (J. P. Bergeret) A. Braun in Walpers, Repert. Bot. Syst. 1: 281 (1842). Laxly caespitose; flowering stems with rosettes of leaves $1-2 \mathrm{~cm}$, ovate-lanceolate, acute, green or scarcely glaucous, thin; petiole $1-3 \mathrm{~cm}$, ciliate. Cauline leaves $1-2 \mathrm{~cm}$, the lower lanceolate, the upper ovate. Bracts $1 \cdot 5-4 \mathrm{~mm}$, green, with scarious margins. Calyx $5-8 \mathrm{~mm}$, glabrous, eglandular, whitish; teeth broadly ovate, obtuse, slightly apiculate. Petals $10-15 \mathrm{~mm}$, white or very pale purplish, emarginate. Seeds c. 1 mm , shining. - W. Pyrenees. Ga Hs.
6. P. viscosa Rothm., Cavanillesia 7: 111 (1935). Like 1 but basal leaves more glaucous, up to 3 cm ; bracts not more than 1 mm ; calyx, pedicels and inflorescence-branches viscid. N.W. Spain (N. \& W. parts of Léon prov.).
7. P. glaucifolia (Lag.) Boiss., Diagn. Pl. Or. Nov. 3 (1): 80 (1853) (P. lagascae (Willk.) Willk.) Plant without rosettes of leaves on flowering stems; stems diffusely branched at base. Lower cauline leaves $1-2 \mathrm{~cm}$, ovate-lanceolate or lanceolate, rather thick and glaucous; petiole up to 2 cm ; upper leaves ovate. Bracts $1-2 \mathrm{~mm}$, entirely scarious. Calyx $7-9 \mathrm{~mm}$, glabrous, eglandular, whitish or purplish; teeth ovate, obtuse. Petals $15-18 \mathrm{~mm}$, purplish, slightly emarginate. Seeds c. 1 mm . - Mountains of $N$. Spain from $2^{\circ} 30^{\prime}$ to $6^{\circ} 30^{\prime} \mathrm{W}$. Hs.
8. P. grandiflora Rothm., Cavanillesia 7: 111 (1935). Plant without rosettes of leaves on flowering stems; stems diffusely branched at base. Lower cauline leaves $1-1.5 \mathrm{~cm}$, ovate-lanceolate or ovate, thin, green or scarcely glaucous; petioles up to 1 cm ; upper leaves ovate. Bracts $2-4 \mathrm{~mm}$, leaf-like. Calyx $10-$ 13 mm , glabrous, eglandular, purplish; teeth ovate, mucronate. Petals c. 20 mm , purplish, slightly emarginate. Seeds 1 mm or less, shining. - N.W. Spain (Peña Rubia, N.W. of Ponferrada). Hs.
9. P. hispanica (Willk.) Pau, Bol. Soc. Aragon Ci. Nat. 1916: 65 (1916) (P. pyrenaica var. hispanica Willk.). Laxly caespitose; flowering stems with rosettes of leaves $1-3 \mathrm{~cm}$, obovate, acute or acuminate, thick, coriaceous, glaucous; petiole $1-3 \mathrm{~cm}$, not ciliate. Cauline leaves $1-3 \mathrm{~cm}$, the lower elliptical or ovate, the upper suborbicular. Bracts $1-2.5 \mathrm{~mm}$, scarious, with green midrib. Calyx $6-8 \mathrm{~mm}$, glabrous, eglandular, whitish; teeth broadly ovate, obtuse. Petals $12-16 \mathrm{~mm}$, white, emarginate. Seeds $1 \cdot 5-$ 1.7 mm , dull. - W.C. Pyrenees (Jaca region). Hs.
10. P. crassifolia Rouy, Ill. Pl. Eur. Rar. 4: 26 (1895). Laxly caespitose; flowering stems with rosettes of leaves $1-2 \mathrm{~cm}$, ovatelanceolate, thick, glaucous; petiole $2-3 \mathrm{~cm}$, not ciliate. Cauline leaves $1-1.5 \mathrm{~cm}$, lanceolate. Bracts $2-5 \mathrm{~mm}$, scarious. Calyx $9-13 \mathrm{~mm}$, glabrous, glandular, whitish; teeth ovate, acute. Petals $20-25 \mathrm{~mm}$, white, scarcely emarginate. Seeds $c .2 \mathrm{~mm}$. - . Pyrenees (Bielsa region). Hs.
${ }^{1}$ By A. O. Chater and S. M. Walters.
11. P. pardoi Pau, Act. Soc. Esp. Hist. Nat. 22: 196 (1898). Plant without rosettes of leaves on flowering stems; stems 510 cm , diffusely branched, shorter than in the other spp. Cauline leaves $2-3 \mathrm{~cm}$; the lower lanceolate-spathulate, scarcely petiolate; the upper lanceolate; all thick, coriaceous and glaucous. Bracts $3-5 \mathrm{~mm}$, coriaceous, greenish or purplish. Calyx $10-12 \mathrm{~mm}$, glabrous, eglandular, whitish or purplish; teeth broadly ovate, acuminate. Petals $20-25 \mathrm{~mm}$, pale purplish, scarcely emarginate. Seeds $1 \cdot 25-1.5 \mathrm{~mm}$, slightly shining. - N.E. Spain (N.W. part of Castellón prov.). Hs.

## 28. Silene L. ${ }^{1}$

Herbs or small shrubs of varied habit. Flowers 5 -merous. Epicalyx absent. Calyx-tube with (5-) $10-30$ veins and 5 short teeth. Limb of petal distinct from claw; stamens 10 ; styles usually 3 (sometimes 4 on same plant), more rarely 5. Fruit a capsule with variably-developed basal septa (absent in species sometimes treated as a separate genus, Melandrium), opening by 6 (more rarely 8 or 10) teeth, twice the number of styles; carpophore present. (Sect. Eudianthe has 5 styles and 5 bifid teeth.) Seeds variable, but never with a tuft of hairs. (Incl. Eudianthe (Reichenb.) Reichenb., Heliosperma (Reichenb.) Reichenb., Melandrium Röhling, Otites Adanson.)
A wide generic concept is adopted, following Chowdhuri. Calyx-length normally changes little between flowering and fruiting, and provides a convenient measurement of flower-size. Measurements of the capsule and carpophore refer to the ripe fruiting stage. Seed-characters have been extensively used in the description of annual species, and ripe seed is necessary to confirm the identification in some groups. There is great variety in seed-form. Most seeds are reniform, and the two sides ('faces' in the descriptions) may be plane, concave, excavate (i.e. with an abrupt, relatively deep excavation), or concavo-convex (i.e. convex, but with a concavity near the hilum). The edge of the seed ('back' in the descriptions) may be plane, grooved, ridged, winged or variously sculptured.
The terminology of the inflorescence is difficult. In the perennial sections there are some paniculate inflorescences with more or less equal opposite branches bearing groups of 3 -flowered dichasia, and it is possible to derive many of the other inflorescence types theoretically from this paniculate type. Chowdhuri's arrangement of the genus, largely adopted here, follows this logical pattern. It is significant that no annual species possess this inflorescence-type. Reduction of the typical panicle produces the narrow spike-like inflorescence in which the opposite branches may be very short-stalked (the inflorescence is then pseudoverticillate) or may be reduced to single flowers.
Further reductions may suppress some or all of the branches, and this series of more or less irregular alternately branched panicles finishes with those species with a solitary flower. In the annual species it is possible to describe most inflorescences as regular or irregular compound dichasia, simple or compound raceme-like monochasia, few-flowered, or solitary. Alar flowers are single in the apparent axil of a branch. As, however, environmental conditions affect the development of the inflorescence, no key which depends on inflorescence-form can work with more than moderate success, and small specimens, whether of annual or perennial species, may be wrongly identified. In the present state of knowledge, there appears to be no remedy to this.

Most annual species of Silene are weeds of ruderal or cultivated habitats, and most perennial species grow in open stony or sandy ground. Many of the perennials are caespitose, mat-forming or, more rarely, pulvinate mountain-plants with relatively large flowers.

Literature: P. Rohrbach, Monographie der Gattung Silene. Leipzig, 1868. F. N. Williams, Jour. Linn. Soc. London (Bot.) 32: 1-196 (1896). P. K. Chowdhuri, Notes Roy. Bot. Gard. Edinb. 22: 221-78 (1957).

1 Annual, without non-flowering shoots at time of flowering, and usually without a woody stock; inflorescence various, but never paniculate with regular and equal opposite branches
2 Styles 5, or flowers male only; capsule with 10 teeth or with 5 bifid teeth
3 Leaves ovate-lanceolate to obovate; petals usually white
4 Calyx (at least in female flowers) with 20 conspicuous veins; capsule usually with erect teeth 105. alb 4 Calyx with 10 inconspicuous veins; capsule with recurved teeth
107. heuffelii

3 Leaves linear-lanceolate; petals pink (Sect. Eudianthe)

5 Calyx less than 12 mm
135. laeta

5 Calyx more than 12 mm
136. coeli-rosa

2 Styles 3; capsule with 6 teeth
6 Calyx 15- to 30 -veined (Sect. Conomorpha)
7 Calyx 15 - to 20 -veined
163. ammophila

7 Calyx 30 -veined
8 Capsule 12-18 mm; seeds more than 1 mm , dark brown
166. conoidea

8 Capsule 7-12 mm; seeds 1 mm or less, pruinose
9 Calyx shortly pubescent
164. conica

9 Calyx with short glandular hairs and $\pm$ dense, long, eglandular hairs
165. lydia

6 Calyx 10-veined
10 Seeds with back narrowly grooved between 2 undulate wings (Sect. Dipterospermae)
11 Carpophore more than 4 mm
12 Seeds $1-1.5 \mathrm{~mm}$; calyx-teeth ovate, obtuse 159. colorata
12 Seeds 2 mm or more; calyx-teeth lanceolate, acute
160. secundiffora

11 Carpophore less than 4 mm
13 Carpophore $2.5-3.5 \mathrm{~mm}$; petals always present
162. longicaulis

13 Carpophore 1-2 mm; petals often 0
161. apetala

10 Seeds without 2 undulate wings on back
14 Flowers solitary, terminal
15 Calyx not contracted at mouth
16 Seeds $1-1.4 \mathrm{~mm}$
150. sericea
16 Seeds $0.6-0.8 \mathrm{~mm}$ 139. littorea 15 Calyx contracted at mouth (Iberian peninsula)
17 Calyx loose and inflated in fruit
138. psammitis

17 Calyx not loose and inflated in fruit
18 Seeds $\pm$ smooth; carpophore (2.5-)4-9 mm
139. littorea

18 Seeds tuberculate; carpophore 2-4 mm
19 Calyx 15 mm or less; calyx-tube 2-3 times as long as teeth; petals white 141. boissier
19 Calyx usually more than 15 mm ; calyx-tube 3-5 times as long as teeth; petals pale pink
142. almolae

14 Flowers in monochasia or dichasia
20 Flowers in raceme-like, simple or branched monochasia, with or without alar flowers
21 Calyx not contracted at mouth
22 Seeds subglobose, umbilicate (Karpathos) 117. insularis 22 Seeds reniform
23 Pedicels patent in fruit, slender, usually longer than calyx
24 Calyx 6-9 mm; seeds $0.3-0.5 \mathrm{~mm} \quad$ 120. sedoides
24 Calyx $10-20 \mathrm{~mm}$; seeds 0.6 mm or more
25 Calyx straight in fruit
139. littorea

25 Calyx curved in fruit 140. adscendens

23 Pedicels erect in fruit, $\pm$ stout, usually shorter than calyx
26 Stems 1(-3)-flowered
150. sericea

26 Stems more than 3-flowered
27 Seeds excavate on face; plant never villous
28 Carpophore less than 2 mm
151. nocturna

28 Carpophore more than 2 mm
149. obtusifolia

27 Seeds $\pm$ plane on face; plant usually villous, at least on buds and shoot-apices
29. Plant not villous (Milos)
148. discolor

29 Plant villous, at least on buds and shoot-apices
30 Carpophore less than 5 mm ; petal-limb 3 mm or less, white
147. micropetala

30 Carpophore more than 5 mm ; petal-limb more than 5 mm , reddish
146. scabriflora

21 Calyx contracted at mouth
31 Fruiting pedicels patent or deflexed
32 Calyx inflated, widest at the middle
33 Cauline leaves ovate to ovate-lanceolate 137. pendula
33 Cauline leaves linear-lanceolate to linear
138. psammitis

32 Calyx not inflated
34 Calyx straight in fruit
139. littorea

34 Calyx curved in fruit
140. adscendens

31 Fruiting pedicels $\pm$ erect
35 Carpophore 5 mm or more; calyx with ascending, $\pm$ bulbous-based hairs on veins 134. trinervia
35 Carpophore not more than 5 mm ; calyx without ascending, bulbous-based hairs
36 Seeds more than 1 mm ; carpophore glabrous
37 Plant entirely glabrous 126. graeca
37 Plant hairy, at least in part (Sect. Dichotomae)
38 Veins of calyx sparsely hispid 143. dichotoma
38 Veins of calyx glabrous but serrate with ascending teeth
144. remotiflora

36 Seeds less than 1 mm ; carpophore pubescent (Sect. Silene)
39 Plant entirely glabrous
154. giraldii

39 Plant hairy, at least in part
40 Veins of calyx distinctly anastomosing above
41 Calyx 11 mm or more; calyx-tube about equalling the linear, acuminate teeth; carpophore $1-2 \mathrm{~mm}$
157. tridentata

41 Calyx usually less than 11 mm ; calyx-tube about twice as long as the lanceolate, acute teeth; carpophore $2-4 \mathrm{~mm} \quad$ 156. cerastoides
40 Veins of calyx obscurely anastomosing or free
42 Calyx more than 13 mm
155. bellidifolia

42 Calyx less than 13 mm
43 Inflorescence subcapitate
158. disticha

43 Inflorescence $\pm$ elongate
44 Calyx $9-12 \mathrm{~mm}$; carpophore $1 \cdot 5-2 \mathrm{~mm}$; seeds with $\pm$ flat face and narrow, acutely grooved back 152. ramosissima
44 Calyx $7-10 \mathrm{~mm}$; carpophore less than 1 mm ; seeds with excavate face and wide, flat or concave back
153. gallica

20 Flowers in regular or irregular dichasia, not in raceme-
like monochasia
45 Calyx not contracted at mouth
46 Flowers usually $2-8$, in sessile or shortly stalked subcapitate dichasia arranged laterally on a simple or branched axis
145. nicaeensis

46 Inflorescence more or less regularly dichasially branched
47 Calyx 11 mm or more
48 Carpophore not more than 4 mm
49 Capsule $10-11 \mathrm{~mm}$; calyx-teeth acute
118. divaricata

49 Capsule $7-8 \mathrm{~mm}$; calyx-teeth very obtuse
50 Calyx usually greenish; petal-limb c. 2 mm , deeply bifid 116. bergiana
50 Calyx whitish and reddish-tinged; petal-limb $3-4 \mathrm{~mm}$, emarginate
115. rubella

48 Carpophore more than 4 mm
51 Calyx glabrous
52 Seeds with 4 rows of acute tubercles on back; petals white, with purplish veins
110. echinosperma

52 Seeds with 1-2 rows of rounded tubercles on back; petals pink or whitish, without darker veins
109. portensis

## 51 Calyx hairy

53 Carpophore $9-10 \mathrm{~mm}$, pubescent 114. pseudatocion
53 Carpophore $4 \cdot 5-8 \mathrm{~mm}$, glabrous
54 Carpophore $4 \cdot 5-7 \mathrm{~mm}$; inflorescence $\pm$ dense
113. fuscata

54 Carpophore 7-8 mm, inflorescence lax
119. integripetala

47 Calyx less than 11 mm
55 Carpophore more than 4 mm 123. laconica
55 Carpophore less than 4 mm
56 Seeds with excavate face
57 Calyx usually greenish; petal-limb c. 2 mm , deeply bifid
116. bergiana

57 Calyx whitish and reddish-tinged; petal-limb
$3-4 \mathrm{~mm}$, emarginate
115. rubella

56 Seeds with plane or concave, but not excavate, face
58 Calyx glabrous
59 Petal-limb exserted; calyx $4-7.5 \mathrm{~mm}$
111. pinetorum

59 Petals absent, or with limb included; calyx $7-10 \mathrm{~mm}$ 112. inaperta
58 Calyx hairy
60 Capsule equalling calyx; carpophore c. 3 mm ; seeds $0.75-1 \mathrm{~mm}$
122. haussknechtii

60 Capsule exceeding calyx; carpophore $c .2 \mathrm{~mm}$; seeds $0.5-0.75 \mathrm{~mm}$
121. pentelica

45 Calyx contracted at mouth
61 Veins of calyx with prominent, ascending, bulbousbased hairs
62 Hairs on veins of calyx c. 1 mm , with distal part shorter than bulbous base 133. squamigera
62 Hairs on veins of calyx c. 1.5 mm , with distal part longer than bulbous base 132. echinata
61 Veins of calyx without bulbous-based hairs
63 Plant entirely glabrous (except sometimes for carpophore)
64 Calyx with 5 green wings
128. stricta

64 Calyx without wings or with scarious wings
65 Carpophore 2 mm or less
66 Inflorescence dense; flowers overlapping
130. holzmannii

66 Inflorescence lax; flowers not overlapping
129. behen

65 Carpophore more than 2 mm
67 Cauline leaves not amplexicaul; calyx-teeth acute
127. muscipula

67 Cauline leaves amplexicaul; calyx-teeth obtuse
68 Upper cauline leaves closely investing base of subcapitate inflorescence 102. compact
68 Upper cauline leaves not closely investing base of laxly or densely corymbose inflorescence
101. armeria

63 Plant hairy, at least at base
69 Flowers in a 3 - to 8 -flowered subcapitate inflorescence; calyx $8-9 \mathrm{~mm}$
158. disticha

69 Inflorescence lax; calyx 9 mm or more
70 Stem pubescent with patent hairs; 30 mm ,
70 Stem pubescent with crispate, deflexed hairs, or puberulent; calyx less than 20 mm
71 Carpophore pubescent
72 Seeds with excavate face; capsule ovoid
131. linicola

72 Seeds with $\pm$ plane face; capsule oblong
127. muscipula

71 Carpophore glabrous
73 Calyx smooth, glabrous, usually shorter than pedicel
74 Carpophore $1-5 \mathrm{~mm}$
124. cretica

[^72]75 Calyx 11-15 mm; calyx-tube 2-3 times as long as teeth; petals white
141. boissieri

75 Calyx (12-) $15-18 \mathrm{~mm}$; calyx-tube 3-5 times as long as teeth; petals very pale pink
142. almolae

1 Perennial (more rarely biennial), usually with non-flowering shoots at time of flowering and a woody, branched stock; inflorescence, if compound, often paniculate with equal, opposite branches
76 Styles 5; dioecious; flowers large (calyx more than 10 mm )
77 Biennial; flowers usually white
78 Calyx (at least in female flowers) with 20 conspicuous veins; capsule usually dehiscing with erect teeth 105. alba
78 Calyx with 10 inconspicuous veins; capsule dehiscing with recurved teeth
107. heuffelii

77 Perennial; flowers pink or red
79 Petals emarginate or shallowly bifid; plant $\pm$ procumbent 108. diclinis

79 Petals deeply bifid; plant erect
106. dioica

76 Styles 3 (rarely 4); flowers usually hermaphrodite (or, if dioecious, calyx less than 8 mm )
80 Calyx 20 -veined
81 Calyx with 10 long and 10 short veins; lateral veins few or absent
57. csereii

81 Calyx with equal main veins and a conspicuous network of lateral veins
82 Calyx glabrous and glaucous; petals bifid
56. vulgaris

82 Calyx pubescent; petals emarginate
62. procumbens

80 Calyx (5-)10-veined
83 Flowers small, unisexual; calyx less than 8 mm ; petals often entire, never deeply bifid (Sect. Otites)
84 Petals spathulate, white
85 Petals entire
85 Petals shallowly bifid
86 Calyx subglabrous, not inflated
39. sendtneri

86 Calyx pubescent, inflated
38. roemeri

84 Petals linear, greenish or white
87 Monoecious; carpophore c. 2 mm
40. ventricosa

87 Usually dioecious; carpophore less than 2 mm
37. sibirica

88 Whole plant, including pedicels and calyx, $\pm$ densely pubescent
89 Calyx 2-3 mm; capsule c. 3 mm , subglobose
41. borysthenica

89 Calyx $3.5-5 \mathrm{~mm}$; capsule $5-9 \mathrm{~mm}$, ovoid 43. helimannii
88 At least pedicels and calyx glabrous
90 Calyx $1.5-3 \mathrm{~mm}$; capsule c. 3 mm , subglobose 42. media
90 Calyx more than 3 mm ; capsule more than 3 mm , ovoid
(44-48). otites group
83 Flowers larger, hermaphrodite; calyx usually more than 8 mm ; petals usually distinctly bifid
91 Inflorescence a more or less spreading racemose panicle with opposite branches, at least one branch with a 3-or more-flowered dichasium
92 Capsule less than $1 \frac{1}{2}$ times as long as carpophore
93 Plant glabrous; flowers large; calyx more than 20 mm
94 Petals red; inflorescence short
13. fruticosa

94 Petals white or pink; inflorescence long 23. bupleuroides
93 Plant hairy, at least in lower part; calyx usually less than 20 mm
95 Inflorescence short, often subcorymbose; plant $\pm$ densely tomentose (4-6). mollissima group
95 Inflorescence $\pm$ elongated; plant not densely tomentose
96 Calyx $8-13 \mathrm{~mm}$; petals small, greenish 7. mellifera
96 Calyx 14 mm or more; petals larger, usually whitish
97 Calyx $25-30 \mathrm{~mm}$; coronal scales lanceolate, acute
8. paradoxa

97 Calyx less than 22 mm ; coronal scales small and obtuse, or absent

1. italica

92 Capsule at least $1 \frac{1}{2}$ times as long as carpophore

98 Calyx glabrous or scabrid, sometimes with very sparse glandular hairs
99 Terminal flower distinctly overtopped by long slender lateral branches of inflorescence arising in axils of two uppermost bracts; filaments more or less hairy (Greece)
20. longipetala

99 Terminal flower not distinctly overtopped by inflore-scence-branches in axils of two uppermost bracts; filaments glabrous
100 Inflorescence a compound panicle of many small flowers; capsule $6-7 \mathrm{~mm}$
18. catholica

100 Inflorescence simpler, with fewer, larger flowers; capsule at least 8 mm
101 Capsule $1 \frac{1}{2}-2$ times as long as carpophore
102 Petals white or purplish; 2 calyx-teeth acute, 3 obtuse
2. patula

102 Petals greenish; calyx-teeth all obtuse 7. mellifera
101 Capsule at least $2 \frac{1}{2}$ times as long as carpophore
103 Petals deep purple; calyx 4-5 mm
19. viscariopsis

103 Petals not deep purple; calyx more than 5 mm
104 Plant densely caespitose; leaves linear or linearlanceolate (Greece)
22. guicciardii

104 Plant not densely caespitose; basal leaves lanceolate or wider
105 Whole plant glabrous; coronal scales very small, obtuse
25. chlorantha

105 Plant usually $\pm$ pubescent; coronal scales obvious, acute
106 Capsule not more than 5 times as long as carpophore
15. nutans

106 Capsule 8-9 times as long as carpophore
16. brachypoda

98 Calyx distinctly pubescent, with or without glandular hairs
107 Plant with a persistent woody cushion of rigid, nonflowering branches (Greece)
12. spinescens

107 Plant woody or not at base, without a cushion of rigid, non-flowering branches
108 Inflorescence short, often subcorymbose; plant $\pm$ densely tomentose (4-6). mollissima group
108 Inflorescence elongated; plant not tomentose
109 Capsule $1 \frac{1}{2}-2$ times as long as carpophore
110 Petals white, with long linear lobes; filaments $\pm$ hairy (Greece)
21. niederi

110 Petals rarely white, with shorter, broader lobes; filaments glabrous
111 Calyx eglandular, or at least with some eglandular hairs
3. hifacensis

111 Calyx with glandular hairs only
112 Petals white or purplish; 2 calyx-teeth acute, 3 obtuse
2. patula

112 Petals greenish; calyx-teeth all obtuse
7. mellifera

109 Capsule at least $2 \frac{1}{2}$ times as long as carpophore
113 Calyx cylindrical, $\pm$ attenuate at base; petal-claw distinctly exserted
17. viridiflora

113 Calyx clavate, truncate or umbilicate at base; petal-claw only slightly exserted
114 Flowers often inclined; inflorescence $\pm$ secund; capsule usually more than 3 times as long as carpophore
15. nutans

114 Flowers erect; inflorescence not secund; capsule c. 3 times as long as carpophore 14. gigantea 91 Inflorescence not a diffuse panicle with opposite branches bearing dichasia
115 Inflorescence more than 5 -flowered
116 Inflorescence a $\pm$ regular dichasium, sometimes corymbose or subcapitate
117 Petals usually 4-toothed or 4-fid; seeds winged (Sect. Heliosperma) (94-100). pusilla group
117 Petals entire, emarginate or bifid; seeds not winged
118 Calyx 4-6 mm
92. rupestris

118 Calyx more than 6 mm

119 Carpophore c. 2 mm ; calyx $\pm$ inflated
120 Calyx strongly inflated; stem leafless in upper half
61. fabarioides

120 Calyx slightly inflated; stem leafy throughout
58. fabaria

119 Carpophore more than 3 mm ; calyx not inflated
121 Flowering stems slender, obviously lateral; calyx $9-12 \mathrm{~mm}$; petal-limb deeply emarginate
93. lerchenfeldiana

121 Flowering stem usually robust, terminal; calyx $12-20 \mathrm{~mm}$; petal-limb entire or emarginate (Sect. Compactae)
122 Upper cauline leaves not closely investing base of laxly or densely corymbose inflorescence
101. armeria

122 Upper cauline leaves (bracts) closely investing base of subcapitate inflorescence
123 Biennial; bracts herbaceous; calyx not purplish
102. compacta

123 Perennial; bracts membranous; calyx purplish
103. asterias

116 Inflorescence not a regular dichasium, and neither corymbose nor subcapitate
124 Calyx hairy (sometimes only slightly so)
125 Calyx 6-7 mm
64. congesta

125 Calyx more than 8 mm
126 Leaves acicular, pungent
71. altaica

126 Leaves not acicular
127 Plant with long creeping stolons and linear leaves
67. repens

127 Not stoloniferous; basal leaves usually lanceolate or spathulate
128 Petals yellow; carpophore $c .1 \mathrm{~mm}$ 63. flavescens
128 Petals not yellow; carpophore 2.5 mm or more
129 Inflorescence-branches alternate, with rather compact long-peduncled 3 -flowered dichasia; basal leaves linear-lanceolate
86. cephallenia

129 Inflorescence-branches not as above; basal leaves lanceolate, ovate or spathulate
130 Robust biennial (rarely perennial), covered with dense viscid glandular hairs 28. viscosa
130 Perennial, not viscid except in inflorescence
131 Inflorescence a narrow panicle with opposite branches
27. multiflora

131 Inflorescence a raceme-like monochasium (Sect. Fruticulosae)
132 Flowering stems arising laterally from below leaf-rosettes; carpophore glabrous
88. legionensis

132 Flowering stems arising terminally from centre of leaf-rosettes; carpophore pubescent 87. ciliata
124 Calyx completely glabrous (except for cilia on teeth)
133 Calyx $20-25 \mathrm{~mm}$ 23. bupleuroides
133 Calyx less than 18 mm
134 Petals greenish; carpophore $2-3 \mathrm{~mm}$
135 Stem glabrous
25. chlorantha

135 Stem scabrid with short deflexed hairs 31. skorpilii
134 Petals white or reddish; carpophore 3 mm or more
136 Inflorescence very long and narrow, with short, opposite, 1 -flowered branches 26. frivaldszkyana
136 Inflorescence shorter and wider, $\pm$ compound
137 Lower part of stem with patent hairs
138 Inflorescence narrow; lower part of stem usually with numerous short, leafy, nonflowering branches 32. tataric
138 Inflorescence a spreading alternately-branched panicle; lower part of stem with few or no short leafy branches (cf. also 1. italica)
10. cythnia

137 Lower part of stem glabrous, or rough with minute deflexed hairs

139 Coronal scales absent; capsule equalling or only slightly longer than carpophore 27. multiflora
139 Coronal scales small; capsule c. 3 times as longas carpophore30. reichenbachii
115 Inflorescence with 5 or fewer flowers; or flowers solitary

140 Calyx hairy, sometimes only sparsely so

    141 Calyx with glandular hairs
    
    142 Calyx strongly inflated, not closely investing ripe capsule
    143 Basal leaves 55. macrorhiza
143 Basal leaves thick and fleshy, in rosettes; capsulewithout basal septa (Sect. Odontopetalae)
144 Calyx 12-15 mm; basal leaves with long cilia$1-2 \mathrm{~mm}$49. auriculata
144 Calyx more than 15 mm ; basal leaves withshorter cilia $c .1 \mathrm{~mm}$, or not ciliate
51. elisabetha 145 Petals dark reddish-purple (S. Alps)
145 Petals white or whitish
146 Calyx 15-17 mm, only slightly glandular50. zawadzkii
146 Calyx (20-)25-30 mm, densely glandular
52. requienii
142 Calyx not strongly inflated, $\pm$ closely investing ripecapsule
147 Flowering stems $\pm$ procumbent
148 Leaves linear 69. supina
148 Leaves ovate or obovate
149 Whole plant viscid with dense glandular pube-scence68. succulenta
149 Plant pubescent and $\pm$ glandular, but not viscid
70. thymifolia
147 Flowering stems erect or suberect
150 Calyx $8-11 \mathrm{~mm}$ (Kriti)11. dictaea
150 Calyx at least 12 mm
151 Cauline leaves cordate-ovate ..... 53. cordifolia
151 Cauline leaves ovate-lanceolate to linea
152 Petal-limb emarginate 54. foetida
152 Petal-limb bifid
153 Pulvinate, with rigid, subulate, falcate leavescapsule completely exserted from calyx
85. falcata
153 Leaves not falcate; capsule $\pm$ included incalyx
154 Capsule scabrid; mat-forming perennial155 Coronal scales small; capsule equallingcarpophore65. vallesia
155 Coronal scales conspicuous; capsule muchshorter than carpophore66. boryi
154 Capsule glabrous; perennial, woody at base,but not mat-forming
156 Basal leaves linear-lanceolate; carpophoreglabrous86. cephallenia
156 Basal leaves oblanceolate-spathulate; car-pophore pubescent
157 Calyx less than 22 mm ; coronal scalessmall and obtuse, or absent
157 Calyx $25-30 \mathrm{~mm}$; coronal scales lanceo-
late, acute 8. paradoxa
141 Calyx eglandular
158 Calyx 10 mm or less
159 Petals yellow; carpophore c. 1 mm ..... 63. flavescens
159 Petals pink or purple; carpophore at least 3 mm
160
Petals pink; basal leaves papillose and punctate89. borderi
160 Petals purple; basal leaves not papillose79. schmuckeri
158 Calyx more than 10 mm
161 Basal leaves obovate-spathulate; petals greenish orreddish (Greece)76. schwarzenbergeri
161 Basal leaves linear or lanceolate, more rarely lanceolate-spathulate; petals white or pink
162 Stems glabrous, viscid above; calyx-teeth acute (Greece) 75. linifolia
162 Stems pubescent, not viscid; calyx-teeth obtuse
163 Flowering stems lateral to leaf-rosettes; veins ofcalyx scarcely anastomosing88. legionensis
163 Flowering stems terminal to leaf-rosettes; veinsof calyx usually obviously anastomosing
87. ciliata
140 Calyx glabrous
164 Calyx less than 10 mm
165 Plant pulvinate; petals pink
166 Calyx 7-9 mm; leaves stiffly ciliate 90. acaulis
166 Calyx 5-6 mm; leaves scabrid (Greece) 84. barbeyana
165 Plant not densely pulvinate; petals white or pink
167 Cauline leaves lanceolate to oblanceolate
168 Stems up to 40 cm ; petals white (Greece) 59. caesia
168 Stems up to 10 cm , arising from long pro-cumbent shoots; petals greyish-violet (Kriti)60. variegata
167 Cauline leaves linear
169 Basal leaves spathulate, $\pm$ fleshy
170 Veins of calyx wide, not anastomosing 29. radicosa
170 Veins of calyx narrow, anastomosing above10. cythnia
169 Basal leaves linear or linear-lanceolate, not fleshy
171 Petals usually 4-toothed or 4-fid; seeds winged
(Sect. Heliosperma) (94-100). pusilla group
171 Petals $\pm$ bifid; seeds not winged
172 Plant caespitose, with many slender floweringstems 78. saxifraga
172 Plant not caespitose; stems solitary or few
173 Calyx not inflated (Maritime Alps)
77. campanula
173 Calyx $\pm$ inflated (Sect. Graminifoliae)
174 Calyx 4-6 mm wide; petal-claw not ciliate
174 Calyx $3-4 \mathrm{~mm}$ wide; petal-claw ciliate34. graminifolia
164 Calyx 10 mm or more175 Calyx $\pm$ inflated; capsule without basal septa(Sect. Gastrolychnis)
176 Petals whitish, exserted ..... 36. furcata
176 Petals dull reddish-purple, scarcely exserted
35. wahlbergella
175 Calyx not inflated; capsule with basal septa177 Cauline leaves lanceolate or wider
178 Calyx 18 mm or more
179 Plant glabrous and glaucous; cauline leavescordate, amplexicaul24. chlorifolia
179 Plant not glaucous; stem somewhat pubescent;cauline leaves not cordate9. nodulosa
178 Calyx not more than 15 mm180 Capsule less than twice as long as carpophore
10. cythnia
180 Capsule about twice as long as carpophore
74. taliewii177 At least some cauline leaves linear181 Calyx more than 18 mm
182 Leaves thick and rigid; coronal scales absent182 Leaves not obviously thick and rigid; coronalscales present
183 Uppermost cauline leaves very close to base ofcalyx of single terminal flower 83. orphanidis
183 Uppermost cauline leaves distinctly separatedfrom flower(s)
184 Flowers solitary, on slender stems c. 10 cm ;petals brownish
184 Inflorescence 1- to 5 -flowered, on stems upto 25 cm ; petals white81. waldsteinii
181 Calyx 10-18 mm


Sect. Siphonomorpha Otth (incl. Sect. Paniculatae (Boiss.) Chowdhuri and Sect. Viridiflorae Boiss.). Perennial with woody stock, more rarely biennial. Lower leaves lanceolate to spathulate. Inflorescence paniculate, with opposite, viscid branches bearing (1-)3- to 7 -flowered dichasia; flowers usually large, erect or inclined at anthesis. Filaments glabrous. Seeds with plane face and usually shallowly grooved back.

1. S. italica (L.) Pers., Syn. Pl. 1:498 (1805). Stems $20-80 \mathrm{~cm}$, pubescent below. Basal leaves lanceolate-spathulate, obtuse. Inflorescence lax, with ascending branches usually bearing 3flowered dichasia. Calyx 14-21 mm, glandular-pubescent; teeth obtuse. Petals usually creamy-white above, reddish or greenish beneath, deeply bifid; coronal scales very small or absent. Capsule 8-10(-12) mm, ovoid, more or less equalling pubescent carpophore. Seeds $c .1 \mathrm{~mm}$, reniform. S. \& C. Europe; casual in $N$. Europe, rarely naturalized. Al Au Bu Co Cr Cz Ga Ge Gr He Hs Hu It Ju Lu Po Rm Rs (W, K) Sa Si Tu [Br].
(a) Subsp. italica: Perennial, with several stems bearing lax panicles; petal-claw usually ciliate. $2 n=24$. S. Europe; casual in W., C. \& N. Europe.
(b) Subsp. nemoralis (Waldst. \& Kit.) Nyman, Consp. 90 (1878): Biennial, with single flowering stem and rather dense panicle; petal-claw usually glabrous. $2 n=24$. C. Europe, and mountains in S. Europe.

Robust plants from Spain, called S. crassicaulis Willk. \& Costa, Linnaea 30: 91 (1859), are best treated as a variety of this subspecies.
S. sieberi Fenzl, Pugillus 8 (1842), described from mountains in Kriti, seems to be a few-flowered variant of 1. Similar plants occur fairly widely in the mountains of S . Europe.
S. coutinhoi Rothm. \& P. Silva, Feddes Repert. 52: 279 (1943), which apparently replaces $\mathbf{1}$ in Portugal and has been reported also from Spain (Aragón), differs only in the subglabrous calyx and somewhat shorter carpophore.
2. S. patula Desf., Fl. Atl. 1: 356 (1798) (S. longicilia (Brot.) Otth). Like 1 but calyx $10-14 \mathrm{~mm}$, subglabrous, with sparse glandular hairs; teeth usually dimorphic ( 2 triangular acute, 3 obtuse with broad hyaline margins); petals reddish-purple (more rarely whitish); capsule $1 \frac{1}{2}-2$ times as long as carpophore. $2 n=24$. W. Portugal. Lu. (N. Africa.)
3. S. hifacensis Rouy ex Willk., Ill. Fl. Hisp. 1 (10): 150 (1885). Like 1 but more robust, often with large woody stock; flowers reddish or purplish; calyx densely pubescent, eglandular; capsule
c. $1 \frac{1}{2}$ times as long as carpophore. Islas Baleares (Ibiza); E. Spain (Alicante prov.). Bl Hs.
S. cintrana Rothm., Bol. Soc. Brot. ser. 2, 13: 275 (1939), described from Portugal (Cintra), differs mainly in the auriculate petal-claw.
S. rothmaleri P. Silva, Agron. Lusit. 9: 18 (1956), described from S.W. Portugal (Cabo de S. Vicente), has whitish flowers in rather dense panicles, and a longer calyx ( $20-23 \mathrm{~mm}$ ).
S. sicula Ucria, Nuovo Racc. Opusc. Aut. Sic. 6: 251 (1793) may be conspecific, but plants referred to this taxon generally have a glandular-hairy calyx. Such plants occur in Sicilia, S. Italy and Greece.
(4-6). S. mollissima group. Robust tomentose perennials with woody stock and flowering stems up to 60 cm . Inflorescence relatively short and broad, often subcorymbose. Calyx (18-)2025 mm , more or less densely hairy with relatively long multicellular glandular or eglandular hairs; teeth obtuse. Petals white, reddish or purplish. Capsule $9-12 \mathrm{~mm}$, ovoid, enclosed in calyx and as long as or somewhat longer than carpophore. Seeds $1 \cdot 5-2 \mathrm{~mm}$, reniform, dark brown.

The above description covers several taxa in S.W. Europe, some of which have been given specific rank (vide W. Rothmaler, Feddes Repert. 52: 275 (1943)). The variation in material from N. Africa has not, however, been satisfactorily correlated with the variation in Europe, so the following treatment is provisional.
1 Calyx eglandular
4. mollissima

1 Calyx glandular, at least in part
2 Calyx with abundant long hairs, all glandular 6. pseudovelutina
2 Calyx with both glandular and eglandular hairs 5. velutina
4. S. mollissima (L.) Pers., Syn. Pl. 1: 498 (1805). Calyx 2022 mm , densely tomentose, eglandular. Petals whitish, with ciliate claw and small coronal scales. Capsule $10-12 \mathrm{~mm}$, as long as carpophore. - Islas Baleares (Ibiza); Gibraltar. Bl Hs.
5. S. velutina Pourret ex Loisel. in Desv., Jour. Bot. Rédigé 2: 324 (1809). Calyx 18-25 mm, tomentose, with rather variable proportion of glandular and eglandular hairs. Petals whitish or reddish. Capsule $9-12 \mathrm{~mm}$, usually somewhat longer than carpophore. Corse. Co ?Sa.
6. S. pseudovelutina Rothm., Feddes Repert. 52: 282 (1943). Calyx $20-25 \mathrm{~mm}$, densely tomentose with long glandular hairs only. Petals whitish, with glabrous claw; coronal scales absent. Capsule $8-12 \mathrm{~mm}$, as long as carpophore. - S. Spain. Hs.
S. tomentosa Otth in DC., Prodr. 1: 383 (1824), widespread in N. Africa, is according to Rothmaler conspecific with S. gibraltarica Boiss., Elenchus 20 (1838), described from Spain (Gibraltar). It is said to differ from other members of the group in its purplish flowers, short glandular hairs on calyx, and capsule longer than carpophore.
S. salzmannii Badaro ex Moretti, Gior. Fis. Chem. Stor. Nat. Pavia 9: 78(1826), non Otth, described from Italy (Ligurian coast), resembles memiuers of this group in hairiness but has a relatively lax few-flowered inflorescence. Its status is uncertain. Plants from Corse referred to this taxon seem to have been misidentified. S. salzmannii sensu Otth is a variant of 5 .
7. S. melliiera Boiss. \& Reuter, Diagn. Pl. Nov. Hisp. 8 (1842) (incl. S. nevadensis Boiss.). Like 1 but flowers somewhat inclined; calyx $8-13 \mathrm{~mm}$; petals greenish; capsule always longer
than carpophore, and sometimes almost twice as long. C., E. \& S. Spain; S. Portugal. Hs Lu.

The ratio of the length of the capsule to the length of the carpophore is unusually variable in this species.
8. S. paradoxa L., Sp. Pl. ed. 2,1673 (1763). Like 1 in general habit, but basal leaves narrower, lanceolate to lanceolateobovate; inflorescence lax, with larger flowers; calyx $25-30 \mathrm{~mm}$, cylindrical, with attenuate base, glandular; teeth lanceolate, acute; petals yellowish beneath; coronal scales acute; capsule $10-13(-15) \mathrm{mm}$, rather narrowly ovoid; carpophore $7-10 \mathrm{~mm}$; seeds c. 1.5 mm . S. Europe, from S.E. France and Corse to Greece. Al Co Ga Gr It Ju.
9. S. nodulosa Viv., Fl. Cors. 6 (1824) (S. pauciflora Salzm. ex DC., non Ucria). Perennial with rather slender, branched woody stock and numerous slender flowering stems up to 40 cm ; lower part of stem and leaves scabrid-puberulent. Lower leaves up to $30 \times 5 \mathrm{~mm}$, oblanceolate to narrowly spathulate; upper cauline leaves linear, distant. Inflorescence glabrous, (1-)2- to 5 -flowered; pedicels up to 7 cm , very slender. Calyx 18-20 mm, narrow, glabrous; teeth obtuse, more or less ciliate. Petals white, reddish beneath. Capsule c. 10 mm , ovoid; carpophore c. 12 mm , glabrous. Seeds c. 1 mm , black. Corse, Sardegna. Co Sa.
10. S. cythnia (Halácsy) Walters, Feddes Repert. 69: 46 (1964) (S. italica var. cythnia Halácsy). Like 1 but panicle-branches alternate; calyx glabrous, with ciliate teeth; petals usually (?always) red; capsule $11-12 \mathrm{~mm}$, ellipsoid, much longer than (up to twice as long as) carpophore. - Aegean region ( $W$. Kikladhes). Gr.
S. goulimyi Turrill, Kew Bull. 1955: 353 (1955), described from S . Greece (Taïyetos), is like 10 , but dwarf and few-flowered, with calyx only $11-12 \mathrm{~mm}$.
11. S. dictaea Rech. fil., Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 105 (2): 72 (1943). Dwarf, woody at base, usually with 1-flowered stems up to 15 cm . Calyx $8-11 \mathrm{~mm}$, glandularpubescent. Capsule c. 8 mm , carpophore c. 2 mm . Mountains of E. Kriti. Cr.
12. S. spinescens Sibth. \& Sm., Fl. Graec. Prodr. 1: 299 (1809). Stock very woody, much-branched; flowering stems $10-25 \mathrm{~cm}$, erect, bearing numerous non-flowering rigid branches below, forming a spiny persistent cushion. Basal leaves spathulate, cauline leaves linear, stiff, often spinescent; leaves and stems greyish-tomentose. Inflorescence-branches mostly 1 -flowered. Calyx c. 20 mm , pubescent; teeth obtuse. Petals white, deeply bifid; coronal scales ovate. Capsule c. $1 \frac{1}{2}$ times as long as carpophore. S.E. Greece. Gr.

Typically very different from 1 in habit, but the rather robust S. spinescens var. argolica Boiss. is not easily distinguished from dwarf variants of 1 .
13. S. fruticosa L., Sp. Pl. 417 (1753). Robust, $20-50 \mathrm{~cm}$, almost completely glabrous. Lower leaves obovate or narrowly spathulate; upper lanceolate, all glabrous and shining above, ciliate. Inflorescence dense; flowers large, erect, on short peduncles. Calyx c. 25 mm , with patent glandular hairs; teeth acute. Petals pink or red, shallowly bifid; coronal scales obvious, acute, sometimes laciniate. Capsule c. 15 mm , ovoid, beaked, equalling or longer than carpophore. Seeds $1 \cdot 5-2 \mathrm{~mm}$. Mediterranean region (Sicilia to Karpathos); very local. Cr Gr Si .
14. S. gigantea L., Sp. Pl. 418 (1753). Robust biennial up to 100 cm , usually unbranched, with a well-developed basal rosette of thick, spathulate leaves; stem and leaves pubescent. Inflore-scence-branches short and pseudo-verticillate (or long and rather diffuse, var. incana (Griseb.) Chowdhuri). Flowers rather small. Calyx $8-12 \mathrm{~mm}$. Petals white, pink or greenish. Capsule c. 3 times as long as carpophore. Aegean region; Balkan peninsula northwards to $42^{\circ} 30^{\prime} N$. Al Bu Cr Gr Ju.

The typical plant is apparently less widespread than the var. incana (Griseb.) Chowdhuri (S. rhodopaea Janka) which is less hairy, with narrower leaves and a laxly paniculate inflorescence.
15. S. nutans L., Sp. Pl. 417 (1753). Stems $20-60 \mathrm{~cm}$, usually unbranched, and obviously pubescent below, rarely glabrous. Lower leaves up to 10 cm , oblong-spathulate; upper linearlanceolate. Flowers usually inclined, in a lax secund panicle. Calyx 9-12 mm, glandular-pubescent, truncate at base; teeth lanceolate, acute. Petals variable in colour, usually whitish above, greenish or reddish beneath, deeply bifid with narrow inrolled lobes; coronal scales lanceolate, acute. Capsule 7-$11(-14) \mathrm{mm}, 3-5$ times as long as pubescent carpophore. Throughout Europe except the extreme north and most of the islands. Al Au Be Br Bu Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Su.

Extremely variable in habit, hairiness, leaf-shape, colour and size of flower, and size of capsule.
(a) Subsp. nutans: Leaves pubescent with multicellular hairs (rarely glabrous, var. glabra DC.). Inflorescence-branches usually at least 3 -flowered. Calyx-teeth usually subequal. Petal-claw $5-8 \mathrm{~mm}$, usually without an auricle. Capsule $c .3$ times as long as carpophore. $2 n=24$. Throughout the range of the species.
(b) Subsp. dubia (Herbich) Zapał., Rozpr. Wydz. Mat.-Przyr. Polsk.Acad. Um. (Biol.) ser. 3, 11B: 151 (1911)(S. dubia Herbich): Leaves with short marginal cilia and usually with some 1 - to 2-cellular hairs on surface. Inflorescence-branches usually 1 - to 3 -flowered. Calyx-teeth usually distinctly unequal. Petal-claw $2 \cdot 5-4 \cdot 5 \mathrm{~mm}$, with well-developed acute auricle. Capsule 4-5 times as long as carpophore. $2 n=24$. Carpathians.

Treated as a separate species by several authors. Plants from coastal localities in S. England and N. France (var. salmoniana Hepper) approach this subspecies in the less hairy leaves and in carpophore/capsule ratio, but do not show the other characters.
16. S. brachypoda Rouy, Ill. Pl. Eur. Rar. 4: 26 (1895). Like 15 (a) but panicle very wide; petals greyish-purple; capsule $15-18 \mathrm{~mm}$, much exceeding calyx and 8-9 times as long as carpophore. S. France. Ga.

Neither the wide panicle nor the flower-colour is diagnostic, since both can occur in 15; but the capsule character is very remarkable.
17. S. viridiflora L., $S p$. Pl. ed. 2, 597 (1763). Robust, 4090 cm . Lower leaves oblong-spathulate; upper ovate-lanceolate, acuminate. Inflorescence lax; peduncles long; flowers inclined. Calyx $15-20 \mathrm{~mm}$, gradually attenuate at base, pubescent; teeth lanceolate, acute. Petals greenish-white, with long-exserted claw and linear lobes; coronal scales oblong, acute. Capsule 1214 mm , ovoid; carpophore c. 2 mm . S. Europe, extending northwards in E.C. Europe to c. $49^{\circ}$ N. in Czechoslovakia. Al $\mathrm{Bu} \mathrm{Co} \mathrm{Cz} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(K)} \mathrm{Sa} \mathrm{Si} \mathrm{Tu}$.
18. S. catholica (L.) Aiton fil. in Aiton, Hort. Kew. ed. 2, 3: 85 (1811). Slender, $40-80 \mathrm{~cm}$, very viscid above. Leaves ovatelanceolate, scabrid and sparsely ciliate. Inflorescence-branches very long; flowers numerous and very small. Calyx $6-8 \mathrm{~mm}$,
glabrous. Petals small, white. Capsule $6-7 \mathrm{~mm}$, ovoid, $1 \frac{1}{2}-2$ times as long as carpophore. - S. \& C. Italy; W. Jugoslavia. It Ju.
19. S. viscariopsis Bornm., Feddes Repert. 17: 38 (1921). Perennial with slender, erect, shortly pubescent stems 20 -$30(-40) \mathrm{cm}$. Basal leaves linear-lanceolate. Panicle 3- to $10(-25)$ flowered, with opposite 1- to 3 -flowered branches; pedicels $1-3 \mathrm{~cm}$, slender. Calyx $4-5 \mathrm{~mm}$, broadly campanulate, contracted at mouth in fruit, 10 -veined, with no lateral veins, more or less pruinose and scabrid. Petals deep purple. Capsule broadly ovoid; carpophore very short. S. Makedonija. Ju.

More information is required about this species; Bornmüller described a new section to accommodate it, and it is only provisionally placed here.

Sect. Lasiostemones (Boiss.) Schischkin. Perennial with woody stock. Inflorescence paniculate; flowers nodding at anthesis. Filaments hairy.
20. S. longipetala Vent., Descr. Pl. Jard. Cels t. 83 (1802). Stock branched, procumbent; stems $30-85 \mathrm{~cm}$. Basal leaves oblong-lanceolate, acute, scabrid; cauline lanceolate or linear. Panicle large, sub-secund, with long spreading branches; terminal flower usually distinctly overtopped by lateral branches in axils of two subtending bracts. Calyx $10-12 \mathrm{~mm}$, glabrous; teeth obtuse. Petals white, with long linear lobes; coronal scales triangular. Capsule $7-10 \mathrm{~mm}$, ovoid; carpophore $2-2.5 \mathrm{~mm}$. C. \& S. Greece. Gr.
21. S. niederi Heldr. ex Boiss., Diagn. Pl. Or. Nov. 3 (6): 32 (1859). Like 20 in habit, leaf-shape and flower-size, but calyx pubescent; coronal scales absent; capsule $1 \frac{1}{2}$ times as long as carpophore. C. Greece. Gr.
22. S. guicciardii Boiss. \& Heldr. in Boiss., loc. cit. (1859). Densely caespitose; flowering-stems $15-30 \mathrm{~cm}$, numerous, erect. Leaves linear-lanceolate to linear, glabrous. Inflorescencebranches with $1-3$ flowers; pedicels very short. Calyx c. 12 mm , glabrous. Petals white, with linear lobes. Capsule c. 10 mm ; carpophore 2-3.5 mm. Mountain rocks. C. Greece (Parnassos). Gr.

Closely related to S. marschallii C. A. Meyer, Verz. Pff. Cauc. 214 (1831) from S.W. Asia, and perhaps better treated as a subspecies; typical S. marschallii differs mainly in its taller habit, its wider more or less pubescent basal leaves and its usually pubescent calyx.

Sect. Sclerocalycinae (Boiss.) Schischkin (incl. Sect. Chloranthae (Rohrb.) Schischkin and Sect. Tataricae Chowdhuri). Perennial with woody stock, more rarely biennial. Inflorescence usually narrow, spike-like, with opposite branches bearing 1- to 3(-5)flowered dichasia. Calyx often glabrous or subglabrous, usually rather sulcate, with conspicuous veins.
23. S. bupleuroides L., Sp. Pl. 421 (1753) (S. longiflora Ehrh.). Stems $25-80 \mathrm{~cm}$, glabrous and glaucous. Basal leaves oblonglanceolate to linear-lanceolate, long-attenuate into petiole. Inflorescence paniculate to pseudo-racemose; flowers large. Calyx $20-25 \mathrm{~mm}$, glabrous and membranous-coriaceous. Petallimb cuneate, deeply bifid, white, pinkish or greenish; coronal scales acute. Capsule $10-12 \mathrm{~mm}$, included in calyx. Seeds $1 \cdot 5-$ 2 mm . S.E. \& E.C. Europe. Al Bu Cz Gr Hu Ju Rm Rs (C, W, K) [Au].

Very variable, and divided into several subspecies by some authors. The described variation in Europe can be accommodated as follows:
(a) Subsp. bupleuroides: Laxly caespitose; flowering stems tall. Basal leaves oblong-lanceolate. Inflorescence lax, lower branches several-flowered. Capsule equalling carpophore. $2 n=24$. Throughout the range of the species except for S. part of the Balkan peninsula.
(b) Subsp. staticifolia (Sibth. \& Sm.) Chowdhuri, Notes Roy. Bot. Gard. Edinb. 22: 255 (1957). Densely caespitose; flowering stems up to 40 cm . Basal leaves linear. Inflorescence very narrow, pseudo-racemose. Capsule shorter than carpophore. S. Albania, Greece, Bulgaria.
24. S. chlorifolia Sm., Pl. Icon. Ined. 1: t. 13 (1789). Glabrous and glaucous; stems $25-50 \mathrm{~cm}$, robust, erect. Basal leaves broadly elliptical to spathulate, attenuate at base, acute or acuminate, thick; cauline broadly cordate, amplexicaul, acute. Inflorescence 1 - to 5 -flowered; flowers very large, on long slender pedicels which are sometimes opposite in upper leaf-axils. Calyx (15-)18-25(-30) mm, rather coriaceous; teeth alternately acute and obtuse. Petals whitish; claw exserted; coronal scales oblong, acute. Capsule oblong, longer than carpophore. Turkey-inEurope (near Tekirdağ). Tu. (S.W. Asia.)
25. S. chlorantha (Willd.) Ehrh., Beitr. Naturk. 7: 144 (1792). Glabrous and usually glaucous; stems $30-80 \mathrm{~cm}$. Basal leaves lanceolate-spathulate; cauline small, linear, much shorter than the slender internodes. Inflorescence typically narrow, subsecund; branches usually 1- to 3-flowered; flowers inclined or horizontal. Calyx 9-12 mm, glaucous, not sulcate; teeth ovate, obtuse, with wide, ciliate, hyaline margin. Petals pale yellowgreen; lobes linear; claw exserted; coronal scales very small. Capsule c. $8 \mathrm{~mm}, 3-4$ times as long as carpophore. Seeds less than $1 \mathrm{~mm} . E . \& C$. Europe, westwards to $c .13^{\circ}$ E. in Germany. Bu Ge Hu Po Rm Rs (B, C, W, K, E).
26. S. frivaldszkyana Hampe, Flora (Regensb.) 20: 226 (1837). Like 25 but inflorescence-branches short, erect, always 1 -flowered; calyx $12-16 \mathrm{~mm}$, teeth ovate-lanceolate, acute; petals whitish; coronal scales very small or absent; capsule $c .10 \mathrm{~mm}$, about twice as long as carpophore. Balkan peninsula. Al Bu Gr Ju.

Large specimens of $\mathbf{2 5}$ and 26 may have more profuselybranched inflorescences, in which the branches themselves have the structure here described for the whole inflorescence.
27. S. multiflora (Waldst. \& Kit.) Pers., Syn. Pl. 1: 496 (1805) (incl. S. syvashica Kleopow). Stems $30-60 \mathrm{~cm}$, simple, rough with minute crisped hairs or glabrous, not viscid. Basal leaves thick, spathulate, very obtuse; upper cauline linear. Inflorescence narrowly paniculate to pseudo-verticillate, branches short, erect, opposite, 1 - to $3(-7)$-flowered. Calyx $12-15 \mathrm{~mm}$, glabrous or sparsely hairy; teeth ovate-lanceolate, acute, margins hyaline, ciliate. Petals white; coronal scales absent. Capsule (7-)8-10 mm, equalling or somewhat longer than pubescent carpophore. $2 n=24$. E. \& C. Europe. Au Cz Hu Rm Rs (C, W, E).
28. S. viscosa (L.) Pers., Syn. Pl. 1: 497 (1805) (Melandrium viscosum (L.) Čelak.). Robust biennial, sometimes perennial, up to 60 cm . Whole plant glandular-tomentose, viscid. Basal and lower cauline leaves ovate-lanceolate, acute, undulate. Inflorescence tall, narrow, pseudo-verticillate; branches short, erect, opposite, 1- to 3(-7)-flowered; flowers large. Calyx 14-24 mm; teeth ovate, obtuse. Petals white; coronal scales absent. Capsule $12-14 \mathrm{~mm}, 3-4$ times as long as carpophore. $2 n=24$. C. \& $E$. Europe; Fennoscandia northwards to $60^{\circ} 30^{\prime} N$. Au Bu Cz Da Fe Ge Hu Ju Po Rm Rs (N, B, C, W) Su.
29. S. radicosa Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 1 (6): 24 (1846). Caespitose, with thick woody stock and numerous erect flowering stems $15-30(-60) \mathrm{cm}$; internodes very long, the lower rough with minute deflexed hairs, the upper glabrous. Basal leaves somewhat fleshy, spathulate, mucronate, margin strongly ciliate; upper cauline very small, linear. Inflorescence small, (1-)2- to 5 -flowered. Calyx $8-13 \mathrm{~mm}$, coriaceous, somewhat sulcate, with wide simple veins; teeth acute, patent, ciliate. Petals reddish or greenish; coronal scales small. Capsule $8-10 \mathrm{~mm}$, slightly exceeding calyx; carpophore $c .3 \mathrm{~mm}$, pubescent. - Mountains of S. part of Balkan peninsula. Al Gr Ju.
S. oligantha Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 75 (1853), described from N. Greece, is considered by some authors to be specifically distinct. It is like 29 but the basal leaves are broadly spathulate and pubescent beneath, and the calyx is c. 7 mm , with short, wide, erect teeth. S. radicosa subsp. pseudoradicosa Rech. fil., Bot. Jahrb. 80: 320 (1961), described from Greece (N. Evvoia), also has a short calyx (c. 7 mm ); the capsule is $c .1 \frac{1}{3}$ as long as the calyx and twice as long as the carpophore. Its relationship to $S$. oligantha is not clear.
30. S. reichenbachii Vis., Fl. Dalm. 3: 169 (1852). Like 29 but basal leaves oblanceolate-spathulate, acute; upper cauline larger, linear-lanceolate; inflorescence 5- to 20 -flowered, with 1- to 3-flowered branches; petals white. - W. Jugoslavia. Ju.
31. S. skorpilii Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1: 39 (1890). Robust, $30-50 \mathrm{~cm}$, with somewhat woody stock. Stem and leaves densely clothed with very short stiff hairs. Basal leaves spathulate, withered at time of flowering; cauline up to $4 \times 1.5 \mathrm{~cm}$, ovate, more or less sessile, with cuneate base. Inflorescence usually narrow, (5-)7- to 13 -flowered; upper flowers more or less aggregated; lower in more distant opposite pairs. Calyx ${ }^{10}$ 12 mm , clavate, glabrous, viscid; veins distinct, simple. Petals narrow, greenish. Capsule $7-9 \mathrm{~mm}, 2-3$ times as long as carpophore. Balkan peninsula from C. Bulgaria to C. Greece. Bu Gr Ju.
32. S. tatarica (L.) Pers., Syn. Pl. 1:497(1805). Stems $30-60 \mathrm{~cm}$, with sparse patent hairs below, almost glabrous and not viscid above; often with short leafy non-flowering branches below. Leaves lanceolate or lanceolate-spathulate, acute; basal smaller and withering early. Inflorescence narrow, with 1 - to 3 -flowered branches; flowers inclined; pedicels erect, slightly hairy. Calyx $10-13 \mathrm{~mm}$, glabrous; teeth ovate-lanceolate, acute; veins distinct. Petals white, cream or greenish-white; lobes linear; coronal scales absent. Capsule $8-10 \mathrm{~mm}, 3-4$ times as long as slightly pubescent carpophore. U.S.S.R. and N.E. Europe, extending to N.E. Germany and arctic Norway. Fe Ge No Po Rs (N, B, C, W, E).

Sect. Graminifoliae Chowdhuri. Small, narrow-leaved perennials with few, linear cauline leaves. Flowers few, hermaphrodite. Calyx glabrous, usually somewhat inflated. Styles 3. Capsule with basal septa.
33. S. paucifolia Ledeb., Fl. Ross. 1: 306 (1842). Dwarf subglabrous plant; stems $5-15 \mathrm{~cm}$, few-flowered, scarcely viscid. Basal leaves few, sparsely hairy, oblong-linear; cauline linear. Calyx 6-9 $\times 4-6 \mathrm{~mm}$, inflated, glabrous. Petal-limb ovate, white; claw glabrous; coronal scales very small or absent. Ural. $\operatorname{Rs}(\mathrm{N}, \mathrm{C})$.
34. S. graminifolia Otth in DC., Prodr. 1: 368 (1824). Like 33 but stems taller, more leafy, viscid above; flowers smaller; calyx 3-4 mm wide; petal-claw hairy. N.E. Russia. Rs (N).

Sect. Gastrolychnis (Fenzl) Chowdhuri. Small, narrow-leaved perennials. Flowers few, hermaphrodite. Styles 5. Capsule without basal septa, dehiscing with 5 more or less bifid teeth.
35. S. wahlbergella Chowdhuri, Notes Roy. Bot. Gard. Edinb. 22 : 237 (1957) (Lychnis apetala L., Melandrium apetalum (L.) Fenzl). Stem simple, erect, pubescent above. Flowers usually solitary, nodding at anthesis. Calyx $14-18 \mathrm{~mm}$, whitish, inflated. Petals not or only slightly exserted, usually dull reddish-purple. Seeds with prominent swollen wings. $2 n=24$. Arctic Europe; Ural. Fe No Rs ( $\mathrm{N}, \mathrm{C}) \mathrm{Su}$.
36. S. furcata Rafin., Autikon Bot. 1: 28 (1840) (Lychnis affinis J. Vahl ex Fries). Like 35 but stem often branched above, glandular, viscid; flowers smaller, erect; calyx $10-12 \mathrm{~mm}$, scarcely inflated; petals whitish, exserted; seeds with narrow wings. $2 n=48$. Arctic Europe. Fe No Rs (N) Su.

European material is mostly subsp. angustiflora (Rupr.) Walters, Feddes Repert. 69: 46 (1964) (Wahlbergella angustiflora Rupr.), with 2-3 pairs of cauline leaves, the lower about equalling the basal, and a narrowly campanulate calyx. Subsp. furcata, with 1 (2) pairs of cauline leaves much shorter than the basal, and a more broadly campanulate calyx somewhat inflated in fruit, occurs widely in arctic Asia and is reported from Spitsbergen, Vajgač and Arctic Ural.

Sect. Otites Otth (incl. Subsect. Sibiricae Schischkin ex Chowdhuri). Biennial or perennial; often dioecious. Flowers small, usually unisexual, in dichasia aggregated in compound racemose panicles, often narrow, with crowded verticillasters. Calyx less than 7 mm . Petals entire or shallowly bifid; coronal scales absent. Carpophore not more than 3 mm , sometimes almost absent.
37. S. sibirica (L.) Pers., Syn. Pl. 1: 497 (1805). Subglabrous perennial $40-60 \mathrm{~cm}$; monoecious. Basal leaves oblong-lanceolate or oblong-linear; cauline leaves linear-lanceolate, in fascicles. Inflorescence narrow, interrupted, with long internodes separating many-flowered verticillasters; flowers mostly unisexual. Calyx $4-5 \mathrm{~mm}$. Petals narrow, entire or emarginate. Capsule c. 6 mm , ovoid, 2-3 times as long as carpophore. Seeds reniform, with plane face and grooved back. C. \& S. Russia; Ukraine. Rs (C, W, E) [Rm].
38. S. roemeri Friv., Flora (Regensb.) 19: 439 (1836). Densely puberulent perennial $20-50 \mathrm{~cm}$. Basal leaves oblong-spathulate, acute, attenuate into a long, ciliate petiole; cauline linear. Inflorescence subcapitate in small specimens but often, in larger plants, more or less interrupted with rather dense verticillasters. Calyx $3-4 \mathrm{~mm}$, subglabrous, teeth ovate. Petal-limb white, broadly spathulate, shallowly bifid, with oblong lobes. Capsule c. 5 mm , broadly ovoid, 2-3 times as long as carpophore. Seeds c. 1 mm , reniform, with plane face and grooved back. - Mountains of Balkan peninsula and of C. \& S. Italy. Al Bu Gr It Ju.
Apparently gynodioecious, with female and hermaphrodite plants, the latter with both male and hermaphrodite flowers.
39. S. sendtneri Boiss., Fl. Or. 1: 608 (1867). Like 38 but with entire or only slightly emarginate petals and more often
capitate inflorescence. Subalpine meadows. - W. part of Balkan peninsula. Al ?Bu Ju.

Apparently almost completely dioecious.
40. S. ventricosa Adamović, Österr. Bot. Zeitschr. 55: 180 (1905). Like 38 but dioecious, with more or less procumbent nonflowering shoots and short erect flowering stems to 30 cm ; inflorescence sub-capitate; calyx $4-5 \times 3 \cdot 5-4 \mathrm{~mm}$, inflated, more or less puberulent, often purplish. - Mountains of S. Albania, S. Jugoslavia and N. Greece. Al Gr Ju.

38, 39 and 40 seem very similar and might be treated as subspecies of a single species, but there is insufficient information.
41. S. borysthenica (Gruner) Walters, Feddes Repert. 69: 47 (1964) (S. otites var. borysthenica Gruner, Otites borysthenica (Gruner) Klokov, S. parviflora (Ehrh.) Pers., non Moench, S. ehrhartiana Soó). Biennial( ?rarely perennial); dioecious; stems up to 80 cm ; whole plant pubescent. Basal leaves narrowly spathulate, often withered at time of flowering; cauline linear-oblanceolate. Inflorescence usually a narrow panicle; flowers very numerous, small; hairs on pedicels short, dense, forwardly-directed and curled. Calyx 2-3 mm. Petals linear, greenish, entire. Capsule $2-3 \mathrm{~mm}$, subglobose; carpophore very short. Seeds c. 1 mm , reniform. $2 n=24$. Dry places, particularly in open coniferous woodland. C. \& E. Europe. Al Bu Cz Hu Ju Po Rm Rs (N, C, W, K, E).

Rather variable in length and nature of hairiness. Further information might justify the recognition of subspecies.
42. S. media (Litv.) Kleopow, Bull. Jard. Bot. Kieff 9: 64 (1929). Like 41 but stem and leaves only sparsely puberulent; cauline leaves more persistent, linear, acute; pedicels glabrous; calyx glabrous, often only 5-veined; calyx of female flowers $1 \cdot 5-2 \cdot 5 \mathrm{~mm}$. S. Russia, S. Ukraine. Rs (W, E).
43. S. hellmannii Claus, Beitr. Pff. Russ. Reich. 8: 289 (1851) (incl. Otites graniticola Klokov). Biennial or perennial; dioecious; stems up to 60 cm ; whole plant, including pedicels and calyx, clothed with dense, more or less straight, deflexed hairs. Basal leaves broadly spathulate, cauline oblanceolate-spathulate. Inflorescence usually a narrow panicle; flowers relatively few. Calyx $3.5-5 \mathrm{~mm}$. Petals linear, greenish, entire. Capsule 5-9 mm, ovoid; carpophore very short. - S. Russia, S. \& E. Ukraine. Rs (W, E).
S. cyri Schischkin in Grossh. et al., Bull. Mus. Géorgie 2: 4 (1925), differing from 43 only in having glabrous calyx and pedicels, is recorded from Astrakhan' and (as var. duriuscula (Velen.) Kleopow) from Bulgaria. Otites dolichocarpa Klokov, Jour. Bot. Acad. Sci. Ukr. 5 (1): 23 (1948), described from S.E. Ukraine (Zaporožskaja Oblast'), has large capsules and glabrous calyx and pedicels, but differs from $S$. cyri in habit and in its longer hairs.
(44-48). S. otites group.
Members of this group are dioecious biennials or short-lived perennials, common in steppe communities and ruderal habitats in S.E. Europe, possessing the general habit of 41-43, but with glabrous pedicels and calyx, and an ovoid capsule $3 \cdot 5-5(-6) \mathrm{mm}$. The main variation is in habit, inflorescence-form, and hairiness. Petal-colour and flower-scent provide valuable characters, unfortunately lost in dried material. Male plants are particularly difficult to identify.

The following is a key to the more widespread taxa:

## 1 Petals white

2 Petal-claw glabrous; hairs on lower part of stem usually more than 1 mm 47. wolgens
2 Petal-claw ciliate; hairs on lower part of stem less than 1 mm
48. baschkirorum

1 Petals greenish
3 Hairs on lower part of stem more than 1 mm ; tall plants 46. exaltata

3 Hairs on lower part of stem less than 1 mm ; plants of varied habit
4 Ultimate 3-flowered dichasia of inflorescence dense; tall plants, often 100 cm or more 45. densiflora

4 Ultimate 3-fiowered dichasia of inflorescence lax; plants usually less than 100 cm
44. otites
44. S. otites (L.) Wibel, Prim. Fl. Werthem. 241 (1799) (incl. S. pseudotites Besser ex Reichenb., S. polaris Kleopow). Stems $10-50(-120) \mathrm{cm}$. Calyx 4-6 mm, glabrous, ovoid; teeth obtuse. Petal-limb inconspicuous, greenish, linear. Capsule 3•5-5(-6) mm, ovoid to subglobose, exceeding calyx; carpophore usually $c .1 \mathrm{~mm}$. $2 n=24$. Widespread in E., S. \& C. Europe; very local in the north and west. Al Au Br Bu Cz Da Ga Ge Gr He Ho Hs Hu It Ju Po RmRs (N, B, C, W) Tu [Be Fe].

Very variable. The typical plant (S. otites (L.) Wibel sensu stricto), is $20-40 \mathrm{~cm}$, with narrow, more or less interrupted inflorescence and ovoid capsule; it is absent from the southeastern part of the range, where taller plants, usually called S. pseudotites Besser ex Reichenb., Fl. Germ. Excurs. 819 (1832), replace it. Such plants usually have broadly spathulate basal leaves, spreading panicles and larger, subglobose capsules, and occur throughout S.E. Europe and along the Mediterranean coast as far as S. France.

Subsp. velebitica Degen, Fl. Veleb. 2: 83(1937), a small plant with linear-lanceolate to narrowly-spathulate basal leaves and a subglobose capsule 5-6 mm, occurs in N.W. Jugoslavia.
45. S. densiflora D’Urv., Mém. Soc. Linn. Paris 1: 303 (1822) (incl. S. donetzica Kleopow, Otites donetzica (Kleopow) Klokov). Like 44 but larger, up to 180 cm , with more or less condensed verticillasters; ultimate dichasia with very short peduncles, and flowers often subsessile. E.C. \& S.E. Europe. Bu Cz Gr Ju Rm Rs (W, K).
46. S. exaltata Friv., Flora (Regensb.) 18: 333 (1835) sensu lato (incl. S. chersonensis (Zapal.) Kleopow, Otites chersonensis (Zapał.) Klokov). Like 45 in habit. Lower part of stem with hairsmore than 1 mm ; ultimate dichasia with rather long peduncles and pedicels. C. \& S.E. Europe. Bu Hu Rm Rs (W, K).

The distinction between 45,46 and $S$. pseudotites seems very unsatisfactory; the indication of geographical distribution merely summarizes opinion in the available Floras.
47. S. wolgensis (Willd.) Besser ex Sprengel, Ind. Sem. Horti Halensis 7 (1818) (incl. Otites orae-syvashicae Klokov). Often 100 cm or more, with very diffuse panicle of small white flowers; lower part of stem with hairs of variable length, usually more than 1 mm . Petal-claw glabrous; filaments hairy. $2 n=24$. S.E. Europe. Bu Ju Rm Rs (C, W, ?K, E).

The white petals, unpleasant flower-scent and wide-angled lower panicle-branches provide good characters in living material. The complete intersterility with $S$. otites sensu stricto emphasizes the distinctness of this species, but the status of several taxa possessing various combinations of the distinguishing characters is as yet quite uncertain. These include S. krymensis Kleopow, Jour. Inst. Bot. Acad. Sci. Ukr. 9 (17): 115 (1936), described from Krym,
with glabrous filaments, and Otites maeotica Klokov in Kotov, Fl. RSS Ucr. 4: 658 (1952), and Otites moldavica Klokov, Jour. Bot. Acad. Sci. Ukr. 5 (1): 24 (1948), both described from Ukraine.
48. S. baschkirorum Janisch., Ber. Saratow. Naturforscherges. 3 (1): 33 (1929). Like 47 in petal-colour, but usually $40-60 \mathrm{~cm}$, and without the longer hairs on the lower part of stem. Petalclaw ciliate; filaments hairy. E. Russia. Rs (C, E).

Sect. Odontopetalae Schischkin ex Chowdhuri. Perennial with woody stock; flowering stems lateral in axils of basal leaves. Flowers large, solitary or in few-flowered dichasia. Calyx more or less inflated, hairy, 10 -veined. Petals with bifid limb toothed near base, and auriculate claw; coronal scales present. Capsule unilocular, without basal septa.
49. S. auriculata Sibth. \& Sm., Fl. Graec. Prodr. 1: 301 (1809). Caespitose, with short branched woody stock and robust 1 - to few-flowered pubescent stems up to 30 cm . Basal leaves up to 12 cm , lanceolate, acute, thick, with roughly punctate surface, densely ciliate with undulate hairs $1-2 \mathrm{~mm}$; cauline leaves $1-3$ pairs, small, remote. Calyx $12-15 \mathrm{~mm}$, densely glandular-hairy; teeth triangular, acute. Petal-limb c. 5 mm ; claw exserted. Capsule $c .3$ times as long as carpophore, ovoid, enclosed within calyx. - Mountains of Italy (Alpi Apuane) and Greece. Gr It.
50. S. zawadzkii Herbich in Zawadzki, Enum. Pl. Galic. Bukow. 191 (1835). Like 49 but basal leaves usually wider, elliptical; cilia shorter; flowers larger; calyx $15-17 \mathrm{~mm}$, hairy, but not or slightly glandular; petal-limb 10 mm or more. - E. Carpathians. Rm Rs (W).
51. S. elisabetha Jan, Flora (Regensb.) 15: 177 (1832) (Melandrium elisabetha (Jan) Rohrb.). Like 49 but basal leaves glabrous or only sparsely ciliate; cauline leaves 3-5 pairs; flowers very large, often solitary; calyx up to 20 mm , densely glandular-hairy; petallimb c. 15 mm , dark red or reddish-purple; coronal scales laciniate; carpophore very short. Calcareous rocks and screes, 1500-2500 m. S. Alps, between $9^{\circ}$ and $11^{\circ}$ E. It.
52. S. requienii Otth in DC., Prodr. 1: 381 (1824). Like 49 but basal leaves wider, subspathulate, not roughly punctate; inflorescence several-flowered; calyx up to 30 mm , cylindricalclavate; capsule oblong-acuminate, only slightly longer than carpophore. Mountain rocks. Corse, Sardegna. Co Sa.

Sect. Cordifoliae Chowdhuri. Caespitose, glandular-hairy perennials with woody stock and numerous ovate or cordateovate acuminate leaves. Inflorescence a few-flowered dichasium. Calyx glandular, somewhat inflated.
53. S. cordifolia All., Fl. Pedem. 2: 82 (1785). Stems up to 20 cm . Basal leaves ovate, attenuate at base, withering early; cauline leaves larger, cordate-ovate, acuminate. Inflorescence of 1-4 erect flowers. Calyx $12-15 \mathrm{~mm}$, glandular-pubescent, slightly inflated, with linear-lanceolate, acuminate teeth. Petallimb bifid, white or pink; claw not auriculate; coronal scales small, obtuse. Capsule $8-10 \mathrm{~mm}$, oblong, twice as long as glabrous carpophore. - Maritime Alps. Ga It.
54. S. foetida Link ex Sprengel, Syst. Veg. ed. 16, 2: 406 (1825) (S. acutifolia Link ex Rohrb., S. melandrioides Lange). Like 53 but cauline leaves ovate-lanceolate; stems usually 3-flowered; petals pink, with rather wide emarginate limb, short auriculate claw and prominent coronal scales. $2 n=24$. Mountains of N. Portugal and N.W. Spain. Hs Lu.
55. S. macrorhiza Gay \& Durieu ex Lacaita, Jour. Bot. (London) 67: 325 (1929) (S. foetida auct., non Link). Like 53 but stock very woody; stems up to 30 cm long, more or less procumbent; leaves more densely pubescent; calyx $22-30 \mathrm{~mm}$, obviously inflated; petal-limb white or pale pink, deeply bifid; claw long, not auriculate; capsule c. 15 mm . Mountains of Portugal and N.W. Spain. Hs Lu.

Sect. Inflatae (Boiss.) Chowdhuri. Perennial. Flowers solitary or in rather few-flowered dichasia. Calyx 10 - or 20 -veined, with conspicuous reticulate venation. Petals with imbricate aestivation.
56. S. vulgaris (Moench) Garcke, Fl. Nord Mittel-Deutschl. ed. 9, 64 (1869) (S. inflata Sm., S. latifolia (Miller) Britten \& Rendle, non Poiret, S. cucubalus Wibel). Perennial, sometimes caespitose and woody at base; stems up to 60 cm , usually branched, glabrous or pubescent, often glaucous. Leaves ovate to linear. Flowers solitary or in cymes. Calyx inflated, persistent, loosely investing ripe capsule, 20 -veined. Petals large, usually whitish, deeply bifid, with distinct claw and often with coronal scales. Capsule $6-14 \mathrm{~mm}$, usually $c .3$ times as long as carpophore. Seeds $1-1.5 \mathrm{~mm}$, with convex back and flat or convex face. Throughout Europe. All except Sb.

Extremely variable. The taxa here included in $S$. vulgaris have been variously treated by different authors. The treatment given below takes into account the large body of experimental and other data summarized in Marsden-Jones \& Turrill, Bladder Campions (1957).
1 Tall, usually $\pm$ erect plants with stout stems and severalflowered inflorescences; bracts usually scarious; capsule with narrow neck (c. 2-3 mm wide) and erect or patent teeth
2 With long stolons; capsule usually c. 12 mm ; petals usually pink or greenish
(d) subsp. macrocarpa

2 Without stolons; capsule usually less than 12 mm ; petals usually white
3 Lower cauline leaves very large, broadly oblong-ovate to ovate-elliptical, often obtuse and apiculate
(c) subsp. commutata

3 Lower cauline leaves ovate-lanceolate to linear
4 Lower cauline leaves ovate-lanceolate (a) subsp. vulgaris
4 Lower cauline leaves linear-lanceolate to linear
(b) subsp. angustifolia

1 Smaller, usually more procumbent plants with slender stems and few- or 1 -flowered inflorescences; bracts usually herbaceous; capsule with wide neck (c. 3-4 mm wide) and patent or deflexed teeth
5 Carpophore usually less than $\frac{1}{3}$ as long as capsule (usually mountain plants)
6 Leaves lanceolate; coronal scales usually well-developed
(e) subsp. glareosa

6 Leaves ovate-lanceolate to ovate, acute; coronal scales absent
(f) subsp. prostrata

5 Carpophore usually more than $\frac{1}{3}$ as long as capsule (usually maritime plants)
7 Leaves broadly elliptical to subspathulate, thick and fleshy, crowded and usually imbricate; stems much-branched, embedded in sand below (S.W. France) $\quad$ (h) subsp. thorei
7 Leaves variable, linear-lanceolate to subspathulate, usually less fleshy and more widely-spaced; stems often rather diffuse, sometimes subcaespitose
(g) subsp. maritima
(a) Subsp. vulgaris: Stems up to 60 cm , ascending or erect. Leaves $3-12 \times 1-2.5 \mathrm{~cm}$, glabrous or rarely pubescent, ovatelanceolate. Inflorescence usually several-flowered; bracts scarious. Capsule c. 10 mm , with narrow neck and erect teeth; carpophore $2-3 \mathrm{~mm} .2 n=24$. Throughout Europe except for some northern islands.
(b) Subsp. angustifolia (Miller) Hayek, Prodr. Fl. Penins. Balcan. 1: 256 (1924): Like (a) but leaves 3-8 $\times 0 \cdot 3-1 \mathrm{~cm}$, linearlanceolate or linear. Usually on coastal sands and rocks. Mediterranean region, Portugal.
(c) Subsp. commutata (Guss.) Hayek, op. cit. 258 (1924): Stems up to 60 cm . Leaves $4-9 \times 2-4 \mathrm{~cm}$, glabrous or pubescent, broadly oblong-ovate to ovate-elliptic, often obtuse and apiculate. Inflorescence several-flowered; bracts scarious. Capsule c. 10 mm ; carpophore $2-3 \mathrm{~mm} .2 n=48$. S. \& S.C. Europe, from Spain to Krym.
(d) Subsp. macrocarpa Turrill, Hook. Ic. 36: t. 3551 (1956): Plant with long stolons; stems up to 50 cm . Leaves $4-7 \times 0 \cdot 7-$ 1.6 cm , narrowly lanceolate. Inflorescence several-flowered; bracts scarious. Flowers pink or greenish. Capsule $10-13 \mathrm{~mm}$, with narrow neck and erect or patent teeth; carpophore $2 \cdot 5$ 3 mm . Introduced and long-established in S.W. England (Plymouth). [Br.] (Cyprus.)
(e) Subsp. glareosa (Jordan) Marsden-Jones \& Turrill, Bladder Campions 20 \& 135 (1957): Caespitose or diffuse, stock sometimes woody; stems $20-30 \mathrm{~cm}$, slender. Leaves $1-4 \times 0 \cdot 2-$ 0.5 cm , lanceolate or narrowly lanceolate, acute. Inflorescence 1- to 5 -flowered; bracts more or less herbaceous. Capsule 69 mm , with wide neck and patent or deflexed teeth; carpophore c. $2 \mathrm{~mm} .2 n=24$. Usually on mountains. ? Jura, Alps, Pyrenees, Carpathians and Jugoslavia.
(f) Subsp. prostrata (Gaudin) Chater \& Walters, Feddes Repert. 70: 2 (1964) (subsp. alpina (Lam.) Schinz \& R. Keller): Caespitose, with woody stock; stems $10-25 \mathrm{~cm}$, slender. Leaves $1-3 \times 0.3-1 \mathrm{~cm}$, ovate to ovate-lanceolate, acute or subobtuse, apiculate, often thick. Inflorescence 1- to 3 -flowered (plants from Italy with the leaves $2-3 \mathrm{~cm}$ sometimes have 3 - to 5 -flowered inflorescences); bracts more or less herbaceous. Ripe capsule $7-9 \mathrm{~mm}$, with wide neck and patent or deflexed teeth; carpophore $c .2 \mathrm{~mm} .2 n=24$. Usually on mountains. ? Alps and S. Europe.
(g) Subsp. maritima (With.) Á. \& D. Löve, Bot. Not. 114: 52 (1961): Plant often rather diffuse, glabrous, glaucous; stems up to 25 cm , branched. Leaves $0 \cdot 5-2(-4) \times 0 \cdot 2-0.7 \mathrm{~cm}$, lanceolate to linear-lanceolate, not usually crowded. Flowers solitary or 2-4 together; bracts thick and more or less herbaceous. Capsule 6-9 mm, with wide neck and patent or deflexed teeth; carpophore $3-3.5 \mathrm{~mm} .2 n=24$. Usually on coastal rocks or shingle. Coasts of W. Europe, from Açores and Spain to Murmansk.

Subcaespitose plants from Iceland with small, very glaucous, imbricate ovate-lanceolate to subspathulate leaves and usually 1 to 2 -flowered stems have been described as var. islandica Á. \& D. Löve.
(h) Subsp. thorei (Duf.) Chater \& Walters, Feddes Repert. 69: 47 (1964) ( $S$. thorei Duf.): Like (g) but stems much-branched and usually embedded in sand below; leaves $0.5-2 \times 0 \cdot 3-$ 1.2 cm , broadly elliptical to spathulate, rather crowded, not or slightly glaucous. Inflorescences mostly 1- to 2 -flowered. Coastal sands. - N. Spain and W. France, northwards to $45^{\circ}$ $30^{\prime} N$.
57. S. csereii Baumg., Enum. Stirp. Transs. 3: 345 (1816). Like 56 (a) but cauline leaves broadly ovate, semi-amplexicaul; calyx smaller, less inflated, with 10 long and 10 short veins and few or no anastomosing lateral veins; capsule subsessile; carpophore c. 1 mm ; seeds with concave face. S.E. Europe; an occasional casual elsewhere. Bu Rm Rs (W, K, E).

The plants from the Ukraine are said to be distinct from those from Bulgaria and Romania, and are called $S$. fabaria in Kotov, Fl. RSS Ucr. 4: 528 (1952). Further investigation is needed.
58. S. fabaria (L.) Sibth. \& Sm., Fl. Graec. Prodr. 1: 293 (1809). Robust glabrous and glaucous perennial up to 100 cm . Leaves fleshy; basal more or less spathulate-ovate; cauline distant, smaller, elliptical or obovate-lanceolate, obtuse, often mucronate. Inflorescence usually branched. Calyx $8-10 \mathrm{~mm}, 10$-veined, not markedly inflated; teeth triangular, acute. Petals white; coronal scales present. Capsule $10-12 \mathrm{~mm}$, ovoid, exceeding the closely appressed calyx: carpophore $c .2 \mathrm{~mm}$. Seeds with concave face. Maritime rocks. Greece. Gr.
S. ionica Halácsy, Consp. Fl. Graec. 1: 158(1900), described from W. Greece (Kefallinia), is said to be more branched, with smaller flowers and a capsule only c. 5 mm . S. thebana Orph. ex Boiss., Fl. Or. 1: 627 (1867), described from C. Greece (Thivai), has small flowers and conspicuous coronal scales. Both are very doubtfully distinct from 58.
59. S. caesia Sibth. \& Sm., Fl. Graec. Prodr. 1: 294 (1809). Like 58 but stems up to 40 cm , slender; inflorescence 3- to 5flowered; calyx-teeth ovate, obtuse; capsule $c .10 \mathrm{~mm}$, subsessile, scarcely exceeding calyx. Mountain rocks. Greece and S. Albania. Al Gr.
60. S. variegata (Desf.) Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 82 (1849). Dwarf plant with long procumbent shoots and short sub-erect 1 - to 5 -flowered stems up to 10 cm . Leaves as in $\mathbf{5 8}$ but smaller. Calyx and capsule as in $\mathbf{5 8}$. Petals greyish-violet. Mountain screes. - Aegean region (Kriti; Samothraki). Cr Gr.

Other taxa related to 59 and $\mathbf{6 0}$ have been described from the mountains on the Greek mainland and the islands, but more information is required.
61. S. fabarioides Hausskn., Mitt. Thür. Bot. Ver. nov. ser., 5: 47 (1893). Like 58 but leaves usually narrower; stem leafless in upper half; calyx distinctly inflated, not closely investing the ripe capsule. Balkan peninsula. Al Bu Gr ?Ju.
62. S. procumbens Murray, Comment. Gotting. ser. 2, 7: 83 (1786). Stems up to 30 cm long, procumbent, branched, scabridpuberulent. Leaves oblong-lanceolate, acute, subglabrous. Flowers solitary or 2-3 together; pedicels equalling calyx. Calyx 1520 mm , hairy, inflated, oblong-campanulate, 20 -veined, with anastomosing lateral veins. Petals white, cuneate, emarginate; coronal scales acute. Capsule $5-6 \mathrm{~mm}$, ovoid-globose, c. 3 times as long as the glabrous carpophore. S., C. \& E. Russia; E. Ukraine. Rs (C, W, E).

Sect. Brachypodae (Boiss.) Chowdhuri. Perennial, sometimes suffruticose, with lanceolate to spathulate basal leaves and fewflowered stems. Capsule included in the hairy calyx, much longer than the short carpophore.
63. S. flavescens Waldst. \& Kit., Pl. Rar. Hung. 2: 191 (1804). Stems up to 30 cm , stiff, erect, shortly pubescent below, viscid above. Basal leaves rather densely hairy, spathulate; cauline few, linear or linear-lanceolate. Flowers usually solitary or paired; pedicels long. Calyx c. 10 mm , cylindrical, distinctly hairy. Petals yellow; coronal scales small. Capsule $c .8 \mathrm{~mm}$; carpophore c. 1 mm . Mountains of Balkan peninsula, extending northwards to S. Carpathians and Hungary. Bu Gr Ju Hu Rm [It].

Plants from the Balkan peninsula differ somewhat from those from the Carpathians in having a denser, more glandular indumentum and a several-flowered inflorescence. They have been
distinguished as S. thessalonica Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 74 (1853), and may merit subspecific rank.
64. S. congesta Sibth. \& Sm., Fl. Graec. Prodr. 1: 300 (1809). Stems up to 30 cm , stiff, erect, woody, with dense pubescence on leaves and lower part of stem. Inflorescence-branches alternate, with terminal subsessile groups of 3-5 rather small flowers. Calyx $c .6 \mathrm{~mm}$, densely glandular-hairy. Petals yellowish; coronal scales absent. Capsule c. 5 mm , broadly ovoid; carpophore $c .2 \mathrm{~mm}$. Mountains of Greece. Gr.

Sect. Auriculatae (Boiss.) Schischkin. Caespitose mountain plants with large flowers terminating short stems. Calyx cylin-drical-clavate, glandular. Petal-claw auriculate.
65. S. vallesia L., Syst. Nat. ed. 10, 2:1032(1759). Mat-forming perennial with ascending glandular-pubescent stems up to 15 cm . Leaves pubescent, oblong-lanceolate to linear. Inflorescence 1to 3 -fiowered. Petals usually pale pink above, red beneath; claw exserted; coronal scales small, truncate. Capsule scabrid, equalling the glabrous carpophore. Mountainrocks. - W.Alps; Italy (Alpi Apuane and C. Appennini); Balkan peninsula. AI Ga He It Ju.
(a) Subsp. vallesia: Leaves oblong-lanceolate or lanceolate. Calyx c. 25 mm . Alps to Appennini.
(b) Subsp. graminea (Vis. ex Reichenb.) Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (2): 124 (1920) (S. graminea Vis. ex Reichenb.): Leaves linear. Calyx $12-15 \mathrm{~mm}$. Petals usually white. Mountains of Jugoslavia and Albania; also in N.W. Italy (Piemont) and S. France (Dauphiné, Provence).
66. S. boryi Boiss., Elenchus 19 (1838) (incl. S. tejedensis Boiss.). Like 65 but coronal scales conspicuous, and carpophore up to 18 mm , much longer than ripe capsule. S. Spain; $N$. Portugal. Hs Lu.

Typically the basal leaves are linear-lanceolate and acuminate, and the habit is laxly mat-forming. The var. tejedensis (Boiss.) Willk. with very long stolons and ovate sub-acute basal leaves, occurs in S. Spain (Sierra Tejeda), but is connected by intermediates to the typical variety.

Sect. Suffruticosae (Rohrb.) Schischkin (incl. Sect. Macranthae Rohrb.). Perennial with more or less woody stock and ovate, lanceolate or linear leaves. Inflorescence few-flowered or flowers solitary and terminal; flowers usually large. Carpophore usually well-developed.
67. S. repens Patrin in Pers., Syn. Pl. 1: 500 (1805). Perennial with long creeping stolons and suberect stems up to 60 cm , more or less scabrid-pubescent throughout. Leaves up to 5 cm , linear, acute; basal withering early. Inflorescence narrow, with short, few-flowered, opposite branches. Calyx $10-12 \mathrm{~mm}$, densely scabrid-pubescent, somewhat inflated in fruit. Petals white; claw glabrous, auriculate; coronal scales very small or absent. Capsule equalling carpophore. C., S. \& E. Russia. Rs (C, E).
68. S. succulenta Forskål, Fl. Aegypt. Ixvi \& 89 (1775) (incl. S. corsica DC.). Fleshy perennial with woody stock and numerous procumbent or ascending stems, clothed throughout with dense viscid glandular pubescence (and therefore always with adhering sand-grains). Leaves obovate or oblanceolate. Flowers large, solitary or paired (rarely 3 or more), in axils of leafy bracts. Calyx 15-20 mm, narrowly clavate, with conspicuous greenish or
reddish veins. Petal-limb bifid, white; claw long-exserted; coronal scales conspicuously toothed. Capsule $c .10 \mathrm{~mm}$, broadly oblong, equalling the deflexed-hairy carpophore. Maritime sands. Corse, Sardegna, Kriti. Co Cr Sa.

Plants from Corse and Sardegna have smaller leaves and rather shorter, more obtuse calyx-teeth than the typical plant, which occurs in Kriti; they have been distinguished as subsp. corsica (DC.) Nyman, Consp. 92 (1878).
69. S. supina Bieb., Fl. Taur.-Cauc. 1: 336 (1808). Stems procumbent, much-branched from a woody stock, more or less scabrid-puberulent. Leaves $20-40 \times 1-4 \mathrm{~mm}$, linear. Inflorescence (1-)2- to 5 -flowered. Calyx $17-20 \mathrm{~mm}$, narrowly cylindrical, densely glandular. Petals white; claw exserted, ciliate, not auriculate; coronal scales small. Capsule $5-6 \mathrm{~mm}$, equalling the pubescent carpophore. $2 n=24$. S.E. Europe. Bu Rm Rs (C, W, K, E) Tu.
70. S. thymifolia Sibth. \& Sm., Fl. Graec. Prodr. 1: 292 (1809) (S. pontica Brandza). Like 69 but leaves fleshy, ovate, conspicuously pubescent; inflorescence few-flowered, with alternate or opposite 1 - to 3 -flowered branches; calyx $12-15 \mathrm{~mm}$, narrowly clavate, glandular-villous; capsule $c .8 \mathrm{~mm}$, slightly longer than the pubescent carpophore. $2 n=48$. Maritime sands. W. coast of Black Sea. Bu Rm Tu.
71. S. altaica Pers., Syn. Pl. 1: 497 (1805). Stems up to 50 cm , much-branched, scabrid-puberulent below, glabrous and viscid above. Leaves up to 3 cm , acicular, pungent, scabrid. Inflorescence more or less compound, with alternate 1 - to 3 -flowered branches; pedicels equalling or longer than calyx. Calyx $10-$ 14 mm , sparsely pubescent. Petals white; claw ciliate; coronal scales present. Capsule $8-10 \mathrm{~mm}, 1 \frac{1}{2}-2$ times as long as carpophore. E. Russia (Sakmara, near Orenburg). Rs (C). (Temperate Asia.)
72. S. cretacea Fischer ex Sprengel, Syst. Veg. ed. 16, 2: 405 (1825). Stems up to 30 cm , much-branched, with hoary pubescence below. Leaves up to 10 mm , linear, thick and rigid, acuminate. Inflorescence 1- to 3-flowered; pedicels usually shorter than calyx. Calyx $18-20 \mathrm{~mm}$, glabrous or slightly scabrid on veins. Petals white; claw exserted; coronal scales absent. Capsule $10-12 \mathrm{~mm}$; carpophore $5-7 \mathrm{~mm}$, stout. Seeds with flat faces and grooved back. Chalk hills. - S. Russia. Rs (C, E).
73. S. suffrutescens Bieb., Beschr. Länd. Terek Kasp. 175 (1800). Stems up to 40 cm , suberect, shortly pubescent. Basal leaves up to 4 mm wide, linear-spathulate, mucronate; upper cauline linear. Inflorescence 1- or few-flowered; pedicels equalling or longer than calyx. Calyx $10-15 \mathrm{~mm}$, glabrous or slightly scabrid. Petals white; coronal scales linear, acute. Capsule c. 10 mm ; carpophore $6-7 \mathrm{~mm}$. S.E. Russia, W. Kazakhstan. Rs (E).
74. S. taliewii Kleopow, Jour. Bot. Acad. Sci. Ukr. 9 (17): 119 (1936). Like 73 but with stems less than 20 cm ; leaves up to 5 mm wide, oblanceolate or lanceolate-spathulate, thick; calyx entirely glabrous; coronal scales absent; capsule about twice as long as carpophore, ovoid-globose. E. Russia. Rs (E).
75. S. linifolia Sibth. \& Sm., Fl. Graec. Prodr. 1: 301 (1809). Stems up to 65 cm , numerous, suberect, with short hoary pubescence below, glabrous and viscid above. Basal leaves linear-lanceolate, puberulent. Inflorescence with few- or 1flowered alternate branches; pedicels shorter than calyx. Calyx
$15-20 \mathrm{~mm}$, abruptly contracted below capsule, usually pubescent; teeth acute. Petals pinkish above, purplish beneath; claw ciliate; coronal scales truncate. Capsule $7-10 \mathrm{~mm}$, equalling or somewhat longer than carpophore. - N. \& C. Greece. Gr.
76. S. schwarzenbergeri Halácsy, Denkschr. Akad. Wiss. Math.Nat. Kl. (Wien) 61 : 472 (1894). Stems simple, erect from woody stock, pubescent, viscid above. Basal leaves small, obovate-spathulate; upper cauline minute, linear. Inflorescence more or less racemose, 1 - to 4 -flowered; pedicels much shorter than calyx. Calyx 12-15 mm, puberulent; teeth ovate-lanceolate, more or less obtuse. Petals greenish; claw glabrous. Capsule equalling or somewhat shorter than carpophore. Mountain rocks. - S. Albania, N. Greece. Al Gr.
77. S. campanula Pers., Syn. Pl. 1: 500 (1805). Slender glabrous perennial up to 20 cm , with the habit of Campanula rotundifolia. Leaves linear to linear-lanceolate, acute, ciliate at base. Flowers solitary or paired, terminal on slender pedicels. Calyx $7-8 \mathrm{~mm}$, campanulate, vinous, glabrous. Petals white, reddish-purple beneath. Capsule $c .6 \mathrm{~mm}$, slightly longer than or up to twice as long as the thick, pubescent carpophore. Calcareous mountain rocks. - Maritime Alps. Ga It.
78. S. saxifraga L., Sp. Pl. 421 (1753) (incl. S. hayekiana Hand.-Mazz. \& Janchen, S. fruticulosa Sieber ex Otth). Usually dwarf, often densely caespitose; stems up to 20 cm , numerous, slender, usually pubescent below, viscid above. Leaves usually linear to linear-spathulate, acute, often slightly scabrid, basally ciliate. Inflorescence 1 - or 2 -flowered. Calyx $8-13 \mathrm{~mm}$, clavate, contracted below the ripe capsule, glabrous, pale, rarely vinous. Petals whitish or greenish above, greenish or reddish beneath; claw more or less exserted; coronal scales small. Capsule 6$10 \mathrm{~mm}, \frac{1}{4}-\frac{3}{4}$ covered by the calyx; carpophore $5-6 \mathrm{~mm}$, glabrous. - S. Europe, mainly in the mountains, extending northwards to Switzerland and the S. Carpathians. Al Au Bu Co Cr Ga Gr He Ho Hs Hu It Ju Rm Si.

The following 3 taxa are related to 78 but their appropriate rank is uncertain:
S. balcanica (Urum.) Hayek, Prodr. Fl. Penins. Balcan. 1: 270 (1924), from Bulgaria and Macedonia, has very densely branched 1-flowered stems, small linear-lanceolate to linear-subspathulate leaves, and the capsule only slightly exceeding the calyx. It is also said to have purple and not yellow anthers.
S. parnassica Boiss. \& Spruner in Boiss., Diagn. Pl. Or. Nov. 2 (8): 91 (1849), described from mountains in Greece and known also from S. Albania and Italy (Appennini), is densely caespitose and has 1 -flowered stems, small, linear, serrate leaves, a long-exserted petal-claw, and the capsule often completely exserted from the calyx.
S. smithii Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 77 (1853), from Greece (Evvoia), is subcaespitose, with 1-, rarely 2 -flowered stems, subspathulate leaves, a slightly exserted petalclaw, a short, stout carpophore $2-3 \mathrm{~mm}$ long, and the ripe capsule only slightly exceeding the calyx.
79. S. schmuckeri Wettst. in Luerssen, Biblioth. Bot. (Stuttgart) 26: 30(1892). Caespitose; stems up to 15 cm . Leaves up to 10 mm , linear-lanceolate, acute (or the lower obtuse), scabrid or puberulent, canescent. Inflorescence 1- to $6(-8)$-flowered. Calyx $7-9 \mathrm{~mm}$, pale greenish or vinous, slightly pubescent above. Petals purple, claw not exserted; carpophore $3-4 \mathrm{~mm}$, slender, slightly pubescent. Capsule $4-5 \mathrm{~mm}$, equalling or slightly exceeding calyx. - Mountains of N.W. Makedonija. Ju.
80. S. multicaulis Guss., Pl. Rar. 172 (1826). Usually less densely caespitose than 78 ; stems up to 40 cm , (1-)3- to $4(-8)$ flowered. Leaves linear-lanceolate to linear. Calyx $14-18 \mathrm{~mm}$, narrowly clavate, pale greenish or vinous, rarely with anastomosing veins, sometimes slightly scabrid above; teeth alternately obtuse and acute. Petals purplish or greenish; claw long-exserted. Capsule $8-9 \mathrm{~mm}$, equalling or up to 2 mm longer than calyx; carpophore $6-9 \mathrm{~mm}$, pubescent, especially below. Mountains of Balkan peninsula, Italy and Corse. Al Co Gr It Ju.
S. genistifolia Halácsy, Österr. Bot. Zeitschr. 42: 369 (1892), with lanceolate leaves, long pedicels, flowers inclined at anthesis, and calyx $16-22 \mathrm{~mm}$, occurs in N. Greece (Athos). S. stenocalycina Rech. fil., Österr. Bot. Zeitschr. 104: 175 (1957), with narrow glabrous calyx c. 18 mm , and slender carpophore $c$. 10 mm , nearly twice as long as subglobose capsule, is described from E. Greece (N. Evvoia). Both seem related to 80, but the group needs further investigation.
81. S. waldsteinii Griseb., Spicil. Fl. Rumel. 1: 179 (1843) (S. clavata (Hampe) Rohrb., non Moench). Densely caespitose, with crowded linear leaves, and 1 - to 5 -flowered erect stems up to 25 cm . Calyx 20-25(-28) mm, narrowly clavate, with acute, distinctly patent teeth; veins anastomosing. Petals white; claw exserted. Capsule exceeding calyx; carpophore pubescent at least near base. - Mountains of Balkan peninsula. Al Bu Gr Ju.
S. macropoda Velen., Abh. Böhm. Ges. Wiss.(Math.-Nat.) 7 (1): 8 (1886), described from Bulgaria, seems closely related, but has calyx 16-24 mm, and glabrous carpophore.
S. regis-ferdinandi Degen \& Urum., Magyar Bot. Lapok 11: 2 (1912), also from Bulgaria, has very large, usually solitary, flowers and calyx $34-36 \mathrm{~mm}$. It is variously treated as a taxon related to 81 or as a variety of $S$. bupleuroides (23).
82. S. pindicola Hausskn., Mitt. Thür. Bot. Ver. 5: 85 (1887). Dwarf, caespitose; flowering stems up to 10 cm , very slender, 1 -flowered, pubescent below, glabrous and very viscid above. Leaves up to 15 mm , linear. Calyx 18-24 mm, narrowly clavate, glabrous, vinous. Petals brownish; claw long-exserted; coronal scales $c .1 \mathrm{~mm}$. Capsule $8-10 \mathrm{~mm}$, half exserted from calyx; carpophore $12-16 \mathrm{~mm}$, pubescent. Serpentine rocks. Mountains of N. Greece. Gr.
83. S. orphanidis Boiss., Fl. Or. 1: 651 (1867). Caespitose; stems very slender, 1 -flowered. Uppermost pair of leaves very close to the base of the calyx. Calyx 20-22 mm. Petals white. Capsule $c .8 \mathrm{~mm}$; carpophore $c .20 \mathrm{~mm}$. $\quad$. Greece (Athos). Gr.
84. S. barbeyana Heldr. ex Boiss., Fl. Or. suppl., 107 (1888). Densely pulvinate, with short branched stock densely clothed with whitish persistent leaves. Leaves linear, glabrous, with scabrid margins. Flowering stems up to 8 cm , very slender, glabrous, 1 -flowered, viscid above, with 1-2 pairs of linear leaves. Calyx 5-6 mm, turbinate, glabrous. Petal-limb obcordate, pale purple. Carpophore very short. - Mountains of C. Greece (Korax, Giona). Gr.
85. S. falcata Sibth. \& Sm., Fl. Graec. Prodr. 1: 301 (1809). Densely pulvinate; whole plant, including calyx, densely glandu-lar-pubescent. Leaves rigid, subulate, strongly falcate. Flowering stems simple, slender, 1 -flowered, with 1 or 2 pairs of distant leaves. Calyx $15-20 \mathrm{~mm}$, narrow. Petals white; claw exserted, dilated above; coronal scales small, ovate. Capsule $5-7 \mathrm{~mm}$,
ovoid, shining, completely exserted from calyx on a long, slender, glabrous carpophore. Mountains of N. Greece (Athos, Olimbos). Gr.
86. S. cephallenia Heldr., Fl. Céphal. 26 (1883). Woody at base, with linear or linear-lanceolate basal leaves. In robust specimens the flowers usually in rather crowded 3-flowered cymes, the inflorescences often with long alternate branches spreading at a wide angle; in small specimens the inflorescence reduced to a single few-flowered group. Calyx $10-18 \mathrm{~mm}$, glandular-hairy. Capsule 6-8 mm; carpophore 4-6 mm, glabrous. Albania, W. Greece. Al Gr.

This species seems to be close to 64 , but further investigation is required.
S. paeoniensis Bornm., Mitt. Thür. Bot. Ver. nov. ser. 36: 44 (1925), described from S.W. Jugoslavia (near Veles), has oblan-ceolate-spathulate basal leaves and an eglandular calyx, but otherwise closely resembles 86.

Sect. Fruticulosae (Rohrb.) Chowdhuri. Perennial with elongated woody stock. Inflorescence a raceme-like monochasial cyme with the axis simple or forked below, without an alar flower. Calyx 10 -veined, clavate and widest at mouth in fruit; teeth ovate, obtuse. Seeds reniform; faces somewhat concave, striate; back concave.
87. S. ciliata Pourret, Mém. Acad. Toulouse 3: 329 (1788) (incl. S. perinica Hayek). Caespitose, with dense rosettes of linearto lanceolate-spathulate leaves; flowering stems $5-30 \mathrm{~cm}$, arising terminally from centre of rosettes, erect or ascending, pubescent. Inflorescence simple, (1-)2- to 3(-7)-flowered, rarely branched. Calyx 11-20 mm, pubescent; veins usually anastomosing. Petals white or pink, usually greenish or reddish beneath. Capsule $5-10 \mathrm{~mm}$, broadly ovoid; carpophore $5-8 \mathrm{~mm}$, pubescent. Seeds c. 1 mm , black, almost smooth, with shallowly grooved back. $2 n=24,36,48,72,84$, c. 96, c. 120 . - Mountains of S. Europe; local. Bu Ga Gr Hs It Ju Lu.

A very variable species. Plants from Italy and Greece usually have large leaves and 4-7 flowers (var. graefferi (Guss.) Fiori). Plants from Portugal (Serra da Estrêla) are small in all their parts and have 1-2 flowers (S. elegans Link ex Brot., Fl. Lusit. 2: 185 (1804)).
88. S. legionensis Lag., Gen. Sp. Nov. 14 (1816). Like 87 but flowering stems $15-40 \mathrm{~cm}$, arising laterally from below leafrosettes; inflorescence usually simple, with 3-9 flowers; calyx $13-23 \mathrm{~mm}$, veins scarcely anastomosing; carpophore $7-12 \mathrm{~mm}$, almost glabrous at maturity. - Spain, N.E. Portugal. Hs Lu.
89. S. borderi Jordan, Ann. Soc. Linn. Lyon nov. ser. 12: 445 (1866). Dwarf mat-forming perennial with thick branching stock and erect glabrous 1 - to $2(-5)$-flowered stems up to 12 cm . Basal leaves with minute papillae on upper surface, ciliate, narrowly spathulate; cauline leaves few, linear. Calyx $8-10 \mathrm{~mm}$, pubescent, with obtuse teeth. Petal-limb pink, bifid; claw ciliate, not auriculate; coronal scales ovate. Capsule $c .6 \mathrm{~mm}$, broadly ovoid, equalling or somewhat longer than the pubescent carpophore. Seeds reniform, with obtuse tubercles, and shallowly grooved back. Mountain rocks. E. \& C. Pyrenees. Ga Hs.

Variously associated with Sect. Macranthae and Sect. Fruticulosae; it resembles small plants of 87 (S. elegans Link ex Brot.), but differs in the papillose leaves and in the tuberculate seeds.

Sect. Nanosilene Otth. Dwarf mat-forming or pulvinate perennials with woody tap-root, linear leaves, and usually 1 flowered stems bearing 1-2(-4) pairs of cauline leaves.
90. S. acaulis (L.) Jacq., Enum. Stirp. Vindob. 78 et 242 (1762). Glabrous, moss-like, mat-forming or pulvinate perennial with short, erect, flowering stems $2-10 \mathrm{~cm}$. Leaves $6-12 \mathrm{~mm}$, linearsubulate; margin cartilaginous, stiffly ciliate. Calyx $7-9 \mathrm{~mm}$, glabrous, campanulate, faintly 10 -veined, without lateral veins. Petal-limb emarginate to shallowly bifid, usually deep pink; claw not auriculate; coronal scales small. Capsule subcylindrical, up to twice as long as calyx and longer than pubescent carpophore. $2 n=24$. Arctic Europe and the higher mountains of W. \& C. Europe. Au Br Bu Cz Fa Fe Ga Ge Hb He Hs Is It Ju No Po Rm Rs (N) Sb Su.

Both unisexual and hermaphrodite plants occur.
Rather variable in habit, size of flower and capsule, capsuleshape, etc. It does not seem possible to define satisfactorily geographical subspecies, although extreme variants can be distinguished in the Alps as follows:
(a) Subsp. longiscapa (Kerner ex Vierh.) Hayek, Österr. Bot. Zeitschr. 53: 361 (1903): Flowering stems more or less extended. Calyx truncate at base. Capsule $1 \frac{1}{2}-2$ times as long as calyx.
(b) Subsp. exscapa (All.) J. Braun, Neue Denkschr. Schweiz. Naturf. Ges. 48: 193 (1913): Flowering stems very short. Calyx more or less cuneate at base. Capsule not much exceeding calyx.
91. S. dinarica Sprengel, Syst. Veg. ed. 16, 2: 405 (1825). Like 90 but stems more or less pubescent, rarely $2(-4)$-flowered, usually with 2-4 pairs of leaves; calyx $12-15 \mathrm{~mm}$, oblong-campanulate, with reticulate lateral venation. - S. Carpathians. Rm.

Sect. Rupifraga Otth. Small slender glabrous perennials with numerous small flowers in regular dichasia. Seeds reniform with flat or shallowly grooved back.
92. S. rupestris L., Sp. Pl. 421 (1753). Stems up to 25 cm , erect, branched below. Basal leaves oblanceolate; cauline numerous, lanceolate, acute. Inflorescence a diffuse compound dichasium with small flowers on long slender pedicels. Calyx 4-6 mm, glabrous, obconical, 10 -veined, without lateral veins. Petal-limb obovate, deeply emarginate, white or pink; coronal scales acute. Capsule c. 5 mm , oblong-ovoid; carpophore $c$. 1 mm , glabrous. $2 n=24$. Fennoscandia; mountains of $W$. \& C. Europe, southwards to the Pyrenees and Sardegna; one isolated station in the E. Carpathians. Au Co Fe Ga Ge He Hs It No Rm Rs (N, C) Sa Su.

Doubtfully recorded outside Europe at one station in W. Siberia.
93. S. lerchenfeldiana Baumg., Enum. Stirp. Transs. 1: 398 (1816). Like 92 but stems arcuate-ascending, obviously lateral, in axils of longer, narrower basal leaves; flowers fewer, larger, shortly pedicellate; calyx $9-12 \mathrm{~mm}$, narrowly clavate, with some lateral venation; petal-limb oblong-linear, usually reddish or purplish; carpophore $5-6 \mathrm{~mm}$, almost equalling capsule. - $S$. Carpathians and mountains of Balkan peninsula southwards to $41^{\circ} N$. Bu Gr Ju Rm.

Sect. Heliosperma Reichenb. Like Sect. Rupifraga, but often hairy; seeds winged with a characteristic dorsal crest, consisting of 2 or more rows of long papillae on the back. Endemic to mountains of S. Europe.
(94-100). S. pusilla group. Perennials with rather slender, sometimes woody stock, and slender, weak, branched stems up to 30 cm . Inflorescence a spreading dichasium of small flowers on long slender pedicels. Calyx $3-10 \mathrm{~mm}$, obconical, weakly 10 -veined. Limb of petal obovate, usually (2-)4-toothed or -fid, white or pink. Capsule $5-8 \mathrm{~mm}$, ovoid, equalling or exceeding calyx; carpophore $1-5 \mathrm{~mm}$.

Plants of this group occur in damp, open habitats, often on calcareous rock, in mountain regions from the Pyrenees to the Carpathians and Balkan peninsula. The great variation in habit, leaf-shape and hairiness shows some geographical and ecological correlation, but has been treated differently by different authors. The following provisional treatment attempts to reconcile the accounts of H. Neumayer in Hayek, Prodr. Fl. Penins. Balcan. 1: 264-7 (1924) and of Ascherson and Graebner, Syn. Mitteleur. Fl. 5 (2): 17-31 (1920).

1 Petal-claw ciliate
100. alpestris

1 Petal-claw glabrous
2 Capsule at least 3 times as long as carpophore
3 Petals entire or shallowly emarginate; calyx c. 8 mm
96. macrantha

3 Petals $\pm$ deeply 2 - to 4 -toothed or -fid; calyx $3-6(-7) \mathrm{mm}$
4 Densely hairy, with long multicellular glandular and eglandular hairs; dorsal crest of seed constituting not more than $\frac{1}{4}$ of diameter of seed 95. veselsk
4 Subglabrous or somewhat glandular-hairy; dorsal crest of seed constituting more than $\frac{1}{3}$ of diameter of seed
94. pusilla

2 Capsule not more than twice as long as carpophore
5 Calyx less than 7 mm
99. chromodonta

5 Calyx at least 7 mm
6 Densely hairy, with long glandular and eglandular hairs; dorsal crest of seed constituting $c$. $\frac{1}{5}$ of diameter of seed
98. retzdorffiana

6 More sparsely hairy, with short glandular hairs; dorsal crest of seed constituting $c \cdot \frac{1}{10}$ of diameter of seed
97. tommasinii
94. S. pusilla Waldst. \& Kit., Pl. Rar. Hung. 3: 235 (1812) (S. quadrifida auct., non L., S. quadridentata subsp. quadridentata sensu Hayek, subsp. pusilla (Waldst. \& Kit.) Neumayer, and subsp. albanica (K. Maly) Neumayer; Heliosperma quadrifidum sensu Hegi). Stems up to 15 cm , weak, ascending, subglabrous or rather sparsely hairy, in upper part viscid with sessile glands and occasionally some multicellular glandular hairs. Leaves $1-2(-4) \mathrm{mm}$ wide, linear or linear-lanceolate. Calyx $3 \cdot 5-7 \mathrm{~mm}$, glabrous or somewhat glandular-hairy. Petals white, rarely pink or lilac; claw glabrous. Capsule broadly ovoid to subglobose, usually equalling or only slightly exceeding calyx, and 3-4 times as long as carpophore. Seeds c. 1 mm ; dorsal crest constituting at least $\frac{1}{3}$ of diameter of seed. $2 n=24$. Mountain rocks, streamsides, etc., rarely below 500 m . - $S$. \& C. Europe, northwards to the French Jura and W. Carpathians. Al $\mathrm{Au} \mathrm{Bu} \mathrm{Co} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.

Two plants described as subspecies of S. quadridentata, subsp. malyi Neumayer, Österr. Bot. Zeitschr. 72: 282 (1923), from N.W. Jugoslavia (Dinara Planina), and subsp. candavica Neumayer, loc. cit. (1923), from Albania (Jablanica), are characterized by unusually well-developed coronal scales, which reach or exceed the base of the petal-lobes. There is insufficient information to decide their status; they could be considered as variants of 94 .
S. monachorum Vis. \& Pančić, Mem. Ist. Veneto 12: 463 (1864), recorded from several localities from the Italian Alps to Crna

Gora, is a more robust plant with wider basal leaves; the dorsal crest of the seed is said to be much narrower. Its status is obscure. A record of this plant from Sicilia needs confirmation.
95. S. veselskyi (Janka) Béguinot, in Fioii \& Béguinot, Sched. Fl. Ital. Exsicc. ser. 3, 14: 187 (1921) (Heliosperma eriophorum Juratska). Like 94, but densely hairy with long multicellular glandular and eglandular hairs; sessile glands absent; capsule subglobose; dorsal crest of seed constituting $\frac{1}{5}-\frac{1}{4}$ of diameter of seed. Cliffs and rocks, in drier habitats than 94, and mainly below 500 m . S.E. Alps; ?Balkan peninsula. Au It ?Ju.

The relationships between this species and the succeeding taxa, together with others listed in Neumayer, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 94: 143 (1917), are by no means clear. Its distribution cannot therefore be precisely given.
96. S. macrantha (Pančić) Neumayer, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 94: 143 (1917). More robust than 94 and 95, with glandular-hairy stems up to 15 cm , and obovate-lanceolate leaves. Flowers relatively large. Calyx 8 mm , slightly hairy. Petals usually pink, with obovate, truncate or slightly emarginate, long-exserted limb. Capsule subglobose, c. 4 times as long as carpophore. Mountain rocks. Albania; S.W. Jugoslavia (Crna Gora). Al Ju.
97. S. tommasinii Vis., Flora (Regensb.) 12, Erg.-Bl. 1: 12 (1829) (S. quadridentata subsp. tommasinii (Vis.) Neumayer). Stems up to 10 cm , slender, clothed with short glandular hairs. Leaves $2-3(-8) \mathrm{mm}$ wide, linear-lanceolate to obovatelanceolate. Calyx $7-9 \mathrm{~mm}$. Petals white; claw glabrous. Capsule ovoid, only slightly longer than carpophore. Dorsal crest of seed very narrow, constituting $c . \frac{1}{10}$ of diameter of seed. Mountain rocks. - Albania, Jugoslavia. Al Ju.
S. quadridentata subsp. marchesettii Neumayer, Verh. Zool.Bot. Ges. Wien 72: 59 (1923), described from N.E. Italy, is said to differ from all other taxa of this section in having a very poorly developed dorsal crest to the seed, constituting only $c$. $\frac{1}{16}$ of the diameter of the seed.
98. S. retzdorffiana (K. Maly) Walters, Feddes Repert. 69: 47 (1964). Like 97 but more robust; stems up to 20 cm ; glandular hairs abundant, long; calyx $8-10 \mathrm{~mm}$; dorsal crest of seed constituting c. $\frac{1}{5}$ of diameter of seed. Wet rocks, 200-300 m. - Albania, W. Jugoslavia. Al Ju.
99. S. chromodonta Boiss. \& Reuter, Diagn. Pl. Or. Nov. 3 (1): 71 (1853) (incl. S. quadridentata subsp. phyllitica Neumayer). Like 97 but calyx only 4-6 mm, and capsule up to twice as long as carpophore. Mountain rocks. Albania, Jugoslavia; Greece (Olimbos). Al Gr Ju.
S. moehringiifolia Uechtr. ex Pančić, Fl. Princ. Serb. Addit. 118 (1884), described from Srbija, differs only in its very narrow leaves and sparse pubescence.
100. S. alpestris Jacq., Fl. Austr. 1: 60 (1773) (S. quadrifida L., nom. ambig.; Heliosperma alpestre (Jacq.) Reichenb.). More robust than 94-99. Stock rather woody; stems up to 30 cm , subglabrous to somewhat hairy. Leaves up to 9 mm wide, obovate-lanceolate to linear-lanceolate. Inflorescence more or less viscid; flowers relatively large. Calyx $5-7 \mathrm{~mm}$, scabrid or more or less glandularpuberulent. Petals usually white, 4- to 6 -toothed; claw ciliate. Capsule ovoid, 3-4 times as long as carpophore, and much exceeding calyx. Seeds as in 94, but somewhat larger ( $1-1.3 \mathrm{~mm}$ ). Mountain rocks, rarely below 1250 m. E. Alps and N. part of Balkan peninsula. Au It Ju.

Heliosperma arcanum Zapał., Rozpr. Wydz. Mat.-Przyr. Polsk. Akad. Um. (Biol.) ser. 3, 11 B: 267 (1911) is, according to Neumayer, conspecific; it was described from a single gathering from a gorge of the Dnestr river, W. Ukraine, but there is no recent confirmation of this record. An old record of S. alpestris from the Polish Carpathians also cannot be verified.

Sect. Compactae (Boiss.) Schischkin. Usually robust annuals, biennials or perennials with cymose, and often densely corymbose inflorescence. Pedicels often very short. Petals entire or emarginate, not bifid.
101. S. armeria L., Sp. Pl. 420 (1753). Erect glabrous and glaucous annual or biennial with usually simple stems up to 40 cm , viscid above. Basal leaves spathulate, withering early; cauline ovate-cordate to lanceolate, amplexicaul, decreasing gradually upwards. Inflorescence usually corymbose, often densely so. Calyx $12-15 \mathrm{~mm}$, cylindrical-clavate; teeth obtuse. Petal-limb obovate, emarginate, usually pink; coronal scales lanceolate, acute. Capsule $7-10 \mathrm{~mm}$, oblong, equalling or somewhat longer than the glabrous carpophore. - Certainly native in C., S. and parts of E. Europe; widely cultivated elsewhere and sometimes naturalized. Al Au BuCoCzGaGe Gr He Hs Hu It Ju Lu Po Rm Rs (C, W) Sa ?Si Tu [Be Br Da Fe Ho No Su].

Variable in habit, leaf-shape and inflorescence. In E. Europe the wild plant has almost entire petals and has been called S. lituanica Zapał., Rozpr. Wydz. Mat.-Przyr. Polsk. Akad. Um. (Biol.) ser. 3, 11 B: 285 (1911). Especially in the E. Mediterranean region, variants with less compact inflorescence occur, which have been called var. serpentini G. Beck and var. sparsiflora Schur. Such plants may deserve subspecific recognition.
102. S. compacta Fischer, Cat. Jard. Gorenk. ed. 2, 60 (1812). Like 101 but stems stouter and leaves wider; upper cauline leaves closely investing base of subcapitate inflorescence; calyx 1320 mm ; petals entire. S.E. Europe, from C. Greece to S.W. Ukraine. Bu Gr Rm Rs (W) Tu.

The plant from the Ukraine has been distinguished as $\mathbf{S}$. hypanica Klokov, Jour. Bot. Acad. Sci. Ukr. 5: 20 (1948); it is said to differ mainly in the upper cauline leaves being herbaceous, not membranous, and in the brown, not black, seeds. It seems best regarded as a variant of $\mathbf{1 0 2}$.
103. S. asterias Griseb., Spicil. Fl. Rumel. 1: 168 (1843). Like 101 but perennial; stems up to 100 cm ; inflorescence capitate, subtended by membranous bracts; cauline leaves few, lanceolate; calyx-teeth acute; petal-limb oblong, entire, deep purple; coronal scales short. - Mountains of Balkan peninsula. Al Bu Gr Ju.

Sect. Elisanthe (Fenzl) Fenzl (Sect. Melandriformes (Boiss.) Chowdhuri). Annual or perennial with large flowers, solitary or in dichasia; dioecious (except $S$. noctiflora). Petal-limb bifid; coronal scales prominent; claw auriculate; styles 5 ( 3 in S. noctiflora). Capsule without basal septa, dehiscing with 6 or 10 teeth; carpophore very short.
104. S. noctiflora L., Sp. Pl. 419 (1753) (Melandrium noctiflorum (L.) Fries). Annual; stems up to 40 cm , erect, simple or with few basal branches, densely hairy below, viscid with abundant glandular hairs above. Leaves ovate or ovate-lanceolate; cauline sessile. Inflorescence few-flowered; flowers large,
hermaphrodite. Calyx $20-30 \mathrm{~mm}, 10$-veined; teeth long, slender. Petal-limb pink above, yellowish beneath, inrolled during day, opening (and scented) in evening; styles 3. Capsule ovoidconical, more or less enclosed by calyx, dehiscing with 6 teeth. $2 n=24$. A weed of cultivated ground, widespread in Europe, but absent from (or only casual in) much of the north and many islands. Au Be Br Bu Cr Cz Ga Ge He Ho Hs Hu It Ju Po Rm Rs (N, B, C, W, K, E) Tu [Da Hb Is No Su].
105. S. alba (Miller) E. H. L. Krause in Sturm, Deutschl. Fl. ed. 2, 5: 98 (1901) (Melandrium album (Miller) Garcke). Dioecious; short-lived perennial (sometimes annual) up to 80 cm , often much-branched, usually rather densely and softly hairy, and more or less glandular above. Leaves ovate or ovate-lanceolate; cauline sessile. Inflorescence a lax compound dichasium of large flowers, opening in the evening and slightly scented. Calyx of male flowers $15-22 \mathrm{~mm}$, 10 -veined; of female $20-30 \mathrm{~mm}, 20-$ veined, more or less inflated and accrescent in fruit; calyx-teeth narrowly triangular. Petals usually white; styles 5. Capsule $10-15 \mathrm{~mm}$, more or less ovoid, dehiscing with 10 teeth. Usually a weed of disturbed or cultivated ground. Almost throughout Europe. All except Az Bl Fa Is Sb ; probably not native in Hb .

1 Calyx eglandular; seeds with acute tubercles.
(c) subsp. eriocalycina

1 Calyx glandular; seeds with obtuse tubercles
2 Calyx-teeth obtuse; capsule-teeth erect $\quad$ (a) subsp. alba
2 Calyx-teeth acuminate; capsule teeth $\pm$ patent or recurved
(b) subsp. divaricata
(a) Subsp. alba: Fruiting calyx glandular, slightly accrescent; teeth obtuse. Capsule teeth erect on dehiscence. Seeds with plane faces and obtuse tubercles. $2 n=24$. Widespread.
(b) Subsp. divaricata (Reichenb.) Walters, Feddes Repert. 69: 48 (1964) (Lychnis divaricata Reichenb., Lychnis macrocarpa Boiss. \& Reuter, Melandrium boissieri Schischkin, M. latifolium (Poiret) Maire): Fruiting calyx glandular, strongly accrescent and inflated; teeth very long, acuminate. Capsule-teeth more or less patent or recurved on dehiscence. Seeds with concave faces and obtuse tubercles. $2 n=24$. Mediterranean region.
(c) Subsp. eriocalycina (Boiss.) Walters, Feddes Repert. 69: 48, (1964) (Melandrium eriocalycinum Boiss.): Like (a) but calyx eglandular and seeds with acute tubercles. E. Mediterranean region. (S.W. Asia.)

Melandrium glutinosum Rouy, Bull. Soc. Bot. Fr. 41 : 325 (1894), is recorded from Portugal and Spain. It is said to differ in its very viscid stems, its (often) pink flowers opening in the daytime, and its smaller capsule. The density of glandular-hairiness and the petal-colour of $S$. alba vary elsewhere in the Mediterranean region, however, and the species needs further investigation.

Melandrium astrachanicum Pacz., Mém. Soc. Nat. Kieff 12 (1): 107 (1892), from south-east Russia (Astrakhan'), is said to differ in its smaller size, narrower leaves and eglandular calyx.
106. S. dioica (L.) Clairv., Man. Herb. 145 (1811) (Melandrium dioicum (L.) Cosson \& Germ., Melandrium rubrum (Weigel) Garcke, Melandrium silvestre (Schkuhr) Röhling). Like 105 but always perennial; stems eglandular or almost so; leaves broadly ovate; flowers usually red, open in daytime; calyx $10-$ 15 mm , teeth broadly triangular; capsule $10-15 \mathrm{~mm}$, globose to broadly ovoid, dehiscing with recurved teeth. $2 n=24$. Usually in woodland. Most of Europe, but rare in the south and absent from most of Russia. Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu Is It Ju Lu No Po Rm Rs (N, B, C, W) Su.

Widespread and variable in habit; dwarf plants occur on mountains and exposed rocks.

Hybrids with 105, usually having pale pink flowers, occur frequently where the two species meet; they are fully fertile.
107. S. heuffelii Soó, Feddes Repert. 69: 48 (1964) (Melandrium nemorale Heuffel ex Reichenb.). Like 105 but usually biennial; calyx 10-12(-15) mm, sparsely hairy, inconspicuously 10 -veined, broadly campanulate in fruit, with triangular teeth; capsule c. 10 mm , subglobose, dehiscing with recurved teeth. Woods in hilly regions. - N. part of Balkan peninsula; E. Carpathians. Al Bu Ju Rm.

Resembles 105 in habit and flower colour, but 106 in capsule; the calyx, particularly in fruiting specimens, distinguishes it from both.
108. S. diclinis (Lag.) M. Laínz, Bol. Inst. Estud. Astur. (Supl. Ci.) 6: 45 (1963) (Lychnis diclinis Lag., Melandrium dicline (Lag.) Willk.). Dioecious; rhizomatous perennial with decumbent, branched stems up to 20 cm , bearing lanceolate 1 -veined leaves and clothed with long, soft, white eglandular hairs. Flowers usually solitary in leaf-axils; pedicels long. Calyx of female flowers $11-14 \mathrm{~mm}$; of male flowers $9-10 \mathrm{~mm}$. Petal-limb deep pink, shallowly bifid (for up to $\frac{1}{4}$ of its length) in female flowers, emarginate and smaller in male; coronal scales prominent, lanceolate, acute; petal-claw long; auricles acute; filaments glabrous; styles 5, hairy. Capsule c. 8 mm , ovoid; carpophore less than 1 mm . Seeds $1 \cdot 5-2 \mathrm{~mm}$, pale, reniform, with convex face and rounded back, tuberculate. Mountain rocks. - E. Spain (near Jativa). Hs.

Sect. Rigidulae (Boiss.) Schischkin. Annual; stems branched, rigid, often filiform, viscid above. Cauline leaves usually fasciculate. Inflorescence very lax, composed of divaricately branched equal dichasia; pedicels usually 1-4 times as long as calyx. Calyx not inflated or contracted at mouth in fruit. Seeds broadly reniform, with flat or slightly convex faces.
109. S. portensis L., $S p$. Pl. ed. 2,600 (1762). Stems $15-40 \mathrm{~cm}$, usually divaricately branched, puberulent or glabrous. Rosetteleaves oblong-spathulate, obtuse, rarely persistent; cauline linear, acute. Calyx 11-16 mm, clavate in fruit, glabrous; teeth short, ovate, obtuse or apiculate. Petal-limb c. 6 mm , bifid to about half-way, pink, rarely whitish; claw slightly exserted. Capsule $5-6 \mathrm{~mm}$; carpophore $6-9 \mathrm{~mm}$, pubescent. Seeds $0.75-1 \mathrm{~mm}$, blackish to pale brown; faces slightly concave, striate, with subconical tubercles at edge; back wide, plane or slightly convex, with 1 or 2 rows of subconical tubercles. S.W. Europe. ?Co Ga Hs It Lu.

Plants from Greece and Kriti (that appear to be introduced) with capsules $6-10 \mathrm{~mm}$, equalling the carpophore in length, have usually been treated as distinct species, S. rigidula Sibth. \& Sm., Fl. Graec. Prodr. 1: 299 (1809), non L., but numerous intermediates occur. Plants from S. Greece (Korinthos) described as S. corinthiaca Boiss. \& Heldr. in Boiss., Fl. Or. suppl. 96 (1888) differ especially in having the back of the seed distinctly grooved, and require further investigation.
110. S. echinosperma Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8) : 78 (1849). Like 109 but usually taller; petal-limb white, with purplish veins; seeds $1-1.4 \mathrm{~mm}$; faces somewhat concavoconvex; back wider, with 4 rows of acute conical tubercles.

- S. Greece (Taïyetos). Gr.

111. S. pinetorum Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 75 (1849). Stems 5-20 cm, branched, puberulent below, glabrous above. Basal leaves often in a rosette, spathulate,
obtuse; uppermost linear-lanceolate, acute. Calyx 4-7(-7.5) mm, clavate in fruit, glabrous; teeth short, ovate, rounded. Petals pink; claw scarcely exserted; limb 2-3 mm, bifid. Capsule 3.54.5 mm ; carpophore $2-3 \mathrm{~mm}$, slender, glabrous. Seeds $0.6-$ 0.8 mm , pale brown; faces slightly concave, very finely striate; back very" wide, plane or slightly concave, smooth or finely striate. Kriti. Cr.
112. S. inaperta L., Sp. Pl. 419 (1753). Stems $15-40 \mathrm{~cm}$, erect, often simple below, divaricately branched above, puberulent. Leaves all narrowly linear, acute. Calyx $7-10 \mathrm{~mm}$, oblong-clavate in fruit, glabrous; teeth short, ovate, acute or apiculate. Petals absent or included in calyx. Capsule $5-8 \mathrm{~mm}$; carpophore $2-$ 3.5 mm , stout, slightly pubescent. Seeds $0.6-0.8 \mathrm{~mm}$, dark chestnut or blackish-brown; faces more or less plane, striate; back narrow, more or less acutely grooved, striate. W. Mediterranean region; Portugal. Co Ga Hs It Lu.

Sect. Atocion Otth. Annual; stems erect, usually slender, not rigid, viscid above. Inflorescence a dichasial or monochasial cyme (except $S$. sedoides). Calyx not contracted at mouth in fruit. Seeds not winged.
113. S. fuscata Link in Brot., Fl. Lusit. 2: 187 (1804). Stems $10-45 \mathrm{~cm}$, simple or branched, not rigid, rather stout, ribbed or angled, pubescent with patent, stout, contorted hairs. Lower leaves oblong-lanceolate, undulate, sparsely hispid or subglabrous. Inflorescence several- to many-flowered, rather densely cymose-paniculate. Calyx $12-16 \mathrm{~mm}$, clavate in fruit, glandularpubescent, usually reddish; teeth ovate, obtuse. Capsule 68 mm ; carpophore $4.5-7 \mathrm{~mm}$, glabrous. Seeds $c .1 \mathrm{~mm}$, reniform; faces concavo-convex, or subexcavate, striate; back wide with shallow median groove. W. Mediterranean region; Portugal. ? Gr Hs It Lu Sa Si.
114. S. pseudatocion Desf., Fl. Atl. 1: 353 (1798). Stems 3060 cm , branched, pubescent with fine, patent hairs. Inflorescence a lax dichasium; pedicels $\frac{1}{4}-1 \frac{1}{4}$ as long as calyx. Calyx (13-)1820 mm , clavate in fruit, glandular-pubescent, greenish; teeth lanceolate, acute. Petal-limb c. 10 mm , entire, pink. Capsule $7-9 \mathrm{~mm}$; carpophore $9-10 \mathrm{~mm}$, pubescent. Seeds $1.5-1.75 \mathrm{~mm}$, reniform; faces very deeply excavate, striate; back very wide, plane or slightly concave, with 3-4 rows of low tubercles. Mallorca; one unconfirmed record from S. Spain. Bl ?Hs. (N. Africa.)
115. S. rubella L., Sp. Pl. 419 (1753) (incl. S. segetalis Dufour). Stems $10-50 \mathrm{~cm}$. Lower leaves oblong-spathulate, pubescent. Calyx whitish and reddish-tinged; teeth ovate-oblong, very obtuse. Petal-limb c. 4 mm , emarginate, pink. Capsule $7-8 \mathrm{~mm}$. Seeds $0.75-1 \mathrm{~mm}$, reniform, with wide notch; faces excavate, sharply ridged or striate; back moderately wide, deeply but obtusely grooved. W. Mediterranean region, extending to Portugal and S.E. Italy. Bl Co Hs It Lu Sa Si [Ju].
(a) Subsp. rubella: Stems often branched, always with short deflexed hairs above, often scabrid below. Leaves undulate. Flowers 2 to 4 together in usually long-stalked dichasia; lowest pedicels up to twice as long as calyx; upper shorter. Calyx 912 mm , subclavate in fruit, puberulent on veins, elsewhere scabrid, rarely glabrous. Carpophore $2-3.5 \mathrm{~mm}$, puberulent. Throughout the range of the species.
(b) Subsp. turbinata (Guss.) Chater \& Walters, Feddes Repert. 69: 48 (1964) (S. turbinata Guss.): Stems usually simple and glabrous. Leaves flat. Cymes laxer; pedicels longer. Calyx shorter, wider, glabrous. Capsule subsessile. Sicilia.
116. S.bergiana Lindman, ActaHorti Berg. 1(6): 3(1891). Like 115 (a) but calyx $8-9 \mathrm{~mm}$, greenish; petal-limb c. 2 mm , deeply bifid; capsule wider; carpophore shorter. - Portugal. Lu.

Described from plants raised from seed gathered wild in Portugal, and not found since.
117. S. insularis W. Barbey, Bull. Soc. Vaud. Sci. Nat. ser. 3, 21: 220 (1886). Stems 5-15 cm, procumbent-ascending, branched, pubescent with patent hairs. Flowers $2-5$ in lax, raceme-like monochasial cymes; pedicels $1-3$ times as long as calyx. Calyx $6-10 \mathrm{~mm}$, oblong-ovoid in fruit; teeth ovate, obtuse. Petal-limb 2 mm , entire, pink. Capsule c. 8 mm ; carpophore $1-2 \mathrm{~mm}$, stout. Seeds $c .1 \cdot 5 \mathrm{~mm}$, subglobose, umbilicate at hilum. - $S$. Aegean region (Karpathos). Cr .
118. S. divaricata Clemente, Elench. Horti Matrit. 103 (1806) (incl. S. willkommiana Gay, S. ramosissima sensu Willk., non Desf.). Stems $10-20 \mathrm{~cm}$, branched, terete, densely hirsute with long patent hairs. Inflorescence lax, irregularly dichotomously and divaricately branched; pedicels mostly 1-3 times as long as calyx. Calyx (11-)13-15 mm, clavate in fruit, hirsute, usually tinged with red; teeth ovate, acute. Petal-limb very short, emarginate, pink. Capsule 10-11 mm; carpophore 3-4 mm, very stout, glabrous. Seeds $0.75-1 \mathrm{~mm}$, reniform; faces excavate, obtusely ridged; back wide, shallowly grooved. S. Spain. Hs. (N.W. Africa.)
119. S. integripetala Bory \& Chaub. in Bory, Expéd. Sci. Morée 3 (2): 123 (1832). Stems $10-40 \mathrm{~cm}$, usually branched, pubescent with rather thick, patent or ascending hairs. Lower leaves often crowded. Inflorescence few- to many-flowered, lax, dichotomously branched; pedicels $\frac{1}{2}-3$ times as long as calyx. Calyx $13-17 \mathrm{~mm}$, narrowly clavate in fruit, reddish, shortly glandularpubescent; teeth ovate, obtuse. Petal-limb 6-10 mm, entire, pink. Capsule $7-8 \mathrm{~mm}$; carpophore $7-8 \mathrm{~mm}$, slender, glabrous. Seeds $0.6-0.75 \mathrm{~mm}$, reniform; faces slightly concave, striate; back not wide, shallowly grooved. - S. Greece, from $37^{\circ} 30^{\prime} \mathrm{N}$. southwards. Gr.
120. S. sedoides Poiret, Voy. Barb. 2: 164 (1789). Stems 5-$20(-30) \mathrm{cm}$, usually much-branched, erect, slender, densely pubescent with patent hairs. Inflorescence profusely and divaricately branched, the branches forming raceme-like monochasial cymes; pedicels mostly 1-2 times as long as calyx, patent in fruit. Calyx $6-8(-9) \times 2-3(-3 \cdot 5) \mathrm{mm}$, oblong-clavate in fruit, shortly and stiffly pubescent, greenish, rarely reddish; teeth ovate, obtuse or subacute. Petal-limb short, reddish or whitish. Capsule $5-6 \mathrm{~mm}$; carpophore $1.5-2 \mathrm{~mm}$. Seeds $0.3-0.5 \mathrm{~mm}$, reniform; faces slightly concave, striate; back wide, obtusely grooved. Mediterranean region; local and mainly on islands. $\mathrm{Al} \mathrm{Bl} ? \mathrm{Co} \mathrm{Cr}$ Ga Gr Hs It Ju Sa Si.
121. S. pentelica Boiss., Diagn. Pl. Or. Nov. 2 (8): 74 (1849). Like 120 but inflorescence a more or less regular dichasium; pedicels erect in fruit; calyx usually reddish-tinged; capsule (5-)6-7.5 mm, often exceeding calyx by c. 2 mm ; carpophore $2-2.5 \mathrm{~mm}$; seeds $0.5-0.75 \mathrm{~mm}$, more acutely striate on face and with slightly narrower back. E. Greece (E. Attika and Evvoia). Gr.
122. S. haussknechtii Heldr. ex Hausskn., Mitt. Thür. Bot. Ver. nov. ser. 5: 51 (1893). Like 120 but inflorescence a very lax, more or less regular dichasium; pedicels erect in fruit; calyx $7-10 \mathrm{~mm}$, clavate in fruit; carpophore $2-3 \mathrm{~mm}$; seeds $0.75-1 \mathrm{~mm}$; back narrow, obtusely grooved. Mountains of C. Greece (Pindhos). Gr.
123. S. laconica Boiss. \& Orph. in Boiss., Diagn. Pl. Or. Nov. 3 (6): 34 (1859). Like 120 but inflorescence a more or less regular dichasium; pedicels erect in fruit; flowers larger; calyx usually reddish-tinged; petal-limb bilobed; carpophore more than 4 mm , equalling capsule. - S. Greece (Parnon). Gr.

Sect. Behenantha Otth. Annual; stems usually glabrous and viscid above. Calyx contracted at mouth in fruit.
124. S. cretica L., Sp. Pl. 420 (1753) (S. clandestina Jacq.; incl. S. annulata Thore and S. tenuiflora Guss.). Stems (15-)3060 cm , usually branched, erect, puberulent at base with deflexed hairs, glabrous above, rarely entirely glabrous. Flowers in lax, usually narrow dichasia; pedicels $2-5$ times as long as calyx. Calyx $9-16 \mathrm{~mm}$, ovoid in fruit; teeth triangular, acute or acuminate. Petal-limb large, emarginate or bifid. Capsule $7-10 \mathrm{~mm}$; carpophore $1-5 \mathrm{~mm}$, glabrous. Seeds $0.75-2 \mathrm{~mm}$, reniform; faces slightly concave, tuberculate-ridged; back wide, plane or slightly concave, with 3 or 4 rows of low, rounded tubercles. Native in E. Mediterranean region, S. Italy and Sicilia; perhaps native in the Iberian peninsula. Widely introduced elsewhere in $S$. \& C. Europe as a weed of flax-fields and naturalized in much of the south; casual further north. *Al Bu Cr Gr *Hs It *Lu Si Tu [Au Co Ga Ge He Ju Sa].

Plants from Greece and Italy with the calyx $14-16 \mathrm{~mm}$, the carpophore $4-5 \mathrm{~mm}$, the capsule c. 10 mm and the seeds $c$. 0.75 mm have been separated as S. tenuiflora Guss., Pl. Rar. 177 (1826). A predominantly western variant with the petals very deeply bifid, the carpophore less than 2 mm , the capsule $7-8 \mathrm{~mm}$, and the seeds $c .2 \mathrm{~mm}$, has been separated as $\mathbf{S}$. annulata Thore, Essai Chlor. Land. 173 (1803) (S. cretica subsp. annulata (Thore) Hayek). These variations are of a clinal nature, and the variants do not merit subspecific status.
125. S. ungeri Fenzl in Unger, Wiss. Ergeb. Reise Griech. 136 (1862) (S.aetolica Heldr.). Stems $15-40 \mathrm{~cm}$, often branched, erect, puberulent at base with deflexed hairs, glabrous and very viscid above, often purplish. Flowers in 3- to 12 -flowered dichasial cymes; pedicels shorter than, or up to c. 4 times as long as calyx. Calyx $14-17 \mathrm{~mm}$, clavate, glabrous; teeth ovate, acute or acuminate, often patent; veins distinctly anastomosing above, reddish. Petal-limb $7-8 \mathrm{~mm}$, emarginate, crimson. Capsule $8-11 \mathrm{~mm}$; carpophore $6-8 \mathrm{~mm}$. Seeds c. 1 mm , reniform; faces concave, tuberculate-ridged; back not wide, more or less plane, with 3 rows of rounded tubercles. - W. Greece and S. Albania. Al Gr.
126. S. graeca Boiss. \& Spruner in Boiss., Diagn. Pl. Or. Nov. 1 (1): 36 (1843). Whole plant glabrous; stems (10-)20-40(-60) cm, usually branched, erect. Leaves glaucous; cauline dense but not usually overlapping. Inflorescence dichotomously branched at base with 1 alar flower and 2 equal, raceme-like, monochasial cymes; pedicels very short; flowers not overlapping. Calyx 915 mm , oblong-subclavate in fruit; teeth ovate, obtuse, usually greenish. Petals white or flesh-coloured; limb $5-10 \mathrm{~mm}$, bifid. Capsule $6-9 \mathrm{~mm}$, ovoid-oblong; carpophore $2-4 \mathrm{~mm}$, stout. Seeds $1-1.3 \mathrm{~mm}$, reniform; faces slightly concave, tuberculatestriate; back very wide, more or less plane, with 4 or 5 rows of low rounded tubercles. W. part of Balkan peninsula. Al Gr Ju .
127. S. muscipula L., Sp. Pl. 420 (1753) (S. arvensis Loscos, non Salisb.). Stems $15-40 \mathrm{~cm}$, usually simple below, erect, glabrous, rather rigid. Cauline leaves dense, always imbricate throughout most of stem. Inflorescence a more or less regularly branched dichasium; internodes rather long; branches strict; pedicels all very short. Calyx $13-17 \mathrm{~mm}$, oblong-clavate; veins
prominent, greenish or reddish, anastomosing; teeth ovatelanceolate, acute. Petal-limb deeply emarginate, pink. Capsule $8-10 \mathrm{~mm}$, oblong; carpophore $3-6(-7) \mathrm{mm}$, pubescent. Seeds $0 \cdot 9-1 \cdot 1 \mathrm{~mm}$, reniform; faces plane, striate, tuberculate on edge; back narrow, obtusely grooved. Mediterranean region; Portugal. Ga Gr Hs It Lu Si .
S. corymbifera Bertol., Fl. Ital. 4: 591 (1841) endemic to N.W. Italy (Liguria), has pubescent-scabrid stems and calyx-veins, fewer flowers, and narrower and more acute leaves. Its status is uncertain.
128. S. stricta L., Cent. Pl. 2: 17 (1756). Like 127 but calyx with 5 herbaceous wings; calyx-teeth lanceolate-acuminate; capsule ovoid-conical, attenuate above; seeds c. 0.75 mm , with subacute tubercles on sides of faces and on back. S. Spain; Portugal. Hs Lu. (N. Africa.)
129. S. behen L., Sp. Pl. 418 (1753) (incl. S. reinholdii Heldr.). Whole plant glabrous; stems $15-20 \mathrm{~cm}$, simple or branched, rather stout, erect or ascending. Cauline leaves glaucous, usually imbricate. Inflorescence a lax dichasium; lowest pair of internodes of fruiting inflorescence $5-10 \mathrm{~cm}$; next pair also long; flowers not overlapping; pedicels stout, usually shorter than calyx. Calyx $11-17 \mathrm{~mm}$, ovoid in fruit, whitish, with reddish anastomosing veins above; teeth ovate, obtuse; petal-limb 36 mm , pink. Capsule 9-10 mm, ovoid; carpophore 1-2 mm, very stout. Seeds c. 1.5 mm , reniform; faces concavo-convex, strongly tuberculate-ridged; back wide, plane or slightly convex, with 4 rows of acute, conical tubercles. C. \& E. Mediterranean region. Cr Gr It Sa Si Tu .
130. S. holzmannii Heldr. ex Boiss., Fl. Or. suppl. 91 (1888). Like 129 but lowest pair of internodes of fruiting inflorescence $2-4 \mathrm{~cm}$; next pair very short; flowers (except the lowest one) overlapping; petals smaller; limb scarcely exserted; seeds echinate with parallel-sided spines. - S. Aegean region. Gr.

Sect. Lasiocalycinae Chowdhuri. Annual. Veins of calyx papillose-scabrid or with ascending bulbous-based hairs; calyx contracted at mouth in fruit.
131. S. linicola C. C. Gmelin, Fl. Bad. 4: 304 (1826). Whole plant scabrid-puberulent; stems erect, slender, with deflexed scales or hairs, simple below, strictly branched above. Inflorescence a lax, subcorymbose, more or less regularly-branched dichasium; pedicels $\frac{1}{2}-3$ times as long as calyx. Calyx $11-14 \mathrm{~mm}$, broadly clavate in fruit, with ascending scales or hairs; veins broad, green, anastomosing; teeth triangular-ovate, obtuse. Petal-limb 2-4 mm, pink. Capsule 9-11 mm, ovoid; carpophore $3-5 \mathrm{~mm}$. Seeds $1.75-2 \mathrm{~mm}$, reniform; faces deeply excavate, ridged-striate; back very wide, slightly concave. Flax-fields. France, Germany, Austria, N. Italy. Au Ga Ge It.
S. crassipes Fenzl, Pugillus 8 (1842) from Syria and Palestine, is closely related to 131 and has been reported from cultivated fields in Thrace. It has broader leaves, shorter pedicels, and a denser inflorescence; the calyx is more densely papillose, and the capsule is slightly wider.
132. S. echinata Otth in DC., Prodr. 1: 380 (1824). Stems $20-$ 60 cm , simple or branched, puberulent to pubescent-hispid with deflexed (or the longer patent) hairs. Inflorescence irregularly dichotomously branched; flowers subsessile, 4-6 in rather dense, long-stalked dichasia. Calyx $15-20 \mathrm{~mm}$, clavate in fruit, greenish, sometimes purplish above; teeth ovate-lanceolate, acute; hairs on
veins $c .1 .5 \mathrm{~mm}$, narrow, with bulbous base shorter than narrow distal part. Petal-limb $6-8 \mathrm{~mm}$, pink or whitish. Capsule (7-)811 mm , ovoid-oblong; carpophore (5-)7.5-9 mm, glabrous. Seeds $0.6-0.8 \mathrm{~mm}$, reniform; faces plane or slightly concave, tuberculate; back concave or grooved, not wide. - C. \& S. Italy. It.
133. S. squamigera Boiss., Diagn. Pl. Or. Nov. 1 (1): 38 (1843). Like $\mathbf{1 3 2}$ but branches more patent; flowers in lax, indistinct dichasia; calyx $14-15 \mathrm{~mm}$, teeth ovate, obtuse; hairs on veins c. 1 mm , with bulbous base longer than narrow distal part; carpophore pubescent; seeds $1-1.25 \mathrm{~mm}$, with radially elongated tubercles on face. C. \& S. Greece. Gr.
134. S. trinervia Sebastiani \& Mauri, Fl. Roman. 152 (1818). Stems $20-60 \mathrm{~cm}$, usually divaricately branched, pubescent with appressed hairs. Inflorescence of one to several 3- to 8flowered, long-stalked raceme-like monochasial cymes; flowers subsessile, usually slightly overlapping. Calyx $13-20 \mathrm{~mm}$, clavate in fruit, greenish; hairs on veins less than 1 mm , relative length of bulbous base variable. Petal-limb c. $6-7 \mathrm{~mm}$, pink. Capsule $8-$ 10 mm ; carpophore $5-8 \mathrm{~mm}$, pubescent, slender. Seeds 0.75 0.9 mm , reniform; faces slightly concavo-convex, tuberculateridged; back wide, more or less plane, with 4 rows of low, rounded tubercles. Balkan peninsula, extending to S.W. Romania and C. Italy. Al Bu Cr Gr It Ju Rm.

Sect. Eudianthe (Reichenb.) A. Braun. Annual. Inflorescence a very lax irregular several-flowered dichasium; lower pedicels 4-10, upper 2-6 times as long as calyx. Styles 5. Capsule dehiscing with 5 bifid teeth. Seeds $0.6-1 \mathrm{~mm}$, subreniform, more or less umbilicate at hilum; faces convex, with obtuse conical tubercles; back very broad and convex, with acute tubercles.
135. S. laeta (Aiton) Godron in Gren. \& Godron, Fl. Fr. 1 : 220 (1847) (Eudianthe laeta (Aiton) Willk.; incl. S. loiseleurii Godron). Whole plant glabrous, or upper part of stems, pedicels and calyx-veins sparsely spinulose-papillose (var. loiseleurii (Godron) Rouy \& Foucaud). Leaves linear-lanceolate. Calyx $6-10 \mathrm{~mm}$, broadly campanulate and widest at mouth in fruit; bands of thickened tissue present between veins; tube 2-3 times as long as the triangular-acuminate, often patent teeth. Petal-limb 4-10 mm, pink. Capsule 5-10 mm, globose to ovoid; carpophore 1-2 mm, glabrous. Damp places. S.W. Europe, extending eastwards to Italy. Co Ga Hs It Lu Sa.
136. S. coeli-rosa (L.) Godron in Gren. \& Godron, op. cit. 221 (1847) (Eudianthe coeli-rosa (L.) Reichenb.). Whole plant glabrous. Stems $20-50 \mathrm{~cm}$. Leaves linear-lanceolate. Calyx $15-28 \mathrm{~mm}$, subclavate and contracted at mouth in fruit, deeply sulcate between veins, with transverse undulations on each side of the grooves; tube 2-3 times as long as the linear, acuminate or acute, usually patent teeth; petal-limb $1-2 \mathrm{~cm}$, pink. Capsule (7-)1017 mm ; carpophore ( $5-$ ) $7-12 \mathrm{~mm}$, glabrous. S.W. Europe, extending eastwards to Italy. Co Hs It Lu Sa Si [Al Au Ju].

Sect. Erectorefractae Chowdhuri. Annual; stems glandularpubescent. Inflorescence of raceme-like monochasial cymes, or dichasial; angle of pedicels to axis changing after flowering. Calyx usually contracted at mouth.
137. S. pendula L., Sp. Pl. 418 (1753). Stems $15-40 \mathrm{~cm}$, pro-cumbent-ascending, branched, pubescent. Cauline leaves $2-$ 5 cm , ovate to ovate-lanceolate, acute, pubescent. Inflorescence
very lax, of raceme-like monochasial cymes. Pedicels usually erect in flower, patent or deflexed in fruit. Calyx $13-18 \mathrm{~mm}$, obovoid in fruit, contracted at mouth, very inflated and loose, with wide hyaline bands between the prominent narrow veins; teeth short, ovate- or triangular-obtuse. Petal-limb 7-10 mm, pink, rarely white. Capsule $9-12 \mathrm{~mm}$, ovoid-conical; carpophore 3-6 mm. Seeds $1 \cdot 3-1.4 \mathrm{~mm}$, subglobose, blackish, faces convex or plano-convex with concentric rings of small tubercles; back convex or plano-convex, with $7-8$ rows of tubercles. S. part of Mediterranean region; widely introduced elsewhere and sometimes naturalized. Cr It Si [Au Cz Ju Rm Rs (C, W)].
138. S. psammitis Link ex Sprengel, Novi Provent. 39 (1819) (S. agrostemma Boiss. \& Reuter; incl. S. lasiostyla Boiss.). Stems $10-20 \mathrm{~cm}$, ascending, much-branched, glandular-pubescent. Basal and lower cauline leaves usually $1-3 \mathrm{~cm}$, linear-lanceolate or linear, somewhat fleshy, often crowded. Inflorescence a fewflowered, usually condensed monochasial cyme; lower pedicels usually longer than calyx, erect in flower, patent or deflexed in fruit. Calyx $13-18 \mathrm{~mm}$, contracted at mouth, straight, less distinctly inflated in fruit than in 137, with wide hyaline bands between the prominent narrow veins. Petals pink, rarely white. Capsule $9-12 \mathrm{~mm}$; carpophore $3-6 \mathrm{~mm}$, glabrous. Seeds $0.8-$ 1.2 mm , otherwise like those of 137. C. \& S. Spain; N. \& C. Portugal. Hs Lu.
139. S. littorea Brot., Fl. Lusit. 2: 186 (1804). Stems $5-15 \mathrm{~cm}$, ascending, much-branched, glandular-pubescent. Basal and lower cauline leaves oblong-obovate to linear-oblong. Inflorescence a few-flowered, usually condensed leafy monochasial cyme; lower pedicels usually equalling or shorter than the calyx. Calyx $10-$ 19 mm , subclavate but not loose and inflated in fruit, with narrow hyaline bands; not or scarcely contracted at mouth. Capsule $6-9 \mathrm{~mm}$; carpophore ( $2 \cdot 5-$ )4-9 mm. Seeds $0 \cdot 6-0 \cdot 8 \mathrm{~mm}$, reniform; faces slightly convex, reticulate-pitted, rather smooth; back not very wide, slightly grooved or plane, smooth. Maritime sands. S.W. Europe. Bl Hs Lu.
140. S. adscendens Lag., Gen. Sp. Nov. 15 (1816). Like 138 but stems $15-30 \mathrm{~cm}$, pubescent with a mixture of long glandular and short eglandular hairs; inflorescence lax; calyx not inflated, with narrow hyaline bands, curved in fruit and slightly contracted at mouth; carpophore c. 7 mm ; seeds $c .0 .9 \mathrm{~mm}$, otherwise like those of 139. - S.E. Spain. Hs.
141. S. boissieri Gay in Cosson, Not. Pl. Crit. 32 (1849). Stems $10-20 \mathrm{~cm}$, erect, usually branched. Basal leaves ovatespathulate; cauline linear-lanceolate to linear. Flowers 3-8 in more or less regular dichasia, sometimes solitary; pedicels of lower flowers often equalling, or of the upper shorter than calyx, usually nodding in flower, erect in fruit. Calyx $11-15 \mathrm{~mm}$, oblong in flower, ovoid in fruit, toothed for $\frac{1}{4} \frac{1}{3}$ of its length with lanceolate-acute or triangular-acuminate teeth; veins rather wide, not or obscurely anastomosing. Petal-limb 3-4 mm, white; claw exserted. Capsule $8-11 \mathrm{~mm}$, ovoid; carpophore $2-4 \mathrm{~mm}$, glabrous. Seeds c. 1 mm , reniform, chestnut or blackish-brown; faces slightly concavo-convex, tuberculate-ridged; back wide, more or less plane, with 3-4 rows of tubercles. - S. Spain. Hs.
142. S. almolae Gay in Cosson, op. cit. 31 (1849). Like 141 but stems always simple, less viscid, sometimes subglabrous in part; calyx (12-)15-18 mm, toothed for $\frac{1}{6}-\frac{1}{4}$ of its length with triangular, acute teeth; veins more distinctly anastomosing; petals very pale pink; claw included; seeds up to $c .1 .4 \mathrm{~mm}$, with 2 rows of tubercles on back. - C. \& S. Spain. Hs.

Sect. Dichotomae (Rohrb.) Chowdhuri. Annual; stems erect, pubescent. Inflorescence branched, composed of raceme-like monochasial cymes. Calyx contracted at mouth in fruit, with prominent simple veins. Seeds reniform with plane or slightly concave, tuberculate faces, and bluntly tuberculate back.
143. S. dichotoma Ehrh., Beitr. Naturk. 7: 143 (1792). Stems $20-100 \mathrm{~cm}$, branched above, puberulent to hispid-pubescent. Lower leaves spathulate to lanceolate; cauline lanceolate. Inflorescence usually with alar flowers; branches 5- to 10-flowered; pedicels all very short; upper bracts small, ovate, scariousmargined. Calyx 7-15 mm, ovoid-oblong in fruit, not inflated, sparsely and shortly pubescent between veins, sparsely hispid on veins; teeth ovate-lanceolate, acute. Petal-limb $7-8 \mathrm{~mm}$, white, rarely pink; filaments and styles very long-exserted. Carpophore $1 \cdot 5-4 \mathrm{~mm}$, very stout, glabrous. Seeds $1 \cdot 1-1.4 \mathrm{~mm}$, blackishbrown. $2 n=24$. Native in E. \& S.E. Europe; widely introduced elsewhere. Bu Cr Gr Hu Ju Po Rm Rs (N, C, W, K, E) Tu [Ga Ge He It].
(a) Subsp. dichotoma: Basal leaves not in dense rosettes, green, pubescent. Flowers crowded, or sometimes separated by their own length; inflorescence $1-2(-3)$ times dichotomously branched; upper bracts not ciliate. Petal-limb bifid for $c . \frac{2}{3}$ of its length. Throughout the range of the species, except Greece and the Aegean region.
(b) Subsp. racemosa (Otth) Graebner in Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (2): 93 (1920): Basal leaves in dense rosettes, more or less densely grey-pubescent. Flowers less densely crowded; inflorescence often more branched; upper bracts ciliate. Petal-limb bifid almost to base. S.E. Europe.
144. S. remotiflora Vis., Fl. Dalm. 3: 166 (1852). Like 143 (a) but lower leaves ovate-lanceolate; cauline linear-lanceolate; inflorescence 1-3 times dichotomously branched, without alar flowers; flowers very remote, 1-3 on each branch; pedicels up to half as long as calyx; upper bracts larger, mostly equalling flowers; calyx scabrid between veins, serrate with ascending sharp teeth on veins. - W. part of Balkan peninsula. Al Gr Ju.

Sect. Scorpioideae (Rohrb.) Chowdhuri. Annual. Calyx not contracted at mouth in fruit; veins usually anastomosing. Seeds of various types, but never winged.
145. S. nicaeensis All., Mélang. Philos. Math. Soc. Roy. Turin (Misc. Taur.) 5: 88 (1774). Whole plant hirsute; stems 1040 cm , erect, stout, usually branched, viscid. Lower leaves linear-spathulate to oblong-lanceolate; cauline linear-lanceolate to linear, often curved. Flowers on pedicels equalling or shorter than calyx, 2 to 8 together in sessile or shortly stalked subcapitate dichasia which are arranged, the lower remote, the upper overlapping, on long axes in a simple or branched inflorescence. Calyx $10-13 \mathrm{~mm}$, subclavate in fruit; teeth ovate, obtuse. Petal-limb very deeply bifid, with oblong-linear lobes, white or reddish-pink. Capsule $6-9 \mathrm{~mm}$, ovoid-oblong; carpophore $3 \cdot 5-5 \mathrm{~mm}$, pubescent. Seeds $0 \cdot 9-1 \cdot 1 \mathrm{~mm}$, reniform, dark brown; faces flat, finely striate; back narrow, more or less deeply grooved. Coastal sands. Mediterranean region, mainly in the west; Portugal. Bl Co Ga Gr Hs It Lu Sa Si.
146. S. scabriflora Brot., Fl. Lusit. 2: 184 (1804) (S. hirsuta Lag., non Poiret). Whole plant often densely villous, sometimes pubescent or subglabrous in part, hairs always more or less ascending; buds and shoot-apices always villous; stems $5-35 \mathrm{~cm}$, ascending or erect, branched. Flowers 4-9 in raceme-like monochasial cymes, all but the lower 1 or 2 usually overlapping and
subsessile; inflorescence usually branched, never with alar flowers. Calyx (11-)13-25 mm, clavate in fruit, usually villous; veins not anastomosing; teeth obtuse. Petal-limb $8-10 \mathrm{~mm}$, pale to deep red. Capsule 5-9 mm, ovoid-oblong; carpophore 7-16 mm. Seeds $0.6-0.8 \mathrm{~mm}$, reniform, brown, slightly pruinose; faces plane, ridged; back wide, plane or concave, tuberculate. Spain, Portugal. Hs Lu.
147. S. micropetala Lag., Gen. Sp. Nov. 15 (1816). Like 146 but calyx $10-15 \mathrm{~mm}$, cuneate-subclavate in fruit; veins usually anastomosing above; petal-limb up to 3 mm , white; capsule $9-10 \mathrm{~mm}$, oblong; carpophore $3-4 \mathrm{~mm}$; seeds with striate face and less strongly tuberculate back. C. \& S. Spain, Portugal. Hs Lu.
148. Silene discolor Sibth. \& Sm., Fl. Graec. Prodr. 1: 292 (1809). Like 146 but stems and calyx with both long, soft hairs and short, glandular hairs; plant never villous; calyx 1012 mm ; petal-limb $4-6 \mathrm{~mm}$, pink above, greenish beneath; capsule $7-8 \mathrm{~mm}$; carpophore 4 mm ; seeds $0.4-0.6 \mathrm{~mm}$, chestnutbrown; faces very finely striate; back narrow, concave or grooved, with a median row of low tubercles. Coastal sands. Kikhlades (Milos). Gr. (Asia Minor, Cyprus.)
149. S. obtusifolia Willd., Enum. Pl. Hort. Berol. 473 (1809). Plant never villous; stems $15-35 \mathrm{~cm}$, erect, branched, densely pubescent with patent or ascending hairs. All leaves except uppermost spathulate to obovate-spathulate, obtuse, rather thick; uppermost oblanceolate, obtuse; all ciliate. Inflorescence as in 146. Calyx $10-13(-14) \mathrm{mm}$, subclavate in fruit, pubescent with short ascending hairs; veins somewhat raised, usually reddish, anastomosing; teeth oblong, obtuse. Petals pink or white. Capsule $8-9 \mathrm{~mm}$, oblong; carpophore $3-5.5 \mathrm{~mm}$, puberulent. Seeds $0 \cdot 6-1 \mathrm{~mm}$, elongate-reniform, dark brown; faces excavate; back very wide, with an obtuse median groove. S.W. Spain, S.W. Portugal. Hs Lu.
150. S. sericea All., Fl. Pedem. 2: 81 (1785). Stems to 50 cm , pubescent, ascending, branched. Leaves linear-lanceolate. Flowers solitary and terminal at ends of stems, rarely 2 or 3 in a reduced monochasial cyme. Calyx $12-20(-23) \mathrm{mm}$; teeth lanceolate, acute or subobtuse. Carpophore 4-10(-12) mm. Seeds $1-$ 1.4 mm , reniform or elongate-reniform, dark brown; faces concave-excavate, striate; back grooved between rounded or angled (not winged and undulate) sides. Coastal sands. W. Mediterranean region. ?Bl Co ?Ga It Sa.

Often confused with 159 and best distinguished by the seeds.
151. S. nocturna L., Sp. Pl. 416 (1753). Stems $10-60 \mathrm{~cm}$, erect, usually branched. Lower leaves obovate- to lanceolate-spathulate, obtuse, pubescent. Flowers $5-15$ in raceme-like monochasial cymes, very densely crowded above, remote below (or flowers $1-5$ in the cymes, mostly remote, var. brachypetala (Robill. \& Cast.) Vis.); inflorescence usually compound, sometimes with alar flowers. Calyx ( $6-$ ) $9-13 \mathrm{~mm}$, oblong-obovoid in fruit, pubescent with ascending hairs; veins wide, green, anastomosing. Petal-limb bifid, exserted (or emarginate and included, var. brachypetala). Capsule $8-11 \mathrm{~mm}$, oblong or ovoid-oblong; carpophore $1-1.5 \mathrm{~mm}$, puberulent. Seeds reniform; faces exca-vate-auriculate; back wide, with shallow, tuberculate groove. Mediterranean region, extending to Portugal and N. Spain. Al Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.
(a) Subsp. nocturna: Plant usually fairly sparsely pubescent below. Flowers strict. Calyx-teeth usually triangular-acuminate or lanceolate and acute. Filaments glabrous. Seeds $0.5-0.7 \mathrm{~mm}$, blackish. Throughout the range of the species.
S. reflexa (L.) Aiton fil. in Aiton, Hort. Kew. ed. 2, 3: 86 (1811), non Moench, is probably a cleistogamous variant of $\mathbf{1 5 1}$ (a).
(b) Subsp. neglecta (Ten.) Arcangeli, Comp. Fl. Ital. 88 (1882) ( $S$. reflexa auct.). Plant usually densely hirsute below. Lower flowers often patent or deflexed. Calyx-teeth linear. Alternate filaments hairy at base. Seeds $0.8-0.9 \mathrm{~mm}$, reddish-brown. S. France, Italy, Sicilia.

Sect. Silene. Annual. Inflorescence of monochasial cymes. Calyx contracted at mouth in fruit. Carpophore pubescent. Seeds less than 1 mm , reniform, not winged.
152. S. ramosissima Desf., Fl. Atl. 1: 354 (1798). Whole plant viscid; stems $10-40 \mathrm{~cm}$, stout, erect, branched, villous. Leaves oblong-spathulate, obtuse, pubescent. Flowers in monochasial cymes; lower pedicels $1-5$ times as long as calyx. Calyx $9-12 \mathrm{~mm}$, cylindrical, becoming ovoid in fruit, hairy, toothed to $\frac{1}{4}$ with lanceolate-triangular, acute teeth. Capsule $8 \mathbf{- 1 0 ~ m m}$; carpophore $1 \cdot 5-2 \mathrm{~mm}$, stout. Seeds pale brown; faces more or less plane and smooth; back very narrow, deeply and acutely grooved. Maritime sands. S. Portugal, S. \& E. Spain. Hs Lu.
153. S. gallica L., Sp. Pl. 417 (1753) (S. anglica L.; incl. S. linophila Rothm.). Stems $15-45 \mathrm{~cm}$, erect, simple to muchbranched, pubescent, viscid above. Leaves pubescent. Flowers subsecund, in one to many raceme-like monochasial cymes; lower pedicels up to $1 \frac{1}{2}$ times as long as calyx, upper short. Calyx $7-10 \mathrm{~mm}$, cylindrical-ovoid, becoming ovoid in fruit, hispid, toothed for $\frac{1}{4}$ of its length with triangular, acute teeth; veins scarcely anastomosing. Petals white or pink (often with a crimson spot, var. quinquevulnera (L.) Koch); limb up to 6 mm , entire or emarginate. Capsule $6-9 \mathrm{~mm}$; carpophore 1 mm or less. Seeds dark brown; faces deeply concave, striate; back wide, plane. $2 n=24$. S. \& C. Europe, northwards to Denmark, Poland and C. Russia. Al Au Az Be Bl Br Bu Co Cr Cz Da Ga Gr ${ }^{*} \mathrm{Hb}$ He Ho Hs Hu It Ju Lu Po Rm Rs (C, W) Sa Si Tu.
154. S. giraldii Guss., Enum. Pl. Inar. 36 (1854). Like 153 but plant completely glabrous, not viscid; calyx often subclavate; carpophore up to 2 mm (usually more than 1 mm ). S. Italy; Sardegna. It Sa.
155. S. bellidifolia Juss. ex Jacq., Hort. Vindob. 3: 44 (1776) ( $S$. vespertina Retz.). Stems $30-60 \mathrm{~cm}$, erect; branched and pubescent or puberulent above; hispid and simple, rarely branched, below. Leaves sparsely hispid. Flowers subsessile, usually secund, in dense, raceme-like, long-stalked monochasial cymes. Calyx 14-17 cm, cylindrical-clavate, becoming clavate in fruit, villous. Petal-limb 3-5 mm, bifid, pink. Capsule $9-11 \mathrm{~mm}$; carpophore 4-5 mm. Seeds very small, dark brown; faces deeply concave, striate; back wide, shallowly and broadly grooved. Mediterranean region; Portugal. Al Bl Co Cr Gr Hs It Lu Sa Si Tu.
156. S. cerastoides L., Sp. Pl. 417 (1753). Whole plant somewhat hispid; stems up to 25 cm , often branched at base. Flowers in lax raceme-like monochasial cymes; pedicels not longer than calyx. Calyx $8-11 \mathrm{~mm}$, cylindrical-clavate, becoming very strongly contracted both above and below capsule in fruit, toothed for $\frac{1}{3}$ of its length with lanceolate, acute teeth; veins conspicuously anastomosing. Petal-limb small, bifid, pink. Capsule $6-8 \mathrm{~mm}$, shortly attenuate above; carpophore $2-4 \mathrm{~mm}$. Seeds dark brown; faces deeply concave, striate; back wide with narrow, shallow central groove. Mediterranean region; Portugal. Bl Gr Hs Ju Lu.
157. S. tridentata Desf., Fl. Atl. 1: 349 (1798). Whole plant hispidulous; stems $10-40 \mathrm{~cm}$, simple or branched. Flowers subsessile, in lax raceme-like monochasial cymes. Calyx $11-14 \mathrm{~mm}$, ellipsoid-cylindrical, becoming ovoid in fruit, not so strongly contracted as in 156, toothed to about half way, with acuminate or linear teeth; veins anastomosing. Petal-limb bifid, almost included in calyx, pink. Capsule $7-10 \mathrm{~mm}$, attenuate above; carpophore $1-2 \mathrm{~mm}$. Seeds dark brown; faces concave, striate; back wide, with wide shallow central groove. C., S. \& E. Spain. Hs. (N. Africa.)
158. S. disticha Willd., Enum. Pl. Hort. Berol. 476 (1809). Whole plant hispid; stems $20-40 \mathrm{~cm}$, erect, simple. Flowers subsessile or shortly pedicellate in 3 - to 8 -flowered subcapitate or fastigiate inflorescence. Calyx $8-9 \mathrm{~mm}$, ellipsoid, becoming ovoid and shortly clavate in fruit, toothed for $\frac{1}{4}$ of its length, with triangular, acute teeth; veins not anastomosing. Capsule $c$. 7 mm ; carpophore $1-2 \mathrm{~mm}$, stout. Seeds dark brown; faces concave, striate; back very wide, with wide, shallow groove. Islas Baleares; Portugal. Bl Lu.

Sect. Dipterospermae (Rohrb.) Chowdhuri. Annual. Inflorescence of various types. Calyx not or scarcely contracted at mouth in fruit. Seeds reniform with flat faces, back deeply and acutely grooved between two undulate wings.
159. S. colorata Poiret, Voy. Barb. 2: 163 (1789). Whole plant pubescent or puberulent. Stems $10-50 \mathrm{~cm}$, decumbent to erect, branched. Leaves linear to ovate-spathulate. Pedicels shorter than calyx; bracts of a pair usually unequal. Calyx 11-13 $(-17) \mathrm{mm}$, cylindrical, becoming broadly clavate in fruit; teeth ovate, obtuse, densely ciliate. Petal-limb 5-9 mm, pink or white. Capsule $7-9 \mathrm{~mm}$, ovoid; carpophore $5-7 \mathrm{~mm}$. Seeds $1-1.5 \mathrm{~mm}$, dark chestnut-brown. S. Europe. Al Bu Cr Gr Hs It Lu Sa Si Tu.

## Often confused with 150.

Plants from S. Italy, Sicilia and Greece with the calyx c. 10 mm , carpophore c. 4 mm and capsule c. 5 mm have been called S. canescens Ten., Prodr. Fl. Nap. xxv (1811), and may be worth subspecific rank.
160. S. secundiflora Otth in DC., Prodr. 1:375 (1824) (S. glauca Pourret ex Lag., non Salisb.). Like 159 but leaves usually ovatelanceolate and often subglabrous; lowest pedicels sometimes up to twice as long as calyx; bracts of a pair usually more or less equal; calyx $13-16 \mathrm{~mm}$; teeth lanceolate, acute; veins more conspicuously anastomosing; carpophore $4.5-6 \mathrm{~mm}$; seeds 2 mm or more. S. \& E. Spain; Islas Baleares. Bl Hs ?Lu.
161. S. apetala Willd., Sp.Pl. 2 (1) : 703 (1799) (incl. S. decipiens Barc., non Ball). Whole plant pubescent; stems $10-35 \mathrm{~cm}$, erect, branched, especially at base. Leaves lanceolate to linear-lanceolate; upper ovate-lanceolate. Lower pedicels as long or up to 3 times as long as calyx. Calyx $7-10 \mathrm{~mm}$, ellipsoid-cylindrical, becoming broadly campanulate in fruit; teeth triangular, acute. Petals absent, or included in calyx, or exserted, with bifid limb up to $c .3 \mathrm{~mm}$. Capsule $6-7.5 \mathrm{~mm}$; carpophore $1-2 \mathrm{~mm}$. Seeds 1 mm or less, dull blackish-brown. $S$. Europe. Al Bl Cr Gr Hs It Lu Sa Si .
162. S. longicaulis Pourret ex Lag., Gen. Sp. Nov. 15 (1816). Stems $10-40 \mathrm{~cm}$, simple or little-branched, pubescent or hispid, glabrescent above; upper internodes very long. Leaves ovate-lanceolate to subspathulate, pubescent. Lower pedicels (1-)2-5 times as long as calyx. Calyx $9-13 \mathrm{~mm}$, oblong-cylindri-
cal, becoming campanulate-subclavate in fruit, pubescent on veins or glabrous; teeth triangular, acute. Petal-limb c. 5 mm , bifid, pink. Capsule $7 \cdot 5-11 \mathrm{~mm}$; carpophore $2 \cdot 5-3.5 \mathrm{~mm}$. Seeds $1-1.5 \mathrm{~mm}$, chestnut-brown. Coastal sands. C. \& S. Portugal; S.W. Spain. Hs Lu.

Sect. Conomorpha Otth. Annual. Inflorescence of lax dichasia. Calyx $15-20$ - or 30 -veined; veins prominent, parallel. Seeds reniform; faces plane or slightly concave, usually striate; back wide with shallow groove.
163. S. ammophila Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 82 (1849). Whole plant grey-pubescent; stems up to 15 cm , branched at base, procumbent or ascending, viscid above. Lower leaves up to 1.5 cm , subobtuse. Flowers pink. Calyx cylindrical, becoming broadly campanulate in fruit, 15- to $20-$ veined; tube twice as long as the lanceolate, acute teeth. Capsule ovoid, subsessile. - S. Aegean region. Cr.
(a) Subsp. ammophila: Calyx $5-7 \mathrm{~mm}$. Petal-limb $1-2 \mathrm{~mm}$, emarginate. Capsule $3-4 \mathrm{~mm}$. Coastal sands. E. Kriti and Gaidhouronisi.
(b) Subsp. carpathae Chowdhuri, Notes Roy. Bot. Gard. Edinb. 22: 278 (1957): Calyx $7-9.5 \mathrm{~mm}$. Petal-limb $3-4 \mathrm{~mm}$, entire. Capsule 5-7 mm. Karpathos.
164. S. conica L., Sp. Pl. 418 (1753). Whole plant pubescent; dichasia 5 - to 30 -flowered. Calyx 30 -veined, toothed to $c$. $\frac{1}{3}$ with acuminate teeth, shortly pubescent, glandular or eglandular. Petal-limb $3-5 \mathrm{~mm}$. Capsule $7-12 \mathrm{~mm}$, obovoid-conical. Seeds $0 \cdot 75-1 \mathrm{~mm}$, pruinose. C. \& S. Europe, extending to Britain and Ukraine. Al Au Br Bu Cr Cz Ga Ge Gr Ho Hs Hu It Ju Rm Rs (W, K) Si Tu [Da He].
1 Carpophore 1-4 mm; calyx 13-18 mm
(b) subsp. subconica
1 Carpophore less than 1 mm ; calyx $8-15 \mathrm{~mm}$
2 Lower leaves obtuse; stems usually ascending (c) subsp. sartorii
2 Lower leaves acute; stems erect
(a) subsp. conica
(a) Subsp. conica: Stems $15-50 \mathrm{~cm}$, erect. Lower leaves oblong- to linear-lanceolate, acute. Calyx $10-15 \mathrm{~mm}$, obovoidcylindrical in flower, broadly obovoid in fruit. Petal-limb comparatively narrow, pink, rarely white, bifid. Capsule $7-12 \mathrm{~mm}$; carpophore less than $1 \mathrm{~mm} .2 n=20$. Almost throughout the range of the species, but absent from most of S.E. Europe and Ukraine.
(b) Subsp. subconica (Friv.) Gavioli in Fiori \& Beguinot, Sched. Fl. Ital. Exs. ser. 3, 16: 363 (1927) (S. subconica Friv.; incl. S. juvenilis Delile, S. tempskyana Freyn \& Sint.): Stems 1550 cm , erect. Lower leaves oblong- to linear-lanceolate, acute. Calyx 13-18 mm, cylindrical in flower, broadly obovoid in fruit. Petal-limb comparatively wide, pink, emarginate (claw sometimes much exceeding calyx, S. subconica var. grisebachii David.). Capsule $7-8 \mathrm{~mm}$; carpophore $1-4 \mathrm{~mm}$. Most of S.E. Europe and Ukraine.
(c) Subsp. sartorii (Boiss. \& Heldr.) Chater \& Walters, Feddes Repert. 69: 49 (1964) (S. sartorii Boiss. \& Heldr.): Stems 520 cm , usually ascending. Lower leaves obovate-spathulate, obtuse. Calyx $8-13 \mathrm{~mm}$, cylindrical in flower, obovoid in fruit. Petal-limb comparatively wide, pink, bifid. Capsule $8-10 \mathrm{~mm}$, ovoid-conical; carpophore less than $1 \mathrm{~mm} . S . W$. part of Aegean region.
165. S. lydia Boiss., Diagn. Pl. Or. Nov. 1 (1): 37 (1843). Like 164 (a) but stems more strongly pubescent and viscid above; upper cauline leaves long-acuminate; calyx with short glandular hairs and long eglandular hairs; teeth longer, often up to half as long as calyx. Balkan peninsula. Gr Ju ?Tu.
166. S. conoidea L., Sp. Pl. 418 (1753). Like 164 (a) but leaves less densely pubescent, often subglabrous, wider; calyx 1528 mm , attenuate above in flower; petal-limb entire or slightly emarginate; capsule $12-18 \mathrm{~mm}$, long-attenuate above; seeds $1 \cdot 25-1.5 \mathrm{~mm}$, dark chestnut-brown. Portugal and S. Spain; European Turkey; perhaps native in N.W. Italy; probably extinct in S.E. France. $\dagger \mathrm{Ga} \mathrm{Hs}^{*} \mathrm{It} \mathrm{Lu} \mathrm{Tu}. \mathrm{(S.W}. \mathrm{Asia)}$.

## 29. Cucubalus L. ${ }^{1}$

Like Silene but fruit indehiscent, somewhat fleshy and berrylike when ripe.

1. C. baccifer L., Sp. Pl. 414 (1753). Weak-stemmed pubescent perennial herb up to 120 cm , with divaricate branches. Leaves ovate, acuminate, entire; petioles short. Inflorescence a lax fewflowered dichasium with leaf-like bracts. Calyx $8-15 \mathrm{~mm}$, broadly campanulate, indistinctly veined, with five long obtuse teeth revolute in fruiting stage. Petals greenish-white, deeply bifid. Fruit 6-8 mm, black, globose; carpophore 2-3 mm. Seeds 1.5 mm , black. $2 n=24$. S. \& C. Europe, extending northwards to the Netherlands and to c. $58^{\circ} \mathrm{N}$. in C. Russia; absent from most of the islands. $\mathrm{Al} \mathrm{Au} \mathrm{Be}{ }^{*} \mathrm{Br} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Ho} \mathrm{Hu} \mathrm{It} \mathrm{Ju}$ Lu Po Rm Rs (B, C, W, K, E) Si Tu.

## 30. Drypis L. ${ }^{2}$

Perennial herb. Leaves and bracts spiny. Inflorescence subcapitate; flowers small. Petals with long claw and bifid limb; stamens 5; stigmas 3. Capsule 1(-2)-seeded, transversely dehiscent.

1. D. spinosa L., Sp. Pl. 413 (1753). Stems $8-30 \mathrm{~cm}$, numerous, stiff, much-branched, glabrous, quadrangular. Leaves spinoussubulate, canaliculate above. Inflorescence a subcapitate compound dichasium surrounded by spiny bracts. Calyx 5 -toothed. Petals very small and narrow, white or pinkish, with small coronal scales; anthers bluish. Capsule ovoid-ellipsoid. $2 n=60$. Open stony or gravelly habitats. S. Europe, from C. Italy to Greece. Al Gr It Ju.
(a) Subsp. spinosa (subsp. linneana Murb. \& Wettst.): Outer bracts lanceolate, with long terminal spine considerably exceeding flowers. Calyx membranous below. Limb of petal bifid to base; claw exceeding calyx. Mountain screes from $800-3000 \mathrm{~m}$. Throughout the range of the species, except N.W. Jugoslavia and N.E. Italy.
(b) Subsp. jacquiniana Murb. \& Wettst. ex Murb., Lunds Univ. Arsskr. 27: 161 (1891): Outer bracts ovate, with short terminal spine scarcely exceeding flowers. Calyx coriaceous. Limb of petal bifid half-way to base; claw equalling calyx. Coastal rocks, dunes, etc., from 0-800 m. N.E. Italy, N.W. \& W. Jugoslavia.

## 31. Gypsophila L. ${ }^{3}$

Annual or perennial herbs. Inflorescence dichasial, paniculate to capitate; bracts scarious. Epicalyx absent. Calyx 5 -veined, with scarious commissures. Petals exceeding calyx, usually gradually narrowed into claw; coronal-scales absent; claw unwinged; stamens 10; styles 2; stigmatic surface terminal. Capsule dehiscing with 4 teeth; carpophore absent. Seeds subreniform, flattened on both sides, with lateral hilum; embryo peripheral, with prominent radicle.

[^73]Literature: F. N. Williams, Jour. Bot. (London) 27: 321-9 (1889). G. Stroh, Beih. Bot. Centr. 59 в: 455-77 (1939). Y. I. Barkoudah, Wentia 9: 1-203 (1962).

1 Annual, without woody stock and vegetative stems
2 Leaves not more than 3 mm wide, linear
3 Calyx 2 mm , glandular-puberulent; petals emarginate

3 Calyx 2.5-4 mm, glabrous; petals entire 24. linearifolia

2 Leaves more than 3 mm wide, lanceolate
4 Plant glabrous
26. muralis

4 Stem villous or hispid
25. elegans

1 Perennial, with woody stock and vegetative stems
5 Flowers subsessile, in dense globose clusters
6 Stem not more than 20 cm , simple, with solitary flowercluster
14. petraea

6 Stem usually more than 20 cm , always branched
7 Branches of inflorescence glabrous; leaves $10-50 \mathrm{~mm}$, semiterete 10. struthium
7 Branches of inflorescence puberulent; leaves $20-100 \mathrm{~mm}$, linear-lanceolate
8 Bracts triangular-acute, entire; seeds with long, acute, conical tubercles 15. glomerata
8 Bracts ovate-orbicular, erose; seeds with obtuse tubercles
16. globulosa

5 Flowers distinctly pedicellate
9 Whole inflorescence, including calyx and pedicels, glabrous 10 Leaves 10 mm or more wide, 3- to 7 -veined
11 Petals emarginate; leaves ovate to oblong-lanceolate
21. perfoliata

11 Petals entire; leaves lanceolate to ovate-lanceolate
23. tomentosa

10 Leaves less than 10 mm wide, usually 1 -veined
12 Leaves $c .6 \times 0.5 \mathrm{~mm}$ 27. macedonica
12 Leaves 10 mm or more long and more than 0.5 mm wide
13 Inflorescence lax, paniculate or subcorymbose; pedicels usually twice as long as calyx or longer
14 Plant with procumbent rhizome; leaves usually subobtuse; calyx-teeth acute 4. repens
14 Plant without procumbent rhizome; leaves acute; calyx-teeth obtuse
15 Calyx $1.5-2 \mathrm{~mm}$ 17. paniculata
15 Calyx $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$ 12. patrinii
13 Inflorescence dense, corymbose; pedicels less than twice as long as calyx
16 Calyx not more than 2 mm ; leaves obtuse or subacute (Spain) 9. hispanic
16 Calyx 2 mm or more; leaves acuminate (not Spain)
17 Bracts and calyx-teeth ciliate; seeds with long, acute, conical tubercles
11. collina

17 Bracts and calyx-teeth not ciliate; seeds with obtuse tubercles
8. papillosa

9 Inflorescence glandular-hairy, at least in part
18 Inflorescence dense; pedicels not more than twice as long as calyx
19 Leaves 1 -veined, linear
20 Calyx $2-3 \mathrm{~mm}$, glabrous
7. fastigiata

20 Calyx $3-4.5 \mathrm{~mm}$, glandular-pubescent
13. uralensis

19 Most leaves 3(-5)-veined, not linear
21 Leaves oblanceolate to linear-oblanceolate, widest above the middle 5. altissima
21 Leaves lanceolate to linear-lanceolate, widest below the middle
20. acutifolia

18 Inflorescence lax; pedicels longer than calyx, usually more than twice as long
22 Leaves c. 0.5 mm wide 3. spergulifolia
22 Leaves more than 1 mm wide
23 Leaves not more than 10 mm ; inflorescence with not more than 10 flowers
24 Whole plant usually viscid-pubescent; petals pale purplish 1. nana
24 Plant hairy only in inflorescence; petals white 2. achaia
23 Leaves more than 10 mm ; inflorescence with more than 10 flowers
25 Leaves 10 mm or more wide
26 Seeds smooth; plant green
26 Seeds with blunt tubercles; plant glaucous
23. tomentosa
22. scorzonerifolia
25 Leaves less than 10 mm wide
27 At least some pedicels pubescent

28 Pedicels 2-3 times as long as calyx
28 Pedicels 5-10 times as long as calyx
27 All pedicels glabrous
29 Calyx $1 \cdot 5-2 \mathrm{~mm}$, teeth obtuse; petals linearspathulate 17. paniculata
29 Calyx 2-3 mm, teeth acute; petal-limb narrower than claw
19. belorossica

Sect. Gypsophila. Perennial. Stems up to 25 cm , usually procumbent or ascending. Leaves linear. Inflorescence usually lax or few-flowered. Pedicels mostly 2 or more times as long as calyx. Calyx campanulate. Capsule globose. Ovules 8-16.

1. G. nana Bory \& Chaub. in Bory, Expéd. Sci. Morée, 3 (2) 116 (1832). Whole plant viscid-pubescent (leaves very rarely glabrous), more or less caespitose; stock covered with brownish leaf-bases; stems $2-4(-15) \mathrm{cm}$, ascending. Leaves $5-10 \times 2-$ 3 mm , narrowly oblong, obtuse, rarely subacute. Flowers up to 10; pedicels mostly $2-3$ times as long as calyx. Calyx $4-5 \mathrm{~mm}$. Petals about twice as long as calyx, pale purplish. Seeds with long, acute, conical tubercles. Rock-crevices. - Mountains of S. Greece and Kriti. Cr Gr.
2. G. achaia Bornm., Feddes Repert. 25: 33 (1928). Like 1 but stock covered with whitish leaf-bases; stems $5-15 \mathrm{~cm}$, glabrous except in the inflorescence; leaves glabrous; pedicels often longer, glandular-pubescent; calyx 3-4 mm, glandular-pubescent; petals 2-3 $\frac{1}{2}$ times as long as calyx, white. Mountain rocks. - $S$. Greece (E. Akhaia). Gr.
3. G. spergulifolia Griseb., Spicil. Fl. Rumel. 1: 183 (1843). Densely caespitose; stems $5-25 \mathrm{~cm}$, much-branched, glabrous below, densely glandular-pubescent in the inflorescence. Leaves $5-15 \times c .0 .5 \mathrm{~mm}$. Pedicels glandular-pubescent. Calyx $2.5-$ 4 mm , sparsely glandular-pubescent. Petals twice as long as calyx, white or pale purplish. Seeds with flattened tubercles. - S. Jugoslavia, Albania. Al Ju.
4. G. repens L., $S p$. Pl. 407 (1753). Plant glabrous; rhizome much-branched, with numerous vegetative and flowering stems up to 25 cm . Leaves $10-30 \times 1 \cdot 5-3 \mathrm{~mm}$, often falcate. Inflorescence usually 5 - to 30 -flowered, subcorymbose; bracts scarious; pedicels mostly 2 or more times as long as calyx. Calyx 2.53.5 mm . Petals more than twice as long as calyx, white, lilac or pale purplish. Seeds with long, acute, conical tubercles. $2 n=34$. Calcicole. - Principal mountains of C. \& S. Europe from the Jura, Alps and Carpathians to N.W. Spain and C. Italy. Au Cz Ga Ge He Hs It Ju Po.

Sect. Corymbosae Barkoudah. Perennial; stems usually more than 25 cm . Inflorescence usually more or less corymbose; pedicels usually short and rigid. Calyx campanulate. Capsule globose. Ovules 8-24.
5. G. altissima L., Sp. Pl. 407 (1753) (incl. G. ucrainica Kleopow). Stock stout; stems $25-80 \mathrm{~cm}$, erect, branched above, glabrous below, glandular-pubescent above. Leaves $50-80 \times$ $5-20 \mathrm{~mm}$, oblanceolate to linear-oblanceolate, acute or subobtuse,

3(-5)-veined. Inflorescence dense; pedicels shorter than or equalling calyx, glandular-pubescent. Calyx $2-2.5 \mathrm{~mm}$; teeth ovate, obtuse. Petals $1 \frac{1}{2}-2$ times as long as calyx. S.\&E. Russia, W. Kazakhstan. Rs (C, W, E).
6. G. litwinowii Kos.-Pol., Sched. Herb. Fl. Ross. 8: 61 (1922). Like 5 but leaves $20-50 \times 2-4.5 \mathrm{~mm}$, linear to linear-lanceolate, obscurely veined; inflorescence a lax diffuse panicle; pedicels 2-3 times as long as calyx. - S.C. Russia (Zemljansk, N.W. of Voronež). Rs (C).

## Possibly a hybrid between 5 and 17.

7. G. fastigiata L., Sp. Pl. 407 (1753). Rhizome woody; stems $5-100 \mathrm{~cm}$, erect, often branched, glabrous below, glandularpubescent above and in the inflorescence; internodes longer than leaves. Leaves $20-80 \times 1-4 \mathrm{~mm}$, linear, obtuse or abruptly acute, 1 -veined. Flowers many, in a rather dense inflorescence; pedicels usually shorter than calyx, usually glabrous. Calyx $2-3 \mathrm{~mm}$, glabrous; teeth ovate, obtuse, not apiculate. Petals c. $1 \frac{1}{2}$ times as long as calyx, obovate, rounded at apex, white or pale purplish. Seeds with long, acute, conical tubercles. $2 n=34$. - Mainly in E.C. Europe, but extending locally to W. Germany, Sweden, arctic Russia, C. Ukraine and W. Jugoslavia. Au Cz Fe Ge Hu Ju Po Rm Rs (N, B, C, W) Su.

Towards the south-east plants become larger, and have laxer, densely pubescent inflorescences with pubescent pedicels and rather larger flowers (G. arenaria Waldst. \& Kit. ex Willd.), but these differences are mostly phenotypic, and the difference in size is the only character that remains constant in cultivation.
8. G. papillosa Porta, Atti Accad. Agiati ser. 3, 11 (2): 1 (1905) (G. glandulosa Porta, non Walpers, G. fastigiata auct. ital., non L.). Like 7 but entirely glabrous; internodes shorter than leaves; leaves linear-lanceolate, long-acuminate; calyx-teeth apiculate; petals emarginate; capsule purplish; seeds with obtuse tubercles. Calcareous, stony hills. N. Italy (near Garda). It.
9. G. hispanica Willk., Strand- Steppengeb. Iber. Halbins. 110 (1852). Plant glabrous; rhizome woody, branched; stems $20-$ 90 cm , ascending or erect, branched above. Leaves $20-30 \times$ $1-2 \mathrm{~mm}$, subtriquetrous or flat, obtuse or subacute. Inflorescence much-branched; flowers in long-pedunculate, dense corymbs; pedicels equalling or somewhat longer than calyx. Calyx 1.52 mm ; teeth oblong-lanceolate, subacute, obtuse or mucronate. Petals $c .3 \mathrm{~mm}$, cuneate, white. Seeds with long, acute, conical tubercles. - Gypsaceous soils. C., E. \& S. Spain. Hs.
10. G. struthium Loefl., Iter Hisp. 79, 303 (1758). Plant more or less caespitose, glaucous, glabrous; stems $30-100 \mathrm{~cm}$, ascending or erect, branched. Leaves $10-50 \mathrm{~mm}$, semiterete, 1 mm thick. Flowers in shortly pedunculate, dense, capitate clusters c. 1 cm in diameter, forming a diffuse, pyramidal panicle; bracts ovate to obovate, obtuse, ciliate; pedicels very short, sometimes glandular-pubescent. Calyx $2-3.5 \mathrm{~mm}$; teeth lanceolate, acute or obtuse, ciliate. Seeds with long, acute, conical tubercles. Gypsaceous soils. - C. \& S.E. Spain. Hs.
11. G. collina Steven ex Ser. in DC., Prod. 1: 352 (1824) ( $G$. dichotoma auct., non Besser). Like 7 but entirely glabrous; internodes shorter than leaves; leaves linear, long-acuminate; inflorescence denser, often subcapitate; calyx $2-2.5 \mathrm{~mm}$; teeth obtuse and mucronate, ciliate; seeds with long, acute, conical tubercles. S.E. Europe, from C. Romania to Krym. Rm Rs (K, W).
12. G. patrinii Ser. in DC., Prodr. 1: 353 (1824). Plant entirely glabrous; stems up to 50 cm , ascending or erect, often branched.

Leaves $10-50 \times 1-4 \mathrm{~mm}$, linear or linear-lanceolate, long-acuminate, flat or triquetrous. Inflorescence lax; pedicels 2-5 times as long as calyx. Calyx $2.5-3.5 \mathrm{~mm}$; teeth obtuse, mucronate, ciliate. Petals 2-3 times as long as calyx, pale purplish. Seeds with flattened tubercles. S. Ural. Rs (C). (Asia.)
13. G. uralensis Less., Linnaea 9: 172 (1834). Caespitose. Stems $5-20 \mathrm{~cm}$, erect, simple, glabrous below, glandularpubescent above. Leaves $10-50 \times 0.5-2 \mathrm{~mm}$, linear, sometimes triquetrous, falcate. Inflorescence dense, with $5-15$ flowers; pedicels glandular-pubescent, not longer than the calyx. Calyx $3-4.5 \mathrm{~mm}$, glandular-pubescent; teeth oblong, obtuse. Petals 2-3 times as long as calyx, white. Seeds with very small tubercles. Ural. Rs ( $\mathrm{N}, \mathrm{C}$ ).

Sect. Capituliformes F. N. Williams. Perennial. Leaves very narrow. Flowers in dense, capitate clusters. Calyx coniccampanulate. Capsule globose. Ovules 4-12.
14. G. petraea (Baumg.) Reichenb., Fl. Germ. Excurs. 801 (1832) (G. transylvanica Sprengel). Densely caespitose. Leaves $20-50 \times$ c. 1 mm , linear, glabrous. Stems $4-20 \mathrm{~cm}$, glabrous or scabrid below, puberulent above, simple, with a globose or subcapitate inflorescence $1-2 \mathrm{~cm}$ in diameter surrounded at base by large, triangular-ovate, scarious bracts. Calyx $2-3.5 \mathrm{~mm}$; teeth triangular-ovate, acute. Petals $1 \frac{1}{2}$ times as long as calyx, white or pale purplish. Seeds with echinate tubercles on the back. Calcicole. Mountain rocks; calcicole. - E. \& S. Carpathians; Rodopi Planina. Bu Rm.
15. G. glomerata Pallas ex Bieb., Fl. Taur.-Cauc. 1: 321 (1808). More or less caespitose; stems $20-80 \mathrm{~cm}$, erect, branched above, glabrous, or sometimes puberulent above; upper branches and inflorescence puberulent, more or less viscid. Leaves $20-$ $100 \times 1-4 \mathrm{~mm}$, linear to linear-lanceolate, glabrous, glaucous. Flower-heads long-pedunculate. Bracts at base of flower-heads large, triangular-acute, entire, ciliate, scarious. Calyx $2-3.5 \mathrm{~mm}$; teeth oblong, obtuse, entire. Petals $1 \frac{1}{2}$ times as long as calyx, white. Seeds with long, acute, conical tubercles. S.E. Europe, from Bulgaria to S. Ukraine. Bu Rm Rs (W, K).
16. G. globulosa Steven ex Boiss., Fl. Or. 1: 547 (1867). Like 15 but bracts at base of flower-heads ovate-orbicular, obtuse, strongly erose; calyx-teeth erose; seeds with obtuse tubercles. S.W. Ukraine (Reni); S.E. Russia (W. of Rostov). Rs (W, E). (Caucasus.)

Sect. Rokejeka (Forskål) A. Braun. Perennial. Inflorescence a lax, diffuse panicle. Calyx campanulate. Capsule globose.
17. G. paniculata L., Sp. Pl. 407 (1753). Glaucous; glabrous (or pubescent below, var. hungarica Borbás), very rarely pubescent throughout except for pedicels and calyx; rhizome stout; stems $50-90 \mathrm{~cm}$, diffusely branched. Leaves $20-70 \times 2 \cdot 5-10 \mathrm{~mm}$, lanceolate, acute or acuminate. Pedicels $2-3$ times as long as calyx. Calyx $1.5-2 \mathrm{~mm}$; teeth ovate, obtuse. Petals $3-4 \mathrm{~mm}$, linear-spathulate, white or pale reddish. Seeds with obtuse tubercles. Dry, sandy and stony places. E. \& C. Europe, extending westwards to C. Austria, southwards to Bulgaria, and northwards to $c .57^{\circ} \mathrm{N}$. in Russia; cultivated for ornament and naturalized in several countries. Au Bu Cz Hu Ju Po Rm Rs (C, W, E) [Be Ge He Po Rs (B)].
18. G. arrostii Guss., Pl. Rar. 160 (1826). Like 17 but some pedicels always pubescent and the rest of plant usually subglabrous; leaves linear to linear-lanceolate; pedicels 5-10 times
as long as calyx; calyx $2-2.5 \mathrm{~mm}$; teeth oblong, obtuse; petals elliptic-oblong, pale purplish; seeds with flattened tubercles. S. Italy, Sicilia; once recorded from Greece. ?Gr It Si.
19. G. belorossica Barkoudah, Wentia 9: 99 (1962). Stems $5-100 \mathrm{~cm}$, erect, often branched, glabrous below, glandularpubescent above and in inflorescence. Leaves $20-80 \times 3-5 \mathrm{~mm}$, linear-lanceolate, obtuse, 1 -veined. Flowers many, in a lax panicle; pedicels twice as long as calyx, glabrous. Calyx 23 mm , glabrous; teeth acute. Petals c. $1 \frac{1}{2}$ times as long as calyx, white or pale purplish; limb narrower than claw. Seeds with obtuse tubercles. - White Russia. Rs (C).
20. G. acutifolia Steven ex Sprengel, Novi Provent. 21 (1819). Stems $20-170 \mathrm{~cm}$, erect, branched, glabrous below, glandularpubescent above. Leaves $20-80 \times 2-10 \mathrm{~mm}$, linear-lanceolate to lanceolate, long-acuminate. Inflorescence a rather dense panicle; pedicels $1-4 \mathrm{~mm}$, glabrous or glandular-pubescent. Calyx 33.5 mm ; teeth oblong, acuminate. Petals twice as long as calyx, white. Seeds with long, acute, conical tubercles. Possibly native in Ukraine; naturalized in Romania; an occasional casual elsewhere. ?Rs (W) [Rm]. (Caucasus.)
G. scariosa Tausch, Flora (Regensb.) 14: 213 (1831), from S.E. Switzerland (Septimer Pass, Albula Alpen), has not been collected since 1866 and is probably extinct. It is like 20 but the leaves are $80-110 \times 3-5 \mathrm{~mm}$, linear-lanceolate and long-acuminate; the pedicels are glabrous and shorter than the calyx; the calyx is $4-5 \mathrm{~mm}$, with lanceolate, acuminate, ciliate teeth; and the petals are white and not more than $1 \frac{1}{2}$ times as long as the calyx.
21. G. perfoliata L., Sp. Pl. 408 (1753) (G. trichotoma Wenderoth, G. scorzonerifolia auct., non Ser.; incl. G. paulii Klokov and G. tekirae Stefanov). Plant yellow-green; stems $30-100 \mathrm{~cm}$, ascending at base, glandular-pubescent below, glabrous above, rarely entirely glabrous. Leaves ovate or oblong-lanceolate, acute to obtuse, amplexicaul and shortly connate at base; the lower $20-80 \times 10-35 \mathrm{~mm}, 3-$ to 7 -veined, pubescent. Pedicels $4-15 \mathrm{~mm}$, glabrous. Calyx $2-2.5 \mathrm{~mm}$; teeth ovate, obtuse. Petals white to pale purple, emarginate. Seeds with very small tubercles. S.E. Europe, from E. Bulgaria to S.E. Russia. Bu RmRs (W, K, E).
22. G. scorzonerifolia Ser. in DC., Prodr. 1: 352 (1824). Like 21 but glaucous, glabrous below, glandular-pubescent above; leaves glabrous; pedicels mostly glandular-pubescent at base; petals darker purple; seeds with obtuse tubercles. Saline and sandy soils. Lower Volga. Rs (E).
23. G. tomentosa L., Cent. Pl. 1: 11 (1755) (G. perfoliata auct. hisp.). Very like 21 but somewhat smaller; stems, in-florescence-branches and leaves usually glandular-pubescent; pedicels usually glabrous; leaves narrower, ovate-lanceolate to lanceolate; petals entire; seeds black, smooth, shining. Saline places. - C. \& N.E. Spain. Hs.

Sect. Dichoglottis (Fischer \& C. A. Meyer) Fenzl. Annual. Inflorescence a dichasial panicle; pedicels capillary; bracts more or less herbaceous. Calyx campanulate. Capsule globose. Ovules 12-24.
24. G. linearifolia (Fischer \& C. A. Meyer) Boiss., Fl. Or. 1: 550 (1867). Stems $3-25 \mathrm{~cm}$, glandular-pubescent below, glabrous above. Leaves $10-20 \times 1-2 \mathrm{~mm}$, linear to linear-spathulate, pubescent. Inflorescence few-flowered; pedicels many times as long as calyx, filiform. Calyx 2.5 mm or less, glandular-puberulent. Petals $3-4 \mathrm{~mm}$, white, bilobed. Seeds with long, acute
conical tubercles. Gypsaceous semi-deserts. S.E. Russia and W. Kazakhstan. Rs (E). (W.C. Asia.)
25. G. elegans Bieb., Fl. Taur.-Cauc. 1: 319 (1808). Glabrous; stems $20-50 \mathrm{~cm}$, branched above. Leaves $20-40 \times 3 \cdot 5(-15) \mathrm{mm}$, oblong- to linear-lanceolate, obscurely 1 - to 3 -veined. Inflorescence lax; bracts scarious, with dark midrib; pedicels many times as long as calyx. Calyx $3-5 \mathrm{~mm}$. Petals $2-5$ times as long as calyx, white, with purple veins. Seeds with obtuse tubercles. S. Ukraine; cultivated elsewhere for ornament and naturalized in a few places. Rs (W, K) [Au]. (Caucasus, Asia Minor.)

Sect. Macrorrhizaea Boiss. Calyx more or less tubular. Capsule oblong. Ovules 24-36.
26. G. muralis L., Sp. Pl. 408 (1753). Annual; stems 4 $25(-40) \mathrm{cm}$, branched, glabrous above, puberulent (often very sparsely so) below. Leaves $5-25 \times 0 \cdot 5-3 \mathrm{~mm}$, linear, acute, glaucous. Inflorescence diffusely corymbose-paniculate; pedicels filiform, several to many times as long as calyx. Calyx $3-4 \mathrm{~mm}$. Petals about twice as long as calyx, entire, pink, with darker veins. Capsule longer than calyx. Seeds with very small tubercles. C. \& E. Europe, extending locally to N.W. Spain, S. Sweden and C. Greece. Au Be Bu Cz *Da Fe Ga Ge Gr He Ho Hs Hu It Ju Po Rm Rs (N, B, C, W, K, E) Su Tu.

Plants from S. Russia (var. stepposa (Klokov) Schischkin) have a narrower calyx and shorter white petals with pink spots.
27. G. macedonica Vandas, Magyar Bot. Lapok 4: 111 (1905). Like 26 but entirely glabrous caespitose perennial with stems up to 15 cm , little-branched; leaves $c .6 \times 0.5 \mathrm{~mm}$; calyx 2 mm or less. S. Jugoslavia (Bitola). Ju.

Sect. Hagenia A. Braun. Annual. Inflorescence paniculate, dichasial. Calyx more or less tubular. Capsule long-ovoid. Ovules 4-20.
28. G. pilosa Hudson, Philos. Trans. Roy. Soc. Lond. (B) 56: 252 (1767) (G. porrigens (L.) Boiss.). Stems $20-65 \mathrm{~cm}$, stout, usually glabrous at base and in the inflorescence, villous or hispid in the middle, branched above. Leaves $40-80 \times 10-15 \mathrm{~mm}$, lanceolate, obscurely 3 -veined. Pedicels 3-4 times as long as calyx, filiform, becoming deflexed. Calyx $4-7 \mathrm{~mm}$. Petals about twice as long as calyx, pink or pale purple. Seeds with obtuse tubercles. Probably naturalized in Mallorca. A frequent casual in many parts of Europe. [?BI.] (W. Asia.)

## 32. Bolanthus (Ser.) Reichenb. ${ }^{1}$

Perennial herbs. Inflorescence dichasial, paniculate to subcapitate; flowers clustered; bracts leafy. Epicalyx absent. Calyx with 5 projecting ribs and scarious commissures. Petals with long linear claw and small patent limb; coronal scales absent; claw delicately winged; stamens 10 ; styles 2 , stigmatose all along their inner side. Capsule oblong-ovoid, dehiscing with 4 teeth; carpophore short. Seeds comma-shaped, with lateral hilum; embryo hook-shaped, with projecting radicle. (Gypsophila Sect. Bolanthus (Ser.) Boiss.)

## Literature: As for Gypsophila.

1 Upper part of stem hairy with the hairs all $\pm$ the same length, or glabrous
2 Calyx $3-4 \mathrm{~mm}$; leaves $10-20 \times 0.5-1 \mathrm{~mm}$ 1. laconicus

2 Calyx 5-6 mm; leaves $5-10 \times 1.5-2 \mathrm{~mm}$
4. graecus

1 Upper part of stem hairy with a mixture of long and short hairs
3 Petal-limb with transverse purple stripe; stem rigid; seeds with flattened tubercles 2. fruticulosus
3 Petal-limb entirely white; stem flexible; seeds with acute tubercles
3. thessalus

1. B. laconicus (Boiss.) Barkoudah, Wentia 9: 163 (1962) (Gypsophila laconica (Boiss.) Boiss. \& Heldr.). Stems 10-25 $(-30) \mathrm{cm}$, slender, mostly unbranched, glabrous to puberulent. Leaves $10-20 \times 0.5-1 \mathrm{~mm}$, linear to linear-subulate, subobtuse. Flowers 2-20 in dense, terminal, long-pedunculate clusters; pedicels shorter than calyx. Calyx $3-4 \mathrm{~mm}$, with small triangular teeth. Petals white. Mountain rocks; calcicole. - S. Greece (Parnon, Taïyetos, ?Evvoia.) Gr.
2. B. fruticulosus (Bory \& Chaub.) Barkoudah, Wentia 9: 164 (1962) (Gypsophila fruticulosa (Bory \& Chaub.) Boiss.). Stems $5-25 \mathrm{~cm}$, rigid, erect, hairy with a mixture of short hairs and long patent hairs. Leaves $5-10 \times 1 \cdot 5-3 \mathrm{~mm}$, oblanceolate, hirsute. Inflorescence usually lax; flowers in dense corymbose clusters; pedicels usually half as long as calyx, sometimes as long as calyx. Calyx $4.5-6 \mathrm{~mm}$, hairy with a mixture of short hairs and long patent hairs. Petals white, with transverse purple stripe. - $C$. \& S. Greece. Gr.
3. B. thessalus (Jaub. \& Spach) Barkoudah, Wentia 9: 164 (1962). (Gypsophila thessala (Jaub. \& Spach) Halácsy). Stems $10-30 \mathrm{~cm}$, flexible, with a mixture of short hairs and long patent hairs. Leaves $5-12 \times 0.5-1 \mathrm{~mm}$, linear-oblanceolate, hirsute. Inflorescence lax, dichasial; pedicels as long as calyx. Calyx 55.5 mm , with a mixture of long and short hairs on the ribs. - C. Greece (Thessalia). Gr.
4. B. graecus (Schreber) Barkoudah, Wentia 9: 166 (1962) (Gypsophila polygonoides (Willd.) Halácsy). Stems $5-25 \mathrm{~cm}$, pubescent, sometimes glandular-hairy. Leaves $5-10 \times 1 \cdot 5-2 \mathrm{~mm}$, linear-elliptic, puberulent. Flowers usually in dense heads; pedicels usually shorter than calyx. Calyx $5-6 \mathrm{~mm}$, puberulent, with long patent hairs on the ribs. Petals with a transverse purple stripe (sometimes entirely white, var. thymifolia (Sibth. \& Sm.) Barkoudah). Greece, Kikhlades, S. Bulgaria. Bu Gr.

## 33. Saponaria L. ${ }^{2}$

Annual or perennial herbs. Inflorescence dichasial, paniculate to capitate; rarely flowers solitary. Epicalyx absent. Calyx cylindrical or oblong, 5 -toothed, 15 - to 25 -veined, without scarious commissures. Petals 5, exceeding the calyx, narrowed abruptly (or rarely gradually) into a long claw; coronal scales usually present; stamens 10 ; styles 2 , rarely 3 . Capsule cylindrical to ovoid, dehiscing with 4 , rarely 6 , teeth. Seeds reniform, with lateral hilum, more or less compressed.

Literature: G. Simmler, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 85: 433-509 (1910).
1 Petals yellow; inflorescence capitate
2 Filaments yellow; leaves spathulate

1. bellidifolia

2 Filaments deep violet; leaves linear-lanceolate 2. lutea
1 Petals reddish or purplish, rarely white, never yellow; inflorescence various
3 Stems 1-flowered
4 Styles 3 (rarely 2); calyx not more than 20 mm ; teeth obtuse
4 Styles 2 ; calyx $20-30 \mathrm{~mm}$; teeth acute 4. pumilio

## 3 Stems 2- or more-flowered

5 Calyx less than 15 mm
6 Plant densely caespitose; flowering stems usually simple; calyx $12-15 \mathrm{~mm}$
3. caespitosa

6 Plant not caespitose; flowering stems much-branched; calyx $7-12 \mathrm{~mm}$
7 Coronal scales absent; limb of petal cuneate, scarcely distinct from claw
10. orientalis

7 Coronal scales present; limb of petal abruptly contracted into claw
8 Perennial, woody below, with conspicuous non-flowering leafy stems; pedicels and calyx glandular-pubescent
8. ocymoides

8 Annual, without conspicuous non-flowering leafy stems; pedicels and calyx glandular-hispid
7. calabrica

5 Calyx more than 18 mm
9 Plant usually caespitose; leaves 1 -veined; inflorescencebranches mostly alternate
6. sicula

9 Plant not caespitose; leaves 3 -veined; inflorescencebranches mostly opposite
10 Plant $\pm$ glabrous, or hairy only in the inflorescence; limb of petal c. 10 mm
9. officinalis

10 Plant glandular-hispid; limb of petal c. 5 mm
5. glutinosa

1. S. bellidifolia Sm., Spicil. Bot. 1: 5 (1791). Caespitose; flowering stems $20-40 \mathrm{~cm}$, erect, unbranched, usually glabrous, usually with one pair of linear-lanceolate leaves. Basal leaves spathulate. Inflorescence capitate, with a pair of linear-lanceolate bracts; flowers sessile. Upper part of calyx hairy; teeth triangular, acute. Limb of petal c. 4 mm ; yellow; filaments yellow, long-exserted. Mountain rocks and pastures. Balkan peninsula; locally elsewhere in S. Europe from the Pyrenees to C. Romania. Al Bu Ga Gr Hs It Ju Rm.
2. S. lutea L., Sp. Pl. ed. 2, 585 (1762). Caespitose; flowering stems $2-12 \mathrm{~cm}$, erect, unbranched, shortly hairy, with 2 or more pairs of linear leaves. Basal leaves linear-lanceolate. Inflorescence more or less capitate; pedicels and calyx densely hairy. Calyx-teeth triangular, acute. Limb of petal c. 4 mm , yellow; filaments deep violet, long-exserted. - S.W. \& C. Alps. Ga He It.
3. S. caespitosa DC., Rapp. Voy. Bot. 2: 78 (1808). Densely caespitose; flowering stems $5-15 \mathrm{~cm}$, usually unbranched, glabrous, or slightly hairy above, with 2 or more pairs of small linear-lanceolate leaves. Basal leaves linear-lanceolate. Inflorescence condensed or capitate. Calyx densely hairy, purplish; teeth triangular-lanceolate, acute. Limb of petal $4-7 \mathrm{~mm}$, purplish. Mountain rocks and screes. - C. Pyrenees. Ga Hs.
4. S. pumilio (L.) Fenzl ex A. Braun, Flora (Regensb.) 26: 801 (1843). Caespitose; stems very short, often shorter than the solitary terminal flower. Leaves linear. Calyx $13-20 \mathrm{~mm}$, rather inflated, hairy; teeth ovate, obtuse. Petals pale purplish, rarely white; limb $7-9 \mathrm{~mm}$; styles 3 , rarely 2. Mountain pastures; calcifuge. - E. Alps; S.E. Carpathians. Au It Rm.
5. S. glutinosa Bieb., Fl. Taur.-Cauc. 1: 322 (1808). Annual or biennial, usually glandular-hispid throughout; stem $25-50 \mathrm{~cm}$, branched above in a pyramidal panicle. Basal leaves spathulate, rarely almost linear; cauline ovate-lanceolate, acute. Calyx 2025 mm ; teeth lanceolate, acuminate. Limb of petal c. 5 mm , purple, bifid. Calcicole. S.E. Europe (local); E. Spain. Al Bu Cr Gr Hs Ju Rm Rs (K).
6. S. sicula Rafin., Specch. Sci. 2: 7 (1814). Caespitose perennial; stems glabrous below. Leaves $1-4 \mathrm{~cm}$, narrowly spathulate to linear-oblanceolate, 1 -veined. Inflorescence usually with alternate branches; branches, pedicels and calyx hairy.

Calyx $20-30 \mathrm{~mm}$, reddish-tinged, becoming somewhat inflated; teeth triangular, acute or acuminate. Limb of petal $5-8 \mathrm{~mm}$, bifid, red. Sicilia; N. \& C. Balkan peninsula. Al Bu Gr Si.

1 Calyx pubescent, eglandular
(b) subsp. intermedia

1 Calyx glandular-pubescent
2 Flowering stems $50-60 \mathrm{~cm}$, mostly more than 8 -flowered; inflorescence-branches glandular-hispid (c) subsp. stranjensis
2 Flowering stems $5-25 \mathrm{~cm}, 2$ - to 8 -flowered; inflorescencebranches glandular-pubescent
(a) subsp. sicula
(a) Subsp. sicula ( $S$. depressa Biv.): Densely caespitose; flowering stems $5-15(-25) \mathrm{cm}$, with $c .2$ pairs of linear-oblanceolate leaves, c. 2- to 8 -flowered. Inflorescence-branches and pedicels densely glandular-pubescent. Calyx densely glandularpubescent with rather stout hairs. Sicilia. (N. Africa.)
(b) Subsp. intermedia (Simmler) Chater, Feddes Repert. 69: 52 (1964) (S. intermedia Simmler): Like (a) but less densely caespitose; flowering stems ( $5-$ ) $10-50 \mathrm{~cm}$, more leafy, 1 - to $30-$ flowered; inflorescence-branches and pedicels less densely pubescent, usually glandular; calyx less densely pubescent with more slender hairs, eglandular. - N. Greece and Albania.
Rather densely caespitose, dwarf plants from Greece (Thessalia), with usually solitary flowers, have been called S. haussknechtii Simmler, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wein) 85: 472 (1910). They are somewhat intermediate between (a) and (b), and are here considered to be habitat variants of (b).
(c) Subsp. stranjensis (Jordanov) Chater, Feddes Repert. 69: 52 (1964) (S. stranjensis Jordanov): Like (a) but less densely caespitose and very woody at the base; flowering stems $50-60 \mathrm{~cm}$, more than 8 -flowered; inflorescence-branches and pedicels glandularhispid; petal-limb more deeply bifid. - S.E. Bulgaria (Strandža Planina and E. Rodopi).
7. S. calabrica Guss., Pl. Rar. 164 (1826). Annual; stem with many divaricate branches, glabrous below, glandular-hairy above. Lower leaves more or less spathulate, upper oblong-ovate. Inflorescence lax, spreading; pedicels glandular-hispid, often deflexed in fruit. Calyx 6-10 mm, glandular-hispid; teeth obtuse. Limb of petal $3-5 \mathrm{~mm}$, pale purplish. E. Mediterranean region. Cultivated for ornament and sometimes found as a casual elsewhere. $\mathrm{Al} \mathrm{Cr} \mathrm{Gr} \mathrm{It} \mathrm{Tu}$.
8. S. ocymoides L., Sp. Pl. 409 (1753). Much-branched perennial with procumbent or ascending hairy stems. Lower leaves subspathulate to ovate-lanceolate, obtuse; upper narrower, acute. Inflorescence lax, spreading; pedicels and calyx glandularpubescent. Calyx $7-12 \mathrm{~mm}$, teeth obtuse. Limb of petal 35 mm , pale purplish. $2 n=28$. S.W. \& S.C. Europe; Italy. Au Co Ga Ge He Hs It Ju Sa [ $\mathrm{Br} \mathrm{Cz} \mathrm{Da]}$.
9. S. officinalis L., Sp. Pl. 408 (1753). Perennial; stems 3090 cm , erect, usually glabrous, simple or branched above. Leaves ovate to ovate-lanceolate, 3 -veined, acute. Inflorescence condensed, with opposite branches bearing few-flowered dichasia; flowers large, shortly pedicellate, usually flesh-coloured. Calyx c. 20 mm , glabrous or rarely hairy, green or reddish; teeth triangular, acute. Limb of petal c. 10 mm , more or less entire. $2 n=28$. Europe, from Belgium, N. Germany and C. Russia southwards; frequently cultivated, often as a variant flore pleno, and naturalized in many places in the north. Al Au Be Bl Bu Co Cr CzGaGe Gr He Hs Hu It Ju Lu Po Rm Rs (C, W, K, E) Sa $\mathrm{Si} \mathrm{Tu}\left[{ }^{*} \mathrm{Br} \mathrm{Da} \mathrm{Fe} \mathrm{Hb} \mathrm{No} \mathrm{*Rs} \mathrm{(B)} \mathrm{Su]}\right.$.
10. S. orientalis L., Sp. Pl. 409 (1753). Annual; stem muchbranched, glandular-hairy. Lower leaves spathulate. Inflorescence lax; bracts linear, acute. Calyx 7-9 mm, glandular-hispid;
teeth lanceolate, acute. Petals pale purplish. ?Greece. ?Gr. (S.W. Asia.)

The only representative in Europe of the Oriental subgenus Saporhizaea.

## 34. Vaccaria Medicus ${ }^{1}$

Annual. Epicalyx absent. Calyx-tube inflated below, whitish, with 5 green wings at the angles, without scarious commissures. Petals 5, long-clawed; coronal scales absent; ovary unilocular (almost 2-locular at base); styles 2. Capsule ovoid, with thick papery exocarp dehiscing with 4 teeth, and with thinner endocarp dehiscing irregularly.

1. V. pyramidata Medicus, Philos. Bot. 1:96(1789) (V. vulgaris Host, V. segetalis Garcke, Saponaria vaccaria L.). Stems $30-$ 60 cm , erect, branched above, glabrous. Leaves $c .5 \mathrm{~cm}$, ovate to lanceolate, glaucous. Flowers in much-branched dichasia; pedicels long; bracts scarious, with green midrib. Calyx 1217 mm ; teeth ovate, acute. Petal-limb 3-8 mm, sometimes exserted, pale or dark purplish, entire or bifid. Seeds $2-2.5 \mathrm{~mm}$, numerous, subglobose. $2 n=30$. Usually a weed of cultivated fields. $S . \&$ C. Europe, extending to Belgium and C. Russia; a frequent casual in other countries. Al Au Be Bu Co Cr Cz Ga Ge Gr He Hs Hu It Ju Lu Rm Rs (C, W, E, K) Sa Si Tu [Ho].

## 35. Petrorhagia (Ser. ex DC.) Link ${ }^{2}$

Annual or perennial herbs. Inflorescence paniculate to capitate. Bracts present or absent. Calyx 5 -toothed, 5 - to 15 -veined with scarious commissures. Petals 5, exceeding the calyx, with or without claw; coronal scales absent; stamens 10; styles 2. Capsule dehiscing with 4 teeth. Seeds dorsiventrally compressed; embryo straight. (Incl. Tunica auct.; Kohlrauschia Kunth.)
It is not practicable to make a clear distinction, as is done in Dianthus (vide p. 188), between epicalyx-scales and bracts. The term 'bract' is therefore used to cover both.

All species occur in dry calcareous or sandy habitats.
Literature: P. W. Ball \& V. H. Heywood, Bull. Brit. Mus. (Bot.) 3: 121-72 (1964).

1 Bracts present; inflorescence often capitate or fasciculate
2 Flowers solitary or fasciculate; bracts usually distinctly shorter than the calyx; stems usually much-branched
3 Stems glandular-pubescent at least at the base; calyx-teeth $\pm$ triangular, acute or sub-obtuse 8. fasciculata
3 Stems eglandular; calyx-teeth oblong, obtuse
9. saxifraga

2 Flowers in a capitulum; bracts $\pm$ completely enclosing the calyx; stems simple or with few branches at the base
4 Largest bracts not more than 4 mm wide; petals linearspathulate, white, with pink or purple veins
5 Calyx-teeth oblong, obtuse, glabrous 11. thessala
5 Calyx-teeth $\pm$ triangular, acute, pubescent 12. dianthoides
4 Largest bracts usually at least 4 mm wide; petals with a long claw and distinct limb, pink or purplish
6 Seeds not more than 1.3 mm , covered with cylindrical papillae; leaf-sheaths at least twice as long as wide
15. velutina

6 Seeds at least 1.3 mm , reticulate or covered with low tubercles, or almost smooth; leaf-sheaths less than twice as long as wide
7 Petal-limb crenate or laciniate; seeds $1 \cdot 7-2 \cdot 2 \mathrm{~mm}$, almost smooth
16. glumacea

7 Petal-limb obcordate; seeds rarely more than 1.8 mm , reticulate or tuberculate
8 Seeds reticulate 13. prolifera
${ }^{1}$ By A. O. Chater.
${ }^{2}$ By P. W. Ball.

8 Seeds tuberculate
9 Outermost bracts mucronate; petal-limb 2-3(-3.5) mm wide; stems often densely tomentose in the middle
14. nanteuilii

9 Bracts all obtuse; petal-limb up to 4.5 mm wide; stems glabrous
16. glumacea

1 Bracts absent; flowers solitary, rarely fasciculate
10 Petals emarginate
11 Calyx-teeth oblong, obtuse; petals usually pink or reddish
10. graminea

11 Calyx-teeth triangular-oblong, $\pm$ acute or mucronate; petals white, sometimes with pink veins
12 Calyx-teeth 3 -veined, the lateral veins sometimes feeble near the apex; seeds $c .1 .5 \mathrm{~mm}$, black, smooth 4. candica
12 Calyx-teeth 1 -veined; seeds c. 1 mm , blackish-brown, $\pm$ tuberculate
8. fasciculata

## 10 Petals entire

13 Annuals, without non-flowering rosettes
14 Glandular-pubescent; calyx-teeth 3 -veined 5. cretica
14 Glabrous; calyx-teeth 1 -veined 6. alpina
13 Perennial, $\pm$ caespitose and woody at the base, with nonflowering rosettes
15 Petals pink; seeds blackish-brown, reticulate-tuberculate
7. phthiotica

15 Petals white or yellow, sometimes with pink veins or purplish spots at the base; seeds black, smooth
16 Stems glandular-pubescent at the base and apex, glabrous in the middle; calyx-teeth strongly 3 -veined
3. armerioides

16 Indumentum of stem variable, but never as above; calyxteeth 1 -veined (rarely with feeble lateral veins)
17 Stems densely glandular-pubescent throughout, or glabrous in the lower part, rarely completely glabrous; flowers white or pale yellow, usually with purple anthers 1. illyri
17 Stems densely glandular-tomentose at the base; usually glabrous in the upper part; flowers yellow, with white $\begin{array}{ll}\text { anthers } & \text { 2. ochroleuca }\end{array}$

Sect. Pseudotunica (Fenzl). P. W. Ball \& Heywood. Annual or perennial. Leaves 3 -veined. Bracts absent. Petals not clawed. Seeds black, smooth, with thin margins.

1. P. illyrica (L.) P. W. Ball \& Heywood, Bull. Brit. Mus. (Bot.) 3: 133 (1964) (Tunica illyrica (L.) Fischer \& C. A. Meyer). Perennial up to 40 cm . Inflorescence lax or subfastigiate. Petals $5 \cdot 5-10 \mathrm{~mm}$, oblong-spathulate, entire, white or rarely pale yellow, spotted with purple at the base and sometimes pink-veined; anthers usually purple. Seeds $1.7-2.3 \times 0.9-1.3 \mathrm{~mm}$. S.E. Europe, extending westwards to Sicilia. Al Bu ?Cr Gr It Ju Rm Si.
1 Stem usually glabrous, at least at the base; calyx $5-8 \mathrm{~mm}$
(b) subsp. haynaldiana

1 Stem glandular-pubescent throughout; calyx $3 \cdot 5-6 \mathrm{~mm}$
2 Calyx-teeth 1 -veined; calyx up to 6 mm ; inflorescence usually sub-fastigiate
(a) subsp. illyrica

2 Calyx-teeth with feeble lateral veins; calyx $3.5-5 \mathrm{~mm}$; inflorescence lax
(c) subsp. taygetea
(a) Subsp. illyrica: - C. Greece and N. Peloponnisos; very doubtfully in Kriti.
(b) Subsp. haynaldiana (Janka) P. W. Ball \& Heywood, op. cit. 3: 134 (1964): Romania, Balkan peninsula southwards to N. Greece; Calabria, Sicilia.
(c) Subsp. taygetea (Boiss.) P. W. Ball \& Heywood, op. cit. 3: 137 (1964) (Tunica cretica sensu Hayek, pro parte): - S. Greece (Taïyetos).
2. P. ochroleuca (Sibth. \& Sm.) P. W. Ball \& Heywood, op. cit. 3: 138 (1964) (Tunica ochroleuca (Sibth. \& Sm.) Fischer \& C. A. Meyer). Very like 1 but the stems densely
glandular-tomentose at the base, glabrous or rarely sparsely glandular (Evvoia) in the upper part; pedicels $4-14 \mathrm{~mm}$; petals 5-7 mm, linear-oblong, pale yellow, purplish at base; anthers white. E. Greece (Attiki and Evvoia). Gr.

Not always easily distinguishable from 3; intermediates occur in Evvoia.
3. P. armerioides (Ser.) P. W. Ball \& Heywood, op. cit. 3: 139 (1964) (Tunica armerioides (Ser.) Halácsy). Perennial up to 30 cm , densely glandular-pubescent at base and apex, glabrous in the middle. Inflorescence fastigiate; pedicels $1-5 \mathrm{~mm}$. Calyx $4-6.5 \mathrm{~mm}$, teeth strongly 3 -veined. Petals $6-8(-9) \mathrm{mm}$, oblongspathulate, white, often purple-spotted at base; anthers usually purple. Seeds $1.8-2.1 \times 1.0-1.3 \mathrm{~mm}$. Aegean islands and S.E. Greece. Gr.

The plants from the mainland of Greece and Evvoia are intermediate between $\mathbf{1}$ and $\mathbf{3}$ or $\mathbf{2}$ and 3 . They usually have the stems glandular-pubescent throughout, and sometimes lax inflorescences with pedicels up to 9 mm . These latter plants have been confused with $P$. candica, from which they can be distinguished by the entire petals.
4. P. candica P. W. Ball \& Heywood, op. cit. 3: 141 (1964) (Tunica cretica Fischer \& C. A. Meyer, pro parte). Perennial up to 20 cm , glabrous or sparsely glandular-pubescent. Inflorescence lax; pedicels up to 20 mm . Calyx $3-4.5 \mathrm{~mm}$; teeth 3 -veined, the lateral veins sometimes feeble. Petals $4.5-7 \mathrm{~mm}$, oblong-spathulate, emarginate, white, with pink veins. Seeds c. $1 \cdot 5 \mathrm{~mm}$. Kriti. Cr.
5. P. cretica (L.) P. W. Ball \& Heywood, op. cit. 3: 142 (1964) (Tunica pachygona Fischer \& C. A. Meyer). Annual up to 40 cm , densely glandular-pubescent. Inflorescence lax; pedicels $4 \cdot 5-20(-30) \mathrm{mm}$, usually glabrous. . Calyx $6-10 \cdot 5 \mathrm{~mm}$, with strongly 3 -veined teeth. Petals linear-spathulate, white, sometimes reddish beneath, usually included in the calyx. Seeds 2-2.8 mm. N. Greece. Gr. (Asia Minor.)

Sect. Pseudogypsophila (A. Braun) P. W. Ball \& Heywood. Annual. Leaves 3- to 5 -veined. Bracts absent. Petals not clawed. Seeds blackish-brown, reticulate-tuberculate, with thickened margin.
6. P. alpina (Habl.) P. W. Ball \& Heywood, op. cit. 3: 145 (1964) (Tunica stricta (Ledeb.) Fischer \& C. A. Meyer, Gypsophila alpina Habl.). Up to 40 cm , glabrous. Inflorescence lax; pedicels up to 30 mm , patent. Calyx $2 \cdot 5-4 \cdot 5(-5 \cdot 5) \mathrm{mm}$, with 1 -veined teeth. Petals $3-6 \mathrm{~mm}$, linear-oblong, white. Seeds 0.7 1.2 mm . S.W. Bulgaria (Pirin Planina). Bu.

In Europe represented only by subsp. olympica (Boiss.) P. W. Ball \& Heywood, op. cit. 3: 146 (1964), which occurs mainly in W. \& S. Anatolia. Subsp. alpina is widespread in the mountains of W. \& C. Asia.

Sect. Petrorhagia. Perennial. Leaves 1(-5)-veined. Flowers with or without bracts. Petals not abruptly clawed. Seeds blackish-brown, tuberculate, margins thickened.
7. P. phthiotica (Boiss. \& Heldr.) P. W. Ball \& Heywood, op. cit. 3: 149 (1964) (Tunica ochroleuca var. phthiotica (Boiss. \& Heldr.) Hayek). $3-20 \mathrm{~cm}$, glabrescent or sparsely glandular. Lower leaves 1 - to 3 -veined. Inflorescence lax. Bracts absent. Calyx $3-5 \mathrm{~mm}$, glabrous; teeth 1 -veined, broadly
triangular, acute to obtuse, mucronate. Petals 4-6.5 $\times 0.5-1 \mathrm{~mm}$, entire, pink. Seeds $1 \cdot 2-1.6 \mathrm{~mm}$. S.C. Greece (Oiti). Gr.
8. P. fasciculata (Margot \& Reuter) P. W. Ball \& Heywood, op. cit. 3: 150 (1964) (Tunica fasciculata (Margot \& Reuter) Boiss.). $\quad 5-30 \mathrm{~cm}$, glandular-pubescent, sometimes glabrous above. Leaves rarely up to 5 -veined. Flowers usually fasciculate and bracteate, rarely in a lax panicle and ebracteate. Calyx $2.5-5 \cdot 5 \mathrm{~mm}$, pubescent or sparsely hirsute, sometimes glandular; teeth 1 -veined, acute or subobtuse. Petals $3 \cdot 5-6 \mathrm{~mm}$, linear-spathulate, emarginate, white. Seeds $0.8-1 \mathrm{~mm}$. - W. Greece (Akarnania to Zakinthos). Gr.
9. P. saxifraga (L.) Link, Handb. 2: 235 (1831) (Tunica saxifraga (L.) Scop.; incl. T. rigida (L.) Boiss.). Up to 45 cm , glabrous or scabrid-pubescent. Inflorescence lax, occasionally fasciculate; flowers usually with 4 bracts. Calyx $3-6(-7) \mathrm{mm}$; teeth oblong, obtuse, 1 -veined with 2 feeble lateral veins. Petals $4 \cdot 5-10 \times$ $1 \cdot 2-3(-4) \mathrm{mm}$, white or pink, limb obcordate, narrowing gradually into the claw. Seeds $0 \cdot 9-1 \cdot 6 \mathrm{~mm} .2 n=60 . C . \& S$. Europe, westwards to C. France, and eastwards to W. Ukraine; S.E. Spain; N. Portugal. Al Au Bu Co Cz Ga Ge Gr He Hs Hu It Ju Lu Po Rm Rs (W) Sa Si ?Tu [Br Ho].
10. P. graminea (Sibth. \& Sm.) P. W. Ball \& Heywood, op. cit. 3: 155 (1964) (Tunica graminea (Sibth. \& Sm.) Boiss.). Up to 40 cm , shortly and densely pubescent, sometimes glabrous above. Inflorescence usually lax, sometimes with a few fasciculate flowers. Bracts absent. Calyx $3 \cdot 5-5 \cdot 5 \mathrm{~mm}$, densely pubescent; teeth oblong, obtuse, 1 -veined, with 2 feeble lateral veins. Petals $5-10 \times 1.8-2.5 \mathrm{~mm}$, pink or reddish; limb obcordate, narrowing gradually into the claw. Seeds $1 \cdot 1-1 \cdot 5 \mathrm{~mm}$. $S$. Greece (Peloponnisos). Gr.
Intermediates between this species and 9 occur in N. Peloponnisos, and require further investigation.
11. P. thessala (Boiss.) P. W. Ball \& Heywood, op. cit. 3: 156 (1964) (Tunica thessala Boiss.). $10-35 \mathrm{~cm}$, papillosepubescent at least at the base. Inflorescence a capitulum, up to 10 -flowered, with 6 -many bracts. Largest bracts $6-10 \times 2 \cdot 5-$ 4 mm , brown with white-membranous margin, rarely (Thraki) $5-7 \times 1.5-2 \mathrm{~mm}$, almost completely white-membranous. Calyx $5.5-7 \mathrm{~mm}$, glabrous or papillose, with oblong, obtuse teeth. Petals 6.5-8 mm, linear-spathulate, entire, emarginate or crenate, white, with pink or purple veins. Seeds $1 \cdot 8-2 \cdot 3 \mathrm{~mm}$. $\quad E$. Greece (Attiki to Thraki). Gr.
12. P. dianthoides (Sibth. \& Sm.) P. W. Ball \& Heywood, op. cit. 3: 158 (1964) (Tunica dianthoides (Sibth. \& Sm.) Boiss.). Like 11 but stems up to 40 cm , glabrous; heads with 1-6(-8) flowers; bracts 4 -many, the largest $4.5-10 \times 1-2.5 \mathrm{~mm}$, whitemembranous except for the brown midrib; calyx pubescent, with triangular-lanceolate, more or less acute teeth; petals 6-10 mm, entire; seeds $1-1 \cdot 3 \mathrm{~mm}$. Kriti. Cr.

Sect. Kohlrauschia (Kunth) P. W. Ball \& Heywood. Annual. Leaves 3 -veined. Inflorescence a capitulum, with very wide brown-scarious bracts. Petals abruptly clawed. Seeds blackishbrown, reticulate to papillose, with thick margins.
13. P. prolifera (L.) P. W. Ball \& Heywood, op. cit. 3: 161 (1964) (Dianthus prolifer L., Tunica prolifera (L.) Scop., Kohlrauschia prolifera (L.) Kunth.). Up to 50 cm , glabrous or scabrid-pubescent. Leaf-sheaths usually about as long as wide. Outermost bracts mucronate, the largest usually obtuse. Petals
$10-13 \times 2-3.5 \mathrm{~mm}$, pink or purplish; limb obcordate. Seeds $1 \cdot 3-$ 1.9 mm , reticulate. $2 n=30$. C. Europe and mountains of $S$. Europe, extending northwards to $S$. Sweden, westwards to $E$. Spain and E. Belgium and eastwards to C. Ukraine. Al Au Be Bu Co Cz Da Ga Ge Gr He Ho Hs Hu It Ju Po Rm Rs (W, K) Si Su Tu.
14. P. nanteuilii (Burnat) P. W. Ball \& Heywood, op. cit. 3: 164 (1964) (Dianthus prolifer, Tunica prolifera, Kohlrauschia prolifera auct. eur. occident., pro parte). Very like 13 but the middle part of the stem often tomentose; leaf-sheaths up to twice as long as wide; seeds tuberculate. $2 n=60 . W$. Europe. ?Bl Br Co Ga Hs Lu Sa.
15. P. velutina (Guss.) P. W. Ball \& Heywood, op. cit. 3: 166 (1964) (Dianthus velutinus Guss., Tunica velutina (Guss.) Fischer \& C. A. Meyer). Very like 13 but the middle part of the stem usually densely glandular-tomentose; leaf-sheaths at least twice as long as wide; all outer bracts acute or mucronate; petallimb $1 \cdot 2-2 \cdot 5 \mathrm{~mm}$ wide; seeds $1-1 \cdot 3 \mathrm{~mm}$, with cylindrical papillae. $2 n=30$. S. Europe. Al ?Bl Bu Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.

This species sometimes has a glabrous stem, and such plants have been confused with 13, particularly in Italy.
16. P. glumacea (Chaub. \& Bory) P. W. Ball \& Heywood, op. cit. 3: 169 (1964) (Kohlrauschia glumacea (Chaub. \& Bory) Hayek). Up to 50 cm , glabrous, more or less simple. Leafsheaths about as long as wide. Bracts obtuse. Petals $12-18 \times$ $2.5-4.5 \mathrm{~mm}$; limb entire, crenate or laciniate, obcuneate or obcordate, purple. Seeds $1 \cdot 5-2.2 \mathrm{~mm}$, tuberculate to almost smooth. Balkan peninsula. Al ?Bu Cr Gr Ju [It].

A variable and somewhat confused species containing two taxa of uncertain status; var. glumacea, with the petal-limb crenate or laciniate, and seeds $1 \cdot 7-2 \cdot 2 \mathrm{~mm}$, almost smooth, but with a few tubercles (southern part of range); and var. obcordata (Margot \& Reuter) P. W. Ball \& Heywood, with the petal-limb entire, obcordate, and seeds $1.5-1.8 \mathrm{~mm}$, tuberculate (northern part of range). It is uncertain to what extent these characters are correlated, but further investigation may show that var. obcordata should be raised to at least subspecific rank. There is also considerable variation in pollen-size. The problem is complicated by extensive confusion of var. obcordata with 13 in Bulgaria and Greece, and, because of this, it is not absolutely certain that $P$. glumacea occurs in Bulgaria at all.

## 36. Dianthus L. ${ }^{1}$

Usually perennial herbs or small shrubs, often with linear, parallel-veined leaves. Flowers solitary or in heads surrounded by bracts. Epicalyx-scales 2-many, usually appressed to calyx. Calyx tubular, 5-toothed, without scarious commissures. Petals 5, long-clawed, entire, dentate or laciniate, but not deeply bifid; coronal scales absent. Stamens 10; styles 2. Capsule dehiscing with 4 teeth; carpophore often present.

Male-sterile plants of a number of species occur sporadically and add to the difficulties of identification, as such plants are often dwarf, with flowers smaller in all their parts than normal and sometimes with a reduced number of epicalyx-scales.

Late flowers, particularly if borne on lateral branches produced by damaged main stems, may also be abnormal. Species which normally have capitate inflorescences frequently produce

[^74]solitary flowers in these circumstances. It is therefore unwise to attempt to identify plants flowering outside their normal season.

The shape and measurements of the calyx refer to the calyx at flowering time. The diameter of the stem is measured just below a node. Bracts occur in species with capitate inflorescences, and should be distinguished from epicalyx-scales; they subtend more than one flower.

Most of the species are more or less interfertile but, since they are usually geographically or ecologically isolated, hybrids are rather local. They do, however, seem to occur in most localities where two or more species grow together, and are particularly common in the Pyrenees.

The pattern of morphological resemblances within the genus is exceptionally reticulate, so that any linear arrangement of species is more than usually artificial, and division into subgenera, sections, etc. is of little practical value. The most satisfactory scheme so far published is that given by Schischkin in Komarov, Fl. URSS 6: 803-61 (1936), but this includes only a quarter of the European species, which are placed in 12 groups; the remainder could perhaps be accommodated in a further 23 groups, but further study of the problem is desirable.
1 Sheaths of cauline leaves not more than twice (rarely 3 times) as long as diameter of stem
2 Calyx pubescent or glandular-pubescent
3 Perennial with stout woody stock or root; non-flowering stems present at flowering
4 Lower leaves obtuse 63. deltoides 4 Lower leaves acuminate
5 Cauline leaves shorter than internodes (S.W. Europe)
44. scaber

5 Cauline leaves at least as long as internodes (Bulgaria, Turkey) 77. roseoluteus
3 Annual or biennial, with slender stock and root; without non-flowering stems
6 Epicalyx-scales about as long as calyx 89. armeria
6 Epicalyx-scales about $\frac{1}{2}$ as long as calyx $\quad$ 85. corymbosus
2 Calyx glabrous
7 Annual, with slender stock and root; without non-flowering stems
8 Calyx verruculose 84. tripunctatus
8 Calyx not verruculose
9 Cauline leaves narrowly oblong, mostly obtuse 8. viridescens
9 Cauline leaves linear, acute or acuminate
10 Flowers in many-flowered heads; calyx c. 10 mm
90. pseudarmeria

10 Flowers usually in clusters of 2-3; calyx (10-) $12-17 \mathrm{~mm}$
85. corymbosus

7 Perennial, with stout stock or root; non-flowering stems usually present at flowering
11 At least some of the leaves obtuse or subobtuse
12 Epicalyx-scales 8 or more
13 Herb, woody only at base; leaves thick but coriaceous 97. rupicola

13 Small shrub; leaves succulent
14 Leaves linear, terete
98. arboreus

14 Leaves oblong-lanceolate, flat 99. fruticosus

12 Epicalyx-scales never more than 6, usually 4
15 Flowers numerous, in a dense head 17. barbatus
15 Flowers solitary, or few together and distinctly pedicellate
16 Leaves of non-flowering stems c. 5 mm , elliptical 17 Leaves on flowering stems similar to those on nonflowering stems, longer than internodes
65. myrtinervius

17 Leaves on flowering stems narrower than on non-
flowering stems, shorter than internodes
18 Stock slender; calyx cylindrical or widening upwards; petals bearded (Balkan peninsula) 64. degenii

18 Stock stout; calyx tapering upwards from below the middle; petals glabrous (Kriti)
66. sphacioticus

16 Leaves of non-flowering stems more than 5 mm , or else not elliptical
19 Stems shortly pubescent
20 Petals glabrous
73. cinnamomeus

20 Petals bearded
21 Petals spotted; basal leaves usually narrowly oblong or lanceolate
63. deltoides

21 Petals unspotted; basal leaves linear or spathulate (vide also 85. corymbosus)
86. viscidus

19 Stems glabrous, smooth or rarely scabrid on the angles
22 Petals laciniate
23 Petal-limb glabrous; leaves of non-flowering stems $1 \cdot 5-2 \mathrm{~mm}$ wide
61. gallicus

23 Petal-limb bearded; leaves of non-flowering stems usually less than 1.5 mm wide
24 Entire part of petal-limb lanceolate, with a greenish or purplish spot at base; epicalyxscales usually 4
58. arenarius

24 Entire part of petal-limb narrowly obovatecuneate, unspotted
25 Epicalyx-scales 2-4 (E. Alps to N.E. Hungary)
52. plumarius

25 Epicalyx-scales 4-6 (E.C. Russia)
59. krylovianus 22 Petals dentate to subentire
26 Epicalyx-scales not more than $\frac{1}{3}$ as long as calyx
27 Calyx c. 10 mm ; petals glabrous
32. subacaulis

27 Calyx $15-20 \mathrm{~mm}$; petals usually bearded
28 Epicalyx-scales gradually narrowed at apex
47. cintranus

28 Epicalyx-scales abruptly contracted at apex
29 Flowers usually 2-4 together; leaves with thin margins 1. seguieri
29 Flowers solitary; leaves with thick margins
30 Epicalyx-scales green and purplish, herbaceous (W. and C. Europe) 28. gratianopolitanus

30 Epicalyx-scales brown, coriaceous (Kriti and Karpathos)
29. xylorrizus

26 Epicalyx-scales at least $\frac{1}{2}$ as long as calyx
31 Epicalyx-scales c. $\frac{1}{2}$ as long as calyx
32 Cauline leaves at least 5 pairs; flowers usually 2-3 together 21. nitidus
32 Cauline leaves 1-3(-4) pairs; flowers nearly always solitary
33 Epicalyx-scales membranous, acute; cauline leaves scale-like 26. microlepis
33 Epicalyx-scales herbaceous, apex subulate; cauline leaves not scale-like
34 Epicalyx-scales often 4, the inner ovate, abruptly narrowed at apex; calyx c. 5 mm wide
19. repens

34 Epicalyx-scales 2, lanceolate, gradually narrowed at apex; calyx c. 3 mm wide 22 . scardicus
31 Epicalyx-scales about as long as calyx
35 Leaf-margins thick and cartilaginous
81. haematocalyx

35 Leaf-margins not thick and cartilaginous
36 Cauline leaves at least 5 pairs
37 Middle cauline leaves much smaller than basal 21. nitidus

37 Middle cauline leaves much larger than basal
23. callizonus

36 Cauline leaves 4 pairs or fewer
38 Basal leaves at least 3 mm wide, oblonglanceolate 20. alpinus
38 Basal leaves up to 2.5 mm wide, linear
(24-25). glacialis group
11 All leaves acute or acuminate
39 Leaves thin and flat, without a thick margin or prominent submarginal veins
40 Sheaths 2-3 times as long as diameter of stem
41 Flowers long-pedunculate
75. lanceolatus

41 Flowers subsessile in heads
42 Calyx-teeth acuminate; epicalyx-scales gradually narrowed at apex 15. membranace
42 Calyx-teeth obtuse; epicalyx-scales rounded and mucronate at apex 16. dobrogens
40 Sheaths 1-2 times as long as diameter of stem
43 Petal-limb laciniate
44 Petal-limb divided more than half-way to middle; entire part narrowly oblong 62. superbu
44 Petal-limb divided not more than half-way to middle; entire part suborbicular 18. monspessulanus
43 Petal-limb dentate to subentire
45 Calyx verruculose, not longitudinally ribbed 83. strictus
45 Calyx not verruculose, distinctly longitudinally ribbed
46 Petals bearded
47 Outer epicalyx-scales at least as long as calyx, leaflike
48 Leaves 7- to 9 -veined, some lateral veins almost as prominent as midrib
9. trifasciculatus

48 Leaves 3 - to 5 -veined, lateral veins all much weaker than midrib
13. guttatus

47 Epicalyx-scales shorter than calyx
49 Stems solitary or few, stout, simple or branched in upper part; flowers often in small heads
50 Petal-limb c. 7 mm , narrowly obovate 11. eugeniae 50 Petal-limb c. 10 mm , broadly ovate
51 Basal leaves present and $\pm$ rosette-forming at flowering
51 Basal leaves withered at flowering
52 Cauline leaves $3-8 \mathrm{~mm}$ wide, usually 10 or more pairs, tapering from about the middle
2. collinus

52 Cauline leaves usually less than 3 mm wide, usually fewer than 10 pairs, tapering from near the base
3. fischeri

49 Stems numerous, slender, usually branched from near the base; flowers usually solitary
53 Basal rosette well-developed at flowering (Pyrenees, N.W. Spain) 7. furcat
53 Basal leaves mostly or quite withered at flowering (Romania and U.S.S.R.)
54 Stem and leaves glabrous; epicalyx-scales usually more than $\frac{1}{2}$ as long as calyx 4. pratensis
54 Stem and leaves usually puberulent; epicalyxscales usually less than $\frac{1}{2}$ as long as calyx
55 Epicalyx-scales shortly aristate, margins not 55 scarious $\begin{aligned} & \text { 12. tesquicola }\end{aligned}$
55 Epicalyx-scales acuminate, margins broadly scarious
56 Calyx tapering markedly from the middle 5. versicolor

56 Calyx scarcely tapering upwards
6. pseudoversicolor

46 Petals glabrous
57 Epicalyx-scales 6 47. cintranus
57 Epicalyx-scales 4
58 Epicalyx-scales gradually narrowed into a green subulate point 7. furcatus
58 Epicalyx-scales abruptly acuminate or cuspidate, point usually brownish
74. pallens

39 At least the upper cauline leaves with a thick margin or strong submarginal veins, often $\pm$ convolute
59 Petal-limb laciniate, divided to nearly halfway or more
60 Leaves not crowded at base of stems, rigid, mostly recurved 57. squarrosus
60 Leaves crowded at base of stems; cauline few and distant, not recurved
61 Calyx $10-12 \mathrm{~mm}$; outer epicalyx-scales at least $\frac{1}{2}$ as long as calyx, with a green subulate point 7. furcatus
61 Calyx at least 16 mm ; epicalyx-scales less than $\frac{1}{2}$ as long as calyx, without a green subulate point
62 Epicalyx-scales ovate, gradually long-acuminate, usually 6 or more
43. malacitanus

62 Epicalyx-scales obovate, not long-acuminate, usually 4(-6)
63 Leaves tapering from near the base; cauline leaves usually 5 or more pairs
64 Plant usually glaucous; cauline leaves (6-)8-14(-19) pairs; calyx-teeth lanceolate, apiculate
53. serotinus

64 Plant usually green; cauline leaves rarely more than 6 pairs; calyx-teeth narrowly acuminate
49. petraeus

63 Leaves tapering from above the middle; cauline leaves 1-4(-10) pairs
65 Petal-limb with a greenish or purplish spot near
base
58. arenarius
65 Petal-limb unspotted
66 Leaves usually not more than 0.5 mm wide (Ural)
66 Leaves usually at least 1 mm wide
67 Calyx $3-6 \mathrm{~mm}$ wide (not U.S.S.R.)
68 Entire part of petal-limb suborbicular; calyx $4-6 \mathrm{~mm}$ wide 52. plumarius
68 Entire part of petal-limb cuneate; calyx 34 mm wide 50 . spiculifolius
67 Calyx 2-3 mm wide (U.S.S.R.)
69 Calyx not more than 20 mm ; epicalyx-scales $\frac{1}{6} \frac{1}{4}$ as long as calyx; petal-limb $\frac{1}{2}-\frac{3}{4}$ as long as calyx 59. krylovian
69 Calyx c. 25 mm ; epicalyx-scales $\frac{1}{4}-\frac{1}{3}$ as long as calyx; petal-limb less than $\frac{1}{2}$ as long as calyx
60. volgicus

59 Petal-limb dentate to subentire
70 Petal-limb bearded, sometimes sparsely so
71 Leaves 3 mm or more wide
97. rupicola

71 Leaves not more than 2 mm wide
72 Leaves without apparent veins, except at base
42. lusitanus

72 Leaves with the midrib apparent throughout their length
73 Densely pulvinate; leaves less than 1 cm ; calyx usually $6-8 \mathrm{~mm}$ (Samothraki) 93. arpadianus
73 Not densely pulvinate; leaves more than 1 cm ; calyx 10 mm or more
74 Small shrub, with erect woody stems
75 Epicalyx-scales obovate, abruptly cuspidate
96. juniperinus

75 Epicalyx-scales ovate, gradually acuminate
76 Leaves $c .0 .5 \mathrm{~mm}$ wide, apparently 1 -veined
55. rigidus

76 Leaves mostly 1 mm or more wide, conspicuously 3 -veined
77 Flowers usually clustered; epicalyx-scales $c$. $\frac{3}{4}$ as long as calyx (Bulgaria) 71. aridus
77 Flowers solitary; epicalyx-scales c. $\frac{1}{3}$ as long as calyx (U.S.S.R.)
56. uralensis

74 Stems herbaceous or, if woody, trailing
78 Flowers subsessile in dense heads
45. crassipes

78 Flowers solitary or few, never subsessile in dense heads
79 Most flowers with 2 or 4 epicalyx-scales
80 Basal leaves or non-flowering stems present at flowering
81 Epicalyx-scales more than $\frac{1}{2}$ as long as calyx 27. pavonius

81 Epicalyx-scales less than $\frac{1}{2}$ as long as calyx
82 Inner epicalyx-scales broadly ovate, or obovate, or almost truncate, apiculate or abruptly aristate
83 Cauline leaves usually 6 or more pairs; stem usually puberulent 87. diffusus 83 Cauline leaves 2-4 pairs; stem glabrous 84 Calyx almost cylindrical; teeth acute to obtuse
28. gratianopolitanus

84 Calyx tapering from below the middle; teeth acuminate
49. petraeus

82 Inner epicalyx-scales ovate, attenuate, acuminate
85 Calyx 17-27 mm
47. cintranus

85 Calyx $10-15 \mathrm{~mm}$
86 Stem puberulent, at least below; basal leaves $c .1 \mathrm{~mm}$ wide 46. graniticus
86 Stem glabrous; basal leaves mostly 0.5 mm wide
91. humilis

80 Basal leaves and non-flowering stems absent at flowering
87 Leaves without visible lateral veins beneath
55. rigidus

87 Leaves with easily visible lateral veins beneath
88 Calyx $10-12(-14) \times 2-3 \mathrm{~mm}$
89 Flowers clustered; pedicels short 71. aridus
89 Flowers solitary; pedicels long
90 Cauline leaves shorter than to as long as internodes; calyx $12-14 \times 2 \mathrm{~mm}$
67. pallidiflorus

90 Cauline leaves much longer than internodes; calyx $10-12 \times 3 \mathrm{~mm}$ 56. uralensis
88 Calyx $15-19 \times 3-4 \mathrm{~mm}$
91 Leaves almost setaceous, usually appressed to stem
70. carbonatus

91 Leaves $1.5-3.5 \mathrm{~mm}$ wide, $\pm$ patent
92 Stems usually $10-20 \mathrm{~cm}$, with many nonflowering branches 69. hypanicus
92 Stems $25-70 \mathrm{~cm}$, without non-flowering branches 68. campestri
79 Most flowers with 6 or more epicalyx-scales
93 At least some epicalyx-scales about as long as calyx-tube
94 Leaves setaceous, rigid; sheaths 2-3 times as long as diameter of stem
102. pinifolius

94 Leaves wider; sheaths about as long as diameter of stem
95 Flowers in small heads
44. scaber

95 Flowers solitary
96 Cauline leaves 6 or more pairs 78. mercurii
96 Cauline leaves $2-3$ pairs 81. haematocalyx
93 Epicalyx-scales distinctly shorter than calyxtube
97 Epicalyx-scales obovate, almost truncate and apiculate 79. gracili
97 Epicalyx-scales ovate, attenuate to the acuminate or aristate apex
98 Leaves up to 1 mm wide
99 Plant up to 10 cm , densely caespitose; leaves $c .0 .5 \mathrm{~mm}$ wide 94 . nardiformis
99 Plant $20-40 \mathrm{~cm}$, not densely caespitose; leaves $c .1 \mathrm{~mm}$ wide
79. gracilis

98 Leaves more than 1 mm wide
100 Flowers in small heads; petal-limb $5-8 \mathrm{~mm}$ 44. scaber
100 Flowers solitary; petal-limb 9-12 mm
47. cintranus

70 Petal-limb entirely glabrous
101 Basal leaves withered at flowering
102 Sheaths 2-3 times as long as diameter of stem
75. lanceolatus

102 Sheaths about as long as diameter of stem
103 Petal-limb narrowly rhombic
76. leptopetalus

103 Petal-limb obovate
104 Stems simple or with 1-2 branches; petal-limb cinnamon beneath 73. cinnamomeu
104 Stems freely branched; petal-limb greenish or
pink beneath
105 Calyx $17-22 \times 4 \mathrm{~mm}$ (Balkan peninsula, Romania)
74. pallens

105 Calyx c. $15 \times 3 \mathrm{~mm}$ (Moldavia to Krym)
72. marschallii
101 Basal leaves or leafy non-flowering stems present at flowering
106 Calyx $20-30 \times 2-3 \mathrm{~mm}$, tapering markedly from about the middle
107 Most leaves $1 \cdot 5-2 \mathrm{~mm}$ wide, tapering rather suddenly near the apex
51. stefanoffii
107 Most leaves less than 1.5 mm wide, tapering gradually from the middle or below
108 Epicalyx-scales gradually long-acuminate
41. pyrenaicus
108 Epicalyx-scales abruptly contracted into an awn
49. petraeus
106 Calyx either less than 20 mm long or $4-5 \mathrm{~mm}$ wide, usually widest about the middle
109 Epicalyx-scales usually 8-12
110 Stem glabrous below; petal-limb $5-10 \mathrm{~mm}$
92. ciliatus
110 Stem puberulent below; petal-limb 3-4 mm
95. ingoldbyi
109 Epicalyx-scales usually 4(-6)
111 At least the outer epicalyx-scales attenuate at apex
112 Leaves c. 0.5 mm wide
113 Calyx 4-5 mm wide (S. Spain)
48. anticarius
113 Calyx c. 3 mm wide
114 Stems 5-10(-20) cm (Pyrénées Orientales)
34. pungens

114 Stems $20-30 \mathrm{~cm}$
115 Stems usually branched (Pyrenees)
41. pyrenaicus

115 Stems usualiy simple (S. Greece)
40. serratifolius

112 Some leaves 1 mm or more wide
116 Calyx $20-25 \mathrm{~mm}$
47. cintranus

116 Calyx c. 15 mm
117 Cauline leaves 5-10 mm, closely appressed to stem; stock stout and woody
36. costae

117 Cauline leaves $10-30 \mathrm{~mm}$, usually patent; stock slender
7. furcatus

111 At least the inner epicalyx-scales abruptly cuspidate to truncate
118 Calyx 15 mm or more
119 Calyx less than 3 mm wide $\quad$ 49. petraeus
119 Calyx at least 4 mm wide
120 Calyx tapering markedly above the middle
35. hispanicus

120 Calyx almost cylindrical
121 Basal leaves usually less than 1 mm wide, convolute, wiry 30. sylvestris
121 Basal leaves over 1 mm wide, flat and rather soft
122 Petal-limb c. 10 mm , pink or purplish
31. caryophyllus

122 Petal-limb c. 5 mm , dirty white
29. xylorrizus

118 Calyx less than 15 mm
123 Calyx-teeth up to twice as long as wide, obtuse or subobtuse and broadly scarious; calyx usually less than 10 mm , often ventricose
124 Flowers white (Balkan peninsula)
33. minutiflorus

124 Flowers pink (S.W. Europe)
125 Basal leaves $c .1 \mathrm{~mm}$ wide; calyx $3-4 \mathrm{~mm}$ wide, ventricose 32. subacaulis
125 Basal leaves $c .0 .5 \mathrm{~mm}$ wide; calyx $c .2 \mathrm{~mm}$ wide, almost cylindrical 38. langeanus
123 Calyx-teeth 3-4 times as long as wide, acuminate or apiculate
126 Inner epicalyx-scales less than twice as long as wide
127 Inner and outer epicalyx-scales similar; flowers solitary
35. hispanicus

127 Outer epicalyx-scales narrow and gradually acuminate, inner obovate, cuspidate; flowers usually 2-3 together
39. laricifolius

126 Inner epicalyx-scales at least twice as long as wide
128 Calyx c. 10 mm ; stem usually simple
32. subacaulis

128 Calyx $c .14 \mathrm{~mm}$; stem usually freely branched 37. planellae

1 Sheaths of cauline leaves at least 3 times as long as diameter of stem
129 Flowers sulphur-yellow
14. knappii

129 Flowers not sulphur-yellow
130 Uppermost leaves greatly widened in lower part 101. capitatus
130 Uppermost leaves not greatly widened in lower part
131 Leaves with thin margins and without prominent submarginal veins beneath
132 Bracts entirely brown
113. cruentus

132 Bracts green, at least in the upper part
133 Epicalyx-scales acute or shortly aristate, brown or scarious, all much shorter than calyx 15. membranaceus
133 Epicalyx-scales aristate, largely green, at least some about as long as calyx
134 Sheaths 2-3 times as long as diameter of stem; bracts 4
9. trifasciculatus

134 Sheaths 5-9 times as long as diameter of stem; bracts numerous
10. urumoffii

131 Leaves with thick margins or prominent submarginal veins beneath
135 Calyx-teeth obtuse or subobtuse but sometimes mucronate
136 Leaves obtuse or subobtuse; calyx-teeth little longer than wide, not mucronate
105. diutinus

136 Leaves acute or acuminate; calyx-teeth at least twice as long as wide, mucronate
137 Calyx not more than 14 mm ; petal-limb 4-8 mm, pink
106. platyodon

137 Calyx 18-22 mm; petal-limb $10-15 \mathrm{~mm}$, dark purplish
107. bessarabicus

135 Calyx-teeth acuminate
138 Plant glandular-viscid; calyx $6-7 \times 1.5 \mathrm{~mm} \mathrm{88}$. formanekii
138 Plant sometimes puberulent but not glandular-viscid; calyx larger
139 Flowers solitary or few together, usually distinctly pedicellate; bracts 0 or narrow and not closely subtending the flowers
140 Epicalyx-scales coriaceous, not broadly scarious; calyx $\pm$ coriaceous
141 Petals with short glandular hairs on upper surface 82. biflorus

141 Petals with long eglandular hairs on upper surface
142 Flowers usually solitary; calyx c. 5 mm wide
79. gracilis

142 Flowers usually in small groups; calyx $2 \cdot 5-3 \mathrm{~mm}$ wide 80 . drenowskianus
140 Epicalyx-scales membranous or broadly scarious; calyx membranous
143 Epicalyx-scales broadly scarious 117. brachyzonus
143 Epicalyx-scales usually dark brown, not or narrowly scarious
144 Leaves usually setaceous, up to c. 1 mm wide; calyx usually green with a green apex (E. \& S. Carpathians)
145 Cauline leaves as long as or longer than internodes; some bracts at least as long as inflorescence 110. tenuifolit
145 Cauline leaves shorter than internodes; bracts shorter than inflorescence
112. henteri

144 Leaves $1-2 \mathrm{~mm}$ wide, usually flat; calyx usually dark purple (widespread)
146 Epicalyx-scales and calyx glabrous
108. carthusianorum

|  | 6 Epicalyx-scales and calyx puberulent 109. puberulus Flowers usually numerous, subsessile, crowded in dense heads; bracts conspicuous, closely subtending the flowers |
| :---: | :---: |
| 147 Calyx more than 10 mm |  |
| 148 Epicalyx-scales gradually narrowed at apex |  |
| 149 Epicalyx-scales broadly scarious; calyx pink- <br> tinged <br> 111. borbasii |  |
| 149 Epicalyx-scales not or scarcely scarious; calyx dark purple |  |
|  | 0 Calyx (14-)17-20 mm 103. giganteus |
| 150 Calyx $10-13 \mathrm{~mm}$ 104. pontederae |  |
| 148 Epicalyx-scales obcordate or almost truncate, abruptly aristate |  |
| 151 Calyx $15-20 \mathrm{~mm}$ |  |
| $152$ | 2 Epicalyx-scales whitish; hyaline margin wide |
|  |  |
| 152 Epicalyx-scales brown or blackish; hyaline margin narrow or none |  |
| 153 Wide part of epicalyx-scales distinctly longer than awn |  |
| 154 Epicalyx-scales and calyx glabrous |  |
|  |  |
| 154 Epicalyx-scales and calyx puberulent |  |
|  |  |
| 153 Wide part of epicalyx-scales usually shorter than awn |  |
|  |  |
| 155 Bracts with a green apex; epicalyx-scales coriaceous <br> 100. ferrugineus |  |
| 151 Calyx $10-15 \mathrm{~mm}$ |  |
|  |  |
| 157 Calyx usually more than 2 mm wide; epicalyxscales at least $\frac{3}{4}$ as long as calyx 101. pinifolius |  |
| 157 Calyx usually less than 2 mm wide; epicalyxscales $c$. $\frac{1}{2}$ as long as calyx <br> 121. moesiacus |  |
| 156 At least the cauline leaves flat |  |
| 158 Epicalyx-scales whitish, $\pm$ pur |  |
|  |  |
|  |  |
| 159 Epicalyx-scales and calyx glabrous |  |
| 159 Epicalyx-scales and calyx puberulent |  |
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| 160 Epicalyx-scales abruptly narrowed into an awn |  |
| 161 Leaves flat |  |
| 162 B | 2 Bracts broadly ovate; awn of epicalyx-scales shorter than wide part of scale, usually patent or deflexed <br> 118. pelvifor |
|  | 2 Bracts ovate-oblong; awn of epicalyx-scales as long as wide part of scale, erect or somewhat patent |
|  | 63 Epicalyx-scales pale purplish 116. stribrnyi |
|  | 63 Epicalyx-scales dark brown 115. tristis |
| 161 At | At least the basal leaves setaceous |
|  | Leaves capillary; epicalyx-scales broadly obovate, awn usually patent <br> 119. stenopetalus |
|  | Leaves c. 1 mm wide; epicalyx-scales oblong; awn erect |

1. D. seguieri Vill., Hist. Pl. Dauph. 1: 330 (1786) (incl. D. sylvaticus Hoppe). Laxly caespitose not glaucous perennial (10-) $30-60 \mathrm{~cm}$, with a slender stock. Stem simple or forked. Leaves $1-4 \mathrm{~mm}$ wide, more or less flat, linear-lanceolate; cauline usually more than 4 pairs; sheaths up to as long as diameter of stem, somewhat inflated. Flowers 1-several. Epicalyx-scales 2-6,
ovate to ovate-lanceolate, gradually or abruptly narrowed to a subulate apex, $\frac{1}{3}-\frac{3}{4}$ as long as calyx. Calyx $14-20 \mathrm{~mm}$, almost cylindrical. Petal-limb 7-17 mm, dentate, reddish-pink, bearded and often whitish-spotted at base. - S.W. \& W.C. Europe, from N.E. Spain to N. Italy. Cz Ga Ge Hs It.
1 Leaves usually $4-6 \mathrm{~mm}$ wide; petal-limb usually more than 12 mm
(d) subsp. italicus

1 Leaves up to 4 mm wide; petal-limb usually less than 12 mm
2 Leaves usually 2-4 mm wide; epicalyx-scales c. $\frac{1}{3}$ as long as calyx
(c) subsp. glaber

2 Leaves usually 1-2 mm wide; epicalyx-scales at least $\frac{1}{2}$ as long as calyx
3 Leaves with midrib much more prominent than lateral veins beneath; flowers often in pairs; epicalyx-scales often nearly as long as calyx
(a) subsp. seguieri

3 Leaves with 3-5 $\pm$ equally prominent veins beneath; flowers often solitary; epicalyx-scales about $\frac{1}{2}$ as long as calyx
(b) subsp. gautieri
(a) Subsp. seguieri: $2 n=90$. W.C. Europe, S. France and $N$. Italy.
(b) Subsp. gautieri (Sennen) Tutin, Feddes Repert. 68: 189 (1963) (D. gautieri Sennen): N.E. Spain.
(c) Subsp. glaber Celak., Prod. Fl. Böhm. 3: 507 (1875) (subsp. sylvaticus (Hoppe) Hegi): Czechoslovakia and S. Germany.
(d) Subsp. italicus Tutin, Feddes Repert. 68: 189 (1963): N. Italy (Alpi Apuane).
2. D. collinus Waldst. \& Kit., Pl. Rar. Hung. 1: 51 (1801). Shortly pubescent to glabrous perennial $20-80 \mathrm{~cm}$. Leaves $3-8 \mathrm{~mm}$ wide, linear-lanceolate, thin; basal few or none at flowering; cauline usually $7-15$ pairs; veins $3-5$, the midrib usually distinctly more prominent than the laterals; sheaths $1-2$ times as long as diameter of stem. Flowers usually $2-8$, commonly in 2 rather lax heads; bracts green, shorter than the flowers. Epicalyx-scales ovate, acuminate, $\frac{1}{2}$ as long as calyx. Calyx 14 18 mm . Petal-limb $7-14 \mathrm{~mm}$, pink or purplish, bearded. - E.C. Europe, extending to C. Jugoslavia and N.E. Romania. Au Cz Hu Ju Po Rm.
(a) Subsp. collinus: Shortly pubescent. E. Austria, Hungary, N. Jugoslavia.
(b) Subsp. glabriusculus (Kit.) Soó, Bot. Közl. 29: 121 (1932): Glabrous. From Poland to Hungary and Romania.
3. D. fischeri Sprengel, PI. Min. Cog. Pug. 2: 62 (1815). Like 2 but cauline leaves $2-3 \mathrm{~mm}$ wide, $c .7$ pairs, tapering from just above the base. -W. \& C. Russia; Ukraine. Rs (C, W).

May perhaps be a subspecies of 2.
4. D. pratensis Bieb., Fl. Taur.-Cauc. 3: 300 (1819). Glabrous perennial $15-60 \mathrm{~cm}$, with a slender creeping stock. Leaves $20-$ $70 \times 2-4 \mathrm{~mm}$, linear-lanceolate; cauline usually $3-4$ pairs. Flowers 1-2; pedicel long. Epicalyx-scales 4(-6), ovate, gradually narrowed into a subulate, herbaceous apex reaching about to the base of the calyx-teeth. Calyx $10-17 \times 4-5 \mathrm{~mm}$, widest at about the middle. Petal-limb $5-7 \mathrm{~mm}$, dentate, pale pink to pinkishpurple, bearded. - S.E. Europe, extending northwards to $c$. $55^{\circ}$ N. in E. Russia. Rm Rs (C, E).
(a) Subsp. pratensis: $15-40 \mathrm{~cm}$, slender. Outer epicalyx-scales c. 5 mm . E.C. \& S.E. Russia.
(b) Subsp. racovitzae (Prodan) Tutin, Feddes Repert. 68: 189 (1963) (D. racovitzae Prodan): $40-60 \mathrm{~cm}$, robust. Outer epicalyxscales $c .10 \mathrm{~mm}$. E. Romania.
5. D. versicolor Fischer ex Link, Enum. Hort. Berol. Alt. 1: 420 (1821). Like 4 but stock very stout; stems and leaves more or
less puberulent and rough; outer epicalyx-scales $c$. $\frac{1}{2}$ as long as calyx, abruptly contracted into a subulate apex; petal-limb pinkish-purple above, greenish beneath. E. Russia, ?N.E. Ukraine. Rs (C, E).
6. D. pseudoversicolor Klokov in Kotov, Fl. RSS Ucr. 4: 660 (1952). Pubescent perennial $10-45 \mathrm{~cm}$. Leaves $10-55 \times 1-$ 3 mm . Epicalyx-scales (4-)6, not more than $\frac{1}{2}$ as long as calyx, mucronate. Calyx $15-18 \times 3-4.5 \mathrm{~mm}$, almost cylindrical. Petallimb 18-25 mm, dentate, pinkish-purple. - S.C. Russia, N.E. Ukraine. Rs (C, W, E).

Like 5 but with narrower leaves and calyx, rather shorter epicalyx-scales, and almost cylindrical calyx.
7. D. furcatus Balbis, Mém. Acad. Sci. Turin 10-11: 13 (1804) (D. requienii Gren. \& Godron, D. fallens Timb.-Lagr.). Like 1, but epicalyx-scales usually c. $\frac{1}{2}$ as long as calyx; calyx $10-17(-20) \mathrm{mm}$, somewhat attenuate upwards; teeth lanceolate, acuminate; petal-limb $5-10 \mathrm{~mm}$, shallowly laciniate to subentire, glabrous, rarely sparsely hairy, pink or whitish, unspotted, but dark at base. Mountains of S.W. Europe. Co Ga Hs It.
1 Stems up to $c .10 \mathrm{~cm}$ and less than 0.5 mm in diameter, simple; 2 pairs of cauline leaves; calyx $10-12 \mathrm{~mm} \quad$ (b) subsp. tener
1 Stems usually $15-30 \mathrm{~cm}$ and more than 0.5 mm in diameter, commonly branched; 3 or more pairs of cauline leaves; calyx usually $14-19 \mathrm{~mm}$
2 Leaves usually 2-3 mm wide, smooth; epicalyx-scales as long as calyx-tube; petals nearly white (d) subsp. gyspergerae
2 Leaves usually 1-2 mm wide, serrulate; epicalyx-scales shorter than calyx-tube; petals pink
3 Calyx c. $15 \times 2.5 \mathrm{~mm}$, tapering markedly from the middle, usually purplish; teeth narrowly triangular (a) subsp. furcatus
3 Calyx c. $17 \times 4 \mathrm{~mm}$, nearly cylindrical, usually green; teeth broadly triangular
(c) subsp. geminiflorus
(a) Subsp. furcatus: S.W. Alps.
(b) Subsp. tener (Balbis) Tutin, Feddes Repert. 68: 189 (1963) (D. tener Balbis): N. Italy (Piemonte).
(c) Subsp. geminiflorus (Loisel.) Tutin, Feddes Repert. 68: 189 (1963) (D. geminiflorus Loisel.): $2 n=30$. Pyrenees; N.W. Spain.
(d) Subsp. gyspergerae (Rouy) Burnat ex Briq., Prodr. Fl. Corse 1: 572 (1910): Corse.
8. D. viridescens Vis., Orto Bot. Padova 138 (1842). Annual up to 60 cm ; stems c. 1.5 mm in diameter, freely branched above. Leaves mostly $2-3 \mathrm{~mm}$ wide, obtuse, thin, flat; basal few or absent at flowering; cauline usually $5-7$ pairs; sheaths short. Epicalyx-scales 2, obovate, with a green subulate apex, about as long as calyx-tube. Calyx c. 17 mm , almost cylindrical; teeth long, acuminate. Petal-limb $7-10 \mathrm{~mm}$, pink, dentate, bearded. - S. \& W. Jugoslavia; N. Albania. Al Ju.
9. D. trifasciculatus Kit. in Schultes, Oestreichs Fl. ed. 2, 1: 654 (1814). Glabrous or puberulent perennial up to 80 cm . Leaves $4-10 \mathrm{~mm}$ wide, linear-lanceolate, thin; basal few or none at flowering; cauline usually $10-20$ pairs; veins $7-9$, at least some of the laterals almost as prominent as the midrib; sheaths 2-3 times as long as diameter of stem. Flowers usually numerous and usually in 3 pedunculate heads; bracts 4 , green at least above, about as long as the flowers. Epicalyx-scales lanceolate to ovate, with a green subulate apex about as long as calyx. Calyx 10 16 mm . Petal-limb 4-10 mm, bearded. - S.E. Europe. Bu Cz Ju Rm Rs (W).
1 Petal-limb c. 4 mm , lilac
(b) subsp. deserti
1 Petal-limb c. 10 mm , pink or purple
2 Heads shortly pedunculate; petals pink
2 Heads long-pedunculate; petals purple
(a) subsp. trifasciculatus (c) subsp. euponticus
(a) Subsp. trifasciculatus: Heads shortly pedunculate. Calyx c. 16 mm . Petal-limb c. 10 mm , pink. Romania, Bulgaria, E. Jugoslavia.
(b) Subsp. deserti (Prodan) Tutin, Feddes Repert. 68: 190 (1963) (D. deserti Prodan): Heads subsessile. Calyx c. 11 mm . Petal-limb c. 4 mm , lilac. Lower Danube valley. Bu Rm.
(c) Subsp. euponticus (Zapał.) Kleopow: Heads long-pedunculate, often more than 3. Calyx $10-13 \mathrm{~mm}$. Petal-limb c. 10 mm , purple. S. \& C. Ukraine, Moldavia. Rs (W).
10. D. urumoffii Stoj. \& Acht., Sborn. Bălg. Akad. Nauk. 29: 42 (1935). Like 9 but sheaths 5-9 times as long as diameter of stem; bracts numerous; calyx $16-20 \times 3-3.5 \mathrm{~mm}$, narrowly cylindrical and narrowed towards the apex. -W. Bulgaria. Bu.
11. D. eugeniae Kleopow, Bull. Jard. Bot. Kieff 14: 103 (1932). Glabrous perennial $40-60 \mathrm{~cm}$. Leaves $2-5 \mathrm{~mm}$ wide, linearlanceolate or linear, basal withered at flowering; sheaths about as long as the leaf-width. Flowers usually solitary at the ends of the branches. Epicalyx-scales ovate, abruptly narrowed to the subulate apex, at least some reaching the base of the calyxteeth; margins scarious. Calyx $15-17 \mathrm{~mm}$. Petal-limb $8-10 \mathrm{~mm}$, purple, with black spots at the base. - N. \& E. Ukraine, and adjoining regions of Russia. Rs (W, C, E).
12. D. tesquicola Klokov, Jour. Inst. Bot. Acad. Sci. Ukr. 5 (1): 26 (1948). Like 11 but usually smaller; stems and leaves more or less puberulent; leaves $1-2 \mathrm{~mm}$ wide; epicalyx-scales shortly aristate, up to $\frac{1}{2}$ as long as calyx; calyx $12-15 \mathrm{~mm}$; petallimb 3-5 mm. - C. \& E. Ukraine. Rs (W).
13. D. guttatus Bieb., Fl. Taur.-Cauc. 1: 328 (1808). Like 11 but $20-45 \mathrm{~cm}$; leaves $1-3 \mathrm{~mm}$ wide; sheaths $c$. $\frac{1}{2}$ as long as leafwidth; outer epicalyx-scales leaf-like, at least as long as calyx; petal-limb $5-8 \mathrm{~mm}$, pinkish with white spots above, yellow-green beneath. - S. \& E. Romania, Moldavia, C. \& S. Ukraine. Rm Rs (W).
14. D. knappii (Pant.) Ascherson \& Kanitz ex Borbás, Math. Term. Közl. 13: 196 (1877). Shortly pubescent perennial c. 40 cm . Leaves linear-lanceolate, 5 - to 7 -veined; midrib more prominent than lateral veins; sheaths $c .3$ times as long as diameter of stem. Heads usually 2, shortly pedunculate, manyflowered; outer bracts leaf-like, inner more or less scarious. Epicalyx-scales ovate, with a green subulate awn nearly as long as the calyx. Calyx 15 mm ; teeth ovate-acuminate. Petals sulphuryellow. - W. Jugoslavia. Ju.
15. D. membranaceus Borbás, Österr. Bot. Zeitschr. 26: 125 (1876) (D. euponticus sensu Schischkin, non Zapał., D. rehmanii Błocki). Perennial $30-70 \mathrm{~cm}$. Leaves linear-lanceolate, acute or acuminate; sheaths 2-4 times as long as diameter of stem. Heads usually 3 - to 6 -flowered, solitary or $2-3$, shortly pedunculate; bracts lanceolate or ovate-lanceolate, acuminate, usually shorter than the flowers. Epicalyx-scales ovate, broadly scarious, narrowed into a short awn, shorter than the broad part of the scale. Calyx 12-18 mm, narrowed upwards; teeth lanceolate, aristate, margins pubescent, whitish. Petal-limb c. 5 mm , bearded, purple. - From N.E. Bulgaria to N. Ukraine. Bu Rm Rs (C, W).
16. D. dobrogensis Prodan, Bul. Acad. Agron. Cluj 5 (1): 97 (1934). Like 15 but epicalyx-scales rounded at apex, mucronate; calyx $c .10 \mathrm{~mm}$; teeth obtuse, sometimes shortly mucronate; petals glabrous, pink. - Dobruja. Bu Rm.
17. D. barbatus L., Sp. Pl. 409 (1753). Subglabrous perennial up to 60 cm . Leaves lanceolate, often narrowed into a short petiole; lower obtuse, upper acute or acuminate; midrib prominent; lateral veins obscure. Heads large, many-flowered; pedicels short; bracts herbaceous, about equalling flowers. Epicalyxscales ovate, aristate. Petal-limb purple, shortly bearded. From the Pyrenees to the E. Carpathians and Balkan peninsula; widely naturalized from gardens elsewhere. Au Bu Cz Ga Hs Hu It Ju Po Rm Rs (W) Tu. [Br Da Fe Ge Ho Lu No Rs (N, B, C, K, E) Su.]
(a) Subsp. barbatus: Leaves sessile. Bracts equalling the flowers. Epicalyx-scales and calyx usually green. Throughout the range of the species, but mainly lowland and often cultivated and naturalized.
(b) Subsp. compactus (Kit.) Heuffel, Verh. Zool.-Bot. Ges. Wien 8: 68 (1858): Lower leaves attenuate into a petiole. Bracts shorter than the flowers. Epicalyx-scales and calyx usually purplish-brown. Appennini; mountains of Jugoslavia; S. \& E. Carpathians.
18. D. monspessulanus L., Amoen. Acad. 4: 313 (1759) (incl. D. sternbergii Sieber, D. hyssopifolius L. pro parte). Laxly caespitose perennial up to 50 cm ; stems slender, simple or littlebranched. Leaves $1-3 \mathrm{~mm}$ wide, linear to linear-lanceolate, thin, acuminate; sheaths about as long as diameter of stem. Flowers (1-)2-5(-7), fragrant; pedicels short. Epicalyx-scales 4, ovate, with a subulate herbaceous apex, $\frac{1}{3}$ to over $\frac{1}{2}$ as long as calyx. Calyx $18-25 \times 3-5 \mathrm{~mm}$, nearly cylindrical; teeth usually ovatelanceolate, mucronate. Petal-limb $10-18 \mathrm{~mm}$, divided to about half-way to the middle into narrow lobes, entire part suborbicular, white or pink, sometimes bearded. $2 n=60 . \quad$ S. \& C. Europe, from N. Portugal to Jugoslavia, and from the Swiss Jura to C. Italy, mainly in the mountains. Au Ga He Hs It Ju Lu.
1 Flowers usually 2-5; plant up to 60 cm ; petal-limb up to c. 15 mm (a) subsp. monspessulanu

1 Flowers usually solitary; plant up to $c .20 \mathrm{~cm}$; petal-limb 1520 mm
2 Plant not glaucous; epicalyx-scales usually at least $\frac{1}{2}$ as long as calyx $\quad$ (b) subsp. marsicu
2 Plant glaucous; epicalyx-scales usually less than $\frac{1}{2}$ as long as calyx
(c) subsp. sternbergii
(a) Subsp. monspessulanus: $20-60 \mathrm{~cm}$, not glaucous. Flowers usually $2-5$. Epicalyx-scales usually more than $\frac{1}{2}$ as long as calyx. Petal-limb $10-15 \mathrm{~mm}$. S. Europe, extending to N.W. Switzerland. Ga He Hs It Ju Lu.
(b) Subsp. marsicus (Ten.) Novák, Acta Fac. Rer. Nat. Carol. 21: 25 (1924): Usually c. 20 cm , not glaucous. Flowers usually solitary. Epicalyx-scales usually at least $\frac{1}{2}$ as long as calyx. Petal-limb $15-20 \mathrm{~mm}$. C. Italy (Abruzzi). It.
(c) Subsp. sternbergii Hegi, Ill. Fl. Mitteleur. 3: 338 (1911): Usually less than 20 cm , glaucous. Flowers solitary. Epicalyxscales less than $\frac{1}{2}$ as long as calyx. Petal-limb $c .15 \mathrm{~mm}$. E. Alps. Au It Ju.
19. D. repens Willd., Sp. PI. 2 (1): 681 (1799). Glabrous perennial $5-22 \mathrm{~cm}$. Leaves linear-oblong, at least the lower obtuse. Epicalyx-scales usually $4, \frac{1}{2}$ as long as the calyx, rarely longer; outer lanceolate with a subulate point, inner ovate, abruptly narrowed at apex. Calyx $9-12 \times 4-5 \mathrm{~mm}$, widening upwards. Petal-limb $10-12 \mathrm{~mm}$, bearded, pink or purplish. Arctic Russia, eastwards from c. $48^{\circ} \mathrm{E}$. Rs (N). (Arctic Asia and Alaska.)
A rather variable species, apparently closely related to the other, much more local, members of the D. alpinus group ( $\mathbf{2 0}$ 23).
20. D. alpinus L., Sp. Pl. 412 (1753). Subcaespitose glabrous perennial $2-20 \mathrm{~cm}$. Leaves oblong to oblanceolate, obtuse; basal $3-5 \mathrm{~mm}$ wide. Flowers borne above the leaves. Epicalyx-scales 2-4, herbaceous, ovate, with a subulate apex, more than $\frac{1}{2}$ as long as calyx. Calyx $15-18 \times 6-7.5 \mathrm{~mm}$, widening upwards; teeth ovate, acute, broadly scarious. Petal-limb $15-18 \mathrm{~mm}$, bearded, purple-red with white spots (rarely entirely white). $2 n=30$. Calcareous rocks. E. Alps. Au It Ju.
21. D. nitidus Waldst. \& Kit., Pl. Rar. Hung. 3: 209 (1806). Like 20 but taller; stems often branched and flowers in pairs; calyx $10-12 \mathrm{~mm}$; petal-limb $8-10 \mathrm{~mm}$. Calcicole. $\quad W$. Carpathians. Cz Po.
22. D. scardicus Wettst., Biblioth. Bot. (Stuttgart) 26: 31 (1892) ( $D$. nitidus sensu Boiss. pro parte, non Waldst. \& Kit.) Subcaespitose, with long non-flowering stems; stems $1 \cdot 5-10 \mathrm{~cm}$. Leaves $c$. $15 \times 2-3 \mathrm{~mm}, 3$-veined. Flowers usually solitary. Epicalyx-scales 2, about half as long as calyx; apex 3 -veined, patent or appressed. Calyx $10-12 \mathrm{~mm}$, widening upwards. Petal-limb 7-8 mm, pink. Mountain pastures. - S. Jugoslavia (S̆ar Planina). Ju.
23. D. callizonus Schott \& Kotschy, Bot. Zeit. 9: 192 (1851). Stems $5-20 \mathrm{~cm}$, 1-flowered, glabrous. Leaves linear-lanceolate; upper acute or acuminate; lower obtuse. Epicalyx-scales 2-4, ovate, with a subulate herbaceous apex, outer about as long as calyx. Calyx c. 16 mm , widening upwards; teeth ovate-lanceolate, acuminate. Petal-limb c. 10-15 mm, carmine. S.Carpathians (Munte Piatra Craiului, S.W. of Braşov). Rm.
(24-25). D. glacialis group. Nearly glabrous caespitose perennials usually $c .5 \mathrm{~cm}$. Leaves linear, or widest above the middle, mostly obtuse; cauline 1-3 pairs. Flowers solitary. Epicalyxscales 2-4, ovate, with a green subulate point, about as long as calyx. Calyx widening upwards.

A group of 2 closely-related species which may be distinguished as follows:

Leaves soft, widest above the middle; flowers purple-red; calyx $\begin{array}{ll}\begin{array}{l}\text { 12-16 } \mathrm{mm} \\ \text { Leaves rigid, linear; flowers pink; calyx } \\ 9-10 \mathrm{~mm}\end{array} & \text { 24. glacialis } \\ \text { 25. freynii }\end{array}$ Leaves rigid, linear; flowers pink; calyx 9-10 mm
24. D. glacialis Haenke in Jacq., Collect. Bot. 2: 84 (1789). Leaves $1-2 \mathrm{~mm}$ wide. Flowers usually surrounded by the leaves. Calyx $12-16 \times 3-7 \mathrm{~mm}$. E. Alps and Carpathians. Au Cz He It Po Rm.
(a) Subsp. glacialis: Leaf-margin almost glabrous. Calyx $3-4 \mathrm{~mm}$ wide. Petal-limb usually $5-7 \mathrm{~mm} .2 n=30$. E. Alps and Carpathians.
(b) Subsp. gelidus (Schott, Nyman \& Kotschy) Tutin, Feddes Repert. 68: 190 (1963) (D. gelidus Schott, Nyman \& Kotschy): Leaf-margin ciliate towards the base. Calyx 5-7 mm wide. Petallimb $10-12 \mathrm{~mm} . S . \& E$. Carpathians.

The subspecies are connected by var. pawlowskianus Soó.
25. D. freynii Vandas, Sitz. -Ber. Böhm. Ges. Wiss. 1890 (1): 255 (1890). Leaves usually less than 1 mm wide. Flowers borne above the leaves. Calyx $8-10 \times 3-4 \mathrm{~mm}$. Petal-limb $5-9 \mathrm{~mm}$. - Balkan peninsula (Bosna, S. Bulgaria). Bu Ju.
26. D. microlepis Boiss., Diagn. Pl. Or. Nov. 1 (1): 22 (1843). Caespitose perennial $1-10 \mathrm{~cm}$; stems leafless or with $1-2$ pairs of scale-like leaves. Basal leaves $10-20 \times 1 \cdot 2-1 \cdot 5 \mathrm{~mm}$, obtuse. Epicalyx-scales 2, more or less remote, membranous, ovate, apex herbaceous or not. Calyx $9-10.5 \mathrm{~mm}$, widening upwards. Petal-
limb $6-7 \mathrm{~mm}$, purple. - Mountains of Bulgaria. Bu ?Ju.
27. D. pavonius Tausch, Flora (Regensb.) 22: 145 (1839) (D. neglectus Loisel. pro parte et auct. mult.). Caespitose perennial $4-10 \mathrm{~cm}$. Leaves linear, acuminate, 3 -veined. Flowers $1(-3)$. Epicalyx scales usually herbaceous, ovate, gradually narrowed to the subulate apex, about as long as calyx. Calyx $c .12-15 \times 4-5 \mathrm{~mm}$, narrowing somewhat upwards; teeth broadly scarious, acute or acuminate. Petal-limb $10-12 \mathrm{~mm}$, bearded, purplish-red. $2 n=30$. S.W. Alps; E. Alps (very rare). Ga It.
28. D. gratianopolitanus Vill., Hist. Pl. Dauph. 3: 598 (1789) (D. caesius Sm.). Subcaespitose glabrous more or less glaucous perennial 6-25 cm. Leaves $1-2 \mathrm{~mm}$ wide, linear-lanceolate, more or less flat, cauline usually $2-3$ pairs. Flowers usually solitary. Epicalyx-scales herbaceous, ovate to obovate, cuspidate or mucronate, $\frac{1}{4}-\frac{1}{3}$ as long as calyx. Calyx 13-17(-20) mm, almost cylindrical; teeth ovate, little longer than wide, often obtuse. Petal-limb $7-15 \mathrm{~mm}$, bearded, pink, unspotted. $2 n=60$. - W. \& C. Europe, extending eastwards to W. Ukraine. Au Be Br Cz Ga Ge He It Po Rs (W).
29. D. xylorrizus Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 67 (1849). Perennial $5-15 \mathrm{~cm}$, with a thick woody stock. Basal leaves up to 4 mm wide, linear-oblong, obtuse or acute, rather thick and soft; midrib prominent beneath; lateral veins obscure; cauline leaves 3-6 pairs, shorter and narrower than basal. Epicalyx-scales usually 4, ovate, acute or cuspidate, coriaceous, $c . \frac{1}{4}$ as long as calyx. Calyx $20-25 \times 4-5 \mathrm{~mm}$, widest below the middle. Petal-limb $4-6 \mathrm{~mm}$, glabrous, dirty white. - Kriti and Kasos. Cr.
30. D. sylvestris Wulfen in Jacq., Collect. Bot. 1: 237 (1786) (D. boissieri Willk., D. virgineus Gren. \& Godron). Densely caespitose perennial with a short stout woody stock. Basal leaves usually numerous, green, slender ( $0.5-1 \mathrm{~mm}$ wide), wiry and often recurved. Flowers not or slightly fragrant. Epicalyx-scales $2-5(-8)$, broadly obovate, truncate or cuspidate, coriaceous, c. $\frac{1}{4}$ as long as calyx. Calyx $12-29 \times 4-7 \mathrm{~mm}$, nearly cylindrical. Petal-limb glabrous, usually pink, dentate to entire. $2 n=30$, c. 60. From S. \& E. Spain to Greece and northwards to the Swiss Jura and the Alps. Al Au Co Ga Ge Gr He Hs It Ju Si.

A polymorphic species closely related to 31 . The following subspecies may be recognized:
1 Plant glaucescent; epicalyx-scales 2(-4); petals entire, usually not contiguous
(e) subsp. tergestinus

1 Plant usually green; epicalyx-scales (2-)4-6(-8); petals dentate or denticulate, usually contiguous
2 Stems usually puberulent below; epicalyx-scales not green at apex; calyx-teeth 2-3 mm, obtuse $\quad$ (c) subsp. nodosus
2 Stems usually glabrous; epicalyx-scales with a green apex; calyx-teeth $3-5 \mathrm{~mm}$, obtuse to acuminate
3 Calyx usually less than 15 mm ; petals denticulate
(d) subsp. bertisceus

3 Calyx usually more than 15 mm ; petals dentate
4 Calyx usually $15-22 \times 4-5 \mathrm{~mm}$; teeth ovate-lanceolate, obtuse; epicalyx-scales usually 4
(a) subsp. sylvestris

4 Calyx usually $25-29 \times 5-7 \mathrm{~mm}$; teeth lanceolate, acuminate; $\begin{array}{ll}\text { epicalyx-scales often } 8 & \text { (b) subsp. siculus }\end{array}$
(a) Subsp. sylvestris: Variable; usually branched, but in alpine plants often simple and c. 10 cm high. Petal-limbs $8-12 \mathrm{~mm}$, usually contiguous. Alps, Jura, France, Italy and Balkan peninsula. $\mathrm{Al} \mathrm{Au} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{It} \mathrm{Ju}$.
(b) Subsp. siculus (C. Presl) Tutin, Feddes Repert. 68: 190 (1963) (D. siculus C. Presl): Robust, usually branched. Petal-
limbs $10-15 \mathrm{~mm}$, usually contiguous. W. Mediterranean region. Co Ga Hs It Si .
(c) Subsp. nodosus (Tausch) Hayek, Prod. Fl. Penins. Balcan. 1: 247 (1924): Calyx $15-20 \times$ c. 4 mm . Petal-limbs $8-10 \mathrm{~mm}$, usually contiguous. Balkan peninsula. Al Gr Ju .
(d) Subsp. bertisceus Rech. fil., Feddes Repert. 38: 150 (1935). Stems usually simple. Calyx (10-)12-16(-20) $\times 5 \mathrm{~mm}$. Petallimbs 5-6 mm. W. \& S. Jugoslavia, Albania.
(e) Subsp. tergestinus (Reichenb.) Hayek, loc. cit. (1924): Calyx $15-20 \times 4-5 \mathrm{~mm}$. Petal-limbs c. 6 mm , usually not contiguous. Italy, W. Jugoslavia, Albania.

In S. France and Italy populations occur which have long obtuse or subacute calyx-teeth and calyx $18-23 \mathrm{~mm}$. In Corse and Sicilia there are similar populations, but the calyx is usually $25-$ 28 mm , tapering somewhat in the upper half, and the calyx-teeth are long, subacute or sometimes acuminate. Commonly in Sicilia the leaves are rather short and up to 1.5 mm wide (D. contractus Jan ex Nyman, Consp. 105 (1878)). Both these have been called D. godronianus Jordan in Billot, Annot. 45 (1855) and appear to be intermediate between 30 (a) and 30 (b).
31. D. caryophyllus L., Sp. Pl. 410 (1753). Laxly caespitose, usually glaucous perennial up to 80 cm ; woody basal part of stem rather long and not very thick. Leaves $2-4 \mathrm{~mm}$ wide, linear, nearly flat. Flowers strongly fragrant. Epicalyx-scales 4, c. $\frac{1}{4}$ as long as calyx, broadly obovate, cuspidate. Calyx usually $25-30 \times$ $5-7 \mathrm{~mm}$, nearly cylindrical; teeth c. 5 mm , acuminate to subobtuse. Petal-limb $10-15 \mathrm{~mm}$, usually contiguous, glabrous, purple, rarely pink or white, dentate. Widely cultivated and frequently naturalized, but apparently not known wild, except perhaps in some Mediterranean countries (S. Spain, Italy, Sardegna, Sicilia, Ionioi Nisoi). *Gr *Hs *It *Sa *Si.
D. arrostii C. Presl in J. \& C. Presl, Del. Prag. 1: 60 (1822), appears to differ only in the patent epicalyx-scales and uniformly pale pink petals.
D. multinervis Vis., Fl. Dalm. 3: 164 (1852), described from the Adriatic island of Pomo, but now extinct, appears to have been close to, or possibly an abnormal form of 31, characterized by the 5 - to 9 -veined leaves which are described as broadly lanceolate, and by the shorter calyx.
32. D. subacaulis Vill., Hist. Pl. Dauph. 3: 597 (1789) (incl. D. brachyanthus Boiss.). Usually densely caespitose perennial $3-20 \mathrm{~cm}$, with a stout woody stock; stems nearly always simple. Leaves linear-lanceolate, often obtuse; basal usually $c .10 \times 1 \mathrm{~mm}$; cauline shorter, appressed. Epicalyx-scales 4, broadly ovate, apiculate or acuminate, $c$. $\frac{1}{3}$ as long as calyx. Calyx $6-10(-13) \times$ $3-4 \mathrm{~mm}$, more or less ventricose. Petal-limb $3-5(-10) \mathrm{mm}$, glabrous, subentire, pale pink. - Mountains of S.W. Europe. Ga Hs Lu .
(a) Subsp. subacaulis: Often laxly caespitose. Epicalyx-scales usually acuminate, sometimes nearly half as long as calyx. Calyxteeth acute or apiculate, c. 3 times as long as wide. S. France, N.E. Spain.

Plants from S. France (near Narbonne) with long slender trailing stems, longer leaves, calyx $10-13 \times 4 \mathrm{~mm}$ and petal-limb c. 10 mm , may be specifically distinct. They have been called var. ruscinonensis Boiss. and are reported to have $2 n=60$.
(b) Subsp. brachyanthus (Boiss.) P. Fourn., Quatre Fl. Fr. 331 (1936): Usually densely caespitose with thick woody stock. Epicalyx-scales apiculate, c. $\frac{1}{3}$ as long as calyx. Calyx-teeth obtuse, twice as long as wide. $2 n=30$. Pyrenees, mountains of Spain and Portugal.
33. D. minutiflorus (Borbás) Halácsy, Consp. Fl. Gracc. 1: 216 (1900) (D. strictus var. brachyanthus (Boiss.) Boiss.). Very like 32, but laxly caespitose, with slender stems; calyx-teeth usually short and obtuse, but sometimes 3 times as long as wide and acute or acuminate; petal-limb subentire, white. Mountains of Greece, S. Jugoslavia and N.E. Albania. Al Gr Ju.

Perhaps only a subspecies of $\mathbf{3 2}$.
34. D. pungens L., Mantissa Alt. 240 (1771). Laxly caespitose perennial $5-20 \mathrm{~cm}$, with slender woody stock; stems simple. Leaves c. $20 \times 0.5 \mathrm{~mm}$, acuminate, rather rigid. Epicalyx-scales 4, ovate, gradually long-acuminate, c. $\frac{1}{2}$ as long as calyx. Calyx c. $15 \times 3-4 \mathrm{~mm}$, nearly cylindrical. Petal-limb c. 5 mm , glabrous, pink. E. Pyrenees Ga. ?Hs.
35. D. hispanicus Asso, Syn. Stirp. Arag. 53 (1779). Perennial $15-40 \mathrm{~cm}$, with a stout woody stock. Stems simple or littlebranched. Leaves usually $2-3 \mathrm{~cm}$, acute, flat or convolute, rigid, often recurved; cauline 2-4(-6) pairs. Epicalyx-scales 4, obovate, cuspidate, mainly coriaceous, c. $\frac{1}{3}$ as long as calyx. Calyx 13$20 \times 4-5 \mathrm{~mm}$, tapering above the middle but becoming cylindrical or even widening upwards in fruit. Petal-limb 3-5 mm, glabrous. - Spain. Hs.

Plants intermediate between this species and 32 are not infrequent.
36. D. costae Willk. in Willk. \& Lange, Prodr. Fl. Hisp. 3: 683 (1878). Perennial $10-40 \mathrm{~cm}$, with stout woody stock. Leaves linear, acuminate, flat; cauline usually $2-6$ pairs, appressed to stem. Flowers solitary or few together; pedicels short. Epicalyxscales 4-6, sometimes with 1-2 pairs of scale-like leaves just below them, $c . \frac{1}{2}$ as long as calyx, ovate, acuminate; margin broadly scarious; apex green. Calyx $10-16 \times 3-4 \mathrm{~mm}$, narrowed from the middle or below. Petal-limb 6-8 mm, dentate, glabrous. © $E$. Spain. Hs.
D. algetanus Graells ex F. N. Williams, Jour. Bot. (London) 23: 347 (1885) from near Madrid, usually has a more slender, elongated stock, clustered flowers and calyx $10-14 \mathrm{~mm}$, and may merit subspecific rank. D. costae Willk. sensu stricto (incl. D. turolensis Pau), from E. Spain, usually has a short stout stock, solitary flowers, and calyx $13-16 \mathrm{~mm}$. It was originally described as having 8-10 epicalyx-scales; this appears to refer to the $1-2$ pairs of scale-like leaves close below the 4-6 true epicalyx-scales.
37. D. planellae Willk., Icon. Descr. Sp. Pl. Nov. 1 (8): 79 (1854). Perennial up to 30 cm , with long rather slender, woody stock and freely branched flowering stems. Leaves slender, convolute; cauline 4-7 pairs. Flowers usually solitary; pedicels eventually divaricate. Epicalyx-scales 4-6, c. $\frac{1}{4}$ as long as calyx, ovate, acuminate; margin scarious. Calyx $9-14 \times 2 \cdot 5-3 \mathrm{~mm}$, nearly cylindrical. Petal-limb $4-6 \mathrm{~mm}$, dentate, glabrous. - N.W. Spain (Miño valley). Hs ?Lu.

Plants from N. Portugal, which have been identified with this species, have abruptly acuminate epicalyx-scales and larger calyces; they appear to be more closely related to 39 , though with much longer leaves than are normal for that species.
38. D. langeanus Willk. in Willk. \& Lange, Prodr. Fl. Hisp. 3: 690 (1878). Laxly caespitose perennial, often with rather slender trailing stems; stems $10-20 \mathrm{~cm}$, slender, simple or little-branched. Leaves $1-2 \mathrm{~cm}$, rather thick and rigid, acute, canaliculate when dry; cauline 2-4 pairs, shorter than internodes, erect. Epicalyxscales $4, c . \frac{1}{4}$ as long as calyx, ovate, subacute, shortly apiculate or obtuse, inner wider than outer. Calyx $8-10 \times 2 \mathrm{~mm}$, almost
cylindrical. Petal-limb 5-7 mm, dentate to entire, pink, glabrous. - N.W. Spain. Hs.

In many respects intermediate between 37 and 39, but apparently distinct from both.
39. D. laricifolius Boiss. \& Reuter, Diagn. Pl. Nov. Hisp. 7 (1842). Laxly caespitose perennial $15-30 \mathrm{~cm}$, with a branched woody stock. Basal leaves usually $10-20 \mathrm{~mm}$, linear-subulate, rigid; cauline 4-6 pairs. Flowers commonly in pairs. Epicalyxscales (4-)6(-8); outer narrowly ovate; inner broadly obovate; all acuminate or cuspidate, usually green at apex, $c$. $\frac{1}{3}$ as long as calyx. Calyx $11-17 \times 2-3 \mathrm{~mm}$, narrowed in upper half. Petallimb 3-5 mm, glabrous, bright magenta. - C. \& W. Spain, C. Portugal. Hs Lu.
40. D. serratifolius Sibth. \& Sm., Fl. Graec. Prodr. 1: 287 (1809). Laxly caespitose perennial $15-30 \mathrm{~cm}$, with long, trailing woody stems. Basal leaves usually $15-30 \mathrm{~mm}$, linear, acuminate, with 3 prominent veins beneath; cauline smaller, 3-7 pairs. Flowers usually solitary. Epicalyx-scales 4-6, ovate, acute or acuminate, usually entirely brown, c. $\frac{1}{3}$ as long as calyx. Calyx $12-15 \times c .3 \mathrm{~mm}$, tapering from near the base, becoming cylindrical in fruit. Petal-limb c. 3 mm , rather deeply dentate, pink. - Mountains of S. Greece. Gr.
41. D. pyrenaicus Pourret, Mém. Acad. Toulouse 3: 318 (1788) (D. attenuatus Sm., D. requienii sensu Willk. pro parte, non Gren. \& Godr.). Laxly caespitose perennial $15-45 \mathrm{~cm}$, usually with long, trailing, rather slender, woody stems. Leaves usually rigid, pungent, not densely crowded on flowering stems. Inflorescence usually branched. Epicalyx-scales (4-)6-8, ovate, gradually acuminate, c. $\frac{1}{3}$ as long as calyx. Calyx $15-30 \times 2-$ 3 mm , tapering markedly from about the middle. Petal-limb $3-8 \mathrm{~mm}$, glabrous, dentate, pink. $2 n=30,60$. Pyrenees, N.E. Spain, Portugal. Ga Hs Lu.
(a) Subsp. pyrenaicus: Not glaucous. Calyx $15-20 \mathrm{~mm}$. Petal-limb c. 3 mm , pale pink. Pyrenees; Portugal.
(b) Subsp. catalaunicus (Willk. \& Costa) Tutin, Feddes Repert. 68: 190 (1963). Usually glaucous. Calyx 20-30 mm. Petal-limb 6-8 mm, deep pink. S. France (Pyrénées-Orientales, Aude); N.E. Spain.
42. D. lusitanus Brot., Fl. Lusit. 2: 177 (1804) (D. lusitanicus auct.). Glaucous perennial $15-45 \mathrm{~cm}$; stems erect or ascending, woody below. Leaves usually $c .10 \mathrm{~mm}$, not crowded on flowering stems, somewhat fleshy and without obvious veins. Inflorescence usually branched. Epicalyx-scales 4, ovate, acuminate, c. $\frac{1}{3}$ as long as calyx. Calyx $20-23 \times 2 \cdot 5-3 \cdot 5 \mathrm{~mm}$, tapering markedly from about the middle. Petal-limb 7-10 mm, bearded, deeply dentate, pink. $2 n=30$. Spain and Portugal. Hs Lu.
43. D. malacitanus Haenseler ex Boiss., Voy. Bot. Midi Esp. 2: 85 (1839) (D. broteri Boiss. \& Reuter, D. valentinus Willk., D. fimbriatus Brot., non Bieb.). Perennial up to 50 cm . Leaves $1-2 \mathrm{~mm}$ wide, linear, acuminate, glaucous. Epicalyx-scales usually 6-8, elliptical to ovate-lanceolate, acuminate, $\frac{1}{3}-\frac{1}{2}$ as long as calyx. Calyx c. 30 mm , tapering from near the base. Petallimb $c .15 \mathrm{~mm}$, laciniate, bearded. $2 n=60 . S$. Spain, S. Portugal. Hs Lu.

This may well be conspecific with D. serrulatus Desf., Fl. Atl. 1: 346 (1798), from N.W. Africa, which is said to differ in the wider leaves ( $3-7 \mathrm{~mm}$ wide) and the smaller flowers with petallimb $6-8 \mathrm{~mm}$; but considerable variation occurs in populations in both Europe and N. Africa.
44. D. scaber Chaix in Vill., Hist. Pl. Dauph. 1: 331 (1786) (D. hirtus Vill.). Laxly caespitose perennial $15-40 \mathrm{~cm}$. Leaves $1-3 \mathrm{~mm}$ wide, flat, linear, acuminate; cauline usually 3-4 pairs. Flowers in small heads; bracts absent or (in subsp. toletanus) as long as flowers. Epicalyx-scales usually 6 , ovate, acuminate, from half as long as to as long as calyx. Calyx $17-22 \mathrm{~mm}$, tapering above the middle. Petal-limb 5-8 mm , dentate, bearded.

- S.W. Europe. Ga Hs Lu.

1 Point of epicalyx-scales subulate, at least $\frac{1}{2}$ as long as wide part of scale, 5 - to 7 -veined in lower part
(c) subsp. toletanus

1 Point of epicalyx-scales setaceous, $\frac{1}{4}-\frac{1}{3}$ as long as wide part of scale, 3 -veined at base
2 Stems usually $10-20 \mathrm{~cm}$; petal-limb $4-5 \mathrm{~mm} \quad$ (a) subsp. scaber
2 Stems usually $20-30 \mathrm{~cm}$; petal-limb $7-8 \mathrm{~mm}$
(b) subsp. cutandae
(a) Subsp. scaber: S.E. France; N.E. Spain.
(b) Subsp. cutandae (Pau) Tutin, Feddes Repert. 68: 190 (1963) (D. cutandae (Pau) Pau): $2 n=30$. C. \& E. Spain.
(c) Subsp. toletanus (Boiss. \& Reuter) Tutin, Feddes Repert. 68: 190 (1963) (D. toletanus Boiss. \& Reuter): C. \& S. Spain, Portugal.
45. D. crassipes R. de Roemer, Linnaea 25: 11 (1852). Robust perennial with a stout woody stock; stems $30-60 \mathrm{~cm}$, puberulent, robust, terete. Cauline leaves $2-2.5 \mathrm{~mm}$ wide, rigid, acute, puberulent; sheaths as long as the diameter of the stem. Flowers usually $20-30$, subsessile in dense corymbose heads; bracts broadly scarious, with a green point, about as long as the flowers. Epicalyx-scales 4, little shorter than the calyx, lanceolate, similar to the bracts but more abruptly and finely acuminate. Calyx $18-25 \mathrm{~mm}$, narrowed above. Petal-limb $7-9 \mathrm{~mm}$, dentate, bearded, purple. - S.C. Spain (Sierra Morena, Sierra de Alcaraz). Hs.
46. D. graniticus Jordan, Obs. Pl. Crit. 7: 13 (1849). Like 44 but more slender with usually more numerous cauline leaves (6-7 pairs); flowers often solitary; epicalyx-scales ovate-lanceolate to rather narrowly obovate, less than $\frac{1}{2}$ as long as calyx; calyx $10-15 \mathrm{~mm} .2 n=30$. S.C. France (Auvergne, Cevennes). Ga.
47. D. cintranus Boiss. \& Reuter, Pugillus 20 (1852). Glabrous perennial $15-35 \mathrm{~cm}$, with trailing woody stems. Leaves $0 \cdot 5-2 \mathrm{~mm}$ wide, flat, acute or acuminate, the lower sometimes obtuse. Inflorescence simple or branched. Epicalyx-scales 4-6, $\frac{1}{3}-\frac{1}{2}$ as long as calyx, ovate, cuspidate to acuminate. Calyx 17-25x $4 \cdot 5-5 \mathrm{~mm}$, not purple-tinged. Petal-limb $4-10 \mathrm{~mm}$, obovate, dentate, bearded to glabrous. Spain and Portugal. Hs Lu.
1 Stems $15-20 \mathrm{~cm}$, usually simple; epicalyx-scales often 6 ; calyx usually c. 20 mm
(c) subsp. charidemii

1 Stems usually more than 20 cm and branched; epicalyx-scales usually 4; calyx usually more than 20 mm
2 Petai-limb usually less than 5 mm ; claw often exserted
(b) subsp. multiceps

2 Petal-limb usually more than 5 mm ; claw usually included
(a) subsp. cintranus
(a) Subsp. cintranus (incl. D. gaditanus Boiss.). $2 n=60 . C$. Portugal, W. Spain.
(b) Subsp. multiceps (Costa ex Willk.) Tutin, Feddes Repert. 68: 190 (1963): N.E. Spain.
(c) Subsp. charidemii (Pau) Tutin, Feddes Repert. 68: 190 (1963): S.E. Spain (Cabo de Gata).
48. D. anticarius Boiss. \& Reuter, Pugillus 19 (1852). Glabrous, laxly caespitose perennial $10-20 \mathrm{~cm}$, with trailing woody stems. Leaves $c .0 .5 \mathrm{~mm}$ wide, convolute, acuminate. Inflorescence usually simple. Epicalyx-scales 4, c. $\frac{1}{3}$ as long as calyx,
ovate, acuminate or cuspidate, coriaceous. Calyx $14-22 \times 4 \cdot 5-$ 5 mm , narrowed from above the middle, usually purple-tinged. Petal-limb $6-10 \mathrm{~mm}$, obovate, dentate, glabrous or sparsely bearded. - S. Spain (Sierra de Antequera, Sierra de Ronda). Hs.

## Perhaps not specifically distinct from 47.

49. D. petraeus Waldst. \& Kit., Pl. Rar. Hung. 3: 246 (1808) (incl. D. integer Vis., D. nicolai G. Beck \& Szysz., D. prenjus G. Beck, D. strictus auct., non Sibth. \& Sm., nec Banks \& Solander, D. suendermanii Bornm.). Green or glaucescent, usually laxly caespitose perennial up to $c .30 \mathrm{~cm}$. Leaves acuminate, tapering from near the middle; cauline usually 2-5 pairs. Epicalyx-scales (2-)4(-8), elliptical to ovate, acuminate or cuspidate, $\frac{1}{5}-\frac{1}{4}$ as long as calyx. Calyx (12-)20-32 $\times(2-) 3-4 \mathrm{~mm}$, tapering from below the middle. Petal-limb $4-10 \mathrm{~mm}$, glabrous or somewhat bearded, laciniate, dentate or subentire, white or less frequently pink. - Balkan peninsula, W. \& C. Romania. Al Bu Gr Ju Rm.

A species which shows great variability in size, division and pubescence of the petals, though the long, narrow, tapering calyx in particular is characteristic. At least four subspecies may be recognized:
1 Epicalyx-scales shortly cuspidate
2 Flowers usually solitary; calyx c. 22 mm ; petals dentate
(c) subsp. simonkaianus

2 Flowers usually shortly pedicellate in groups of 2-3; calyx c. 27 mm ; petals laciniate $\quad$ (d) subsp. noeanus

1 Epicalyx-scales narrowed into an acute or acuminate herbaceous apex
3 Calyx 22-25 mm; petal-limb dentate to laciniate
(a) subsp. petraeus

3 Calyx 12-20 mm; petal-limb nearly or quite entire
(b) subsp. integer
(a) Subsp. petraeus: Throughout the range of the species.
(b) Subsp. integer (Vis.) Tutin, Feddes Repert. 68: 190 (1963) (D. integer Vis.): Albania and Jugoslavia.
(c) Subsp. simonkaianus (Péterfi) Tutin, Feddes Repert. 68: 190 (1963) (D. simonkaianus Péterfi): C. Romania, Bulgaria.
(d) Subsp. noeanus (Boiss.) Tutin, Feddes Repert. 68: 190 (1963) (D. noeanus Boiss.): Bulgaria; ?E. Jugoslavia.
50. D. spiculifolius Schur, Enum. PI. Transs. 98 (1866). Like 49 but differing mainly in the deeply laciniate, always bearded petals with limb 10-15 mm. Calcicole. E. Carpathians. Rm Rs (W).

May perhaps be regarded as a subspecies of 49 .
51. D. stefanoffii Eig, Jour. Bot. (London) 75: 191 (1937) (D. strictus Sibth. \& Sm., non Banks \& Solander). Like 49 but leaves c. $15 \times 1.5-2 \mathrm{~mm}$, rather abruptly narrowed at the acute apex; epicalyx-scales c. $\frac{1}{3}$ as long as calyx; petal-limb subentire, glabrous. - N. Greece (Athos). Gr.
52. D. plumarius L., Sp. Pl. 411 (1753). A more or less glaucous perennial up to 40 cm ; flowering stems with $1-4(-10)$ pairs of leaves. Leaves $c .1 \mathrm{~mm}$ wide, narrowed only in the upper part, acute or subacute. Flowers 1 (rarely more, except in cultivars), fragrant. Epicalyx-scales (2-)4(-6), obovate, often almost truncate, shortly apiculate, $c . \frac{1}{4}$ as long as calyx. Calyx $17-30 \times 4-6 \mathrm{~mm}$, almost cylindrical, green or slightly purple; teeth lanceolate to ovate, obtuse or apiculate; margin broadly scarious. Petal-limb $12-18 \mathrm{~mm}$, divided to about the middle into narrow lobes, white or bright pink, usually bearded. Calcareous mountains of E.C. Europe, from the Italian Alps to N.E. Hungary and the Tatra. Au Cz Hu It Po.

Widely cultivated and more or less naturalized in much of Europe. Many hybrids between this and D. gratianopolitanus are grown in gardens. A number of isolated and slightly different populations have been given specific rank. The most distinct of these are D. hungaricus Pers., Syn. Pl. 1: 494 (1805), with broadly scarious epicalyx-scales and violet filaments (Tatra), and D. lumnitzeri Wiesb., Bot. Centr. 26: 85 (1886), with a narrow, rather attenuate calyx like that of 53 , but other characters as in 52 (from E. Austria (Hainburger Berge) to N.E. Hungary (Bükk Hegyseg)).
53. D. serotinus Waldst. \& Kit., Pl. Rar. Hung. 2: 188 (1804). Like 52 but flowering stems usually more slender, with (6-)8-14(-19) pairs of leaves; leaves narrowed gradually from near the base; flowers often $2-5$; calyx $20-28 \times 2.5-4 \mathrm{~mm}$, tapering upwards from below the middle; teeth lanceolate, apiculate; petallimb usually cream. Sandy ground. From E. Austria and S.E. Czechoslovakia to E. Romania. Au Cz Hu Rm.
54. D. acicularis Fischer ex Ledeb., Fl. Ross. 1: 284 (1842). Caespitose perennial up to 30 cm ; flowering stems quadrangular, with 2-4 pairs of leaves. Leaves $c .0 .5 \mathrm{~mm}$ wide, narrowly linear, acuminate. Epicalyx-scales 4, obovate, obtusely mucronate, c. $\frac{1}{4}$ as long as calyx. Calyx $20-25 \times 3-4 \mathrm{~mm}$, tapering from about the middle. Petal-limb $10-15 \mathrm{~mm}$, laciniate; entire part oblong, bearded. E. Russia, from near Kujbyšev to S. Ural. Rs (C, E). (W. Siberia.)
55. D. rigidus Bieb., Fl. Taur.-Cauc. 1: 325 (1808). Dwarf shrub $10-50 \mathrm{~cm}$, with rigid, much-branched erect woody stems and herbaceous flowering stems. Leaves not crowded at base of stem, linear, apparently 1 -veined. Epicalyx scales 4, ovate, acuminate, $c . \frac{1}{4}$ as long as calyx; outer much smaller than inner. Calyx $10-12 \times 2 \mathrm{~mm}$, cylindrical. Petal-limb c. 5 mm , dentate, bearded, white. S.E. Russia; Krym. Rs (K, E).
56. D. uralensis Korsh., Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 8, 7: 59 (1898). Like 55 but most leaves wider ( 1 mm or more), distinctly 3 -veined; epicalyx-scales $c . \frac{1}{3}$ as long as calyx; calyx c. 3 mm wide; petal-limb pink above, yellowish-green beneath. S. Ural. Rs (C).
57. D. squarrosus Bieb., Fl. Taur.-Cauc. 1: 331 (1808). Laxly caespitose perennial $15-30 \mathrm{~cm}$. Leaves $10-20 \mathrm{~mm}$, not crowded at base of flowering stems, linear, acuminate, recurved. Inflorescence branched. Epicalyx-scales 4, obovate, cuspidate, c. $\frac{1}{5}$ as long as calyx; outer much smaller than inner. Calyx c. $25 \times 3 \mathrm{~mm}$, tapering from below the middle. Petal-limb $c$. 8 mm , deeply laciniate, bearded. U.S.S.R. from C. Ukraine to W. Kazakhstan. Rs (W, E).
58. D. arenarius L., Sp. Pl. 412 (1753). Caespitose perennial up to $c .45 \mathrm{~cm}$; stems slender, subcylindrical, simple or branched. Leaves frequently less than 1 mm wide, linear, obtuse or acute. Flowers fragrant. Epicalyx-scales 2-4, broadly ovate to obovate, up to $\frac{1}{4}$ as long as calyx, often with a short obtuse apiculus. Calyx $16-25 \times 2-3 \mathrm{~mm}$, nearly cylindrical. Petal-limb $10-15 \mathrm{~mm}$, laciniate to beyond the middle, white with a green spot, often with a purplish margin, at base, bearded. E. Europe, southwards to c. $49^{\circ} \mathrm{N}$. in C. Ukraine, and extending westwards to Czechoslovakia, E. Germany and Sweden. Cz Fe Ge Po Rs (N, B, C, W).
1 Stems usually $10-20 \mathrm{~cm}$, simple or little branched
(a) subsp. arenarius

1 Stems usually over 20 cm , freely branched
2 Plant not glaucous; leaves usually 0.5 mm wide; petal-limb
usually $c .10 \mathrm{~mm}$

2 Plant glaucous; leaves usually c. 1 mm wide; petal-limb usually c. 15 mm
3 Stem with 1-3 flowers; epicalyx-scales 4; calyx usually 44.5 mm wide $\quad$ (c) subsp. pseudoserotinus

3 Stem with (1-)3-24 flowers; epicalyx-scales 4-6; calyx usually $3-4 \mathrm{~mm}$ wide
(d) subsp. pseudosquarrosus
(a) Subsp. arenarius: Caespitose, usually not glaucous; lower leaves usually obtuse; calyx $c .20 \mathrm{~mm} .2 n=60$. S. Sweden.
(b) Subsp. borussicus (Vierh.) Kleopow, Bull. Jard. Bot. Kieff 12-13: 34 (1931) (D. borussicus Vierh.): Loosely caespitose, not glaucous; stems flexuous. Lower leaves short, acute or subacute. Calyx c. $20-25 \times 3 \mathrm{~mm}$. N.E. \& N.C. Europe.
(c) Subsp. pseudoserotinus (Błocki) Tutin, Feddes Repert. 68: 190 (1963) (D. pseudoserotinus Błocki): Laxly caespitose, glaucous; stems straight. Lower leaves long, acute or acuminate. Calyx c. $20 \times 4 \mathrm{~mm}$. N. Ukraine.
(d) Subsp. pseudosquarrosus (Novák) Kleopow, Bull. Jard. Bot. Kieff 12-13: 35 (1931) (D. pseudosquarrosus Novák): Laxly caespitose, glaucous. Lower leaves long, acuminate, recurved. Calyx usually $22-30 \times 3-4 \mathrm{~mm}$. White Russia and Ukraine.

A local population in subarctic Russia (on the S. coast of the Polustrov Kol'skiy) is intermediate between (a) and (b).
59. D. krylovianus Juz., Not. Syst. (Leningrad) 13: 71 (1950). Caespitose perennial; stems $12-28 \mathrm{~cm}$, branched, subcylindrical. Leaves up to 1.5 mm wide, often subobtuse. Epicalyxscales 4-6, broadly ovate or obovate, $\frac{1}{6}-\frac{1}{4}$ as long as calyx, shortly mucronate. Calyx $17-20 \times 2-3 \mathrm{~mm}$, nearly cylindrical. Petal-limb $8-15 \mathrm{~mm}$, laciniate usually to less than halfway, white, bearded. - E.C. Russia (N. \& E. of Kazan'). Rs (C).
60. D. volgicus Juz., op. cit. 73 (1950). Like 59 but laxly caespitose; epicalyx-scales 4 , acute or acuminate, $\frac{1}{4}-\frac{1}{3}$ as long as calyx; calyx c. 25 mm ; petal-limb less than $\frac{1}{2}$ as long as calyx. - E. Russia (W. of Kujbyšev). Rs (E).
61. D. gallicus Pers., Syn. Pl. 1: 495 (1805). Laxly caespitose perennial up to 50 cm . Leaves c. $10-15 \times 1 \cdot 5-3 \mathrm{~mm}$, obtuse or subacute; cauline usually $6-10$ pairs. Flowers $1-3$ together, fragrant. Epicalyx-scales 4, broadly obovate, cuspidate, or the outer narrower, mostly green, c. $\frac{1}{3}$ as long as calyx. Calyx $20-$ $25 \times 3-4 \mathrm{~mm}$, slightly tapering. Petal-limb $10-15 \mathrm{~mm}$, laciniate, bearded, pink. $2 n=60$. Maritime sands. Atlantic coasts of France, Spain and Portugal. Ga Hs Lu.
62. D. superbus L., Fl. Suec. ed. 2, 146 (1755). Perennial up to 90 cm ; stems often decumbent below, branched above. Leaves linear-lanceolate. Flowers fragrant. Epicalyx-scales 2-4, ovate, acuminate or shortly awned, $\frac{1}{4} \frac{1}{3}$ as long as calyx. Calyx 15$30 \times 3-6 \mathrm{~mm}$, narrowed upwards. Petal-limb (6-)15-30 mm, laciniate more than half-way to middle, pink or purplish, rarely white, bearded. Europe, except the extreme west and south and the islands. Au Bu Cz Da Fe Ga Ge He Ho Hu It Ju No Po Rm Rs (N, B, C, W, E) Su.
1 Calyx c. $24 \times 3 \mathrm{~mm}$, green or somewhat purple-tinged
(c) subsp. stenocalyx

1 Calyx $15-30 \times 4-6 \mathrm{~mm}$, purple or violet
2 Not or slightly glaucous; petal-limb c. 20 mm
2 Glaucous; petal-limb c. 30 mm
(a) subsp. superbus
(a) Subsp. superbus: Throughout the range of the species; lowland.
(b) Subsp. speciosus (Reichenb.) Pawł., Fl. Tatr. 1: 250 (1956): $2 n=30$. Higher mountains throughout the range of the species.
(c) Subsp. stenocalyx (Trautv.) Kleopow, Bull. Jard. Bot. Kieff 12-13: 39 (1931): C. \& S. Russia, Ukraine.
63. D. deltoides L., Sp. Pl. 411 (1753). Subcaespitose green or glaucous perennial $15-45 \mathrm{~cm}$; stems puberulent. Leaves of nonflowering stems linear-oblanceolate, obtuse or subacute; of flowering stems (4-)6-10 pairs, linear, acute; all shortly pubescent on margins and midrib. Epicalyx-scales 2(-4), ovate, $c$. $\frac{1}{2}$ as long as calyx, narrowed to a subulate apex, herbaceous, with a scarious margin. Epicalyx-scales and calyx puberulent. Calyx 14-18 mm, nearly cylindrical. Petal-limb c. 8 mm , bearded, deep pink or rarely white, with a darker basal band and pale spots. $2 n=30$. Most of Europe, but very rare in the Mediterranean region. All except Az Bl Co Cr Fa Hb Is Sb .
64. D. degenii Bald., Nuovo Gior. Bot. Ital. nov. ser., 6:27 (1899) ( $D$. deltoides var. serpyllifolius Borbás). Like 63 but leaves of nonflowering stems c. 5 mm , elliptical; of flowering stems usually 4 pairs, narrowly oblong; epicalyx-scales (2-)4, $\frac{1}{3}-\frac{1}{2}$ as long as calyx; calyx 8-10 mm. Balkan peninsula. Al Gr Ju.

The distinction between 63 and 64 is not always clear-cut, and intermediate populations occur on mountains in Albania and the adjoining parts of Greece and Jugoslavia. These plants have been called D. oxylepis (Boiss.) Kümmerle \& Jáv., Balkan-Kutat. Tud. Eredm. 3: 233 (1926). It might perhaps be better to regard 64 as a subspecies of 63.
65. D. myrtinervius Griseb., Spicil. Fl. Rumel. 1: 194 (1843). More or less procumbent, densely leafy perennial. Leaves $2-$ 5 mm , elliptical, longer than the internodes. Epicalyx-scales 2-4, the outer usually leaf-like, c. $\frac{1}{2}$ as long as calyx. Calyx $5-8 \mathrm{~mm}$, campanulate, herbaceous. Petal-limb $3-5 \mathrm{~mm}$, bearded, pink. - Macedonia. Gr Ju.
66. D. sphacioticus Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 70 (1849). Perennial $2-10 \mathrm{~cm}$ with a stout woody stock. Leaves $c .5 \mathrm{~mm}$, oblong to oblong-lanceolate; those of the flowering stems shorter than the internodes. Epicalyx-scales usually $6, c . \frac{1}{3}$ as long as calyx; outer ovate and leaf-like; inner obovate, cuspidate. Calyx $13-16 \mathrm{~mm}$, tapering from below the middle. Petal-limb 3-4 mm, subentire, bearded. Kriti. Cr.
67. D. pallidiflorus Ser. in DC., Prodr. 1: 358 (1824). Freelybranched perennial up to 50 cm , with a stout stock. Basal leaves withered at flowering; cauline $3 \cdot 5-6 \mathrm{~cm}$, usually $6-7$ pairs, flat, rather soft. Flowers usually long-pedicellate. Epicalyx-scales usually $4, \frac{1}{3}-\frac{1}{2}$ as long as calyx, ovate with scarious margins, shortly aristate. Calyx $10-14 \times 2 \mathrm{~mm}$, tapering above the middle. Petal-limb $4-6 \mathrm{~mm}$, dentate, bearded, white or pale pink. Bulgaria; S. \& E. Russia, E. Ukraine. Bu Rs (C, W, K, E).
68. D. campestris Bieb., Fl. Taur.-Cauc. 1: 326 (1808). Usually puberulent perennial with a stout stock and numerous stems $20-$ 40 cm . Leaves $c .1 \mathrm{~mm}$ wide, the lower withered at flowering; sheaths $2-4 \mathrm{~mm}$. Flowers solitary or in pairs, terminating all the branches. Epicalyx-scales 4-6, c. $\frac{1}{3}$ as long as calyx, ovate, acuminate, with scarious margins. Calyx $15-18 \times 3-4 \mathrm{~mm}$, nearly cylindrical. Petal-limb $6-7 \mathrm{~mm}$, dentate, bearded, pink or purplish above, greenish-yellow beneath. E. \& S. Russia, Ukraine, Moldavia, N.E. Romania. Rm Rs (C, W, K, E).

[^75](a) Subsp. campestris: Plant up to 30 cm , puberulent. Branches of inflorescence long. Widespread.
(b) Subsp. laevigatus (Gruner) Klokov in Kotov, Fl. RSS Ucr. 4: 625 (1952): Plant $40-60 \mathrm{~cm}$, glabrous. Branches of inflorescence long. Dnepr and Dnestr valleys.
(c) Subsp. steppaceus Sirj. in Sirj. \& Lavrenko, Consp. Crit. Fl. Prov. Charkov. 1 (1926): Plant up to 50 cm , glabrous or puberulent. Branches of inflorescence short. E. Ukraine.
69. D. hypanicus Andrz., Trudy Kommiss. Kiev. Učebn. Okr. $4(1): 18(1860)$. Like 68 but stems $10-20(-25) \mathrm{cm}$, slender, with numerous short non-flowering branches; leaves $1-2 \mathrm{~mm}$ wide; sheaths up to 1.5 mm ; flowers solitary; epicalyx-scales usually $\frac{1}{4}$ as long as calyx. - S.C. Ukraine. Rs (W).
70. D. carbonatus Klokov, Sci. Mag. Biol. (Kharkov) 1927: 15 (1927). Like 68 but leaves rarely as much as 1 mm wide, almost setaceous; sheaths $1-3 \mathrm{~mm}$; flowers often 2-3 together; epicalyxscales usually $\frac{1}{2}$ as long as calyx which is usually 2.5 mm wide. - Moldavia, Ukraine. Rs (?C, W, K).
71. D. aridus Griseb. ex Janka, Österr. Bot. Zeitschr. 23: 196 (1873). Like 68 but with shortly pedicellate, clustered flowers; epicalyx-scales usually $\frac{3}{4}$ as long as calyx; calyx c. 10 mm . S. \& E. Bulgaria. Bu ?Gr.
72. D. marschallii Schischkin, Jour. Governm. Bot. Gard. Nikita 10 (2): 39 (1928). Perennial $20-30 \mathrm{~cm}$ with a woody stock and no basal leaves at flowering; stems usually with long branches. Cauline leaves usually 3-5 pairs, linear, acuminate. Epicalyxscales ovate, cuspidate, $c . \frac{1}{3}$ as long as calyx. Calyx $c .15 \times 3 \mathrm{~mm}$, narrowed in upper half; teeth triangular. Petal-limb $7-10 \mathrm{~mm}$, glabrous, subentire, yellowish-white above, pink beneath. - Moldavia to Krym. Rs (W, K).
73. D. cinnamomeus Sibth. \& Sm., Fl. Graec. Prodr. 1: 287 (1809). Perennial $15-30 \mathrm{~cm}$, with a stout stock; stem terete, more or less puberulent. Lower leaves usually obtuse; basal often withered at flowering. Epicalyx-scales obovate, apiculate to cuspidate $\frac{1}{4}-\frac{1}{3}$ as long as calyx. Calyx c. $18 \times 4 \mathrm{~mm}$; teeth oblonglanceolate. Petal-limb c. 3 mm , glabrous, cream above, cinnamon beneath. S. Greece, Kikladhes. Gr.
74. D. pallens Sibth. \& Sm., op. cit. 286 (1809). Like 73 but often taller (up to 60 cm ) and usually pruinose; leaves sometimes with thin margins; sheaths about as long as diameter of stem; epicalyx-scales ovate, acute or acuminate; calyx $17-22 \times 4 \mathrm{~mm}$; teeth lanceolate, acuminate; petal-limb greenish beneath. S. \& E. parts of Balkan peninsula; S.E. Romania. Bu Gr Rm Ju Tu.
75. D. lanceolatus Steven ex Reichenb., Pl. Crit. 6: 34 (1828) (D. leptopetalus auct.). Robust perennial up to $c .50 \mathrm{~cm}$, with a woody stock and no basal leaves at flowering; stems usually branched above. Cauline leaves usually 5-7 pairs, linear, acuminate, thin; sheaths 2-3 times as long as diameter of stem. Epicalyx-scales $4, \frac{1}{4} \frac{1}{3}$ as long as calyx; outer ovate, abruptly acuminate; inner broadly obovate, cuspidate. Calyx $25-30 \times 4-5 \mathrm{~mm}$, narrowed in the upper half. Petal-limb $c$. 10 mm , dentate, whitish, glabrous. - U.S.S.R. from c. $51^{\circ} \mathrm{N}$. southwards. Rs (C, W, E).
76. D. leptopetalus Willd., Enum. Pl. Hort. Berol. 468 (1809). Like 75 but calyx 20-28 $\times 3-4 \mathrm{~mm}$, tapering markedly from below the middle; petal-limb narrowly rhombic, widest just above the middle, purplish beneath. S.E. Europe, from Macedonia to the lower Volga. Bu Gr Rm Rs (C, W, E).
77. D. roseoluteus Velen., Österr. Bot. Zeitschr. 36: 226 (1886). Pubescent branched perennial $30-50 \mathrm{~cm}$. Basal leaves withered at flowering; cauline $20-30 \times 2-3 \mathrm{~mm}$, usually $5-10$ pairs, at least as long as internodes, flat, acuminate; sheaths about as long as diameter of stem. Epicalyx-scales usually 6 ; outer leaf-like and about as long as calyx; inner ovate with a subulate point. Calyx $18-22 \times c .4 \mathrm{~mm}$, tapering from about the middle; teeth usually $5-8 \mathrm{~mm}$. Petal-limb c. 7 mm , dentate, bearded, pink above, yellowish beneath. Bulgaria and Turkey. Bu Tu.
78. D. mercurii Heldr., Atti Congr. Bot. Firenze 1876: 237 (1876). Like 77 but glabrous, leaves longer; sheaths 2-3 times as long as diameter of stem; flowers often 2-3 together; calyx 25$30 \times$ c. 5 mm ; petal-limb c. 15 mm . On rocks. - S. Greece (Akhaia). Gr.
79. D. gracilis Sibth. \& Sm., Fl. Graec. Prodr. 1: 288 (1809). Glabrous perennial $15-40 \mathrm{~cm}$; stems simple or branched. Basal leaves $c .1 \mathrm{~mm}$ wide, often absent at flowering; cauline 4-6 pairs, shorter than the internodes, flat, acuminate; sheaths c. 3 times as long as diameter of stem. Epicalyx-scales $4-6, \frac{1}{4}-\frac{1}{3}$ as long as calyx, obovate, cuspidate or, rarely, gradually tapering from about the middle. Petal-limb $5-10 \mathrm{~mm}$, dentate, bearded with long hairs, deep pink above, yellow or purplish beneath. $2 n=60$. - N. \& E. Greece, Macedonia, Albania. A1 Bu Gr Ju.

1 Point of epicalyx-scales less than $\frac{1}{2}$ as long as the wide part of scale
2 Epicalyx-scales usually 6; flowers mostly in groups of 2 or more; pedicels very short
(d) subsp. friwaldskyanus

2 Epicalyx-scales usually 4; flowers mostly solitary; pedicels long
(b) subsp. xanthianus

1 Point of epicalyx-scales more than $\frac{1}{2}$ as long as the wide part of scale
3 Basal leaves usually present at flowering; cauline leaves rigid; epicalyx-scales $c$. $\frac{3}{4}$ as long as calyx. (c) subsp. armerioides
3 Basal leaves usually absent at flowering; cauline leaves soft; epicalyx-scales $c . \frac{1}{2}$ as long as calyx
4 Flowers nearly always solitary; calyx c. 5 mm wide, slightly ventricose $\quad$ (a) subsp. gracili
4 Flowers shortly pedicellate, in small clusters; calyx $3-4 \mathrm{~mm}$ wide, cylindrical
(e) subsp. achtarovii
(a) Subsp. gracilis: E. Greece (E. Makedhonia, Thessalia, Samothraki).
(b) Subsp. xanthianus (Davidov) Tutin, Feddes Repert. 68: 191 (1963) (D. xanthianus Davidov): Thraki.
(c) Subsp. armerioides (Griseb.) Tutin, Feddes Repert. 68: 191 (1963) (D. gracilis var. armerioides Griseb., D. suskalovicii Adamović): Macedonia, Albania.
(d) Subsp. friwaldskyanus (Boiss.) Tutin, Feddes Repert. 68:191 (1963) (D. friwaldskyanus Boiss.): S.W. Bulgaria and Macedonia.
(e) Subsp. achtarovii (Stoj. \& Kitanov) Tutin, Feddes Repert. 68: 191 (1963) (D. achtarovii Stoj. \& Kitanov): Thasos.
80. D. drenowskianus Rech. fil., Feddes Repert. 31 : 158 (1932). Like 79 but usually smaller; leaves tapering from the middle or below; sheaths usually 4-6 times as long as diameter of stem; epicalyx-scales usually 4 ; awn about as long as the wide part of scale, rigid, often patent; calyx $10-14 \mathrm{~mm}$; petal-limb with short and long hairs on upper surface. E. Macedonia. Bu Gr.
81. D. haematocalyx Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 65 (1853). Caespitose glabrous perennial $1-30 \mathrm{~cm}$. Leaves linear to linear-lanceolate, acute or obtuse. Epicalyxscales 4-6, ovate-lanceolate, with a long, more or less patent apex. Calyx $16-26 \times 4-7 \mathrm{~mm}$, narrowed upwards; teeth acuminate. Petal-limb bearded, purple above, yellow beneath. $S$. part of Balkan peninsula. Al Gr Ju.

1 Epicalyx-scales tapering gradually towards the apex; stems up to 30 cm , usually branched, 1 - to 5 -flowered
2 Plant not glaucous; leaves not markedly rigid; epicalyx-scales about as long as calyx (a) subsp. haematocaly
2 Plant glaucous; leaves rigid; epicalyx-scales shorter than calyx
(b) subsp. pruinosus

1 Epicalyx-scales abruptly contracted into a subulate apex; stems up to 10 cm , usually 1 -flowered
3 Plant glaucescent; stem up to 10 cm ; leaves linear; calyx ventricose at base
(c) subsp. sibthorpii

3 Plant not glaucescent; stems up to 5 cm ; leaves linear-lanceolate; calyx scarcely ventricose at base $\quad$ (d) subsp. pindicola
(a) Subsp. haematocalyx: S. Jugoslavia, Greece.
(b) Subsp. pruinosus (Boiss. \& Orph.) Hayek, Prodr. Fl. Penins. Balcan. 1: 240 (1924): E. Greece (near Volos).
(c) Subsp. sibthorpii (Vierh.) Hayek, loc. cit. (1924): S.C. Greece; Albania.
(d) Subsp. pindicola (Vierh.) Hayek, loc. cit. (1924): N. Greece, S. Albania.
82. D. biflorus Sibth. \& Sm., Fl. Graec. Prodr. 1: 285 (1809) (D. cinnabarinus Spruner ex Boiss.; incl. D. samaritanii Heldr. ex Halácsy). Laxly caespitose perennial $15-40 \mathrm{~cm}$. Cauline leaves 3-4 pairs, acuminate; sheaths several times as long as diameter of stem. Flowers solitary or few in a head. Epicalyx-scales usually $6, c \cdot \frac{1}{3}-\frac{1}{2}$ as long as calyx, obovate, aristate, coriaceous. Calyx $20-25 \times 4-5 \mathrm{~mm}$, tapering from about the middle. Petallimb $8-15 \mathrm{~mm}$, dentate, with numerous very short hairs and glands all over the upper surface. Mountain rocks. - C. \& S. Greece. Gr.
83. D. strictus Banks \& Solander in A. Russell, Nat. Hist. Aleppo ed. 2, 2: 252 (1794) (D. multipunctatus Ser.). Glabrous perennial $30-50 \mathrm{~cm}$, with woody stock and simple or branched stems. Basal leaves withered at flowering; cauline $1-3 \mathrm{~mm}$ wide, acuminate, 6-12 pairs, about as long as internodes. Epicalyxscales $c . \frac{1}{3}$ as long as calyx, ovate, cuspidate, broadly scarious. Calyx 15-18 mm, conical, verruculose, unribbed but with purple lines on the teeth continued downwards from the sinuses. Petal$\operatorname{limb} c .10 \mathrm{~mm}$, dentate, bearded. $2 n=30$. Kriti. Cr. (S.W. Asia.)
84. D. tripunctatus Sibth. \& Sm., Fl. Graec. Prodr. 1: 286 (1809). Divaricately-branched glabrous annual $15-40 \mathrm{~cm}$. Basal leaves (usually withered at flowering) $3-8 \mathrm{~mm}$ wide, oblongspathulate, obtuse; cauline linear, acuminate. Epicalyx-scales c. $\frac{3}{4}$ as long as calyx, ovate with a long, usually green, subulate apex. Calyx $c .15 \mathrm{~mm}$, conical, broadly ribbed and verruculose on the sides of the ribs. Petal-limb c. 10 mm , dentate, bearded. S. Greece and Aegean region; Italy (Calabria, Elba); Portugal (Estremadura). Cr Gr It Lu.
85. D. corymbosus Sibth. \& Sm., Fl. Graec. Prodr. 1: 285 (1809) (incl. D. tenuiflorus Griseb., D. tymphresteus (Boiss. \& Spruner) Heldr. \& Sart. ex Boiss.). Annual or perennial 1040 cm , more or less pubescent and often glandular. Basal leaves linear, linear-lanceolate or spathulate, usually withered at flowering; upper cauline linear, acuminate. Flowers usually in clusters of 2-3. Epicalyx-scales c. $\frac{1}{2}-\frac{3}{4}$ as long as calyx, ovatelanceolate, with a green apex usually about as long as the broad part of the scale. Calyx $10-17(-20) \times 2 \cdot 5-3 \mathrm{~mm}$, usually pubescent, almost cylindrical. Petal-limb $7-10 \mathrm{~mm}$, dentate, bearded. $2 n=30$. Balkan peninsula. Al Bu Gr Ju Tu.
86. D. viscidus Bory \& Chaub., Nouv. Fl. Pélop. 26 (1838). Like 85 but perennial; flowers usually in larger clusters; epicalyxscales more or less inflated, shiny, with a setaceous point; calyx
$18-22 \times 3-4 \mathrm{~mm}$, glabrous, tapering from about the middle. Greece. Gr.
87. D. diffusus Sibth. \& Sm., Fl. Graec. Prodr. 1: 285 (1809) (incl. D. pubescens Sibth. \& Sm., D. glutinosus Boiss. \& Heldr., D. chalcidicus Halácsy). Like 85 but perennial; flowers solitary, or 2 together but distinctly pedicellate; epicalyx-scales broadly ovate, with a wide scarious margin and setaceous point usually shorter than wide part of scale; calyx $18-22 \times 3-4 \mathrm{~mm}$, glabrous. S. part of Balkan peninsula; Aegean region. ?Bu Gr Ju Tu.
88. D. formanekii Borbás ex Form., Verh. Naturf. Ver. Brünn 32: 187 (1894). Glandular-viscid perennial up to $c .50 \mathrm{~cm}$. Leaves $0 \cdot 5-1 \mathrm{~mm}$ wide, linear, acute, flat; sheaths several times as long as diameter of stem. Flowers numerous, in small dense heads; bracts ovate-oblong, shortly aristate. Epicalyx-scales like the bracts, $\frac{1}{2}-\frac{3}{4}$ as long as calyx. Calyx $6-7 \times 1.5 \mathrm{~mm}$, narrowed from below the middle. Petal-limb c. 2 mm , denticulate, purple. - Macedonia and Thessalia. Gr Ju.
89. D. armeria L., Sp. Pl. 410 (1753) (D. epirotus Halácsy). Usually pubescent and branched annual or biennial c. 40 cm . Basal leaves oblong, obtuse; cauline linear, acute, all flat and thin. Flowers clustered; bracts leaf-like, about as long as flowers. Epicalyx-scales about as long as calyx, lanceolate, with greên subulate apex. Calyx $15-20 \times 2-3 \mathrm{~mm}$, narrowed above the middle. Petal-limb c. 5 mm , dentate, bearded, reddish. Most of Europe, but rare in the north. Al Au Be Br Bu Co Cz Da Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs (C, W, K, E) Sa Su Tu.
(a) Subsp. armeria: Inner epicalyx-scales lanceolate. Calyx green. $2 n=30$. Throughout the range of the species.
(b) Subsp. armeriastrum (Wolfner) Velen., Fl. Bulg. suppl. 42 (1898) (D. armeriastrum Wolfner) Inner epicalyx-scales ovate. Calyx purplish. $2 n=30$. From Hungary and W. Romania to Albania and S. Bulgaria. Al Bu Hu Ju Rm.
90. D. pseudarmeria Bieb., Fl. Taur.-Cauc. 1: 323 (1808). Like 89 but epicalyx-scales ovate, abruptly contracted into a subulate point; calyx c. $10 \times 1.5 \mathrm{~mm}$; petal-limb pink. Lowlands of S.E. Europe, from E. Jugoslavia to S. Russia. Bu Ju Rm Rs (W, K, E) Tu.
91. D. humilis Willd. ex Ledeb., Fl. Ross. 1: 280 (1842). Densely caespitose perennial $5-35 \mathrm{~cm}$; stems simple or littlebranched. Leaves short, stiff, setaceous ( $0 \cdot 5-1 \mathrm{~mm}$ wide). Epicalyx-scales usually 6, c. $\frac{2}{3}$ as long as calyx; inner ovate, acuminate; outer much smaller and narrower. Calyx 10-15x 2 mm , tapering above the middle. Petal-limb $2-3 \mathrm{~mm}$, dentate, bearded. - S. Ukraine. Rs (W, K).
92. D. ciliatus Guss., Ind. Sem. Boccad. 1825: 5 (1825). Laxly caespitose perennial up to $c .60 \mathrm{~cm}$. Leaves $1-2 \mathrm{~mm}$ wide, more or less flat, linear, acuminate, basal often few at flowering. Epicalyx-scales usually $8, c . \frac{1}{2}$ as long as calyx, ovate, acuminate. Calyx $15-23 \times 3 \mathrm{~mm}$, tapering from below the middle. Petallimb $5-10 \mathrm{~mm}$, dentate to subentire, glabrous. - Adriatic region. Al It Ju.
(a) Subsp. ciliatus: Stock stout; stems little-branched. Cauline leaves usually 4-6 pairs; petals shallowly dentate or subentire. E. Italy, Istra, Dalmatia.
(b) Subsp. dalmaticus (Čelak.) Hayek, Prodr. Fl. Penins. Balcan. 1: 246 (1924): Stock slender; stems much-branched. Cauline leaves usually 7-13 pairs. Petals dentate. Dalmatia to Albania.
93. D. arpadianus Ade \& Bornm., Feddes Repert. 36: 385 (1934). Pulvinate perennial up to 5 cm . Leaves usually $5-8 \mathrm{~mm}$, linear, acuminate; cauline 1-2 pairs. Epicalyx-scales usually 4, c. $\frac{1}{2}$ as long as calyx, ovate with a subulate apex. Calyx $6-8 \times$ $1.5-2 \mathrm{~mm}$, almost cylindrical. Petal-limb $2-3 \mathrm{~mm}$, dentate, bearded. N.E. Greece (Thraki, Samothraki). Gr. (Asia Minor.)
94. D. nardiformis Janka, Österr. Bot. Zeitschr. 23: 195 (1873). Caespitose perennial up to c. 10 cm , with slender, branched, woody stems. Basal leaves $c .10 \mathrm{~mm}$, setaceous, $\frac{1}{2}$-terete; cauline 6-10 pairs, longer than internodes. Flowers solitary. Epicaiyxscales (4-)6, c. $\frac{1}{2}$ as long as calyx, ovate, aristate. Calyx 1518 mm , narrowed from about the middle. Petal-limb c. 5 mm , dentate, bearded, pink. $2 n=30$. Lower Danube valley and Dobruja. Bu ?Ju Rm.
95. D. ingoldbyi Turrill, Kew Bull. 1924: 314 (1924). Caespitose perennial c. 30 cm , with a woody stock; stems puberulent below. Leaves c. 2 mm wide, linear, acuminate, coriaceous. Flowers 2-5 together, subsessile. Epicalyx-scales 10-12, ovate, gradually acuminate. Calyx $15-17 \times 2 \mathrm{~mm}$, tapering above the middle. Petal-limb $2-4 \mathrm{~mm}$, denticulate, whitish- or greenishyellow. Gelibolu peninsula. Tu.
96. D. juniperinus Sm., Trans. Linn. Soc. London (Bot.) ser. 1, 2:303(1794). Small shrub with erect, woody branched stems bearing herbaceous flowering stems $10-15 \mathrm{~cm}$. Leaves $c .20 \times 0.5-1.5$ mm , linear, abundant on non-flowering stems, 2-3 pairs on flowering stems. Epicalyx-scales $4-8, \frac{1}{3} \frac{1}{2}$ as long as calyx, obcordate, with a subulate apex. Calyx $13-20 \times 2-3 \cdot 5 \mathrm{~mm}$, nearly cylindrical; teeth acute. Petal-limb $4-8 \mathrm{~mm}$, dentate, bearded. $2 n=30$. - Kriti. Cr.
97. D. rupicola Biv., Sic. Pl. Cent. 1: 31 (1806). Small shrub $30-60 \mathrm{~cm}$. Leaves $3-5 \mathrm{~mm}$ wide, rather thick, linear-oblong; lower obtuse; upper acute. Flowers in bracteate heads; pedicels short. Epicalyx-scales 12-16, obovate, acuminate. Calyx 25$30 \times 4-5 \mathrm{~mm}$, almost cylindrical. Petal-limb $10-15 \mathrm{~mm}$, dentate, bearded, pink. Mallorca, S. Italy, Sicilia. Bl It Si.
98. D. arboreus L., Sp. Pl. 413 (1753). Small shrub up to 50 cm with tortuous branches. Leaves 3 mm wide, linear, obtuse, subterete, fleshy, glaucous. Flowers numerous, scented; pedicels short. Epicalyx-scales 10-20, obovate, shortly cuspidate. Calyx $18-22 \times 2-3 \mathrm{~mm}$, narrowed from about the middle. Petal-limb c. 10 mm , dentate, bearded, pink. $2 n=30$. S. Aegean region; one station in S.W. Greece. Cr Gr.
99. D. fruticosus L., Sp. Pl. 413 (1753). Like 98 but leaves 4-8 mm wide, elliptic or oblanceolate, rounded at apex; flowers not scented; epicalyx-scales $8-10$; calyx $20-25(-30) \mathrm{mm}$. Kikladhes (Sikinos, Serifos, Folegandros). Gr.
100. D. ferrugineus Miller, Gard. Dict. ed. 8, no. 9 (1768) (D. balbisii Ser.). Perennial with woody stock; stems $30-60 \mathrm{~cm}$, numerous, simple. Leaves convolute to linear-lanceolate, acuminate; sheaths more than 3 times as long as diameter of stem. Heads few- to many-flowered, usually dense; bracts oblong to ovate, long-acuminate, herbaceous above, about equalling the flowers. Epicalyx-scales 4, oblong to ovate, abruptly contracted into the awn, about as long as calyx. Calyx $17-24 \times 3-5 \mathrm{~mm}$, almost cylindrical; teeth lanceolate, acuminate or aristate. Petallimb pink, spotted with purple, more or less bearded. C. Mediterranean region. Al Ga It Ju.
1 Leaves convolute
(c) subsp. vulturius

1 Leaves flat

2 Leaves 2-3 mm wide; calyx c. 20 mm ; petal-limb 7-10 mm
(a) subsp. ferrugineus

2 Leaves $4-7 \mathrm{~mm}$ wide; calyx c. 24 mm ; petal-limb $10-15 \mathrm{~mm}$
(b) subsp. liburnicus
(a) Subsp. ferrugineus (D. liburnicus sensu Hayek): $2 n=30$. Throughout the range of the species.
(b) Subsp. liburnicus (Bartl.) Tutin, Feddes Repert. 68: 191 (1963) (D. liburnicus Bartl.): N.W. Italy, Jugoslavia.
(c) Subsp. vulturius (Guss. \& Ten.) Tutin, Feddes Repert. 68: 191 (1963): S. Italy.

Subsp. vulturius approaches 102 in the leaves and the often rather small heads with more or less oblong bracts, but is larger in all its parts; intermediates between it and subsp. ferrugineus occur.
101. D. capitatus Balbis ex DC., Cat. Pl. Hort. Monsp. 103 (1813). Glaucous perennial up to 70 cm . Leaves $2-3 \mathrm{~mm}$ wide, linear, the upper $1-2$ pairs greatly enlarged near the base; sheaths more than 3 times as long as diameter of stem. Heads manyflowered, dense, solitary; bracts about as long as the calyx, ovate, coriaceous, with a green or brown apex. Epicalyx-scales half as long as to nearly as long as calyx, ovate, shortly awned; margins scarious. Calyx 9-19 mm, narrowed upwards; teeth lanceolate to ovate, acute. Petal-limb c. 5 mm , bearded to almost glabrous, purple. - S.E. Europe, extending northwards to S. Ural. ?Bu Gr Ju Rm Rs (C, W, K, E) Tu.
(a) Subsp. capitatus: Calyx $16-19 \mathrm{~mm}$; epicalyx-scales about as long as calyx; petals distinctly bearded. Scattered localities around the Black Sea. Rm Rs (K, E) Tu.
(b) Subsp. andrzejowskianus Zapał., Rozpr. Wydz. Mat.-Przyr. Polsk. Akad. Um. (Biol.) ser. 3, 11B: 25 (1911) (D. andrzejowskianus (Zapal.) Kulcz.): Calyx $10-15 \mathrm{~mm}$; epicalyx-scales about half as long as calyx; petals almost glabrous. Almost throughout the range of the species. ? $\mathrm{Bu} \mathrm{Gr} \mathrm{Ju} \mathrm{Rm} \operatorname{Rs}(\mathrm{C}, \mathrm{W}, \mathrm{E})$.
102. D. pinifolius Sibth. \& Sm., Fl. Graec. Prodr. 1: 284 (1809) (incl. D. androsaceus (Boiss. \& Heldr.) Hayek, D. lydus sensu Hayek, D. rhodopeus Davidov, D. serulis Kulcz.). Densely caespitose perennial up to 40 cm . Leaves less than 1 mm wide, linear, acuminate, usually rather rigid, with prominent midrib and strongly thickened margins; sheaths (2-)3-8 times as long as diameter of stem. Flowers in dense heads; bracts coriaceous, ovate- to obovate-oblong, aristate. Epicalyx-scales usually 6, obovate, aristate. Calyx $10-20 \times 2-4 \mathrm{~mm}$, tapering somewhat above the middle. Petal-limb $5-7(-10) \mathrm{mm}$, dentate, purple or lilac. Balkan peninsula, S.W. Romania. Al Bu Gr Ju Rm Tu.

1 Bracts about as long as calyx
(b) subsp. serbicus

1 Bracts distinctly shorter than the calyx
2 Calyx c. 10 mm ; flowers lilac
2 Calyx 12 mm or more; flowers purple
(c) subsp. lilacinus (a) subsp. pinifolius
(a) Subsp. pinifolius (subsp. smithii Wettst.): $2 n=30$. Balkan peninsula. Bu Gr Ju Tu .
(b) Subsp. serbicus Wettst., Biblioth. Bot. (Stuttgart) 26: 34 (1892): Albania, Bulgaria, S.W. Romania, ?N. Greece.
(c) Subsp. lilacinus (Boiss. \& Heldr.) Wettst., op. cit. 33 (1892): Albania, Greece.
103. D. giganteus D’Urv., Mém. Soc. Linn. Paris 1: 301 (1822). Robust, often pruinose perennial $20-100 \mathrm{~cm}$. Leaves usually $2-4 \mathrm{~mm}$ wide, widest near the middle, flat, linear, acuminate; sheaths several times longer than diameter of stem. Flowers usually numerous, in dense heads, occasionally with a pair of leaves close below the head. Epicalyx-scales usually half as long
as calyx, brown or scarious, ovate, acute or acuminate. Calyx (15-)17-22 $\times(2-) 3-4 \mathrm{~mm}$, tapering from about the middle. Petallimb $5-8 \mathrm{~mm}$, dentate, purple. $2 n=30$. Balkan peninsula, extending northwards to Romania; one station in C. Italy. Al Bu Gr Hu It Ju Rm Tu.

1 Epicalyx-scales scarious, whitish (f) subsp. leucophoeniceus
1 Epicalyx-scales membranous or almost coriaceous, brownish
2 Epicalyx-scales acute to acuminate, glabrous (a) subsp. giganteus
2 Epicalyx-scales cuspidate, usually $\pm$ puberulent
3 Cauline leaves $5-7 \mathrm{~mm}$ wide $\quad$ (d) subsp. haynaldianus
3 Cauline leaves rarely more than 3 mm wide
4 Calyx usually $18-22 \mathrm{~mm}$; epicalyx-scales often reaching base of calyx-teeth, pale brown, $\pm$ membranous (e) subsp. italicus
4 Calyx up to 17 mm ; epicalyx-scales distinctly shorter than calyx-tube, usually dark brown and somewhat coriaceous
5 Calyx 14-17 $\times 2.5-3 \mathrm{~mm}$
(b) subsp. croaticus
5 Calyx 12-15 $\times 3-4.5 \mathrm{~mm}$
(c) subsp. banaticus
(a) Subsp. giganteus: Plant very robust, sometimes pruinose. Heads many-flowered. Epicalyx-scales acute or acuminate, glabrous, brownish. Calyx 17-20 mm. C. \& E. Romania, Bulgaria, Turkey.
(b) Subsp. croaticus (Borbás) Tutin, Feddes Repert. 70: 1 (1964) (D. croaticus Borbás): Plant usually slender, green. Cauline leaves rarely more than 3 mm wide. Heads rather few-flowered. Epicalyx-scales cuspidate, dark brown, awned; awn of epicalyxscales usually $3-5 \mathrm{~mm}$. Calyx $14-17 \times 2 \cdot 5-3 \mathrm{~mm}$. Jugoslavia, N. Greece, Bulgaria.
(c) Subsp. banaticus (Heuffel) Tutin, Feddes Repert. 68: 191 (1963) (D. carthusianorum var. banaticus Heuffel, D. banaticus (Heuffel) Borbás): Like (b) but awn of epicalyx-scales usually $1-2 \mathrm{~mm}$ and calyx $12-15 \times 3-4.5 \mathrm{~mm}$. S.W. Romania.
(d) Subsp. haynaldianus (Borbás) Tutin, Feddes Repert. 68: 191 (1963) (D. haynaldianus Borbás): Like (b) but cauline leaves $5-7 \mathrm{~mm}$ wide; calyx 20 mm . S. part of Balkan peninsula.
(e) Subsp. italicus Tutin, Feddes Repert. 68: 191 (1963): Plant slender, green. Heads rather few-flowered. Epicalyx-scales cuspidate, brownish. Calyx $18-22 \mathrm{~mm}$. C. Italy (Monte Morrone).
(f) Subsp. leucophoeniceus (Dörfler \& Hayek) Tutin, Feddes Repert. 68: 191 (1963) (D. leucophoeniceus Dörfler \& Hayek): Plant rather stout, green. Heads many-flowered. Epicalyx-scales scarious, whitish. Calyx c. 15 mm . Albania, Makedonija.
104. D. pontederae Kerner, Sched. Fl. Exsicc. Austro-Hung. 2: 67 (1882). Like 103 but smaller and more slender; inner epicalyxscales obovate, acute or shortly aristate; calyx $8-14 \times 2-3 \mathrm{~mm}$; petal-limb 3-5 mm. E.C. Europe, extending to N. Italy and Bulgaria. Au Bu Cz Hu It Ju Rm.
1 Calyx c. 8 mm ; teeth subobtuse and mucronate
(c) subsp. kladovanus

1 Calyx 10 mm or more; teeth acute
2 Calyx c. 10 mm ; outer epicalyx-scales brown, abruptly contracted into a short awn (a) subsp. pontedera
2 Calyx c. 14 mm ; outer epicalyx-scales straw-coloured, acuminate
(b) subsp. giganteiformis
(a) Subsp. pontederae: $2 n=30$. Throughout the range of the species.
(b) Subsp. giganteiformis (Borbás) Soó, Acta Geobot. Hung. 2: 78 (1938): Hungary, Romania, Jugoslavia.
(c) Subsp. kladovanus (Degen) Stoj. \& Acht., Sborn Bǎlg. Akad. Nauk. 29: 50 (1935): Jugoslavia, Bulgaria, Romania.
D. vandasii Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1893 (37): 16 (1894), from Bulgaria, resembles 104 in the size and shape of calyx but has narrow (c. 0.5 mm wide), often convolute leaves, the
lower cauline ones longer than the internodes, and cuspidate epicalyx-scales.
105. D. diutinus Kit. in Schultes, Oestreichs Fl. ed. 2, 1: 655 (1814). Somewhat glaucous perennial up to $c .50 \mathrm{~cm}$. Basal leaves setaceous, cauline up to 1 mm wide, linear, obtuse or subobtuse; sheaths several times as long as diameter of stem. Flowers 2 -several, in a dense head; bracts and epicalyx-scales ovate, coriaceous, apiculate or shortly aristate. Calyx (10-)12$15 \times 2-3 \mathrm{~mm}$, somewhat narrowed above the middle; teeth rounded, little longer than wide. Petal-limb $5-8 \mathrm{~mm}$, dentate, glabrous, pinkish-lilac. - Hungary. Hu ?Ju.
106. D. platyodon Klokov, Jour. Bot. Acad. Sci. Ukr. 5 (1): 27 (1948) (D. polymorphus Bieb. pro parte). Perennial $10-30 \mathrm{~cm}$. Leaves c. 1 mm wide, linear, acute; sheaths several times as long as diameter of stem. Flowers 1 -several in a head; bracts lanceolate, acuminate. Epicalyx-scales obovate, abruptly acuminate or mucronate, coriaceous, with scarious margins. Calyx $10-14 \times 3-4 \mathrm{~mm}$; teeth oblong, mucronate. Petal-limb $5-8 \mathrm{~mm}$, bearded, deep pink. Ukraine; S.E. Russia. Rs (W, K, E).
107. D. bessarabicus (Kleopow) Klokov in Kotov, Fl. RSS Ucr. 4: 659 (1952). Robust perennial $30-50 \mathrm{~cm}$. Leaves linear, acute; lower cauline up to $c .2 \mathrm{~mm}$ wide; sheaths several times as long as diameter of stem. Flowers usually several in a head; bracts oblong, often with a green point. Epicalyx-scales obovateoblong, mucronate, coriaceous, with hyaline margins. Calyx 18$22 \times 5-6 \mathrm{~mm}$; teeth ovate, obtuse. Petal-limb $10-15 \mathrm{~mm}$, bearded, deep purplish. - Romania, Moldavia, N.E. Greece. Gr Rm Rs (W).
108. D. carthusianorum L., Sp. Pl. 409 (1753)(incl. D. sanguineus Vis., D. rogowiczii Kleopow). Glabrous perennial up to $c .60 \mathrm{~cm}$. Leaves $0.5-5 \mathrm{~mm}$ wide, linear, acuminate, flat; sheaths several times as long as diameter of stem. Flowers few to many in a usually dense head; bracts lanceolate to oblong, more or less herbaceous to coriaceous. Epicalyx-scales obovate to obcordate, abruptly aristate, coriaceous to membranous. Calyx 10-20x $2-5 \mathrm{~mm}$, narrowed above the middle. Petal-limb usually $10-$ 15 mm , dentate, deep pink to purple, very rarely white, bearded. $2 n=30$. S., W. \& C. Europe. Al Au Be Cz Ga Ge He Ho Hs Hu It Ju Po Rm Rs (W) Si Tu.

A very variable species which has been much subdivided. The variation in leaf-width, length of awn, colour, shape and texture of epicalyx-scales, length and colour of the calyx, and petal-size seems to be largely continuous and with little correlation between the different characters. The variation does not in general fall into a geographical pattern, though some fairly distinct populations appear to exist, especially near the limits of the distribution of the species.

For diverse accounts of the intraspecific taxa see Ascherson \& Graebner, Syn. Mitteleur. Fl. 5 (2): 306-30 (1921), Hegi, Ill. Fl. Mitteleur. 3: 323-6 (1910), and Prodan in Săvul. Fl. Rep. Pop. Române 2: 250-5 (1953).
D. commutatus (Zapał.) Klokov in Kotov, Fl. RSS Ucr. 4: 659 (1952), is very robust with wide leaves and a puberulent calyx, but otherwise resembles 108.
109. D. puberulus (Simonkai) Kerner, Sched. Fl. Exsicc. Austro-Hung. 2: 63 (1882). Like 108 but stems, leaves, bracts and epicalyx-scales puberulent; petal-limb less than 10 mm , pink. - N. part of Balkan peninsula, Romania. Bu Ju Rm.

Might perhaps be regarded as one of the more distinct variants of 108 .
110. D. tenuifolius Schur, Verh. Siebenb. Ver. Naturw. 143 (1859). Like 108 but with very numerous stems up to 25 cm ; leaves $0 \cdot 5-1(-2) \mathrm{mm}$ wide; cauline longer than internodes; flowers $1-4(-6)$ in a head; bracts as long as or longer than inflorescence; calyx $2-3 \mathrm{~mm}$ wide. E. Carpathians. Rm.

Might perhaps be regarded as a subspecies of 108.
111. D. borbasii Vandas, Österr. Bot. Zeitschr. 36: 193 (1886). Perennial with an unbranched woody stock from which flowering stems and short leafy shoots arise. Leaves $c .1 \mathrm{~mm}$ wide, linear, acuminate; basal mostly withered at flowering. Stems $30-50 \mathrm{~cm}$, simple, or little-branched near the top. Heads (1)2- to 8 -flowered. Epicalyx-scales ovate, narrowed into a short awn, pale brown and broadly scarious. Calyx $14-17 \times 3-4 \mathrm{~mm}$, pink or purplish. Petal-limb c. 10 mm , dentate, pink, bearded. Poland; U.S.S.R. southwards from c. $57^{\circ} N$. Po Rs (C, W, K, E).
(a) Subsp.borbasii: Bracts and epicalyx-scales usually not more than $\frac{1}{2}$ as long as calyx. Calyx-teeth $3 \cdot 5 \cdot 4 \cdot 5 \mathrm{~mm}$. Throughout the range of the species.
(b) Subsp. capitellatus (Klokov) Tutin, Feddes Repert. 68: 192 (1963) (D. capitellatus Klokov): Bracts and epicalyx-scales more than $\frac{1}{2}$ as long as calyx. Calyx-teeth 5-6 mm. Ukraine.
112. D. henteri Heuffel ex Griseb. \& Schenk, Arch. Naturgesch. (Berlin) 18 (1): 303 (1852). Caespitose perennial 15-30 cm. Leaves c. 0.5 mm wide, linear, acuminate, rather rigid; cauline shorter than internodes; sheaths 3-4 times as long as diameter of stem. Flowers usually 2-3 together; bracts narrow, often herbaceous, shorter than inflorescence. Epicalyx-scales broadly ovate to obovate, often somewhat retuse, aristate. Calyx $12-14 \times 4$ 5 mm , nearly cylindrical, green or purplish with brown teeth. Petal-limb 8-12 mm, dentate. Damp, grassy places. - $S$. Carpathians. Rm.
113. D. cruentus Griseb., Spicil. Fl. Rumel. 1: 186 (1843) (incl. D. lateritius Halácsy, D. calocephalus Bald., non Boiss., D. holzmannianus Heldr. \& Hausskn.). Usually glaucescent perennial up to 100 cm . Leaves $1-3 \mathrm{~mm}$ wide, linear, acuminate, flat; sheaths several times as long as diameter of stem. Flowers numerous, in a dense head; bracts puberulent, oblong to ovateoblong with an awn, up to about as long as calyx. Epicalyxscales similar but smaller, pale to reddish-brown. Calyx 18$20 \times 3-4 \mathrm{~mm}$, somewhat tapering from about the middle, puberulent, usually reddish-purple. Petal-limb $5-8 \mathrm{~mm}$, dentate, more or less bearded. $2 n=30$. Balkan peninsula. Al Bu Gr Ju Tu.
(a) Subsp. cruentus: Awn considerably longer than the reddishbrown epicalyx-scales; petals more or less glabrous, deep purple. Bosna to Albania and W. Bulgaria.
(b) Subsp. turcicus (Velen.) Stoj. \& Acht. in Stoj. \& Stefanov, Fl. Bálg. ed. 3, 405 (1948) (D. turcicus Velen.): Awn about as long as the pale epicalyx-scales; petals bearded, pinkish-purple. Albania and S.W. Greece to E. Bulgaria and Turkey.
114. D. quadrangulus Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1892: 372 (1893). Like 113 but smaller and less robust; basal leaves convolute; cauline $0.5-1(-2) \mathrm{mm}$ wide, flat; bracts and epicalyxscales usually whitish; awn of epicalyx-scales usually longer than the scale; calyx $12-14 \times 3 \mathrm{~mm}$, reddish-purple; petal-limb $c$. 4 mm , purple, bearded. $2 n=30$. N.E. Jugoslavia, Bulgaria, E. Greece. Bu Gr Ju.
D. strymonis Rech. fil., Bot. Jahrb. 69: 450 (1939), from N.E. Greece (near Serrai), may be a variety of this species. It differs in being more slender, with few-flowered heads and brownish epicalyx-scales.
115. D. tristis Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1889 (2): 41 (1890). Like 113 but smaller and less robust; cauline leaves $1-2 \mathrm{~mm}$ wide; bracts and epicalyx-scales glabrous, dark brown; awn of epicalyx-scales up to about as long as scale, often patent; calyx c. $10 \times 2 \mathrm{~mm}$, dark purple; petal-limb pink, nearly or quite glabrous. $2 n=30$. Jugoslavia, Albania, N.W. Greece, Bulgaria. Al Bu Gr Ju.
116. D. stribrnyi Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1893 (37): 15 (1894). Like 113 but smaller and less robust; cauline leaves $2-3 \mathrm{~mm}$ wide; bracts and epicalyx-scales purplish; awn of epicalyx-scales about as long as scale; calyx $8-10 \times 2-3 \mathrm{~mm}$, purplish; petal-limb pale pink, nearly or quite glabrous. $N$. Albania, Bulgaria. Al Bu.
117. D. brachyzonus Borbás \& Form., Verh. Naturf. Ver. Brünn 35: 194 (1897). Perennial up to 50 cm . Leaves $1-3 \mathrm{~mm}$ wide, linear, acuminate, flat; sheaths several times as long as diameter of stem. Flowers 1-7 together; bracts ovate-lanceolate, with a long, usually green, subulate point. Epicalyx-scales broadly obovate, almost truncate, emarginate, whitish-coriaceous and broadly scarious; awn 3-6 mm. Calyx $15-20 \times 2-3 \mathrm{~mm}$, almost cylindrical. Petal-limb $4-5 \mathrm{~mm}$, dentate, dark purple, bearded. $2 n=30$. - Jugoslavia, S. Albania, N.W. Greece. Gr Ju.
118. D. pelviformis Heuffel, Flora (Regensb.) 36: 625(1853) (incl. D. zernyi Hayek). Perennial up to 40 cm . Leaves c. 2 mm wide, linear, acute, flat; sheaths several times as long as diameter of stem. Flowers numerous, in a dense head; bracts broadly ovate, imbricate, usually emarginate with a patent or deflexed, sometimes green, subulate point. Epicalyx-scales ovate, broadly scarious, shortly awned. Calyx $7-8 \times 2-3 \mathrm{~mm}$, somewhat ventricose. Petal-limb $2-3 \mathrm{~mm}$, dentate, glabrous, dark purple. Jugoslavia, N.E. Albania, W. Bulgaria. Al Bu Ju.
119. D. stenopetalus Griseb., Spicil. Fl. Rumel. 1: 189 (1843). Caespitose perennial almost stemless or up to $c .40 \mathrm{~cm}$. Leaves c. 0.5 mm wide, convolute; sheaths several times as long as diameter of stem. Flowers few to many in a head; bracts broadly ovate, emarginate, awned, coriaceous. Epicalyx-scales ovate, awned, broadly scarious, pale. Calyx $5-7 \times 2-3 \mathrm{~mm}$, somewhat ventricose, purple. Balkan peninsula. Al Bu Gr Ju.
120. D. burgasensis Tutin, Feddes Repert. 68: 192 (1963). Caespitose perennial up to 60 cm , with a stout woody stock.

Leaves c. 1 mm wide, convolute (or cauline flat); sheaths several times as long as diameter of stem. Flowers numerous, in dense heads; bracts oblong or ovate-oblong, coriaceous, with a usually green subulate point. Epicalyx-scales similar but smaller, about as long as calyx. Calyx c. $10 \times 2 \mathrm{~mm}$, tapering from about the middle. Petal-limb c. 3 mm , narrowly obovate-oblong, subentire, glabrous. E. Bulgaria. Bu.
121. D. moesiacus Vis. \& Pančić, Mem. Ist. Veneto 15: 17 (1870). Caespitose perennial up to 60 cm . Leaves setaceous; basal c. 0.25 mm wide; sheaths several times as long as diameter of stem. Flowers numerous, in rather narrow dense heads; bracts obovate-oblong, emarginate, with a subulate point, coriaceous. Epicalyx-scales like the bracts but smaller, shortly awned, c. $\frac{1}{2}$ as long as calyx. Calyx $10-12 \times 1 \cdot 5-2 \mathrm{~mm}$, tapering from the middle. Petal-limb $3-4 \mathrm{~mm}$, obovate, dentate, glabrous.

- Srbija, Bulgaria. Bu Ju.


## 37. Velezia L. ${ }^{1}$

Annual with rigid, dichotomously branched stems. Flowers shortly pedicellate, solitary or in clusters of 2-3 at the nodes. Epicalyx absent. Calyx narrowly tubular, 5-toothed, (5-)15veined, without scarious commissures. Petals 5, with long claw and small limb; coronal scales small or absent; stamens 10 (rarely 5 ?); styles 2 . Capsule cylindrical, very narrow, dehiscing with 4 teeth; carpophore absent. Seeds few, scutate, with facial hilum, usually with projecting radicle.

Limb of petal bifid; calyx linear, 5-6 times as long as pedicel; plant glandular-pubescent

1. rigida

Limb of petal 4-toothed; calyx narrowly elliptical, 2-3 times as
long as pedicel; plant sparsely glandular-pubescent or glabrous
2. quadridentata

1. V. rigida L., Sp. Pl. 332 (1753). Glandular-pubescent; stems up to $15(-30) \mathrm{cm}$, procumbent or ascending, rigid, with many divaricate branches. Leaves $10-20 \mathrm{~mm}$, linear-acuminate, lower sometimes linear-subspathulate, all ciliate. Flowers solitary or paired, borne at most nodes. Calyx $10-14 \mathrm{~mm}$, linear, $5-6$ times as long as pedicel. Limb of petal bifid. $2 n=28 . S$. Europe. Al Bu?Co Cr Ga Gr Hs It Ju Lu Rs (K) Sa Si Tu.
2. V. quadridentata Sibth. \& Sm., Fl. Graec. Prodr. 1: 283 (1809). Like 1, but plant sparsely glandular-pubescent or glabrous; flowers solitary or 2-3 together; calyx $9-13 \mathrm{~mm}$, slightly inflated near middle, narrowly elliptical, 2-3 times as long as pedicel; limb of petal 4 -toothed. Aegean region. Gr Tu.

## RANALES

## LVIII. NYMPHAEACEAE ${ }^{2}$

Aquatic herbs. Leaves ovate to orbicular, with a deep basal sinus. Flowers solitary, hermaphrodite, actinomorphic. Perianth usually differentiated into sepals and petals. Stamens numerous, often petaloid. Carpels 8 or more; ovary superior to inferior; ovules 1 -many, scattered all over the inner walls of the carpels.

[^76]Flowers white, rarely red; ovary semi-inferior Flowers deep yellow; ovary superior

## 1. Nymphaea L. ${ }^{3}$

Perennial, rhizomatous herbs. Leaves reddish beneath, stipulate; lateral veins anastomosing. Sepals $4(-5)$, green beneath. Petals
numerous, white, rarely red, outer longer than sepals. Ovary semi-inferior.

Literature: H. S. Conard, The Waterlilies. Washington. 1905.
1 Sepals conspicuously white-veined; leaves spinous-dentate
4. lotus

1 Sepals obscurely veined; leaves not spinous-dentate
2 Sepals persistent, coriaceous; leaves 4-7 cm in diameter
3. tetragona

2 Sepals deciduous or decaying after flowering; leaves 7-30 cm in diameter
3 Stigma flat; filaments of innermost stamens filiform 1. alba
3 Stigma strongly concave; filaments of innermost stamens lanceolate
2. candida

1. N. alba L., Sp. Pl. 510 (1753) (Castalia alba (L.) W. Wood). Rhizome creeping. Leaves all floating, suborbicular with a deep basal sinus, lobes parallel or divergent. Buds usually rounded. Receptacle cylindrical. Flowers $10-20 \mathrm{~cm}$ in diameter, scented, floating, open nearly all day. Sepals lanceolate, white above, decaying after flowering. Petals 20-25. Filaments of innermost stamens filiform; connective not prolonged beyond the anthers. Pollen c. $20 \mu$ in diameter, pale yellow, rugose and papillate with rod-shaped papillae. Stigma flat, rays usually 14-20. Seeds $2-3 \mathrm{~mm} .2 n=84$, c. 105, 112. Almost throughout Europe. All except Az Fa ls Sb .
2. N. candida C. Presl in J. \& C. Presl, Del. Prag. 224 (1822) (Castalia candida (C. Presl) Schinz \& Thell.). Like 1 but rhizome erect or ascending; basal lobes of leaves contiguous or overlapping; buds usually acute; receptacle weakly 4 -angled; sepals oblong-ovate; petals 15-18; filaments of innermost stamens lanceolate; pollen c. $35 \mu$ in diameter, deep yellow; stigma strongly concave; rays $6-14$; seeds $3-4 \mathrm{~mm} .2 n=c .160$. Scattered in N., C. \& E. Europe; N. Spain. Au Cz Fe Ga Ge $\dagger \mathrm{He}$ Hs Ju No Po Rm Rs (N, B, C) Su.
3. N. tetragona Georgi, Reise Russ. Reich 1: 220 (1775). Like 1 but rhizome erect; receptacle strongly 4 -angled; flowers open in the afternoon; sepals persistent and coriaceous in fruit; petals 8-17; connective prolonged into a small conical point beyond the anthers; stigma-rays 7-10. N.E. Europe. Fe Rs (N, B, C).

1-3 are not always clearly separable, probably owing to frequent hybridization. Small plants of $N$. alba have been called $N$. occidentalis (Ostenf.) Moss but do not merit specific rank.
4. N. lotus L., Sp. Pl. 511 (1753). Perennating by tubers produced on the ends of slender stolons. Leaves $20-50 \mathrm{~cm}$, orbi-cular-peltate, prominently veined beneath, margins undulate and spinous-dentate. Flowers open at night. Petals 12-25, white, purplish beneath. Sepals conspicuously white-veined. Hot springs in N.W. Romania. Rm. (Egypt, tropical Africa and Asia.)

## 2. Nuphar Sm. ${ }^{1}$

Perennial, rhizomatous herbs. Leaves green beneath, exstipulate; lateral veins forked but not anastomosing. Sepals 4-6, yellowish. Petals numerous, yellow, outer shorter than sepals. Ovary superior.

Literature: E. O. Beal, Jour. Elisha Mitchell Soc. 72: 317-46 (1956).

Flowers 4-6 cm in diameter; stigma-rays 15-20

1. lutea

Flowers $1 \cdot 5-3 \cdot 5 \mathrm{~cm}$ in diameter; stigma-rays $8-10$
2. pumila

1. N. lutea (L.) Sibth. \& Sm., Fl. Graec. Prodr. 1: 361 (1809). Floating leaves $12-40 \times 9-30 \mathrm{~cm}$, ovate, with a deep acute basal sinus; submerged leaves thin, cordate. Flowers smelling of alcohol, rising out of the water. Sepals $2-3 \mathrm{~cm}$, obovate, persistent, 3 times as long as the broadly spathulate petals. Stigmarays not reaching the entire margin of the stigmatic disc. Seeds $5 \mathrm{~mm} .2 n=34$. Almost throughout Europe. All except Az Bl Co CrFa Is Sb .
2. N. pumila (Timm) DC., Reg. Veg. Syst. Nat. 2: 61 (1821). Like 1 but smaller, sepals suborbicular, stigma-rays reaching the lobed margin of the stigmatic disc; seeds $4 \mathrm{~mm} .2 n=34$. N. \& C. Europe, extending to C. France, S.W. Jugoslavia and S.E. Russia. Au Be Br Cz Da Fe Ga Ge He Ju No Po Rs (N, B, C, E) Su .
$N$. lutea $\times$ pumila ( $N . \times$ spennerana Gaudin) occurs frequently in N. Europe, where local populations may consist exclusively of it .

## LIX. NELUMBONACEAE ${ }^{2}$

Like Nymphaeaceae but leaves borne (like the flowers) above the surface of the water; carpels numerous, immersed in the obconic receptacle; ovules 1-2; seeds without endosperm.

## 1. Nelumbo Adanson ${ }^{1}$

Perennial, rhizomatous herbs. Sepals 4-5, inserted at base of receptacle. Petals and stamens numerous.

The only genus.
${ }^{2}$ Edit. T. G. Tutin.

1. N. nucifera Gaertner, Fruct. Sem. Pl. 1: 73 (1788). Rhizome $10-20 \mathrm{~m}$, stout, branching, bearing numerous scalelike leaves as well as foliage leaves. Foliage leaves peltate, without sinus; petioles $1-2 \mathrm{~m}$; lamina $30-100 \mathrm{~cm}$ in diameter, almost circular, glaucous and unwettable. Flowers $16-23 \mathrm{~cm}$ in diameter, solitary, pink, scented, borne above the leaves. Seeds $1.7 \times 1.3 \mathrm{~cm}$, ovoid. Volga delta; cultivated in some Mediterranean countries and naturalized in Romania. Rs (E). [Rm.]

## LX. CERATOPHYLLACEAE ${ }^{1}$

Monoecious herbs with whorled leaves. Perianth of 8-12 linear segments, united at the base. Stamens numerous; filaments short or absent; connective prolonged apically. Ovary superior, 1celled; fruit a 1 -seeded nut.

## 1. Ceratophyllum L. ${ }^{2}$

Submerged aquatics, perennating by dormant terminal buds. Leaves in whorls of 3-8, dichotomously divided. Flowers axillary, sessile, the male and female at different nodes. Perianth green in female flowers, whitish in male. Stamens c. 15. Nut usually spiny.

The species are distinguished principally by the fruit; since flowers are produced rather rarely many records are open to doubt.

All species inhabit still or slow-moving waters.

## 1 Nut without basal spines

2. submersum

1 Nut with two conspicuous basal spines at least 2 mm long
2 Nut muricate with small spines on the lateral faces
4. muricatum

2 Nut with smooth faces; spines arising only from margins or apex
3 Terminal spine of nut $5-9 \mathrm{~mm}$; leaves forked once or twice

1. demersum

3 Terminal spine of nut less than 2.5 mm (sometimes absent); leaves forked 3-5 times
3. tanaiticum

1. C. demersum L., Sp. Pl. 992 (1753). Stems $30-150 \mathrm{~cm}$. Leaves dark green, rather stiff, forked once or twice into linear, flattened, denticulate segments. Nut $4-5 \mathrm{~mm}$, with a terminal spine at least as long, and two basal spines of variable length. $2 n=24$. Most of Europe. All except Bl Cr Fa Is Rs (K) Sb.
(a) Subsp. demersum: Nut not winged. Basal spines terete, directed latero-proximally. Throughout the range of the species.
(b) Subsp. platyacanthum (Cham.) Nyman, Consp. 251 (1879) (C. platyacanthum Cham.): Nut surrounded by a broad wing
between the bases of the spines. Basal spines flattened, directed laterally. E.C. Europe, from Germany to Ukraine.

Plants generally similar to C. demersum, but with 5 spines on the nut (the two extra spines arising from near or slightly above the centre of each face and projecting laterally), have been recorded from time to time from various parts of Europe. In C. pentacanthum Haynald, Magyar Növ. Lapok 5: 109 (1881), described originally from Kalocsa (Hungary) and since recorded for W. France (Charente Maritime), the nut in other respects resembles that of subsp. (b); but in C. komarovii Kuzen. in Komarov, FI. URSS 7: 719 (1937), recorded from Pavlovsk, near Leningrad, and from the Rostov region, it is closer to that of subsp. (a). The fact that two out of four records for these 5spined plants are from ornamental ponds suggests that they may be introduced from outside Europe; and C. komarovii is, indeed, scarcely distinguishable from C. oryzetorum Komarov, Bull. Jard. Bot. URSS 30: 200 (1931) from E. Asia.
2. C. submersum L., Sp. Pl. ed. 2, 1409 (1763). Stems 20 80 cm . Leaves fresh green, soft, forked 3-4 times into filiform, sparingly denticulate segments. Nut c. 4 mm , ellipsoidal or globose, not winged; without basal spines, with or without a short terminal spine. Most of Europe except the extreme north. $2 n=24$, 40. ? Al Au Be Br Bu Cz Da Ga Ge Gr He Ho Hs Hu It Ju Po Rm Rs (C, W, E) Si Su.
3. C. tanaiticum Sapjegin, Trudy Obš. Ispsyt. Prir. Har'kov 37: 315 (1902) (incl. C. kossinskyi Kuzen.). Like 2 but with the nut somewhat fiattened, edged with a more or less denticulate wing, and with 2 basal spines $c .2 \cdot 5 \mathrm{~mm}$ long. Terminal spine up to 3 mm , or absent. S. \& E. Russia; Ukraine. Rs (W, E).
4. C. muricatum Cham., Linnaea 4: 504 (1829). Leaves as in 2. Nut c. 4 mm , ellipsoidal, with a narrow, toothed wing, and with the lateral faces muricate with small spines; terminal spine $3 \cdot 5-$ 7 mm ; basal spines $c .2 .5 \mathrm{~mm}$, curved, directed latero-proximally. Established in rice-fields in Bulgaria (near Plovdiv). [Bu.] (Egypt; perhaps elsewhere in Africa.)

## LXI. RANUNCULACEAE ${ }^{3}$

Herbs or rarely woody climbers. Leaves alternate, exstipulate, rarely opposite or stipulate. Flowers usually hermaphrodite and actinomorphic, hypogynous. Perianth petaloid or sepaloid, whorled. Honey-leaves (petaloid structures bearing nectaries) often present, funnel-shaped or petaloid. Stamens numerous, usually spirally arranged, extrorse. Carpels 1-many, usually free and spirally arranged. Fruit usually of 1 or more follicles or a head of achenes.

The term 'fruit' is used in the English sense of the product of a single flower, whether the ovary be apocarpous, syncarpous or intermediate between the two.

1 Flowers actinomorphic
2 Leaves opposite
17. Clematis

[^77]2 Leaves alternate or whorled
3 Honey-leaves spurred
4 Leaves spathulate, all basal; spurs appressed to pedicel; achenes in a long head
21. Myosurus

4 Leaves ternately divided, some cauline; spurs not appressed; follicles in one whorl
22. Aquilegia

3 Honey-leaves, if present, not spurred
5 Perianth of one whorl of green or variously coloured segments; nectaries present or absent, but not petaloid
6 Perianth-segments and honey-leaves shorter than stamens
7 Fruit an achene $\quad$ 23. Thalictrum
7 Fruit a group of follicles, or a berry 8 Fruit a berry 8 Follicles 2-8, dry
8. Actaea

6 Perianth-segments or honey-leaves longer than stamens
9 Funnel-shaped or spathulate honey-leaves present 10 Follicles united for at least $\frac{1}{3}$ their length; annual 11 Honey-leaves much shorter than the $\pm$ persistent perianth-segments
4. Nigella

11 Honey-leaves longer than the caducous perianthsegments
5. Garidella

10 Follicles free or united only at base; perennial
12 Perianth green, purplish or white
13 Leaves palmate or pedate 1. Helleborus
13 Leaves 2-ternate
7. Isopyrum

12 Perianth yellow
14 Cauline leaves in a whorl of 3 2. Eranthis
14 Cauline leaves not whorled
6. Trollius

9 Honey-leaves absent (nectar-secreting staminodes present in Pulsatilla)
15 Flowers subtended by a whorl of leaves or bracts
16 Flowers closely subtended by 3 sepaloid bracts
15. Hepatica

16 Bracts $\pm$ leaf-like and some distance below the flower
17 Styles not elongating in fruit; flowers without nectarsecreting staminodes
14. Anemone

17 Styles elongating greatly and becoming feathery in fruit; nectar-secreting staminodes present
16. Pulsatilla

15 Flowers not subtended by a whorl of leaves or bracts
18 Leaves simple; fruit a head of follicles
10. Caltha

18 Leaves pinnate or ternate
19 Flowers in a raceme; fruit a head of follicles
9. Cimicifuga

19 Flowers in a panicle; fruit a head of achenes
23. Thalictrum

5 Perianth of 2 dissimilar whorls (or apparently so), the inner of which may consist of petaloid honey-leaves
20 Petaloid whorl with nectaries at base
21 Achenes with an empty cell on either side; beak 2-3 times as long as achene 20. Ceratocephalus
21 Achenes without empty cells; beak less than twice as long as achene
22 Honey-leaves yellow
19. Ranunculus

22 Honey-leaves white
23 Leaves simple or palmately divided
19. Ranunculus

23 Leaves 2-pinnate
3. Callianthemum

20 Petaloid whorl of the perianth without nectaries
24 Leaves finely divided
18. Adonis

24 Leaves with 3-5 shallow ovate lobes
15. Hepatica

1 Flowers zygomorphic
25 Flowers not spurred; upper perianth-segment hooded
11. Aconitum

25 Flowers spurred; upper perianth-segment not hooded
Follicles 2 or more
12. Delphinium Follicle 1
13. Consolida

## 1. Helleborus L. ${ }^{1}$

Perennial herbs with rhizomes or erect, rather woody stems and digitate or pedate leaves. Inflorescence cymose. Flowers large; perianth-segments 5 ; honey-leaves $8-12$, obliquely infundibuliform, smaller than the perianth-segments; involucre absent. Fruit of 3-8, several-seeded follicles.

The treatment of spp. 3-10 is based on H. Merxmüller \& D. Podlech, Feddes Repert. 64: 1-8 (1961).

[^78]5 Flowers cream at first, becoming greenish-yellow-brown; leaves overwintering
4. orientalis

[^79]5 Flowers clear green; leaves not overwintering 3. cyclophyllus
4 Follicles connate at base for about $\frac{1}{4}$ their length
6 Flowers reddish or purplish, at least outside
7 Leaves entirely glabrous, even on the slender inconspicuous veins beneath
9. dumetorum

7 Leaves pubescent, at least on the stout prominent veins beneath
8 Leaves digitate; flowers $4-6 \mathrm{~cm}$ in diameter
10. purpurascens

8 Leaves pedate; flowers $3-4.5 \mathrm{~cm}$ in diameter 7. multifidus 6 Flowers greenish with no reddish or purplish tinge
9 Flowers at most $3.5-4 \mathrm{~cm}$ in diameter, nodding; perianthsegments not or scarcely imbricate
10 Leaves pubescent, at least on the prominent veins beneath; cauline leaves small 7. multifidus
10 Leaves glabrous or nearly so, even on the slender veins beneath; cauline leaves large
11 Leaves very finely dentate; flowers unscented, overtopped by the leaves 9. dumetorum
11 Leaves coarsely incise-dentate; flowers scented, overtopping the leaves
5. viridis

9 Flowers at least 4 cm in diameter, not or slightly nodding at anthesis; perianth-segments imbricate
12 Flowers $4-5 \mathrm{~cm}$ in diameter, yellow-green; veins slender, but prominent beneath 5. viridis

12 Flowers $5-7 \mathrm{~cm}$ in diameter, yellowish; veins stout, very prominent beneath
13 Leaf-segments 7-11, undivided or with the marginal ones somewhat divided
13 Leaf-segments usually 5-7, more deeply divided
14 Leaves usually entirely glabrous; basal c. 10 cm wide; cauline little smaller 8. bocconei
14 Leaves pubescent, at least on the veins beneath; basal $20-30 \mathrm{~cm}$ wide; cauline much smaller
15 Leaf-segments linear-lanceolate, most or all 2 - to 10 -fid, coarsely dentate 8. bocconei
15 Leaf-segments wider, some undivided, others 2 - to 5 -fid, finely dentate
6. odorus

1. H. foetidus L., Sp. Pl. 558 (1753). Stems $20-80 \mathrm{~cm}$, stout, leafy, overwintering. Basal leaves absent; lower cauline pedate, petiolate, with sheathing base; leaf-segments $7-11$, narrowly lanceolate, serrate. Bracts broadly ovate, entire, occasionally with a small lamina. Flowers $1-3 \mathrm{~cm}$ in diameter, numerous, nodding, campanulate. Perianth green, usually with purplish margins. Follicles usually 3, connate below. - S.W. Europe, extending to Britain, N. Germany, Switzerland and much of Italy. $\mathrm{Be} \mathrm{Bl} \mathrm{Br} \mathrm{Co} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Lu}$.
2. H. lividus Aiton, Hort. Kew. ed. 1, 2: 272 (1789). Like 1 but leaf-segments never more than 3 , unequally ovate-lanceolate; perianth-segments patent, pale green. - Islands of the W. Mediterranean. $\mathrm{Bl} \mathrm{Co} \mathrm{Sa}$.
(a) Subsp. lividus: Leaf-segments with small, distant teeth or entire. Islas Baleares.
(b) Subsp. corsicus (Willd.) Tutin, Feddes Repert. 69: 53 (1964): Leaf-segments closely spinescent-dentate. Corse and Sardegna.
3. H. cyclophyllus Boiss., Fl. Or. 1: 61 (1867). Up to 60 cm . Leaves not overwintering; basal usually very large, solitary, weakly pedate to almost digitate with 5-9 usually undivided, ovate-lanceolate, serrate segments; cauline smaller, 3- to 5 -fid. Flowers 3-4, c. 6 cm in diameter. Perianth-segments patent, light glaucous-green. Follicles free and narrowed to the shortly stipitate base. Woods and thickets. Balkan peninsula. Al Bu Gr Ju.

Plants intermediate between 3 and 6 occur occasionally. In N.W. Greece (Kerkira) plants occur which have some follicles
united at the base, but which are otherwise indistinguishable from 3.
4. H. orientalis Lam., Encycl. Méth. Bot. 3: 96 (1789). Like 3 but leaves overwintering; segments $5-11$, biserrate; perianthsegments very pale greenish-cream, becoming brownish-yellowgreen (rarely purplish). Thrace. Gr Tu.
5. H. viridis L., Sp. Pl. 558 (1753). Leaves not overwintering; basal usually 2 , digitate to weakly pedate with 7-13 serrate segments and slender prominent veins beneath; cauline smaller, more or less digitate. Flowers 2-4, 4-5 cm in diameter. Perianthsegments patent, yellow-green. Follicles connate at base. - W. and C. Europe, eastwards to Italy and E. Austria. Au Be Br $\mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{[Cz} \mathrm{Po]}$.
(a) Subsp. viridis: Leaves pubescent beneath; segments finely serrate. Perianth-segments broadly ovate. C. Europe and Maritime Alps.
(b) Subsp. occidentalis (Reuter) Schiffner, Bot. Jahrb. 11: 105 (1890): Leaves glabrous beneath; segments coarsely serrate. Perianth-segments narrower. W. Europe.
6. H. odorus Waldst. \& Kit. in Willd., Enum. Pl. Hort. Berol. 592 (1809). Up to 60 cm . Basal leaves overwintering, usually solitary; segments (5-)7-11, ovate-lanceolate, undivided or rarely with a marginal segment divided, coriaceous, pubescent beneath. Flowers $2-3,5-7 \mathrm{~cm}$ in diameter, scented. Perianth-segments patent, broadly ovate, clear green. Follicles connate at base. - E., C. \& S. Europe from N. Italy to S. Romania. Al Bu Hu It Ju Rm.
(a) Subsp. odorus: Leaf-segments 7-11, mostly undivided. Throughout the range of the species, except Italy.
(b) Subsp. laxus (Host) Merxm. \& Podl., Feddes Repert. 64:5 (1961): Leaf-segments usually $5-7$, mostly 2 - to 5 -fid. N. Italy and N.W. Jugoslavia.
7. H. multifidus Vis., Flora (Regensb.) 12 (1) Erg.: 13 (1829) (H. odorus subsp. multifidus (Vis.) Hayek). Like 6 but leaf-segments 9-15, divided almost to the base into 3-12 linear lobes. Flowers $3-4 \mathrm{~cm}$ in diameter; perianth-segments narrow, scarcely overlapping. - Jugoslavia, Albania. Al Ju ?Rm.
1 Leaf-segments entire or divided to a little beyond the middle, usually finely dentate
(c) subsp. istriacus

1 Leaf-segments all divided nearly to base, rather coarsely and remotely dentate
2 Flowers purplish-violet $\quad$ (b) subsp. serbicus
2 Flowers green (a) subsp. multifidus
(a) Subsp. multifidus: Albania, W. Jugoslavia, ?Romania.
(b) Subsp. serbicus (Adamović) Merxm. \& Podl., Feddes Repert. 64: 5 (1961): Srbija.
(c) Subsp. istriacus (Schiffner) Merxm. \& Podl., loc. cit. (1961): Jugoslavia.
8. H. bocconei Ten., Corso Bot. Lez. 4 (1): 459 (1822). Like 6 but leaf-segments 5-7, lanceolate or linear-lanceolate, usually divided to the middle. Italy, Sicilia. It Si.
(a) Subsp. bocconei: Leaves pubescent, at least on the veins beneath; basal leaves $20-30 \mathrm{~cm}$ wide. C. \& S. Italy.
(b) Subsp. siculus (Schiffner) Merxm. \& Podl., Feddes Repert. 64: 5 (1961): Leaves usually entirely glabrous; basal leaves c. 10 cm wide. S. Italy, Sicilia.
9. H. dumetorum Waldst. \& Kit. in Willd., Enum. Pl. Hort. Berol. 592 (1809) (H. viridis subsp. dumetorum (Waldst. \& Kit.)

[^80]Hayek). Up to 45 cm . Basal leaves 2-3, thin, not overwintering; segments 7-11, distinctly pedate, undivided; veins not prominent beneath. Flowers $2-3,3 \cdot 5-5 \mathrm{~cm}$ in diameter. Perianth-segments patent, violet or green. Follicles connate at base. - E.C. Europe. Au Cz Hu Ju Rm.
(a) Subsp. dumetorum: Flowers $3-4.5 \mathrm{~cm}$ in diameter, green. Throughout the range of the species.
(b) Subsp. atrorubens (Waldst. \& Kit.) Merxm. \& Podl., Feddes Repert. 64: 5 (1961) (H. atrorubens Waldst. \& Kit.): Flowers $4-5.5 \mathrm{~cm}$ in diameter, violet. Jugoslavia.
10. H. purpurascens Waldst. \& Kit., Pl. Rar. Hung. 2: 105 (1802 or 1803). Up to 35 cm . Basal leaves usually 2 , not overwintering; segments usually 5 , not distinctly pedate, divided to the middle into 2-5 lobes, pubescent, at least on the prominent veins beneath. Flowers up to $3,5-7 \mathrm{~cm}$ in diameter. Perianth-segments patent, purplish-violet. Follicles connate at base. - E.C. Europe, extending southwards to Crna Gora and eastwards to W. Ukraine. Cz Hu Ju Po Rm Rs (C, W).
11. H. niger L., Sp. Pl. 558 (1753). Up to 30 cm . Basal leaves overwintering, pedate with 7-9 segments; cauline leaves ovate, entire, pale green. Flowers 2-3, $3-10 \mathrm{~cm}$ in diameter. Perianthsegments white or pink-tinged, ovate. Follicles $c$. 7 , connate at base. Woods and thickets, mainly in the mountains; calcicole. E. Alps, Appennini and adjacent regions. Widely cultivated for ornament and sometimes naturalized. Au Ge He It Ju [Ga Po *Rs (C, W)].
(a) Subsp. niger: Leaf-segments oblong-cuneate, dark green, distinctly serrate near the top; perianth-segments often pinkish, broadly ovate. Throughout the range of the species.
(b) Subsp. macranthus (Freyn) Schiffner, Bot. Jahrb. 11: 105 (1890): Leaf-segments broadly lanceolate, glaucescent, spinuloseserrate; perianth-segments usually white, ovate. Italy, N. Jugoslavia.

## 2. Eranthis Salisb. ${ }^{1}$

Perennials with tuberous rhizomes. Basal leaves petiolate, deeply palmately divided; cauline leaves 3 , similar to basal but sessile and arranged in a whorl close to the solitary terminal flower. Perianth-segments usually 6 , yellow; honey-leaves tubular, 2lipped. Stamens numerous. Follicles usually 6.

1. E. hyemalis (L.) Salisb., Trans. Linn. Soc. London (Bot.) 8: 304 (1807). Glabrous, $5-15 \mathrm{~cm}$. Flowers $20-30 \mathrm{~mm}$ in diameter. Perianth-segments narrowly ovate; honey-leaves shorter than the stamens. Follicles $c .15 \mathrm{~mm}$, shortly stalked. - S. Europe from S.E. France to Bulgaria; naturalized from gardens in C. \& W. Europe. Bu Ga It Ju [Au Be Br Cz Ge He Ho Hu Rm].
The Bulgarian plant (var. bulgaricus Stefanov, Bull. Inst. Roy. Hist. Nat. (Sofia) 12: 316 (1939)) is in some respects closer to E. cilicicus Schott than to E. hyemalis.

## 3. Callianthemum C. A. Meyer ${ }^{1}$

Small perennials of high mountains. Leaves imparipinnate, the divisions 2 - or 3 -pinnatifid. Perianth-segments sepaloid, shorter than honey-leaves; honey-leaves $5-20$, petaloid. Stamens numerous. Carpels numerous, very shortly stipitate; ovule 1 , pendulous. Fruit a 1 -seeded follicle.

Literature: J. Witasek, Verh. Zool.-Bot. Ges. Wien 49: 316 (1899).
1 Honey-leaves broadly ovate; basal leaves flowering
developed at
3. coriandrifolium
1 Honey-leaves linear or linear-oblong; basal leaves developing after flowering
2 Plant 5-22 cm; fruit 4.5-5 $\times 2 \mathrm{~mm}$, strongly reticulately veined

1. anemonoides
2 Plant 3-6 cm ; fruit $3-4 \times 2.5 \mathrm{~mm}$, smooth
2. kerneranum
3. C. anemonoides (J. Zahlbr.) Endl. ex Heynh., Nomencl. Bot. 2: 106 (1846) (C. rutifolium auct., pro parte). Basal leaves longpetiolate, more or less triangular in outline; segments linearoblong; cauline leaves similar but sessile and less divided, uppermost bract-like. Flowers $30-35 \mathrm{~mm}$ in diameter. Honey-leaves pink to white, with orange nectaries. Fruit $4.5-5 \times 2 \mathrm{~mm}$, strongly veined. $2 n=32$. Open coniferous woods, somewhat calcicole. N.E. Alps. Au.
4. C. kerneranum Freyn ex Kerner, Sched. Fl. Exsicc. AustroHung. 5: 36 (1888). Like 1 but smaller; lower branches of the basal leaves shortly stalked; flowers c. 25 mm diameter; fruit $3-4 \times$ 2.5 mm , smooth. Exposed stony slopes; calcicole. - S. Alps from c. $10^{\circ} 30^{\prime}$ to $c .11^{\circ} 30^{\prime} E$. It.
5. C. coriandrifolium Reichenb., Fl. Germ. Excurs. 727 (1832) (C. rutifolium auct., pro parte). Like 1 but honey-leaves broadly ovate and fruit $3 \times 2-2.5 \mathrm{~mm} .2 n=16$. Somewhat calcifuge. - Alps and Carpathians; outlying stations in the Pyrenees and Bosna. Au Cz Ga He lt Ju Po Rm.

## 4. Nigella L. ${ }^{1}$

Annuals. Leaves usually 2 - to 3 -pinnatisect into linear segments. Perianth-segments 5, petaloid, persistent for a time after flowering. Honey-leaves 5, opposite to and much smaller than the perianthsegments. Stamens numerous. Fruit of 5 (rarely 10) partly or completely united follicles; styles long, patent or rarely erect.
1 Flowers yellowish-white; lower lip of honey-leaves very short; seeds compressed
12. orientalis

1 Flowers blue, bluish or greenish; lower lip of honey-leaves at least $\frac{1}{2}$ as long as upper; seeds ovoid or triquetrous
2 Anthers mucronate, occasionally shortly so
3 Cauline leaves with short, ovate or oblong segments, or sometimes undivided
4 Follicles transversely rugose, united to the middle 6. cretica
4 Follicles not transversely rugose, united for $c$. $\frac{1}{3}$ their length
5. degenii

3 Cauline leaves deeply divided into linear segments
5 Beak $1 \frac{1}{2}-2$ times as long as follicle
8. doerfleri

5 Beak not longer than follicle
6 Follicles 3 -veined throughout, united for $c$. $\frac{1}{2}$ of their length

1. arvensis

6 Follicles 1 -veined, united for $\frac{2}{3}$ or more of their length
7 Claw of perianth-segments not more than $\frac{1}{4}$ as long as limb; follicles usually densely glandular $\quad$ 2. hispanica
7 Claw of perianth-segments $\frac{1}{3}$ as long to as long as limb; follicles eglandular or sparsely glandular
8 Claw of perianth-segments usually more than $\frac{1}{2}$ as long as limb; lobes of lower lip of honey-leaves with a lingulate, obtuse apex
3. gallica 8 Claw of perianth-segments $\frac{1}{3}-\frac{1}{2}$ as long as limb; lobes of lower lip of honey-leaves with an acute apex
4. segetalis

2 Anthers not mucronate
9 Involucre absent
10 Stems procumbent; leaf-segments small, ovate; follicles united for $\frac{1}{3}$ of their length
7. fumariifolia

> 10 Stems erect; leaf-segments linear; follicles united for nearly all their length (see also 4)
> 9. sativa
> Flowers with an involucre
> 11 Perianth-segments not clawed; lobes of lower lip of honeyleaves $c .3$ times as long as broad; fruit 5-celled 10. elata
> 11 Perianth-segments shortly clawed; lobes of lower lip of honey-leaves about as long as broad; fruit 10-celled
> 11. damascena

1. N. arvensis L., $S p$. Pl. 534 (1753). $10-30 \mathrm{~cm}$. Leaves with linear segments. Involucre absent (or present in some E. Mediterranean plants). Flowers $20-30 \mathrm{~mm}$ in diameter. Perianthsegments ovate-cordate, apiculate, bluish; claw usually at least as long as limb. Follicles 3 -veined. Seeds granulate. Cornfields. Most of Europe, except the north; rare in the south-west. Al Au $\mathrm{Be} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{*Lu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W}, \mathrm{C}$, K, E) $\mathrm{Sa} \mathrm{Si} \mathrm{Tu}[\mathrm{Az}]$.
1 Cauline leaves soft, not forming an involucre below the flower
(a) subsp. arvensis

1 Cauline leaves $\pm$ rigid, forming an involucre below the flower
2 Follicles not transversely rugose
(b) subsp. aristata
2 Follicles transversely rugose
(c) subsp. rechingeri
(a) Subsp. arvensis: Leaves green, soft, cauline not crowded to form an involucre below the flower. Follicles not transversely rugose. Throughout the range of the species.
(b) Subsp. aristata (Sibth. \& Sm.) Nyman, Consp. 17 (1878) (N. aristata Sibth. \& Sm.): Leaves glaucescent, rigid, upper cauline crowded and forming an involucre below the flower. Follicles not transversely rugose. Greece, Kikladhes.
(c) Subsp. rechingeri (Tutin) Tutin, Feddes. Repert. 70: 22 (1964) (N. aristata subsp. rechingeri Tutin): Leaves rather rigid, upper cauline crowded and forming an involucre below the flower. Follicles transversely rugose. E. Greece (N.W. Evvoia).
2. N. hispanica L., Sp. PI. 534 (1753). Like 1 but flowers 3570 mm in diameter, blue; claw of perianth-segments up to $\frac{1}{4}$ as long as limb; follicles usually densely glandular. Spain, Portugal. Hs Lu.
(a) Subsp. hispanica: Claw of perianth-segments absent or very short; follicles densely glandular. Spain, Portugal.
(b) Subsp. atlantica Murb., Lunds Univ. Arsskr. 33 (12): 3 (1897): Claw of perianth-segments up to $\frac{1}{4}$ as long as limb; follicles sparsely glandular. S. Spain. (N.W. Africa.)
3. N. gallica Jordan, Pugillus Pl. Nov. 3 (1852). Leaves with broadly linear segments. Involucre absent. Flowers $20-35 \mathrm{~mm}$ in diameter. Perianth-segments pale blue; claw usually more than $\frac{1}{2}$ as long as limb. Lobes of lower lip of honey-leaves ovatelanceolate in lower half, upper half lingulate, obtuse. Anthers distinctly mucronate. Follicles glabrous or very slightly glandular. Cornfields. - S. France, N. \& C. Spain. Ga Hs Lu.
4. N. segetalis Bieb., Fl. Taur.-Cauc. 2: 16 (1808). Like 3 but claw of perianth-segments half as long as limb; lobes of lower lip of honey-leaves ovate, acute; anthers very shortly mucronate. Cornfields. S. Ukraine. Rs (W, K).
5. N. degenii Vierh., Magyar Bot. Lapok 25: 148 (1926). Stems usually erect. Cauline leaves with oblong segments. Follicles free for most or all of their length; beak slender, not longer than follicle. Kikladhes and Karpathos. Cr Gr.
6. N. cretica Miller, Gard. Dict. ed. 8, no. 4 (1768). Usually branched from the base with procumbent or ascending branches. Cauline leaves with few ovate lobes or quite entire. Perianth-

[^81]segments broadly ovate, clawed. Follicles united for $\frac{1}{2}$ their length. Kriti. Cr.

Apart from the difference in the shape of the lobes of the cauline leaves this is very similar to $\mathbf{1}$ and could perhaps be treated as a subspecies of it.
7. N. fumariifolia Kotschy in Unger \& Kotschy, Ins. Cypr. 319 (1865). Stems numerous, procumbent. Leaf-segments ovate, very small. Perianth-segments ovate-oblong, cordate, clawed, greenish-white. Follicles united for $\frac{1}{3}$ their length, tuberculaterugose in lower half. Karpathos. Cr. (Cyprus.)
8. N. doerfleri Vierh., Magyar Bot. Lapok 25: 147 (1926). Plant short, glaucescent, with few, usually divaricate branches. Leaf-segments few, ovate. Flowers small, greenish-blue. Follicles united for nearly all their length; beak $1 \frac{1}{2}-2$ times as long as follicle, stout, spreading. Kriti. Cr.

Perhaps closely related to $N$. stellaris Boiss. from Asia Minor.
9. N. sativa L., Sp. Pl. 534 (1753). Stems erect, branched. Perianth-segments ovate, shortly clawed, whitish. Follicles united for all their length, tuberculate on the back. $2 n=12$. Widely cultivated for its aromatic seeds and frequently naturalized; possibly native in parts of S.E. Europe. [ $\mathrm{Bu} \mathrm{Cr} \mathrm{Cz} ? \mathrm{Ga} \mathrm{Gr} \mathrm{Hu} \mathrm{It}$ Ju Po Rm Rs (C, W, K) Tu.]
10. N. elata Boiss., Diagn. Pl. Or. Nov. 1 (1): 66 (1843). Involucre with short rigid segments. Perianth-segments ovateoblong, not clawed, blue. Lobes of lower lip of honey-leaves c. 3 times as long as wide. Fruit 5-celled. ?Thrace ? Gr ?Tu. (Asia Minor, Cyprus.)
11. N. damascena L., $S p$. Pl. 534 (1753). Involucral leaves similar to the lower cauline. Perianth-segments ovate-oblong, clawed, bluish. Lobes of lower lip of honey-leaves about as long as wide. Follicles united for all their length, forming an inflated 10 -celled capsule, the 5 outer loculi sterile. S. Europe; frequently cultivated for ornament and more or less naturalized elsewhere. $\mathrm{Al} \mathrm{Bl} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Rs} \mathrm{(W}, \mathrm{K)} \mathrm{Sa} \mathrm{Si} \mathrm{Tu} \mathrm{[Au} \mathrm{Be}$ $\mathrm{Cz} \mathrm{Ho} \mathrm{Hu} \mathrm{Po} \mathrm{Rm]}$.
12. N. orientalis L., Sp. Pl. 534 (1753). Perianth-segments oblong, shortly clawed, yellowish-white with red dots, eventually deflexed. Follicles united for $\frac{1}{2}$ their length, their beaks erect. ?Thrace. ?Gr ?Tu. (S.W. Asia.)

## 5. Garidella L. ${ }^{1}$

Like Nigella but perianth-segments caducous, shorter than the honey-leaves; follicles $2-3$, united below, inflated; styles very short.

1. G. nigellastrum L., Sp. Pl. 425 (1753) (Nigella nigellastrum (L.) Willk.). Stem $30-50 \mathrm{~cm}$, slender, simple or with ascending branches. Flowers 10 mm in diameter, long-pedicellate. Perianthsegments $3-4 \mathrm{~mm}$, greenish, tinged purplish or reddish. Mediterranean region and Krym; very local. Cr Ga Hs Rs (K). (S.W. Asia.)

## 6. Trollius L. ${ }^{1}$

Perennial herbs. Flowers with all parts spirally arranged. Perianth-segments $5-15$, petaloid; honey-leaves $5-15$, small, narrow, yellow. Stamens numerous. Fruit of many follicles.

[^82]Perianth-segments strongly incurved; honey-leaves as long as stamens

1. europaeus

Perianth-segments not strongly incurved; honey-leaves 2-3 times as long as stamens
2. asiaticus

1. T. europaeus L., Sp. Pl. 556 (1753). Plant $10-70 \mathrm{~cm}$, glabrous. Basal leaves long-petiolate, 3-5 lobed; lobes cuneate and more or less deeply lobed and serrate; cauline leaves smaller and more or less sessile. Flowers up to 5 cm in diameter, globular. Perianth-segments commonly 10, lemon-yellow, rarely the outer green beneath, incurved. Honey-leaves about as long as the stamens. Follicles $c .12 \mathrm{~mm}$; beak $0.5-5 \mathrm{~mm}$. Widespread in Europe, but only on mountains in the south. Al Au Be BrCzDa Fe Ga Ge Hb He Hu It Ju No Po Rm Rs (N, B, C, W, E) Su.

The length of the beak of the mature follicle and the shape of the basal leaves is rather variable, especially in E. Europe. The prevalence of self-pollination probably helps to emphasize this variation. Two subspp. can be recognized:
(a) Subsp. europaeus: Plant usually $30-50 \mathrm{~cm}$; stigma $0 \cdot 3-$ 3 mm , straight. $2 n=16$. Widespread.
(b) Subsp. transsilvanicus (Schur) Jáv., Magyar Flora 352 (1924): Plant usually $10-20 \mathrm{~cm}$; stigma $3-5 \mathrm{~mm}$, more or less recurved. $2 n=16$. Carpathians.
2. T. asiaticus L., $S p$. Pl. 557 (1753). Like 1 but usually smaller; perianth-segments orange, patent; honey-leaves 2-3 times as long as the stamens. N.E. Russia. Rs (N, C).
T. uralensis Gorodkov is intermediate between 1 and 2; it is recorded from arctic Russia and N. Ural. It is presumably of hybrid origin.

## 7. Isopyrum L. ${ }^{1}$

Perennials. Flowers solitary. Perianth-segments 5, petaloid; honey-leaves small or absent. Stamens numerous, shorter than the perianth-segments. Fruit of $2-20$ sessile, free follicles.

1. I. thalictroides L., $S p$. Pl. 557 (1753). $10-30 \mathrm{~cm}$, slender, glabrous, more or less glaucous. Rhizome creeping. Stem simple and leafless below, branched and leafy above. Basal leaves petiolate, ternate; leaflets 3 -fid; segments ovate, more or less 3-lobed. Cauline leaves similar to basal but sessile, with conspicuous stipules. Flowers $10-20 \mathrm{~mm}$ in diameter. Perianthsegments white. Honey-leaves $1-1.5 \mathrm{~mm}$. Follicles usually 2, broadly ovate, compressed. $2 n=14$. C. Europe, extending to the Pyrenees, C. Italy, Bulgaria and C. Ukraine. Au Bu Cz Ga He Hs Hu It Ju Po Rm Rs (C, W).

## 8. Actaea L. ${ }^{1}$

Perennials. Flowers small, in short racemes. Perianth-segments 3-5, petaloid; honey-leaves 4-10, small. Stamens numerous. Carpel 1. Fruit a berry with several seeds.

Fruit $12-13 \mathrm{~mm}$, black when ripe
Fruit $9-10 \mathrm{~mm}$, red when ripe

1. spicata
2. erythrocarpa
3. A. spicata L., Sp. Pl. 504 (1753). $30-65 \mathrm{~cm}$, glabrous. Basal leaves large, 2 -ternate or -pinnate; leaflets ovate, more or less dentate, more or less pubescent beneath; cauline leaves much smaller. Flowers white. Honey-leaves shorter than the white stamens. Berry 12-13 mm, ovoid, black when ripe. $2 n=16$. Most of Europe, but only on mountains in the south. Al Au Be Br

Bu Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju No Po Rm Rs (N, B, C, W, E) Su.
2. A. erythrocarpa Fischer in Fischer \& Meyer, Ind. Sem. Hort. Petrop. 1: 20 (1835). Like 1 but leaves usually more divided, berry smaller (c. 10 mm ) and red when ripe. N.E. Europe. Fe Rs (N, C) Su.

## 9. Cimicifuga L. ${ }^{1}$

Like Actaea, but with 2-8 dry dehiscent follicles.

1. C. europaea Schipcz. in Komarov, Fl. URSS 7: 85 (1937) (C. foetida auct.). Foetid herb $40-100(-200) \mathrm{cm}$. Stem glabrous. Leaves very large, 2- to 3-pinnate; leaflets ovate, acuminate, irregularly 2 -serrate; petioles sparsely pubescent. Raceme long and narrow. Flowers greenish. Bracts lanceolate, acuminate, shorter than pedicels. Follicles $10-17 \mathrm{~mm}$, pubescent. $2 n=16$. E. \& $C$. Europe from Czechoslovakia to Bulgaria. Au Bu Cz Hu Po Rm Rs (C, W).

## 10. Caltha L. ${ }^{1}$

Perennial herbs with more or less cordate leaves. Inflorescence a few-flowered corymbose cyme. Perianth-segments 5 or more, yellow. Honey-leaves absent; carpels nectar-secreting. Stamens numerous. Follicles 5-15.

1. C. palustris L., Sp. Pl. 558 (1753). Stems $15-30(-60) \mathrm{cm}$, hollow, glabrous, creeping and rooting, to erect. Leaves crenate to dentate; basal long-petiolate, cauline smaller, shortly petiolate to subsessile. Flowers $1.5-5 \mathrm{~cm}$ in diameter; perianth-segments bright shining yellow above, often greenish beneath. Ripe follicles $9-18 \mathrm{~mm}$, beaked, erect or recurved. $2 n=32,53-62$, with 0-6 B chromosomes. Most of Europe, but very rare in the Mediterranean region. All except Az Bl Co Cr Sa Sb Si Tu.

This species varies greatly in many characters such as habit, size, shape of leaf and follicle and in chromosome number. Several taxa have been described from Europe and given specific or subspecific rank; these have been mostly based on follicle characters, which seem to vary independently of other morphological characters and of chromosome number.

The following taxa, the status of which is doubtful, are recognized in some European floras, in addition to C. palustris:
C. cornuta Schott, Nyman \& Kotschy, Analect. Bot. 31 (1854). Ripe follicles recurved and narrowed to an acute apex. C. Europe, Italy, Balkan peninsula.
C. laeta Schott, Nyman \& Kotschy, op. cit. 32 (1854). Ripe follicles with the dorsal side straight or slightly curved, the ventral side rather strongly curved, and often with a long beak. Widespread, from France and Poland southwards.
C. longirostris G. Beck, Verh. Zool.-Bot. Ges. Wien 36: 348 (1886). Ripe follicles gradually narrowed into a beak $4-6 \mathrm{~mm}$ long. Jugoslavia.
C. minor Miller, Gard. Dict. ed. 8, no. 2 (1768). Follicles like those of 1 but plant small; stems decumbent or procumbent and often rooting at the nodes; flowers up to 3 cm in diameter, solitary or few; perianth-segments narrow. N. Europe.
C. polypetala Hochst. ex Lorent, Wanderungen 339 (1845). 1 Perianth-segments 7-10, narrow. Bulgaria.

[^83]
## 11. Aconitum L. ${ }^{2}$

Perennial, with stout leafy stems, and tuberous stock with brown, fragile roots. Leaves alternate, palmately or pedately divided, the segments dentate or lobed. Flowers zygomorphic, in a terminal raceme or racemose panicle. Perianth-segments 5, petaloid, the posterior forming a large erect hood (helmet). Honey-leaves 2-10; posterior pair included in the helmet, the claw long and the limb prolonged into nectar-secreting spurs; others very small or absent. Stamens numerous. Follicles 2-5, free or shortly connate at base.

The measurements of the helmet given in the text are from the highest point of the straight or arched part of the base of the hood to the apex (height), and across the most nearly parallel part (width).

A great deal of variation occurs in all the species, perhaps as a result of hybridization, but it does not in general fall into a recognizable morphological or geographical pattern, though many local populations can be recognized and have been given specific rank. Consequently the species in the following account are aggregates of minor taxa, some of which may merit specific rank.

The following account is based on unpublished work by $\mathbf{H}$. Merxmüller and K. Warncke, who have studied the $A$. lycoctonum group in detail. Much work remains to be done, so the account of the other species must be regarded as no more than a provisional outline of the grouping of the very numerous small species which have been described.

Literature: G. Gáyer, Magyar Bot. Lapok 5: 122-37 (1906); 6: 286-303 (1907); 8: 114-206, 310-27 (1909). H. G. L. Reichenbach, Monographia Generis Aconiti. Leipzig. 1820-21.
1 Helmet c. 3 times as high as wide, conical-cylindrical; nectaryspurs $\pm$ spirally curved (1-5). vulparia gro
1 Helmet never more than twice as high as wide, rounded or hemispherical; nectary-spurs straight
2 Flowers almost always yellow; perianth persistent 6. anthora
2 Flowers blue or purple, sometimes white, rarely variegated; perianth deciduous
3 Helmet usually higher than wide; seeds winged on one angle and with transverse wings on the sides
(7-9). variegatum group
3 Helmet usually wider than high; seeds winged on three angles but smooth or rugulose and unwinged on the sides
(10-14). napellus group
(1-5). A. vulparia group. Leaf-segments divided into 3 or more incise-serrate to very deeply laciniate-dentate lobes. Inflorescence simple or branched. Perianth-segments deciduous. Helmet $15-25 \times 3-8 \mathrm{~mm}$, c. 3 times as high as wide, conicalcylindrical. Nectary-spurs spirally curved. Follicles usually 3. Seeds brownish-black, 4 -sided with obtuse angles.

1 Helmet with a wide base, tapering abruptly into a narrow, elongated hood (N. \& E. Europe)
2 Flowers dark violet 1. septentrionale 2 Flowers yellowish 2. Iasiostomu
1 Helmet usually saccate, not conspicuously wider at base (S. \& C. Europe)

3 Flowers blue 3. moldavicum
3 Flowers yellowish
4 Leaf-segments 3 -fid to the middle; terminal inflorescence small and few-flowered
4. vulparia

4 Leaf-segments divided beyond the middle into several lobes; terminal inflorescence large and many-flowered 5. lamarckii

1. A. septentrionale Koelle, Spicil. Acon. 22 (1786) (A. lycoctonum L., nom ambig.; incl. A. excelsum Reichenb.). Leaves dark
green; segments 4-6, each 3-fid. Flowers dark violet (very rarely yellow); helmet $18-25 \mathrm{~mm}$, tapering abruptly from the wide base. Inflorescence villous with glandular and eglandular hairs. $2 n=16$. Norway to C. Russia. Fe No Rs (N, B, C) Su.
2. A. lasiostomum Reichenb., Ill. Acon. t. 49 (1825). Like 1 but flowers yellowish; distinguished from 4 by the narrower helmet and the large, many-flowered inflorescence. Romania, C. \& S. U.S.S.R. Rm Rs (C, W, K, E).
3. A. moldavicum Hacq. ex Reichenb., Uebersicht Acon. 67 (1819). Leaves dark green; segments 4-6, each 3-fid. Flowers blue; helmet not tapering abruptly from a wide base. Inflorescence covered with short crispate eglandular hairs. - E.C. Europe, extending to W. Ukraine. $\mathrm{Cz} \mathrm{Hu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.
4. A. vulparia Reichenb., Uebersicht Acon. 70 (1819) (A. lycoctonum auct.). Like 3 but flowers yellowish; leaf-segments 3 -fid to the middle; main inflorescence small, few-flowered. $2 n=16$. - From France and the Netherlands eastwards to Romania and Poland. Au Be ?Bu Cz Ga Ge He Ho Hu It Ju Po Rm.
5. A. lamarckii Reichenb., Ill. Acon. t. 40 (1825) (A. pyrenaicum L. pro parte). Leaves light green; segments 7-8, each several times divided beyond the middle. Inflorescence large, manyflowered. Flowers yellowish. Mountains of southern Europe. Al Au Bu Ga ? Gr He Hs It Ju Rm.

Intermediates between 4 and 5 occur, particularly in the southern Alps and Jugoslavia. Among these are A. dasytrichum (Degen ex Gáyer) G. Grinţ. in Săvulescu, Fl. Rep. Pop. Române. 2: 506 (1953) and A. platanifolium Degen ex Gáyer, Magyar Bot. Lapok 6: 118 (1907).
6. A. anthora L., Sp. Pl. 532 (1753). Leaves divided 3 times completely to the base or midrib; segments not more than 3 mm wide, linear. Inflorescence simple or branched; rhachis and pedicels with eglandular hairs. Flowers yellowish, rarely blue; perianth persistent. Helmet $8-12 \times 14-16 \mathrm{~mm}$, more or less hemispherical. Nectary-spurs not spirally curved. Follicles usually 5 . Seeds black, irregularly 4 -sided, with acute angles. S., C. \& E. Europe, mainly in the mountains. Au Bu ? Co Cz Ga He Hs Hu It Ju Po Rm Rs (C, W, K, E).
(7-9). A. variegatum group. Leaves divided to the base, the wide segments often divided beyond the middle, and deeply incise-dentate. Inflorescence nearly always branched, the terminal part not much larger than the branches. Flowers white, blue or variegated. Helmet $8-15 \times 9-14 \mathrm{~mm}$, up to twice as high as wide, hemispherical to conical. Nectary-spurs not spirally curved. Follicles 3-5. Seeds winged on one angle but with the side transversely plicate, the folds with membranous wings.

[^84]Plants from France, Switzerland and Italy resembling 9 but with glandular hairs only above the bracts have been called A. hebegynum DC., Reg. Veg. Syst. Nat. 1: 376 (1817); they may be a subspecies of 9 .
9. A. paniculatum Lam., Fl. Fr. 3:646(1773). Inflorescence more or less glandular-hairy; bracts linear; helmet scarcely higher than wide. $2 n=16$. Mountains of C. Europe, extending to $C$. Italy and Romania. $\mathrm{Au} ? \mathrm{Bu} ? \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs}$ It Ju ?Po Rm Rs (W).
A. angustifolium Bernh. in Reichenb., Monogr. Acon. 95 (1820), from Jugoslavia has seeds resembling those of 7 but differing in their brown colour and in the structure of the wings on the 3 sides. The deeply divided leaves resemble those of $\mathbf{1 3}$, but are distinctive. These characters and the completely glabrous branches of the inflorescences suggest that $A$. angustifolium merits specific rank.
A. burnatii Gáyer, Magyar Bot. Lapok 8: 141 (1909) from S.E. France (Alpes Maritimes) and A. zahlbruckneri Gáyer, op. cit. 184 (1909), from the E. Alps, are possibly of hybrid origin $(9 \times 13)$.
(10-14). A. napellus group. Leaves divided to the base, the usually narrow segments commonly divided more than half-way to the midrib into more or less linear lobes $1-8 \mathrm{~mm}$ wide. Inflorescence simple or branched, the terminal part larger than the branches. Flowers violet or blue. Helmet $7-14 \times 11-18 \mathrm{~mm}$, hemispherical. Nectary-spurs not spirally curved. Follicles usually 3. Seeds winged at the angles but with the sides smooth or rugulose.
1 Leaves not crowded below inflorescence; inflorescence simple to much-branched
2 Leaf-segments divided almost to the midrib into narrow linear lobes; inflorescence glandular-pubescent (S.W. Europe)
14. nevadense

2 Leaf-segments divided half-way to the midrib, or more, into oblong lobes; inflorescence not glandular-pubescent
3 Inflorescence usually simple and few-flowered; leaf-segments divided about half-way to the midrib (E. \& E.C. Europe)
10. firmum

3 Inflorescence simple to much-branched, usually manyflowered; leaf-segments divided more than half-way to the midrib (W. \& W.C. Europe)
11. napellus

1 Leaves crowded below inflorescence; inflorescence almost always simple
4 Leaf-segments with rather wide lobes (E. Alps, Romania)
12. tauricum

4 Leaf-segments with narrow, linear lobes (W. Alps) 13. compactum
10. A. firmum Reichenb., Uebersicht Acon. 20 (1819) (incl. A. callibotryon Reichenb., A. flerovii Steinb., A. pentheri Hayek, A. superbum Fritsch). Leaves not crowded below the inflorescence, the leaf-segments divided about half-way to the midrib into oblong lobes. Inflorescence usually simple and few-flowered. - C. Europe, extending to Romania. ?Bu Cz Ge Hu Ju Po Rm Rs (W).
A. divergens Pančić, Elem. Fl. Bulg. 13 (1883), from Jugoslavia and Bulgaria, is described as having arcuate pedicels and a glandular indumentum and may perhaps be distinct.
11. A. napellus L., Sp. Pl. 532 (1753). Like 10 but leafsegments divided more than half-way to the midrib; inflorescence often much-branched and usually many-flowered. $2 n=32$. - W. \& C. Europe from Britain to E. Austria. Au Be BrGa Ge HeSu.
12. A. tauricum Wulfen in Jacq., Coll. Bot. 2: 112 (1788). Leaves crowded below the inflorescence, the leaf-segments with
rather broad lobes. Inflorescence nearly always simple. E. Alps, Romania. Au Ge Ju Rm.
13. A. compactum Reichenb., Uebersicht Acon. 27 (1819). Like 12 but leaf-segments with narrow, linear lobes. -W. Alps and Pyrenees. Au Ga He It? Lu .
14. A. nevadense Uechtr. ex Gáyer, Magyar Bot. Lapok 8: 180 (1909). Like 13 but leaves hairy, divided into narrow, almost linear, lobes; inflorescence densely covered with glandular hairs, like those of 9. S. Spain (Sierra Nevada). Hs.
A. delphinense Gáyer, Magyar Bot. Lapok 8: 174 (1909) from Dauphiné, is like 14 but the whole plant is glandular-pubescent. A. corsicum Gáyer, op. cit. 181 (1909), from Corse, is eglandular and has glabrous leaves.

## 12. Delphinium L. ${ }^{1}$

Leaves usually about as wide as long and deeply pinnatisect. Flowers zygomorphic. Perianth-segments 5 , the upper with a spur. Honey-leaves 4, free; the two upper (nectariferous) with spurs inserted into the spur of the uppermost perianth-segment, and with the limb exserted; the two lateral with wide limb and a narrow claw. Stamens in 8 spirally arranged series. Follicles $3(-5)$, free.
1 Perennial; limb of lateral honey-leaves ciliate and bearded on upper surface
2 Tubers absent; seeds not covered with scales, winged at angles
3 Stems (especially above) and perianth-segments with mostly smooth arcuate hairs; perianth-segments rather narrow
4 Perianth-segments usually $22-32 \mathrm{~mm}$, acuminate; hairs not crowded near apex of perianth-segments 3. oxysepalum
4 Perianth-segments rarely more than 23 mm , subobtuse or acute; hairs $\pm$ crowded near apex of perianth-segments
5 Perianth-segments pale blue; petiole, even of upper leaves, not or scarcely shorter than lamina; carpels usually densely pubescent 1. montanum
5 Perianth-segments deep blue; petiole of upper and middle leaves usually many times shorter than lamina; carpels glabrous or sparsely (very rarely densely) puberulent
2. dubium

3 Stems with straight hairs or minutely scabrid arcuate hairs; perianth-segments $1-2(-3)$ times as long as wide, suborbicular or obovate, rarely oblong
6 Honey-leaves blue, or the upper yellowish; leaves 3-lobed almost to the base
8. dictyocarpum

6 Honey-leaves blackish or dark brown (if blue then leaves not 3-lobed to base)
7 Leaves $\pm$ cordate at base; lobes rather wide, not free to base 4. elatum
7 Leaves $\pm$ cuneate at base; lobes rather narrow, usually free to base
8 Bracteoles ovate or ovate-lanceolate
7. rossicum

8 Bracteoles linear or linear-lanceolate
9 Inflorescence-axis and perianth-segments glabrous, more rarely patent-pubescent; leaf-lobes linear-lanceolate, with an elongate apex
5. simonkaianum

9 Inflorescence-axis and perianth-segments covered with subappressed minutely scabrid hairs; leaf-lobes oblong, without an elongate apex 6. cuneatum
2 Tubers present; seeds covered with membranous scales, not winged
10 Base of petiole little dilated, surrounding less than $\frac{1}{2}$ the circumference of the stem; pedicels of lower flowers usually at least as long as the flowers

[^85]11 Carpels nearly always 5
9. pentagynum

11 Carpels 3
12 Perianth-segments bright blue, distinctly shorter than spur 10. nevadens
12 Perianth-segments bluish-lilac, about as long as spur
11. emarginatum

10 Base of petiole strongly dilated, almost completely surrounding stem; pedicels of lower flowers usually shorter than flowers
13 Stem angled; petiole of middle and upper cauline leaves very short
15. schmalhausenii

13 Stem $\pm$ terete; all cauline leaves $\pm$ long-petiolate
14 Flowers dirty blackish-violet-purple, rather widely open; spur $\pm$ equalling perianth-segments
14. puniceum

14 Flowers blue, violet-blue, lilac or whitish, not widely open; spur usually distinctly longer than perianthsegments
15 Bracts and bracteoles linear; flowers (incl. spur) 24 27 mm , blue or lilac
12. fissum

15 Bracts and bracteoles ovate-lanceolate; flowers (incl. spur) $19-23 \mathrm{~mm}$, pale blue or whitish 13. albiflorum
1 Annual or biennial; lateral honey-leaves glabrous and not ciliate (Mediterranean region)
16 Limb of upper honey-leaves with lateral wings; seeds numerous, covered with transverse membranous scales
17 Limb of lateral honey-leaves cuneate at base, gradually narrowed into claw
18 Limb of lateral honey-leaves ovate or elliptic; spur of perianth-segments up to twice as long as the segments
16. peregrinum

18 Limb of lateral honey-leaves subquadrate, with wide truncate apex; spur of perianth-segments $\pm$ equalling the segments 17. hirschfeldianum
17 Limb of lateral honey-leaves abruptly contracted into claw
19 Limb of lateral honey-leaves not or little shorter than claw, usually distinctly exserted, not cordate at base
18. obcordatum

19 Limb of lateral honey-leaves $\frac{1}{2}-\frac{3}{4}$ as long as claw, cordate or subcordate at base
20 Limb of lateral honey-leaves oblong, $1 \frac{1}{2}-2$ times as long as wide, exserted
21 Limb of lateral honey-leaves usually $1 \frac{1}{4}-2$ times as long as wide; perianth-segments usually $7-9 \mathrm{~mm} \quad$ 22. gracile
21 Limb of lateral honey-leaves up to $1 \frac{1}{3}$ times as long as wide; perianth-segments usually $5-7 \mathrm{~mm}$
23. hellenicum

20 Limb of lateral honey-leaves suborbicular, included
22 Limb of lateral honey-leaves strongly cordate at base
21. verdunense

22 Limb of lateral honey-leaves weakly cordate at base
23 Follicles and outside of perianth-segments minutely appressed-pubescent (rarely follicles glabrous)
19. halteratum

23 Follicles and outside of perianth-segments densely covered with patent hairs
20. balcanicum

16 Limb of upper honey-leaves unwinged; seeds few, rugoseareolate
24 Spur $\frac{1}{5}-\frac{1}{3}$ as long as perianth-segments; seeds $5 \cdot 5-7 \cdot 5 \mathrm{~mm}$
24. staphisagria

24 Spur at least $\frac{2}{5}$ as long as perianth-segments; seeds 34.5 mm

25 Inflorescence-axis, pedicels and outside of perianthsegments shortly pubescent; bracteoles inserted at the base of the pedicels
25. pictum

25 Inflorescence-axis and outside of perianth-segments villose-hirsute; bracteoles inserted at some distance above the base of the pedicels
26. requienii

Sect. Delphinastrum DC. Perennial. Limb of lateral honeyleaves deflexed, ciliate, bearded on the upper surface. Upper honey-leaves not winged, not clawed. Seeds numerous.

1. D. montanum DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 641 (1815). Tubers absent. Stems $15-50(-65) \mathrm{cm}$, densely covered, like the leaves, pedicels and perianth-segments, with erectopatent hairs. Petioles not sheathing at base, those of upper leaves about as long as lamina. At least the 3 lowest bracts divided; all bracts shorter, or the lower 1-4 bracts longer, than the flowers. Perianth-segments $12-20(-24) \times 3.5-8 \mathrm{~mm}$, pale blue. Honey-leaves about half as long as perianth-segments. Carpels densely pubescent (very rarely glabrescent). Seeds winged at angles. Pyrenees. Ga Hs.
2. D. dubium (Rouy \& Fouc.) Pawł., Bull. Int. Acad. Sci. Cracovie (Math. Nat.) ser. B. 1933 (1): 39 (1934). Like 1 but 30-100 cm; hairs usually appressed; petioles of upper leaves shorter than lamina; lower bracts longer than flowers; perianth-segments $16-23(-28) \times 4-10(-14) \mathrm{mm}$, dark blue; carpels glabrous (rarely pubescent). S.W. Alps. Ga It.
3. D. oxysepalum Borbás \& Pax in Borbás, Term.-Tud. Közl. 22: 647 (1890). Tubers absent. Stems $10-50(-80) \mathrm{cm}$, subglabrous below, more or less densely pubescent above with appressed hairs. Petioles scarcely sheathing at base, those of upper leaves about as long as lamina. Usually not more than the 2 lowest bracts divided and all of them shorter than the flowers. Perianthsegments $20-32(-40) \mathrm{mm}$, deep blue or bluish-violet. Honeyleaves about half as long as perianth-segments. Carpels glabrous (rarely sparsely pubescent). Seeds winged at angles. $2 n=32$. W. Carpathians. Cz Po.
4. D. elatum L., Sp. Pl. 531 (1753). Tubers absent. Stems $40-$ 200 cm , with patent or slightly deflexed hairs below, glabrous or with patent hairs above, usually pruinose. Petioles not sheathing at base, those of upper leaves shorter than lamina; lamina palmately lobed. All bracts usually shorter than flowers, the lower $0-5$ divided. Perianth-segments (9-)13-19(-22) mm, deep or dirty blue, or bluish-violet, glabrous or with patent hairs on the outside. Carpels glabrous or more or less patent-pilose. Seeds winged at angles. Mountains of C. Europe and Jugoslavia; N. \& C. Russia. Au Cz Ga He Ju Po Rm Rs (N, C, W).

A polymorphic species including 3 subspecies and many varieties in Europe.
1 Honey-leaves the same colour as the perianth, or the upper paler or yellowish
(c) subsp. austriacum

1 Honey-leaves blackish or dark brown
2 Lower perianth-segments $1 \frac{1}{2}-2 \frac{1}{2}$ times as long as wide, the lateral distinctly wider $\quad$ (a) subsp. elatum
2 Lower perianth-segments $2 \frac{1}{2}-3 \frac{1}{2}$ times as long as wide, the lateral little wider (b) subsp. helveticum
(a) Subsp. elatum (D. intermedium Aiton; incl. D. alpinum Waldst. \& Kit., D. tiroliense Kerner and ?D. cryophilum Nevski): Perianth-segments (without spur) (11)14-19(22) mm. Spur usually distinctly longer than perianth-segments. $2 n=32$. Au Cz He Ju Po Rm Rs (N, C, W).
(b) Subsp. helveticum Pawł., Bull. Int. Acad. Sci. Cracovie (Math. Nat.) ser. B. 1933 (1): 99 (1934): Perianth-segments (12)15$19(24) \mathrm{mm}$. Spur about equalling perianth-segments. W. Alps. GaHe .
(c) Subsp. austriacum Pawł., Fragm. Fl. Geobot. 9: 434 (1963): Flowers usually larger. Perianth-segments (without spur) (16)17$21(25) \mathrm{mm}$. Spur about equalling perianth-segments. C.E. Alps. Au .
5. D. simonkaianum Pawł., Bull. Acad. Polon. Sci. Lett. Cl. Math. Nat. B. (1) 1933: 107 (1934). Tubers absent. Stems very sparsely hairy below, otherwise glabrous (rarely puberulent in
inflorescence), with few, short branches. Leaves shortly cuneate at base, palmatisect, the segments elongate. Bracts all linear and entire. Perianth-segments with a tuft of hairs at the apex, otherwise glabrous (rarely pilose outside). Carpels glabrous (rarely puberulent). Seeds winged at angles. - C. Romania. Rm.
6. D. cuneatum Steven ex DC., Reg. Veg. Syst. Nat. 1: 359 (1817). Tubers absent. Stems with deflexed hairs below; in-florescence-axis, pedicels and outside of perianth-segments puberulent with minutely scabrid hairs. Leaves distinctly cuneate at base, deeply palmatisect. Lowest 1-2 bracts divided. Carpels glabrous or puberulent. Seeds winged at angles. C. Russia (northwards to c. $56^{\circ} N$. ); N. \& C. Ukraine. Rs (C, W, E).
7. D. rossicum Litv. in Majevski, Fl. Sred. Ross. ed. 5, 21 (1917). Like 5 but leaf-segments not elongate; lowest $1-3$ bracts divided, upper ovate-lanceolate; bracteoles ovate or ovateoblong; hairs at apex of perianth-segments not tufted. C. \& S.E. Russia, E. Ukraine. Rs (C, E).
8. D. dictyocarpum DC., Reg. Veg. Syst. Nat. 1: 360 (1817). Tubers absent. Leaves rigid, with closed or narrow basal sinus and narrow segments. Bracts and bracteoles linear. Perianthsegments pale blue, about equalling the spur. Lateral honeyleaves usually with suborbicular limb, very densely long-ciliate and bearded. Seeds winged at angles. E. Russia. Rs (E).
(a) Subsp. dictyocarpum: Stems glabrous, or patent-pilose at base; petioles glabrous or long-ciliate below. Perianth-segments glabrous outside. Follicles glabrous, or ciliate on suture. E. Russia. (C. Asia, W. Siberia.)
(b) Subsp. uralense (Nevski) Pawł., Fragm. Fl. Geobot. 9: 435 (1963) (D. uralense Nevski): Stems, leaves, pedicels, perianthsegments and follicles covered with appressed hairs. - E. Russia.
9. D. pentagynum Lam., Encyc. Méth. Bot. 2: 264 (1786). Tubers present. Stock surrounded by fibres. Stems $30-70 \mathrm{~cm}$, slender, slightly angled, with patent or somewhat deflexed hairs below and subappressed hairs above, more rarely glabrous above. Base of petiole of cauline leaves surrounding not more than half the circumference of stem. Upper leaves palmatisect, with more or less linear segments; lower palmatipartite, with wider segments. Flowers pale or dirty violet-blue; lateral perianth-segments $13-$ 16 mm , about equalling the subacute spur. Follicles 5, more or less divergent. Seeds $1.2-1.5 \mathrm{~mm}$, obscurely angled, covered with long scales. S. Spain, C. \& S. Portugal. Hs Lu.
D. gautieri Rouy, Ill. Pl. Eur. Rar. 5: 34 (1896) is evidently closely related to 9 . It is described as being taller, with wider, subobtuse leaf-segments, and flowers almost twice as large, with a very obtuse spur $1 \frac{1}{2}$ times as long as the perianth-segments. It was described from the Spanish Pyrenees, and does not appear to have been collected more than once.
10. D. nevadense G. Kunze, Flora (Regensb.) 29: 647 (1846). Tubers present. Stock surrounded by fibres. Stems up to 120 cm , robust, distinctly angled, glabrous above. Base of petiole of cauline leaves surrounding not more than half the circumference of stem. Pedicels glabrous. Perianth-segments $10-13 \mathrm{~mm}$, bright blue, yellow-spotted above, glabrous on the outside, distinctly shorter than the spur. Follicles 3, glabrous. Seeds obscurely angled, covered with scales. S. Spain (Sierra Nevada). Hs. (N.W. Africa.)
11. D. emarginatum C. Presl in J. \& C. Presl, Del. Prag. 1: 6 (1822). Tubers present. Stock surrounded by fibres. Stems up to 80 cm , distinctly angled, glabrous or slightly pubescent above. Base of petiole of cauline leaves surrounding not more than half the circumference of stem. Pedicels glabrous or subglabrous. Perianth-segments $10-14 \mathrm{~mm}$, bluish-lilac, glabrous on the outside, as long as or scarcely shorter than spur. Follicles 3, erect. Seeds obscurely angled, covered with scales. Sicilia. Si. (N. Africa.)
12. D. fissum Waldst. \& Kit., Pl. Rar. Hung. 1: 83 (1802) (D. leiocarpum Huth, D. pallasii Nevski). Tubers present. Stock without fibres. Stems $50-150 \mathrm{~cm}$, terete, 3-6 mm thick, simple or little-branched. Leaves mostly 3 -fid; segments linear-lanceolate to linear, acute. Base of petiole of lower cauline leaves almost surrounding stem. Bracts and bracteoles linear; margin not membranous. Flowers (incl. spur) $24-27 \mathrm{~mm}$, blue, violet-blue or lilac; perianth-segments directed forwards; spur more or less horizontal. Seeds $2-3 \mathrm{~mm}$, densely covered with undulate scales. S. Europe, northwards to Slovenija, N. Romania and C. Ukraine. Al Bu Ga It Ju Rm Rs (W, E) Tu.

A polymorphic species which should perhaps be divided. It varies greatly in the degree and nature of the pubescence on all parts, the bracts may be entire or the lower divided, and the leafsegments may be linear to lanceolate.
D. sordidum Cuatrec., Trab. Mus. Cien. Nat. Barcelona 12: 277 (1929), with broadly lanceolate leaf-segments and dirty yellowishviolet flowers with connivent, densely pubescent perianthsegments, was described from S. Spain (Sierra de Mágina), and has been found once only.
13. D. albiflorum DC., Reg. Veg. Syst. Nat. 1: 353 (1817). Like 12 but bracts and bracteoles ovate-lanceolate, usually membranous-margined; flowers (incl. spur) $19-23 \mathrm{~mm}$; perianthsegments pale blue, whitish or yellowish-white; honey-leaves blue. Bulgaria, N. Greece (Athos). Bu Gr. (Anatolia.)
14. D. puniceum Pallas, Reise 3: 736 (1776). Tubers present. Stock without fibres. Stems $30-80 \mathrm{~cm}$, shortly appressed-pubescent. Leaf-segments linear. Base of petiole of lower cauline leaves almost surrounding stem. Bracts shorter than pedicels, linear. Perianth-segments dark purple-violet, puberulent on outside. Follicles appressed-pubescent, more rarely glabrous. Seeds obscurely angled, covered with scales. S.E. Russia, E. Ukraine. Rs (E). (W. \& C. Asia.)
15. D. schmalhausenii Albov, Trudy Odessk. Obšč. Sad. 1890: 441 (1891). Tubers present. Stock without fibres. Stems $40-130 \mathrm{~cm}$, distinctly angled, more or less pubescent. Leaves with numerous linear segments; petioles of middle and upper leaves very short, widely membranous-margined, almost surrounding the stem. Inflorescence long and dense. Flowers deep bluish-violet; spur little longer than perianth-segments, steeply ascending. Seeds obscurely angled, covered with scales. S.E. Russia. Rs (E). (Caucasus, Asia Minor.)

Sect. Delphinium. Annual or biennial. Honey-leaves glabrous, the same colour as the perianth-segments, the upper winged, not clawed. Seeds numerous.
16. D. peregrinum L., Sp. Pl. 531 (1753). Stems (15-)3080 cm , erect, pruinose, pubescent throughout or only at base, with ascending branches. Leaves 1-(2)-palmatisect, with linearlanceolate or linear segments; upper leaves entire. Flowers dirty violet or bluish-violet. Perianth-segments puberulent on the out-
side, the lateral $7-10 \mathrm{~mm}$, distinctly shorter than spur. Honeyleaves longer than perianth-segments; upper with the distal part (above the wings) 3-6 times as long as wide; lateral with elliptical, ovate or obovate limb, gradually narrowed into claw. Follicles usually pubescent. C. \& E. Mediterranean region. Al Bu Cr Gr It Ju Si Tu.
17. D. hirschfeldianum Heldr. \& Holzm. in Boiss., Fl. Or. suppl. 19 (1888). Like 16 but perianth-segments deep blue, about equalling spur; limb of lateral honey-leaves subquadrate, crenatedentate, shortly cuneate at base. - Aegean islands (Aiyina, Kithnos). Gr.
18. D. obcordatum DC., Reg. Veg. Syst. Nat. 1: 350 (1817). Stems $10-30(-70) \mathrm{cm}$, slender, usually appressed-pubescent, with numerous long arcuate-divaricate branches. Inflorescence 2- to (10-15)-flowered, lax. Pedicels and outside of perianth-segments appressed-pubescent. Flowers deep bluish-violet; spur about twice as long as perianth-segments. Limb of lateral honey-leaves about as long as claw, not cordate at base. Follicles $7-11 \mathrm{~mm}$, $3 \frac{1}{2}-5$ times as long as wide, slender, densely appressed-puberulent, often more or less divaricate. Spain. Hs.
19. D. halteratum Sibth. \& Sm., Fl. Graec. Prodr. 1: 37 (1809) (D. longipes Moris). Stem $10-70 \mathrm{~cm}$, minutely appressedpubescent (rarely glabrous), few- or many-branched; branches sometimes long, but not virgate. Upper leaves often entire, not shorter than the internodes. Inflorescence 3- to 50 -flowered, usually more or less lax, often long, rarely dense. Perianthsegments $7-10(12) \mathrm{mm}$, minutely and more or less densely appressed-pubescent. Follicles (6) $7-10 \mathrm{~mm}, 2 \frac{1}{2}-3 \frac{1}{2}(4)$ times as long as wide, appressed-pubescent (rarely glabrous). W. Mediterranean region. Ga It Sa Si .
20. D. balcanicum Pawl., Fragm. Fl. Geobot. 9: 439 (1963). Inflorescence mostly very dense (rarely more or less lax). Perianth-segments 6-9 mm, patent-pilose. Follicles 5-7(9) mm, 2-3 times as long as wide, densely covered with rather long patent hairs. Balkan peninsula. Bu Gr Ju.
21. D. verdunense Balbis, Cat. Stirp. Hort. Bot. Taur. app. 3, 31 (1813). Stems 10-40(-80) cm, slender, minutely appressedpuberulent; branches usually erecto-patent, not virgate. Leaves small, usually all divided into linear-oblong segments. Inflorescence rather short and dense, usually 5 - to 15 -flowered. Flowers deep bluish-violet; perianth-segments $8-12 \mathrm{~mm}$, appressedpuberulent outside; spur $14-19 \mathrm{~mm}$. Limb of lateral honeyleaves up to $\frac{3}{4}$ as long as claw, included, strongly cordate at base. Follicles $6-10(-11) \mathrm{mm}, 2 \frac{1}{2}-4 \frac{1}{2}$ times as long as wide, almost glabrous. S.W. Europe. Ga Hs Lu.
22. D. gracile DC., Reg. Veg. Syst. Nat. 1: 350 (1817). Stems $20-90 \mathrm{~cm}$, very slender, with numerous long virgate branches, appressed-puberulent or more or less glabrous. Upper leaves mostly entire, shorter than internodes. Inflorescence usually lax, (1-)3- to $15(-30)$-flowered. Flowers often pale lilac-violet or whitish; perianth-segments (6-)7-9 mm, minutely appressedpuberulent outside; spur ( $1 \frac{1}{2}$ ) $2-2 \frac{1}{2}$ times as long as perianthsegments. Lateral honey-leaves longer than perianth-segments; limb $1 \frac{1}{3}-2$ times as long as wide, oblong, exserted. Follicles 6$11 \mathrm{~mm}, 2 \frac{1}{2}-4$ times as long as wide, glabrous or sparsely appressedpubescent. Spain and Portugal. Hs Lu.
23. D. hellenicum Pawł., Fragm. Fl. Geobot.9: 442 (1963). Like 22 but up to 100 cm , sparsely branched; perianth-segments 5-$7(-8) \mathrm{mm}$; spur $2 \frac{1}{2}-3$ times as long as perianth-segments; limb of
lateral honey-leaves $c .1^{\frac{1}{4}}$ times as long as wide, ovate or subquadrate; follicles glabrous. Greece. Gr.

Sect. Staphisagria DC. Annual or biennial. Honey-leaves glabrous, the same colour as the perianth-segments, the upper paler or yellowish, shortly clawed, unwinged. Seeds few.
24. D. staphisagria L., Sp. Pl. 531 (1753). Stems $30-100 \mathrm{~cm}$, stout, simple, patent-pilose. Leaves palmately 5 - to 7 -fid or -lobed, pubescent on both surfaces with mixed very short and longer hairs; segments entire or 3 -lobed, with ovate-lanceolate, or oblong, acute lobes. Flowers deep blue. Perianth-segments $13-$ 20 mm . Limb of lateral honey-leaves gradually narrowed into claw. Follicles $8-11 \mathrm{~mm}$ wide, inflated. Mediterranean region. Al Bl Co Cr Ga Gr Hs It Ju Lu Sa Si.
25. D. pictum Willd., Enum. Pl. Hort. Berol. 574 (1809). Stems pubescent, sometimes with mixed long and short hairs. Rhachis, pedicels and outside of perianth-segments shortly pubescent. Inflorescence usually dense; pedicels shorter than flowers (except sometimes the lower); bracteoles inserted at base of pedicels. Perianth-segments $9-14 \mathrm{~mm}$, pale blue; spur $6-8 \mathrm{~mm}$. Limb of lateral honey-leaves suborbicular, abruptly contracted into claw. Follicles up to 6 mm wide, inflated. W. Mediterranean islands, Italy. Bl Co It Sa.
26. D. requienii DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 642 (1815). Like 24 but rhachis, pedicels and outside of perianthsegments villous-hirsute, inflorescence usually lax; lower and middle pedicels distinctly longer than flowers; bracteoles inserted distinctly above base of pedicels; limb of lateral honeyleaves obovate, more or less gradually narrowed into claw. S. France (Isles d'Hyères), Corse, ?Sardegna. Co Ga ?Sa.

## 13. Consolida (DC.) S. F. Gray ${ }^{1}$

Like Delphinium but always annual; the 2 upper honey-leaves coalescent into a single structure (nectary), with a single spur; lateral honey-leaves absent; stamens in 5 spirally arranged series; carpel 1.

Literature: E. Huth, Bot. Jahrb. 20: 365-91 (1895). R. de Soó, Österr. Bot. Zeitschr. 71: 233-46 (1922).
1 Nectary ovate, entire; follicle appressed-silky 3. hellespontica 1 Nectary lobed; follicle glabrous or pubescent but not silky
2 Spur circinate-involute at apex
3 Intermediate lobes of nectary acute; follicle $15-25 \mathrm{~mm}$

1. aconiti

3 Intermediate lobes of nectary obtuse; follicle c. 7 mm
2. thirkeana

2 Spur straight or scarcely curved
4 Follicle glabrous
5 Perianth-segments 9 mm or more $\quad$ 9. regalis
5 Perianth-segments less than $9 \mathrm{~mm} \quad$ 10. tenuissima
4 Follicle pubescent
6 Spur less than 7 mm
7 Lower pedicels not more than 5 mm 8. tuntasiana
7 Lower pedicels more than 7 mm
6. brevicornis

6 Spur 7 mm or more
8 Lower bracts entire
9 Inflorescence racemose, not or little-branched
7. uechtritziana 9 Inflorescence paniculate, much-branched
10 Upper lobe of nectary more than 2 mm wide; plant sparsely pubescent; flowers dark blue; seeds black
9. regalis
${ }^{1}$ By A. O. Chater.

10 Upper lobe of nectary not more than 2 mm wide; plant densely whitish-pubescent; flowers violet, pale blue or whitish; seeds grey or reddish
11. pubescens

8 Lower bracts dissected
11 Both spur and perianth-segments $5-7 \mathrm{~mm}$ 12. rigida
11 Either spur, or perianth-segments, or both, more than 7 mm
12 Bracteoles reaching to or beyond the base of the flower; spur not more than 12 mm ; inflorescence racemose
4. orientalis

12 Bracteoles, at least of lower flowers, not reaching base of the flower; spur 12 mm or more
13 Inflorescence paniculate, lax; ripe follicle $10-15 \mathrm{~mm}$, $\frac{1}{2}-\frac{1}{3}$ as long as lower pedicels 11. pubescens
13 Inflorescence usually racemose; ripe follicle 1520 mm , mostly more than $\frac{1}{2}$ as long as lower pedicels
5. ambigua
(A) Spur of perianth-segment circinate-involute at apex; nectary attached to pedicel by the extreme end, between the two lateral (lower) lobes; spur remote from lateral lobes and pedicel; intermediate lobes present above each lateral lobe; upper lobe small, bifid.

1. C. aconiti (L.) Lindley, Jour. Hort. Soc. 6: 55 (1851) (Delphinium aconiti L.). Stem up to 50 cm , much-branched, densely covered with short, deflexed hairs. Leaf-segments linear. Inflorescence paniculate. Perianth-segments $5-6 \mathrm{~mm}$, blue; spur c. 12 mm . Nectary with triangular, acute intermediate lobes. Follicle 15-25 mm, linear, glabrous. Turkey-in-Europe (Eceabat). Tu.

Known only from the European and Asiatic shores of the Dardanelles.
2. C. thirkeana (Boiss.) Bornm., Feddes Repert. (Beih.) 89: 14 (1936) (Delphinium thirkeanum Boiss.). Like 1 but nectary with obtuse intermediate lobes; follicle $c .7 \mathrm{~mm}$. Turkey-in-Europe. Tu.
(B) Spur of perianth-segment straight or slightly curved; nectary attached to pedicel by the middle, near base of spur which is adjacent to the two lateral (lower) lobes; intermediate lobes absent; upper lobe bifid or entire (in 3, nectary, except for spur, entire).
3. C. hellespontica (Boiss.) Chater, Feddes Repert. 69: 55 (1964) (C. olopetala var. paphlagonica sensu Hayek; Delphinium tomentosum Boiss. 1867 pro parte, non Boiss. 1841; D. hellesponticum Boiss.). Leaf-segments linear. Inflorescence racemose. Perianth-segments $12-15 \mathrm{~mm}$, bluish-violet; spur $12-22 \mathrm{~mm}$. Nectary ovate, entire, or minutely bifid at apex. Follicle 1015 mm , appressed-silky. S.W. Bulgaria; N.E. Greece. Bu Gr.
In Europe only as subsp. macedonica (Halácsy \& Charrel) Chater, Feddes Repert. 69: 55 (1964). The typical subspecies, from Asia Minor, is smaller in all its parts.
4. C. orientalis (Gay) Schrödinger, Abhand. Zool.-Bot. Ges. Wien 4 (5): 25 (1909). Stem up to 100 cm , simple or branched. Basal leaves with linear-oblong segments; cauline with linear segments. Inflorescence racemose; lower bracts dissected; bracteoles usually close to, and reaching beyond the base of the flower. Perianth-segments purplish-violet. Nectary 3-lobed, with bifid upper lobe. Follicle $15-20 \times 5 \mathrm{~mm}$, very abruptly contracted at apex; seeds reddish-brown. S. \& E. part of Iberian peninsula; S.E. Europe; locally naturalized elsewhere. Al Bu Gr Hs Hu Ju $\mathrm{Lu} \mathrm{Rm} \operatorname{Rs}(\mathrm{W}, \mathrm{K}, \mathrm{E}) \mathrm{Tu}[\mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{It]}$.
(a) Subsp. orientalis (Delphinium orientale Gay; incl. D. hispanicum Willk.): Inflorescence relatively dense; lower pedicels
mostly more than 12 mm in fruit, but less than twice as long as ripe follicle. Perianth-segments $10-14(-20) \mathrm{mm}$; spur (8-)1012 mm . Throughout the range of the species.
(b) Subsp. phrygia (Boiss.) Chater, Feddes Repert. 36: 193 (1963) (C. phrygia (Boiss.) Soó): Inflorescence relatively lax; lower pedicels $5-10 \mathrm{~mm}$ in fruit. Perianth-segments and spur $c$. 10 mm . Macedonia and Thasos.
5. C. ambigua (L.) P. W. Ball \& Heywood, Feddes Repert. 66: 151 (1962) (Delphinium ajacis auct., Consolida ajacis auct.). Stem up to 100 cm , simple or branched. Basal leaves with oblong segments; cauline with linear segments. Inflorescence usually racemose, occasionally paniculate; lower bracts dissected; bracteoles small, remote, usually not reaching base of flower. Lower pedicels mostly more than 12 mm in fruit, but less than twice as long as ripe follicle. Perianth-segments $10-14(-20) \mathrm{mm}$, usually deep blue; spur $13-18 \mathrm{~mm}$. Nectary 3 -lobed, with bifid upper lobe. Follicle $15-20 \times 5 \mathrm{~mm}$, pubescent, gradually narrowed at apex; seeds black. Mediterranean region; locally naturalized elsewhere. $\mathrm{Al} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Tu} \mathrm{[Au} \mathrm{Be} \mathrm{Bl} \mathrm{Cz} \mathrm{He} \mathrm{Lu} \mathrm{Po}$ Rm].

4 and 5 are both frequently cultivated for ornament, and naturalized plants often belong to cultivars of these species.
6. C. brevicornis (Vis.) Soó, Österr. Bot. Zeitschr. 71: 245 (1922). Like 5 but plant less robust; basal leaves often with linear segments; perianth-segments violet; follicle abruptly contracted at apex; spur $5-6 \mathrm{~mm}$. - W. coast of Jugoslavia; N.W. Greece (Ionioi Nisoi). Gr Ju.
7. C. uechtritziana (Pančic) Soó, Österr. Bot. Zeitschr. 71: 236 (1922). Like 5 but lower bracts entire; spur almost twice as long as perianth-segments; seeds reddish-brown. - ?Crna Gora; Srbija; Akhaia. Gr Ju [Hu].

According to Huth, this species becomes very similar to 5 in cultivation, but the available information is insufficient for any decision to be made as to its status.
8. C. tuntasiana (Halácsy) Soó, Österr. Bot. Zeitschr. 71: 239 (1922). Stem less than 15 cm , simple or little-branched. Basal leaves with cuneate-obovate segments; cauline with linear segments. Flowers up to 6, in lax racemes; bracts dissected. Pedicels not more than 5 mm , very stout. Perianth-segments c. 10 mm , pale violet; spur c. 4 mm . Nectary with very broad, shallowly bifid upper lobe. Follicle $15-17 \mathrm{~mm}$, pubescent. - S. Greece (highest summit of Yerania Ori, Korinthos). Gr.
9. C. regalis S. F. Gray, Nat. Arr. Brit. Pl. 2: 711 (1821). Stem up to 50 cm , branched, covered with short deflexed hairs. Leafsegments all linear. Inflorescence paniculate; all bracts linear, entire; lower pedicels longer than flower and ripe follicle. Spur $12-25 \mathrm{~mm}$. Upper lobe of nectary more than 2 mm wide, entire, erose, or shallowly bifid with rounded lobes. Follicle $8-15 \mathrm{~mm}$; seeds black. $2 n=16$. Most of Europe, except the extreme north and south All except Az Bl Br Co Cr Fa Hb Is ? Lu SaSb .
(a) Subsp. regalis (Delphinium consolida L.): Stem littlebranched; inflorescence rather dense; perianth-segments 1215 mm , usually light violet-blue; follicle usually 3 times as long as wide, glabrous. Most of Europe, northwards to c. $60^{\circ} \mathrm{N}$. in Scandinavia (further north only as a casual), but absent from most islands and the south, and much of the Balkan peninsula.
(b) Subsp. paniculata (Host) Soó, Österr. Bot. Zeitschr. 71: 243 (1922) (Delphinium paniculatum Host; incl. D. divaricatum

[^86]Ledeb.): Stem much-branched; inflorescence very lax; perianthsegments $9-11 \mathrm{~mm}$, dark blue; follicle usually twice as long as wide, glabrous or appressed-pubescent. S.E. Europe, extending to N. Italy.

Plants with appressed-pubescent follicles have been called C. divaricata (Ledeb.) Schrödinger, Abhand. Zool.-Bot. Ges. Wien 4 (5): 25 (1909), but do not seem to merit even subspecific rank.
10. C. tenuissima (Sibth. \& Sm.) Soó, Österr. Bot. Zeitschr. 71: 241 (1922). Stem up to 50 cm , branched, covered with patent hairs. Segments of basal leaves oblong; segments of cauline leaves linear. Inflorescence lax, paniculate; lower bracts linear, entire; lower pedicels longer than flower and ripe follicle. Perianth-segments $5-7 \mathrm{~mm}$, violet-blue; spur $7-10 \mathrm{~mm}$. Upper lobe of nectary broad, bifid, with obtuse lobes. Follicle $5-8 \mathrm{~mm}$, less than twice as long as wide, glabrous. - S.E. Greece. Gr.
11. C. pubescens (DC.) Soó, Österr. Bot. Zeitschr. 71: 241 (1922) (Delphinium pubescens DC.; incl. D. loscosii Costa). Whole plant densely appressed-pubescent; stem up to 50 cm , branched. Leaf-segments linear. Inflorescence lax, paniculate; lower bracts entire or dissected; bracteoles not reaching base of flower; pedicels longer than flower and ripe follicle. Perianth-segments $6-12 \mathrm{~mm}$, violet, pale blue or whitish; spur $12-20 \mathrm{~mm}$. Upper lobe of nectary not more than 2 mm wide, bifid, with acute lobes. Follicle $10-15 \times 5 \mathrm{~mm}$, sparsely pubescent; seeds grey or reddish. S.W. Europe, extending to W. Italy and Sicilia. Ga Hs It Si.
12. C. rigida (DC.) Hayek, Prodr. Fl. Penins. Balcan. 1: 315 (1924). Stem up to 60 cm , much-branched, glandular-hairy. Leafsegments oblong-linear. Inflorescence paniculate; lower bracts dissected; pedicels longer than flower and ripe follicle. Perianthsegments and spur each $5-7 \mathrm{~mm}$, pale violet or pale purple. Upper lobe of nectary bifid. Follicle $10-15 \mathrm{~mm}$, pubescent. Perhaps naturalized in W. Jugoslavia. [?Ju.] (W. Asia.)

## 14. Anemone L. ${ }^{1}$

Perennial herbs. Flowering stems with a whorl of 3(4) often partially united leaves. Flowers conspicuous, usually solitary. Perianth-segments 5-14, petaloid, imbricate. Honey-leaves absent. Stamens numerous. Achenes numerous; style not elongated or feathery.
1 Cauline leaves sessile
2 Stems branched
10. dichotoma

2 Stems simple
3 Cauline leaves undivided or almost so
4 Perianth-segments $12-19$, narrowly elliptical 16. hortensis
4 Perianth-segments $7-12$, broader 17. pavonina
3 Cauline leaves much divided
5 Flowers 2-8 in an umbel, rarely fewer; achenes glabrous, winged
9. narcissiflora

5 Flowers solitary; achenes woolly, not winged
6 Basal leaves deeply cut; flowers not yellow 15. coronaria
6 Basal leaves shallowly lobed, suborbicular; flowers yellow
14. palmata

1 Cauline leaves petiolate
7 Plant with a creeping or tuberous rhizome; achenes not woolly
8 Perianth-segments $1-1.5 \mathrm{~mm}$ wide, greenish-white, strongly deflexed
8. reflexa

8 Perianth-segments at least 2.5 mm wide, variously coloured but not greenish-white, patent
9 Leaves tripartite and serrate but not further divided
3. trifolia

9 Leaves with primary divisions lobed
10 Anthers pale yellow or white; flowers usually blue

$$
\begin{aligned}
& 11 \text { Perianth-segments pubescent beneath; head of achenes } \\
& \text { erect } \\
& 11 \text { (erianth-segments glabrous beneath; head of achenes } \\
& \text { nodding }
\end{aligned}
$$

2. altaica

7 Plant without a creeping or tuberous rhizome; achenes very woolly
15 Primary divisions of leaves 5 ; perianth-segments usually 5 11. sylvestris

15 Primary divisions of leaves 3 ; perianth-segments 7-10
16 Plant $5-12 \mathrm{~cm}$ ( -20 cm in fruit); stock slender, with few or no remains of petioles of former years; heads of achenes elongating in fruit
12. baldensis

16 Plant $25-30 \mathrm{~cm}$; stock stout, clothed in remains of old petioles; head of achenes globose
13. pavoniana

Sect. Sylvia Gaudin. Achenes not or slightly compressed, not woolly. Style short, hooked.

1. A. nemorosa L., $S p$. Pl. 541 (1753). Rhizome brown, creeping. Basal leaves 1-2, 3-partite, divisions shortly stalked and again deeply lobed; petioles long. Flowering stems $6-30 \mathrm{~cm}$; cauline leaves without buds in their axils, similar to basal leaves but smaller and petioles flattened; marginal hairs $0.5-0.75 \mathrm{~mm}$. Perianth-segments (5-)6-7(-12), white, flushed with pink or purple beneath (rarely entirely purple or blue), oblong-ovate, glabrous. Anthers yellow. Achenes downy. Heads of achenes nodding. $2 n=28-32,37,42,45,46$. Most of Europe, but rare in the Mediterranean region. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Cr} \mathrm{Fa} \mathrm{Is} \mathrm{Lu} \mathrm{Rs} \mathrm{(E)}$ Sa Sb Si .

An isolated population in arctic Russia (Poluostrov Kol'skij), with 9-12 perianth-segments, is somewhat intermediate between 1 and 2. Sterile hybrids between 1 and 4 occur where the parents grow together.
2. A. altaica Fischer ex C. A. Meyer in Ledeb., Fl. Altaica 2: 362 (1830). Like 1 but with a rather thick yellow rhizome, marginal hairs on cauline leaves shorter and flowers with $8-12(-15)$ perianth-segments which are violet- or blue-veined inside. Woodland margins. N.E. Russia. Rs (N, C). (N. Asia.)

Closely related to 1 and perhaps a disjunct subspecies of it.
3. A. trifolia L., Sp. Pl. 540 (1753). Like 1 but basal leaves usually absent; all leaves 3-partite and serrate, but not lobed. Cauline leaves with buds in their axils. Anthers white or blue. Achenes shortly setose. $2 n=32$. N.W. Spain and Portugal; C. Italy and C. Austria to Hungary and N. Jugoslavia. Au?Ga Hs Hu It Ju Lu [Cz Fe].
(a) Subsp. trifolia: Perianth-segments ovate; anthers blue; head of achenes erect. Usually calcicole. Throughout the range of the species, except the Iberian peninsula.
(b) Subsp. albida (Mariz) Tutin, Feddes Repert. 69: 53 (1964): Perianth-segments elliptical; anthers white; head of achenes usually nodding. Usually calcifuge. Spain and Portugal.
4. A. ranunculoides L., Sp. Pl. 541 (1753). Rhizome brown. Basal leaves 0-1, deeply divided. Stem $7-30 \mathrm{~cm}$; cauline leaves
deeply divided; petioles short. Flowers $1.5-2 \mathrm{~cm}$ in diameter, solitary or $2(-5)$, yellow. Perianth-segments broadly ovate, slightly pubescent beneath; epidermal cells of upper surface not mammillate. Anthers yellow. Most of Europe except the islands, but very rare in the Mediterranean region. Au Be Bu Cz Da Fe $\mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C}, \mathrm{W}, \mathrm{K}, \mathrm{E)} \mathrm{Su}$.
(a) Subsp. ranunculoides: Rhizome far-creeping; plant large. $2 n=32$. Throughout the range of the species.
(b) Subsp. wockeana (Ascherson \& Graebner) Hegi, Ill. Fl. Mitteleur. 3: 520 (1912): Rhizome short; plant small, forming dense patches. N.C. Europe.
5. A. uralensis Fischer ex DC., Prodr. 1: 19 (1824). Like 4 but flowers reddish, purplish, yellow or white; epidermal cells of upper surface of perianth-segments mammillate. Open coniferous woodland. - C. and S. Ural ( $55^{\circ}$ to $58^{\circ} N$.). Rs (C).
$A$. uralensis is intermediate between $A$. ranunculoides and $A$. caerulea DC. from Siberia, and may perhaps be of hybrid origin.
6. A. apennina L., $S p$. Pl. 541 (1753). Like 1 but rhizome tuberous; leaves pubescent beneath, primary divisions stalked, acute; flowers blue (or white, var. albiflora Strobl); perianthsegments 8-14, pubescent beneath; anthers pale yellow or white; head of achenes erect. - S. Europe. Al Bu Co Gr It Ju Si [Da].
7. A. blanda Schott \& Kotschy, Öesterr. Bot. Wochenbl. 4: 129 (1854). Like 6 but leaves glabrous beneath, primary divisions subsessile, more or less obtuse; perianth-segments usually more numerous, glabrous; head of achenes nodding. - S.E. Europe. Al Bu ? Cr Gr Tu .

Perhaps only subspecifically distinct from 6.
8. A. reflexa Stephan in Willd., Sp. Pl. 2 (2): 1282 (1799). Rhizome slender. Flowers less than 1 cm in diameter. Perianthsegments $5-6,1-1.5 \mathrm{~mm}$ wide, greenish-white, deflexed parallel to the peduncle. E. Russia (near Perm'). Rs (C). (N. Asia.)

Sect. Omalocarpus DC. Achenes strongly compressed, often winged, not woolly. Style short, hooked.
9. A. narcissiflora L., Sp. Pl. 542 (1753). 20-40 cm, pubescent. Stock stout. Leaves deeply palmately divided; petioles long. Cauline leaves sessile, deeply cut, segments narrowly linear. Inflorescence umbellate, with 3-8 flowers. Flowers $2-3(-4) \mathrm{cm}$ in diameter, white, sometimes pinkish outside; pedicels $3-4 \mathrm{~cm}$. Perianth-segments 5-6, obovate. Anthers yellow. $2 n=14$. Mountains of S. and C. Europe; Ural. Al Au Bu Cz Ga Ge He Hs It Ju Po Rm Rs (N, C, W).

Variable in E. Europe and still more so in Asia, and probably divisible into a number of subspecies or closely related species, but a thorough review of the whole complex is needed.
A. laxa (Ulbr.) Juz. in Komarov, Fl. U.R.S.S. 7: 738 (1937), from W. Ukraine, is very like 9 but has straight (not curved), leaf-segments. A. biarmiensis Juz., loc. cit. (1937) from N.E. Russia is also very closely related to 9 , but has 3 (not 5) stalked (not sessile) primary divisions of the leaves.

Sect. Anemonidium Spach. Achenes strongly compressed and winged, not woolly. Style about as long as achene, straight.
10. A. dichotoma L., Sp. Pl. 540 (1753) (A. pennsylvanica sensu Ledeb., non L.). Rhizome slender. Stems $20-70 \mathrm{~cm}$, repeatedly branched. Leaves deeply 5 - to 7 -lobed; petioles long. Lowest
cauline leaves 3 in a whorl, deeply 2- to 3-lobed, the others 2 in a whorl; all sessile. Flowers $c .3 \mathrm{~cm}$ in diameter, white. Perianthsegments 5, unequal. Achenes glabrous. E. Russia. Rs (C, E). (N. Asia.)

Sect. Anemone. Achenes densely woolly with hairs longer than the diameter of the achene.
11. A. sylvestris L., $S p$. Pl. 540 (1753). $15-50 \mathrm{~cm}$, pubescent, spreading by root-buds. Basal leaves deeply palmately divided, petioles long; cauline leaves similar but smaller, petioles short. Flowers solitary (-2), 4-7 cm in diameter, white. Perianth-segments usually 5 , broadly ovate. Anthers yellow. $2 n=16$. C. \& E. Europe, extending to S.E. Sweden and N.E. France. Au Bu Cz Ga Ge He Hu It Ju Po Rm Rs (N, B, C, W, K) Su [Be].
12. A. baldensis L., Mantissa 78 (1767). $5-12 \mathrm{~cm}(-20 \mathrm{~cm}$ in fruit), pubescent. Basal leaves 3 times 3 -fid with 2 - or 3 -lobed segments, cauline leaves similar but smaller, with short, broad petioles. Flowers solitary $(-2), 2 \cdot 5-4 \mathrm{~cm}$ in diameter, white. Perianth-segments (6-) $8-10$, ovate, acute. Anthers yellow. Head of achenes ovoid-oblong. Alps, local; mountains of Jugoslavia, southwards to Crna Gora. Au Ga He It Ju.
13. A. pavoniana Boiss., Diagn. Pl. Or. Nov. 3 (1): 6 (1853). Like 12 but 25-30 cm, sparsely pubescent. Stock stout, perianthsegments 7-8, elliptic-oblong, obtuse; head of achenes subglobose. - N. \& C. Spain. Hs.
14. A. palmata L., $S p$. Pl. 538 (1753). $10-30 \mathrm{~cm}$. Rhizome tuberous. Stem pubescent. Basal leaves suborbicular, with 3-5 shallow, obtuse, dentate lobes. Cauline leaves united at base, with 3-5 linear-lanceolate divisions. Flowers $1-2,2 \cdot 5-3 \cdot 5 \mathrm{~cm}$ in diameter, yellow. Perianth-segments $10-15$, oblong. S.W. Europe. Ga ? Gr Hs Lu SaSi .
15. A. coronaria L., Sp. Pl. 539 (1753). 15-45 cm. Basal leaves biternate, segments deeply lobed. Cauline leaves deeply cut into narrow divisions. Flowers $3.5-6.5 \mathrm{~cm}$ in diameter, solitary, red, blue or white. Perianth-segments 5-8, elliptic. Anthers blue. Mediterranean region. *Bl Co $\mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{*Hs} \mathrm{*It} \mathrm{Ju} \mathrm{*Sa} \mathrm{*Si}$ Tu [Lu].
16. A. hortensis L., Sp. Pl. 540 (1753) (A. stellata Lam.). Like 15 but lowest leaves less divided (or only lobed) with broader segments, cauline leaves linear-lanceolate, usually undivided; perianth-segments 12-19 (usually 15) narrowly elliptic, patent, pale purplish. C. Mediterranean region. Al Co Ga It Ju Sa Si.
17. A. pavonina Lam., Encycl. Méth. Bot. 1: 166 (1783). Like 16 but perianth-segments (7-)8-9(-12), broader, scarlet, pink or purple, often yellowish at base. S. Europe from S.W. France to Turkey, local. Bu Co Cr Ga Gr *It Ju Tu.
A. fulgens Gay in DC., Prodr. 1: 18 (1824) is probably $A$. hortensis $\times$ pavonina. It is more or less intermediate and does not breed true.

## 15. Hepatica Miller ${ }^{1}$

Like Anemone but with 3- to 5-lobed evergreen leaves with entire or crenate-dentate lobes, and a calyx-like involucre of 3 small entire bracts usually close below the flower.
Rhizome short; leaf-lobes entire (rarely with 1-2 teeth); pollengrains with 3 pores

1. nobilis

Rhizome long; leaf lobes with 3-5 large crenations; pollen-grains with 5 pores
2. transsilvanica

1. H. nobilis Miller, Gard. Dict. ed. 8, no. 1 (1768) (Anemone hepatica L.). Stock short, thick, dark brown. Petioles and peduncles $5-15 \mathrm{~cm}$. Leaves often purplish beneath, cordate at base, 3-lobed; lobes ovate, sericeous when young and sometimes persistently villous beneath. Flowers $15-25 \mathrm{~mm}$ in diameter, bluish-violet, purple, white or pinkish. Bracts ovate, entire. Perianth of $6-7(-10)$ narrow, ovate segments. $2 n=14$. Most of continental Europe, except the extreme north and south; Corse. Al Au Bu Co Cz Da Fe Ga Ge He Hs Hu It Ju No Po Rm Rs (N, B, C, W) Su.
2. H. transsilvanica Fuss, Verh. Siebenb. Ver. Naturwiss. 1: 83 (1850). Like 1 but with a long slender stock; leaf-lobes crenatedentate; flowers $25-40 \mathrm{~mm}$ in diameter, usually with 8-9 elliptical perianth-segments; and bracts with $2-3$ small teeth near the top. $2 n=28$. Mountain woods. C. Romania. Rm.
H. $\times$ media Simonkai (H. nobilis $\times$ transsilvanica) occurs locally with the parents and has sterile pollen.

## 16. Pulsatilla Miller ${ }^{1}$

Caespitose perennial herbs with a stout stock. Leaves usually 2to 4-pinnately or -palmately divided, often sericeous when young. Cauline leaves usually sessile and united at base. Flowers solitary. Perianth-segments usually 6 , silky beneath; nectarsecreting staminodes present. Styles elongating and feathery in fruit.

The species are usually local, probably mainly owing to Postglacial climatic changes and intolerance of ploughing, shade and bad drainage; they display considerable variation in pubescence, dissection of leaves and size and colour of perianth-segments. These characters have been used as a basis for specific distinction, but correlations between characters that are reliable within a small area break down when larger areas are considered. The variation, in fact, appears to be of the 'dissected continuous' type, rather than the discontinuous kind met with in related genera. The variation does not often appear to fall into the geographical pattern characteristic of subspecies. For example some populations of $P$. grandis from C. Europe do not seen to be morphologically distinguishable from P. vulgaris from N.W. Europe, though both differ markedly from some populations of $P$. vulgaris from France.
Literature: D. Aichele \& H. W. Schwegler, Feddes Repert. 60: 1-230 (1957). ; K. Krause, Bot. Jahrb. 78: 1-68 (1958).
1 Cauline leaves shortly petiolate, resembling the basal but smaller
2 Terminal segments of mature leaves not divided to midrib; lamina distinctly pubescent 1. alpina
2 Terminal segment of mature leaves divided to midrib; lamina almost or quite glabrous 2. alba
1 Cauline leaves sessile, divided into linear segments and not closely resembling the basal
3 Basal leaves palmately divided
9. patens

3 Basal leaves pinnately divided
4 Basal leaves evergreen, 1-pinnate; segments lobed; flowers usually white 3. vernalis
4 Basal leaves withering in autumn, 2- to 4-pinnate; flowers usually purple
5 Flowers erect
6 Basal leaves pinnate, with 3-5 primary segments, the terminal long-stalked; segments pinnatifid; plant persistently lanate
8. halleri

$$
\begin{array}{cc}
6 & \text { Basal leaves 3- to 4-pinnatisect, with 7-9 primary segments; } \\
\text { plant at first sericeous, then glabrescent } & \text { 7. vulgaris } \\
5 & \text { Flowers nodding }
\end{array}
$$

1. P. alpina (L.) Delarbre, Fl. Auvergne ed. 2, 552 (1800) (Anemone alpina L.). $20-45 \mathrm{~cm}$. Basal leaves long-petiolate, distinctly pubescent, 2-pinnate; terminal segment not divided quite to midrib, lobes often recurved; cauline leaves similar, but with short, broad petioles. Flower 4-6 cm in diameter, more or less erect; perianth-segments ovate, outer purplish, inner white, or all pale yellow, sericeous. $2 n=16$. Mountains of C. \& $S$. Europe. Au Co Ga Ge He Hs It Ju.
(a) Subsp. alpina: Outer perianth-segments white or purplish, inner white; achenes $c .5 \mathrm{~mm}$. Usually calcicole. Throughout the range of the species.
(b) Subsp. apiifolia (Scop.) Nyman, Consp. 2 (1878) (subsp. sulphurea (DC.) Ascherson \& Graebner): Perianth-segments pale yellow; achenes c. 4 mm . Usually calcifuge. Throughout the range of the species.
2. P. alba Reichenb., Fl. Germ. Excurs. 732 (1832) (incl. P. alpina subsp. austriaca Schwegler). Like 1 but usually smaller, with smaller flowers which are never yellow; terminal segments of mature leaves divided quite to the midrib, lobes not recurved; lamina almost or quite glabrous; flowers $2 \cdot 5-4.3 \mathrm{~cm}$ in diameter. Usually calcifuge. Mountains of C. Europe, extending to C. France and C. Jugoslavia. Au Cz Ga Ge Ju Po Rm Rs (W).
3. P. vernalis (L.) Miller, Gard. Dict. ed. 8, no. 3 (1768) (Anemone vernalis L.). Stem $5-15 \mathrm{~cm}$ (up to 35 cm in fruit). Basal leaves shortly petiolate, evergreen, subglabrous, 1-pinnatifid with 3-5 dentate segments; cauline leaves sericeous; segments linear. Flower 4-6 cm in diameter, nodding, then erect; perianthsegments narrowly ovate, outer flushed pink, violet or blue, inner white, sericeous. $2 n=16$. From c. $63^{\circ} N$. in Scandinavia to $S$. Spain, N. Italy and Bulgaria. Au Bu Cz Da Fe Ga Ge He Hs It Ju No Po Rs (N, C) Su.
4. P. pratensis (L.) Miller, Gard. Dict. ed. 8, no. 2 (1768) (P. nigricans Störcke; Anemone pratensis L.). Stem c. 10 cm (up to 45 cm in fruit). Basal leaves pubescent, petiolate, usually 3 -pinnate; segments deeply cut into narrow lobes; lobes c. 150 ; cauline leaves united below, pubescent; lobes c. 30. Flowers $3-4 \mathrm{~cm}$ in diameter, more or less cylindrical, nodding, dark purple, reddish, pale violet, greenish-yellow or rarely white; perianth-segments recurved at apex, less than $1 \frac{1}{2}$ times as long as the stamens. $2 n=16,32$. C. \& E. Europe extending westwards to S.E. Norway, W. Denmark and N. Jugoslavia. Au ? Bu Cz Da Ge Hu Ju No Po Rm Rs (B, C, W, E) Su.

The variation in flower-colour is correlated with distribution. Plants with dark purple flowers occur in the north, those with the flowers dirty yellow or pale greyish-violet inside occur in the south-east and those with pale violet flowers occur in the intervening area. They have been called subsp. nigricans (Störck) Zamels, subsp. hungarica Soó, and subsp. pratensis respectively.
5. P. montana (Hoppe) Reichenb., Fl. Germ. Excurs. 733 (1832) (Anemone montana Hoppe). Like 4 but cauline leaves
with c. 25 lobes; flowers bluish to dark violet; perianth-segments not recurved at the apex but soon spreading from the base, and about twice as long as the stamens. $2 n=16$. From S.W. Switzerland to E. Romania and Bulgaria. Bu He Hu It Ju Rm.
6. P. rubra (Lam.) Delarbre, Fl. Auvergne ed. 2, 553 (1800). Like 5 but cauline leaves with c. 20 lobes; flowers dark redbrown to purplish- or blackish-red, rarely dark violet; perianth segments $2-2 \frac{1}{2}$ times as long as stamens. - C. \& S. France; C. \& E. Spain. Ga Hs.

The populations in Spain have been described as subsp. hispanica Zimm. ex Aichele \& Schwegler, Feddes Repert. 60: 158 (1957). They are said to differ from subsp. rubra in having blackish or purplish-violet flowers and the leaves developing with the flowers.
7. P. vulgaris Miller, Gard. Dict. ed. 8, no. 1 (1768) (Anemone pulsatilla L.). Stem 3-12 cm (up to 45 cm in fruit). Basal leaves more or less sericeous when young, becoming glabrous or subglabrous, pinnately divided into 7-9 segments, these again 2 - to 3 -pinnatisect; lobes linear to linear-lanceolate; cauline leaves united below, sericeous. Flowers $5.5-8.5 \mathrm{~cm}$ in diameter, campanulate, erect or suberect, dark to pale purple; perianthsegments usually straight, acute, 2-3 times as long as stamens.

- From England and W. France northwards to $60^{\circ} \mathrm{N}$. in Sweden and eastwards to the Ukraine. Au Be Br Cz Da Ga Ge He Ho Hu Po ?Rm Rs (W, E) Su.

A very variable complex which has been divided into numerous species and subspecies which are, however, ill-defined and appear to represent the more distinct of the numerous isolated populations into which the species has been divided as a result of climatic changes and agricultural operations in Post-glacial times.

The smaller and more isolated of these populations, particularly round the periphery of the area occupied by the species, are fairly homogeneous, but in other areas there is considerable variation within populations. While it is likely that most populations are statistically separable from one another there is a large amount of overlap between them and intermediates frequently occur.
(a) Subsp. vulgaris: Leaves appearing with the flowers; basal leaves usually with more than 100 lobes; perianth-segments narrowly elliptical. $2 n=32$. W. and C. Europe; S. Scandinavia.
(b) Subsp. grandis (Wenderoth) Zamels, Act. Hort. Bot. Univ. Latv. 1 (2): 104 (1926) (P. grandis Wenderoth): Leaves appearing after the flowers; basal leaves with $c .40$ lobes; perianth-seginents broadly elliptic. C. Europe; Ukraine.

On Gotland there is an isolated population which seems to belong to subsp. (b). It has been called subsp. gotlandica (K. Joh.) Zamels \& Paegle, Act. Hort. Bot. Univ. Latv. 2: 159 (1927).
8. P. halleri (All.) Willd., Enum. Pl. Hort. Berol. 580 (1809). Like 7 but basal leaves persistently and often densely lanate, simply pinnate with $3-5$ segments, the terminal long-stalked; segments pinnatifid, the lobes oblong-lanceolate; flowers dark violet. $2 n=32$ (all subspp.). Widely isolated, apparently relict populations. Alps; W. Carpathians; Balkan peninsula; Krym. $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Gr} \mathrm{He} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rs} \mathrm{(K)}$.

## 1 Plant rarely more than 5 cm at flowering; basal leaves densely lanate, with $50-100$ lobes <br> 2 Primary divisions of basal leaves often petiolate

(a) subsp. rhodopaea

2 Primary divisions of basal leaves almost always sessile
(b) subsp. taurica

1 Plant usually more than 5 cm at flowering; basal leaves $\pm$ lanate, usually with fewer than 50 lobes
3 Primary divisions of basal leaves usually 3
(c) subsp. slavica

3 Primary divisions of basal leaves usually 5
4 Lamina $3-7 \mathrm{~cm}$
(d) subsp. halleri

4 Lamina $5-11 \mathrm{~cm}$
(e) subsp. styriaca
(a) Subsp. rhodopaea K. Krause, Bot. Jarhb. 78: 44 (1958): Jugoslavia, S. Bulgaria, N. Greece.
(b) Subsp. taurica (Juz.) K. Krause, Bot. Jahrb. 78: 45 (1958): Krym.
(c) Subsp. slavica (G. Reuss) Zamels, Act. Hort. Bot. Univ. Latv. 1 (2): 104 (1926): W. Carpathians.
(d) Subsp. halleri: S.W. \& C. Alps.
(e) Subsp. styriaca (G. A. Pritzel) Zamels, loc. cit. (1926): S.E. Austria (Steiermark).
9. P. patens (L.) Miller, Gard. Dict. ed. 8, no. 4 (1768) (Anemone patens L.). Like 7 but the basal leaves with 3-7 palmate primary divisions; flowers usually bluish-violet; perianthsegments spreading widely from the base. E. and E.C. Europe westwards to Sweden and E. Germany. Bu Cz Fe Ge Hu Po Rm Rs (N, B, C, W, E) Su.
1 Lobes of basal leaves usually $17-30,5-12 \mathrm{~mm}$ wide
(a) subsp. patens

1 Lobes of basal leaves usually $30-80,1-4 \mathrm{~mm}$ wide
2 Flowers yellow to yellowish-white $\quad$ (d) subsp. flavescens
2 Flowers violet
3 Middle segment of basal leaves sessile or very shortly stalked
(b) subsp. teklae

3 Middle segment of basal leaves with a long stalk (rarely sessile)
(c) subsp. multifida
(a) Subsp. patens: $2 n=16$. Throughout the range of the species. Hybridizes with 3 in Finland.
(b) Subsp. teklae (Zamels) Zamels, Act. Hort. Bot. Univ. Latv.

1 (2): 87 (1926): Poland and Baltic regions of U.S.S.R.
(c) Subsp. multifida (Pritzel) Zamels, op. cit. 98 (1926): E. Russia. (Siberia.)
(d) Subsp. flavescens (Zucc.) Zamels, op. cit. 95 (1926): E. Russia. (N. Asia.)

## 17. Clematis L. ${ }^{1}$

Woody climbers or perennial herbs. Leaves opposite, simple, ternate or 1 - to 2 -pinnate. Perianth-segments 4 (rarely 5,6 or 8 ), petaloid, valvate. Honey-leaves absent; petaloid staminodes sometimes present. Stamens numerous. Achenes numerous; style persistent, often long and plumose.
1 Plant erect, not climbing; stems herbaceous, or woody at base only
2 Leaves simple; flowers deep violet or blue, very rarely white
9. integrifolia

2 Leaves pinnate; flowers white
3 Leaves 1-pinnate; leaflets up to 9 cm
4. recta

3 Leaves 2-pinnate (rarely 1-pinnate); leaflets $3-5 \mathrm{~cm}$
5. pseudoflammula

1 Plant climbing or scrambling by means of tendrils; stems usually woody
4 Spathulate petaloid staminodes present 10. alpina
4 Petaloid staminodes absent
5 Flowers blue, purple or violet-tinged; styles not plumose in fruit
6 Style glabrous; perianth-segments patent
7. viticella

6 Style pubescent in the lower $\frac{2}{3}$; flowers $\pm$ campanulate
8. campaniflora

5 Flowers white or yellowish, rarely reddish; styles plumose in fruit
${ }^{1}$ By T. G. Tutin.
7 Flowers nodding; bracteoles connate, forming a 2-lipped involucre beneath the flower 6. cirrhosa
7 Flowers erect; bracteoles free, not forming an involucre
8 Stamens ciliate; leaves glaucous
3. orientalis
8 Stamens glabrous; leaves not glaucous
9 Leaves 1-pinnate; perianth-segments tomentose on both surfaces 2. vitalba
9 Leaves 2-pinnate; perianth-segments glabrous on upper surface

1. flammula

Sect. Clematis. Bracteoles free; flowers white or yellowish, usually numerous, in large panicles; staminodes absent; styles plumose in fruit.

1. C. flammula L., Sp. Pl. 544 (1753). A more or less woody deciduous climber 3-5 m. Leaves 2-pinnate; leaflets narrowly oblong to suborbicular, entire or 3-lobed. Flowers c. 2 cm in diameter, fragrant. Perianth-segments obtuse, pubescent beneath and on the margins. Anthers $3-4 \mathrm{~mm}$. Receptacle thinly puberulent to glabrous. Achenes strongly compressed. S. Europe. $\mathrm{Al} \mathrm{Bl} \mathrm{Bu} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Sa} \mathrm{Tu} \mathrm{[Cz} \mathrm{Hu]}$.
2. C. vitalba L., Sp. PI. 544 (1753). A deciduous woody climber up to 30 m . Leaves 1 -pinnate; leaflets ovate, rarely linear-lanceolate, dentate or subentire. Flowers c. 2 cm in diameter, fragrant. Perianth-segments obtuse, greenish-white, pubescent on both surfaces. Anthers $1-2 \mathrm{~mm}$. Receptacle pubescent. Achenes scarcely compressed. S., W. \& C. Europe. Al Au Be Br Bu Co Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Rm Rs (K) Sa Si Tu [Hb No Po Su].
3. C. orientalis L., Sp. Pl. 543 (1753). Like 2 but leaflets oblong or linear, 3 -lobed, often dentate, glaucous. Perianthsegments acuminate, yellowish. Stamens ciliate. S.E. Russia and Ukraine; Aegean region (Tinos). Gr Rs (K, E). [Cz.]
4. C. recta L., Sp. Pl. 544 (1753). Erect herb with fistular stems $1-1.5 \mathrm{~m}$. Leaves up to 25 cm , 1-pinnate; leaflets $5-9 \mathrm{~cm}$, ovate, usually entire, stalked. Flowers $c .2 \mathrm{~cm}$ in diameter, white, erect, fragrant. Perianth-segments $0.5-1.8 \mathrm{~cm}$, with tomentose margins but otherwise glabrous. C., S. \& E. Europe, northwards to C. Russia and westwards to N. Spain. Au Bu Co Cz Ga Ge He Hs Hu It Ju Po Rm Rs (C, W, K, E) [No].
5. C. pseudoflammula Schmalh. ex Lipsky, Mém. Soc. Nat. Kieff 12: 230 (1894). Like 4 but stems not more than 70 cm , the leaves almost always 2-pinnate with leaflets 3-5 cm. $S$. Russia, S. and E. Ukraine. Rs (W, E).

Sect. Cheiropsis DC. Bracteoles united into a 2-lipped involucre; flowers white, yellowish or sometimes red-spotted, solitary in the leaf-axils; staminodes absent; styles plumose in fruit.
6. C. cirrhosa L., Sp. Pl. 544 (1753). Evergreen climber up to 4 m . Leaves $2 \cdot 5-5 \mathrm{~cm}$, simple, dentate or 3-lobed, or 1- to 2ternate with dentate or lobed leaflets. Flowers $4-7 \mathrm{~cm}$ in diameter; pedicels $2-5 \mathrm{~cm}$. Perianth-segments yellowish-white, sometimes with red spots, oval, pubescent beneath. S. Europe. Bl $\mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.

Sect. Viticella Link. Bracteoles free; flowers blue, violet or violet-tinged, $1-3$ in the leaf-axils; staminodes absent; styles not plumose in fruit.
7. C. viticella L., Sp. Pl. 543 (1753). A deciduous more or less woody climber 3-4 m. Leaves $10-13 \mathrm{~cm}, 1$-pinnate, the primary divisions with 3 lanceolate to ovate, often lobed, leaflets $2-7 \mathrm{~cm}$.

Flowers 4 cm in diameter, blue or purple, fragrant. Styles glabrous. S. Europe; often cultivated and locally naturalized. $\mathrm{Al} \mathrm{Bu} \mathrm{Cr} \mathrm{Gr} \mathrm{It} \mathrm{Ju} \mathrm{Tu} \mathrm{[Au} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{Lu]}$.
8. C. campaniflora Brot., Fl. Lusit. 2; 359 (1804). Like 7 but stems up to 7 m , very slender; flowers broadly campanulate, pale violet; styles pubescent in the lower $\frac{2}{3}$. - Portugal, S. Spain. Hs Lu.

Sect. Viorna (Reichenb.) Prantl. Bracteoles absent; flowers dark violet or blue, rarely white, solitary, terminal; staminodes absent; styles plumose in fruit.
9. C. integrifolia L., Sp. Pl. 544 (1753). Erect herb $30-70 \mathrm{~cm}$. Stems usually simple. Leaves up to $9 \times 5 \mathrm{~cm}$, simple, ovate, acute, entire. Flowers solitary, rarely $2-3$, terminal, nodding, stellatecampanulate. Perianth-segments $3-5 \mathrm{~cm}$, glabrous except near the margins. C. \& S.E. Europe, northwards to c. $53^{\circ} \mathrm{N}$. in C. Russia. Au Bu Cz Hu ?It Ju Rm Rs (C, W, K, E) [He].

Sect. Atragene (L.) DC. Bracteoles free, basal; flowers violet or yellowish-white, solitary, terminal on short axillary shoots; staminodes present, petaloid; styles plumose in fruit.
10. C. alpina (L.) Miller, Gard. Dict. ed. 8, no. 9 (1768). Deciduous. Stems $1-2 \mathrm{~m}$, scrambling, woody. Leaves 2 -ternate; leaflets $2.5-5 \mathrm{~cm}$, ovate-lanceolate, coarsely serrate. Flowers solitary, nodding, stellate-campanulate. Perianth-segments $2 \cdot 5-$ 4 cm , violet or yellowish-white, silky beneath. Staminodes at most $\frac{1}{2}$ as long as perianth-segments. N. Europe and mountains of C. \& S. Europe. Au Bu Cz Fe Ga Ge He Hu It Ju No Po Rm Rs ( $\mathrm{N}, \mathrm{C}$ ).
(a) Subsp. alpina (Atragene alpina L.): Flowers violet (very rarely white). $2 n=16$. Mountains of $C$. \& $S$. Europe.
(b) Subsp. sibirica (L.) O. Kuntze, Verh. Bot. Ver. Prov. Brandenb. 26: 162 (1885) (Atragene sibirica L.): Flowers yellowishwhite (rarely pale violet). N.E. Europe; one isolated station in Norway.

## 18. Adonis L. ${ }^{1}$

Herbs with 1- to 3 -pinnate leaves with more or less linear segments. Sepals $5(-8)$, often somewhat petaloid; petals $3-20$, glossy; nectaries absent. Stamens numerous. Achenes numerous, rugose, forming an elongated head at maturity.

[^87]${ }^{1}$ By T. G. Tutin.

8 Sepals hirsute; beak of achene black at the apex 8. flammea
8 Sepals glabrous; beak of achene green throughout
9 Upper projection on inner margin of achene at $\frac{1}{3}$ the distance from apex to base, broad and rounded
9. aestivalis

9 Upper projection on inner margin of achene close to the style, obtuse
10. microcarpa

Sect. Consiligo DC. Perennial; flowers yellow; petals 10 or more; anthers yellow.

1. A. vernalis L., Sp. Pl. 547 (1753). $10-40 \mathrm{~cm}$. Stem scaly at base. Cauline leaves sessile, not or scarcely longer than wide, 2 -pinnatisect into linear, entire lobes. Flowers $4-8 \mathrm{~cm}$ in diameter. Sepals $\frac{1}{2}$ as long as petals, broadly obovate, pubescent. Petals $10-20$, elliptic. Achenes $c .3 .5 \mathrm{~mm}$, almost globose, reticulately rugose and rather densely pubescent; beak short, curved and appressed to achene. $2 n=16$. E., C. \& S. Europe, extending northwards to C. Ural and S.E. Sweden (Gotland). Au $\mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)} \mathrm{Su}$.
2. A. volgensis Steven in DC., Reg. Veg. Syst. Nat. 1: 545 (1817). Like 1 but stems more branched and leaf-lobes broader and dentate; sepals $\frac{1}{3}$ as long as petals; petals more numerous, narrowly lanceolate; achenes pubescent only at base. U.S.S.R. southwards from c. $54^{\circ}$ N., extending locally westwards to S.E. Hungary. Hu Rm Rs (C, W, K, E).
A. vernalis $\times$ volgensis (A. $\times$ hybrida H. Wolff) occurs with the parents.
3. A. sibirica Patrin ex Ledeb., Ind. Sem. Hort. Dorpat. suppl., 2 (1824). Glabrous. Leaves at least twice as long as wide, segments 2-pinnatifid into linear lobes. Flowers $4-6 \mathrm{~cm}$ in diameter. Petals obovate. Achenes more or less pubescent. N.E. Russia. Rs (N, C). (N. Asia.)
4. A. pyrenaica DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 635 (1815). Stems $25-40 \mathrm{~cm}$, straight, without scales at base. Basal leaves long-petiolate. Sepals glabrous, c. $\frac{1}{2}$ as long as petals. Achenes $c .6 \mathrm{~mm}$, sparsely pubescent or almost glabrous; beak c. 2 mm , flattened, curved, not appressed to achene. Pyrenees; one station in Alpes Maritimes. Ga Hs.
5. A. distorta Ten., Fl. Nap. 4: 337 (1830). Like 4 but seldom more than 15 cm , with curved stems and leaf-segments; sepals pubescent; beak of achene $c .1 \mathrm{~mm}$, strongly curved. - $C$. Appennini. It.
6. A. cyllenea Boiss., Heldr. \& Orph. in Boiss., Diagn. Pl. Or. Nov. ser. 2, 3 (5): 5 (1856). Like 4 but stems often up to 60 cm and freely branched; sepals about as long as petals; beak $c .3 \mathrm{~mm}$, almost as long as achene, terete, hooked at apex. - S. Greece (Killini Oros, W. of Korinthos). Gr.

Sect. Adonis. Annual; flowers usually red, though often yellow when dried; petals 8 or fewer; anthers blackish-purple.
7. A. annua L., Sp. Pl. 547 (1753) (A. autumnalis L.). 1040 cm . Leaves 3-pinnate, segments linear, mucronate. Flowers $15-25 \mathrm{~mm}$ in diameter. Sepals glabrous, ovate, patent. Petals $5-8$, suberect, concave, oblong, somewhat longer than sepals, bright scarlet with a dark basal spot. Achenes $3 \cdot 5-5 \mathrm{~mm}$, the inner margin nearly straight, the outer curved; beak straight. S. Europe, extending northward to S. Switzerland; sometimes naturalized and often a casual elsewhere. Al Bl Bu Co Cr Ga Gr

He Hs It Ju Sa Si Tu [Au Br Be Cz Da Hu Po Rm Rs (W, $\mathrm{K})$ ].
(a) Subsp. annua: Achenes without a transverse keel on the back near the base. Throughout the range of the species.
(b) Subsp. carinata Vierh., Österr. Bot. Zeitschr. 84: 127 (1935): Achenes with a transverse, entire or subdentate keel on the back near the base. S. Europe.
A. baetica Cosson, Not. Pl. Crit. 25 (1849) is of uncertain status but may perhaps be another subspecies of 7. It has rather larger achenes ( $5-6 \mathrm{~mm}$ ), the outer margins of which have a prominent tooth, and the plant is more robust. It occurs in S. Portugal and S. Spain.
8. A. flammea Jacq., Fl. Austr. 4: 29 (1776). Like 7 but often rather larger. Flowers $20-30 \mathrm{~mm}$ in diameter. Sepals more or less hirsute, appressed to the deep scarlet (rarely yellow), linearoblong petals. Inner margin of achene with a rounded projection just below the ascending beak. $S . \&$ C. Europe, extending to N. France; sometimes casual elsewhere. Al Au Bu Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs (W, K) Tu.
9. A. aestivalis L., Sp. Pl. ed. 2, 771 (1762). Like 7 but achenes $5-6 \mathrm{~mm}$, with a transverse ridge about the middle; inner margin with 2 projections, the lower acute and the upper obtuse and $\frac{1}{3}$ the distance from apex to base. Most of Europe, except the north. Au Be Bu Co Cr Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs (W, K, E) Sa Tu.
10. A. microcarpa DC., Reg. Veg.Syst. Nat. 1: 223(1817)(A.cupaniana Guss., A. dentata auct. eur., non Delile). Like 7 but petals usually yellow and achenes $3-4 \mathrm{~mm}$, with or without a transverse ridge; upper projection from inner edge of achene close to beak. S. Europe. Bl Bu Cr Gr Hs It Ju Lu Sa Si Tu.

## 19. Ranunculus L. ${ }^{1}$

Annual or perennial herbs, sometimes aquatic. Flowers solitary or in cymose panicles. Perianth-segments (sepals) (3)5(7). Honey-leaves ( $0-$ )5( -12 ), petaloid, yellow, white or reddish. Achenes numerous, usually with a persistent glabrous style.
1 Flowers white, pink or purple but never yellow
2 Terrestrial; leaves mostly basal; achene not transversely
rugose
3 Basal leaves hastate (S. Spain)
97. acetosellifolius
3 Basal leaves not hastate
4 Most of the basal leaves entire to dentate, but not more
deeply divided
5 Cauline leaves lanceolate to ovate, amplexicaul
6 Sepals glabrous; achene strongly veined 118. amplexicaulis
6 Sepals pubescent; achene smooth
7 Petiole not widening into lamina; main veins usually 7
(Alps, Pyrenees, N. Spain) 116. parnassifolius
7 Petiole widening into lamina; main veins usually 5
(Albania)
117. wettsteinii
5 Cauline leaves linear to linear-oblong, not amplexicaul
8 Basal leaves never crenate or dentate 112. pyrenaeus
8 Basal leaves crenate or sometimes dentate at apex
9 Honey-leaves rounded at apex 92. crenatus
9 Honey-leaves emarginate to deeply notched at apex
93. bilobus
4 All leaves $\pm$ deeply lobed
$\begin{array}{ll}10 & \text { Sepals } 3 \\ 10 & \text { Sepals } 5 \text { or more }\end{array}$
11 Sepals densely ferrugineous-vilious 98. glacialis
11 Sepals glabrous or nearly so

12 Flowers at least 30 mm in diameter; honey-leaves 7 or more; roots tuberous
64. asiaticus

12 Flowers $10-20(-25) \mathrm{mm}$ in diameter; honey-leaves 5; roots not tuberous
13 Cauline leaves differing markedly from basal, simple or rarely trifid; receptacle glabrous
14 Basal leaves (3-)5-lobed; lobes deeply crenate; cauline leaves 3 -fid 90. alpestris
14 Basal leaves 3-lobed; middle lobe 3-fid, lateral 2-fid; cauline leaf simple
91. traunfellneri

13 Cauline leaves like basal, lobed and dentate; receptacle pubescent
15 Plant rarely as much as 20 cm ; segments of basal leaves narrowly oblong; flowers 1 -few 96. seguieri
15 Plant usually more than 20 cm ; segments of basal leaves ovate-cuneate; flowers numerous
16 Middle segment of basal leaves free to base
94. aconitifolius

16 Middle segment of basal leaves not free to base
95. platanifolius

2 Aquatic or marsh plants; leaves all cauline; achene transversely rugose
17 Laminate leaves present; capillary leaves present or absent 18 Capillary leaves absent
19 Achene pubescent (sometimes sparsely and minutely so)
124. peltatus

19 Achene entirely glabrous
20 Receptacle glabrous
21 Leaf-segments widest at the sinus; honey-leaves not or scarcely longer than sepals 119. hederaceu
21 Leaf-segments narrowest at the sinus; honey-leaves 2-3 times as long as sepals $\quad \mathbf{1 2 0}$. omiophyllus
20 Receptacle pubescent
22 Honey-leaves less than 6 mm , not contiguous; receptacle globose 121. tripartitu
22 Honey-leaves more than 6 mm , contiguous; receptacle ovoid
123. baudotii

18 Capillary leaves present
23 Honey-leaves less than 6 mm , not contiguous
121. tripartitus

23 Honey-leaves more than 6 mm , contiguous
24 Immature achene completely glabrous; laminate leaves 3 -lobed to $\frac{2}{3}$ or more
25 Capillary leaves collapsing when removed from water; mature achene unwinged; receptacle globose (fresh water)
122. ololeucos

25 Capillary leaves not collapsing when removed from water; mature achene winged; receptacle ovoid (brackish water)
123. baudotii

24 Immature achene pubescent (sometimes minutely so); laminate leaves 3- to 5-lobed, usually to less than $\frac{2}{3}$
26 Pedicel in fruit usually less than 50 mm , rarely exceeding the petiole of the subtending laminate leaf; honeyleaves rarely more than 10 mm ; nectaries circular
127. aquatilis

26 Pedicel in fruit usually more than 50 mm , often exceeding the petiole of the subtending laminate leaf; honey-leaves usually more than 10 mm ; nectaries elongate, $\pm$ pyriform
27 Capillary leaves shorter than the internodes
27 Capillary leaves longer than the internodes
125. pseudofluitans

17 Laminate leaves absent
28 Leaves usually exceeding 8 cm (up to 30 cm ), longer than internodes, their segments usually parallel to the main axis
29 Receptacle nearly or quite glabrous
131. fluitans

29 Receptacle distinctly hairy
125. pseudofluitans

28 Leaves usually much less than 8 cm , shorter than internodes, their segments rarely parallel to the main axis
30 Leaf-segments lying in one plane; leaves circular in outline
130. circinatus

30 Leaf-segments not lying in one plane
31 Honey-leaves rarely exceeding 5 mm , not contiguous; nectaries lunate
Achene more than 1.5 mm 128. trichophyllus
Achene less than 1 mm
129. rionii

31 Honey-leaves usually exceeding 5 mm , contiguous; nectaries not lunate
33 Immature achene quite glabrous; mature achene winged 123. baudotii
33 Immature achene pubescent (sometimes minutely so); mature achene unwinged
34 Pedicel in fruit usually less than 50 mm ; honey-leaves rarely more than 10 mm ; nectaries circular
127. aquatilis

34 Pedicel in fruit usually more than 50 mm ; honeyleaves usually more than 10 mm ; nectaries elongate, $\pm$ pyriform
35 Achene more than 1.5 mm
124. peltatus

35 Achene less than 1 mm
126. sphaerospermus

1 Flowers yellow
36 Aerial leaves (including the cauline) entire, serrate, crenate or dentate, but not lobed
37 Achene puberulent
$\begin{array}{llr}38 & \text { Sepals 3; honey-leaves } 8-12 & \text { 83. ficaria } \\ 38 & \text { Sepals 5; honey-leaves 5 } & \text { 71. flabellifolius }\end{array}$
37 Achene glabrous or rarely hispid
39 Sepals 3
84. ficarioides

39 Sepals 5
40 Cauline leaves at least as wide as long, entire below, increasingly coarsely dentate towards the sometimes almost 3-lobed apex
41 Basal leaves present at flowering time
88. hybridus

41 Basal leaves not developed at flowering time
42 Lower cauline leaf wider than long, reniform; stems 1- to few-flowered
86. thora

42 Lower cauline leaf about as long as wide, deeply cordate; stems usually several-flowered 87. scutatu
40 Cauline leaves distinctly longer than wide, not becoming conspicuously more strongly dentate towards the apex, rarely absent
43 Leaves mostly crowded at base of stem; cauline small and few, or absent
44 Leaves horizontal, bullate, hispid beneath 85. bullatus
44 Leaves $\pm$ erect, smooth, glabrous or softly pubescent
45 Basal leaves not cuneate
82. cymbalaria

45 Basal leaves cuneate at base
46 Petals pale yellow; basal leaves ovate
113. bupleuroides

46 Flowers deep yellow; basal leaves linear to lanceolate
47 Roots fibrous; leaves not cucullate at apex; honeyleaves 5
114. gramineus

47 Roots tuberous; leaves cucullate at apex; honeyleaves 8-10
115. abnormis

43 All or most of the leaves cauline
48 Flowers sessile or nearly so
49 Leaves abruptly narrowed at base; beak about as long as achene
109. lateriflorus

49 Leaves gradually narrowed at base; beak less than half as long as achene
110. nodiflorus

48 Flowers all distinctly pedicellate
50 Achene less than 1 mm ; flowers up to 8 mm in diameter
51 Submerged leaves divided into filiform segments; lowest aerial leaves often shallowly 3-lobed (C. \& E. Europe) 111. polyphyllu

51 Submerged leaves absent; lowest leaves spathulate, entire (Sardegna)
103. batrachioides

50 Achene more than 1 mm ; flowers rarely less than 10 mm in diameter
52 Stems filiform, procumbent; flowers solitary; achene up to 1.5 mm
102. reptans

52 Stems stouter, usually erect; flowers rarely solitary; achene more than 1.5 mm

53 Flowers $30-50 \mathrm{~mm}$ in diameter (rarely less); achene 2.5 mm ; plant 50 cm or more
104. lingua

53 Flowers up to $15(-20) \mathrm{mm}$ in diameter; achene $1 \cdot 5-2 \mathrm{~mm}$; plant rarely more than 50 cm
54 Achene smooth
55 Perennial; pedicels sparsely appressed-pubescent 101. flammula

55 Annual; pedicels glabrous
106. fontanus

54 Achene granulate or tuberculate
56 Sepals longer than honey-leaves, usually pubescent
108. revelieri

56 Sepals equalling or shorter than honey-leaves, $\pm$ glabrous
57 Sepals equalling honey-leaves; lower pedicels not more than half as long as subtending leaves
107. longipes

57 Sepals shorter than honey-leaves; lower pedicels at least as long as subtending leaves
105. ophioglossifolius

36 At least some of the aerial leaves distinctly lobed or even more deeply divided
58 Stems creeping, rooting at nodes; leaves not crowded at base of stem; small arctic plants
59 Honey-leaves 3
77. hyperboreus

59 Honey-leaves 5 or more
60 Sepals 3
80. lapponicus

60 Sepals 5
61 Flowers $20-30 \mathrm{~mm}$ in diameter; achene c. 3 mm (widespread)
6. repens

61 Flowers c. 10 mm in diameter; achene c. 1.5 mm (Arctic Russia)
79. gmelinii

58 Stems not creeping and rooting at nodes; leaves mostly crowded at base; plant sometimes with stolons from a well-marked rosette
62 Roots of 2 kinds, some fibrous, some fleshy, forming fusiform to ovoid tubers
63 Sepals 3
84. ficarioides

63 Sepals 5
64 Sepals deflexed in flower
65 Leaves or leaf-segments linear-lanceolate, entire
48. illyricus

65 Leaf-segments cuneate, variously cut or lobed, or leaves suborbicular and shallowly lobed
66 Achene tuberculate, with a compressed appendage at the base; beak about as long as achene, broad, falcate
47. isthmicus

66 Achene without an appendage
67 Pedicels sulcate
68 All but the lowest cauline leaves small and bractlike 29. neapolitanus
68 Several of the cauline leaves similar to basal, but smaller
69 Middle segment of leaf usually stipitate; beak of achene $c .0 .5 \mathrm{~mm} \quad 31$. bulbosus
69 Middle segment of leaf sessile; beak of achene c. 1 mm
30. pratensis

67 Pedicels terete
70 Leaves appressed-pubescent or sericeous
71 Tubers ovoid or shortly oblong
44. rumelicus

71 Tubers fusiform or cylindrical
72 Achene glabrous, verrucose (Aegean) 43. psilostachys
72 Achene slightly pubescent, not verrucose (W. Mediterranean region)
45. monspeliacus

70 Leaves not appressed-pubescent
73 Leaf-segments deeply divided into numerous linear-lanceolate lobes
46. miliarakesii

73 Leaf-segments obtusely lobed or incise-serrate
74 Leaves longer than wide; beak of achene straight
42. oxyspermus

74 Leaves usually wider than long; beak of achene curved
75 Leaves sericeous, deeply divided; middle segment stipitate
45. monspeliacus
75 Leaves not sericeous, usually not divided to base
41. gracilis

## 64 Sepals not deflexed in flower

76 Basal leaves glabrous, pedately 3- to 5-partite; segments linear-lanceolate, entire or deeply 2 -lobed 49. pedatus
76 Basal leaves not as above
77 Achene circular, flat, winged; beak very short, hooked (S.E. Russia)
50. platyspermus
77 Achene not as above
78 Anthers purplish-black
64. asiaticus
78 Anthers yellow
79 Stock swollen, densely and persistently fibrous
51. paludosus
79 Stock not swollen and densely and persistently fibrous
80 Basal leaves $\pm$ lobed for up to $c . \frac{3}{4}$
81 Basal leaves shallowly lobed; segments contiguous or overlapping
82 Basal leaves coriaceous, rugose
83 Leaves c. 2 cm across, $\pm$ glabrous; flowers few, c. 25 mm in diameter (Spain and Portugal)
56. nigrescens
83 Leaves c. 15 cm across, densely appressedvillous; flowers numerous, c. 40 mm in diameter (Açores)
57. cortusifolius
82 Basal leaves thin, not rugose
84 Leaves c. 8 cm across; flowers several (Kriti) 59. creticus
84 Leaves c. 5 cm across; fiowers solitary ( -2 ) (W. Mediterranean region) 58. rupestris
81 Basal leaves lobed to c. $\frac{3}{4}$; segments distant
85 Plant stout; basal leaves $\pm$ patent-pubescent
62. spruneranus
85 Plant slender; basal leaves appressed-pubescent or nearly or quite glabrous
86 Basal leaves appressed-pubescent (Spain, Portugal, Sicilia)
87 Honey-leaves 15 mm or more 58. rupestris
87 Honey-leaves c. 10 mm 63. gregarius
86 Basal leaves nearly or quite glabrous (Balkan peninsula)
88 Stems much-branched; beak about as long as achene, stout, curved
60. thasius
88 Stems simple or nearly so; beak shorter than achene, slender, hooked 61. subhomophyllus
80 Basal leaves lobed nearly or quite to base
89 Segments of basal leaves dentate or lobed but not 2- to 3-pinnatisect
63. gregarius
89 Segments of basal leaves 2- to 3-pinnatisect
90 Honey-leaves copper-coloured beneath (Kriti)
52. cupreus
90 Honey-leaves yellow on both surfaces
91 Honey-leaves 7-12 (Greece)
55. millii
91 Honey-leaves 5
92 Receptacle pubescent at insertion of stamens
63. gregarius
92 Receptacle glabrous at insertion of stamens
93 Sepals glabrous
53. millefoliatus
93 Sepals pubescent beneath
54. garganicus
62 Roots all fibrous, fibres sometimes thick but not obviously tuberous
94 Achene not or slightly compressed, with strongly convex sides
95 Annual; head of achenes cylindrical; achenes 70-100, c. 1 mm
78. sceleratus
95 Perennial; head of achenes globose; achenes fewer and larger
96 Achene puberulent
97 Basal leaves pedate
73. pedatifidus
97 Basal leaves not pedate
98 Basal and cauline leaves markedly dissimilar
(65-71). auricomus group
98 Basal and cauline leaves $\pm$ similar
72. polyrhizos
96 Achene glabrous
99 Most leaves entire at base and then increasingly strongly dentate to the wide apex, wider than long
100 Basal leaves usually 2 ; cauline 2-3; achene $2-3 \mathrm{~mm}$; beak short
88. hybridus
100 Basal leaves several; cauline $1(-2)$; achene 4 mm ; beak long 89. brevifoliu
99 Most leaves $\pm$ regularly lobed all round, longer than wide
101 Cauline leaves divided to base into linear or linearlanceolate, entire segments (65-71). auricomus group
101 Cauline leaves less divided, or segments wider
102 Stems slender, flexuous; upper cauline leaves simple, bract-like, or cauline leaves absent (Mallorca and Sardegna)
103 Hairs all appressed; sepals deflexed; achenes smooth 99. cymbalarifolius
103 Hairs at base of stems and petioles patent; sepals patent; achenes strongly veined 100. weyleri
102 Stems stout, erect; upper cauline leaves at least 3-lobed
104 Flowers not more than 10 mm in diameter; stem rarely exceeding 4 cm , about as long as the basal leaves at flowering time 74. pygmaeu
104 Flowers usually 15 mm or more in diameter; stem $8-60 \mathrm{~cm}$, much longer than basal leaves at flowering time
105 Basal leaves reniform, deeply lobed; head of achenes cylindrical; beak about as long as achene 75. nivali
105 Basal leaves cuneate at base, shallowly lobed; head of achenes broadly ovoid; beak about half as long as achene
76. sulphureus
94 Achene strongly compressed
106 Achene distinctly spiny or muricate with either numerous or long projections (annual)
107 Honey-leaves 2-3 times as long as sepals
108 Achene 3-4 mm; keel sulcate
34. marginatus
108 Achene $7-8 \mathrm{~mm}$; keel winged 37. cornutus
107 Honey-leaves equalling or slightly longer than sepals 109 Achene c. 3 mm
110 Receptacle pubescent
35. trilobus
110 Receptacle glabrous
111 Peduncles not thickened in fruit; achene more than twice as long as beak 39. parvifloru
111 Peduncles greatly thickened in fruit; achene at most twice as long as beak
40. chius
109 Achene c. 7 mm ; receptacle pubescent
112 Sepals patent; leaves, except the lowest, deeply lobed 38. arvensis
112 Sepals deflexed; leaves shallowly lobed 36. muricatus 106 Achene smooth, punctulate or with few small obtuse tubercles (perennial, except 32 and 34)
113 Receptacle glabrous
114 Sepals deflexed at flowering
115 Leaf-segments cuneate-obovate 1. velutinus
115 Leaf-segments broadly ovate 2. constantinopolitanus
114 Sepals not deflexed at flowering
116 Honey-leaves orange-yellow; basal leaves usually 3-lobed to about $\frac{3}{4}$; stock premorse; achene 4 5 mm 7. lanuginosu
116 Honey-leaves golden-yellow; basal leaves usually more deeply divided, or rhizome stout, creeping; achene $2-3.5 \mathrm{~mm}$
117 Achene at least 4 times as long as beak; leafsegments sessile (widespread) 8. acri
117 Achene at most twice as long as beak; leaf-segments $\pm$ stipitate (S. Italy eastwards)
118 Leaves $\pm$ sericeous beneath; achene twice as long as beak 9. serbic
118 Leaves pubescent to nearly glabrous beneath; achene as long as beak
10. brutius
113 Receptacle pubescent
119 Sepals deflexed at flowering
120 Annual
121 Honey-leaves pale yellow; achene $2 \cdot 5-3 \mathrm{~mm}$; beak$-0.5 \mathrm{~mm}$121 Honey-leaves deep yellow; achene 3-4 mm; beak1 mm34. marginatus
120 Perennial
122 Pedicels terete; sepals at first patent, later $\pm$strongly deflexed 24. macrophyllus
122 Pedicels sulcate; sepals strongly deflexed soonafter the flower opens
123 Stems prostrate, rooting at nodes 33. cordigerus
123 Stems erect, not rooting at nodes
124 Cauline leaves (except the lowest) small andbract-like29. neapolitanus
124 Several of the lower cauline leaves similar to thebasal, but smaller
125 Basal leaves lobed to the base; middle segmentoften stipitate; beak of achene $c .0 .5 \mathrm{~mm}$(widespread) 31. bulbosu125 Basal leaves lobed to $\frac{3}{4}$; segments unit
30. pratensis
119 Sepals not deflexed at flowering
126 Achene strongly keeled or sulcate
127 Pedicel sulcate
128 Stolons present 6. repens
128 Stolons absent
129 Leaves divided into linear- or oblong-lanceolatelobes 3. polyanthemo
129 Leaves divided into cuneate-obovate segments with ovate, dentate lobes
130 Middle segment of basal leaves sessile (wide-spread)4. nemorosus
130 Middle segment of basal leaves long-stipitate(U.S.S.R.)5. caucasicus
127 Pedicel terete
131 Plant rarely more than 15 cm ; achene with keeledbut not sulcate margin (11-22). montanus group
131 Plant 30 cm or more; achene with keeled andsulcate margin
132 Cauline leaves conspicuously smaller than basal;uppermost 3 -fid with entire segments, orsimple (W. Mediterranean region)
24. macrophyllus
132 Cauline leaves about as large as basal; upper-most 3 -fid with lobed and dentate segments(Carpathians)23. carpaticus126 Achene neither keeled nor sulcate133 Sepals glabrous (Corse)27. marschlinsii133 Sepals pubescent
134 Leaves hairy beneath (Krym) 28. dissectus
134 Leaves glabrous or almost (Balkanpeninsula, Italy, Spain)
135 Basal leaves with shortly stipitate segments;flowers usually solitary 25 . demissus
135 Basal leaves not divided to base; flowers usually several

Subgen. Ranunculus. Usually terrestrial plants. Leaves various but very rarely divided into capillary segments. Flowers yellow, white, reddish or purplish. Achenes very rarely transversely rugose.

Sect. Ranunculus. Honey-leaves yellow, caducous; nectary covered by a flap which is more or less free laterally; achenes glabrous, distinctly beaked, compressed; receptacle in fruit not more than 3 times its length in flower.
(A) Pedicel terete; sepals deflexed; receptacle glabrous.

1. R. velutinus Ten., Ind. Sem. Hort. Bot. Neap. 12 (1825). Perennial $40-80 \mathrm{~cm}$. Petioles and lower part of stems patentpubescent; otherwise appressed-sericeous. Basal leaves broadly ovate, deeply trifid; segments cuneate-obovate, 3-lobed and dentate; cauline leaves small, linear. Pedicels slender. Flowers $15-25 \mathrm{~mm}$ in diameter. Head of achenes depressed-globose; achenes compressed, strongly bordered; beak very short, straight. $C \& E$. Mediterranean region. Al Bu Co Cr Ga Gr It Ju Sa Si Tu.
2. R. constantinopolitanus (DC.) D'Urv., Mém. Soc. Linn. Paris 1: 317 (1822). Perennial c. 45 cm , densely patent-pubescent below, appressed-pubescent above. Basal leaves triangular-ovate, $\frac{3}{4}$ trifid; segments broadly ovate, again cut into dentate lobes; cauline leaves small, linear. Flowers $15-25 \mathrm{~mm}$ in diameter. Head of achenes globose; achenes $4-5 \mathrm{~mm}$, ovate, rounded; beak 1 mm , falcate. S.E. Europe. Bu Gr Rm Rs (K) Tu.
(в) Pedicel sulcate; sepals patent; receptacle pubescent.
3. R. polyanthemos L., Sp. Pl. 554 (1753) (R. meyeranus Rupr.). A usually much-branched perennial $10-130 \mathrm{~cm}$. Petioles and lower part of stems patent-pubescent or glabrescent, appressedpubescent above. Basal leaves (3-)5-fid; segments cut into linearlanceolate or linear, dentate lobes; cauline leaves like the basal, but smaller. Flowers $18-25 \mathrm{~mm}$ in diameter; honey-leaves 714 mm , golden-yellow. Head of achenes globose; achenes $3-5 \mathrm{~mm}$, compressed, bordered; beak $c .0 .5 \mathrm{~mm}$, curved. Europe, except the west and much of the south. Al AuBe Bu Cz Da Fe Ga Ge Gr Ho Hu It Ju No Po Rm Rs (N, B, C, W, K, E) Su.
1 Basal leaves deeply 3-fid; stems up to 130 cm
(c) subsp. polyanthemoides

1 Basal leaves 5 -fid; stems rarely more than 60 cm
2 Stems usually much-branched; plant 30-60 cm
(a) subsp. polyanthemos

2 Stems simple or little-branched; plant $10-30 \mathrm{~cm}$
(b) subsp. thomasii
(a) Subsp. polyanthemos: Rarely more than 60 cm . Basal leaves 5 -fid; segments all more or less equal, more or less pubescent. $2 n=16$. Throughout the range of the species except France and S. Italy.
(b) Subsp. thomasii (Ten.) Tutin, Feddes Repert. 69: 53 (1964): Stems $10-30 \mathrm{~cm}$, simple or little-branched. Basal leaves 5 -fid; middle segments usually longest. Calabria.
(c) Subsp. polyanthemoides (Boreau) Ahlfvengren in Neuman, Sver. Fl. 502 (1901): Up to 130 cm . Basal leaves very deeply 3 -fid; middle segment very long, narrow, cuneate, 3 -lobed, densely pubescent. Mainly in the Alps; the only subsp. in France.

This subspecies can only be distinguished with certainty from 4 by the achenes. Subsp. polyanthemoides is more or less intermediate and has often been placed under 4 on vegetative characters. However, the achene has a short beak and closely resembles 3.
4. R. nemorosus DC., Reg. Veg. Syst. Nat. 1: 280 (1817) ( $R$. breyninus auct., non Crantz). Like 3 but basal leaves trifid, with broadly ovate, lobed and dentate segments; honey-leaves $15-20 \mathrm{~mm}$, golden-yellow; achenes with a strongly curved beak c. $1.5 \mathrm{~mm} .2 n=16$. Most of Europe, except the north and extreme south. Al Au Bu Cz Da Ga Ge Gr He Ho Hs It Ju Po Rm Rs (B, C, W) Su.

The following seem best regarded as subspecies. Though showing differences in vegetative morphology they are all interfertile and intermediates occur.

1 Stems becoming procumbent and rooting at nodes; lower cauline leaves resembling basal
(c) subsp. serpens

1 Stems always erect, never rooting at nodes; lower cauline leaves with narrow $\pm$ entire segments
2 All basal leaves pentagonal in outline, trifid; segments lobed and dentate
(a) subsp. nemorosus

2 Outer basal leaves orbicular in outline, more divided and with narrow lobes
(b) subsp. polyanthemophyllus
(a) Subsp. nemorosus: Erect perennial $20-80 \mathrm{~cm}$. Stem sparsely appressed- or slightly patent-pubescent. Basal leaves pentagonal in outline, deeply 3 -fid; segments obovate-cuneate, lobed and dentate; cauline leaves with narrow more or less entire segments. Throughout the range of the species.
(b) Subsp. polyanthemophyllus (W. Koch \& H. Hess) Tutin, Feddes Repert. 69: 53 (1964): Like (a) but often $50-100 \mathrm{~cm}$; leaves orbicular in outline, more divided and with narrower lobes; middle segment often stipitate; later leaves similar to those of (a). Alps. Au Ga Ge He It.
(c) Subsp. serpens (Schrank) Tutin, Feddes Repert. 69: 54 (1964) (R. nemorosus proles radicescens (Jordan) Rouy \& Fouc.): Like (a) but biennial $10-20 \mathrm{~cm}$; stems at first erect, later procumbent and rooting at the nodes, patent-pubescent below; lower cauline leaves resembling the basal. Jura, Alps, Schwarzwald, Pyrenees. Au Ga Ge He It.
5. R. caucasicus Bieb., Fl. Taur.-Cauc. 2: 27 (1808). A slender pubescent perennial c. 30 cm . Stock erect, with fibres. Basal leaves with 3 segments; middle long-stipitate; lateral usually 3-lobed, the lobe on the lower side downward-directed and more or less covering the petiole; all lobes cuneate-obovate, dentate; cauline leaves less divided, with narrower lobes. Flowers $c$. 10 mm in diameter. Achenes c. 4 mm , strongly compressed, 2 -veined on upper margin; beak c. 1 mm , stout, curved, 2 -veined at base. Krym. Rs (K).
6. R. repens L., Sp. Pl. 554 (1753). A nearly glabrous to somewhat pubescent perennial $15-60 \mathrm{~cm}$. Stolons long, rooting at the nodes. Basal leaves triangular-ovate, 3-partite; middle lobe long-stipitate; segments usually cut into 3 -dentate lobes; cauline leaves smaller and less divided. Flowers $20-30 \mathrm{~mm}$ in diameter. Head of achenes globose; achenes c. 3 mm , compressed, bordered; beak c. $1 \cdot 5 \mathrm{~mm}$, falcate. $2 n=32$. Europe, except Kriti and Islas Baleares. All except Bl Cr Tu ; introduced in Az Sb .

A very variable species much in need of detailed investigation.
(c) Pedicel terete; sepals patent; receptacle glabrous.
7. R. lanuginosus L., Sp. Pl. 554 (1753). A pubescent perennial $30-50 \mathrm{~cm}$; stock premorse. Stem with long patent hairs. Basal leaves usually about as wide as long, $3(-5)$-lobed to $c$. $\frac{3}{4}$; segments broadly ovate, irregularly dentate; cauline leaves similar but smaller. Flowers (15-)20-30(-40) mm in diameter. Honey-leaves deep orange-yellow. Head of achenes globose; achenes $4-5 \mathrm{~mm}$, compressed, bordered; beak $c .1 .5 \mathrm{~mm}$, broad, strongly recurved. $2 n=28$. Mainly C. \& S. Europe. Al Au Be Bu Co Cz Da Ga Ge Gr He Hu It Ju Po Rm Rs (B, C, W, K) Sa Si.
8. R. acris L., Sp. Pl. 554 (1753). Perennial $30-100 \mathrm{~cm}$. Glabrescent, appressed-pubescent or with stiff patent or deflexed hairs on stem. Stock premorse, oblique, or forming a stout creeping rhizome. Basal leaves more or less deeply divided into 3-7 sessile segments, which are ovate-cuneate in outline, dentate and simple or again divided; cauline leaves resembling the basal but smaller. Flowers $15-25 \mathrm{~mm}$ in diameter. Honey-leaves golden-yellow. Head of achenes globose. Achenes $2-3.5 \mathrm{~mm}$,
broadly elliptic or suborbicular; beak short, hooked. Most of Europe. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Cr} \mathrm{Lu} \mathrm{Rs} \mathrm{(K)} \mathrm{Si} \mathrm{Tu;} \mathrm{introduced} \mathrm{in} \mathrm{Sb}$.

This very variable species is divisible into a number of subspecies, most of which are in need of further investigation. They differ in presence or absence of rhizome; shape and dissection of leaves; pubescence; presence or absence of hairs on the filaments; and shape and size of achene. Intermediates appear to occur between the various taxa where their distributions overlap. The following are among the better known and more distinct subspecies but several others undoubtedly occur:
1 Stock short, premorse; leaf-lobes linear-lanceolate or, if wider, plant rarely more than 20 cm
2 Plant $30-50 \mathrm{~cm}$, glabrescent or $\pm$ appressed pilose; basal leaves usually much-divided, lobes narrow; flowers numerous (a) subsp. acris
2 Plant $10-20 \mathrm{~cm}$, usually patent-pilose below; basal leaves with $3(-5)$ usually wide segments with a few coarse teeth; flowers usually $1-3$, large, often brown-veined
(b) subsp. borealis

1 Stock a stout $\pm$ horizontal rhizome; leaf-lobes ovate or ovateoblong; plant usually $50-120 \mathrm{~cm}$
3 Leaves soft, thin, sericeous beneath when young; filaments glabrous; beak of achene strongly curved
(c) subsp. friesianus

3 Leaves coriaceous, thick, strigose; filaments pubescent; beak of achene $\pm$ straight
4 Basal sinus of lower leaves narrow; sepals with whitish $\pm$ appressed hairs all of about the same length
(d) subsp. granatensis

4 Basal sinus of lower leaves wide; sepals with $\pm$ patent reddish hairs, short at base and long at apex of sepal
(e) subsp. strigulosus
(a) Subsp. acris: $2 n=14$. Widespread, though often ruderal or probably introduced in hay-fields; rare in the Mediterranean region.
(b) Subsp. borealis (Trautv.) Nyman, Consp. 12 (1878) ( $R$. borealis Trautv.; R. glabriusculus Rupr.): $2 n=14$. Arctic and subarctic Europe. Br ? Da Fa Fe Is No Rs (N) Su.
(c) Subsp. friesianus (Jordan) Rouy \& Fouc., Fl. Fr. 1: 103 (1893): France, Switzerland north of the Alps, N. Spain; introduced elsewhere. Ga He Hs [Au ?Be Ge Su].
(d) Subsp. granatensis (Boiss.) Nyman, Consp. 12 (1878): Spain. Hs.
(e) Subsp. strigulosus (Schur) Hyl., Symb. Bot. Upsal. 7: 1 (1943) (R. stevenii auct. ross.): E. \& E.C. Europe. Au Bu Cz Hu Ju Po Rm Rs (W, E).
9. R. serbicus Vis., Mem. Ist. Venet. 9: 168 (1858). Rhizome long, stout. Leaves sericeous, at least when young; basal with 3 cuneate, sometimes stipitate, segments which are variously cut and dentate; cauline resembling the basal but smaller. Filaments pubescent. Beak rather shorter than achene, nearly straight. - S. Italy, Balkan peninsula. A1 Bu Gr It Ju.
10. R. brutius Ten., Prodr. Fl. Nap. 1: Ixi (1811). Patentpubescent perennial $30-50 \mathrm{~cm}$, with shortly creeping stock. Basal leaves large, pentagonal-reniform in outline, 3-partite or pedately 5 -partite; segments often stipitate, 2- to 3 -fid and strongly serrate; cauline leaves resembling the basal but smaller and sessile. Filaments glabrous. Achenes compressed, keeled; beak about as long as the achene, slender, curved. Italy, Greece, Turkey-in-Europe. Gr It Tu.
R. crimaeus Juz., Not. Syst. (Leningrad) 22: 5 (1950) from Krym, appears to be closely related to 10 , from which it is said to differ in its more dissected leaves and the shorter beak of the achene.
(D) Pedicel terete; sepals patent; receptacle pubescent.
(i) Achenes sharply keeled.
(11-22). R. montanus group. Glabrous or pubescent perennials $5-50 \mathrm{~cm}$. Rhizome often with fibres and sometimes with hairs. Basal leaves 3- to 5(-7)-lobed; segments obovate, dentate; cauline leaves deeply 3 - to 5 -lobed with narrower, usually entire segments. Flowers $1-3(-5), 20-40 \mathrm{~mm}$ in diameter. Achenes $2.5-3.5 \mathrm{~mm}$, compressed, keeled; beak $0.5-2.5 \mathrm{~mm}$, hooked.

There are a number of closely related species in the mountains of C., E. \& S. Europe. The following key may help with their identification.

Literature: E. Landolt, Ber. Schweiz. Bot. Ges. 64: 9-83 (1954) and 66: 92-117 (1956).
1 All leaves glabrous or nearly so
2 Stems glabrescent at base; beak $\frac{1}{3}-\frac{1}{2}$ as long as achene (Corse)
15. clethraphilus

2 Stems pubescent at base; beak not more than $\frac{1}{3}$ as long as achene
3 Segments of cauline leaves linear (Alps, N.W. Balkan peninsula, Jura, Pyrenees)
14. carinthiacus

3 Segments of cauline leaves linear-lanceolate or wider
4 Beak $\frac{1}{4} \frac{1}{3}$ as long as achene (Alps, Jura, Schwarzwald)
16. montanus

4 Beak of achene very short (Carpathians, E. Balkan peninsula)
17. pseudomontanus

1 Leaves pubescent, except occasionally the first basal ones
5 Beak very short, appressed to achene; receptacle pubescent at insertion of stamens; segments of cauline leaves linear (widespread)
21. oreophilus

5 Beak $\frac{1}{4}-\frac{2}{3}$ as long as achene; receptacle usually glabrous at insertion of stamens or, if pubescent, segments of cauline leaves not linear
6 Apex of rhizome with numerous $3-4 \mathrm{~mm}$ long hairs; cauline leaves often semi-amplexicaul (Pyrenees) 11. gouanii
6 Rhizome glabrous or rarely with few short hairs, sometimes with fibres
7 Hairs of sepals over 2 mm ; beak at least $\frac{1}{2}$ as long as achene (S.W. Alps, Spain) 22. aduncus

7 Hairs of sepals less than 2 mm ; beak usually less than $\frac{1}{2}$ as long as achene
8 Segments of cauline leaves linear (or, if lanceolate, widest near the base)
9 Beak of achene slender; lateral segments of basal leaves divided for $c$. $\frac{1}{2}$ their length (Alps) 20. grenieranus
9 Beak of achene rather stout and rigid, lateral segments of basal leaves usually divided for more than $\frac{1}{2}$ their length 10 (Pyrenees)
12. ruscinonensis 10 (Appennini and Balkan peninsula) 13. sartorianus
8 Segments of cauline leaves not linear, widest near the middle
11 Leaves sparsely pubescent; beak of achene slender (Alps, Jura, Schwarzwald) 16. montanus
11 Leaves rather densely pubescent; beak of achene stout, rigid
12 Receptacle usually pubescent at insertion of stamens (Balkan peninsula)
18. croaticus

12 Receptacle glabrous at insertion of stamens (N.E. Italy)
19. venetus
11. R. gouanii Willd., Sp. Pl. 2 (2): 1322 (1800). Pubescent. Rhizome with $3-4 \mathrm{~mm}$ long hairs at apex, usually with fibres. Cauline leaves usually semi-amplexicaul. Sepals rather densely pubescent. Honey-leaves $10-25 \mathrm{~mm}$. Beak at least $\frac{1}{3}$ as long as achene, rigid. $2 n=16$. Pyrences. Ga Hs.
12. R. ruscinonensis Landolt, Ber. Schweiz. Bot. Ges. 66: 101 (1956). Pubescent. Rhizome without hairs. Cauline leaves not amplexicaul. Sepals rather densely pubescent. Honey-leaves $8-15 \mathrm{~mm}$. Beak c. $\frac{1}{3}$ as long as achene, rigid. $2 n=16$. © . Pyrenees. Ga Hs.
13. R. sartorianus Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 8 (1853). Apparently not certainly distinguishable from 12, though widely separated geographically. Further investigation of these two is required. Italy and Balkan peninsula. Al Bu Gr It Ju.
14. R. carinthiacus Hoppe in Sturm, Deutschl. Fl. 1 (12): Heft 46 (1826). Rhizome usually without fibres. Leaves glabrous but ciliate. Sepals slightly pubescent, sometimes only at the base. Honey-leaves $5-15 \mathrm{~mm}$. Beak of achenes very short, appressed. $2 n=16$. Alps, N.W. Balkan peninsula, Jura, Pyrenees. Al Au Ga Ge He Hs It Ju.
15. R. clethraphilus Litard., Bull. Acad. Int. Géogr. Bot. (Le Mans) 19: 94 (1909). Like 14 but basal leaves obtusely dentate; beak of achene $c .1 .8 \mathrm{~mm}$. Corse. Co.
16. R. montanus Willd., Sp. Pl. 2 (2): 1321 (1800). Leaves glabrous or sparsely pubescent; cauline leaves linear-lanceolate to cuneiform or elliptic, dentate, often semi-amplexicaul. Sepals finely pubescent. Honey-leaves $7-20 \mathrm{~mm}$. Receptacle glabrous at insertion of stamens. Beak $\frac{1}{4} \frac{1}{3}$ as long as achene. $2 n=32$. - Alps, Jura, Schwarzwald. Au Ga Ge He It Ju.
17. R. pseudomontanus Schur, Verh. Naturforsch. Ver. Brünn 15 (2): 42 (1877). Like 16 but achene with a very short beak. - Carpathians, Balkan peninsula. Bu Cz Gr Po Rm.
18. R. croaticus Schott, Öesterr. Bot. Wochenbl. 7: 182 (1857). Like 16 but leaves pubescent; beak of achene stouter and more rigid; receptacle usually pubescent at insertion of stamens. - Balkan peninsula. A1 Ju.
19. R. venetus Huter, ex Landolt, Feddes Repert. 70: 3 (1964). Like 16 but leaves pubescent; beak of achene stouter and more rigid. $2 n=32$. S.E. Alps. It.
20. R. grenieranus Jordan in F. W. Schultz, Arch. Fl. Fr. Allem. 304 (1854). Rhizome often with abundant fibres. Leaves densely pubescent; segments of cauline leaves linear to lanceolate, widest near the base. Sepals finely pubescent. Honey-leaves $5-15 \mathrm{~mm}$. Beak up to $\frac{1}{2}$ as long as achene. $2 n=16$. Mainly Alps. Au Ga Ge He It.
21. R. oreophilus Bieb., Fl. Taur.-Cauc. 3: 383 (1819). Rhizome with fibres and hairs in upper part. Basal leaves pubescent; young folded lamina deflexed. Sepals usually finely patentpubescent. Honey-leaves $7-15 \mathrm{~mm}$. Receptacle pubescent at insertion of stamens. Beak of achene very short, appressed. $2 n=16$. Mountains of C. \& S. Europe. Al Au Co Cz Ga Ge He It Ju Po Rm Rs (W, K).
22. R. aduncus Gren. in Gren. \& Godron, Fl. Fr. 1: 32 (1847). Rhizome glabrous and usually without fibres. Leaves pubescent, lower cauline petiolate or with sheathing base. Sepals with long (over 2 mm ) hairs. Honey-leaves $8-15 \mathrm{~mm}$. Beak at least $\frac{1}{2}$ as long as achene, stout. $2 n=16$. - S.W. Alps, Spain. Ga Hs It.
R. brachylobus Boiss. \& Hohen., Diagn. Pl. Or. Nov. 2 (8): 6 (1849), has been reported from Bulgaria, but the identity of the plant is doubtful.
23. R. carpaticus Herbich, Sel. Pl. Rar. Galic. 15 (1836) (R. dentatus (Baumg.) Freyn). Glabrescent or appressed-pubescent perennial $15-40 \mathrm{~cm}$. Rhizome creeping. Basal leaves $1-3$, up to 15 cm wide, 3- to 5 -fid; segments broad, rhombic-ovate, dentate; cauline leaves similar, shortly petiolate. Sepals pubescent.

Honey-leaves $c .20 \mathrm{~mm}$. Achenes c. 3 mm , broadly obovate; beak short, curved. $2 n=28$. E. Carpathians. Rm Rs (W).
24. R. macrophyllus Desf., Fl. Atl. 1: 437 (1798). Robust pubescent perennial $30-60 \mathrm{~cm}$. Stock stout, erect, surrounded by fibres. Basal leaves c. $4-7 \times 5-10 \mathrm{~cm}$, pentagonal-orbicular, deeply cordate, 3 - to 5 -partite; segments wide, irregularly incised and crenate-dentate; upper cauline leaves 3 -fid with entire segments, or undivided. Flowers $25-30 \mathrm{~mm}$ in diameter. Achenes 4 mm compressed, bordered, smooth, minutely pitted, or with scattered bulbous-based hairs; beak c. 1 mm , stout, more or less curved. W. Mediterranean region. Bl Co Hs ?Lu Sa Si [Ga].
(ii) Achenes obtusely bordered.
25. R. demissus DC., Reg. Veg. Syst. Nat. 1: 275 (1817). Glabrous or sparsely pubescent perennial up to c. 20 cm . Rhizome oblique, crowned with fibres. Basal leaves orbicular, 3 - to 5 -partite; segments shortly stipitate, divided into linearoblong, obtuse lobes; cauline leaves sessile; segments linear, entire. Stems slender, decumbent. Flowers usually solitary. Sepals pubescent. Achenes 2.5 mm , broadly obovate, not keeled; beak very short, hooked. Mountains of S. Europe. Al Cr Gr Hs It Ju.
26. R. hayekii Dörfler, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 94: 146 (1918). Like 25 but basal leaves less deeply divided; cauline entire or 3 - to 5 -fid, with lanceolate segments; flowers usually several; achenes $c .3 \mathrm{~mm}$. - N. Albania. Al.
27. R. marschlinsii Steudel, Nomencl. Bot. ed. 2, 2: 434 (1841). Like 25 but basal leaves reniform; segments united at the base and irregularly dentate at apex; sepals glabrous; achenes $1-1.5 \mathrm{~mm}$. - Corse. Co.

This appears to be closely related to the two preceding species.
28. R. dissectus Bieb., Fl. Taur.-Cauc. 2: 25 (1808). More or less erect perennial $10-20 \mathrm{~cm}$, usually with long white hairs below. Basal leaves ovate-orbicular, cut into oblong-lanceolate lobes, hairy beneath; petioles short. Flowers $20-30 \mathrm{~mm}$ in diameter, 1 or few. Sepals pubescent, obtuse. Achenes $3-3.5 \mathrm{~mm}$, elliptical, smooth, compressed; beak $0 \cdot 8-1 \mathrm{~mm}$, hooked. -Krym . Rs (K).

Represented in Europe by subsp. dissectus only; several other subspecies occur in Anatolia.
(E) Pedicel sulcate; sepals deflexed; receptacle pubescent.
29. R. neapolitanus Ten., Ind. Sem. Hort. Bot. Neap. 11 (1825) ( $R$. eriophyllus C. Koch). Patent-pubescent perennial $20-50 \mathrm{~cm}$, without a corm-like stock but often with thick fusiform roots. Basal leaves 3-partite; segments cuneate-obovate, the lateral 2-lobed, acutely dentate; cauline leaves mostly bract-like. Flowers $20-30 \mathrm{~mm}$ in diameter. Achenes orbicular, smooth; beak triangular, very short. $2 n=16$. S.E. Europe. Al Bu Cr Gr It Ju Rm Rs (K) Tu.
30. R. pratensis C. Presl in J. \& C. Presl, Del. Prag. 9 (1822). Like 29 but stouter and larger, with a more or less corm-like stock; stems appressed-pubescent, often sparsely so; cauline leaves not all small and bract-like; achenes often tuberculate and sparsely hispid, with a longer uncinate beak. Sardegna, Sicilia and?Corse. ?Co Sa Si.

This species and 29 are closely related to $\mathbf{3 1}$ and may prove to be subspecies of it.
31. R. bulbosus L., Sp. Pl. 554 (1753). Pubescent perennial up to $c .50 \mathrm{~cm}$. Basal leaves 3-partite; middle segment abruptly contracted into a stalk, or cuneate and sessile; all variously dentate and lobed; lower cauline leaves resembling the basal but smaller; upper sessile with linear-lanceolate lobes. Flowers 20 30 mm in diameter. Achenes $2-4 \mathrm{~mm}$; margin keeled and grooved; beak short, curved. Most of Europe westwards from c. $30^{\circ}$ E. All except $\mathrm{Az} \mathrm{Cr} \mathrm{Fa} \mathrm{?Gr} \mathrm{Is} \mathrm{Rs} \mathrm{(K}, \mathrm{E)} \mathrm{Sb}$ Tu.

A variable species and imperfectly understood, particularly in S. Europe; it may be tentatively divided into the following subspecies whose distributions overlap to some extent.

1 Middle segment of basal leaves stipitate
2 Stock conspicuously swollen and corm-like; roots stout but not tuberous
3 Plant usually $20-50 \mathrm{~cm}$; basal leaves $\pm$ densely hairy above; branches long, strict
(a) subsp. bulbosus

3 Plant rarely as much as 20 cm ; basal leaves sparsely hairy or often glabrescent above; branches short, divaricate
(b) subsp. castellanus

2 Stock not or scarcely swollen and corm-like; roots fusiform, tuberous
4 Basal leaves all similar; receptacle elongate-conical
(d) subsp. aleae

4 Inner and outer basal leaves markedly different in lobing; receptacle ellipsoidal
(e) subsp. adscendens

1 Middle segment of basal leaves sessile
5 Stock conspicuously swollen and corm-like; roots stout but not tuberous
(c) subsp. bulbifer

5 Stock not or scarcely swollen and corm-like; roots fusiform, tuberous
(f) subsp. gallecicus
(a) Subsp. bulbosus: Stock conspicuously swollen and cormlike, usually without fibres; roots not swollen. Leaves more or less densely hairy above; middle segment of basal leaves stipitate. Branches long, strict. Pedicel strongly sulcate. Receptacle subglobose. Achenes $2-3 \mathrm{~mm}$, finely punctate. $2 n=16$. Widespread in N. \& C. Europe.
(b) Subsp. castellanus (Boiss. \& Reuter ex Freyn) P. W. Ball \& Heywood, Feldes Repert. 66: 151 (1962): Like (a) but leaf-bases very widely sheathing, basal leaves small, cordate-ovate or widely pentagonal in outline, sparsely hairy or glabrescent above; branches short, divaricate. N. \& C. Spain.
(c) Subsp. bulbifer (Jordan) Neves, Contrib. Portug. Ranunc. 84 (1944): Plant usually small and hairy. Stock swollen and cormlike, often separated by a slender axis from the current year's growth, the old corm often persistent; roots not tuberous. Pedicel almost terete, receptacle globose. $2 n=16$. England, France, Portugal, Spain, Switzerland, Sardegna.
(d) Subsp. aleae (Willk.) Rouy \& Fouc., Fl. Fr. 1: 106 (1893): Robust; stock not or scarcely swollen and corm-like, usually with abundant fibres; roots thick, fleshy, fusiform or cylindrical. Middle segments of basal leaves stipitate. Pedicel sulcate near the top, striate below. Receptacle elongate-conical. Achenes smooth. S. Europe.
(e) Subsp. adscendens (Brot.) Neves, op. cit. 170 (1944): Plant usually stout, glabrescent or pubescent. Stock not conspicuously swollen; roots fusiform, tuberous. Outer basal leaves with broad obtuse lobes; innermost with elongate, lanceolate, acute lobes. Pedicel sulcate. Receptacle ellipsoidal. $2 n=16 . S$. \& S.E. Spain and Portugal.
(f) Subsp. gallecicus (Freyn ex Willk.) P. W. Ball \& Heywood, Feddes Repert. 66: 151 (1962): Stock scarcely corm-like, roots fleshy. Basal leaves with obovate-cuneate, sessile or equally shortly stipitate segments, the lateral spreading widely; cauline often small, with entire segments; stems slender, 1- to fewflowered. N.W. Spain.
32. R. sardous Crantz, Stirp. Austr. 2: 84 (1763). A more or less pubescent annual $10-45 \mathrm{~cm}$, with the habit of $R$. bulbosus but without fleshy roots and with the corm-like stock not or feebly developed. Flowers $12-25 \mathrm{~mm}$ in diameter. Honey-leaves pale yellow. Achenes $2 \cdot 5-3 \mathrm{~mm}$, minutely punctate, with small, obtuse tubercles near the margin, or sometimes smooth; beak $c .0 .5 \mathrm{~mm}$, upward curving. $2 n=16$. Most of Europe. All except Az Fa Fe Hb Is No Rs ( $\mathrm{N}, \mathrm{B}$ ) Sb .
R. pseudobulbosus Schur, Verh. Siebenb. Ver. Naturwiss. 10: 84 (1859) is a subspecies or variety of this species. It differs in having a slightly longer, almost straight beak to the always smooth achene.
33. R. cordiger Viv., Fl. Cors. 8 (1824). Like 32 but perennial; basal leaves suborbicular-cordate, incised-crenate, appressedpubescent and long petiolate; petioles broadly winged at the base. Corse, Sardegna. Co Sa.
34. R. marginatus D'Urv., Mén. Soc. Linn. Paris 1: 318 (1822). Like 32 but honey-leaves $3-4 \mathrm{~mm}$, golden-yellow; margin of achenes wider; beak c. 1 mm , lanceolate and 2 -veined. S.E. Europe; Corse, Sardegna, Sicilia. Al Co Cr Gr Ju Rs (K) Sa Si Tu.

The achenes vary from almost smooth to strongly tuberculate in var. trachycarpus (R. trachycarpus Fischer \& Meyer).
35. R. trilobus Desf., Fl. Atl. 1: 437 (1798). Nearly glabrous annual. Lowest leaves simple; the next 3-partite; segments simple, cuneate-obovate, dentate, upper with more numerous linear-oblong lobes. Flowers $10-15 \mathrm{~mm}$ in diameter. Honeyleaves about as long as sepals. Achenes $c .2 \mathrm{~mm}$, with numerous small tubercles; beak short, triangular. S.W. Europe. Al Az Bl Co Ga Gr Hs It Lu Sa Si.
36. R. muricatus L., Sp. Pl. 555 (1753). Glabrescent annual up to $c .50 \mathrm{~cm}$. Leaves all similar, coarsely crenate-dentate and often shallowly lobed. Honey-leaves little longer than sepals. Receptacle pubescent. Achenes $7-8 \mathrm{~mm}$, ovate, spiny with a broad smooth margin; beak $2-3 \mathrm{~mm}$, nearly straight. $2 n=48,64$. S. Europe. Al Az Bl Bu Co Cr Ga Gr Hs It Ju Rm Rs (K) Sa Si Tu.
37. R. cornutus DC., Reg. Veg. Syst. Nat. 1: 300 (1817) (R. lomatocarpus Fischer \& Meyer). Like 36 but the leaves divided into 3 segments; segments of the upper leaves cut into lanceolate, acute lobes; honey-leaves 2-3 times as long as the sepals; achenes tuberculate. ?Turkey (near Istanbul). ?Tu.

Sect. Echinella DC. Nectary covered by an entire, truncate scale, attached laterally or free to base; achenes beaked, strongly bordered and with spines, hooked hairs or tubercles.
38. R. arvensis L., Sp. Pl. 555 (1753). More or less pubescent annual $15-60 \mathrm{~mm}$. Lowest leaves simple; the others 3 -lobed and often again divided into narrow, entire or dentate segments. Pedicel terete. Flowers $4-12 \mathrm{~mm}$ in diameter, pale greenishyellow. Sepals patent. Receptacle pubescent. Achenes $6-8 \mathrm{~mm}$, few (4-8), in 1 whorl, spiny or tuberculate, rarely only ribbedreticulate, with a broad sulcate border; beak $3-4 \mathrm{~mm}$, straight. $2 n=32 . S ., W . \& C$. Europe. All except Az Fa Is Rs (N, B, C, E) Sb ; introduced in Fe .
39. R. parviflorus L., Syst. Nat. ed. 10, 1087 (1759). Pubescent, spreading to decumbent annual $10-40 \mathrm{~cm}$. Lower leaves $3-$ to 5 -lobed; segments obovate-cuneate, dentate; upper simple or
with entire, oblong segments. Flowers $3-6 \mathrm{~mm}$ in diameter. Sepals deflexed. Receptacle glabrous. Achenes c. 3 mm , bordered, with hooked spines; beak short, hooked at apex. Mediterranean region extending to Britain and the Açores. Az Bl Br Co GaGr Hb Hs It Ju Lu Sa Si.
40. R. chius DC., Reg. Veg. Syst. Nat. 1: 299 (1817). Like 39 but leaves 3 -lobed; middle segment entire to $3(-5)$-dentate; fruiting pedicel greatly thickened; beak at least $\frac{1}{2}$ as long as the achene. Balkan peninsula, Italy, Krym and the Mediterranean islands. Bu Co Cr Gr It Ju Rs (K) Sa Si Tu.

Sect. Ranunculastrum DC. Roots of 2 sorts, some tuberous and some fibrous. Achenes compressed, keeled; receptacle elongating in fruit and becoming more or less cylindrical.
(A) Sepals deflexed at flowering.
41. R. gracilis E. D. Clarke, Travels 2 (2): 336 (1814) (R. chaerophyllos sensu Hayek, non L.). Simple or little-branched perennial with ovoid tubers. Stock usually without fibres. Basal leaves glabrous or slightly patent-pilose, outer suborbicular, shallowly 3-lobed, inner more deeply cut into obovate-cuneate, dentate segments. Achenes ovoid; beak somewhat curved, nearly as long as achene. Italy, Balkan peninsula. Bu Cr Gr It Ju Si Tu.
42. R. oxyspermus Willd., Sp. Pl. 2 (2): 1328 (1800). Like 41 but tubers fusiform; all the leaves patent-hirsute, mostly conspicuously longer than wide, deeply lobed with deeply divided segments; achenes tapering into a straight sharp beak longer than the achene. S.E. Europe. Bu Ju Rm Rs (C, W, K, E).
43. R. psilostachys Griseb., Spicil. Fl. Rumel. 1: 304 (1843). Like 41 but tubers fusiform; leaves sericeous beneath, mostly conspicuously longer than wide; achenes verrucose. $2 n=32$. - Balkan peninsula. Al Bu Gr Ju Tu Hu.
44. R. rumelicus Griseb., op. cit. 305 (1843). Like 41 but tubers oblong; leaves sericeous beneath, distinctly longer than wide; achenes tuberculate; beak straight. Balkanpeninsula. Bu Gr Ju Tu.
45. R. monspeliacus L., Sp. Pl. 553 (1753). Whitish-lanate or sericeous perennial up to 50 cm , with cylindrical or fusiform tubers. Basal leaves variable, ovate-cordate, more or less deeply 3 -lobed and dentate to 3 -fid with oblong-cuneate, laciniate, stipitate segments. Flowers c. 25 mm in diameter. Receptacle glabrous. Head of achenes cylindrical. Achenes ovoid, sparsely pubescent; beak c. $\frac{1}{2}$ as long as achene, curved. W. Mediterranean region. Co Ga Hs It Si .
46. R. miliarakesii Halácsy, Magyar Bot. Lapok 11: 116 (1912). Like 45 but very slender; tubers ovoid; basal leaves 3-partite; segments often stipitate, cuneate, again 3-partite; lobes linearlanceolate. Flowers 15 mm in diameter. Head of achenes globose; beak of achene very short, hooked. - Thessalia. Gr.
47. R. isthmicus Boiss., Diagn. Pl. Or. Nov. 1 (6): 4 (1846) (incl. R. orientalis auct., non L.). Small, spreading, appressedpubescent perennial with fusiform tubers. Basal leaves 2- to 3-pinnatisect, or the outer 3 -sect or 3-partite; lobes linearlanceolate. Achenes tubercled, with an appressed appendage at base; beak as long as achene, wide, falcate. Sicilia, Greece. Gr Si .

Represented in Europe by subsp. isthmicus only.
48. R. illyricus L., Sp. Pl. 552 (1753). Appressed-sericeous perennial up to $c .50 \mathrm{~cm}$, with ovoid tubers. Basal leaves 3 -fid;
segments linear-lanceolate, entire or 2- to 3 -fid into linearlanceolate entire lobes. Receptacle glabrous. Achenes $c .3 \mathrm{~mm}$, more or less triangular, strongly compressed and almost winged, finely punctate; beak about as long as achene, nearly straight. C. \& S.E. Europe extending to Italy; Öland. Au Bu Cz Ge Gr Hu It Ju Po Rm Rs (C, W, K, E) Su Tu.
(в) Sepals not deflexed at flowering.
49. R. pedatus Waldst. \& Kit., Pl. Rar. Hung. 2: 112 (1802 or 3). Almost glabrous perennial up to $c .30 \mathrm{~cm}$, with oblong tubers. Basal leaves glabrous, pedately 3- to 5 -partite; segments linearlanceolate, entire or deeply 2 -lobed. Achenes membranous, strongly compressed and almost winged; beak straight, except for the hooked tip. Czechoslovakia and Jugoslavia to E. Russia. $\mathrm{Bu} \mathrm{Cz} \mathrm{Hu} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)}$.
50. R. platyspermus Fischer ex DC., Prodr. 1: 37 (1824). Like 49 but villous; basal leaves 1 - to 2 -ternate, with pinnatifid segments. Achenes circular, strongly compressed and winged; beak very short, hooked. S.E. Russia. Rs (E). (C. Asia.)
51. R. paludosus Poiret, Voy. Barb. 2: 184 (1789) (R. flabellatus Desf., R. chaerophyllos sensu Coste, non L.; incl. R. heldreichianus Jordan, R. winkleri Freyn). A very variable pubescent perennial up to $c .50 \mathrm{~cm}$, with fusiform tubers. Stock usually stout and fibrous. Outer basal leaves shallowly 3-lobed; inner 3-fid; middle segment long-stipitate; all divided into narrow dentate segments. Receptacle glabrous. Achenes c. 2 mm , minutely punctate, sparsely pubescent, strongly keeled on back, tapering into a nearly straight beak about as long as the achene and hooked at tip. $2 n=32$. Mediterranean region; W. Europe northwards to the Channel Islands. Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.
52. R. cupreus Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 3 (1849). A somewhat pubescent perennial $10-20 \mathrm{~cm}$, with ovoid tubers. Basal leaves 2-pinnatisect; segments obovate. Flowers 15 mm in diameter. Honey-leaves copper-coloured beneath. Achenes 1.2 mm , with a broad hooked beak $c .1 \mathrm{~mm}$. - Kriti. Cr.
53. R. millefoliatus Vahl, Symb. Bot. 2: 63 (1791). More or less pubescent perennial $c .15 \mathrm{~cm}$, with ovoid or shortly oblong tubers. Basal leaves 2- to 3-pinnatisect, with linear-lanceolate acute lobes. Pedicel stout. Sepals glabrous. Honey-leaves 5, yellow on both surfaces. Receptacle glabrous. Achenes $c$. 3.5 mm , rounded, broadly keeled on back; beak $\frac{1}{2}$ as long as achene, wide, hooked. S. \& E.C. Europe. Al Bu Cz ${ }^{*} \mathrm{Ga}$ Gr It Ju Rm Si .
54. R. garganicus Ten., Fl. Nap. 4: 344 (1830). Like 53 but larger $(c .30 \mathrm{~cm})$; tubers oblong to cylindrical; leaf-lobes obtuse; pedicel slender; sepals pubescent; beak of achene nearly straight. - France, Italy, Jugoslavia, Albania. Al Ga It Ju.

Plants intermediate between 53 and $\mathbf{5 4}$ sometimes occur.
55. R. millii Boiss. \& Heldr. in Boiss., Fl. Or. 1: 35 (1867). Like 53 but tubers ovoid; honey-leaves 7-12, oblong-ovate; achenes c. 2 mm ; beak strongly hooked, c. $\frac{1}{4}$ as long as the achene. Greece. Gr.
56. R. nigrescens Freyn in Willk. \& Lange, Prodr. Fl. Hisp. 3: 921 (1880). Somewhat pubescent, erect, little-branched perennial up to $c .25 \mathrm{~cm}$, with cylindrical tubers. Basal leaves $c .2 \mathrm{~cm}$ across, reniform, 3 -fid to the middle, crenate, rather thick and rugose, nearly or quite glabrous; cauline leaves few, all bract-like.

Flowers $1-2, c .25 \mathrm{~mm}$ in diameter. Head of achenes c. 12 mm . Achenes glabrous, orbicular; beak shorter than achene, curved. - N. Spain, Portugal. Hs Lu.
57. R. cortusifolius Willd., Enum. Pl. Hort. Berol. 588 (1809). Robust densely villous perennial up to $c .100 \mathrm{~cm}$, with fusiform tubers. Basal leaves up to $c .30 \mathrm{~cm}$ wide, coriaceous, orbicularcordate, shallowly lobed; segments nearly parallel-sided, shallowly lobed and dentate at apex; lower cauline leaves resembling basal but smaller; upper sessile, bract-like. Inflorescence corymbose. Flowers up to 50 mm in diameter. Receptacle nearly glabrous. Achenes 3 mm , glabrous, smooth; beak 1 mm , curved. Açores. Az. (Madeira, Canarias.)
58. R. rupestris Guss., Ind. Sem. Boccad. 8 (1826) (R. blepharicarpos Boiss., R. suborbiculatus Freyn). Pubescent perennial up to $c .30 \mathrm{~cm}$, with fusiform tubers. Basal leaves reniform or orbicular, shallowly 3 -lobed; middle segment smaller than the lateral; all more or less shallowly lobed and crenate, thin, densely appressed-hirsute on both surfaces. Flowers c. 40 mm in diameter, few. Receptacle pubescent. Achenes obovate, glabrous or with short setae; beak c. $\frac{1}{2}$ as long as achene, broad-based, recurved and hooked. S. Portugal, S. Spain, Sicilia. Hs Lu Si.
59. R. creticus L., Sp. Pl. 550 (1753). A branched, patentpubescent perennial. Basal leaves reniform, crenate and shallowly lobed; cauline leaves 3 -fid; segments lanceolate, entire. Flowers c. 25 mm in diameter, numerous. Receptacle nearly glabrous. Achenes $4-5 \mathrm{~mm}$, pubescent, compressed; beak c. 0.5 mm , hooked. Kriti and Karpathos. Cr.
60. R. thasius Halácsy, Österr. Bot. Zeitschr. 42: 412 (1892). Slender, flexuous, much-branched, more or less glabrous perennial, with oblong tubers. Basal leaves orbicular-cordate, 3-fid; segments divided into ovate, obtuse lobes. Flowers numerous. Achenes about as long as the stout, slightly curved beak. - Thasos. Gr.
61. R. subhomophyllus (Halácsy) Vierh., Österr. Bot. Zeitschr. 84: 131 (1935) (R. cadmicus auct., non Boiss.). Slender, not or little-branched, more or less glabrous perennial, with oblong tubers. Basal leaves orbicular or wider than long, 3 -sect; segments with obtuse lobes. Flowers 1-2. Achene longer than the slender hooked beak. Aegean region. Cr Gr .
R. incomparabilis Janka, Österr. Bot. Zeitschr. 22: 174 (1872) from the N. Balkan peninsula is like 61 but has cylindrical tubers and achenes with longer hooked beaks. It is probably not specifically distinct from 61 but further information about the range of variation is needed.
62. R. spruneranus Boiss., Diagn. Pl. Or. Nov. 1 (1): 64 (1843). Much-branched spreading-pubescent to subglabrous perennial, with cylindrical tubers. Basal leaves orbicular-cordate, 3- to 5 -fid. Flowers numerous. Achenes with tubercle-based hairs; beak about as long as achene, nearly straight but hooked at apex. Balkan peninsula and S. Aegean region. Bu Cr Gr Ju.
63. R. gregarius Brot., Fl. Lusit. 2: 369 (1804) (R. nevadensis Willk., R. escurialensis Boiss. \& Reuter, R. carpetanus Boiss. \& Reuter). Slender pubescent perennial up to $c .30 \mathrm{~cm}$, with cylindrical tubers. Basal leaves reniform or pentagonal, 3- to 5 -fid; segments more or less lobed and dentate, sometimes divided into narrow sessile or stipitate lobes, appressed-hirsute to glabrescent. Flowers $1-4$, c. 25 mm in diameter. Head of achenes c. 10 mm . Receptacle pubescent to nearly glabrous. Achenes
broadly orbicular, sparsely setose or rarely glabrous; beak shorter than achene, hooked. Portugal, Spain. Hs Lu.

This species occurs in more or less isolated populations which differ from one another mainly in leaf-shape and degree of pubescence; many of these have been given specific rank. Among the more distinct is R. henriquesii Freyn, Bot. Centralb. 6 (3): 21 (1881) (Portugal) with narrow, acute, villous, distant leaf-lobes and densely pubescent receptacle and R. malessanus Degen \& Hervier, Bull. Acad. Int. Géogr. Bot. (Le Mans) 16: 222 (1906) (Spain) with oblong, obtuse, more or less glabrous and overlapping leaf-lobes, scapose stems and nearly glabrous receptacle.
64. R. asiaticus L., Sp. Pl. 552 (1753) (Cyprianthe asiatica (L.) Freyn). Pubescent perennial. Outer basal leaves 3-lobed and dentate; inner 3 -sect; segments stipitate, pinnatisect. Flowers $30-50 \mathrm{~mm}$ in diameter; honey-leaves white, yellow, red or purple. Head of achenes $c .10 \mathrm{~mm}$. Achenes ovate, attenuate into a wide hooked beak. Kriti, Karpathos. Cr. (S.W. Asia.)

Frequently cultivated.
Sect. Auricomus Spach. Roots all fibrous. Achenes slightly compressed, often puberulent; receptacle not elongating in fruit.
(65-71). R. auricomus group. Perennial herbs with simple to deeply palmately divided reniform to suborbicular-cordate basal leaves; cauline leaves smaller, sessile, deeply dissected or rarely simple. Pedicels terete. Sepals patent, pubescent. Honey-leaves yellow, often unequal or some or all lacking. Achenes slightly compressed, puberulent (rarely glabrous), borne on peg-like projections from the glabrous or pubescent receptacle. Most of Europe but absent from much of the Mediterranean region. All except Az Bl Co Cr Lu Rs (K) Sa Si Tu.

65-71 include a small number of sexual diploids and a large number of polyploids which are facultative or obligate apomicts and which have perhaps arisen from hybrids between the sexual species. Most of the apomicts are very local but a few have a fairly wide distribution. Detailed investigations have been made in some areas, but much work remains to be done before a thorough understanding of the group can be attained.

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69 is known to be diploid and sexual, and cytology indicates that some other sexual species remain to be recognized. 71 is clearly marked off from the rest by its undivided cauline leaves. The remainder, however, form a continuous or nearly continuous series, so that the reference of a plant to one 'species' or another is frequently a matter of opinion. The characters given in the following account are those found to be usually, though not invariably, associated with one another in the different 'species'.

1 Cauline leaves dentate near the apex, but not deeply divided 71. flabellifolius

1 Cauline leaves always deeply divided; margin of segments entire or dentate
2 Achenes glabrous
3 Outer basal leaves crenate (Albania)
70. degenii

3 Outer basal leaves deeply lobed (Arctic) 69. affinis
2 Achenes puberulent
4 Scale-like sheaths present at base outside foliage leaves
5 Basal leaves usually $1-2$, serrate-crenate but not lobed
6 Basal leaves pubescent beneath; segments of cauline leaves dentate; beak of achene long 65. cassubic
6 Basal leaves glabrous beneath; segments of cauline leaves entire or slightly dentate; beak of achene short
67. monophyllus

5 Basal leaves usually 2-3, at least some lobed or coarsely dentate
66. fallax

4 Scale-like sheaths absent
7 Basal leaves usually 5 or more; segments of cauline leaves usually entire
68. auricomus

7 Basal leaves usually 2-3; segments of cauline leaves dentate and often lobed
66. fallax
65. R. cassubicus L., Sp. Pl. 551 (1753). Tall (c. 40 cm ), stout. Scale-like sheaths present. Basal leaves $1-2$, up to 10 cm wide, orbicular-cordate, serrate-crenate, pubescent beneath; segments of cauline leaves dentate. Receptacle densely pubescent. Beak of achene long. $2 n=24,32,40,44,64 . C . \& E$. Europe.
66. R. fallax (Wimmer \& Grab.) Kerner, Sched. Fl. Exsicc. Austro-Hung. 5: 50 (1888) (incl. R. allemannii Br.-Bl.). Like 65 but scale-like sheaths small and soon decaying. Basal leaves 2-3, at least some lobed or coarsely dentate, pubescent beneath; segments of cauline leaves dentate or lobed. Receptacle more or less pubescent. Achenes densely pubescent; beak medium. $2 n=32$. Intermediate between nos. 65 and 68. C. \& E. Europe.
67. R. monophyllus Ovcz., Not. Syst. (Leningrad) 3: 54 (1922). Like 66 but small (c. 20 cm ), slender. Scale-like sheaths larger and persistent; cauline leaves entire or slightly dentate; achenes sparsely and shortly pubescent. $2 n=32$. E. Europe.
68. R. auricomus L., $S p$. Pl. 551 (1753). Variable in size. Scale-like sheaths absent. Basal leaves commonly 5 or more, some or all deeply 3- to 5-lobed, usually glabrous beneath; cauline leaves with narrow, usually entire segments. Receptacle pubescent or glabrous. Achenes densely pubescent; beak short. $2 n=16,32,40,48$. Widespread in Europe.
69. R. affinis R. Br. in Parry, Jour. Voy. N.W. Pass. (Suppl. App.) 265 (1824) ( $R$. auricomus var. glabratus Lynge). Scale-like sheaths absent. Basal leaves deeply 3- to 5 -lobed; cauline with linear segments. Achenes glabrous. Arctic Europe.
70. R. degenii Kümmerle \& Jáv. Bot. Közl. 19: 19 (1921). Scale-like sheaths absent. Outer basal leaves crenate, inner divided to $\frac{2}{3}$; cauline with narrowly oblanceolate entire segments. Achenes glabrous. - N.E. Albania.
A very similar plant, but with densely pubescent achenes, occurs in S. Jugoslavia.
71. R. flabellifolius Heuffel ex Reichenb., Fl. Germ. Excurs. 723 (1832). $20-30 \mathrm{~cm}$. Scale-like sheaths present, large. Basal leaves few, reniform, crenate; cauline leaves long-cuneate, entire, except for the rounded, serrate apex. Beak of achene long. - Hungary, Romania.
72. R. polyrhizos Stephan ex Willd., Sp. Pl. 2 (2): 1324 (1800). Almost glabrous perennial $8-15 \mathrm{~cm}$. Basal leaves 3 -lobed or 3 -sect; segments narrow, not markedly different from the smaller sessile 3 - to 5 -sect cauline leaves. Sepals patent. Receptacle pubescent. Achenes puberulent. S. \& S.E. parts of U.S.S.R. Rs (C, W, E).
73. R. pedatifidus Sm. in Rees, Cyclop. 29 no. 72 (1814). Almost glabrous perennial up to $c .30 \mathrm{~cm}$. Stems simple or nearly so. Basal leaves ovate-cordate in outline, deeply pedately 5 - to 9 -lobed; segments usually entire; cauline leaves sessile or nearly so, deeply divided into linear, entire lobes. Receptacle pubescent. Sepals patent, villous beneath. Honey-leaves c. 10 mm , little longer than sepals. Achenes c. 2 mm , obovoid, scarcely compressed, puberulent; beak subulate, deciduous. Spitsbergen. Sb.
74. R. pygmaeus Wahlenb., Fl. Lapp. 157 (1812). Nearly glabrous perennial $1 \cdot 5-4(-7) \mathrm{cm}$ with a stout premorse stock. Stems simple. Basal leaves reniform in outline, 3-lobed; segments wide, obtuse, lateral usually shallowly lobed; cauline leaves usually sessile, 3(-5)-lobed, segments ovate-lanceolate, entire, obtuse. Flowers $5-10 \mathrm{~mm}$ in diameter. Sepals villous at base. Achenes $c .1 \mathrm{~mm}$, ovoid, smooth; beak short, hooked. $2 n=16$, 32. Arctic, subarctic and mountains of C. Europe. Au Cz Fa Fe Ho Is It No Rs (N) Sb Su.
75. R. nivalis L., $S p$. Pl. 553 (1753). Usually unbranched perennial 8-15(-25) cm. Basal leaves orbicular-reniform in outline, deeply pedately lobed; cauline leaves sessile, with linearlanceolate entire lobes. Receptacle nearly glabrous, cylindrical. Sepals patent, villous. Achenes ovoid, smooth; beak c. as long as achene, slender. $2 n=40,48,56$. Arctic Europe extending northwards to $62^{\circ}$ N. in Norway. Fe No Rs (N) Sb Su.
76. R. sulphureus C. J. Phipps, Voy. N. Pole 202 (1774). Like 75 but stouter; basal leaves cuneate, shallowly lobed; receptacle densely pubescent, ovoid; sepals with abundant brown hairs; beak half as long as the achene. $2 n=96$. Arctic Europe. Fe No Rs (N) Sb Su .

Sect. Hecatonia (Lour.) DC. Marsh- or water-plants. Nectaryscale often forked or completely surrounding the nectary. Achenes small, scarcely compressed; beak usually very short.
77. R. hyperboreus Rottb., Skr. Kiobenhavnske Selsk. Laerd. Vid. 10: 458 (1770). Small, slender creeping or floating, nearly glabrous perennial. Leaves 5-lobed, ovate; petioles short. Flowers c. 5 mm in diameter, solitary, axillary. Sepals and honey-leaves 3. Achenes ovoid; beak short, obtuse. Arctic and subarctic Europe. Fa Fe Is No Rs (N) Sb Su.
(a) Subsp. hyperboreus: Scarcely caespitose; leaf-lobes ovate, divaricate; head of achenes $4-5 \mathrm{~mm}$ in diameter. $2 n=32$. Throughout the range of the species.
(b) Subsp. samojedorum (Rupr.) Hultén, Lunds Univ. Arsskr. ser. 2 (2), 40: 758 (1944) (R. samojedorum Rupr.): Somewhat caespitose; leaf-lobes linear-oblong, not divaricate; head of achenes c. 2 mm in diameter. Arctic Russia.
78. R. sceleratus L., Sp. Pl. 551 (1753). Stout, erect, more or less glabrous annual up to 60 cm . Basal leaves reniform, 3-lobed, the lateral lobes often again lobed, all crenate; upper cauline leaves sessile, up to 3 -lobed; segments entire. Flowers $5-10 \mathrm{~mm}$ in diameter, numerous. Sepals deflexed, pubescent beneath. Receptacle pubescent, much elongated in fruit. Achenes $c .1 \mathrm{~mm}$, ovoid, glabrous but faintly rugose; beak very short, obtuse. Europe. All except Al Az Cr Fa Is Sb .
(a) Subsp. sceleratus. Stems glabrescent; sepals and honeyleaves 5. $2 n=32$. Widely distributed.
(b) Subsp. reptabundus (Rupr.) Hultén, Bot. Not. 1947: 352 (1947) (R. reptabundus Rupr.): Stems densely pubescent; sepals 3-4; honey-leaves 5 or absent. N. Russia.
79. R. gmelinii DC., Reg. Veg. Syst. Nat. 1: 303 (1817). Creeping, floating or decumbent, rooting at the nodes. Leaves orbicular or reniform, with 3-5 cuneate segments divided into linear lobes. Flowers few, c. 10 mm in diameter. Achenes $c$. 1.5 mm , ovoid; beak slender. Arctic Russia. Rs (N).

Sect. Coptidium (Prantl) Tutin. Perennial. Roots fibrous. Sepals 3. Honey-leaves 6-8, yellow. Achenes scarcely compressed, the upper part filled with spongy tissue; beak long, slender. Receptacle scarcely enlarging in fruit.
80. R. lapponicus L., Sp. Pl. 553 (1753). Slender, creeping, rooting at the nodes. Leaves reniform in outline, 3-partite; lateral segments spreading; all obovate-cuneate, shallowly lobed and crenate-dentate. Flowers axillary, solitary, long-pedicellate. Sepals deflexed. Honey-leaves yellow. Achenes $3-4.5 \mathrm{~mm}$, ovoid-fusiform, constricted about the middle, keeled; beak hooked, little shorter than achene. $2 n=16$. Arctic Europe extending southwards to $62^{\circ} N$. in Sweden. Fe No Rs (N) Sb Su.

Sect. Pallasiantha (L. Benson) Tutin. Like Sect. Coptidium but with reddish or white honey-leaves, the upper part of the achenes not filled with spongy tissue and the receptacle distinctly enlarged in fruit.
81. R. pallasii Schlecht., Animadv. Ranunc. 1: 15 (1819). Like 80 but leaves deeply 3-lobed, obovate-cuneate in outline; lobes narrow, entire; flowers larger, with 6-12, reddish-violet or white honey-leaves; achenes $5-7 \mathrm{~mm}$. Arctic Russia, Spitsbergen. Rs (N) Sb.
R. $\times$ spitzbergensis Hadač, Norges Svalb.-Ishavs-Undersok. Skr. 87: 36 (1944), is $\mathbf{8 0 \times 8 1}$. Leaf-lobes narrow; the lateral spreading, usually yellow. Spitsbergen. Sb.

Sect. Halodes (A. Gray) L. Benson. Perennial. Roots fibrous. Sepals 5. Honey-leaves 5, yellow; margins of nectary-scale free from honey-leaf. Achenes compressed, veined or striate. Receptacle elongating in fruit.
82. R. cymbalaria Pursh, Fl. Amer. Sept. 2: 392 (1814). Slender, with ascending stems and creeping stolons. Leaves obtuse, reniform or truncate at base, crenate or dentate. Scapes up to 25 cm , 1 - to 10 -flowered. Flowers $6-9 \mathrm{~mm}$ in diameter, bright yellow. Achenes thin-walled, obovate, longitudinally ribbed; beak very asymmetrical, short, slender. Naturalized in N. Europe. [Fe No Su.] (North America.)

Sect. Ficaria (Schaeffer) Boiss. Some roots tuberous, some fibrous. Leaves broadly ovate, cordate. Flowers yellow. Sepals 3. Honey-leaves 8-12. Achenes ovoid, scarcely compressed, keeled; beak minute.
83. R. ficaria L., Sp. Pl. 550 (1753) (Ficaria verna Hudson, F. ranunculoides Roth). Perennial $5-30 \mathrm{~cm}$. Some roots fibrous, some forming fusiform tubers. Leaves broadly ovate, cordate, obtusely angled, shallowly crenate or rarely dentate. Flowers $15-50 \mathrm{~mm}$ in diameter. Receptacle pubescent. Sepals 3. Honeyleaves $8-12$, ovate. Achenes 2.5 mm , ovoid, keeled, pubescent; beak minute. Europe. All except Az Fa Is Sb.

This species shows a considerable amount of morphological and cytological variation. It is possible to recognize the following subspp. which, however, are not always clear-cut.

[^88]2 Bulbils present in the leaf-axils after flowering; flowers up to c. 20 mm in diameter, with obovate-oblong not overlapping honey-leaves
(b) subsp. bulbifer

2 Bulbils not present in the leaf-axils; flowers usually more than 20 mm in diameter, with broadly obovate overlapping honey-leaves
3 Sepals green, with narrow scarious margin; flowers $20-$ 30 mm in diameter; achenes puberulent (c) subsp. ficaria
3 Sepals yellowish-white; flowers $30-50 \mathrm{~mm}$ in diameter; achenes pubescent
(d) subsp. ficariiformis
(a) Subsp. calthifolius (Reichenb.) Arcangeli, Comp. Fl. Ital. 11 (1882), excl. descr. (Ficaria calthifolia Reichenb.): Plant small. Stems at flowering time very short. Leaves crowded in a rosette. Basal sinus of leaves narrow. Sepals herbaceous, with a narrow scarious border; achenes well-developed, hirsute. C. \& E. Europe. Au Bu Cz ?Gr Hu It Ju Po Rm Rs (W, K, E).
(b) Subsp. bulbifer Lawalrée in Robyns, Fl. Gén. Belg. (Spermat.) 2: 60 (1955): Plant up to 30 cm , rather slender. Leaves not in a rosette, basal sinus usually wide. Bulbils present in leaf-axils. Flowers up to 20 mm in diameter. Sepals herbaceous; achenes mostly sterile, puberulent. $2 n=32$. Widely distributed.
(c) Subsp. ficaria: Like subsp. (b) but plant rather stout; bulbils absent; flowers $20-30 \mathrm{~mm}$ in diameter; achenes welldeveloped. $2 n=16$. W. Europe. Be Br Co Da Ga Hb Ho Hs It Lu No Sa Si ?Su.
(d) Subsp. ficariiformis Rouy \& Fouc., Fl. Fr. 1: 73 (1893): Plant very robust. Sepals yellowish-white. Flowers $30-50 \mathrm{~mm}$ in diameter. Achenes pubescent. S. Europe. Bl Co Cr Ga Gr Hs It Ju Lu Sa Si.
84. R. ficarioides Bory \& Chaub., Nouv. Fl. Pélop. 34 (1838). Perennial up to c. 7 cm . Pedicels shorter than basal leaves. Leaves ovate-cordate, coarsely crenate-dentate or shallowly lobed. Sepals yellowish. Achenes glabrous. Greece. Gr.

Sect. Physophyllum Freyn. Roots tuberous; leaves all basal; achenes inflated; receptacle ovoid.
85. R. bullatus L., Sp. Pl. 550 (1753). Perennial. Leaves ovate, crenate, hispid beneath, more or less bullate. Pedicels $5-20 \mathrm{~cm}$, pubescent, 1-2-flowered. Flowers c. 25 mm in diameter, scented. Sepals greenish, pubescent. Honey-leaves 5-12, oblong, yellow. Receptacle glabrous. Achenes narrowly bordered; beak short, curved. Mediterranean region to N.W. Spain and Portugal. $\mathrm{Bl} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.

Sect. Thora DC. Roots tuberous; leaves broader than long; achenes scarcely compressed, strongly veined; receptacle ovoid.
86. R. thora L., Sp. Pl. 550 (1753). Perennial $10-30 \mathrm{~cm}$. Leaves glaucous, glabrous; lower reniform, entire at base and then increasingly corasely serrate to apex; basal petiolate, appearing after flowering; lower cauline sessile; upper cauline small, lanceolate, mostly 3 -lobed. Flowers 1 -few, $10-20 \mathrm{~mm}$ in diameter, yellow. Sepals glabrous. Honey-leaves ovate. Receptacle sparsely hairy. Achenes c. 4 mm , few, glabrous, subglobose; beak short, hooked. Calcicole. - C. Pyrenees, N.W. Spain (Cordillera Cantábrica), Jura, Alps, Carpathians, Balkan peninsula. A1 Au $\mathrm{Cz} \mathrm{Ga} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Po} \mathrm{Rm}$.
87. R. scutatus Waldst. \& Kit., Pl. Rar. Hung. 3: 205 (1806 or 1807). Like 86 but taller. Lower cauline leaf about as long as wide, deeply cordate, amplexicaul; stems usually several-flowered. - Balkan peninsula. Al Ju.

86 and 87 are closely related and doubtfully merit specific distinction.
88. R. hybridus Biria, Hist. Renonc. 38 (1811). Like 86 but smaller; basal leaves usually 2 , present at flowering, truncate or broadly cuneate at base, coarsely dentate at apex, otherwise entire. Flowers $12-25 \mathrm{~mm}$ in diameter. Achenes $2-3 \mathrm{~mm}$; beak short, hooked. - E. Alps, N. Balkan peninsula. Au Ge It Ju ?Rm.
89. R. brevifolius Ten., Prodr. Fl. Nap. 1: Ixviii (1815). Like 86 but smaller; basal leaves several; cauline 1(-2), 3-sect, smaller. Flowers $15-25 \mathrm{~mm}$ in diameter. Achenes $3-4 \mathrm{~mm}$; beak long, curved. Italy, Balkan peninsula. Al Cr Gr It Ju.
(a) Subsp. brevifolius: Basal leaves 1-3; achenes c. 4 mm . C. Italy, Crna Gora and Albania.
(b) Subsp. pindicus (Hausskn.) E. Mayer, Razpr. Mat.-Prir. Akad. Ljubljani 5: 26 (1959): Basal leaves 4-10; achenes c. 3 mm . Greece, Kriti.

Sect. Leucoranunculus Boiss. Roots fibrous; basal leaves lobed; honey-leaves white (rarely pink), caducous; receptacle glabrous; achenes subglobose, smooth; beak long, nearly straight.
90. R. alpestris L., Sp. Pl. 553 (1753). Glabrous caespitose perennial $3-12 \mathrm{~cm}$. Leaves shiny; basal several, (3-)5-lobed; lobes deeply crenate; cauline leaves $1-2$, lower 3 -fid, upper simple. Flowers c. 20 mm in diameter, usually 2-3. Sepals glabrous. Honey-leaves obcordate. Receptacle glabrous. Achenes c. 2 mm , glabrous, obovoid; beak slender, nearly straight. $2 n=16$. Pyrenees, N. Spain, Jura, Alps, Appennini, Carpathians. Au Cz Ga Ge He Hs It Ju Po Rm.
91. R. traunfellneri Hoppe in Sturm, Deutsch. Fl. 1 (12): Heft 46 (1826). Like 90 but not caespitose, smaller; leaves matt; basal usually 3 -lobed; middle lobe 3 -fid, the lateral deeply 2 -fid; cauline leaf usually linear, simple; flower c. 15 mm in diameter, usually solitary. S.E. Alps. Au It.

This is perhaps best regarded as a subspecies of $\mathbf{9 0}$.
92. R. crenatus Waldst. \& Kit., Pl. Rar. Hung. 1: 9 (1799). Perennial 4-10 cm, glabrous. Basal leaves petiolate, suborbicular, weakly cordate, crenate, sometimes 3-lobed at apex, obscurely veined. Cauline leaves 1-2, lanceolate to linear, bract-like. Flowers 1-2, $20-25 \mathrm{~mm}$ in diameter. Sepals narrowly ovate. Honey-leaves broadly ovate or oblong, obcordate. Achenes glaucous, smooth, ovoid; beak about as long as achene, slender, hooked at apex. E. Alps, Appennini, E. Carpathians, Balkan peninsula. Al Au Bu It Ju Rm Rs (W).
93. R. bilobus Bertol., Misc. Bot. 19: 5 (1858). Like 92 but basal leaves with prominent veins; sepals wider; honey-leaves emarginate or more deeply notched. Calcicole. N. Italy. It.

Sect. Aconitifolii Tutin. Roots fibrous; basal leaves lobed; honey-leaves white, caducous; receptacle pubescent; achenes subglobose, veined; beak short, curved.
94. R. aconitifolius L., $S p$. Pl. 551 (1753). Perennial up to c. 50 cm . Leaves palmately 3 - to 5 -lobed; lobes serrate-dentate, the middle one free to base; cauline leaves sessile. Pedicels $1-3$ times as long as subtending leaf, pubescent above. Flowers $10-20 \mathrm{~mm}$ in diameter. Sepals reddish or purple beneath, glabrous, caducous. Honey-leaves 5, ovate, weakly obcordate. Achenes 5 mm , slightly compressed, beak slender. $2 n=14,16$. - C. Europe extending to C. Spain, C. Italy and C. Jugoslavia. $\mathrm{Au} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Rs} \mathrm{(W)}$.
95. R. platanifolius L., Mantissa 79 (1767). Like 94 but often larger (up to 130 cm ), leaves 5- to 7-lobed, the middle lobe not free to base; pedicels $4-5$ times as long as subtending leaves, nearly or quite glabrous above. $2 n=16$. C. \& S. Europe, Belgium, W. Fennoscandia. Al Au Be Bu Co Cz Ga Ge Gr He Hs It Ju No Po Rm Rs (W) Sa Su.
96. R. seguieri Vill., Prosp. Pl. Dauph. 50 (1779). Perennial $8-20 \mathrm{~cm}$, at first pubescent, later glabrescent. Basal leaves palmately 3 - to 5 -lobed, segments again divided; cauline leaves similar but smaller. Flowers up to 25 mm in diameter. Sepals glabrous. Honey-leaves emarginate. Achenes c. 4 mm , broadly ovoid; beak slender. Calcicole. Alps, Cordillera Cantábrica, Appennini, S.W. Jugoslavia. Au Ga He Hs It Ju.
(a) Subsp. seguieri. Slightly pubescent; flowers $20-25 \mathrm{~mm}$ in diameter; achenes inflated. $\mathrm{Au} \mathrm{Ga} \mathrm{He} \mathrm{Hs} \mathrm{It}$.
(b) Subsp. montenegrinus (Halácsy) Tutin, Feddes Repert. 69: 55 (1964). Tomentose; flowers smaller; achenes ovate, sulcate. Ju.

Sect. Acetosellifolii Tutin. Roots tuberous, fusiform; leaves all basal, palmately 5- to 7 -veined, hastate; honey-leaves white, caducous; receptacle glabrous; achenes keeled on inner margin, veined; beak very short.
97. R. acetosellifolius Boiss., Elenchus 5 (1838). Glabrous perennial $3-20 \mathrm{~cm}$. Stock stout, fibrous. Stems decumbent or ascending, simple or divaricately branched. Leaves hastate and irregularly laciniate at base; middle lobe longest. Flowers 1525 mm in diameter. Honey-leaves obovate. Achenes subglobose; beak curved. - Spain (Sierra Nevada). Hs.

Sect. Crymodes (A. Gray) Tutin. Roots fibrous; leaves deeply lobed; honey-leaves white to purple, persistent; receptacle glabrous; achenes strongly compressed and winged on 2 sides.
98. R. glacialis L., Sp. Pl. 553 (1753) (Oxygraphis vulgaris Freyn). Perennial 4-25 cm, usually glabrous, except for the sepals. Stem stout, erect or ascending. Basal leaves thick, 3 -sect; segments usually stipitate, deeply divided into elliptical or oblong lobes; cauline leaves similar but smaller, sessile or shortly petiolate. Sepals with abundant red-brown hairs beneath. Achenes 2.5 mm , glabrous; beak c. 1.5 mm , nearly straight. $2 n=16$. N. Europe, higher mountains of C. Europe, Pyrenees, Sierra Nevada. Au Cz Fa Fe Ga Ge He Hs Is It No Po Rm Rs (N) Sb Su .
R. kamchaticus DC., Reg. Veg. Syst. Nat. 1: 302 (1817) (Oxygraphis glacialis (Fischer) Bunge) occurs in N. Ural and may be in Europe. It is a glabrous perennial up to 6 cm , with broadly ovate, entire or weakly and remotely dentate leaves in a basal rosette. The solitary flowers have 5 broadly ovate sepals which are appressed to the 11-15, narrowly oblong, yellow petals.

Sect. Insulares Tutin. Roots fleshy, cylindrical; honey-leaves yellow, caducous; receptacle pubescent; achenes ovoid, with a sulcate border, smooth; beak short, curved.
99. R. cymbalarifolius Balbis ex Moris, Stirp. Sard. 1: 2 (1827). Tufted, appressed-pilose perennial up to $c .5 \mathrm{~cm}$. Basal leaves up to $c .1 \mathrm{~cm}$, orbicular, 3-lobed usually to half-way or less; segments ovate, strongly crenate; cauline leaves small, few, near the base of the slender strigose pedicels. Petioles enlarged and sheathing at base. Flowers $c .10 \mathrm{~mm}$ in diameter, solitary. Sepals deflexed, shortly pubescent. Honey-leaves narrowly elliptic, not contiguous, pale glossy yellow. Achenes smooth, strongly keeled; beak short, curved. Sardegna. Sa.
100. R. weyleri Marés, Bull. Soc. Bot. Fr. 12: 232 (1865). Like 99 but plant up to 20 cm , with patent hairs at base of stems and petioles; leaves up to 2 cm , ovate-elliptic, deeply 3-lobed; segments often stipitate; petioles not enlarged and sheathing at base; sepals patent; achenes rough, with prominent veins. - Mallorca. BI.

Sect. Flammula Webb. Roots fibrous; leaves all simple; honeyleaves yellow, caducous; receptacle glabrous; achenes slightly compressed; beak very short.
101. R. flammula L., Sp. Pl. 548 (1753). Usually glabrous perennial $8-80 \mathrm{~cm}$, erect, or creeping and rooting at the nodes. Leaves variable, orbicular to subulate, entire or serrate; lower petiolate; upper smaller and sessile. Flowers 1-many, $7-20 \mathrm{~mm}$ in diameter. Pedicel sulcate. Achenes glabrous, minutely pitted, weakly bordered; beak very short. Europe; very rare in the Mediterranean region. All except Al Bl Cr ? $\mathrm{Gr} \mathrm{Rs}(\mathrm{K}) \mathrm{Sb} \mathrm{Tu}$.

1 Lamina of basal leaves suborbicular-cordate, fleshy
(b) subsp. minimus

1 Lamina of basal leaves at least twice as long as broad, thin
2 Basal leaves persistent; lamina ovate to lanceolate
(a) subsp. flammula

2 Basal leaves caducous; lamina spathulate or very small
(c) subsp. scoticus
(a) Subsp. flammula: Stem erect to procumbent, often rooting at nodes; internodes 4-7 cm. Basal leaves about twice as long as wide, usually cuneate or rounded at base, thin. Achenes $c, 1 \cdot 5$ times as long as wide. $2 n=32$. Widespread.
(b) Subsp. minimus (Ar. Benn.) Padmore, Watsonia 4: 21 (1957): Stem more or less procumbent, not rooting at nodes; internodes $0 \cdot 5-2 \mathrm{~cm}$. Basal leaves suborbicular-cordate, thick and fleshy. Achenes scarcely longer than wide. $2 n=32$. - $N$. \& W. Scotland, W. Ireland.
(c) Subsp. scoticus (E. S. Marshall) Clapham in Clapham, Tutin \& Warburg, Fl. Brit. Is. 91 (1952): Stems erect. Basal leaves caducous; petioles long; lamina subulate or very small. Flowers few, usually 1. Otherwise like subsp. (a). N. Scotland, ?N.W. Ireland.
102. R. reptans L., $S p$. Pl. 549 (1753). Like small forms of 101 but with very slender, always procumbent stems rooting at every node; leaves all petiolate, spathulate to narrowly elliptic; flowers $5(-10) \mathrm{mm}$ in diameter, solitary. $2 n=32$. $N$. Europe; very local in C. Europe. Au Br?Cz Da Fa Fe Ga Ge He Is It No Po Rs (N, B, C) Su .
103. R. batrachioides Pomel, Nouv. Mat. Fl. Atl. 249 (1874). Slender, branched, glabrous annual 3-6 cm. Leaves spathulate, entire. Flowers $5-8 \mathrm{~mm}$ in diameter. Sepals patent. Achenes 0.5 mm , ovoid, keeled; beak very short, slender. C. Sardegna. Sa. (N.W. Africa.)
104. R. lingua L., Sp. Pl. 549 (1753). Robust stoloniferous perennial $50-120 \mathrm{~cm}$. Basal leaves ovate, cordate, long-petiolate, soon withering; cauline oblong-lanceolate, shortly petiolate to sessile; all more or less serrate. Flowers (20-) $30-50 \mathrm{~mm}$ in diameter, few; pedicels terete. Achenes c. 2.5 mm , glabrous, minutely pitted, bordered; beak short and wide. $2 n=128$. Most of Europe, rare in the Mediterranean region. All except Al Az Bl Co Cr Fa Is Lu Rs (K) Sa Sb .
105. R. ophioglossifolius Vill., Hist. Pl. Dauph. 3 (2): 731 (1789). Annual $10-40 \mathrm{~cm}$. Basal leaves ovate or suborbicular, cordate, long-petiolate; upper smaller, narrower, shortly petiolate or
sessile; all entire or obscurely serrate; lower pedicels as long as leaves. Flowers $5-9 \mathrm{~mm}$ in diameter, numerous; pedicel somewhat sulcate, appressed-pubescent. Sepals glabrous. Honeyleaves obovate, nearly twice as long as sepals. Achenes $c$. 1.5 mm , compressed, minutely tubercled; beak about $\frac{1}{10}$ as long as achene. $2 n=16$. S. Europe; isolated localities in Gotland and England. Al Bl Br Bu Co Cr Ga Gr Hs It Ju Lu Rm Rs (K) Sa Si Su Tu.
R. thracicus Aznavour, Bull. Soc. Bot. Fr. 46: 136 (1899) (from the Bosphorus) needs further investigation.
106. R. fontanus C. Presl in J. \& C. Presl, Del. Prag. 6 (1822). Like 105 but smaller and more or less procumbent; pedicels glabrous; flowers smaller; achenes smooth; beak longer. Corse, S. Italy, Sicilia, Jugoslavia, Albania. Al Co It Ju Si.
107. R. longipes Lange ex Cutanda, Fl. Comp. Madrid, 103 (1861) ( $R$. dichotomiflorus Freyn). Like 105 but the basal leaves mostly elliptic or lanceolate, rarely ovate; lower pedicels $\frac{1}{2}-\frac{1}{3}$ as long as leaves; honey-leaves oblong, about as long as sepals. Beak about $\frac{1}{4}$ as long as achene. Spain, Portugal. Hs Lu.
108. R. revelieri Boreau, Mém. Soc. Acad. (Angers) 1: 85 (1857). Annual $10-20 \mathrm{~cm}$. Leaves lanceolate, petiolate. Pedicel terete, thickened in fruit; lower about as long as leaves. Sepals usually pubescent beneath, longer than honey-leaves. Achenes 1.5 mm , minutely tubercled, scarcely compressed; beak very short. - Corse, Sardegna and S. France. Co Ga Sa.
(a) Subsp. revelieri: Pedicel stout, fistular; sepals densely pubescent beneath. Corse.
(b) Subsp. rodiei (Litard.) Tutin, Feddes Repert. 69: 55 (1964). Pedicel less stout, scarcely fistular; sepals glabrous or with few scattered hairs beneath. S.E. France (Var).

Sect. Micranthus (Ovcz.) A. Nyárády. Like Sect. Flammula but flowers sessile or nearly so, not more than 3 mm in diameter, yellow. Achenes tuberculate; beak $\frac{1}{2}$ as long to as long as achene.
109. R. lateriflorus DC., Reg. Veg. Syst. Nat. 1: 251 (1817). Much-branched annual $5-25 \mathrm{~cm}$. Lower leaves ovate, broadly cuneate at base; petioles very long; upper leaves narrower, with shorter petioles; all remotely denticulate. Flowers $2 \cdot 5-3 \mathrm{~mm}$ in diameter, sessile at the nodes or in the dichotomies of the stem, pale yellow. Sepals glabrous, yellow. Honey-leaves about as long as sepals. Achenes $25-30$, c. $2 \cdot 5 \mathrm{~mm}$, narrowed into a beak about as long as the achene, curved at tip. C., S., \& S.E. Europe. $\dagger \mathrm{Au} \mathrm{Bu} \mathrm{Cr} \mathrm{Cz} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(W}, \mathrm{K}, \mathrm{E)} \mathrm{Si} \mathrm{Tu}$.
110. R. nodiflorus L., Sp. Pl. 549 (1753). Like 108 but leaves narrower, tapering gradually into the petiole, entire or slightly serrulate; achenes 12-28; beak c. $\frac{1}{2}$ as long as achene. France, Portugal, Spain. Ga Hs Lu.

Sect. Xanthobatrachium (Prantl) Ovcz. Like Sect. Flanmula but submerged leaves with filiform verticillate segments; flowers 3-6 mm in diameter, yellow; achenes less than 1 mm ; beak almost absent.
111. R. polyphyllus Waldst. \& Kit. ex Willd., Sp. Pl. 2 (2): 1331 (1800). Plant $10-15 \mathrm{~cm}$, creeping then ascending. Stems stout, divaricately branched. Aerial leaves entire or 3-lobed, more or less elliptic in outline; lamina $5-10 \mathrm{~mm}$. Flowers $3-6 \mathrm{~mm}$ in
diameter. Achenes numerous, minutely papillose. E.C. \& E. Europe. ? $\mathrm{Cz} \mathrm{Hu} \mathrm{Rm} \mathrm{Rs}(\mathrm{C}, \mathrm{W}, \mathrm{E})$.

Sect. Ranuncella (Spach) Freyn. Roots fibrous or rarely tuberous. Leaves entire, more or less parallel-veined. Flowers yellow, white or pinkish. Achenes more or less compressed, veined, keeled.
112. R. pyrenaeus L., Mantissa Altera 248 (1771). Perennial $5-15 \mathrm{~cm}$. Stock fibrous. Leaves linear to broadly lanceolate, sessile; cauline few, sessile. Pedicels 1 - to 10 -flowered, glabrous below, pubescent above. Flowers c. 20 mm in diameter, white. Sepals glabrous, whitish. Honey-leaves obovate, often imperfect or some lacking. Receptacle ovoid, pubescent. Achenes rhomboid, inflated, nearly smooth; beak short, nearly straight. $2 n=32$. Alps, Pyrenees, mountains of Spain, Corse. Au Co Ga He Hs It.

The populations of this species from the Pyrenees and Corse usually have narrow leaves and slender stems. Those of the Alps with broad leaves and more robust stems have been called subsp. plantagineus (All.) Rouy \& Fouc., Fl. Fr. 1: 80 (1893). The variation here, however, seems to be more or less continuous. The population in the Sierra Nevada appears to merit subspecific rank:
(a) Subsp. pyrenaeus: Stems often branched; leaves linear, cauline 1-3; flowers $10-20 \mathrm{~mm}$ in diameter. - Alps, Pyrenees, mountains of N. Spain, Corse.
(b) Subsp. alismoides (Bory) O. Bolós \& Font Quer, Collect. Bot. (Barcelona) 6: 355 (1962): Stems usually simple; leaves lanceolate, cauline 0-1; flowers $10-13 \mathrm{~mm}$ in diameter. $\quad S$. Spain (Sierra Nevada).
113. R. bupleuroides Brot., Fl. Lusit. 2: 365 (1804). Like 112 but more branched; basal leaves ovate or lanceolate-ovate with slender petioles. Plant glabrous except for petioles and base of stem. Flowers pale yellow. Achenes transversely rugose. $2 n=16$. N.W. Spain, Portugal. Hs Lu.
114. R. gramineus L., Sp. Pl. 549 (1753). Glaucous, glabrous or pubescent perennial $20-50 \mathrm{~cm}$. Stock stout, fibrous. Basal leaves linear to lanceolate, flat, sessile; cauline few, small, sessile. Pedicels 1 - to few-flowered. Flowers $c .20 \mathrm{~mm}$ in diameter, deep yellow. Sepals glabrous, yellowish. Honey-leaves broadly obovate. Receptacle ovoid, glabrous. Achenes 3 mm , slightly compressed, keeled, veined; beak 0.5 mm , stout, nearly straight. - S. Europe; very local. Ga He Hs It Lu Sa.
115. R. abnormis Cutanda \& Willk., Linnaea 30: 83 (1859). Perennial. Roots tuberous. Stem $5-20 \mathrm{~cm}$, glabrous or pubescent. Leaves linear-lanceolate, cucullate at apex; cauline small, sessile. Pedicels 1- to 3 -flowered, more or less pubescent. Flowers $20-25 \mathrm{~mm}$ in diameter, yellow. Sepals yellowish, more or less pubescent. Honey-leaves $8-10$, oblong-obovate. Receptacle oblong, glabrous. Achenes ovate, slightly compressed, smooth; beak very short, curved. - W. and C. Spain, Portugal. Hs Lu.
116. R. parnassifolius L., Sp. Pl. 549 (1753). Perennial 4-$10(-20) \mathrm{cm}$. Basal leaves entire, ovate-cordate or broadly lanceolate, at first pubescent at base, on margins and beneath; main veins usually 7 ; petioles not widened into the lamina; cauline leaves amplexicaul. Pedicels pubescent above, 1- to severalflowered. Flowers $20-25 \mathrm{~mm}$ in diameter, white or reddish. Sepals pubescent. Honey-leaves broadly ovate. Achenes smooth, inflated; beak very short, hooked. Alps, Pyrenees, N. Spain. Au Ga He Hs It.
117. R. wettsteinii Dörfler, Anzeig. Akad. Wiss. (Wien) 15: 282 (1918). Like 116 but petiole widened gradually into the lamina; main veins usually 5 ; leaves often coarsely 2 - to 4 -dentate. - Jugoslavia (N.E. of Korab). Ju.

This is perhaps best regarded as a subspecies of $\mathbf{1 1 6}$.
118. R. amplexicaulis L., Sp. Pl. 549 (1753). Perennial 830 cm . Basal leaves ovate-lanceolate; cauline amplexicaul. Pedicels glabrous, 1- to several-flowered. Flowers c. 20 mm in diameter, white. Sepals glabrous, greenish, caducous. Honeyleaves obovate-orbicular. Achenes inflated, strongly veined; beak curved. Pyrenees, and mountains of N. Spain. Ga Hs.

Subgen. Batrachium (DC.) A. Gray. Aquatic or marsh plants. Leaves all with a broad lamina (laminate) or all divided into capillary segments (capillary), or of both kinds. Honey-leaves white; claw yellow or white. Achenes transversely rugose.
119. R. hederaceus L., $S p$. Pl. 556 (1753). A procumbent annual or biennial growing on mud or in shallow water. Leaves $1-2 \mathrm{~cm}$ wide, reniform or suborbicular-cordate, with 3(-5) shallow, semi-orbicular or triangular, obtuse, entire segments which are widest at their base. Honey-leaves up to 4.5 mm , scarcely longer than sepals, not contiguous. Receptacle glabrous. Achenes glabrous; beak lateral. $2 n=16$. W. Europe, extending eastwards to C. Germany and S.E. Sweden. Be Br Da Ga Ge Hb Ho Hs Lu Su. [No.]
120. R. omiophyllus Ten., Fl. Nap. 4: 338 (1830) (R. lenormandii F. W. Schultz). Like 119 but leaf-segments narrowest at their base, with wide shallow crenations; honey-leaves up to 7 mm , about twice as long as sepals; beak of achene almost central. $2 n=16,32$. W. Mediterranean region and W. Europe to Ireland and the Netherlands. Br Ga Hb Ho Hs It Lu Si .
121. R. tripartitus DC., Icon. Pl. Gall. Rar. 1: 15 (1808) (incl. R. lutarius (Revel) Bouvet). An annual or perennial growing on mud or in water. Leaves up to 4 cm wide, reniform or suborbicular, with $3(-5)$ cuneate, distant, entire or crenate segments. Capillary leaves with very slender, sometimes compressed segments, absent in terrestrial plants. Honey-leaves up to 6 mm , not more than twice as long as sepals. Receptacle globose, pubescent. Achenes glabrous; beak lateral or subterminal. $2 n=48$. W. Europe from Portugal to Britain and the Netherlands. $\mathrm{Br} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Ho} \mathrm{Hs} \mathrm{Lu}$.
122. R. ololeucos Lloyd, Fl. Loire-Inf. 3 (1844). Like 121 but honey-leaves usually more than 6 mm , more than twice as long as sepals, contiguous; claw white. $2 n=16$. W. Europe from Portugal to the Netherlands, except the British Isles. Be Ga Ge Ho Hs Lu.
R. Iusitanicus Freyn, Flora (Regensb.) 63: 24 (1880), differs in having honey-leaves with a yellow claw.
123. R. baudotii Godron, Mém. Soc. Roy. Nancy, 1839: 21 (1840) (Batrachium marinum Fries). An annual or perennial with either laminate or capillary leaves, or both. Laminate leaves with 3 deep, cuneate, distant, entire or crenate segments. Capillary leaves robust, not collapsing when removed from water. Honeyleaves usually more than 6 mm , contiguous. Receptacle ovoid, pubescent. Achenes glabrous, distinctly winged. $2 n=32$. In brackish water. Coasts of most of Europe. Au Be Bl Br Co Da Fe Ga Ge ? Gr Hb Ho Hs It Lu Po Rs (N, B) Si Su.
124. R. peltatus Schrank, Baier. Fl. 2: 103 (1789) (R. petiveri auct., non Koch; Batrachium dichotomum Schmalh., B. langei F. W. Schultz, B. triphyllos (Wallr.) Dumort.). An annual or perennial with either laminate or capillary leaves, or both. Laminate leaves semi-orbicular with a truncate base, to orbicular, with 3-7 shallow, usually crenate segments. Capillary leaves shorter than the internodes. Pedicel in fruit usually more than 50 mm and exceeding the petiole of the subtending leaf. Honeyleaves usually more than 10 mm , contiguous; nectaries more or less pyriform. Achenes more than 2 mm , ovate. $2 n=32$. Most of Europe. All except Al Az Fa Is Sb .
125. R. pseudofluitans (Syme) Newbould ex Baker \& Foggitt, Thirsk Nat. Hist. Bot. Exch. Club Cur. Rep. 1864: 5 (1865) (Batrachium carinatum Schur, B. kaufmannii (Clerc) V. Krecz.). Like 124 but larger, more robust; capillary leaves longer than internodes and plant usually found in flowing water. $2 n=24,32$, 40, 48. Most of Europe except the Balkan peninsula. Au Be Br $\mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Lu} \mathrm{Po} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K)} \mathrm{Su}$.

This species is not yet understood. The treatment given here is very conservative. There are several genetically different races that can be recognized in cultivation, but phenotypic variation is so great that their detection in the field is impossible.
126. R. sphaerospermus Boiss. \& Blanche in Boiss., Diagn. Pl. Or. Nov. 3 (5): 6 (1856). Like 124 but without laminate leaves and achenes up to 1 mm , subglobose. Balkan peninsula. Gr Ju Tu. (Asia Minor.)
127. R. aquatilis L., Sp. Pl. 556 (1753) (Batrachium gilibertii V. Krecz.). Like 124 but segments of laminate leaves with dentate margins; pedicel in fruit rarely more than 50 cm and usually shorter than the petiole of the subtending leaf; honey-leaves up to c. 10 mm ; nectaries circular. $2 n=48$. Most of Europe. All except Al Az Fa Is Sb ?Tu.
128. R. trichophyllus Chaix in Vill., Hist. Pl. Dauph. 1: 335 (1786) ( $R$. paucistamineus Tausch, Batrachium divaricatum (Schrank) Wimmer, R. drouetii F. W. Schultz ex Godron, B. eradicatum (Laest.) Fries, B. trichophyllum (Chaix) van den Bosch). An annual or perennial without laminate leaves. Capillary leaves rarely more than 4 cm . Pedicel in fruit usually less than 40 mm . Honey-leaves rarely more than 5 mm , not contiguous. Achenes more than 2 mm , ovate. Most of Europe. All except Az Bl Sb.
(a) Subsp. trichophyllus: Robust, erect, rooting only at lower internodes; not arctic-alpine. $2 n=32$. Throughout the range of the species.
(b) Subsp. lutulentus (Perr. \& Song.) Vierh., Abhand. Zool.Bot. Ges. Wien 16: 109 (1935): Delicate, procumbent, rooting at most internodes; arctic-alpine. $2 n=32 . C . \& N$. Europe. Au Fe Ga Ge He ?Hs ?It No Rs (N) Su.
129. R. rionii Lagger, Flora (Regensb.) 31: 49 (1848) (Batrachium rionii (Lagger) Nyman). Like 128 but short-lived annual with subglobose achenes up to $1 \mathrm{~mm} .2 n=16$. Czechoslovakia and Jugoslavia to S.E. Russia. Au Cz Gr Hu Ju Rm Rs (W, E); probably extinct in He .
130. R. circinatus Sibth., Fl. Oxon. 175 (1794) (R. divaricatus sensu Coste, Batrachium foeniculaceum auct.). Perennial without laminate leaves. Capillary leaves c. 3 mm , circular in outline, segments rigid, divergent, lying in one plane. Honey-leaves rarely more than 10 mm , contiguous. Receptacle pubescent. $2 n=16$. Most of Europe except the south-west. Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hu It Ju Po RmRs (B, C, W, K, E) Su.
131. R. fluitans Lam., Fl. Fr. 3: 184 (1778). A perennial without laminate leaves. Capillary leaves usually more than 8 cm ; segments not diverging, collapsing when removed from water. Receptacle nearly or quite glabrous, $2 n=16,24,32$. - Local in W. \& C. Europe. Au Be Br Bu Cz Ga Ge He Ho Hu ?It Po Rm Su.

## 20. Ceratocephalus Pers. ${ }^{1}$

Like Ranunculus but achenes with an empty cell on either side of the seed and an acuminate more or less up-curved beak 2-3 times as long as the achene.
Beak falcate, broad; empty cells far apart

1. falcatus

Beak nearly straight, narrow; empty cells nearly touching
2. testiculatus

1. C. falcatus (L.) Pers., Syn. Pl. 1: 341 (1805) (Ranunculus falcatus L.). Pubescent annual $2-10 \mathrm{~cm}$. Leaves 3-fid and once or twice forked into linear-oblong segments. Flowers $10-15 \mathrm{~mm}$ in diameter, solitary. Honey-leaves yellow; nectaries c. $\frac{1}{3}$ as long as honey-leaf. Receptacle elongated in fruit. Achenes $9-10 \mathrm{~mm}$, numerous, with broad falcate beaks and empty cells far apart. Cultivated fields and waste places. S. \& C. Europe. Bu Cz Gr $\mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(K}, \mathrm{E)} \mathrm{Tu} \mathrm{[Ga]}$.
2. C. testiculatus (Crantz) Roth, Enum. 1: 1014 (1827) (C. orthoceras DC., Ranunculus testiculatus Crantz). Like 1 but less hairy and rather glaucous; flowers $5-10 \mathrm{~mm}$ in diameter; achenes $5-6 \mathrm{~mm}$, with narrow, nearly straight beaks and empty cells nearly touching. Cultivated fields and waste places. E.C. \& S.E. Europe. Au Bu Cz Gr Hu Po Rm Rs (C, W, K, E).

## 21. Myosurus L. ${ }^{1}$

Small annuals. Flowers solitary, small. Perianth-segments 5 or more; honey-leaves 5-7, tubular, sometimes absent. Stamens few. Achenes numerous; receptacle greatly elongated in fruit.

## Pedicel slender in fruit

1. minimus

Pedicel becoming much thickened in fruit
2. heldreichii

1. M. minimus L., Sp. Pl. 284 (1753). Glabrous. Leaves linear, entire, in a basal rosette. Pedicel 5-12 cm. Flowers pale greenishyellow. Perianth-segments $3-4 \mathrm{~mm}$, linear-oblong, spurred at base. Honey-leaves with a short oblong limb. Achenes $1-1.5 \mathrm{~mm}$, keeled, very shortly beaked. $2 n=16,28$. Cultivated fields. Most of Europe, but rare in the extreme north and south and in the islands. Au Be Br Bu Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju No Po RmRs (N, B, C, W, K, E) Si Su Tu.

2 M. heldreichii Léveillé, Bull. Acad. Int. Géogr. Bot. (Le Mans) 11: 296 (1902). Like 1 but the pedicel much thickened in fruit; beak of the achenes longer, straight. On ground flooded in spring. - Aegean region (Dhilos). Gr.

## 22. Aquilegia L. ${ }^{2}$

Perennial herbs with erect, woody stock. Leaves compound, 1 to 3-ternate. Flowers hermaphrodite. Perianth-segments (sepals) 5 , petaloid; honey-leaves (petals) 5, more or less tubular, each with a flat limb and a backwardly directed nectar-secreting spur. Stamens numerous, the innermost represented by scarious staminodes. Carpels free. Follicles several, free.

Many species and hybrids are cultivated for ornament.
Literature: P. A. Munz, Gentes Herbarum 7: 1 (1946).

[^89]1 Flower yellow
14. aurea

1 Flower purple, blue or white
2 Spur shorter than limb of honey-leaf
3 Perianth-segments $22-40 \times 16-22 \mathrm{~mm}$
3 Perianth-segments less than $20 \times 11 \mathrm{~mm}$
4 Spur straight; basal leaves biternate

## 3. transsilvanica

4 Spur 15. kitaibelii
4 Spur strongly hooked; basal leaves ternate (rarely biternate)
5 Flowers violet-blue; perianth-segments elliptic-ovate

1. litardierei

5 Flowers pale blue to white; perianth-segments ellipticlanceolate
2. paui

2 Spur at least as long as the limb of honey-leaf
6 Flowers bicolorous
7 Limb of honey-leaf 9 mm or more
8 Basal leaves ternate; perianth-segments $25-30 \mathrm{~mm}$
9. dinarica

8 Basal leaves 2-ternate; perianth-segments $18-24 \mathrm{~mm}$
9 Limb of honey-leaf 13-14 mm, rounded at apex; stamens not exserted 7. amaliae
9 Limb of honey-leaf $16-20 \mathrm{~mm}$, truncate at apex; stamens exserted
8. ottonis

7 Limb of honey-leaf less than 8 mm
10 Leaves 3-ternate, with numerous glandular hairs on both surfaces
11. pancicii

10 Leaves 2-ternate, with few glandular hairs
11 Spur c. 12 mm , strongly hooked
10. dichroa

11 Spur 6-10 mm, $\pm$ straight (19-22). pyrenaica group
6 Flowers concolorous
12 Stamens exserted at least 1 mm beyond the limb of honeyleaf
13 Spur strongly hooked
14 Perianth-segments $15-24 \mathrm{~mm}$; leaves glabrous beneath
12. atrata

14 Perianth-segments $25-35 \mathrm{~mm}$; leaves pubescent beneath
13. nigricans

13 Spur $\pm$ straight
15 Limb of honey-leaves 3-6 mm; spur 3-7 mm
(19-22). pyrenaica group
15 Limb of honey-leaves $8-20 \mathrm{~mm}$; spur more than 8 mm
16 Perianth-segments greenish at the apex; honey-leaves pale blue 25. nevadensi
16 Perianth-segments not greenish at the apex; honeyleaves purple to violet 26. grata
12 Stamens either not exserted beyond the limb of the honeyleaf, or exserted for less than 1 mm
17 Leaves mostly ternate; stem viscid above
6. hirsutissima

17 Leaves all 2-ternate; stem not viscid above
18 Plant subscapose; all cauline leaves $\pm$ undivided, linear, sessile
19 Perianth-segments $10-18 \mathrm{~mm}$ wide, staminodes 67 mm
18. bertolonii

19 Perianth-segments $7-8 \mathrm{~mm}$ wide; staminodes c. 5 mm
20 Leaves glabrous beneath; limb of honey-leaves 810 mm
16. einseleana

20 Leaves pubescent beneath; limb of honey-leaves 1113 mm 17. thalictrifolia
18 Plant not subscapose; cauline leaves divided like the basal leaves, or somewhat smaller
21 Spur strongly hooked
22 Staminodes acute; follicles c. 12 mm 5. viscosa
22 Staminodes obtuse; follicles $15-25 \mathrm{~mm}$ 4. vulgaris
21 Spur straight, or somewhat curved, never strongly hooked
23 Perianth-segments $5-7 \mathrm{~mm}$ wide; spur $6-7 \mathrm{~mm}$
23. cazorlensis

23 Perianth-segments $8-16 \mathrm{~mm}$ wide; spur $10-25 \mathrm{~mm}$
24 Follicles $13-17 \mathrm{~mm}$
(19-22). pyrenaica group
24 Follicles $20-30 \mathrm{~mm}$
25 Spur $15-17 \mathrm{~mm}$; styles $10-15 \mathrm{~mm}$
24. bernardii

25 Spur 18-25 mm; styles 6-7 mm 27. alpina

1. A. litardierei Briq., Prodr. Fl. Corse 1: 589 (1910). Stems up to 12 cm , ascending, simple, glabrous below, with sparse
long eglandular hairs above. Basal leaves ternate; leaflets 3 -fid, crenate, subglabrous above, with short eglandular hairs beneath. Flowers violet-blue, nodding. Perianth-segments $14 \times$ 7 mm , elliptic-ovate; limb of honey-leaf c. $12 \times 7 \mathrm{~mm}$; spur up to 8 mm , hooked. Stamens slightly exserted. Follicles puberulent. - Corse. Co.
2. A. paui Font Quer, Trab. Mus. Ci. Nat. Barcelona 5: 198 (1920). Stems $8-15 \mathrm{~cm}$, glandular-pubescent. Basal leaves ternate or 2-ternate; leaflets 3 -fid, glandular-hairy beneath. Flowers pale blue to white. Perianth-segments $c .10 \mathrm{~mm}$, elliptic-lanceolate; limb $9 \times 5 \mathrm{~mm}$; spur $6-7 \mathrm{~mm}$, hooked. Stamens not exserted. Follicles c. 10 mm . N.E. Spain. Hs.
3. A. transsilvanica Schur, Verh. Siebenb. Ver. Naturw. 4: 31 (1853). Stems 15-45 cm, subglabrous below, with long eglandular hairs above. Basal leaves 2-ternate; leaflets 2 - to 3 - or more-fid, glabrous above, with sparse short eglandular hairs beneath. Flowers blue-violet, nodding. Perianth-segments $22-40 \times 16-$ 22 mm ; limb of honey-leaf $20-24 \mathrm{~mm}$; spur strongly hooked. Follicles pubescent. Carpathians. Po Rm Rs (W).
4. A. vulgaris L., Sp. Pl. 533 (1753). Stems usually $30-60 \mathrm{~cm}$, subglabrous to hairy, eglandular. Basal leaves biternate; leaflets 2- to 3 -fid, glabrous above, hairy beneath. Flowers nodding, usually violet, occasionally red or white. Perianth-segments $18-25 \times 10-12 \mathrm{~mm}$; limb of honey-leaf $10-13 \times 9-12 \mathrm{~mm}$; spur $15-22 \times 7-9 \mathrm{~mm}$, strongly hooked. Stamens occasionally somewhat exserted; staminodes obtuse. Follicles glandular-pubescent. $2 n=14$. W., C. \& S. Europe. Au Az Be Br Co Cz Ga Ge $\mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{*Rm} \mathrm{Rs} \mathrm{(N)} \mathrm{Sa} \mathrm{Si} \mathrm{[Da} \mathrm{Fe} \mathrm{No} \mathrm{Rs}$ (B, C, W, K, E) Su].

No attempt has been made to account for the many variants, both wild and cultivated, of this polymorphic species; for further information see Munz (op. cit.).
5. A. viscosa Gouan, Fl. Monsp. 267 (1765). Like 4 but with glandular-hairy stems; staminodes acute; follicles c. 12 mm . S. France, Italy. Ga It.
6. A. hirsutissima (Lapeyr.) Timb.-Lagr. ex Gariod, Bull. Soc. Bot. Fr. 19: xcix (1872). Stems $10-25 \mathrm{~cm}$, with viscid-glandular hairs. Basal leaves ternate; leaflets 3-fid, glandular-hairy all over; cauline leaves few, small. Flowers pale blue to white. Perianthsegments $20-24 \times 6-10 \mathrm{~mm}$; limb of honey-leaf $7-12.5 \times 6-8 \mathrm{~mm}$; spur $10-19 \mathrm{~mm}$, hooked. Follicles glandular-pubescent. S.E. France, N.E. Spain. Ga Hs.
7. A. amaliae Heldr. ex Boiss., Diagn. Pl. Or. Nov. 3 (1): 11 (1853). Stems 20-30 cm, glandular-hairy. Basal leaves 2-ternate; leaflets 2 - to 3 -fid, glabrous above, with long eglandular hairs beneath. Flowers nodding, bicolorous. Perianth-segments $18 \times 8-9 \mathrm{~mm}$, pale blue-violet; limb $13-14 \times 8 \mathrm{~mm}$, white, rounded at the apex; spur $13-14 \times 3-4 \mathrm{~mm}$, pale violet, strongly hooked. Follicles c. 12 mm , glandular-pubescent. Balkan peninsula. Al Ju Gr.
8. A. ottonis Orph. ex Boiss., op. cit. 11 (1853). Like 7 but limb of honey-leaf $16-20 \mathrm{~mm}$, truncate at apex; stamens exserted. - C. \& S. Italy; Greece. Gr It.

Plants from S. Italy described as var. unguisepala Borbás are distinct in having very glandular-pilose stems and petioles and larger flowers. They may deserve subspecific status.

This species and 7 are connected by intermediates which have sometimes been recognized as A. amaliae var. taygetea (Orph.) Hayek.
9. A. dinarica G. Beck, Ann. Naturh. Mus. (Wien) 6: 341 (1891). Stems up to 20 cm , with patent villous hairs in the lower half. Basal leaves ternate; leaflets more or less deeply 3-partite, greyish, covered with soft patent hairs. Flowers nodding, bicolorous. Perianth-segments $25-30 \mathrm{~mm}$, intense blue; limb of honey-leaf $11-20 \times 11 \mathrm{~mm}$, white or bluish inside; spur $13-15 \mathrm{~mm}$, blue, hooked. Follicles glandular-pubescent. Calcareous rocks and screes, 1200-2000 m. - N.W. Balkan peninsula. Al Ju.
10. A. dichroa Freyn, Flora (Regensb.) 63: 26 (1880). Stems $20-75 \mathrm{~cm}$, with eglandular hairs below, and glandular hairs above. Leaves 2-ternate; leaflets 2- to 3-fid, crenate, subglabrous. Flowers nodding, bicolorous. Perianth-segments $15-20 \times 6 \mathrm{~mm}$, blue; limb of honey-leaf $c .8 \times 8 \mathrm{~mm}$, blue with white apex; spur $c .12 \mathrm{~mm}$, hooked. Staminodes obtuse. Follicles glandular-pubescent. - Portugal, N.W. Spain. Hs Lu.
11. A. pancicii Degen, Magyar Bot. Lapok 4: 118 (1905). Like 10 but stems with glandular hairs only; leaves 3-ternate; staminodes acute. - Srbija. Ju.
12. A. atrata Koch, Flora (Regensb.) 13: 119 (1830). Stems $40-80 \mathrm{~cm}$, densely pilose, at least above. Basal leaves 2-ternate; leaflets 2 - to 3 -fid, more or less glabrous. Flowers nodding, dark purple-violet. Perianth-segments $15-24 \times 8-9 \mathrm{~mm}$; limb of honeyleaf $8-12 \times 7-9 \mathrm{~mm}$; spur $10-15 \times 4 \mathrm{~mm}$, hooked. Stamens long-exserted. Follicles glandular-pubescent. $2 n=14$. Alps, Appennini. Au Ga Ge He It.

A number of variants of this species have been described, but they seem of doubtful status.
13. A. nigricans Baumg., Enum. Stirp. Transs. 2: 104 (1816). Like 12 but stems glandular-hairy; leaves and leaflets smaller; flowers larger (perianth-segments $25-35 \mathrm{~mm}$, limb of honey-leaf $11-14 \times 8-10 \mathrm{~mm}$, spur $13-15 \times 5-6 \mathrm{~mm}$ ). C. \& S.E. Europe. $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.
(a) Subsp. nigricans: Stems $40-80 \mathrm{~cm}$. Flowers numerous, purplish. Throughout the range of the species.
(b) Subsp. subscaposa (Borbás) Soó, Acta Geobot. Hung. 5: 206 (1943): Stems up to 30 cm . Flowers 1-3, bright blue.

Romania.
14. A. aurea Janka, Österr. Bot. Zeitschr. 22: 174 (1872). Stems $10-40 \mathrm{~cm}$, subglabrous to densely hairy. Basal leaves 2-ternate; leaflets 2 - to 3 -fid, glabrous above, pubescent beneath. Flowers suberect, yellow. Perianth-segments $20-30 \times 10-15 \mathrm{~mm}$; limb of honey-leaf $15-20 \times 10-12 \mathrm{~mm}$; spur $13-15 \times 4 \mathrm{~mm}$, hooked. Follicles pubescent. Bulgaria, Makedonija. Bu Ju.
15. A. kitaibelii Schott, Verh. Zool.-Bot. Ges. Wien 3: 129 (1853). Stems $15-30 \mathrm{~cm}$, glandular-hairy, densely so above. Basal leaves 2-ternate; leaflets hairy above and beneath. Flowers suberect, red-violet to blue-violet. Perianth-segments $16-20 \times 8$ 11 mm ; limb of honey-leaf $10-13 \times 7-10 \mathrm{~mm}$; spur $5-10 \times 3-$ 4 mm , straight or slightly curved, not hooked. Follicles glandularpubescent. Jugoslavia; N.E. Italy. It Ju.
16. A. einseleana F. W. Schultz, Arch. Fl. France Allem. 135 (1848). Stems $10-45 \mathrm{~cm}$, subscapose, subglabrous below, sparsely glandular above. Basal leaves 2-ternate; leaflets shallowly 2 - to 3 -fid, subglabrous above, glabrous beneath; cauline leaves more or less entire, linear. Flowers nodding, blue-violet. Perianthsegments $15-19 \times 7-8 \mathrm{~mm}$; limb of honey-leaf $8-10 \times 6-9 \mathrm{~mm}$; spur $7-10 \times 2-3 \mathrm{~mm}$, straight; staminodes c. 5 mm . Follicles glandular-pubescent. Alps. Au Ge He It.
17. A. thalictrifolia Schott \& Kotschy, Verh. Zool.-Bot. Ges. Wien 3: 130 (1853). Like 16 but leaves, petioles and stems glandular-pubescent; perianth-segments c. 20 mm ; lamina 11$13 \times 7-9 \mathrm{~mm}$; spur $8-11 \times 3-4 \mathrm{~mm}$. N. Italy. It.
18. A. bertolonii Schott, Verh. Zool.-Bot. Ges. Wien 3: 127 (1853) (A. reuteri Boiss.). Stems $10-30 \mathrm{~cm}$, subscapose, glandularpubescent above. Basal leaves biternate, leaflets 2- to 3-fid; cauline leaves more or less entire, linear. Flowers nodding, blue-violet. Perianth-segments $18-33 \times 9-14 \mathrm{~mm}$; limb of honey-leaf 10 $14 \times 6-8 \mathrm{~mm}$; spur $10-14 \times 3-4 \mathrm{~mm}$, straight or somewhat curved. Staminodes $6-7 \mathrm{~mm}$. Follicles pubescent. France, Italy. Ga It.
(19-22). A. pyrenaica group. Stems $10-30 \mathrm{~cm}$, subglabrous to glandular-pubescent, sometimes subscapose. Basal leaves usually biternate; leaflets 2 - to 3 -fid, glabrous to glandular-pubescent; cauline leaves more or less simple, linear. Flowers bright blue, occasionally with white lamina, nodding. Spur at least as long as the limb of the honey-leaf, straight or slightly curved.
1 Flowers concolorous

2 Perianth-segments 10 mm ; spur 3-7 mm
2 Perianth-segments $20-35 \mathrm{~mm}$; spur $10-16 \mathrm{~mm}$
1 Flowers bicolorous
3 Stems not branched, 1- to 2 -flowered
3 Stems branched, many-flowered
19. A. pyrenaica DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 640 (1815). Stems $10-30 \mathrm{~cm}$. Basal leaves 2-ternate; leafiets subglabrous. Flowers bright blue. Perianth-segments $20-35 \times 10-$ 16 mm ; limb of honey-leaf $12-15 \times 8-10 \mathrm{~mm}$; spur $10-16 \times 3-$ 4 mm , straight or slightly curved. Follicles $13-17 \mathrm{~mm}$, glandularpubescent. Pyrenees and N. Spain (Santander). Ga Hs.

Divided into several species by workers on the flora of the Pyrenees (vide O. Bordères, Doc. Cartes (Vég. Sér. Pyrénées Tome Généralités) 3 (2) (1942).
20. A. aragonensis Willk. in Willk. \& Lange, Prodr. Fl. Hisp. 3: 966 (1880). Stems $10-15 \mathrm{~cm}$, densely pubescent. Leaves ternate; leaflets puberulent. Flowers deep blue. Perianth-segments 10 mm ; limb of honey-leaf $3-6 \mathrm{~mm}$; spur $3-7 \mathrm{~mm}$, straight. - Pyrenees (Aragón). Hs.
21. A. discolor Levier \& Leresche, Jour. Bot. (London) 17: 197 (1879). Like 20 but stems subglabrous below; leaflets glabrous; limb of honey-leaf white; spur 6-10 mm. - N. Spain (Picos de Europa). Hs.
22. A. guarensis Losa, Collect. Bot. (Barcelona) 2: 78 (1948). Like 20 but stems up to 30 cm , glandular-pubescent; limb of honey-leaf whitish-blue; spur 10-11 mm. - N.E. Spain (Sierra de Guara, near Huesca). Hs.
23. A. cazorlensis Heywood, Bull. Brit. Mus. (Bot.) 1: 84 (1954). Stems $15-25 \mathrm{~cm}$, subglabrous to glandular-pubescent, branched below. Basal leaves 2-ternate; leaflets subglabrous to glandularpubescent; cauline leaves numerous. Flowers concolorous, bright blue. Perianth-segments $10-16 \times 5-7 \mathrm{~mm}$; limb of honeyleaf $8-9 \times 6-7 \mathrm{~mm}$; spur $6-7(-9) \mathrm{mm}$, slightly recurved. Limestone slopes, 2000 m. - S.E. Spain (Cerro Cabañas, Jaén prov.). Hs.
24. A. bernardii Gren. \& Godron, Fl. Fr. 1: 45 (1847). Stems $50-80 \mathrm{~cm}$, glabrous below, glandular-pubescent above. Basal
leaves 2-ternate; leaflets 2- to 3- or more-fid, glabrous. Flowers nodding, pale blue. Perianth-segments $25-35 \times 15 \mathrm{~mm}$; limb of honey-leaf $15-20 \times 15 \mathrm{~mm}$; spur $15-17 \mathrm{~mm}$, straight or somewhat curved. Follicles $20-25 \mathrm{~mm}$, glandular-pubescent; styles $10-$ 15 mm . Corse, Sardegna. Co Sa.
25. A. nevadensis Boiss. \& Reuter, Ann. Sci. Nat. ser. 4, 2: 380 (1854). Stems $15-60 \mathrm{~cm}$, glandular-pubescent. Leaves 2-ternate; leaflets 3 -fid, glandular-pubescent above and beneath. Flowers nodding. Perianth-segments with a green apex. Follicles viscid. - S. Spain. Hs.

Easily distinguished from the other species of the genus in Spain by its very glandular leaves.
26. A. grata F. Maly ex Zimmeter, Jahresb. Staats-Ober-Realschule Steyr 46 (1875). Stems 15-45 cm, glandular-hairy. Basal leaves 2-ternate; leaflets 3 -fid, glandular-pubescent above and beneath. Flowers nodding, purplish-violet. Perianth-segments $c$. $30 \times 9-11 \mathrm{~mm}$; limb of honey-leaf $6-10 \mathrm{~mm}$; spur $14-20 \mathrm{~mm}$, straight. Stamens exserted. Follicles glandular-pubescent. - Jugoslavia. Ju.
27. A. alpina L., $S p$. Pl. 533 (1753). Variable. Stems $15-80 \mathrm{~cm}$, with long sparse hairs below, densely pubescent above. Basal leaves 2-ternate; leaflets 2 - to 3 -fid, subglabrous. Flowers nodding, bright blue. Perianth-segments $30-45 \times 14-22 \mathrm{~mm}$; limb of honey-leaf $14-17 \times 8-11 \mathrm{~mm}$; spur $18-25 \times 6-7 \mathrm{~mm}$, straight to curved. Follicles $20-28 \mathrm{~mm}$; styles 6-7 mm. Alps, N. Appennini. Au Ga He It.

## 23. Thalictrum L. ${ }^{1}$

Perennial herbs. Leaves 2- to 3-pinnate or -ternate, stipulate and sometimes with stipels. Flowers small, in panicles or racemes. Perianth-segments 4-5, usually caducous. Honey-leaves absent. Stamens numerous, conspicuous. Achenes few, stipitate or sessile, ribbed, angled or winged.

Literature: J. C. Lecoyer, Bull. Soc. Bot. Belg. 24: 78-325 (1885).

1 Filament near the top at least as wide as the anther
2 Filament about the same width as the anther
3 Achenes pendent, 3-angled and winged; most leaflets about as wide as long (widespread) 1. aquilegifolium
3 Achenes erect, ribbed but not winged; most leaflets nearly twice as wide as long (S. Italy, Sicilia)
2. calabricum

2 Filament at least twice as wide as the anther
3. uncinatum

1 Filaments filiform
4 Inflorescence a simple raceme
7. alpinum 4 Inflorescence a panicle
5 Perianth-segments 8 mm or more, white
6 Leaves evenly spaced; achenes 2-6; roots not tuberous
6. orientale

6 Leaves crowded at base; achenes (6-) $10-30$; roots tuberous
5. tuberosum

5 Perianth-segments c. 3 mm , greenish, purplish or yellowish
7 Achenes $c .10 \mathrm{~mm}$, with anastomosing ribs 4. macrocarpum
7 Achenes less than 5 mm , with longitudinal ribs only
8 Leaves 3- to 4 -ternate, about as wide as long
9 Plant not densely glandular
9 Plant densely glandular
10 Stigma strongly fimbriate
9. minus

## 10 Stigma not fimbriate

8. foetidum 9. minus 8 Leaves 2- to 3-pinnate, distinctly longer than wide 11 Stamens pendent; anthers apiculate $\quad$ 10. simplex 11 Stamens erect; anthers not or very shortly apiculate
12 Rhizome not far-creeping; stipels absent on young leaves 11. lucidum
12 Rhizome far-creeping; stipels present on young leaves
[^90]13 Leaflets of upper leaves dentate or lobed; inflorescence oblong-ovoid, stem not shining 13. flavum
13 Leaflets of upper leaves entire; inflorescence wide, with patent branches; stem shining
12. morisonii
(A) Stamens longer than perianth; filaments widened towards the top.

1. T. aquilegifolium L., Sp. Pl. 547 (1753). Glabrous perennial $40-150 \mathrm{~cm}$, with a short stock. Leaves 2 - to 3 -ternate, with stipels; leaflets obovate-cuneate, dentate. Panicle much-branched, corymbose. Flowers usually numerous, erect. Filaments as wide as anthers, lilac or whitish. Achenes $c .7 \mathrm{~mm}$, long-pedicelled, pendulous, with 3 winged angles; beak short, appressed. $2 n=14$. $E . \& C$. Europe and locally on mountains in the south. Al Au Bu $\mathrm{CzFe} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C)} \mathrm{Su}$.
2. T. calabricum Sprengel, Pl. Min. Cog. Pug. 1: 37 (1813). Like 1 but leaves without stipels; flowers few; achenes shortly pedicellate, 7 - to 8 -ribbed, not winged. $2 n=42$. Shady places. - S. Italy (Calabria); Sicilia. It Si.
3. T. uncinatum Rehman, Spraw. Kom. Fizyogr. Kraków. 7: 90 (1873) (T. petaloideum auct., non L.). Glabrous perennial 1540 cm . Leaves 2 - to 3-pinnate, with stipels; leaflets suborbicular, entire or 3-lobed, sessile, glaucous. Panicle compact and umbellike. Flowers erect. Filaments white, at top much wider than anthers. Achenes $3-4 \mathrm{~mm}$, sessile, ovoid-elliptical, ribbed; beak c. 1 mm , hooked. - W. Ukraine (Upper Dnestr valley). Rs (W).
T. podolicum Lecoyer, Bull. Soc. Bot. Belg. 24: 173 (1885) was described from a single collection from the same region and has not been rediscovered. It is said to differ from 3 in having the leaves pubescent on the veins beneath, a broad pyramidal inflorescence, yellowish filaments and achenes with a curved, not hooked beak.
(B) Stamens longer or shorter than perianth; filaments filiform.
(a) Carpels longer than stamens and perianth-segments.
4. T. macrocarpum Gren., Séances Publiq. Acad. Sci. Besançon 117 (1838). Glabrous perennial $30-60 \mathrm{~cm}$, with a short stock. Basal leaves 3- to 4-ternate, without stipels; leaflets broadly ovate, coarsely dentate. Flowers yellowish, few, long-pedicellate, erect. Achenes few, sessile, erect, compressed; beak long, curved. Damp limestone rocks. - W. \& C. Pyrenees. Ga ?Hs.
(b) Carpels shorter than stamens and perianth-segments.
(i) Perianth-segments longer than stamens.
5. T. tuberosum L., Sp. Pl. 545 (1753). Glabrous perennial $20-40 \mathrm{~cm}$, with a short stock and ovoid tuberous roots. Leaves mostly basal, 2- to 3 -pinnate, without stipels; leaflets suborbi-cular-cuneate, dentate. Flowers yellowish-white, few, erect. Perianth-segments c. 15 mm . Achenes numerous, sessile, fusiform, sulcate; beak short. Dry rocky places. - Pyrenees, Corbières and E. Spain. Ga Hs.
6. T. orientale Boiss., Ann. Sci. Nat. sér. 2, Bot. 16: 349 (1841). Glabrous perennial $10-30 \mathrm{~cm}$, shortly rhizomatous with fibrous roots. Leaves mostly cauline, like those of 5 . Flowers white, few, erect. Perianth-segments not more than 10 mm . Achenes 2-6, subsessile, narrowly oblong, sulcate; beak short. S. Greece (foothills of Tailyetos). Gr. (S. Anatolia, N. Syria.)
(ii) Perianth-segments shorter than stamens; anthers not or scarcely apiculate.
7. T. alpinum L., Sp. Pl. 545 (1753). Glabrous perennial 520 cm , with a short stock. Leaves almost all basal, 2-ternate, without stipels; leaflets suborbicular, dentate. Flowers purplishgreen, at first pendent, later erect, in a simple raceme. Fruit pendent; achenes $2-3$, narrowly oblong, ribbed, shortly stalked; beak short, curved. $2 n=14$. Arctic and subarctic Europe, extending southwards very locally on mountains to the Pyrenees, Alps and E. Carpathians. Au Br Fa Fe Ga Hb He Hs Is It Ju No RmRs(N) Su.
(iii) Perianth-segments shorter than stamens; stamens pendent; anthers apiculate.
8. T. foetidum L., Sp. Pl. 545 (1753). Glandular, foetid, shortly rhizomatous perennial $10-40 \mathrm{~cm}$, with some long eglandular hairs. Basal leaves 3- to 4-ternate, without stipels; leaflets $2-4 \mathrm{~mm}$, suborbicular or broadly ovate, irregularly dentate in the upper half. Inflorescence with long branches. Flowers yellow, pendent. Filaments slightly thickened. Stigma minutely fimbriate. Fruit erect; achenes $c .10$, sessile, compressed, ovate in outline, strongly ribbed; beak nearly as long as achene. $2 n=14$. Mountains of E., C. \& S.W. Europe, westwards to E. Spain. Au Bu Cz Ga He Hs Hu It Ju Rm Rs (C, W).

The plants from the Pyrenees and Spain are devoid of eglandular hairs and may be T. minus subsp. pubescens (Schleicher ex DC.) Rouy \& Fouc. They require further investigation.

All the remaining species are very variable and it is sometimes difficult, if not impossible, to identify a given specimen with certainty. Many more or less uniform populations have been described as species but they appear generally to be connected with one another by numerous intermediates. The variation-pattern is complicated by the common occurrence of the plants in small isolated populations which may, in rhizomatous species, often consist of single clones. All the populations which have been examined cytologically are polyploid and inbreeding or possibly apomixis may occur.
9. T. minus L., Sp. Pl. 546 (1753). Glabrous or somewhat glandular perennial $15-150 \mathrm{~cm}$, subcaespitose or rhizomatous. Basal leaves 3- to 4-ternate, without stipels; leaflets suborbicular or broadly ovate, irregularly lobed or dentate in the upper half. Inflorescence with long branches. Flowers yellowish, pendent, becoming erect. Filaments filiform. Stigma not fimbriate. Fruit erect; achenes $3-15$, sessile, not or slightly compressed, broadly ovoid to narrowly oblong-ovoid, ribs not very strong; beak much shorter than achene. Most of Europe. All except Az Bl Fa Is Sb Tu.

The following grouping into subspecies is provisional, in the absence of thorough experimental and cytological investigation of the species. Achene-size and -shape and the presence or absence of glandular hairs seem at present to be valueless as characters.
1 Leaves crowded at or below the middle of the stem; leaflets
with prominent veins beneath
1 Leaves $\pm$ evenly spaced; leaflets without prominent veins beneath
2 Plant densely glandular, at least on the lower surface of the leaflets
(d) subsp. pubescens

2 Plant not or scarcely glandular
3 Branches of the leaf-rhachis terete or flattened
(e) subsp. pseudominus

3 Branches of the leaf-rhachis strongly ribbed
4 Stigmas strongly fimbriate (arctic)
(f) subsp. kemense
$4 \begin{aligned} & 4 \\ & 4\end{aligned}$ Stigmas strongly fimbriate

> 5 Leaflets usually 4-15 mm wide; panicle branching above the middle of the stem
> (a) subsp. minus

> 5 Leaflets usually $10-30 \mathrm{~mm}$ wide; panicle branching from about the middle of the stem
> (b) subsp. majus
(a) Subsp. minus: Stems usually $25-50 \mathrm{~cm}$. Leaves evenly spaced; leaflets 4-15 mm wide. Panicle usually branching above the middle of the stem. $2 n=42$. Widespread except in the north.
(b) Subsp. majus (Crantz) Rouy \& Fouc., Fl. Fr. 1: 16 (1893) (T. elatum Jacq.): Stems usually $50-120 \mathrm{~cm}$. Leaves evenly spaced; leaflets usually $10-30 \mathrm{~mm}$ wide. Panicle usually branching from about the middle of the stem. Widespread except in the north.
(c) Subsp. saxatile Schinz \& Keller, Fl. Schweiz ed. 3, 1: 270 (1909): Stems usually $15-30 \mathrm{~cm}$. Leaves crowded at or below the middle of the stem; leaflets coriaceous, with prominent veins beneath. C. \& E. Europe.
(d) Subsp. pubescens (Schleicher ex DC.) Rouy \& Fouc., Fl. Fr. 1: 14 (1893): Plant densely glandular, at least on the lower surface of the leaflets; leaflets $4-15 \mathrm{~mm}$, about as long as wide. France and Spain.
(e) Subsp. pseudominus (Borbás) Soó in Soó \& Jáv., Magyar Növ. Kéz. 1: 226 (1951): Plant glaucous; stems $10-40 \mathrm{~cm}$; branches of the leaf-rhachis terete or flattened, not ribbed; leaflets $10-20 \mathrm{~mm}$ wide. On dolomite. S.E. Europe.
(f) Subsp. kemense (Fries) Tutin, Feddes Repert. 69: 55 (1964): Stems up to 60 cm ; inflorescence narrow, flowers few; stigma strongly fimbriate. Arctic Europe.
10. T. simplex L., Mantissa 78 (1767). Glabrous perennial $20-120 \mathrm{~cm}$, with a long rhizome. Basal leaves 2- to 3-pinnate, without stipels; leaflets ovate-cuneate to linear, lobed or dentate to entire. Inflorescence usually narrowly oblong, with short branches. Flowers yellowish, pendent, becoming erect. Fruit ellipsoid, ribbed; stigma sagittate. Most of continental Europe; rarer in the west and absent from the islands. Au Bu $\mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C}, \mathrm{W}, \mathrm{K}$, E) Su .

1 Leaflets of upper leaves linear-lanceolate to linear, entire
2 Some leaflets linear-lanceolate or wider, 2- to 3-lobed
(d) subsp. bauhinii

2 All leaflets narrowly linear, entire
(e) subsp. galioides

1 Leaflets of upper leaves oblong- to ovate-cuneate, lobed or dentate
3 Inflorescence a lax ovoid-pyramidal panicle (France)
(c) subsp. gallicum

3 Inflorescence narrowly ovoid or oblong
4 Leaflets of upper leaves oblong-cuneate (widespread)
(a) subsp. simplex

4 Leaflets of upper leaves obovate-cuneate (arctic)
(b) subsp. boreale
(a) Subsp. simplex ( $T$. strictum Ledeb.): Leaflets oblongcuneate, lobed or dentate. Inflorescence usually leafy to the apex; flowers numerous, pedicels short. $2 n=56$. Throughout the range of the species except the extreme north.
(b) Subsp. boreale (F. Nyl.) Tutin, Feddes Repert. 69: 55 (1964): Leaflets ovate-cuneate, lobed or minutely dentate. In-
florescence very leafy, except at the apex; flowers few, pedicels long. Stigma papillose. N. Fennoscandia.
(c) Subsp. gallicum (Rouy \& Fouc.) Tutin, Feddes Repert. 69: 55 (1964): Leaflets obovate-cuneate, usually 3-lobed, margins recurved. Inflorescence with rather long patent, or ascending branches; flowers numerous; pedicels long. $E$. France.
(d) Subsp. bauhinii (Crantz) Tutin Feddes Repert. 69: 55 (1964): Leaflets linear-lanceolate to narrowly oblong, entire or 2- to 3-lobed, margins recurved. Inflorescence with short, erect or ascending branches; flowers numerous; pedicels short. C. Europe and Sweden.
(e) Subsp. galioides (Nestler) Borza, Consp. Fl. Roman. 105 (1947): Leafiets linear, entire. Inflorescence leafless at the apex; flowers numerous; pedicels short. C. \& S.E. Europe.
(iv) Perianth-segments shorter than stamens; stamens erect; anthers not or very shortly apiculate.
11. T. lucidum L., Sp. Pl. 546 (1753) (incl. T. bulgaricum Velen.). Caespitose perennial $60-120 \mathrm{~cm}$. Leaves mostly sessile, 2- to 3-pinnate, without stipels; leaflets of lower leaves ovatecuneate to linear-oblong, of upper leaves lanceolate to linear, all entire or 2- to 3-lobed at apex. Inflorescence ovoid, branches long, ascending. Flowers yellowish, in rather dense clusters. Achenes oblong-ovoid, with $8-10$ strong ribs; beak short. C. \& E. Europe. Al Au Bu Cz Ge Gr Hu Ju Po Rm Rs (N, C, B, W) Tu.
12. T. morisonii C. C. Gmelin, Fl. Bad. 4: 422 (1826) (T. exaltatum Gaudin). Perennial $50-190 \mathrm{~cm}$, with far-creeping rhizomes. Stem shiny. Leaves 2- to 3-pinnate, with stipels when young; leaflets of lower leaves obovate-cuneate, lobed, of upper leaves linear to linear-lanceolate, entire. Inflorescence ovoid, branches long, patent. Flowers yellow, not densely clustered. Achenes broadly ovoid, with $8-10$ strong ribs; beak short. $W$. Mediterranean region, extending locally northwards to S.W. Germany. Co Ga Ge He Hs It.
(a) Subsp. morisonii: Leaves glabrous beneath. W. Alps, doubtfully in N.E. Spain.
(b) Subsp. mediterraneum (Jordan) P. W. Ball, Feddes Repert. 66: 153 (1962): Leaves pubescent or glandular beneath. $W$. Mediterranean region.
13. T. flavum L., Sp. Pl. 546 (1753). Perennial $50-120 \mathrm{~cm}$, with far-creeping rhizomes and stolons. Stem not shiny, often with adventitious roots at the base. Leaves 2- to 3-pinnate, with stipels when young; leaflets obovate-cuneate to oblong, 3to 4-lobed at apex. Inflorescence narrowly oblong-ovoid. Flowers yellow, in dense clusters. Achenes ovoid, with 6 ribs. Most of Europe. Al Au Be Br Bu Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Su.
(a) Subsp. flavum: Plant not glaucous; leaflets without prominent veins beneath. $2 n=84$. Most of Europe.
(b) Subsp. glaucum (Desf.) Batt. in Batt. \& Trabut, Fl. Algér. (Dicot.) 4 (1888) (T. speciosissimum L.): Plant glaucous; leaflets with prominent veins beneath. Spain and Portugal.

## LXII. PAEONIACEAE ${ }^{1}$

Perennial herbs or shrubs. Leaves alternate, exstipulate. Flowers usually solitary, hermaphrodite, actinomorphic, hypogynous. Sepals 5, free. Petals 5-10(-13), free. Stamens numerous. Carpels 2-8, free, borne on a fleshy disc. Fruit a group of 2-8 follicles, each with several seeds.

## 1. Paeonia L. ${ }^{2}$

Perennial herbs, usually with woody stems, dying down in the winter, or evergreen, with erect tuberous stocks and fleshy roots. Leaves large, simply biternate, or further divided. Flowers 614 cm in diameter; petals white, pink or red. Stamens numerous. Carpels 2-8, free, glabrous or pubescent. Fruit a group of horizontally spreading follicles; seeds in two rows.

A number of species and hybrids are widely cultivated for ornament.

Literature: F. C. Stern, A Study of the Genus Paeonia. London. 1946.

1 Segments of lower leaves more than 40, each segment less than 5 mm wide

1. tenuifolia

1 Segments of lower leaves less than 40 , each segment more than 5 mm wide
2 Petals white, occasionally flushed pink 5. clusii
2 Petals red or deep pink
3 Most leaflets divided, the lower leaves with 17-30 narrowly elliptical to lanceolate segments
4 Leaves with minute bristles along the veins on the upper surface
5 Ultimate leaf-segments cut to $\frac{1}{5}$ or $\frac{1}{6}$ of the total leaflet length, broadly triangular, spreading, the leaflet appearing serrate at the apex
3. peregrina

5 Ultimate leaf-segments cut to $\frac{1}{3}$ or more of the total leaflet length, narrowly triangular, deltate or subulate, leaflet not appearing serrate at the apex
2. anomala

4 Leaves without such bristles
6 Leaves glaucous and glabrous beneath; leaflets narrowly elliptical; filaments yellow 6. broter
6 Leaves green or brownish and pubescent beneath; leaflets very narrowly elliptical to lanceolate; filaments red
4. officinalis

3 Most leaflets undivided, the lower leaves with 9-16 elliptical, ovate or orbicular segments
7 Leaflets orbicular; margins undulate 8. daurica
7 Leaflets generally narrower; margins not undulate
8 Follicles 5-8, c. 6 cm , glabrous, purple 10. cambessedesii
8 Follicles less than 5 , less than 6 cm , glabrous or pubescent, never purple, sometimes reddish
9 Follicles (3.5-) $4 \cdot 5 \mathrm{~cm}$, glabrous, with apex attenuate into stigma 9. coriacea
9 Follicles $2 \cdot 5-4 \mathrm{~cm}$, usually pubescent, with obtuse or rounded apex and sessile stigma
10 Leaves glabrous beneath; leaflets 2-4 cm wide, narrowly elliptical 6. broteroi
10 Leaflets usually pubescent beneath; leaflets $5-10 \mathrm{~cm}$ wide, elliptical
7. mascula

1. P. tenuifolia L., Syst. Nat. ed. 10, 2: 1079 (1759). Leaves divided into many linear segments, which are less than 5 mm wide; glabrous above, pubescent beneath. Flowers $6-8 \mathrm{~cm}$ in diameter, red, appearing to rest on the leaves. Filaments yellow. Follicles 2-3, c. 2 cm , tomentose. S.E. Europe. Bu Ju Rm Rs (W, K, E).

[^91]${ }^{2}$ By J. Cullen and V. H. Heywood.
2. P. anomala L., Mantissa Altera 247 (1771). Leaf-segments numerous, the ultimate segments deltoid or subulate, wider than 5 mm ; glabrous beneath, with minute bristles along the main veins on the upper surface. Flowers $7-9 \mathrm{~cm}$ in diameter, red. Filaments yellow. Follicles 3-5, c. 2 cm . N.E. Russia. Rs (N, C). (N. Asia.)

Most European plants of this species belong to var. intermedia (C. A. Meyer) B. Fedtsch., with villous follicles, and are regarded by some Russian authors as var. intermedia (C. A. Meyer) Krylov of $P$. hybrida Pallas. Var. anomala, with glabrous follicles, is restricted in Europe to parts of Ural.
3. P. peregrina Miller, Gard. Dict. ed. 8, no. 3 (1768) ( $P$. decora G. Anderson). Lower leaves divided into 17-30 narrowly elliptical segments, the ultimate segments short, broadly triangular, spreading, giving the apex of the leaflet a serrate appearance, sparsely villous to glabrous beneath, with minute bristles along the main veins above. Flowers 7-13 cm in diameter, red, cup-shaped. Filaments red. Follicles $2-3,2-3 \cdot 5 \mathrm{~cm}$, tomentose. Italy, Balkan peninsula, S. Romania. Al Bu Gr Ju It Rm.
4. P. officinalis L., Sp. Pl. 530 (1753). Lower leaves divided into $17-30$ segments, pubescent beneath, glabrous above; petiole deeply channelled on the upper surface. Flowers $7-13 \mathrm{~cm}$ in diameter, red, not cup-shaped. Filaments red. Follicles 2-3, $2-3.5 \mathrm{~cm}$, usually tomentose, sometimes glabrous. S. \& S.C. Europe. Al Au Ga He Hs Hu It Ju Lu Rm [Cz].
1 Leaflets cut into segments almost to the base
2 All or most of the leaflets so divided $\quad$ (a) subsp. officinalis
2 Only the central leaflet so divided $\quad$ (b) subsp. banatica
1 Leaflets cut into segments which are at most $\frac{1}{3}$ of the total leaflet length
3 Follicles pubescent; stems and petioles floccose (d) subsp. villosa
Follicles glabrous; stems and petioles pubescent
(c) subsp. humilis
(a) Subsp. officinalis: From France to Hungary and Albania.
(b) Subsp. banatica (Rochel) Soó, Növényföldrajz 146 (1945) (P. banatica Rochel): Hungary, Jugoslavia, Romania.
(c) Subsp. humilis (Retz.) Cullen \& Heywood, Feddes Repert. 69: 34 (1964) (P. humilis Retz): S.W. Europe.
(d) Subsp. villosa (Huth) Cullen \& Heywood, Feddes Repert. 69: 34 (1964): S. France to C. Italy.

Plants from Baziaş, in the Banat, identified as P. banatica Rochel by many authors, are not subsp. banatica but variants of 7 and have the wide leaflets typical of that species.
5. P. clusii F. C. Stern, Bot. Mag. 162: t. 9594 (1940) (P. officinalis var. glabra (Boiss.) Hayek). Lower leaves with 30 or more narrowly oblong to narrowly elliptical segments, glabrous above and beneath, or slightly pubescent beneath. Flowers $7-9 \mathrm{~cm}$ in diameter, white, or occasionally flushed pink. Follicles 2-4, c. 3 cm , densely tomentose. $2 n=10$. Kriti and Karpathos. Cr.
6. P. broteroi Boiss. \& Reuter, Diagn. Pl. Nov. Hisp. 4 (1842). Lower leaves divided into (9-)17-20 narrowly elliptical, glabrous segments; petiole more or less terete. Flowers $8-10 \mathrm{~cm}$ in diameter, red. Filaments yellow. Follicles 2-4, 3-4 cm, densely tomentose. $2 n=10$. - S. \& W. Spain; Portugal. Hs Lu.
7. P. mascula (L.) Miller, Gard. Dict. ed. 8, no. 1 (1768) ( $P$. corallina Retz., P. caucasica (Schipcz.) Schipcz.; incl. P. banatica auct. hung. et al., non Rochel). Leaves simply biternate, or with a few leaflets divided; segments $9-16$, narrowly to broadly elliptical to ovate, glabrous or pubescent beneath. Flowers 814 cm in diameter, red. Follicles $3-5,2-4 \mathrm{~cm}$, usually pubescent, rounded at the apex, with a sessile stigma. S. Europe, extending northwards to N.C. France and Austria. Al Au Bu Co Cr Ga Gr $\mathrm{Ju} \mathrm{Rm} \operatorname{Sa} \mathrm{Si}[\mathrm{Br}]$.

1 Leaves glabrous beneath
(a) subsp. mascula

1 Leaves pubescent beneath
2 Lower leaves with 12-15 narrowly elliptical leaflets
(c) subsp. arietina

2 Lower leaves with 9-10 broadly elliptical to ovate leaflets
(b) subsp. russii
(a) Subsp. mascula: Widespread.
(b) Subsp. russii (Biv.) Cullen \& Heywood, Feddes Repert. 69: 35 (1964) (P. russii Biv.): $2 n=20$. Islands of $W$. Mediterranean.
(c) Subsp. arietina (G. Anderson) Cullen \& Heywood, Feddes Repert. 69:35(1964) (P. arietina G. Anderson): E. Europe.

Specimens identified by Stern as $P$. russii var. reverchonii Le Grand and P. russii var. leiocarpa (Cosson) F. C. Stern, appear to be intermediate between $P$. mascula subsp. russii and 9 .
8. P. daurica Andrews, Bot. Reposit. 7: t. 486 (1807) (P. triternata Pallas). Very like 7 (a) but leaflets ovate to orbicular with undulate margins; follicles fewer (2-3). S.E. Europe. Ju Rm Rs (K, W).

This species is probably part of the $P$. mascula complex; further studies are necessary before its status can be settled.
9. P. coriacea Boiss., Elenchus 7 (1838). Very like 7 (a), but leaves coriaceous; follicles fewer (usually 2 ), longer ( $3 \cdot 5-4 \cdot 5 \mathrm{~cm}$ ), glabrous, with the apex attenuate into the stigma. S. Spain; possibly Corse and Sardegna. ?Co Hs ?Sa.
10. P. cambessedesii (Willk.) Willk. in Willk. \& Lange, Prodr. Fl. Hisp. 3: 976 (1880), in obs., et Willk., Ill. Fl. Hisp. 1: 104, t. 65A (1883). Lower leaves biternate, leaflets lanceolate to ovate, occasionally elliptical, glabrous above and beneath, flushed purple beneath. Flowers $6-10 \mathrm{~cm}$ in diameter, red. Follicles 5-8, c. 6 cm , glabrous, purplish. $2 n=10$. Islas Baleares. Bl.

## LXIII. BERBERIDACEAE ${ }^{1}$

Shrubs or herbs. Leaves alternate or basal. Flowers hermaphrodite, 3-(rarely 2 -)merous. Perianth-segments 6-9, in 3 or 4 whorls, at least the inner ones petaloid; honey-leaves 4-6, petaloid or nectariform. Stamens 4-6, opposite the honeyleaves; anthers dehiscing by apically-hinged valves. Carpel solitary, superior.

## 1 Herbs; fruit dry

2 Stamens 4; ovules numerous, on 2 lateral placentae

## 4. Epimedium

2 Stamens 6; ovules 2-8, on a basal placenta
$\begin{array}{ll}3 \text { Leaves all basal; honey-leaves flat, petaloid } & \text { 3. Bongardia }\end{array}$
3 Stem $\pm$ leafy; honey-leaves small, convolute
4 Several cauline leaves on each stem, most of them with an axillary raceme; fruit $25-40 \mathrm{~mm}$ 1. Leontice
4 Each flowering stem with a single cauline leaf and raceme; fruit $c .5 \mathrm{~mm}$
1 Shrubs; fruit a berry
5 Leaves simple
2. Gymnospermium

5 Leaves pinnate
5. Berberis
6. Mahonia

## 1. Leontice L. ${ }^{2}$

Glabrous herbs with tuberous rhizome. Leaves 2- to 3-ternate, not all basal. Flowers in terminal and axillary, bracteate racemes. Perianth-segments $6(-8)$, conspicuous, yellow, petaloid. Honey-leaves 6, much smaller, convolute. Stamens 6. Fruit 1to 4 -seeded, with inflated, membranous pericarp, dehiscing irregularly by decay. Seeds without aril.

1. L. leontopetalum L., Sp. Pl. 312 (1753). Stem $30-50 \mathrm{~cm}$, erect, branched above. Leaves up to 20 cm wide, the lower with long petioles, the upper sessile, all 2 - to 3 -ternate; ultimate segments broadly obovate, entire. Racemes usually numerous, in axils of upper leaves, pedunculate, with conspicuous bracts, of which the lower are often compound or lobed. Flowers 15-40, on long pedicels, crowded at first, later distant. Perianth-segments c. 8 mm , ovate-oblong. Honey-leaves 1.5 mm , less than

[^92]half as long as stamens. Fruit $25-40 \mathrm{~mm}$, ovoid. Ploughed fields and waste places. S.E. part of Balkan peninsula; Aegean islands. Bu Cr Gr Tu. (S.W. Asia, N. Africa.)

## 2. Gymnospermium Spach ${ }^{2}$

Like Leontice, but each stem with one basal and one cauline leaf and a single raceme; fruit dehiscing apically by rounded lobes before the seeds are ripe; seeds with a membranous aril.

1. G. altaicum (Pallas) Spach, Hist. Vég. (Phan.) 8: 67 (1839) (Leontice altaica Pallas; incl. L. odessana (DC.) Fischer ex G. Don fil.). Stems 5-20 cm, slender, each with a long-petiolate basal leaf and a subsessile cauline leaf immediately below the inflorescence. Leaves ternate, the primary divisions divided palmately into 4-7 entire, oblong, obtuse segments $15-35 \mathrm{~mm}$ long. Raceme short, with $6-12$ flowers. Perianth-segments $8-10 \mathrm{~mm}$, oblong; honey-leaves somewhat shorter than stamens. Fruit $5-6 \mathrm{~mm}$, subglobose, pendent; seeds $1-4$, remaining attached for some time after dehiscence of the fruit. Black Sea region, from Krym to E. Romania. Rm Rs (W, K).

In spite of the wide geographical separation, typical material from the Altai Mountains agrees well with plants from Europe, and the separation of the latter at more than varietal level does not seem to be justified.

## 3. Bongardia C. A. Meyer ${ }^{2}$

Like Leontice, but leaves all basal, pinnatisect; perianth-segments small; honey-leaves large and petaloid.

1. B. chrysogonum (L.) Griseb., Spicil. Fl. Rumel. 1: 294 (1843) (Leontice chrysogonum L.). Tuber large, subglobose. Leaves 1025 cm , all basal, spreading horizontally, deeply pinnatisect into 7-17 sessile, oblong-cuneate segments, which are usually 3 - to

5 -toothed at the apex but sometimes bifid to the base, glaucousgreen, often reddish near the rhachis. Stem up to 60 cm , the upper half consisting of a large panicle with ascending branches. Perianth-segments 6 , small, suborbicular, sepaloid, caducous. Honey-leaves $8-12 \times 3.5-5 \mathrm{~mm}$, irregularly crenate distally, petaloid, golden yellow. Fruit $c .15 \mathrm{~mm}$, ovoid; seeds 1-2, large, black, pruinose. Ploughed fields. S. Aegean region (Astipalaia); perhaps extinct. ?Gr. (S.W. Asia.)

## 4. Epimedium L. ${ }^{1}$

Rhizomatous herbs. Leaves compound. Flowers 2-merous, in panicles. Perianth-segments 8 , the outer 4 sepaloid, the inner 4 petaloid. Honey-leaves 4, flat proximally and tubular distally (slipper-shaped). Stamens 4. Fruit many-seeded, dry, dehiscing into 2 unequal valves.

Literature: W. T. Stearn, Jour. Linn. Soc. London (Bot.) 51: 409 (1938).
Inflorescence shorter than cauline leaf; inner perianth-segments
dark red 1. alpinum
Inflorescence overtopping cauline leaf; inner perianth-segments pink
2. pubigerum

1. E. alpinum L., Sp. Pl. 117 (1753). Stems $15-30 \mathrm{~cm}$, numerous, arising from a slender, extensively creeping rhizome, each bearing a single leaf which overtops the lax, terminal, nodding panicle; basal leaves also present. Leaves 2 - to 3 -ternate; leaflets 5-10, ovate, cordate, acute, spinose-ciliate, pubescent below at first but glabrous at maturity. Outer 4 perianth-segments pinkish-grey, caducous; inner 4 dull, dark red, longer; honeyleaves bright yellow, lying in the concavity of the inner perianthsegments. Shady places. Foothills and lower slopes of mountains, from N. \& C. Italy to Austria and Albania; often cultivated in gardens in W. \& C. Europe and locally naturalized. Al Au It Ju [ $\mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He]}$.
2. E. pubigerum (DC.) Morren \& Decne, Ann. Sci. Nat. ser. 2, 2: 355 (1834). Like 1 but with shorter, stouter rhizome; mature leaflets usually white-pubescent beneath; inflorescence more erect, raising the flowers above the leaves; inner perianthsegments pale pink. Thrace. Bu Tu. (Asia Minor and Caucasus.)

## 5. Berberis L. ${ }^{2}$

Shrubs; wood bright yellow. Leaves on long shoots transformed into spines, simple or palmately divided to the base into 3 or 5 . Foliage-leaves simple (deciduous in European species), clustered on short shoots in the axils of the spines. Flowers in racemes, sometimes condensed to small, umbel-like clusters. Perianthsegments usually 9 ; the 3 outermost (sometimes interpreted as bracteoles) small and sepaloid, the 6 inner bright yellow, petaloid. Honey-leaves petaloid, similar to inner perianth-segments. Stamens 6, usually sensitive to touch. Fruit a 2 -seeded berry.

Literature: C. K. Schneider, Bull. Herb. Boiss. ser. 2, 5: 33 seq. (1905); 8: 192 seq. (1908). L. W. S. Ahrendt, Jour. Linn. Soc. London (Bot.) 57: 1-410 (1961),

[^93]1. B. vulgaris L., Sp. Pl. 330 (1753). $1 \cdot 5-3 \mathrm{~m}$; branches mostly erect; twigs yellowish, ridged. Spines usually 3 -fid; segments $6-18 \mathrm{~mm}$, subequal, slender. Leaves $25-55 \mathrm{~mm}$, exceeding the spines, elliptic-obovate, spinulose-serrate. Racemes $30-50 \mathrm{~mm}$, pendent, with (12-)15-30 flowers. Honey-leaves $5-6 \mathrm{~mm}$, slightly exceeding inner perianth-segments. Berry $10 \times 5 \mathrm{~mm}$, oblong, bright orange-red; stigma quite sessile. $2 n=28$. Most of continental Europe except the extreme north, but rare in the Mediterranean region. Al Au Be Bu Cz Ga Ge Gr He Ho Hs Hu It Ju * Lu Po Rm Rs (B, C, W, K, E). [Br Da Fe Hb No Rs (N) Su Tu.]

The limits of this species as a native cannot be precisely determined. On the one hand, it has been extensively planted, originally for its edible fruit and more recently for ornament, and has become naturalized; on the other hand, in some regions attempts to extirpate it (as the intermediate host of Puccinia graminis) have been more or less successful.
2. B. aetnensis C. Presl, Fl. Sic. 1: 28 (1826). $30-60 \mathrm{~cm}$; branches spreading and tortuous. Spines usually 3 -fid; segments $13-25 \mathrm{~mm}$, stout. Leaves $15-40 \mathrm{~mm}$, usually narrowly elliptical, spinulose-serrate at least in apical half. Racemes $20-30 \mathrm{~mm}$, with 3-14 flowers. Honey-leaves $3-4 \mathrm{~mm}$, shorter than the inner perianth-segments. Berry dark red; stigma very shortly stipitate. $2 n=28$. - Mountains of C. Mediterranean region. Co It ?Ju Sa Si.

Sometimes regarded as a subspecies of $\mathbf{1}$; plants with intermediate characters are found in the Alps and S. France and have been described as $B$. vulgaris var. alpestris Rikli. On the other hand some authors distinguish from typical B. aetnensis (of Italy and Sicilia) the plants from Corse and Sardegna as B. boissieri C. K. Schneider, Bull. Herb. Boiss. ser. 2, 5: 660 (1905), which is said to have leaves with less prominent veins and teeth, and shorter racemes. These differences, however, seem scarcely constant enough even for subspecific distinction.
3. B. hispanica Boiss. \& Reuter, Pugillus 3 (1852). $60-150 \mathrm{~cm}$, densely and intricately branched; twigs at first green, later dark red, ridged. Spines usually 3-fid; segments $12-20 \mathrm{~mm}$ (the median the longest), stout. Leaves $8-18(-22) \mathrm{mm}$, rarely exceeding the spines, elliptical-obovate, usually entire but sometimes with up to 6 distant, broad-based marginal teeth. Racemes $10-25 \mathrm{~mm}$, pendent, with 6-15 flowers. Honey-leaves 3 mm , shorter than the inner perianth-segments. Berry $9 \times 5 \mathrm{~mm}$, oblong, dark red or black; stigma very shortly stipitate. Mountains of C. \& S. Spain, c. 1500-2300 m. Hs.

Sometimes regarded as a subspecies of 1; plants with intermediate characters are found in E. \& C. Spain and include those described as B. garciae Pau, Not. Bot. Fl. Esp. 2: 6 (1889).
4. B. cretica L., Sp. Pl. 331 (1753). Very like 3, but said to be stoloniferous; leaves nearly always entire; racemes $7-15 \mathrm{~mm}$, scarcely exceeding the leaves, with only $3-8$ flowers; honeyleaves c. 4.5 mm , longer than the inner perianth-segments; fruit $6-7 \mathrm{~mm}$. Mountains of Greece and Aegean region. Cr Gr .

## 6. Mahonia Nutt. ${ }^{2}$

LikeBerberis but with unarmed stems and pinnate, evergreen leaves.

1. M. aquifolium (Pursh) Nutt., Gen. N. Amer. Pl. 1: 212 (1818) (Berberis aquifolium Pursh). A stoloniferous shrub 50-100 $(-200) \mathrm{cm}$. Stems stout, sparingly branched. Leaves evergreen composed of 5-9(-13) leaflets; leaflets $4-8 \times 2-4 \mathrm{~cm}$, ovate, distantly
spinose dentate, coriaceous, dark, shining green. Racemes $5-8 \mathrm{~cm}$, suberect, in groups of 3-5; flowers yellow. Honey-leaves c. 8 mm , slightly exceeding inner perianth-segments. Berries globose, black,
strongly bluish-pruinose. Frequently cultivated in W. \& C. Europe, and locally naturalized. [ $\mathrm{Au} \mathrm{Br} \mathrm{Cz} \mathrm{Ge} \mathrm{Gr} \mathrm{Ho} \mathrm{Hu]}$. (W. North America.)

## LXIV. MAGNOLIACEAE ${ }^{1}$

Trees or shrubs with alternate, simple leaves. Stipules large, deciduous, leaving annular scars at the nodes. Flowers actinomorphic, hermaphrodite, large, solitary. Perianth-segments free, arranged in whorls of 3-6, usually not differentiated into sepals and petals. Stamens numerous, spirally arranged. Carpels unilocular, numerous, spirally arranged. Fruiting carpels dry or fleshy, 1- or more-seeded, usually dehiscent. Embryo minute; endosperm copious.

Apart from Liriodendron, several species of Magnolia, with entire leaves which are not truncate or emarginate at apex, and with dehiscent fruiting carpels from which the seeds hang on long, silky threads, are cutilvated for ornament.

## 1. Liriodendron L. ${ }^{2}$

Deciduous tree. Leaves with a broad truncate or emarginate apex and 1-2 large lobes on each side; stipules enclosing the bud and each of the young leaves. Perianth petaloid. Fruiting carpels numerous, brown, densely imbricate, each with a terminal wing, indehiscent, ultimately separating from the axis.

1. L. tulipifera L., Sp. Pl. 535 (1753). Glabrous tree up to 60 m . Leaves $7-12 \mathrm{~cm}$; petiole $5-10 \mathrm{~cm}$. Flowers campanulate; perianth-segments $4-5 \mathrm{~cm}$, greenish-white, the inner with a broad orange band near the base. Fruit $5-8.5 \mathrm{~cm}$; fruiting carpels up to 5 cm . Planted for timber and as an ornamental tree. [ Au Da Ge.] (E. North America.)

## LXV. LAURACEAE ${ }^{1}$

Trees or shrubs. Leaves evergreen, entire, gland-dotted, alternate. Dioecious, or flowers hermaphrodite or polygamous; flowers actinomorphic, small, greenish. Perianth deeply 4- to 6-lobed. Stamens usually in 4 whorls, anthers opening by valves. Ovary superior, 1 -celled; style simple. Fruit a berry.
Inflorescence subsessile; perianth 4-lobed

1. Laurus
Inflorescence long-pedunculate; perianth 6-lobed
2. Persea

## 1. Laurus L. ${ }^{2}$

Dioecious. Inflorescence subsessile. Perianth 4-lobed; stamens $8-12$; anthers all introrse, opening by 2 valves.
Leaves oblong-lanceolate, glabrous; young twigs glabrous 1. nobilis Leaves suborbicular to lanceolate, tomentose-hirsute beneath, at least on the midrib, when young; young twigs densely tomentosehirsute
2. azorica

1. L. nobilis L., Sp. Pl. 369 (1753). Shrub or small tree $2-$ 20 m , with slender glabrous twigs. Leaves $5-10 \times 2-4(-7 \cdot 5) \mathrm{cm}$, narrowly oblong-lanceolate, acute or acuminate, glabrous. Male flowers with $8-12$ stamens, all or most with 2 glands at base;
anthers opening by 2 valves. Female flowers with 2-4 staminodes. Fruit $10-15 \mathrm{~mm}$, ovoid, black when ripe. $2 n=42$. Mediterranean region; cultivated elsewhere and naturalized in places. Al *B] $\mathrm{Co} \mathrm{Cr}{ }^{*} \mathrm{Ga} \mathrm{Gr}{ }^{*} \mathrm{Hs} \operatorname{It~Ju}{ }^{*} \mathrm{Lu} \mathrm{Sa} \mathrm{Tu}$ [Rs (K)].
2. L. azorica (Seub.) J. Franco, Anais Inst. Sup. Agron. (Lisboa) 23: 96 (1960). Like 1 but twigs usually stout, densely tomentosehirsute when young; leaves $5-10(-17) \times 3-8 \mathrm{~cm}$, suborbicular to lanceolate, tomentose-hirsute beneath, at least on the midrib, when young. Açores. Az. (Madeira, Canarias.)

## 2. Persea Miller ${ }^{2}$

Inflorescence with a long peduncle. Perianth 6-lobed; flowers hermaphrodite or polygamous; stamens 9 , staminodes 3 ; anthers all opening by 4 valves, those of the third whorl extrorse.

1. P. indica (L.) Sprengel, Syst. Veg. 2: 268 (1825). Tree up to 20 m , with a broad rounded crown and stout twigs, finely sericeous when young. Leaves $8-23 \times 3-8 \mathrm{~cm}$, lanceolate, obtuse or acute, glabrous. Perianth finely sericeous. Fruit c. 20 mm , ellipsoid, bluish-black when ripe. Naturalized in the A̧ores but now very rare. [Az.] (Madeira, Canarias.)

## RHOEADALES

## LXVI. PAPAVERACEAE ${ }^{1}$

Herbs with latex or watery sap. Leaves usually spirally arranged, variously dissected. Flowers hermaphrodite, actinomorphic or zygomorphic, hypogynous. Sepals 2(-3), caducous. Petals 4-6. Stamens 2, 4, or numerous, whorled. Ovary superior, unilocular, bilocular or imperfectly multilocular; carpels 2 to many.
${ }^{2}$ By T. G. Tutin.

## 1 Flowers actinomorphic

2 Sap watery; sepals connate, forming a hood 7. Eschscholzia 2 Latex present; sepals free
3 Capsule less than 10 times as long as wide, narrowed at base
4 Style short; stigmas distinct 2. Meconopsis
4 Style absent; stigmas on a sessile disc at the top of the ovary

5 Leaves not spiny; capsule opening by pores below the stigmatic disc

1. Papaver

5 Leaves spiny; capsule opening by 4-6 valves
3. Argemone

3 Capsule more than 10 times as long as wide, $\pm$ parallel-sided
6 Flowers violet; capsule opening by 2-4 valves 4. Roemeria
6 Flowers yellow or red; capsule opening by 2 valves
7 Flowers solitary; petals 2 cm or more; capsule 2-locular
5. Glaucium

7 Flowers in a simple umbel; petals up to 1 cm ; capsule 1-locular
6. Chelidonium

1 Flowers zygomorphic
8 Flowers weakly zygomorphic; petals not spurred or saccate
8. Hypecoum

8 Flowers strongly zygomorphic; upper petal spurred or saccate at base
9 All fruits 2- to many-seeded, dehiscent
10 Fruit splitting into two; placenta not persistent
11. Sarcocapnos

10 Fruit dehiscing by 2 valves; placenta persistent
11 The two outer petals similar
9. Dicentra

11 The two outer petals dissimilar
10. Corydalis

9 At least the lower fruits 1 -seeded, indehiscent
12 Upper fruits dehiscent, usually 2 -seeded; flowers less than 5 mm 15. Ceratocapnos
12 All fruits indehiscent and 1 -seeded; flowers more than 5 mm
13 Upper petal not spurred; stigma 3-fid, the middle lobe deeply notched, the lateral patent or deflexed
13. Platycapnos

13 Upper petal spurred; stigma 2-lobed, with a small tooth between the lobes
14 Annual; cauline leaves numerous; flowers in racemes
12. Fumaria

14 Perennial; cauline leaves few; flowers in corymbs
14. Rupicapnos

## Subfam. Papaveroideae

Latex usually present. Flowers solitary or umbellate, actinomorphic. Sepals entire; petals entire, not spurred. Stamens numerous. Capsule dehiscing by pores or longitudinal valves.

## 1. Papaver L. ${ }^{1}$

Herbs with latex. Sepals 2, free, caducous. Petals 4, entire, often bright red, crumpled in bud, usually caducous. Stigmas 4-15, sessile over the placentae. Capsule subcylindrical to globose, opening by pores below the stigmatic disc. Aril absent.
Literature: General: F. Fedde in Engler, Pflanzenreich 40 (IV. 104): 288-386 (1909). Sect. Scapiflora: A. C. Fabergé, Jour. Genet. 44: 169-93 (1942); 45: 139-70 (1943); 46: 125-49 (1944). G. Knaben, Op. Bot. (Lund) 2 (3): 1-74 (1959); 3 (3): 1-96 (1959). F. Markgraf in G. Hegi, Ill. Fl. Mitteleur. ed. 2, 4 (1): 29-49 (1958).

1 Scapose perennials with solitary, usually yellow, flowers
(17-26). alpinum group
1 Annuals, biennials or perennials with cauline leaves; flowers usually red or purple
2 Perennials; non-flowering stems present
3 Robust, with stems up to 100 cm ; petals $5-8 \mathrm{~cm}$ 16. orientale
3 Slender, with stems up to 50 cm ; petals less than 4 cm
15. rupifragum

2 Annuals or biennials; all stems bearing flowers
4 Plant glaucous; leaves lobed, rarely pinnatisect, upper amplexicaul 1. somniferum
4 Plant not or only slightly glaucous; leaves usually deeply divided to pinnatisect, upper not amplexicaul
${ }^{1}$ By A. B. Mowat and S. M. Walters.

5 Capsule setose; stigmatic disc convex
6 Capsule $1.5-2 \mathrm{~cm}$, oblong-clavate 10. argemone
6 Capsule $1-1.5 \mathrm{~cm}$, ellipsoid to subglobose
7 Bud broadly ovoid, subglabrous
12. apulum

7 Bud subglobose, obviously hairy
8 Capsule $1-1.5 \mathrm{~cm}$, elongate-ellipsoid 11. nigrotinctum
8 Capsule $1-1.25 \mathrm{~cm}$, subglobose 13. hybridum
5 Capsule glabrous; stigmatic disc flat or convex
9 Capsule subglobose to broadly obovoid, less than twice as long as wide 2. rhoeas
9 Capsule clavate to oblong-elliptical, at least twice as long as wide
10 Stigmatic disc deciduous on mature capsule, with distinctly keeled rays (Lower Volga) 14. macrostomum
10 Stigmatic dise not deciduous, $\pm$ flat (3-9). dubium group
Sect. Papaver. Subglabrous annuals with lobed leaves, the cauline amplexicaul. Stigmatic disc more or less flat.

1. P. somniferum L., Sp. Pl. 508 (1753). Erect glaucous annual $30-100(-150) \mathrm{cm}$. Leaves $7-12 \mathrm{~cm}$, ovate-oblong, pinnately lobed; lower leaves with short petiole, upper amplexicaul. Petals $35-45 \mathrm{~mm}$, suborbicular, white to purple, with dark spot at base. Filaments clavate, white; anthers pale yellow. Capsule 5-9×36 cm , glabrous. Margin of stigmatic disc deeply lobed; stigmatic rays $5-12(-18)$, not reaching edge of lobes. Cultivated since ancient times in most of Europe except the extreme north for its medicinal and narcotic latex and its seeds, which are used as a condiment and a source of oil, and more recently grown in gardens for ornament; widespread as a naturalized alien or casual, and probably native in the W. \& C. Mediterranean region. All except $\mathrm{Al} \mathrm{Be} \mathrm{Da} \mathrm{Fa} \mathrm{Fe} \mathrm{Is} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C)} \mathrm{Sb}$.

The taxonomic treatment of this very variable species is difficult. Three subspecies may be distinguished as follows:

1 Lobes of stigmatic disc flat, with entire margin and obtuse apex
(c) subsp. songaricum

1 Lobes of stigmatic disc sulcate, with dentate margin and truncate apex
2 Setulose; leaves with acute lobes; stigmatic rays 5-8
(b) subsp. setigerum

2 Subglabrous; leaves coarsely dentate or shallowly and obtusely lobed; stigmatic rays $8-12(-18)$ (a) subsp. somniferum
(a) Subsp. somniferum (incl. subsp. hortense (Hussenot) Corb.): Subglabrous, glaucous, up to $100(-150) \mathrm{cm}$. Leaves more or less pinnately lobed; basal attenuate into petiole. Capsule up to $9 \times 6 \mathrm{~cm}$, ovoid to subglobose. Lobes of stigmatic disc sulcate, with dentate margin and truncate apex. Cultivated and escaped throughout most of Europe; origin probably from (b).

Very variable in shape and colour of petals, colour of seeds, shape and size of capsule, etc. Some cultivars have indehiscent capsules.
(b) Subsp. setigerum (DC.) Corb., Nouv. Fl. Normand. 30 (1893): Like (a) but more or less setulose; stems up to 60 cm . Leaves more deeply and acutely lobed; lobes often with an apical seta; capsule $5-6 \times 3-4 \mathrm{~cm}$, subglobose to obovoid. Probably native in the W. Mediterranean region; a weed elsewhere. $\mathrm{Bl} \mathrm{Co}{ }^{*} \mathrm{Cr} \mathrm{Ga}$ *Gr Hs It *Lu *Rs (K) Si.
(c) Subsp. songaricum Basil., Bull. Appl. Bot. Plant-Breed. Leningrad) 19 (2): 134 (1928): Like (a) but lobes of stigmatic disc flat, with entire margin and obtuse apex. Cultivated in the Balkan peninsula. [Bu Gr Ju.] (Asia.)

Sect. Orthorhoeades Fedde. Hispid annuals, with pinnatisect or pinnatifid leaves, cauline not amplexicaul. Capsule glabrous. Stigmatic disc more or less flat.
2. P. rhoeas L., Sp. Pl. 507 (1753). Patent-hispid annual 2590 cm . Leaves 3-15 cm, 1- to 2-pinnate; lower petiolate, upper sessile; segments coarsely dentate, acuminate, terminal usually larger than laterals. Pedicel patent-hispid. Petals $30-45 \mathrm{~mm}$, orbicular, usually red, sometimes with dark spot at base. Filaments filiform, purple; anthers bluish. Capsule $1-2 \mathrm{~cm}$, subglobose or broadly obovoid, rounded at base, slightly ribbed, glabrous. Stigmatic disc more or less flat; rays (5-)8-12(-18). $2 n=14$. Throughout most of Europe as a weed of cultivation and native at least in the south; casual in the north. All except Fa Is Rs (N, B, ?C) Sb Tu.

Very variable. The following taxa may be worthy of specific distinction:
P. strigosum (Boenn.) Schur, Verh. Naturf. Ver. Brünn 15 (5): 66 (1877), occurring through much of the range of 2, with appressed-hispid pedicel and unspotted, usually purple petals.
P. tumidulum Klokov in Klokov \& Wissjul., Fl. RSS Ucr. 5: 502 (1953), from Ukraine, with a large dark spot (sometimes double) on the petals, and a capsule $1 \cdot 2-2 \times 0.6-0.8 \mathrm{~cm}$.
P. tenuissimum Fedde, Bull. Herb. Boiss. ser. 2, 5: 446 (1905), from C. Greece, a small plant (up to 25 cm ), with appressedhispid pedicel and a distinctly stipitate, broadly obovoid capsule $0.75-1 \mathrm{~cm}$.
P. commutatum Fischer \& Meyer, Ind. Sem. Hort. Petrop. 4: 41 (1837), from Kriti and Krym (and Asia Minor), robust, with petals distinctly spotted at about the middle, and slightly stipitate, broadly obovoid, capsule.
(3-9). P. dubium group. Like 2 but somewhat glaucous; upper part of stem and pedicels with appressed hairs; leaves with shorter and wider segments, terminal one not larger than the laterals; petals usually paler red; capsule $1.5-2 \times 0.5-0.75 \mathrm{~cm}$, obovoid-oblong, at least twice as long as wide, and tapering at base; stigmatic rays usually 7-9.

Very variable. Many described taxa have been given infraspecific or separate specific rank. The following seem to be the most important:
1 Capsule distinctly stipitate (carpophore at least 1 mm )

2 Petals unspotted
8. stipitatum

2 Petals with two dark spots
9. maeoticum

1 Capsule sessile or subsessile
3 All leaves bipinnatifid
3 Leaves mostly simply pinnatifid or pinnatisect
4 Anthers violet
4 Anthers yellow or yellow-brown
5 Stems with patent hairs below
5 Stems appressed-hairy throughout, or subglabrous 6 Leaves subglabrous 5. 6 Leaves $\pm$ hispid
5. laevigatum
4. lecoqii
3. P. dubium L., Sp. Pl. 1196 (1753) (incl. P. obtusifolium Desf., $P$. modestum Jordan and $P$. nothum Steven). Hispid annual $20-$ 60 cm ; hairs patent in lower parts, appressed above. Root and latex white. Leaves somewhat glaucous; basal pinnatisect or pinnatifid, segments ovate, obtuse; cauline often bipinnatifid, segments linear-lanceolate, acute. Pedicel appressed-hispid. Petals $15-30(-35) \mathrm{mm}$, suborbicular, red, sometimes with dark spot at base. Filaments filiform, purple; anthers violet, usually below the stigmatic disc. Capsule $1.5-2 \times 0.5-0.75 \mathrm{~cm}$, obovoid, frequently ribbed, glabrous. Stigmatic disc more or less flat; rays $7-9$. $2 n=42$. Throughout most of Europe as a weed of cultivation, but only as a casual in parts of the north. All except Is $\mathrm{Rs}(\mathrm{N}, \mathrm{C}) \mathrm{Sb}$ ?Tu.
P. albiflorum (Besser) Pacz., Acta Horti Bot. Univ. Jurjev 6: 3 (1906), with white or pale pink unspotted flowers, occurs mainly in S.E. Europe, and may be worth subspecific rank.
4. P. lecoqii Lamotte, Ann. Sci. Lit. Industr. Auvergne 23: 429 (1851). Like 3 but less hairy; root and latex yellow; leaves less glaucous, more deeply dissected; anthers yellow, usually reaching the stigmatic disc. $2 n=28$. Mainly in W. Europe. Au Be Br Co Ga Gr Hs ? Ju Lu.
5. P. laevigatum Bieb., Fl. Taur.-Cauc. 3: 364 (1819). Like 3 but subglabrous; petals smaller, $c .15 \mathrm{~mm}$; stigmatic disc slightly convex. S.E. Europe. Bu Rs (W, K) Tu.

Detailed distribution of 4 and 5 is uncertain because of taxonomic confusion.
6. P. arenarium Bieb., Fl. Taur.-Cauc. 3: 364 (1819). Like 3 but more robust, with 2(-3)-pinnatifid leaves; buds with small rounded mammilliform apex; capsule $1-1.5 \mathrm{~cm}$. S.E. Russia; W. Kazakhstan. Rs (E). (Caucasus, Iran.)
7. P. pinnatifidum Moris, Fl. Sard. 1: 74 (1837). Erect hispid annual $30-60 \mathrm{~cm}$. Leaves usually pinnatifid, lower petiolate, upper sessile; segments triangular-ovate, entire or dentate. Pedicel appressed-hispid above, patent-hispid below. Petals $20-$ 25 mm . Filaments filiform, dark violet; anthers yellow. Capsule c. $2 \times 0.5-0.7 \mathrm{~cm}$, oblong-obconic, slightly tapered towards base, ribbed, glabrous. Stigmatic disc slightly convex, not wider than capsule; rays 6-8. Mediterranean region, extending to Bulgaria and Portugal. Bl Bu Co Ga Gr Hs It Lu Sa Si.
8. P. stipitatum Fedde in Engler, Pflanzenreich 40 IV. 104: 322 (1909). Ascending, sparsely appressed-hispid annual $c$. 20 cm . Leaves pinnatilobed, the upper less deeply so. Pedicel appressed-hispid. Petals $c .1 .5 \mathrm{~cm}$, without basal spot. Capsule $1.25-1.5 \times 0.5-0.6 \mathrm{~cm}$, clavate, more or less distinctly ribbed and obviously stipitate. Stigmatic disc somewhat convex; rays often 5. - Aegean region (Skopelos). Gr.
9. P. maeoticum Klokov in Klokov \& Wissjul., Fl. RSS Ucr. 5: 503 (1953). Erect, somewhat glaucous, sparsely appressed-hispid annual up to 35 cm . Petals $1-1.8 \mathrm{~cm}$, triangular-obovate, with two dark spots, one smaller at base, one larger, irregularly rhombic, above the other. Capsule $1-1.6 \times 0.4-0.6 \mathrm{~cm}$, oblongclavate, attenuate at base into a short ( $1-1.5 \mathrm{~mm}$ ) carpophore. Stigmatic disc more or less convex; rays 6-8. - S.E. Ukraine, near Zhdanov. Rs (W, E).

Said to be near to 5 , but the distinctly stipitate capsule and 2 -spotted petals seem to differentiate it clearly.

Sect. Argemonorhoeades Fedde. Like Sect. Orthorhoeades, but capsule setose and stigmatic disc convex.
10. P. argemone L., Sp. Pl. 506 (1753). Hispid annual $20-$ 50 cm . Leaves stiffly hispid, pinnatisect; segments linear- to oblong-lanceolate, usually aristate. Pedicel appressed-hispid. Buds oblong-ovoid. Petals $20-25 \mathrm{~mm}$, obovate, red, sometimes with a dark spot at base. Filaments clavate, violet; anthers bluish. Capsule $1 \cdot 5-2 \mathrm{~cm}$, obovoid-oblong to subcylindrical, distinctly ribbed, with a few erect setae. Stigmatic disc convex; rays 4-6. $2 n=42$. Native in $S$. Europe and widespread as a weed of cultivation farther north. Au Be Bl Br Co Cr Cz DaFa Fe Ga Ge Gr Hb He Ho Hs It Ju Lu No Po Rm Rs (C, W, K) Sa ? Si Su Tu.
11. P. nigrotinctum Fedde in Engler, Pflanzenreich $\mathbf{4 0}$ (IV. 104): 330 (1909). Like 10 but smaller; stems $10-20 \mathrm{~cm}$, numerous, ascending; basal leaves more or less rosulate, bipinnatifid with lanceolate segments; buds ovoid-globose; petals broadly obovate, with large dark spot at base; capsule $1-1 \cdot 5 \mathrm{~cm}$, elongate-ellipsoid. Aegean region (Korinthos, Kikladhes). Gr.

Considered by Fedde to be the hybrid $10 \times 12$, but better treated as a distinct species.
12. P. apulum Ten., Fl. Nap. 4: 305 (1830). Hispid annual $15-40 \mathrm{~cm}$. Leaves subglabrous or sparsely hairy, bipinnatisect; segments of basal leaves suborbicular, of cauline linear. Pedicel densely appressed-hispid. Petals $20-25 \mathrm{~mm}$, obovate, red, with dark spot at base. Filaments clavate, dark violet; anthers violet. Capsule up to 1 cm , ellipsoidal, not or only slightly ribbed, with erect setae. Stigmatic disc convex; rays 4-7. Balkan peninsula, Aegean region, S. Italy and Sicilia. Al Bu Gr It Ju Si.
13. P. hybridum L., Sp. Pl. 506 (1753) (P. hispidum Lam.). Hispid annual $10-50 \mathrm{~cm}$. Leaves hispid, 1- to 2-pinnatisect; segments linear- to oblong-lanceolate, often aristate; lower petiolate, upper sessile. Pedicel densely appressed-hispid, less so above. Petals $10-20(-25) \mathrm{mm}$, obovate, red, with dark spot at base. Filaments clavate, dark violet; anthers pale blue. Capsule $1-1.25 \mathrm{~cm}$, obovoid-globose, ribbed, with stiff erect setae. Stigmatic disc convex; rays $4-8.2 n=14$. Native in $S$. Europe and widespread as a weed of cultivation further north. Au Be Bl Br Bu Co Cr CzFaGaGe Gr He Ho Hs Hu It Ju Lu No Rm Rs (W, K, E) Sa Si Tu .

Sect. Carinata Fedde. Like Sect. Orthorhoeades, but stigmatic disc convex, deciduous at maturity, and rays distinctly keeled.
14. P. macrostomum Boiss. \& Huet in Boiss., Fl. Or. 1: 115 (1867). Hispid annual $20-50 \mathrm{~cm}$. Leaves pinnatisect, the cauline with narrower linear-lanceolate lobes. Pedicel appressed-hispid. Petals $c .2 \mathrm{~cm}$, red or purplish, with a dark spot at base. Capsule $1-1.5 \mathrm{~cm}$, ellipsoid-oblong; stigmatic rays $5-10$, strongly keeled, on a deciduous disc. S.E. Russia (Volga delta). Rs (E). (Caucasus, Asia Minor.)

Sect. Pilosa Prantl. Perennials with more or less deeply lobed leaves, some cauline; petals usually orange-red; capsule more or less clavate, glabrous.
15. P. rupifragum Boiss. \& Reuter, Pugillus 6 (1852). Ascending, many-stemmed, subglabrous perennial up to 50 cm . Leaves pinnatisect, sparsely hispid on midrib and petiole, mostly basal, with persistent bases; segments irregular, oblong or lanceolate, aristate. Pedicel sparsely hispid or subglabrous. Petals $20-$ 25 mm , brick-red. Filaments subulate. Capsule c. 2.5 cm , oblong-clavate, faintly ribbed. Stigmatic disc pyramidal; rays 8. Crevices in mountain rocks. - S. Spain (near Grazalema). Hs.
P. atlanticum (Ball) Cosson, Ill. Fl. Atl. 1: 11 (1882), from Morocco, with dull orange petals $25-40 \mathrm{~mm}$, and narrowly clavate capsule, and P. lateritium C. Koch, Ind. Sem. Hort. Berol. 14 (1854), from Armenia, with brick-red petals of similar size and obovoid-clavate capsule, are both recorded as locally naturalized in Britain.

Sect. Macrantha Elkan. Robust perennials with large flowers. Capsule subglobose.
16. P. orientale L., Sp. Pl. 508 (1753) (incl. P. bracteatum Lindley). Robust hispid perennial $60-100 \mathrm{~cm}$. Leaves pinnatisect, with lanceolate or oblong segments; lower petiolate, upper
sessile. Pedicel with appressed white pubescence. Petals $5-8 \mathrm{~cm}$, 4 to 6 in number, obovate, red, usually with a dark basal spot. Filaments clavate, purple; anthers violet. Capsule up to 3.5 cm , subglobose, glaucous, glabrous. Stigmatic disc flat; rays 13-18. Widely cultivated in gardens and occasionally more or less naturalized. [ $\mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Ho} \mathrm{Hu]}. \mathrm{(S.W}. \mathrm{Asia)}$.

Sect. Scapiflora Reichenb. Perennials with a rosette of petiolate leaves; stems scapose, bearing solitary flowers. Petals usually yellow. Capsule usually more or less obovoid, more rarely subglobose, almost always setose.

In addition to the group described below, cultivars referable to the Asiatic $P$. nudicaule L., sensu lato are widely grown in gardens and sometimes become locally naturalized. They are more robust, with flowering stems up to 50 cm , larger flowers (up to 6 cm ) and broadly lobed leaves. They are all diploid $(2 n=14)$.
(17-26). P. alpinum group. Small arctic or mountain plants with flowering stems up to $20(30) \mathrm{cm}$, variably clothed with appressed or patent hairs. Leaves 1 - to 3-pinnatisect, segments linear to oblong. Petals $10-30 \mathrm{~mm}$, yellow, orange, white, or more rarely red or pink. Capsule variable in shape from oblongellipsoid to subglobose, more or less setose with appressed or patent hairs. Plants of this group are found usually on calcareous open ground in the Arctic and in most of the principal mountain ranges of Europe.

The limits of the many described taxa are disputed by different authorities. The following treatment endeavours to take into account the most important work, including that dealing with the cytogenetics and experimental taxonomy. It cannot, however, pretend to do more than supply a framework of reference.
1 Petals not becoming blue-green on drying (diploid taxa of principal mountains of Europe: P. alpinum L., sensu lato)
2 Petals usually less than 15 mm , not imbricate at base; stamens equalling or shorter than ovary 17. suaveolens
2 Petals usually at least 15 mm , imbricate at base; stamens longer than ovary
3 Leaf-bases forming a compact tunic; lower leaf-segments alternate, ovate or ovate-lanceolate
4 Leaf-segments obtuse; petals yellow 18. rhaeticum
4 Leaf-segments usually acute; petals white 19. sendtneri
3 Leaf-bases forming a loose tunic; lower leaf-segments opposite, usually lanceolate, rarely narrowly obovate
5 Leaves 1- to 2-pinnate; capsule obovoid 22. corona-sancti-stephani

5 Leaves 2- to 3-pinnate; capsule clavate
6 Petals white
20. burseri 6 Petals yellow 21. kerneri

1 Petals becoming blue-green on drying (polyploid taxa of arctic and subarctic Europe: P. radicatum Rottb., sensu lato)
7 Capsule pyriform or clavate, widest towards the top; stigmatic disc convex
8 Latex yellow; pedicel erect; stigmatic disc $\pm$ pyramidal
23. lapponicum

8 Latex white; pedicel $\pm$ curved; stigmatic disc more shallowly convex 24. dahlianu
7 Capsule subcylindrical to subglobose, widest about the middle; stigmatic disc usually flat or slightly concave, rarely slightly convex
9 Pedicel erect; capsule ellipsoidal to subglobose; stigmatic disc usually narrower than capsule 25. radicatu
9 Pedicel curved; capsule subcylindrical; stigmatic disc about as wide as capsule
26. laestadianum
17. P. suaveolens Lapeyr., Hist. Abr. Pyr. Suppl. 72 (1818). Hispid perennial. Leaf-bases persistent, not forming a compact tunic. Leaves all \{basal, usually hispid. Pedicel c. 10 cm , pubescent with patent or somewhat appressed hairs. Petals
$10-15 \mathrm{~mm}$, obovate, rather longer than wide, not at all imbricate in full flower, yellow or red. Stamens equalling or shorter than ovary. Capsule obovoid-ellipsoid. Stigmatic disc pyramidal. - Spain. Hs.
(a) Subsp. suaveolens: Leaves usually somewhat hispid, rarely subglabrous, pinnatisect. Pyrenees and Sierra Nevada.
(b) Subsp. endressii Ascherson, Bot. Zeit. 27: 128 (1869): Leaves hispid, bipinnatisect. Pyrenees.
18. P. rhaeticum Leresche in Gremli, Excurs.-Fl. Schweiz, ed. 4, 64 (1881) (P. alpinum subsp. rhaeticum (Leresche) Hayek, P. pyrenaicum subsp. rhaeticum (Leresche) Fedde; P. alpinum L., nom. ambig.). Leaf-bases forming a compact tunic. Leaves asymmetrically 1- to 2-pinnate with 2-4 pairs of ovate to ovate-lanceolate, obtuse segments $1-6 \mathrm{~mm}$ wide. Pedicel $8-20 \mathrm{~cm}$, appressed-hispid. Petals $20-25 \mathrm{~mm}$, usually goldenyellow, rarely red or white. Capsule $c .14 \mathrm{~mm}$, oblong-ellipsoidal. Stigmatic disc usually flat, rarely pyramidal; rays 5-7, decurrent for about $\frac{2}{5}$ of the length of the ovary. $2 n=14$. E. Pyrenees, S.W. \& E. Alps. Au Ga He Hs It Ju.
19. P. sendtneri Kerner ex Hayek, Österr. Bot. Zeitschr. 53:406 (1903) ( $P$. alpinum subsp. sendtneri (Kerner ex Hayek) Schinz \& Keller, P. pyrenaicum subsp. sendtneri (Kerner ex Hayek) Fedde). Leaf-bases forming a compact tunic. Leaves asymmetrically 1 to 2-pinnate with usually 2 pairs of ovate-lanceolate, usually acute segments $1 \cdot 5-2 \cdot 2(-2 \cdot 5) \mathrm{mm}$ wide. Pedicel $5-15 \mathrm{~cm}$, appressedhispid or patent-hispid. Petals $15-20(-30) \mathrm{mm}$, usually white. Capsule c. 12 mm , oblong-ellipsoid. Stigmatic disc flat; rays usually 5 , decurrent for about $\frac{2}{5}$ of the length of the ovary. $2 n=14$. - C. \& E. Alps. Au Ge He.
P. alpinum subsp. ernesti-mayeri Markgraf in Hegi, Ill. Fl. Mitteleur. ed. 2, 4 (1): 40 (1958) from the S.E. Alps and Mte Majella, Appennini, resembles 19 but has obtuse leaf-segments, and a pyramidal stigmatic disc with rays decurrent for about $\frac{2}{3}$ of the length of the ovary.
20. P. burseri Crantz, Stirp. Austr. 2: 129 (1763) (P. alpinum subsp. alpinum sensu Markgraf, non L.). Subglabrous. Leafbases forming a loose tunic. Leaves symmetrically 2- to 3pinnate with 3-4 pairs of lanceolate to linear, acute segments $0 \cdot 5-1 \cdot 5(-3) \mathrm{mm}$ wide. Pedicel $8-20 \mathrm{~cm}$, appressed-hispid. Petals $15-20 \mathrm{~mm}$, usually white. Capsule $10-12 \mathrm{~mm}$, clavate. Stigmatic disc pyramidal; rays usually 4 , decurrent for at least $\frac{1}{2}$ the length of the ovary. - N. Alps; N. Carpathians. Au Cz He Po.
21. P. kerneri Hayek, Österr. Bot. Zeitschr. 53: 409 (1903). Like 20 but petals yellow; capsule c. 10 mm , broadly clavate; stigmatic rays usually 5. $2 n=14$. S.E. Alps, C. Jugoslavia. Au It Ju.
22. P. corona-sancti-stephani Zapał., Rozpr. Wydz. Mat.-Przyr. Polsk. Akad. Um. (Biol.) ser. 3, 11 B: 444 (1911) (P. alpinum L. subsp. corona-sancti-stephani (Zapał.) Borza). Subglabrous. Leafbases forming a loose tunic. Leaves 1 - to 2-pinnate, glabrous, rather glaucous, with 3-4 pairs of elliptic to narrowly obovate segments $1-2(-4) \mathrm{mm}$ wide, with short (c. 1 mm ) terminal seta. Pedicel up to 12 cm , sparsely to fairly densely appressed-hispid, sometimes patent-hispid below. Petals up to 15 mm , yellow. Capsule $7-10 \times 4-5 \mathrm{~mm}$, obovoid. Stigmatic disc pyramidal; rays decurrent for at least $\frac{1}{2}$ the length of the ovary. © E. \& S. Carpathians. Rm.

The following taxa are closely related to 22 :

[^94]P. alpinum subsp. tatricum A. Nyárády, Acta Geobot. Hung. 5:19 (1942), from the W. Carpathians (? and Alps) with white petals, lanceolate leaf-segments, and obovoid-ellipsoid capsule $c .11 \mathrm{~mm}$.
P. pyrenaicum subsp. degenii Urum. and Jáv., Magyar Bot. Lapok 19: 33 (1920) from S.W. Bulgaria (? and C. Italy) with somewhat smaller yellow or orange petals, lanceolate leaf-segments and more or less ellipsoid capsule c. 12 mm .
23. P. lapponicum (Tolm.) Nordh., Bergens Museums Aarb. 1931 (1), 2: 45 (1932). Densely caespitose perennial. Latex yellow. Leaf-bases persistent, forming a compact tunic. Leaves $4-12 \mathrm{~cm}$, whitish-hispid, pinnatifid with 3-4 pairs of lanceolate or linear-lanceolate, acute, usually entire segments. Pedicel (10-) $15-20(-30) \mathrm{cm}$, stiffly erect, appressed-hispid above, subglabrous below. Petals $13-23 \mathrm{~mm}$, yellow, usually caducous. Stamens about as long as ovary; filaments filiform, anthers yellow. Capsule $10-17 \times 4-7 \mathrm{~mm}$, subpyriform-ellipsoid or clavate, widest in upper half, sparsely appressed-setose. Stigmatic disc pyramidal, as wide as capsule; rays $5-8$, decurrent. $2 n=56$. Arctic Norway and Russia. No Rs (N).
24. P. dahlianum Nordh., Bergens Museums Aarb. 1931 (1), 2: 46 (1932) ( $P$. radicatum subsp. brachyphyllum Tolm. \& subsp. polare Tolm. pro max. parte). Like 23, but latex usually white; leaves less finely dissected; lobes ovate-lanceolate, obtuse; pedicel often decumbent; petals $20-25 \mathrm{~mm}$, yellow or white; capsule larger, $16-20 \times 8-9 \mathrm{~mm} .2 n=70$. Arctic Norway and Russia. No $\mathrm{Rs}(\mathrm{N}) \mathrm{Sb}$.
25. P. radicatum Rottb., Skr. Kiøbenhavnske Selsk. Laerd. Vid. 10: 454 (1770). Caespitose perennial. Latex usually various shades of yellow, rarely white. Leaf-bases persistent, forming a compact tunic. Leaves (2-)3-6(-10) cm, pinnatisect to pinnatifid, with $2-5$ pairs of ovate-lanceolate to sublinear, usually acute, entire or incised segments. Pedicel (5-)15-25(-30) cm, erect, sparsely or densely patent- or rarely appressed-hispid. Petals (11-)15-20( -24 ) mm, usually yellow, sometimes whitish or rarely pink, caducous or persistent. Stamens as long as or longer than ovary; filaments filiform, anthers yellow. Capsule (7-)13-17(-20) $\times(5-) 7-10 \mathrm{~mm}$, ellipsoidal to obovoid or rarely subglobose, widest about middle, densely patent- or appressed-setose. Stigmatic disc flat or convex, usually narrower than capsule; rays 5 , not or shortly decurrent. $2 n=70$. N.W. Europe. Fa Is No Su.

Extremely variable. Fourteen subspecies have been described, the majority restricted each to a small area in the Norwegian mountains.
P. chibinense N. Semen. in Pojark., Fl. Murmansk. 3: 368 (1956), described from N.W. Russia (Khibiny mountain), resembles 25 in capsule-shape, but has more finely dissected leaves. Its relationships are obscure.
26. P. laestadianum (Nordh.) Nordh., Bot. Not. 1939: 693 (1939). Like 25 but leaves yellowish-hispid, less finely dissected, with lanceolate or ovate-lanceolate, acuminate segments; pedicel curved at base, densely patent-hispid; capsule $11-12 \times 6-8 \mathrm{~mm}$, subcylindrical; stigmatic disc flat or slightly concave, about as wide as capsule. $2 n=56$. Arctic Scandinavia. No Su.

## 2. Meconopsis Vig. ${ }^{1}$

Latex yellow. Sepals free. Petals 4, rarely more, entire. Stigmas 4-6, alternating with placentae; style short. Capsule ovoid, opening from above by $4-6$ valves to $c \cdot \frac{1}{5}$ of its length. Aril absent.

1. M. cambrica (L.) Vig., Hist. Pavots Argém. 48 (1814). Sparsely pubescent perennial. Stems $30-60 \mathrm{~cm}$. Basal leaves long-petiolate, pinnate; segments ovate to lanceolate, dentate, glaucous beneath; cauline leaves similar but more shortly petiolate. Flowers solitary, long-pedicellate, in axils of upper leaves. Petals $2-4 \mathrm{~cm}$, yellow, obovate. Stamens yellow; filaments not expanded. Capsule $2-4 \mathrm{~cm}$, glabrous. $2 n=22$. Shady places. $W$. Europe; cultivated there and elsewhere in gardens and sometimes naturalized. Br Ga Hb Hs [ $\mathrm{Ge} \mathrm{He} \mathrm{Ho]}$.

## 3. Argemone L. ${ }^{1}$

Latex yellow. Sepals 2-3, free. Petals 4-6, entire. Stigmas 4, sessile over the placentae. Capsule ellipsoid, spiny, opening by 4-6 short valves. Aril present.

1. A. mexicana L., Sp. Pl. 508 (1753). Glaucous. Stem up to 90 cm , spiny. Leaves ternate, spiny. Flowers solitary, subtended by $2-3$ bracts. Petals $2-3 \mathrm{~cm}$, pale yellow to orange, obovate. Capsule ellipsoid, spiny. Naturalized in C. \& S. Europe. [Au Bu Ga Ge He Hs Lu , probably elsewhere.] (S.W. United States and C. America.)

## 4. Roemeria Medicus ${ }^{1}$

Latex yellow. Sepals free. Petals 4, entire. Stigmas 2-4, sessile over the placentae. Capsule linear, not spiny, opening from above almost to base by $2-4$ valves. Aril absent.

1. R. hybrida (L.) DC., Reg. Veg. Syst. Nat. 2: 92 (1821) ( $R$. violacea Medicus). Sparsely pubescent. Stems $20-40 \mathrm{~cm}$. Leaves 3-pinnate; ultimate segments linear, bristle-pointed; basal leaves petiolate; upper sessile. Flowers solitary, terminal or axillary. Petals $1 \cdot 5-3 \mathrm{~cm}$, violet with a dark spot at base, rounded. Anthers yellow; filaments purple-black. Capsule $5-10 \mathrm{~cm}$, straight, more or less hispid. S. Europe. Bl Bu Cr Ga Gr Hs Ju? Lu Rs (K) Tu [Au Br Ho].

## 5. Glaucium Miller ${ }^{1}$

Glaucous; latex yellow. Sepals free. Petals 4, entire. Stigma 2-lobed, sessile over placentae. Capsule linear, 2-celled, opening from above almost to base by 2 valves. Seeds embedded in septum. Aril absent.

| 1 | Petals usually orange-red; capsule hispid | 3. corniculatum |
| :---: | :---: | :---: |
| 1 | Petals yellow; capsule glabrous, but often tuberculate |  |
| 2 | Ovary tuberculate throughout its length; capsule not con- |  |
| stricted between the seeds | 1. flavum |  |
| 2 | Ovary tuberculate at apex only; capsule slightly constricted |  |
|  | between the seeds | 2. leiocarpum |

1. G. flavum Crantz, Stirp. Austr. 2: 133 (1763). Sparsely pubescent biennial or perennial. Stems $30-90 \mathrm{~cm}$. Basal leaves $15-35 \mathrm{~cm}$, lyrate, pinnately lobed; lower segments smaller and more or less entire, upper coarsely dentate; cauline leaves smaller, ovate, lobed, amplexicaul. Flowers solitary, terminal or axillary. Sepals more or less pubescent. Petals $3-4 \mathrm{~cm}$, yellow, broadly obovate. Stamens yellow. Ovary tuberculate throughout its length. Capsule $15-30 \mathrm{~cm}$, often curved, glabrous, not constricted between the seeds. $2 n=12$. Sandy and gravelly seashores; also as a ruderal. Coasts of S. \& W. Europe, northwards to Oslo; Black Sea; frequently naturalized in C. Europe. Al Be Bl Br Bu Co Cr Da Ga Ge Gr Hb Ho Hs It Ju Lu No Rm Rs (K) $\mathrm{Sa} \mathrm{Si} \mathrm{Tu}[\mathrm{Au} \mathrm{Cz} \mathrm{He} \mathrm{Hu} \mathrm{Po]}$.

[^95]${ }^{2}$ By A. B. Mowat and T. G. Tutin.
2. G. leiocarpum Boiss., Fl. Or. 1: 122 (1867). Like 1 but petals deep yellow; ovary tuberculate at apex; capsule not more than 10 cm , slightly constricted between the seeds. Dry, stony places and sea-shores. Balkan peninsula, Aegean region, E. Romania. $\mathrm{Bu} \mathrm{Cr} \mathrm{Gr} \mathrm{Ju} \mathrm{Rm}$.

There has been much confusion between this species and variants of 1, and many of the records of $\mathbf{2}$ from Europe are incorrect.
3. G. corniculatum (L.) J. H. Rudolph, Fl. Jen. Pl. 13 (1781) (G. grandiflorum sensu Hayek, non Boiss. \& Huet). Pubescent annual, rarely biennial. Stems $30-40 \mathrm{~cm}$. Leaves lyrate, pinnatifid; segments unequal, dentate; basal leaves petiolate, upper sessile. Flowers solitary, terminal or axillary. Petals up to $3(-4) \mathrm{cm}$, obovate, orange or reddish, often with dark spot at base. Stamens with dark anthers; filaments yellow. Capsule up to 20 cm , usually straight, pubescent. Waste places and cultivated ground. S. Europe, extending northwards to Hungary and S. C. Russia; often naturalized elsewhere. Bl Bu Cr Ga Gr Hs Hu It Ju Lu Rm Rs (C, W, K, E) Sa Si Tu [Au Be Br Cz Da Ge He Ho Po Su].

## 6. Chelidonium L. ${ }^{1}$

Latex orange. Sepals free. Petals 4, entire. Stigma 2-lobed; style very short. Capsule linear, without septum, opening from below by 2 valves. Aril crested.

1. C. majus L., Sp. Pl. 505 (1753). Glaucous, sparsely pubescent perennial. Stems $30-90 \mathrm{~cm}$. Leaves pinnate; leaflets 5-7, ovate to oblong, terminal usually 3 -lobed, lateral often with a stipule-like lobe at base on lower side, all crenate (or deeply incised, var. laciniatum (Miller) Syme). Inflorescence umbellate; flowers 2-6. Petals up to 1 cm , obovate, bright yellow. Stamens yellow; filaments expanded above. Capsule $3-5 \mathrm{~cm}$, more or less straight, glabrous; aril white. $2 n=12$. Europe, except the extreme north, but in some districts only as an escape from gardens. All except Fa Is Sb ; only as a naturalized alien in Hb and perhaps elsewhere.

## 7. Eschscholzia Cham. ${ }^{1}$

Sap watery. Sepals connate, forming a hood which is shed when the flower opens, leaving two rims at base of ovary. Petals 4 , entire. Capsule ribbed, opening from below by 2 valves, which separate from the placentae. Aril absent.

1. E. californica Cham. in Nees, Horae Phys. Berol. 74 (1820). Glaucous, glabrous annual or perennial. Cotyledons 2-fid. Stems $20-60 \mathrm{~cm}$, erect or spreading. Leaves ternately divided; ultimate segments linear. Flowers solitary, long-pedicellate, terminal. Petals $1-6 \mathrm{~cm}$, orange to yellow, darker at base, obovate. Stamens yellow, filaments not expanded; anthers yellow. Capsule $7-10 \mathrm{~cm}$, straight, glabrous. Naturalized in C. \& W. Europe; often casual elsewhere. [ Au Bl Br Co Cz Ga Ge Ho Hu Hs Lu Rm.] (S.W. United States.)

## Subfam. Hypecooideae

Flowers solitary or in cymes. Corolla slightly zygomorphic; petals not spurred. Capsule linear.

## 8. Hypecoum L. ${ }^{2}$

Glabrous, glaucous annuals with watery sap. Sepals free. Petals 4, at least the inner pair 3-lobed. Stamens 4. Stigmas 2; style short. Capsule ribbed or jointed, usually breaking up into 1 -seeded portions. Aril absent.

1 Stem striate; outer petals almost as long as wide, $\pm 3$-lobed
2 Lateral lobes of outer petals much smaller than the middle one

1. procumbens

2 Lateral lobes of outer petals as large as or larger than the middle one
2. imberbe

1 Stem smooth; outer petals almost twice as long as wide, entire
3 Middle lobe of inner petals suborbicular, stipitate; fruit pendent
3. pendulum

3 Middle lobe of inner petals linear; fruit erect
4. ponticum

1. H. procumbens L., Sp. Pl. 124 (1753). Stem striate, procumbent. Leaves 2-pinnatisect, glaucous; lobes linear to lanceolate. Inflorescence cymose; flowers $0.5-1.5 \mathrm{~cm}$ in diameter. Sepals ovate or ovate-lanceolate, acute, much shorter than petals, deciduous. Petals yellow, the outer 3-lobed, almost as wide as long, with the lateral lobes much smaller than the middle one; the inner petals deeply trifid, with suborbicular, ciliate middle lobe. Anthers $1-1 \cdot 2 \mathrm{~mm}$. Fruit 4-6 cm, arcuate, erect, jointed. Sandy ground, especially near the sea. S. Europe. Bl Bu Co Cr Ga Gr Hs It Ju Lu Rm Sa Si Tu.
2. H. imberbe Sibth. \& Sm., Fl. Graec. Prodr. 1: 107 (1806) (H. grandiflorum Bentham). Like 1 but stem erect or ascending; leaves 2- to 3-pinnatisect; flowers $1-1.5 \mathrm{~cm}$ in diameter; sepals lanceolate; lateral lobes of outer petals as large as or larger than the middle one; anthers $1.5-2 \mathrm{~mm}$; fruit scarcely jointed. Cultivated ground and waste places. S. Europe. Al Bl Bu Co Ga Gr Hs It Ju Lu Sa Si Tu.
3. H. pendulum L., Sp. Pl. 124 (1753). Stem smooth, procumbent to ascending. Leaves 2- to 3-pinnatisect, glaucous; lobes narrowly linear. Sepals ovate, subobtuse. Petals pale yellow, the outer entire, almost twice as long as wide, the inner deeply trifid, with suborbicular, stipitate, ciliate middle lobe. Fruit almost straight, pendent, scarcely jointed and not disarticulating. Cultivated ground and waste places. S.W. \& S.E. Europe. Bu Ga Gr Hs ?Ju Rs (W, K, E) Tu.
4. H. ponticum Velen., Fl. Bulg. suppl. 1, 14 (1898). Like 3 but sepals acute; middle lobe of inner petals linear, gradually narrowed towards the base; fruit erect. Maritime sands. Bulgaria and Turkey. Bu Tu.

## Subfam. Fumarioideae

Usually glabrous herbs with watery sap. Inflorescence racemose, bracteolate. Corolla transversely zygomorphic. Upper exterior petal spurred or saccate. Stamens 2, tripartite.

## 9. Dicentra Bernh. ${ }^{1}$

Perennial herbs with pinnate or ternate leaves and racemose inflorescences. Sepals 2, free. Outer petals alike, saccate at the base. Fruit a 2 -valved capsule with several seeds. Seeds with or without an aril.

## Literature: K. R. Stern, Brittonia 13: 1-57 (1961).

1. D. spectabilis (L.) Lemaire, Fl. Serres Jard. Eur. ser. 1, 3: t. 258 (1847). Glabrous. Stem $30-40 \mathrm{~cm}$, leafy, reddish. Leaves biternate; leaflets often ternatisect; ultimate segments obovatecuneate, irregularly dentate. Racemes $18-25 \mathrm{~cm}$, nearly horizontal, with $7-12$ pendent flowers. Sepals small, pink. Outer petals c. $25 \times 9 \mathrm{~mm}$, bright reddish-pink, cucullate, with broad

[^96]gibbous base and narrow, spathulate, deflexed apex. Inner petals about as long as outer, but not deflexed at apex and therefore projecting beyond them, white, keeled, sharply constricted near the middle; apices coherent. Stamens included; filaments geniculate at junction of free and fused portions. Cultivated for ornament, and locally naturalized. [Cz Fe.] (E. Asia.)

## 10. Corydalis Vent. ${ }^{2}$

Glabrous (but see $\mathbf{1}(\mathrm{b})$ ) herbs with compound leaves and racemose inflorescences. Sepals 2, free, or absent. Petals 4; 2 inner similar, oblong, broadened and coherent at apex; 2 outer dissimilar, the lower usually somewhat saccate at base, expanded into a broad limb at apex, the upper with a distinct spur at the base and a more or less expanded limb at apex. Stigma emarginate or bifid. Fruit an oblong, 2-valved capsule with 2 to many seeds. Seeds with a conspicuous aril.

Literature: M. Ryberg, Acta Horti Berg. 16 (7): 233-40 (1953) and 17 (5): 115-75 (1955). K. v. Poellnitz, Feddes Repert. 44: 154-7 (1938) and 45: 96-112 (1938). F. Fedde, in Engler \& Prantl, Natürl. Pflanzenfamilien ed. 2, 17 в: 123 (1936).

[^97]Sect. Corydalis. Annual or biennial, or perennial with rhizomatous stock. Stems usually branched, with many leaves. Racemes axillary.

1. C. claviculata (L.) DC. in Lam. \& DC., Fl. Fr. ed. 3, 4: 638 (1805). Delicate, climbing, much-branched annual $20-100 \mathrm{~cm}$. Leaves 2-pinnate; rhachis ending in a branched tendril. Racemes 6 - to 8 - (to 10 -)flowered, dense. Bracts $1-3 \mathrm{~mm}$, oblong-lanceolate. Lower pedicels $1-2 \mathrm{~mm}$. Corolla $5-6 \mathrm{~mm}$; spur short, saccate. Fruit c. 10 mm ; style deciduous. -W. Europe, extending eastwards to E. Denmark. Be Br Da Ga Ge Hb Ho Hs Lu No.
(a) Subsp. claviculata: Plant glaucous. Petals cream. Fruit glabrous. $2 n=32$. Throughout the range of the species.
(b) Subsp. picta (Samp.) P. Silva \& J. Franco, Feddes Repert. 69: 56 (1964): Plant not glaucous. Outer petals pinkish-violet. Fruit puberulent. N. Portugal (Vila-Nova-de-Paiva).
2. C. capnoides (L.) Pers., Syn. Pl. 2: 270 (1806) (incl. C. alba Mansfield). Robust, ascending or erect annual or biennial up to 40 cm . Leaves 2-ternate, all petiolate; ultimate segments 3 -fid or variously dissected. Racemes 5 - to 8 -flowered, lax. Lower bracts compound, like the upper leaves; upper bracts entire. Corolla $11-16 \mathrm{~mm}$, cream or white, yellow at apex; spur 5-7 mm, slender. Fruit $20-30 \mathrm{~mm}$, slender; style persistent, straight. C. \& E. Europe. Au Cz It Po Rm Rs (N, C, W) [Fe].
3. C. lutea (L.) DC. in Lam. \& DC., Fl. Fr. ed. 3, 4: 638 (1805). Erect perennial $10-40 \mathrm{~cm}$. Leaves 2- to 3-pinnate, green above, glaucous beneath; petiole unwinged. Racemes 6- to 16flowered, dense. Bracts oblong-lanceolate, entire, much shorter than pedicels. Corolla 12-20 mm, golden yellow, darker at apex; spur $2-4 \mathrm{~mm}$. Fruit c. 10 mm , pendent; style deciduous. Seeds black, shiny. Shady rocks and screes, usually on limestone. - S. foot-hills of C. \& E. Alps; widely naturalized elsewhere in W. \& C. Europe, especially on walls. He It $\mathrm{Ju}[\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge}$ $\mathrm{Hb} \mathrm{Ho} \mathrm{Hs]}$.
4. C. acaulis (Wulfen) Pers., Syn. Pl. 2: 270 (1806). Like 3 but annual, densely branched at base; leaves very glaucous on both surfaces; corolla $12-15 \mathrm{~mm}$, white, yellowish-green at apex; seeds dull. Rocks and walls. - N.W. Jugoslavia. Ju.
5. C. ochroleuca Koch, Flora (Regensb.) 14: 708 (1831). Erect perennial up to 40 cm . Leaves 3-pinnate, glaucous on both surfaces; petiole very narrowly but distinctly winged. Racemes up to $14-$ (to 22-)flowered, dense. Bracts oblong-lanceolate, entire. Corolla c. 15 mm , cream, yellow at apex; spur saccate. Fruit 10 mm or more, erect; style deciduous. Italy and W. part of Balkan peninsula; naturalized in W. and C. Europe. Al Gr It Ju [Au Be $\mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho]}$.
(a) Subsp. ochroleuca: Bracts less than $\frac{1}{3}$ as long as pedicels. Seeds distinctly tuberculate, dull. Italy, Jugoslavia and N. Albania.
(b) Subsp. leiosperma (Conr.) Hayek, Prodr. Fl. Penins. Balcan. 1: 362 (1925): Bracts at least $\frac{1}{3}$ as long as pedicels, sometimes longer. Seeds smooth or slightly rugose, shiny. W. part of Balkan peninsula.
6. C. nobilis (L.) Pers., Syn. Pl. 2: 269 (1806). Very robust perennial $30-50 \mathrm{~cm}$. Leaves 2- to 3-pinnate, glaucous. Racemes 20 - to 30 -flowered, capitate. Bracts cuneate, dissected, much longer than pedicels. Lower pedicels $5-15 \mathrm{~mm}$. Corolla c. 20 mm , yellow or white; spur c. 7 mm . Fruit $10-20 \mathrm{~mm}$; style persistent, somewhat geniculate at anthesis. Seeds black, shiny. Naturalized in Sweden. [Su.] (C. Asia.)
7. C. sempervirens(L.) Pers., Syn. Pl. 2:269 (1806). Erect annual or biennial $10-100 \mathrm{~cm}$, branched above. Leaves 1- to 3-pinnate, glaucous, petiolate, the upper subsessile. Racemes $c$. 10 -flowered, lax, or inflorescence sometimes almost paniculate. Bracts 35 mm , much shorter than pedicels, ovate-lanceolate, sometimes toothed. Corolla 11-18 mm, pale purplish, yellow at apex; spur $3-4 \mathrm{~mm}$, saccate. Fruit $30-50 \mathrm{~mm}$, erect or ascending; style persistent, somewhat geniculate at anthesis. Naturalized in Norway. [No.] (North America.)

Sect. Bulbocapnos (Bernh.) Koch. Perennial with tuberous stock. Stems simple, or with 1-2 branches, with 1-3 leaves on each stem or branch. Racemes terminal.
8. C. rutifolia (Sibth. \& Sm.) DC., Reg. Veg. Syst. Nat. 2: 115 (1821). Stem $5-15 \mathrm{~cm}$, erect, without a scale below leaves; tuber solid. Leaves opposite, usually 2 -ternate. Raceme 1 - to 2 - (to 3 -) flowered. Bracts broadly ovate, entire. Corolla $15-25 \mathrm{~mm}$, whitish, marked with purple; spur $8-12 \mathrm{~mm}$. Fruit becoming pendent. Stony places on high mountains. Kriti. Cr. (S.W. Asia.)

The European plant has been called C. uniflora (Sieber) Nyman, Syll. 185 (1855) and may merit subspecific status. The typical plant from S.W. Asia has racemes with more flowers and the corolla has a slightly shorter spur.
9. C. bulbosa (L.) DC. in Lam. \& DC., Fl. Fr. ed. 3, 4: 637 (1815) (C. cava (L.) Schweigg. \& Koerte). Stem 10-35 cm, erect, without a scale below lowest leaf. Leaves 2 -ternate, usually alternate. Raceme 10 - to 20 -flowered, more or less dense. Bracts ovate, entire. Corolla $18-30 \mathrm{~mm}$; spur curved at apex. Fruit $20-25 \mathrm{~mm}, 3-4$ times as long as pedicels, pendent when ripe; ovary at anthesis gradually narrowed into straight style. Europe, except the north and much of the Mediterranean region. Al Au Bu Cz Da Ga Ge Gr He Ho Hs Hu It Ju Lu Po Rm Rs (B, C, W, K, E) $\mathrm{Su}[\mathrm{Be} \mathrm{Br}]$.

Three subspecies may be distinguished, but there is often considerable overlapping of the characters.
1 Corolla whitish, cream or yellow; tuber solid
(c) subsp. marschalliana

1 Corolla purplish; tuber hollow
2 Leaf-segments obtuse; median leaflets long-cuneate at base, $\pm$ sessile
(a) subsp. bulbosa

2 Leaf-segments acute; median leaflets long-petiolate
(b) subsp. blanda
(a) Subsp. bulbosa: Tuber hollow. Leaves glaucous or green; median leaflets long-cuneate at base, more or less sessile; segments obtuse. Corolla purplish, rarely white. Throughout the range of the species, except the south-east.
(b) Subsp. blanda (Schott) Chater, Feddes Repert. 69: 56 (1964) (C. blanda Schott; incl. C. parnassica Orph. \& Heldr. ex Boiss.): Tuber hollow. Leaves glaucous; median leaflets longpetiolate; segments acute. Corolla purplish. - W. part of Balkan peninsula.
(c) Subsp. marschalliana (Pallas) Chater, Feddes Repert. 69: 56 (1964) (C. marschalliana (Pallas) Pers.): Tuber often solid. Leaves glaucous, rarely green; median leaflets shortly petiolate; segments obtuse. Corolla whitish, cream or yellow, rarely purplish. S.E. Europe.
10. C. paczoskii N. Busch, Trudy Tiflis S. Bot. Sada 9 suppl.: 55 (1903). Tuber solid. Stem $10-20 \mathrm{~cm}$, erect, simple or branched, with an ovate scale below lowest leaf. Leaves usually 3-ternate; segments narrowly oblong. Racemes 4 - to 8 -flowered, lax. Lower bracts 3 - to 8 -fid; upper mostly 3 -fid. Corolla $15-25 \mathrm{~mm}$, purple; spur straight. Fruit $17-25 \mathrm{~mm}, 2-3$ times as long as pedicels; style straight. - Ukraine. Rs (W, K).
11. C. angustifolia (Bieb.) DC., Reg. Veg. Syst. Nat. 2: 120 (1821). Like 10 but leaf-segments linear-lanceolate; lower bracts always 3 -fid, the upper 3 -fid or entire; corolla $20-30 \mathrm{~mm}$, yellow. Naturalized near Leningrad. [Rs (C).] (Caucasus.)
C. bracteata (Stephan) Pers., Syn. Pl. 2: 269 (1807), native in Siberia, is also reported as an alien and perhaps naturalized near Leningrad. It is like $\mathbf{1 0}$, but is a somewhat stouter plant with broader, yellow petals and less deeply divided bracts.
12. C. intermedia (L.) Mérat, Nouv. Fl. Env. Par. 272 (1812) (C. fabacea Pers.). Tuber solid. Stem 7-20 cm, erect, with an
ovate scale below lowest leaf. Leaves 2 -ternate with variously dissected segments. Racemes 2- to 8 -flowered, dense. Bracts ovate, entire. Pedicels c. 5 mm . Corolla $10-15 \mathrm{~mm}$, purple, rarely white; spur straight or curved. Fruit $15-20 \mathrm{~mm}$; ovary at anthesis gradually narrowed into straight, persistent style. $2 n=20$. - N. \& C. Europe, extending to S. France, C. Italy and Ukraine. Au Cz Da Fe Ga Ge He Hu It Ju No Po Rm Rs (N, B, C, W) ?Si Su.
C. integra Barbey \& Major has been erroneously recorded from the European side of the Dardanelles.
13. C. pumila (Host) Reichenb., Fl. Germ. Excurs. 698 (1832). Tuber solid. Stem 7-20 cm, erect, with ovate scale near base. Leaves 2 -ternate. Racemes (3-)4- to 8 -flowered, dense. Bracts cuneate, digitate. Pedicels less than 5 mm . Corolla $12-17 \mathrm{~mm}$, purplish; spur almost straight. Fruit $15-20 \mathrm{~mm}$; ovary at anthesis gradually narrowed into straight, persistent style. C. Europe, extending northwards to $60^{\circ} \mathrm{N}$. in Fennoscandia and southwards to Corse and C. Jugoslavia. Au Co Cz Da Ga Ge Hu Ju No Po Rm Su.
14. C. solida (L.) Swartz, Svensk Bot. 8: t. 531 (1817) (C. halleri Willd; incl. C. tenella Ledeb. ex Nordm.). Tuber solid. Stem 10-20(-30) cm, erect, with ovate scale near base. Leaves mostly 2 -ternate. Racemes (4-)10- to 20 -flowered. Lower bracts always lobed. Pedicels $10-20 \mathrm{~mm}$. Corolla $15-25(-30) \mathrm{mm}$; spur usually slightly curved. Fruit $10-25 \mathrm{~mm}$, pendent when ripe. Most of Europe except the extreme north and west; rare and local in the Mediterranean region. Al Au Be Bu Co CzFe Ga Ge Gr He Ho Hs Hu It Ju Po Rm Rs (N, B, C, W, K, E) Sa Si Su [Br Da No].

Very variable. Four subspecies are given below, but the treatment is unsatisfactory, especially because of the occasional close similarity between specimens of subspp. (b) and (c), and because of the very great variability of subsp. (a).
1 Uppermost bracts entire
2 Racemes very lax; ultimate leaf-segments narrowly oblong
(d) subsp. wettsteinii

2 Racemes dense; ultimate leaf-segments broadly obovate
(c) subsp. slivenensis

1 Uppermost bracts lobed or laciniate
3 Racemes dense; ultimate leaf-segments oblong, narrowly obovate or linear-lanceolate
(a) subsp. solida

3 Racemes lax; ultimate leaf-segments broadly obovate
(b) subsp. laxa
(a) Subsp. solida: Stem usually solitary and simple. Ultimate leaf-segments oblong or narrowly obovate (or linear-lanceolate, var. densiflora (C. Presl) Boiss.). All bracts usually simply lobed (or lobes of lower bracts lobed or toothed, var. densiflora (C. Presl) Boiss.). Racemes usually dense. Corolla purplish. Ovary at anthesis abruptly contracted into a usually geniculate style. Throughout the range of the species.
(b) Subsp. laxa (Fries) Nordst., Bot. Not. 1920 app. : 30 (1920): Stem usually solitary and simple. Ultimate leaf-segments usually broadly obovate. Bracts usually larger than in (a), all simply lobed, or the uppermost sometimes entire. Racemes usually lax. Corolla purplish. Ovary at anthesis usually narrowed into straight style. - Sweden and S.W. Finland.
(c) Subsp. slivenensis (Velen.) Hayek, Prodr. Fl. Penins. Balcan. 1: 364 (1925): Stem usually solitary and simple. Ultimate leaf-segments broadly obovate. Lower bracts lobed, the upper entire. Racemes dense. Corolla pale purplish or yellowish-white.

[^98]Ovary at anthesis abruptly contracted into geniculate style. S. Romania, Bulgaria, S. \&. E. Jugoslavia.
(d) Subsp. wettsteinii (Adamović) Hayek, op. cit. 365 (1925): Stems usually several, often branched. Ultimate leaf-segments narrowly oblong. Lower bracts simply lobed, the upper entire. Racemes very lax. Corolla purplish. Ovary at anthesis abruptly contracted into geniculate style. - N.E. Greece (Athos).

## 11. Sarcocapnos DC. ${ }^{1}$

Caespitose, perennial herbs with entire or 1-3 times ternatisect or pinnatisect leaves. Flowers white, yellow or pale pink, in short corymb-like racemes with long, slender pedicels. Upper petal spurred or gibbous. Fruit ovate, compressed, indehiscent, usually 2 -seeded; valves 3 -veined.

All species are chasmophytes growing in rock-crevices, on walls, etc.

Literature: V. H. Heywood, Bull. Brit. Mus. (Bot.) 1 (4): 90-2 (1954).

1 Flowers spurred
2 Flowers 8-10(-15) mm; sepals ovate; leaves 2-3 times ternatisect or pinnatisect

1. enneaphylla
2 Flowers $15-20 \mathrm{~mm}$; sepals ovate-la
2. crassifolia
1 Flowers not spurred
3 Leaves simple, fleshy
3. integrifolia
3 Leaves ternatisect, $\pm$ thin 4. baetica

## Sect. Sarcocapnos. Upper petal spurred.

1. S. enneaphylla (L.) DC., Reg. Veg. Syst. Nat. 2: 129 (1821). Much-branched, low-growing caespitose perennial; stems 515 cm , woody at the base. Leaves $2-3$ times ternatisect or pinnatisect, long-petiolate with the segments ovate-rounded, obtuse, often apiculate, the terminal segment often reniform-cordate. Pedicels slender. Flowers $8-10(-15) \mathrm{mm}$, white to yellowish, purple-tipped, with the spur much shorter than the rest of the corolla. $2 n=c .32$. Shady calcareous rock-crevices. - S.C. \& E. Spain; E. Pyrenees. Ga Hs.

Very plastic. Plants may vary from 4.5 cm in diameter to large clumps of $20-30 \mathrm{~cm}$ and the leaves vary in fleshiness according to the amount of shade.
2. S. crassifolia (Desf.) DC., op. cit. 2: 130 (1821) (incl. S. speciosa Boiss.). Like 1 in habit but more robust, leaves usually more fleshy, 1 - or sometimes 2 -ternatisect or more or less simple; flowers $15-20 \mathrm{~mm}$, usually pinkish; sepals ovate-lanceolate. $2 n=c$. 32. Rock crevices in mountains. S. \& S.E. Spain. Hs.

The European plants are often distinguished as var. speciosa (Boiss.) Lange; they differ from plants from N. Africa in having larger flowers and fruits, and longer, more slender spurs.

Sect. Aplectrocapnos (Boiss.). Upper petal not spurred.
3. S. integrifolia (Boiss.) Cuatrec., Trab. Mus. Ci. Nat. Barcel. 12: 286 (1929) (S. baetica var. integrifolia (Boiss.) Lange). Caespitose low-growing perennial. Leaves glaucous, simple, more or less ovate, obtuse. Flowers c. 5 mm , white to yellowish. Upper petal not spurred. Rock-crevices in calcareous mountains. - S. Spain (La Sagra; Sierra de Mágina). Hs.
4. S. baetica (Boiss. \& Reuter) Nyman, Consp. 26 (1878). Like 3 in habit but leaves ternatisect with the segments 2- to 3partite. Leaves very variable, the leaflets $0.4-1 \cdot 2 \mathrm{~cm} \times 0.3-$ $1 \cdot 1 \mathrm{~cm}$. Rock-crevices, usually calcareous. S. Spain. Hs.

## 12. Fumaria L. ${ }^{1}$

Annuals with long stems, erect, diffuse or climbing. Leaves cauline, 2 - to 4 -pinnatisect. Inflorescence racemose, bracteate, with short pedicels. Sepals 2, lateral. Corolla at least 5 mm , usually larger, zygomorphic, consisting of a spurred upper petal, 2 inner petals, and a lower one. Fruit 1 -seeded, indehiscent, when dry showing 2 apical pits due to clefts in the mesocarp.

In W. Europe mostly weeds of arable land, but in southern and eastern countries found also in rocky, sandy and grassy places.

In this account the measurement of the corolla is that of the largest flowers, and cleistogamous or more or less depauperate corollas produced by plants grown in an unfavourable environment are not considered. The direction of the wings of the upper petals, and the margins of the lower petals, can only be determined with certainty when the plant is fresh.

Literature: H. W. Pugsley, Jour. Bot. (London) 50, Suppl. 1: 1-76 (1912). Jour. Linn. Soc. London (Bot.) 44: 233-354 (1919); 47: 427-69 (1927); 49: 93-113 (1932); 49: 517-29 (1934); 50: 541-59 (1937).
1 Corolla at least 9 mm ; wings of the upper petal turned upwards
2 Sepals more than 3 mm wide, wider than the corolla
12. macrosepala

2 Sepals not more than 3 mm wide and usually narrower than the corolla
3 Fruit more than 3 mm long and wide
8. macrocarpa

3 Fruit not more than 3 mm long and wide
4 Sepals $1 \cdot 5-2 \times c .1 \mathrm{~mm}$
7. amarysia 4 Sepals longer
5 Fruit smooth when dry
6 Raceme shorter than or as long as peduncle
7 Sepals obtuse to subacute; pedicels often arcuate-recurved
8 Corolla usually white or cream (rarely flushed pink); upper petal narrow, laterally compressed; wings not exceeding keel
9. capreolata

8 Corolla purplish; upper petal wider, not laterally compressed; wings exceeding the keel 11. purpurea
7 Sepals acute to acuminate; pedicels erect or erectopatent
9 Corolla $12-14 \mathrm{~mm}$, pinkish-white 16. sepium
9 Corolla 9-12 mm, pink
17. muralis 6 Raceme longer than peduncle
10 Sepals $2.5-3 \times 1.5-2 \mathrm{~mm}$
11 Fruit $2-2.5 \times 2-2.5 \mathrm{~mm} \quad$ 14. bastardii
11 Fruit $2 \times 1.5-1.75 \mathrm{~mm}$
12 Fruiting pedicels arcuate-recurved; sepals obscurely sinuate-dentate (Balkan peninsula) 19. petteri
12 Fruiting pedicels patent; sepals subentire (Spain)
20. transiens

10 Sepals 3-4.5 $\times 1.5-3 \mathrm{~mm}$
13 Sepals subentire
14 Raceme 15 - to 20 -flowered; corolla $11-13 \mathrm{~mm}$; margins of lower petal patent 15. martinii
14 Raceme with fewer flowers; corolla $9-11 \mathrm{~mm}$; margins of lower petal erect 18. reuteri
13 Sepals dentate
15 Raceme sessile or with very short peduncles 19. petteri
15 Raceme little longer than peduncle
17. muralis

5 Fruit rugose when dry
16 Pedicels arcuate-recurved
17 Flowers creamy-white
10. flabellata

17 Flowers pink or purple
18 Corolla $9-10 \mathrm{~mm}$; sepals $2.5-3 \mathrm{~mm}$
19. petteri

18 Corolla $10-13 \mathrm{~mm}$; sepals $4 \cdot 5-6 \cdot 5 \mathrm{~mm}$
11. purpurea

16 Pedicels erect or patent
19 Sepals $3-5 \times 1-3 \mathrm{~mm}$
20 Corolla white or pinkish-white; fruit c. $3 \times 2.5-3 \mathrm{~mm}$, with a subemarginate beak

21 Sepals $3 \cdot 5-5 \times 1-2 \mathrm{~mm}$; wings of upper petal not blotched with dark purple

1. agraria

21 Sepals $4-4.5 \times 2-3 \mathrm{~mm}$; wings of upper petal blotched with dark purple, with a white margin; apex of inner petals dark purple
2. occidentalis

20 Corolla pink; fruit $2.5-3 \times 2-3 \mathrm{~mm}$, obtuse to very slightly beaked
22 Corolla $9-10.5 \mathrm{~mm}$
19. petteri

22 Corolla $10 \cdot 5-14 \mathrm{~mm}$
23 Wings of upper petal pale pink; inner petals with dark purple apex; sepals subentire or slightly dentate
3. rupestris

23 Wings of upper petal and apex of inner petals dark purple or red; sepals incise-dentate
24 Sepals $4-5 \times 2.5-3 \mathrm{~mm}$
17. muralis

24 Sepals $3-4 \times 1.5-2 \mathrm{~mm}$
25 Sepals $3-3.5 \times 1.5-2 \mathrm{~mm}$; corolla $12-14 \mathrm{~mm}$; upper petal obtuse; fruit subglobular-ovoid, mucronulate
4. bella

25 Sepals $3-4 \times$ c. 2 mm ; corolla $10-12 \mathrm{~mm}$; upper petal subacute; fruit subglobular-quadrate, submucronulate
5. gaillardotii

19 Sepals $2-3 \times 1-2 \mathrm{~mm}$
26 Corolla white, sometimes pink tinted
27 Fruit $c .3 \times 3 \mathrm{~mm}$
6. judaica

27 Fruit $2-2.25 \times 1.5-1.75 \mathrm{~mm}$
13. bicolor

26 Corolla pink
28 Raceme 8 - to 12 -flowered; sepals $2-2.5 \times 1 \mathrm{~mm}$
13. bicolor

28 Raceme 15 - to 25 -flowered; sepals $2-3 \times 1-2 \mathrm{~mm}$
29 Fruit $2 \times 1.5-1.75 \mathrm{~mm}$ 20. transiens
29 Fruit $2-2.5 \times 2-2.5 \mathrm{~mm}$
14. bastardii

1 Corolla not more than 9 mm ; wings of the upper petal less turned upwards
30 Sepals $0.5-1(-1.5) \times 0.25-0.75 \mathrm{~mm}$, not more than $\frac{1}{5}$ as long as and always narrower than the corolla
31 Bracts equalling or longer than pedicels; corolla usually white
33. parviflora

31 Bracts shorter than pedicels; corolla pink
32 Pedicels 4 mm ; bracts not more than $\frac{1}{3}$ as long as pedicels
29. schleicheri

32 Pedicels up to $2 \cdot 5(-3) \mathrm{mm}$; bracts more than $\frac{1}{3}$ as long as pedicels
33 Fruits 2-2.25 $\times 2-2.25 \mathrm{~mm}$; bracts $\frac{3}{4}$ as long as pedicels 31. vaillantii

33 Fruits $1.75-2 \times 1.75-2 \mathrm{~mm}$; bracts $\frac{1}{2}$ as long as pedicels
34 Upper petals not dorsally compressed, with wings turned upwards 30. microcarpa
34 Upper petals dorsally compressed, with wings patent
32. schrammii

30 Sepals $1.5-3.5 \times 0.75-3 \mathrm{~mm}$, more than $\frac{1}{4}$ and often more
than $\frac{1}{3}$ as long as the corolla
35 Sepals $1.5-2 \times 0.75-1 \mathrm{~mm}$
36 Fruit acuminate at apex
27. jankae

36 Fruit obtuse or truncate at apex
37 Corolla 7-9 mm; wings of upper petal and apex of inner petals dark purple; fruit with truncate apex
25. officinalis

37 Corolla 6-7 mm; wings of upper petal not dark purple; fruit with rounded-obtuse apex
28. caroliana

35 Sepals $2-3.5 \times 1-3 \mathrm{~mm}$
38 Bracts shorter than the fruiting pedicels
39 Fruit c. $2 \times 2 \mathrm{~mm}$, subglobose
24. rostellata

39 Fruit $2 \times 2.5-3 \mathrm{~mm}$, obreniform in profile
40 Raceme exceeding the peduncle; sepals $2.5-3.5 \times 1$ 1.5 mm ; corolla $7-9 \mathrm{~mm}$; upper petal obtuse; apical pits of fruit without black spots
25. officinalis

40 Raceme scarcely longer than peduncle; sepals $2 \times$ 1.5 mm ; corolla $c .9 \mathrm{~mm}$; upper petal subacute; apical pits of fruit black-spotted 26. ragusina
38 Bracts about as long as or longer than fruiting pedicels
41 Fruiting pedicels arcuate-recurved; fruit nearly smooth when dry
21. kralikii

|  |  |  |
| :---: | :---: | :---: |
| 42 | Sepals $2.5-3.5 \times 2-3 \mathrm{~mm}$ | 23. densiflora |
| 42 | Sepals $2-2.25 \times 1-2 \mathrm{~mm}$ |  |
| 43 | Corolla c. 7 mm ; fruit $2-2.5 \times 2.2-2.5 \mathrm{~mm}$ | 22. mirabili |
| 43 | Corolla $7-8.5 \mathrm{~mm}$; fruit $2 \times 1.5 \mathbf{1} .75 \mathrm{~mm}$ | 19. pette |

Sect. Grandiflorae Pugsley. Leaf-segments flat and relatively broad, from broadly ovate to oblong or lanceolate (except in 19 and 20). Corolla at least 9 mm , the wings of the upper petal turned upwards, the lower petal not spathulate (subspathulate in 8 and obscurely so in 20).

1. F. agraria Lag., Gen. Sp. Nov. 21 (1816). Raceme 15 - to 22 -flowered, longer than the peduncle. Bracts about $\frac{2}{3}$ as long to as long as the patent fruiting pedicels. Sepals $3 \cdot 5-5 \times 1-2 \mathrm{~mm}$, dentate to subentire. Corolla $12-14 \mathrm{~mm}$, pinkish-white, only the inner petals with dark purple apices; lower petal with patent margin. Fruit $c .3 \times 2.5 \mathrm{~mm}$, ovoid, strongly keeled and rugose when dry, apex with an emarginate beak. Mediterranean region from Jugoslavia westwards. Bl Hs It Ju Lu Sa Si.
2. F. occidentalis Pugsley, Jour. Bot. (London) 42: 218 (1904). Raceme 12- to 20 -flowered, as long as the peduncle. Bracts shorter than or nearly as long as the suberect fruiting pedicels. Sepals $4-5.5 \times 2-3 \mathrm{~mm}$, incise-dentate. Corolla $12-14 \mathrm{~mm}$, pinkish-white; apex of inner petals dark purplish; wings of upper petal dark purplish with white margin; lower petal with patent or slightly deflexed margin. Fruit $3 \times 3 \mathrm{~mm}$, subglobose, distinctly keeled; apex with a short emarginate beak, tuberculate-rugose when dry. - S.W. England (Cornwall). Br.
3. F. rupestris Boiss. \& Reuter, Pugillus 4 (1852). Raceme 8to $12(-20)$-flowered, longer than the rather short peduncle. Bracts equalling the suberect fruiting pedicels. Sepals $3-5.5 \times$ $1-2 \mathrm{~mm}$, narrowly lanceolate, subentire or slightly dentate. Corolla $10-14 \mathrm{~mm}$, pale pink; apex of inner petals dark purple; margin of lower petal commonly nearly obsolete, rarely narrow and patent. Fruit $2 \cdot 5-2.75 \times 2-2.5 \mathrm{~mm}$, subglobose-ovoid; apex obscurely apiculate, keeled, tuberculate-rugose when dry. $S$. Spain. Hs.
4. F. bella P. D. Sell, Feddes Repert. 68: 175 (1963) (F. major Badaro, non Roth; F. agraria sensu Coste, non Lag.). Racemes 10 - to $15(-20)$-flowered, the upper ones very often shorter than the peduncle. Bracts more or less equalling the suberect fruiting pedicels. Sepals $3-3.5 \times 1.5-2 \mathrm{~mm}$, irregularly incise-dentate. Corolla 12-14 mm, pink; apex of inner petals and wings of upper one dark purple; lower petal with broad patent margin. Fruit $2 \cdot 5-3 \times 2 \cdot 5-3 \mathrm{~mm}$, subglobose to obovoid; apex very obtuse or subtruncate, slightly keeled, densely tuberculate-rugose when dry. Mediterranean region; S.E. Russia. Ga ?Gr Hs It Rs (E) Sa Si.
5. F. gaillardotii Boiss., Fl. Or. 1: 139 (1867). Like 4 but sepals $3-4 \times c .2 \mathrm{~mm}$; corolla $10-12(-13) \mathrm{mm}$, paler, with the upper petal with narrower wings and larger spur; and fruit sub-globose-quadrate. E. Mediterranean region, westwards to Sicilia. Cr Gr It Ju Si.
6. F. judaica Boiss., Diagn. Pl. Or. Nov. 2 (8): 15 (1849). Raceme 10 - to 20 -flowered, often slightly longer than the peduncle. Bracts $\frac{1}{3}-\frac{1}{2}$ as long as the suberect fruiting pedicels. Sepals $2 \times 1 \mathrm{~mm}$, more or less dentate. Corolla $9-13 \mathrm{~mm}$, white, often becoming tinted with pink; apex of inner petals dark purple; lower petal with rather broad, patent margin. Fruit $c .3 \times 3 \mathrm{~mm}$, subglobose; apex very obtuse or slightly emarginate, obscurely keeled, tuberculate-rugose when dry. E. Mediterranean region, westwards to Sicilia. Al Cr Gr It Ju Si.
7. F. amarysia Boiss. \& Heldr. in Boiss., Fl. Or. 1: 138 (1867). Like 6 but sepals $1 \cdot 5-2 \times 1 \mathrm{~mm}$; corolla $9-10 \mathrm{~mm}$, pale pink; and fruit c. $2.5 \times 2.5 \mathrm{~mm}$. E. Greece (around Athinai). Gr.
8. F. macrocarpa Parl., Pl. Novae 5 (1842). Raceme $2-4 \mathrm{~cm}$, 7- to 11 -flowered, about as long as the peduncle. Bracts longer than the patent fruiting pedicels. Sepals $2 \cdot 5-3 \times 1 \mathrm{~mm}$, strongly dentate. Corolla $9-11 \mathrm{~mm}$, pale pink without any dark purple colouring; lower petal with patent margin. Fruit 3-4×3-4 mm, subglobose, obscurely keeled, rugose when dry; apex obtuse. Greece and Kriti. Cr Gr.
9. F. capreolata L., Sp. Pl. 701 (1753). Raceme up to 20flowered, shorter than the peduncle. Fruiting pedicels often rigidly arcuate-recurved. Sepals more or less dentate. Corolla $10-14 \mathrm{~mm}$, creamy-white or pinkish, rarely deep red; wings of upper petal and apex of inner petals blackish-red; lower petal with very narrow, erect margin. Fruit smooth, obscurely keeled. S., W. \& C. Europe. Al Be Bl Br Co Cr Cz Ga Ge Gr Hb He Hs It Ju Lu Po Rs (K) Sa Si Tu [Au Da Ho No].
(a) Subsp. capreolata: Bracts usually shorter than fruiting pedicels. Sepals $4-6 \times 2-3 \mathrm{~mm}$. Fruit $2 \times 2 \mathrm{~mm}$ or smaller, subglobose; apex very obtuse but not truncate. $2 n=56$. Throughout the range of the species, except the British Isles.
(b) Subsp. babingtonii (Pugsley) P. D. Sell, Feddes Repert. 68: 176 (1963) (F. capreolata var. babingtonii Pugsley). Bracts more or less equalling fruiting pedicels. Sepals frequently narrower. Upper petals more acute. Fruit $2.5 \times 2.5 \mathrm{~mm}$, often truncate at apex and more or less rectangular in outline. Britain and Ireland.
10. F. flabellata Gaspar., Rendic. Accad. Sci. Fis. Mat. (Napoli) 1: 51 (1842). Like 9 but raceme 10 - to 30 -flowered, at first as long as, then longer than, the peduncle; sepals $3-5 \times 1 \cdot 5-2.5 \mathrm{~mm}$; lower petal with wide patent margin; fruit 2-2.75 $\times 2-2.75 \mathrm{~mm}$, densely tuberculate-rugose when dry. Mediterranean region. Bl Co Cr Gr It Ju Sa Si.
11. F. purpurea Pugsley, Jour. Bot. (London) 40: 135 (1902). Raceme up to 24 -flowered, about as long as the peduncle. Bracts as long as or longer than the sometimes rigidly patent-recurved fruiting pedicels. Sepals $4.5-6.5 \times 2-3 \mathrm{~mm}$, entire. Corolla $10-$ 13 mm , purple, with the wings of upper petal and apex of inner petals darker purple; lower petal with narrow erect margin. Fruit $2.5 \times 2.5 \mathrm{~mm}$, squarish in profile, faintly rugose when dry; apex truncate. Britain and Ireland. Br Hb.
12. F. macrosepala Boiss., Elenchus 8 (1838) (incl. F. malacitana Hausskn. \& Fritze). Raceme 5- to 11 -flowered, shorter than the peduncle. Bracts as long as or longer than the more or less erect fruiting pedicels. Sepals $4-6 \times(2 \cdot 5-) 3-4 \mathrm{~mm}$, wider than corolla, subentire. Corolla $10-12 \mathrm{~mm}$, white and often reddish tinted; wings of upper petal and apex of inner petals dark purple; lower petal with narrow erect margin. Fruit $2.5 \times 2-2.5 \mathrm{~mm}$, subglobose, rugulose when dry; apex mucronulate or obtuse. S. Spain. Hs.
13. F. bicolor Sommier ex Nicotra, Fum. Ital. 55 (1897). Raceme 8 - to 12 -flowered, shorter than the peduncle. Bracts $\frac{1}{4}-\frac{1}{2}$ as long as the more or less suberect fruiting pedicels. Sepals $2-2 \cdot 5 \times c$. 1 mm , more or less dentate. Corolla $10-13 \mathrm{~mm}$, white or pinkishwhite, finally all pink; apex of inner petals dark purple; lower petal with narrow patent margin. Fruit $2-2.25 \times 1.5-1.75 \mathrm{~mm}$, subglobose-ovoid, obscurely keeled, rugose when dry; apex subacute. W. part of Mediterranean region. Bl Co Ga It ?Sa Si.
14. F. bastardii Boreau in Duchartre, Rev. Bot. 2: 359 (1847). Raceme usually 15 - to 25 -flowered, longer than the peduncle. Bracts $\frac{1}{3}-\frac{1}{2}$ as long as the suberect or erecto-patent fruiting pedicels. Sepals $2-3 \times 1-2 \mathrm{~mm}$, more or less serrate. Corolla $9-12 \mathrm{~mm}$, pale pink with the apex of the inner petals and sometimes the wings of the upper petal dark purple; upper petal narrow and laterally compressed; lower petal with narrow patent margin. Fruit $2-2.5 \times 2-2.5 \mathrm{~mm}$, ovoid with a wide, flattish base and more or less obtuse apex, slightly keeled and usually rugose. $2 n=c .48$. S. \& W. Europe, northwards to Scotland. Az Bl Br Co Ga Gr Hb Hs It Ju Lu Sa Si.
15. F. martinii Clavaud, Act. Soc. Linn. Bordeaux 42: lxix (1889). Raceme up to 20 -flowered, much longer than the peduncle. Bracts $\frac{1}{2}-\frac{2}{3}$ as long as the arcuate-deflexed, becoming erectopatent, fruiting pedicels. Sepals $3-5 \times 1 \cdot 5-2 \cdot 5 \mathrm{~mm}$, subentire. Corolla $11-13 \mathrm{~mm}$, pink; wings of upper petal and apex of inner blackish-red; lower petal with very narrow patent margin. Fruit $2.5-2.75 \times 2-2.5 \mathrm{~mm}$, subglobose, obscurely keeled, nearly smooth when dry, apex more or less acute. S.W. England, France, Portugal and Spain. Br Ga Hs Lu.
16. F. sepium Boiss. \& Reuter in Boiss., Diagn. Pl. Or. Nov. 3 (1): 16 (1853) (F. gaditana Hausskn.). Raceme 6- to 12- (to 16-)flowered, shorter than the peduncle. Bracts subequalling or shorter than the erecto-patent fruiting pedicels. Sepals $3-5 \times 1 \cdot 5-$ 2.5 mm , subentire. Corolla $12-14 \mathrm{~mm}$, pinkish-white, apex often tinged red; wings of upper petal and apex of inner dark purple; lower petal with very narrow erect or sub-patent margin. Fruit c. $2 \times 2 \mathrm{~mm}$, subglobose, keeled, smooth when dry, apex very obtuse. Spain and Portugal. Hs Lu.
17. F. muralis Sonder ex Koch, Syn. Fl. Germ. ed. 2, 1017 (1845). Raceme about as long as or longer than the peduncle. Bracts $\frac{1}{2}$ as long as to about as long as the more or less erect fruiting pedicels. Sepals $3-5 \times 1 \cdot 5-3 \mathrm{~mm}$. Corolla pink; wings of upper petal and tips of inner ones blackish-red; lower petal with narrow erect margin. Fruit obscurely keeled. W. Europe. Az Be ? $\mathrm{Bu} \mathrm{Br} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Ho} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{No} \mathrm{Sa} \mathrm{Si} \mathrm{[Da]}$.
1 Corolla $10-12 \mathrm{~mm}$; fruit $2.25-2.5 \times 2 \mathrm{~mm}$, obscurely rugose when dry
(b) subsp. boraei

1 Corolla $9-10 \mathrm{~mm}$; fruit $2 \times 2 \mathrm{~mm}$, smooth when dry
2 Racemes less than 15 -flowered; sepals dentate; fruit subacute at apex
(a) subsp. muralis

2 Racemes up to 20 -flowered; sepals subentire; fruit truncate at apex
(c) subsp. neglecta
(a) Subsp. muralis: Plant slender; racemes less than 15 flowered; sepals dentate; corolla $9-10(-11) \mathrm{mm}$; fruit $2 \times 2 \mathrm{~mm}$, subglobose-ovoid, smooth when dry; apex subacute. Throughout the range of the species.
(b) Subsp. boraei (Jordan) Pugsley, Jour. Bot. (London) 40: 180 (1902): Plant slender or robust; raceme less than 15 -flowered; sepals dentate; corolla $10-12 \mathrm{~mm}$; fruit $2.25-2.5 \times 2 \mathrm{~mm}$, more or less obovoid, often obscurely rugulose when dry; apex obtuse. Throughout the range of the species.
(c) Subsp. neglecta Pugsley, Jour. Bot. (London) 50, Suppl. 1: 24 (1912): Plant robust; raceme up to 20 -flowered; sepals subentire; corolla c. 10 mm ; fruit $2 \times 2 \mathrm{~mm}$, shortly obovoid, nearly smooth when dry, almost truncate at apex. - S.W. England (Cornwall).
18. F. reuteri Boiss., Diagn. Pl. Or. Nov. 2 (8): 13 (1849) (F. apiculata Lange). Like 17 but lobes of the leaves narrower; racemes with very short peduncles; pedicels erect; sepals $3 \cdot 5$ $4.5 \times c .2 \mathrm{~mm}$, subentire; upper petal narrow and acute; and fruit smooth when dry, with a persistent apiculus at the apex. Spain and Portugal. Hs Lu.
19. F. petteri Reichenb., Icon. Fl. Germ. 3: 1 (1838). Raceme shortly pedunculate or subsessile. Bracts about equalling the fruiting pedicels. Sepals weakly dentate. Corolla pink; wings of upper petal and apex of inner dark purple; lower petal with very narrow erect margin. Fruit ovoid, subglobose-ovoid or turbinate, obscurely keeled, more or less rugose when dry; apex more or less acute. Balkan peninsula, Krym. Al Bu Gr Ju Rm Rs (K).
(a) Subsp. petteri: Raceme usually 12 - to 18 -flowered; fruiting pedicels patent or erecto-patent; sepals $3.5-4.5 \times 2-2.5 \mathrm{~mm}$; corolla 9-10 mm; fruit 2.5-2.75 $\times 2 \mathrm{~mm}$. Jugoslavia.
(b) Subsp. thuretii (Boiss.) Pugsley, Jour. Linn. Soc. London (Bot.) 50: 550 (1937) (F. thuretii Boiss., F. pikermiana Boiss. \& Heldr.): Raceme 15 - to 35 -flowered; fruiting pedicels arcuaterecurved; sepals $2.5-3 \times 1.5-2 \mathrm{~mm}$; corolla $7-10 \mathrm{~mm}$; fruit $c$. $2 \times 1.5-1.75 \mathrm{~mm}$. Throughout the range of the species.
20. F. transiens P. D. Sell, Feddes Repert. 68: 177 (1963) ( $F$. reuteri auct., non Boiss.). Very like 19 b but sepals subentire, corolla paler pink, and fruiting pedicels patent. Spain and Portugal. Hs Lu.

Sect. Fumaria. Leaf-segments flat or channelled, relatively narrow, from oblong or lanceolate to linear or setaceous. Peduncles usually short. Corolla not more than 9 mm and generally much smaller; wings of upper petal less turned upwards, occasionally even patent; lower petal more or less spathulate.

21 F. kralikii Jordan, Cat. Jard. Dijon 19 (1848). Raceme 10to 18 -flowered; peduncle very short. Bracts more or less equalling the recurved fruiting pedicels. Sepals $2-2.75 \times 1.5-2 \mathrm{~mm}$, dentate. Corolla $5-6(-8) \mathrm{mm}$, pale pink with the wings of the upper petal and apex of the inner petals dark purple; lower petal with patent margin. Fruit $c .1 .75 \times 1.75 \mathrm{~mm}$, subglobose, nearly smooth or slightly rugose when dry, apex obtuse. S. Europe. Bu Co Ga Gr It Rm Rs (K) Sa Tu [Ho].
22. F. mirabilis Pugsley, Jour. Linn. Soc. London (Bot.) 47: 432 (1927). Raceme 15- to 25 -flowered, subsessile or shortly pedunculate. Bracts about equalling or just exceeding the erecto-patent fruiting pedicels. Sepals $2-2.25 \times 1-1.25 \mathrm{~mm}$, irregularly dentate. Corolla c. 7 mm , pale pink; apex of inner petals dark purple; lower petal with rather broad, patent margin. Fruit $2-2.5 \times 2.2-2.5$ mm , subglobose, obscurely keeled, rugose when dry; apex very obtuse. Spain. Hs.
23. F. densiflora DC., Cat. Pl. Hort. Monsp. 113 (1813) (F. micrantha Lag.). Raceme 20 - to 25 -flowered, much exceeding the very short or obsolete peduncle. Bracts normally exceeding the erecto-patent fruiting pedicels. Sepals (2-)2.5-3.5 $\times(1 \cdot 5-) 2-3 \mathrm{~mm}$, subentire or laciniate. Corolla $6-7 \mathrm{~mm}$, pink; wings of upper petal and apex of inner blackish-red; lower petal with patent margin, subspathulate. Fruit $2-2.5 \times 2-2.5 \mathrm{~mm}$, subglobose, keeled, rugose when dry; apex rounded-obtuse. W. \& S. Europe, sometimes casual elsewhere. Al ? Az Be Bl Br Bu Co Ga Gr Hb Hs It Ju Lu Rm Sa Si [Ge Ho No Su].
24. F. rostellata Knaf, Flora (Regensb.) 29: 290 (1846). Raceme 15 - to 25 -flowered, longer than the short peduncle. Bracts $\frac{2}{3}$ as long as the patent fruiting pedicels. Sepals $2-2.5 \times c .1 .5 \mathrm{~mm}$, dentate. Corolla $7-9 \mathrm{~mm}$, purplish-pink; wings of upper petal and apex of inner ones blackish-purple; lower petal with patent margin, spathulate. Fruit c. $2 \times 2 \mathrm{~mm}$, subglobose, keeled, nearly smooth when dry; apex subtruncate. C. Europe, Balkan peninsula, Romania and Ukraine. Au Bu Cz Ge Gr Hu Ju Po Rm Rs (C, W) Tu.
25. F. officinalis L., Sp. Pl. 700 (1753). Raceme longer than the peduncle. Bracts half as long as to nearly as long as the erectopatent fruiting pedicels. Sepals $1.5-3.5 \times 1-1.5 \mathrm{~mm}$, irregularly dentate. Corolla 7-9 mm, purplish-pink; wings of upper petal and apex of inner ones blackish-red; lower petal with patent margin, spathulate. Fruit c. $2 \times 2.5-3 \mathrm{~mm}$, nearly obreniform in profile, obscurely keeled, rugose when dry; apex truncate or slightly emarginate. Almost throughout Europe. All except $\mathrm{Az} \mathrm{Cr} \mathrm{Sb;}$ only a casual in Fa Is.
(a) Subsp. officinalis: Raceme normally more than 20 flowered; sepals $2.5-3.5 \times 1-1.5 \mathrm{~mm} .2 n=28,32$. Throughout the range of the species.
(b) Subsp. wirtgenii (Koch) Arcangeli, Comp. Fl. Ital. 27 (1882): Raceme 10 - to 20 -flowered; sepals $1 \cdot 5-2 \times 1 \mathrm{~mm} .2 n=48$. C. \& S. Europe.
26. F. ragusina (Pugsley) Pugsley, Jour. Linn. Soc. London (Bot.) 49: 524 (1934). Like 25 but habit more slender; foliage less dissected; peduncle not much shorter than the raceme; sepals $2 \times 1.5 \mathrm{~mm}$, subglobose-ovate; corolla c. 9 mm ; upper petal usually subacute or shortly rostellate; fruit rounded-truncate or truncate and mucronulate at the apex; apical pits black-spotted. - Jugoslavia and Albania. Al Ju.
27. F. jankae Hausskn., Flora (Regensb.) 56: 491 (1873). Like 25 but sepals $1.5 \times 0.75 \mathrm{~mm}$; corolla $4-5 \mathrm{~mm}$; fruit c. $2 \times 2 \mathrm{~mm}$ ovoid, acuminate. N.W. Romania (Săcueni). Rm.
28. F. caroliana Pugsley, Jour. Linn. Soc. London (Bot.) 47: 448 (1927). Raceme 10- to 15- (to 20-)flowered, much longer than the short peduncle. Bracts about half as long as the suberect fruiting pedicels. Sepals $1 \cdot 5-2 \times 0.75-1 \mathrm{~mm}$, irregularly incise-dentate. Corolla 6-7 mm, pink; inner petals with dark purple apex; lower petal obovate-spathulate, with patent margin. Fruit c. $2 \times$ 2.5 mm , subglobose, obscurely keeled, rugose when dry; apex rounded-obtuse with a short apiculus when young. $N$. France (near Arras). Ga.
29. F. schleicheri Soyer-Willemet, Observ. Pl. France 17 (1828). Raceme usually 12- to 20 - (rarely more) flowered, at first equalling but later exceeding the peduncle. Bracts about $\frac{1}{3}$ as long as the suberect fruiting pedicels. Sepals $c .1 \times 0.5-0.75 \mathrm{~mm}$, irregularly incise-dentate. Corolla $5-6 \mathrm{~mm}$, deep pink; wings of upper petal and apex of inner dark purple; lower petal with patent margin. Fruit $c .2 \times 2 \mathrm{~mm}$, subglobose, keeled, obscurely rugose when dry; apex rounded-obtuse and apiculate. $C . \& S$. Europe, extending to c. $50^{\circ} \mathrm{N}$. in Ukraine. Au Bu Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs (C, W, K, E) Sa [Da Ho].
30. F. microcarpa (Hausskn.) Pugsley, Jour. Linn. Soc. London (Bot.) 44: 312 (1919). Like 29 but with dwarfer and more erect habit; bracts $\frac{1}{2}$ as long as the pedicels; flowers smaller and less deeply coloured; fruit c. $1.75 \times 1.75 \mathrm{~mm}$. S.E. Russia (near Volgagrad). Rs (E).
31. F. vaillantii Loisel. in Desv., Jour. Bot. Rédigé2: 358 (1809). Raceme generally 6- to 12 -flowered, longer than the short peduncle. Bracts about $\frac{3}{4}$ as long as the more or less erect fruiting pedicels. Sepals $0.7-1 \times 0.3-0.5 \mathrm{~mm}$, more or less laciniate-dentate. Corolla $5-6 \mathrm{~mm}$, pale pink; apex of inner petals and wings of upper petal often tinted with blackish-red; lower petal with patent margin, spathulate. Fruit c. $2 \times 2 \mathrm{~mm}$, sub-
${ }^{2}$ By V. H. Heywood.
globose, obscurely keeled, granular-rugose when dry; apex rounded-obtuse and mucronulate when young. $2 n=32$. Most of Europe except the north, but present in the Baltic region. Al Au Be Bl Br Bu Co Cz Fe He Ho Hs Hu It Ju Lu Po Rm Rs (B, C, W, K, E) Sa Si Su.
32. F. schrammii (Ascherson) Velen., Fl. Bulg. 22 (1891). Like 31 but leaf-segments narrower; raceme more or less sessile; flower paler; fruit $1.75-2 \times 1.75-2 \mathrm{~mm}$, apiculate. Scattered through Europe from France and Spain to Greece and Ukraine. $\mathrm{Al} \mathrm{Bu} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{Rs} \mathrm{(W)}$.
33. F. parviflora Lam., Encycl. Méth. Bot. 2: 567 (1788) (F. caespitosa Loscos). Like 31 but lobes of the leaves channelled, raceme up to 20 -flowered, subsessile; bracts as long as or longer than the fruiting pedicels; corolla white, occasionally flushed pink; fruit distinctly keeled and often subacute. C. \& S. Europe extending northwards to Britain and Belgium. Be Bl Br Bu Co Cr CzGaGe Gr Hs Hu It Ju Lu Rm Rs (W) Sa Si [Ho].

## 13. Platycapnos (DC.) Bernh. ${ }^{1}$

Annual or short-lived perennials. Leaves 2-pinnatisect. Inflorescence subglobose or oblong-ovoid and spicate. Flowers very shortly pedicellate, whitish to purplish; upper petals not spurred; stigma 3-fid, the middle lobe deeply notched, the laterals patent or deflexed. Fruit a 1 -seeded nut, strongly compressed.
Ultimate leaf-segments $4-5 \times 0.4-0.5 \mathrm{~mm}$; bracts about twice as
long as the pedicels

1. spicata
Ulimate leaf-segments $8-10 \times 0.6-0.9 \mathrm{~mm}$; bracts $\pm$ equalling the
pedicels
2. saxicola
3. P. spicata (L.) Bernh., Linnaea 8: 471 (1833) (Fumaria spicata L.). More or less glaucous annual. Stems up to 30 cm , branched, leafy. Leaves 2-pinnatisect; segments 4-5 $\times 0.4-0.5 \mathrm{~mm}$, mucronulate. Racemes $2.5-5 \mathrm{~cm}$; bracts lanceolate to ovate; pedicels recurved in fruit. Flowers whitish or yellowish, dark purple at apex of petals; sepals $\frac{1}{6}-\frac{1}{3}$ as long as petals, entire or denticulate, caducous. Fruit ovate, flat or convex, usually rugulose, obtuse, mucronate. S.W. Europe extending eastwards to Italy. Ga Hs It Lu Si.
(a) Subsp. spicata: Racemes oblong-ovoid; sepals $c . \frac{1}{3}$ as long as petals; fruit flat, rugulose. Throughout the range of the species.
(b) Subsp. echeandiae (Pau) Heywood, Feddes Repert. 64: 51 (1961): Racemes subglobose; sepals $c$. $\frac{1}{6}$ as long as petals; fruit convex at sides, smooth. E. \& S.E. Spain.
4. P. saxicola Willk., Bot. Zeit. 1848: 367 (1848). Glaucous, with stems up to 20 cm arising from a slender vertical stock. Cauline leaves few. Leaves 2-pinnatisect; segments $8-10 \times 0.6-0 \cdot 9 \mathrm{~mm}$, with an acute somewhat hooded apex. Racemes $1-1.5 \mathrm{~cm}$, subglobose; bracts ovate; pedicels arcuate in fruit. Flowers pale pink or pale purple, dark purple at apex of petals; sepals $\frac{1}{2}-\frac{2}{3}$ as long as petals, entire. Fruits obovate, striate, slightly rugulose, subemarginate. Mountain screes. S. \& S.E. Spain (Granada, Jaén prov.). Hs.

## 14. Rupicapnos Pomel ${ }^{2}$

Flowers in corymbose racemes. Pedicels elongate, becoming deflexed in fruit. Upper petal spurred. Fruit a more or less globose 1 -seeded nut with thickened, rugose, tuberculate exocarp.

1. R. africana (Lam.) Pomel, Nouv. Mat. Fl. Atl. 240 (1874) quoad basionym, excl. descr. (Fumaria africana Lam.). Glaucous perennial with elongate root and thick, branched, decumbent stock. Leaves mainly basal, more or less fleshy, very longpetiolate, 2-pinnatisect into oblong-elliptic or cuneate lobes. Flowers $12-16 \mathrm{~mm}$, white; spur $c .4 \mathrm{~mm}$. Fruit $3 \times 3 \mathrm{~mm}$, shortly mucronate. Crevices in limestone rocks. S.W. Spain. Hs. (N.W. Africa.)

Subsp. decipiens (Pugsley) Maire in Jahandiez \& Maire, Cat. Pl. Maroc 2: 261 (1932) (Rupicapnos decipiens Pugsley, Fumaria africana auct. hisp., non Lam.) is the only European representative of the species. The typical subspecies and another subspecies grow in N.W. Africa.

## 15. Ceratocapnos Durieu ${ }^{1}$

Climbing or scrambling annual with very small flowers (less than 5 mm ). Fruits dimorphic: the lower indehiscent, 1 -seeded; the upper dehiscent, usually 2 -seeded.

1. C. heterocarpa Durieu in Parl., Gior. Bot. Ital. 1 (1): 336 (1844). Much-branched fleshy annual, up to c. 1 m . Leaves ternate or 2-pinnate, with tendrils; segments lanceolate to almost orbicular. Racemes 5- to 12 -flowered, leaf-opposed. Flowers $3-5 \mathrm{~mm}$, pinkish-purple. Lower fruits $c .2 .5 \mathrm{~mm}$, ovoid-quadrangular, transversely rugose; upper fruits $4-5 \mathrm{~mm}$ (including beak), lanceolate, longitudinally ribbed, with an elongate beak. Shady calcareous cliffs. S.W. Spain (Esparteros, near Morón de la Frontera). Hs. (N.W. Africa.)

## LXVII. CAPPARIDACEAE ${ }^{2}$

Herbs, shrubs or trees. Leaves simple, or ternate to palmate, alternate, stipulate or not, stipules sometimes spinose. Flowers solitary or in racemes, actinomorphic or more usually zygomorphic, hermaphrodite. Sepals 4. Petals 4. Stamens 6-many. Ovary single, superior, on a gynophore; carpels 2. Fruit a 2valved, unilocular capsule, or a berry.

Flowers solitary; stamens numerous; fruit a berry 1. Capparis Flowers in racemes; stamens 6; fruit a capsule
2. Cleome

## 1. Capparis L. ${ }^{3}$

Shrubs with simple leaves, and usually with stipular spines. Flowers solitary, showy, zygomorphic; sepals 4, white or pink; stamens numerous. Fruit a berry borne on a long gynophore.

Literature: M. Zohary, Bull. Res. Counc. Israel 8 D: 49-64 (1960).

Leaves orbicular or orbicular-ovate; midrib ending in a scarcely visible mucro 1. spinosa Leaves oblong to elliptical or ovate; midrib prolonged into a distinct projecting mucro
2. ovata

1. C. spinosa L., Sp. Pl. 503 (1753) (incl. C. rupestris Sibth. \& Sm .). Leaves glabrous, petiolate, orbicular or orbicular-ovate, obtuse or emarginate at the apex. Stipular spines recurved, sometimes weakly developed. Flowers $5-7 \mathrm{~cm}$ in diameter, slightly zygomorphic. Sepals purplish. Mediterranean region; Portugal; Krym. Al Bl Co Cr Ga Gr Hs It Ju Lu Rs (K) Sa Si.

There has been selection for large flower-buds in the typical plant (which is probably introduced in the western part of its distribution) for their use as a condiment. A distinctive coastal variant with pendent branches, somewhat succulent leaves, and stipular spines absent or caducous at an early stage, is probably more widespread as a native plant (var. inermis Turra).
2. C. ovata Desf., Fl. Atl. 1: 404 (1798) (incl. C. sicula Duh.). Leaves sometimes slightly pubescent, petiolate, oblong to elliptical or ovate, acute or acuminate at the apex, distinctly

[^99]mucronate. Stipular spines weak or strong, straight or curved, occasionally absent. Flowers $4-5 \mathrm{~cm}$ in diameter, strongly zygomorphic. Hills and cliffs. Arid areas in the Mediterranean region. $\mathrm{Al} \mathrm{Bl} \mathrm{Cr} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Si} \mathrm{Tu}$.

The European plant is almost entirely var. canescens (Cosson) Heywood, with leaves oblong to elliptical, stems and buds pubescent, and stipular spines strong and curved. It hybridizes with var. ovata (which is otherwise confined to N.W. Africa) in Sicilia. Var. ovata has ovate leaves and straight stipular spines.

The recognition of the above two species is tentative; intermediates occur between them and parallel variations are frequent. The geographical distribution, which is complicated by the secondary area of $C$. spinosa due to cultivation, does not fit into a subspecific pattern.

## 2. Cleome L. ${ }^{4}$

Erect, glandular-pubescent, viscid annuals with exstipulate, simple or ternate leaves. Flowers in long, bracteate racemes; sepals 4, deciduous; petals 4 , contracted into a distinct claw, more or less dimorphic; stamens 6. Receptacle short. Fruit a linear, 2-valved, many-seeded capsule on a long gynophore.
Ripe fruit less than 30 mm ; upper bracts $c . \frac{1}{3}$ as long as pedicels 1. ornithopodioides Ripe fruit more than 40 mm ; upper bracts at least as long as pedicels
2. violacea

1. C. ornithopodioides L., Sp. Pl. 672 (1753) (incl. C. aurea Čelak., non Torrey \& Gray). Stems $15-50 \mathrm{~cm}$, erect, usually branched. Leaves petiolate, ternate, except for the uppermost which are simple; leaflets oblong-lanceolate, entire. Bracts of upper flowers $c . \frac{1}{3}$ as long as pedicels. Petals $c .3 \mathrm{~mm}$, whitish or yellow, sometimes red-striped, slightly dimorphic. Ripe fruit $15-25 \times 1.5 \mathrm{~mm}$, torulose, deflexed. S.E. Europe, from Athos to the lower Don. Bu Gr Rs (K, E) Tu.
2. C. violacea L., Sp. Pl. 672 (1753). Like 1 but the middle and upper cauline leaves simple; leaflets linear or linear-lanceolate; upper bracts at least as long as pedicels; petals violet, rarely yellow, strongly dimorphic (the longer petals $4-6 \mathrm{~mm}$ ); ripe fruit $50-100 \times 2 \mathrm{~mm}$, not torulose. S. \& W. Spain, Portugal. Hs Lu.

## LXVIII. CRUCIFERAE ${ }^{1}$

Annual to perennial herbs, rarely small shrubs. Leaves alternate, exstipulate. Flowers usually hermaphrodite, actinomorphic, hypogynous. Sepals 4, free, in 2 decussate pairs. Petals 4, rarely absent, free, clawed, imbricate or contorted, alternating with the sepals. Stamens usually 6 , rarely 4,2 or 0 , tetradynamous (an outer pair with short filaments, and two inner pairs, one posterior and one anterior, with long filaments); filaments sometimes winged or with a tooth-like appendage. Nectarial glands of various sizes, shapes, colours and dispositions around the base of the stamens and ovary. Ovary of 2 carpels, syncarpous, with 2 parietal placentas, usually bilocular through the formation of a membranous false septum by the union of outgrowths of the placentas; sometimes transversely plurilocular. Stigma capitate to bilobed. Fruit usually a dehiscent capsule opening by 2 valves from below, called a siliqua when at least 3 times as long as wide or a silicula if less than 3 times as long as wide; sometimes indehiscent, breaking into 1 -seeded portions or not; rarely transversely articulate with dehiscent and indehiscent segments, sometimes dividing at maturity into 1 -seeded portions (lomentum). Seeds in 1 or 2 rows in each loculus.

There is great diversity in the form and structure of the fruit in this family, often affording an easy means of identification, especially in genera which do not possess a normal siliqua or silicula.

The following notes of diagnostic features of particular genera may assist in identification:

Flowers zygomorphic: Iberis, Teesdalia, Teesdaliopsis, Ionopsidium (one sp.).

Spiny small shrubs: Ptilotrichum (part), Vella.
Valves of fruit covered with conical spines: Succowia.
Fruits flattened, didymous, winged: Biscutella, Megacarpaea.
Filaments of the inner stamens connate in pairs: Leptaleum, Sterigmostemum, Euzomodendron, Vella, Boleum.

1 Fruit with 2 segments, the upper flat, foliaceous or lingulate, the lower with 1 or 2 seeds
2 Fruit pendent; filaments free; annual herbs 95. Carrichtera
2 Fruit erect; filaments of the inner stamens connate in pairs; small shrubs
3 Lower segment of fruit glabrous or sparsely setose; ovary shortly stipitate 96. Vella
3 Lower segment of fruit densely setose; ovary sessile 98. Boleum 1 Fruit without a terminal, flat, foliaceous or lingulate segment, often not segmented or with more than 2 segments
4 Fruit covered with conical spines $1-3 \mathrm{~mm}$ long 97. Succowia
4 Fruit not covered with conical spines
5 Fruit pendent, flat, not more than 12 times as long as wide
6 Hairs branched or stellate; petals yellow 57. Clypeola
6 Plant glabrous, or with a few unbranched or medifixed hairs
7 Petals yellow; fruit with a wide often inflated wing surrounding the loculus; loculus usually with a distinct longitudinal rib
14. Isatis

7 Petals white; fruit not winged, without a longitudinal rib
47. Peltaria

5 Fruit erect or patent, rarely pendent and $\pm$ flattened, but then more than 12 times as long as wide
8 Fruit strongly compressed, convex beneath, concave with incurved margins above so as to be more or less hemispherical
15. Tauscheria

8 Fruit not convex beneath, and concave with incurved margins above
${ }^{1}$ Edit. V. H. Heywood.

9 Pedicels pendent, with the fruit erect or erecto-patent on the end of the pedicel
17. Goldbachia

9 Pedicels various but never pendent with the fruit erect or erecto-patent
10 Fruits lomentaceous-that is transversely articulate with 2 or more segments often separating at maturity; the lower segment 2 -valved and dehiscent or sterile and stipitiform; the upper segment usually indehiscent
11 Stigma deeply 2-lobed
12 Fruit with a beak $15-30 \mathrm{~mm}$ long, almost as long as the rest of the fruit 33. Chorispora
12 Fruit not beaked, the style not more than 5 mm long
13 Grey-tomentose with branched hairs; petals yellow 25. Sterigmostemum

13 Sparsely pubescent with unbranched hairs; petals white or purplish
32. Diptychocarpus

11 Stigma entire, capitate or slightly 2-lobed
14 Leaves and flowers all basal; pedicels elongating and curving downwards to bury the fruit 105. Morisia
14 Plant with obvious long stem; pedicels not curving downwards to bury the fruit
15 Upper segment of fruit globose or ovoid, sometimes shortly beaked
16 Upper segment of fruit not beaked; style absent
103. Crambe

16 Upper segment of fruit beaked or with a distinct, persistent style
17 Cauline leaves amplexicaul with acute auricles
104. Calepina

17 Cauline leaves not amplexicaul
18 Petals white; upper segment of fruit with a pungent beak
102. Didesmus

18 Petals yellow; upper segment of fruit without a pungent beak
19 Upper segment of fruit with 8 longitudinal winged ribs, sparsely hispid 106. Guiraoa
19 Upper segment of fruit variously ribbed, but not winged, usually glabrous or with appressed hairs
101. Rapistrum

15 Upper segment of fruit cylindrical or oblong-ovoid, sometimes constricted between the seeds
20 Lower segment of fruit 2 -valved, dehiscent, with 2-4 seeds (rarely some fruits with a sterile, stipitiform lower segment)
21 Upper segment of fruit gradually attenuate into a beak 94. Hutera
21 Upper segment of fruit abruptly contracted into the persistent style
99. Erucaria

20 Lower segment of fruit indehiscent, often sterile and stipitiform or very small, with 0-2 seeds
22 Upper segment of fruit not more than 3 times as long as wide, mitre-shaped, usually 1 -seeded
100. Cakile

22 Upper segment of fruit at least 5 times as long as wide, cylindrical and often contracted between the seeds
23 Racemes bracteate, at least in the lower half
107. Enarthrocarpus

23 Racemes ebracteate
108. Raphanus

10 Fruit a siliqua or silicula, sometimes dividing into
several portions, or hard and indehiscent
24 Fruit a siliqua, at least 3 times as long as wide
25 Glabrous or with unbranched hairs only
26 Fruit $\pm$ compressed laterally, with 2 triangular wings at apex, indehiscent
62. Andrzeiowskia

26 Fruit compressed dorsally or with convex valves
27 Sepals erect (calyx closed)

28 Fruits of 2 kinds, the lower ones articulate, indehiscent, the upper ones opening by valves
32. Diptychocarpus

28 Fruits all similar and dehiscent
29 Leaves simple, entire, somewhat fleshy
30 Petals purple or sordid whitish-purple or white
31 Siliqua $3.5-5.5 \mathrm{~mm}$ wide; seeds $4-5.5 \mathrm{~mm}$ (including wing); flowering stems scapose
28. Parrya

31 Siliqua not more than 3 mm wide; seeds less than 3 mm ; flowering stems not scapose
32 Plant pubescent, with some glandular hairs 27. Clausia

32 Plant glabrous
85. Moricandia

30 Petals yellow or yellowish-white
33 Cauline leaves cordate-amplexicaul; glabrous annual
84. Conringia

33 Cauline leaves not amplexicaul; perennial or biennial
34 Valves of siliqua with 1 prominent vein
88. Brassica

34 Valves of siliqua with 3 distinct veins
92. Rhynchosinapis

29 At least some leaves toothed, lobed or divided (lyrate to pinnatisect)
35 Small, much-branched shrub with crowded, pinnatisect leaves divided into $\pm$ fleshy segments; filaments of inner stamens united in pairs
86. Euzomodendron

35 Habit and leaves not as above; filaments free
36 Stigma deeply 2 -lobed
37 Siliqua with an ensiform beak; cauline leaves pinnatifid
90. Eruca

37 Siliqua not beaked; middle and upper cauline leaves simple, dentate or serrate
38 Seeds in 2 rows in each loculus; inner sepals not saccate at base; scapose 28. Parrya
38 Seeds in 1 row in each loculus; inner sepals saccate at base; not scapose
39 Glabrous or with very few eglandular hairs
20. Hesperis

39 Pubescent, with some hairs glandular
27. Clausia

36 Stigma capitate, entire or slightly 2-lobed
40 Petals pink; siliqua $8-9 \mathrm{~mm}$ wide, not beaked
45. Ricotia

40 Petals white or yellow; siliqua not more than 5 mm wide, rarely up to 12 mm wide and then distinctly long-beaked
41 Valves of siliqua with 1 prominent vein
88. Brassica

41 Valves of siliqua with 3 veins, at least when young
42 Petals with short claw; ovary with 8-14 ovules
93. Hirschfeldia

42 Petals with long filiform claw; ovary with 16-50 ovules
92. Rhynchosinapis

27 Sepals erecto-patent or patent
43 Siliqua indehiscent, oblong-pyriform (Krym)
12. Sobolewskia

43 Siliqua dehiscent, not oblong-pyriform
44 Valves with 3-7 veins
45 Petals white
6. Alliaria

45 Petals yellow
46 Siliqua 3- to 7 -veined; beak 10 mm or more
89. Sinapis

46 Siliqua 3-veined, not beaked
47 Siliqua clavate at apex, constricted in the middle; stigma sessile 2. Lycocarpus
47 Siliqua not clavate nor constricted; style distinct; stigma not sessile 1. Sisymbrium
44 Valves with a single median vein or veinless
48 Siliqua not more than 7 times as long as wide

49 Seeds in 1 row in each loculus
43. Arabis

49 Seeds in 2 rows in each loculus
50 Radicle incumbent; stem hairy, at least at the base 10. Braya
50 Radicle accumbent; stem glabrous 59. Draba
48 Siliqua more than 7 times as long as wide
51 Valves with median vein weak or absent
52 Valves flat, the siliqua strongly compressed
53 Valves coiling spirally from the base and dehiscing suddenly at maturity 41. Cardamine
53 Valves not coiling spirally
43. Arabis

52 Valves convex, the siliqua not strongly compressed
54 Siliqua attenuate; seeds mucilaginous when moistened 37. Sisymbrella
54 Siliqua not attenuate; seeds not mucilaginous
55 Petals white 40. Nasturtium
55 Petals yellow
56 Infructescence corymbose; seeds in 1 row in each loculus
36. Barbarea

56 Infructescence not corymbose; seeds in 2 rows in each loculus
38. Rorippa

51 Valves with distinct median vein
57 Siliqua strongly compressed
58 Cauline leaves sessile 43. Arabis
58 At least the lower and middle cauline leaves distinctly petiolate 42. Cardaminopsis
57 Siliqua not strongly compressed
59 Petals yellow, sometimes with violet veins 60 Seeds in 2 rows in each loculus
61 Not caespitose; stems leafy

61 Caespitose perennial; cauline leaves few or absent
88. Brassica

60 Seeds in 1 row in each loculus
62 Valves of the siliqua rounded on the back; median nectaries absent; lateral nectaries prismatic 88. Brassica
62 Valves of the siliqua keeled; median nectaries present or, if absent, the lateral nectaries semilunar or 2-lobed
63 Median nectaries present; valves of siliqua not or only slightly torulose
36. Barbarea

63 Median nectaries absent; valves of siliqua torulose
91. Erucastrum

59 Petals white, white veined with violet, or purple
64 Seeds in 2 rows in each loculus
65 Siliqua with distinct beak up to 6 mm ; cauline leaves cuneate or hastate at base
87. Diplotaxis

65 Siliqua without beak, the style very short; cauline leaves with rounded auricles at base 1 row in each loculus
64 Seeds in 1 row in each loculus
66 Stout perennial up to 2 m ; basal leaves $10-40 \mathrm{~cm} \quad$ 88. Brassica
66 Slender annual or perennial up to 50 cm ; basal leaves much less than 10 cm
67 Most flowers subtended by a bract

1. Sisymbrium

67 Flowers ebracteate
68 Petals emarginate (sometimes only shallowly); inner sepals saccate at base
3. Murbeckiella

68 Petals entire, or absent; inner sepals not saccate at base
69 Basal leaves truncate or cordate at base, fleshy; seeds $c .3 \mathrm{~mm}$, winged 7. Eutrema
69 Basal leaves attenuate at base; seeds less than 1 mm , not winged
8. Arabidopsis

25 Hairs stellate, branched, or a mixture of branched and unbranched
70 Stigma deeply 2-lobed, the lobes sometimes erect and connate to form a beak on the siliqua
71 Lobes of the stigma with a dorsal swelling or horn

> 29. Matthiola

71 Lobes of the stigma without a swelling or horn
72 Style at least $\frac{1}{2}$ as long as the rest of the siliqua
33. Chorispora

72 Style much less than $\frac{1}{2}$ as long as the rest of the siliqua
73 Petals yellow
74 Sepals not saccate; filaments of the inner stamens connate in pairs; siliqua articulated
25. Sterigmostemum

74 Inner sepals strongly saccate at base; filaments all free; siliqua not articulated
75 Hairs all medifixed; style $2-3 \mathrm{~mm}$ in fruit
26. Cheiranthus

75 Hairs various, but not all medifixed; style $c$. 1 mm or less in fruit
20. Hesperis

73 Petals white, pink or violet, rarely reddish
76 Inner sepals saccate at base
77 Style short, the stigma-lobes free
20. Hesperis

77 Style absent, the stigma-lobes erect, connate
21. Malcolmia

76 Inner sepals not saccate at base
78 Filaments of the inner stamens connate in pairs; seeds in 2 rows in each loculus 24. Leptaleum
78 Filaments all free; seeds in 1 row in each loculus
21. Malcolmia

70 Stigma capitate, retuse or slightly 2-lobed
79 Siliqua with 2 or 4 horns at the apex
80 Siliqua with 2 horns at the apex; petals white
30. Notoceras

80 Siliqua with 4 horns at the apex; petals yellow
31. Tetracme

79 Siliqua without horns at the apex
81 Leaves 2- to 3-pinnatisect
82 Petals shorter than sepals; siliqua $0.5-0.75 \mathrm{~mm}$ wide; seeds $0.8-1 \mathrm{~mm}$ 4. Descurainia
82 Petals exceeding sepals; siliqua $1 \cdot 2-1.5 \mathrm{~mm}$ wide; seeds c. 2 mm
5. Hugueninia

81 Leaves entire to pinnatisect
83 Petals yẹllow
84 Style at least $\frac{1}{2}$ as long as the rest of the siliqua; siliqua with mostly medifixed hairs lying transversely across it
19. Syrenia

84 Style not more than $\frac{1}{3}$ as long as the rest of the siliqua; hairs on the siliqua not as above
85 Siliqua not more than $10(-12) \mathrm{mm}$, not more than 6 times as long as wide
86 Cauline leaves sagittate, amplexicaul
11. Chrysochamela

86 Caulineleaves cuneateat base or absent 59. Draba
85 Siliqua 10 mm or more, at least 10 times as long as wide
87 Cauline leaves not amplexicaul 18. Erysimum
87 Cauline leaves amplexicaul, sagittate or cordate at base
$\begin{array}{lll}88 & \text { Siliqua glabrous } & \text { 43. Arabis } \\ 88 & \text { Siliqua pubescent } & \text { 8. Arabidopsis }\end{array}$
83 Petals white, pink or purple
89 Plant $\pm$ densely covered with medifixed hairs; style ( $1 \cdot 5-$ ) $2-6 \mathrm{~mm}$ 18. Erysimum
89 Plant with unbranched, branched or stellate hairs, sometimes mixed with a few medifixed
90 Style at least 2.5 mm
44. Aubrieta

90 Style not more than 2 mm
91 Siliqua less than 10 times as long as wide
92 Seeds in 1 row in each loculus
$\begin{array}{lll}93 & \text { Siliqua torulose } & \text { 10. Braya } \\ 93 & \text { Siliqua not or scarcely torulose } & \text { 43. Arabis }\end{array}$

92 Seeds in 2 rows in each loculus
94 Radicle incumbent; hairs unbranched and 2-fid 10. Braya
94 Radicle accumbent; usually with at least some stellate and branched hairs 59. Draba
91 Siliqua at least 10 times as long as wide
95 Valves of the siliqua flat, rarely keeled
96 Lower and middle cauline leaves sessile or subsessile, entire to deeply dentate
43. Arabis

96 Lower and middle cauline leaves distinctly petiolate, often pinnatifid or pinnatisect
97 Valves of siliqua with a distinct median vein 42. Cardamino
43. Arabis

97 Valves of siliqua without a median vein 43.
95 Valves of the siliqua rounded or angled
98 Siliqua pubescent at least when immature
99 Hairs all stellate and $\pm$ appressed
23. Maresia

99 At least some hairs unbranched or 2-fid, patent, hispid
22. Torularia

98 Siliqua glabrous
100 Petals $\pm$ emarginate; inner sepals $\pm$ saccate at base 3. Murbeckiella
100 Petals entire or $\pm$ truncate; inner sepals not saccate at base
101 Siliqua at least 1 mm wide 10. Braya
101 Siliqua less than 1 mm wide
8. Arabidopsis

24 Fruit a silicula, less than 3 times as long as wide
102 Silicula didymous, flat
103 Petals yellow; style long
78. Biscutella

103 Petals white or pink; stigma sessile 79. Megacarpaea
102 Silicula not didymous (rarely didymous and then not flat)
104 Silicula with 3 loculi, the upper 2 side by side, sterile, the lower 1 -seeded 13. Myagrum
104 Silicula without 2 sterile loculi side by side
105 Silicula with 4 longitudinal wings or ridges or covered with irregular protuberances 16. Bunias
105 Silicula without 4 wings or ridges and not covered with irregular protuberances
106 Silicula latiseptate (compressed parallel to the septum which is therefore as wide as the widest diameter of the fruit), rarely nucumentaceous
107 Ovary surrounded at the base by a glandular intrastaminal ring; small aquatic; leaves all basal 83. Subularia
107 Ovary without glandular ring; terrestrial, or if aquatic then leaves not all basal
108 Glabrous or with unbranched hairs
109 Sepals erect or nearly so (calyx closed)
110 Petals (10-) 12 mm or more; silicula 20 $90 \times(10-) 15-35 \mathrm{~mm}$ 46. Lunaria
110 Petals not more than 10 mm ; silicula not more than $12 \times 8 \mathrm{~mm}$
111 Petals pale violet or with violet veins; perennial with fleshy leaves 45. Ricotia
111 Petals white or yellow; annual or biennial, not fleshy
66. Camelina

109 Sepals patent or erecto-patent (calyx $\pm$ open)
112 Petals yellow
113 Plant with at least some leaves pinnate or pinnatifid or coarsely toothed; cauline leaves numerous 38. Rorippa
113 Leaves usually entire; cauline leaves usually absent
59. Draba

112 Petals white
114 Silicula longitudinally 6-veined, the veins in 2 groups of 3 which diverge from the base
35. Litwinowia

114 Silicula not longitudinally 6-veined
115 Plants grey-pubescent 61. Petrocallis
115 Plants green, glabrous or sparsely hairy
116 Silicula with a short broad obtuse beak;petals unequal, the inner distinctlylonger than the outer 104. Calepi
116 Silicula not beaked, but sometimes with a persistent style; petals $\pm$ equal
117 Robust plants up to 1 m with fusiform roots
39. Armoracia
117 Slender plants $2-40 \mathrm{~cm}$; roots not fusiform
118 Filaments straight

## 63. Cochlearia

118 Filaments curved
119 Racemes bracteate
65. Rhizobotrya
119 Racemes ebracteate
120 Seeds not bordered
59. Draba
120 Seeds with a membranous border
64. Kernera
108 At least some of the hairs branched or stellate
121 Sepals erect (calyx closed)
122 Silicula indehiscent, subglobose, sometimes compressed, reticulate-rugose 67. Neslia
122 Silicula dehiscent, variously shaped, not reticulate-rugose
123 Silicula stipitiform at the base 48. Alyssoides
123 Silicula sessile
124 Silicula compressed; petals short-clawed
51. Fibigia
124 Silicula inflated
125 Silvery, caespitose perennial; silicula ellipsoidal; seeds 2 in each loculus
49. Degenia
125 Annual or biennial; silicula pyriform, obovoid or globose; seeds usually numerous 66. Cameli
121 Sepals patent or erecto-patent (calyx $\pm$ open) 126 Petals deeply 2-lobed
127 Scapigerous; leaves mainly in basal rosette
60. Erophila
127 Not scapigerous; cauline leaves present 128 Petals white
129 Ovules 2-6 in each loculus; style long; seeds winged or margined 52. Berteroa
129 Ovules 1-2 in each loculus; style short; seeds not winged or margined
53. Lepidotrichum
128 Petals yellow
130 Petals divided for more than $\frac{1}{3}$ of their length
52. Berteroa
130 Petals less deeply divided
131 Inner sepals saccate at base; seeds 4-8 in each loculus 48. Alyssoides
131 Sepals not saccate at base; seeds 1-4 in each loculus
50. Alyssum
126 Petals entire or emarginate
132 Petals yellow
133 Valves of silicula reticulate-veined; cauline leaves sagittate-amplexicaul
10. Chrysochamela
133 Valves of silicula not reticulate-veined; cauline leaves not sagittate-amplexicaul
134 Dwarf scapose perennials; leaves usually entire, often linear 59. Draba
134 Annual or perennial, not scapose; leaves often toothed, wider
135 Inner sepals saccate at base; ovary with $4-8$ ovules in each loculus
48. Alyssoides
135 Inner sepals not saccate at base; ovary with $1-2(-6)$ ovules in each loculus
50. Alyssum

132 Petals white, pink or purplish

136 Silicula indehiscent, longitudinally 4veined; pedicels stout, about as thick as the silicula
34. Euclidium

136 Silicula dehiscent, not longitudinally 4veined; pedicels much thinner than the silicula
137 Hairs nearly all medifixed
138 Ovary and silicula completely glabrous; flaments with a short tooth at the base
55. Bornmuellera

138 Ovary and silicula pubescent, the silicula sometimes $\pm$ glabrescent; filaments without appendages
56. Lobularia

137 Hairs stellate or branched
139 Ovules and seeds 1 or 2 in each loculus, seeds usually winged 54. Ptilotrichum
139 Ovules and seeds 4 or more in each loculus
140 Filaments of the inner stamens winged
58. Schivereckia

140 Filaments of the inner stamens not winged
59. Draba

106 Silicula angustiseptate-compressed at right angles to the septum
141 Fruits didymous, reniform or cordate
142 Cauline leaves sessile, amplexicaul; petals $c$. 4 mm
81. Cardaria

142 Cauline leaves shortly petiolate; petals $0.5-$ $1.5 \mathrm{~mm} \quad$ 82. Coronopus
141 Fruits not didymous, reniform or cordate, but sometimes obcordate
143 Outer petals conspicuously larger than the inner
144 Style distinct; stigma capitate 77. Iberis
144 Style inconspicuous
145 Annual; stigma 2-lobed
73. Teesdalia

145 Caespitose perennial; stigma capitate
76. Teesdaliopsis

143 Petals (when present) equal in size
146 Filaments with a wing or tooth-like appendage
147 Leaves entire, not $\pm$ confined to a basal rosette; sepals erect 75. Aethionema
147 Leaves usually pinnatifid, mostly confined to a basal rosette; sepals erecto-patent
73. Teesdalia

146 Filaments not appendaged
148 Valves of fruit winged or strongly keeled
149 Inflorescence leafy, or bracteate at base $149 b$ Flowers white, pink or purple
72. Ionopsidium
$149 b$ Flowers yellow 72 bis. Bivonaea
149 Inflorescence ebracteate; seeds not covered with transparent papilliform glands
150 Seed solitary, pendent from apex of each loculus
80. Lepidium

150 Seeds 1-8 in each loculus
74. Thlaspi

148 Valves of fruit not winged or keeled
151 Fruits triangular-obcordate 68. Capsella
151 Fruits not triangular-obcordate
152 Leaves simple
153 Valves of fruit convex, not strongly compressed 63. Cochlearia
153 Valves of fruit $\pm$ strongly compressed
70. Hymenolobus

152 Leaves pinnate or pinnatisect
154 Perennial; seeds 1-2 in each loculus
69. Hutchinsia

154 Annual or biennial
155 Seeds 1-2 in each loculus; hairs stellate when present
71. Hornungia

155 Seeds 3-10 in each loculus; hairs unbranched when present 70. Hymenolobus

## 1. Sisymbrium L. ${ }^{1}$

Annual or perennial herbs; glabrous or hairs unbranched. Leaves entire to pinnatisect. Sepals not saccate at base; petals yellow, rarely white, entire. Fruit a siliqua; valves usually 3veined; style distinct; stigma more or less 2 -lobed. Seeds small (not more than 2.5 mm ).

Many of the widespread lowland species occur as weeds, and, as such, are often of uncertain status in many parts of Europe.

Literature: O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 46-157 (1924).

1 Inflorescence bracteate, at least in the lower part
2 Flowers white; valves of the siliqua with a distinct median vein and reticulate lateral veins

1. supinum

2 Flowers pale yellow; valves of the siliqua 3 -veined
3 Petals $2.5-3.5 \mathrm{~mm}$; style almost as thick as siliqua 16. runcinatum
3 Petals $1.5-2.5 \mathrm{~mm}$; style distinctly thinner than siliqua
4 Pedicels $0.5-1 \mathrm{~mm}$ in fruit; siliqua recurved; style $0.5-1 \mathrm{~mm}$
14. polyceratium

4 Pedicels 2-3 mm in fruit; siliqua $\pm$ straight; style 1-2 mm
15. confertum

1 Inflorescence ebracteate
5 Siliqua not more than 20 mm , closely appressed to the stem
6 Siliqua (8-)10-20 mm, straight, conical-cylindrical; petals 2-4 mm
18. officinale

6 Siliqua $7-10 \mathrm{~mm}$, curved or twisted, strongly compressed at the apex; petals $c .1 .5 \mathrm{~mm} \quad$ 19. matritens
5 Siliqua usually more than 20 mm , not closely appressed to the stem
7 Lower leaves ovate, entire or dentate
8 Annual; petals less than 3 mm , not exceeding the sepals 17. erysimoides

8 Biennial or perennial; petals more than 3 mm , exceeding the sepals
9 Seeds $2-3 \mathrm{~mm}$; lower pedicels $5-10 \mathrm{~mm}$ in fruit; petals $4 \cdot 5-10 \mathrm{~mm}$
2. strictissimum

9 Seeds $1-1.5 \mathrm{~mm}$; lower pedicels $3-6 \mathrm{~mm}$ in fruit; petals $3 \cdot 5-5 \mathrm{~mm}$
8. austriacum

7 At least the lower leaves deeply lobed or divided
10 Petals less than 3 mm , shorter than or only slightly exceeding the sepals; anthers $c .0 .5 \mathrm{~mm}$
11 Pedicels $3-6 \mathrm{~mm}$ in flower, up to 20 mm in fruit and much thinner than the siliqua
11 Pedicels $1-2 \mathrm{~mm}$ in flower, up to 5 mm in fruit and almost as thick as the siliqua
12 Lower leaves lyrate-pinnatifid, the lateral lobes obovate to lanceolate; stamens $c .3 \mathrm{~mm}$, longer than the petals
17. erysimoides

12 Lower leaves sinuate-pinnatifid, the lateral lobes $\pm$ triangular; stamens c. 1.5 mm , shorter than the petals
14. polyceratium

10 Petals 3 mm or more, distinctly exceeding the sepals; anthers ( $0.7-$ ) $1-3 \mathrm{~mm}$
13 Pedicel about as thick as siliqua, usually at least 0.7 mm in diameter at the base
14 Ovules not more than 30 in each loculus; siliqua rarely more than 60 mm
8. austriacum

14 Ovules $40-60$ in each loculus; siliqua $50-100(-180) \mathrm{mm}$
15 Uppermost leaves $\pm$ sessile, pinnatisect, with the terminal lobe linear; outer sepals horned 12. altissimum
15 Uppermost leaves shortly petiolate, entire or hastate, with the terminal lobe oblong or lanceolate; outer sepals not horned
13. orientale

13 Pedicel thinner than siliqua, rarely more than 0.5 mm in diameter at the base
16 Inflorescence very contracted, the young siliquae distinctly overtopping the flowers and buds; anthers c. 0.7 mm

[^100]16 Inflorescence elongate, the young siliquae not or scarcely overtopping the flowers; anthers $1-2 \mathrm{~mm}$
17 Siliqua less than 15 mm , usually strongly contorted
8. austriacum

17 Siliqua more than 15 mm , straight or only slightly contorted
18 Septum of the siliqua white, opaque; stem glabrous or with short upwardly curving hairs; seeds $1-1.5 \mathrm{~mm}$
19 Valves of siliqua with slender veins; septum not or only slightly foveolate; petals usually less than $6.5 \mathrm{~mm} \quad$ 8. austriacum
19 Valves of siliqua with prominent, usually very thick veins; septum foveolate; petals more than 6.5 mm
(9-11). crassifolium group
18 Septum of the siliqua more or less hyaline; stem glabrous or hispid
20 Seeds $0 \cdot 7-1 \mathrm{~mm}$; sepals $2-4 \mathrm{~mm}$; petals $4-7 \mathrm{~mm}$
21 Stem and leaves pubescent, at least in the lower part; basal leaves not distinctly larger than the cauline, often dead at the time of flowering 4. Ioeselii
21 Stem and leaves glabrous or glabrescent; basal leaves $15-35 \mathrm{~cm}$, persistent, much larger than the cauline
5. assoanum

20 Seeds $1-1.5 \mathrm{~mm}$; sepals $3 \cdot 5-6 \mathrm{~mm}$; petals $6-10 \mathrm{~mm}$
22 Lower leaves triangular-hastate with prominent basal lobes; siliqua $1-1.2 \mathrm{~mm}$ in diameter, the valves with weak lateral veins 7. volgens
22 Lower leaves deeply pinnatisect with c. 4 pairs of lobes; siliqua $0.7-1 \mathrm{~mm}$ in diameter, the valves $\pm$ distinctly 3 -veined
6. polymorphum

Sect. Kibera (Adanson) DC. Inflorescence bracteate; flowers white, not fasciculate; valves of siliqua with a median vein and reticulate lateral veins.

1. S. supinum L., $S p$. Pl. 657 (1753). Annual $5-35 \mathrm{~cm}$, shortly pubescent with patent hairs. Leaves sinuate-pinnatisect, the terminal lobe oblong to obovate, the laterals linear to oblong. Pedicels $1-2 \mathrm{~mm}$ in flower, $2-4 \mathrm{~mm}$ in fruit. Petals $3-4 \mathrm{~mm}$; anthers 0.5 mm . Siliqua $10-30 \times 1 \cdot 5-2 \mathrm{~mm}$, obtuse, pubescent; style $1-2.5 \mathrm{~mm} .2 n=42$. Scattered through C. \& W. Europe northwards to S. Sweden (Gotland and Öland). Be Ga Ge He Ho ? Hs Su [Fe No].

Sect. Norta (Adanson) DC. Leaves simple; inflorescence ebracteate; flowers yellow; valves of siliqua 3 -veined.
2. S. strictissimum L., Sp. Pl. 660 (1753). Perennial $50-100$ $(-150) \mathrm{cm}$, glabrescent or shortly pubescent. Lower leaves ovate, acute, dentate or entire. Pedicels $4-10 \mathrm{~mm}$. Petals $4 \cdot 5-10 \mathrm{~mm}$; stamens $4-7 \mathrm{~mm}$, the anthers $1-2 \mathrm{~mm}$. Siliqua ( $15-$ ) $30-80 \times$ $0 \cdot 7-2 \mathrm{~mm}$. Seeds $2-3 \mathrm{~mm} . \quad 2 n=28$. © From France and Italy eastwards to E.C. Russia and Bulgaria; introduced further west. Al $\mathrm{AuBuCzGaGeHeHuIt} \mathrm{Ju} \mathrm{Po} \mathrm{RmRs} \mathrm{(C}, \mathrm{W}, \mathrm{E)} \mathrm{[Be} \mathrm{Br} \mathrm{Hb} ? \mathrm{Hs}$ ].

Sect. Irio DC. Inflorescence ebracteate; flowers yellow; valves of siliqua 3 -veined.
3. S. irio L., Sp. Pl. 659 (1753). Annual up to 60 cm , glabrescent or with long curved hairs. Lower leaves sinuate-pinnatifid, the terminal lobe larger than the laterals; cauline leaves lobed or entire and hastate, shortly petiolate. Inflorescence condensed, the young siliquae overtopping the flowers and buds; pedicels $3-6 \mathrm{~mm}$ in flower, up to 20 mm in fruit. Petals $2 \cdot 5-3 \cdot 5(-6) \mathrm{mm}$; anthers $c .0 .7 \mathrm{~mm}$. Siliqua $25-65 \times 0.7-1 \mathrm{~mm}$, torulose; style rarely more than 0.5 mm ; septum more or less hyaline. Seeds c. $1 \mathrm{~mm} .2 n=42$. Probably native only in $S$. Europe, but occurring throughout Europe except the extreme north. *Au Bl Bu Co Cr Ga Gr He Hs It Ju Lu *Rm Sa Si [Az Be Br Cz Da Ge Hb Ho Hu No Rs (C, W) Po Su].
4. S. loeselii L., Cent. Pl. 1:18 (1755). Annual 20-100(-180) cm, usually more or less hispid. Leaves lyrate- or sinuate-pinnatisect, the terminal lobe triangular-ovate to triangular-oblong; upper shortly petiolate. Petals $4-7 \mathrm{~mm}$; anthers c. 1.5 mm . Siliqua (10-)15-45 $\times 0.7-1 \mathrm{~mm}$; style $0.5-1.2 \mathrm{~mm}$; septum more or less hyaline. Seeds $0.7-1 \mathrm{~mm}$. C. \& E. Europe, westwards to Germany and Italy; often introduced in the west and north. Au Bu Cz Ge Gr Hu It Ju Po Rm Rs (N, B, C, W, K, E) Tu [Be Br Da Fe Ga He Ho Hs No Su].
5. S. assoanum Loscos \& Pardo, Ser. Pl. Arag. 6 (1863). Like 4 but the stem glabrous or shortly pubescent at base; basal leaves $15-35 \mathrm{~cm}$, much larger than the cauline, the terminal lobe oblongelliptical; cauline leaves often simple; petals $4-6 \mathrm{~mm}$; anthers c. 1 mm . E. \& C. Spain. Hs.
6. S. polymorphum (Murray) Roth, Man. Bot. 2: 946 (1830). Annual or perennial $20-100 \mathrm{~cm}$, glabrescent, or hispid at base. Lower leaves pinnatisect, the terminal lobe large, ovate, the laterals linear; upper leaves entire, linear. Petals $6-9 \mathrm{~mm}$; anthers $1.5-3 \mathrm{~mm}$. Siliqua ( $12-$ ) $20-40 \times 0.7-1 \mathrm{~mm}$, the style rarely more than 0.7 mm ; septum more or less hyaline. Seeds $1-1.5 \mathrm{~mm}$. E. \& E.C. Europe. Bu Hu Po Rm Rs (C, W, K, E) [Rs (N)].
7. S. volgense Bieb. ex E. Fourn., Rech. Fam. Crucif. 97 (1865). Like 6 but glabrescent or shortly pubescent at the base; lower leaves ovate or elliptic-triangular, hastate, with prominent basal lobes; petals $6-10 \mathrm{~mm}$; siliqua $25-50 \times 1-1.2 \mathrm{~mm}$, the style rarely more than 0.5 mm ; valves with weak lateral veins. S.E. Russia; naturalized or casual elsewhere. $\quad \mathrm{Rs}(\mathrm{E})[\mathrm{Be} \mathrm{Br} \mathrm{Da} \mathrm{Fe} \mathrm{Ga}$ Ge Ho No Rs (N, B, C, W) Su].
8. S. austriacum Jacq., Fl. Austr. 3: 35 (1775) (S. pyrenaicum (L.) Vill., non L.). Biennial or perennial $10-100 \mathrm{~cm}$, glabrescent or with upward-curving hairs. Leaves entire to sinuate-pinnatisect. Petals $3 \cdot 5-7(-8) \mathrm{mm}$; anthers $1-2 \mathrm{~mm}$. Siliqua up to $60 \times 0.5-1.5 \mathrm{~mm}$; septum yellowish, opaque. Seeds $1-1.5 \mathrm{~mm}$. W.C. \& S.W. Europe, from c. $15^{\circ}$ E. to the Iberian peninsula. Au Cz Ga Ge He Hs It * Lu [ $\mathrm{Br} \mathrm{Ho} \mathrm{Hu} \mathrm{No} \mathrm{Su]}$.

1 Middle and upper cauline leaves entire or dentate; siliqua $0 \cdot 5-1 \mathrm{~mm}$ in diameter
2 Basal leaves pinnatifid or pinnatisect; sepals $2-3 \mathrm{~mm}$
(c) subsp. contortum

2 Basal leaves entire or sinuate-pinnatifid; sepals $1.5-2.5 \mathrm{~mm}$
(d) subsp. hispanicum

1 Middle and upper cauline leaves pinnatifid; siliqua 0.7 1.7 mm in diameter

3 Siliqua 7-15 mm, strongly contorted (b) subsp. chrysanthum
3 Siliqua (10-)15-50 mm, not or slightly contorted
4 Stem glabrous or sparsely setose; petals $4-7 \mathrm{~mm}$; siliqua $0.7-1.7 \mathrm{~mm}$ in diameter
(a) subsp. austriacum

4 Stem densely setose; petals $3-5.5 \mathrm{~mm}$; siliqua $0.7-1 \mathrm{~mm}$ in diameter
(c) subsp. contortum
(a) Subsp. austriacum: Throughout the range of the species except for parts of the Iberian peninsula. Frequently casual elsewhere.
(b) Subsp. chrysanthum (Jordan) Rouy \& Fouc., Fl. Fr. 2: 17 (1895) (S. pyrenaicum auct.): C. \& W. Pyrenees, mountains of $N$. Spain.
(c) Subsp. contortum (Cav.) Rouy \& Fouc., op. cit. 19 (1895) (S. contortum Cav.): N. \& C. Spain.
(d) Subsp. hispanicum (Jacq.) P. W. Ball \& Heywood, Feddes Repert. 64: 17 (1961) (S. hispanicum Jacq.): C. \& S.E. Spain.
(9-11). S. crassifolium group. Stem glabrescent or with up-ward-curving hairs; lower leaves sinuate-pinnatifid to pinnatisect;
petals $6.5-11 \mathrm{~mm}$, pale yellow; siliqua usually $1-1.5 \mathrm{~mm}$ in diameter, the valves with very prominent veins; style up to 2 mm ; septum thick, opaque, foveolate. Seeds $1-1 \cdot 5 \mathrm{~mm}$.

1 Inflorescence condensed, at least the upper flowers overtopping the buds; valves of siliqua with very thick veins
9. crassifolium

1 Inflorescence lax; valves of siliqua with thin but prominent veins
2 Seeds ovate-oblong; lower leaves usually sinuate-pinnatifid, the lateral lobes triangular; uppermost leaves dentate or entire 10 . laxiflorum
2 Seeds cylindrical; lower leaves sinuate-pinnatisect, the lateral lobes oblong- to ovate-triangular; uppermost leaves usually with linear lobes at the base
11. arundanum
9. S. crassifolium Cav., Descr. Pl. 437 (1803). Biennial or perennial $30-70(-100) \mathrm{cm}$. Lower leaves sinuate-pinnatifid, the lateral lobes usually triangular; uppermost leaves dentate to entire. Inflorescence condensed; pedicels 2-6 mm, up to 12 mm in fruit. Siliqua $35-90 \mathrm{~mm}$, the valves with very thick, broad veins. Seeds ovoid-oblong to oblong. C., E. \& S. Spain. Hs.
10. S. laxiflorum Boiss., Elenchus 9 (1838). Like 9 but inflorescence lax; pedicels $1 \cdot 5-4 \mathrm{~mm}$ in flower, up to 10 mm in fruit; valves of the siliqua with slender, very prominent veins. - Mountains of S. Spain. Hs.
11. S. arundanum Boiss., Voy. Bot. Midi Esp. 2: 30 (1839). Like 9 but lower leaves sinuate-pinnatisect, the lateral lobes ovate- to oblong-triangular; upper leaves with linear lobes at their base; racemes lax; seeds cylindrical. - Mountains of S. Spain. Hs.

Sect. Sisymbrium. Inflorescence ebracteate; pedicels about as thick as siliqua; siliqua patent, with $80-120$ seeds.
12. S. altissimum L., Sp. Pl. 659 (1753) (S. sinapistrum Crantz). Annual up to 100 cm , usually hispid at base. First-formed basal leaves minute, oblong-obovate, subentire; lower cauline leaves sinuate-pinnatifid; the upper sessile, with linear lobes. Pedicels $4-10 \mathrm{~mm}$. Outer sepals with a short horn at the apex; petals $5-8(-10) \mathrm{mm}$; anthers $1-2 \mathrm{~mm}$. Siliqua (35-) $50-100 \times 1-1.5 \mathrm{~mm}$; style $0.5-1.5 \mathrm{~mm}$, cylindrical, with shortly 2 -lobed stigma. Seeds $0 \cdot 8-1 \mathrm{~mm} .2 n=14$. C. \& E. Europe; often introduced elsewhere. Al Au Bu Cz Ge Gr He Hu It Ju Po Rm Rs (C, W, K, E) Tu [Be Br Da Fe Ga Ho Is Lu No Rs (N) Sb Su].
13. S. orientale L., Cent. Pl. 2: 24 (1756) (S. columnae Jacq.; incl. S. costei Fouc. \& Rouy). Like 12 but the stem softly pubescent; upper leaves petiolate, simple or 3-lobed, the terminal lobe linear or lanceolate; sepals without a short horn at the apex; petals ( $6-$ ) $8-10 \mathrm{~mm}$; style and stigma $1-3.5 \mathrm{~mm}$, clavate, the apex about as thick as the siliqua. $2 n=14$. S. Europe; frequently introduced elsewhere. $\mathrm{Al}{ }^{*} \mathrm{Au} \mathrm{Bl} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{*} \mathrm{Hu} \mathrm{Hs} \mathrm{It} \mathrm{Ju}$ *Lu *Rm Si Tu [Be Br Cz Da Fe Ge Hb He Ho No Po Rs (W, $\mathrm{K}, \mathrm{E}) \mathrm{Su}$ ].

Sect. Chamaeplium (Wallr.) Thell. Inflorescence bracteate; flowers pale yellow; valves of siliqua 3-veined.
14. S. polyceratium L., Sp. Pl. 658 (1753) (Chamaeplium polyceratium (L.) Wallr.). Usually glabrous annual up to 75 cm . Lower leaves sinuate-pinnatifid, the lobes triangular. Inflorescence bracteate to the apex; flowers usually fasciculate; pedicels $0 \cdot 5-1 \mathrm{~mm}$ in fruit. Petals $1 \cdot 5-2 \mathrm{~mm}$, equalling or slightly exceeding sepals; anthers $0.3-0.5 \mathrm{~mm}$. Siliqua $10-25 \times 0.7-1.2 \mathrm{~mm}$, recurved, torulose; style thinner than siliqua. Seeds $0 \cdot 6-1 \mathrm{~mm}$. S. Europe, from Corse eastwards. Al Bu Co Cr Ga Gr It Ju Sa Si Tu [Lu].
15. S. confertum Steven ex Turcz., Bull. Soc. Nat. Moscou 27 (2): 304 (1854) (S. anomalum Aznav., S. austriacum subsp. thracicum Aznav.). Very like 14 but the inflorescence often ebracteate in the upper part; pedicels $2-3 \mathrm{~mm}$ in fruit; petals $2-2.5 \mathrm{~mm}$; siliqua up to 45 mm , usually more or less straight; style $1-2 \mathrm{~mm}$. Krym; Turkey-in-Europe. Rs (K) Tu. (S.W. Asia.)
16. S. runcinatum Lag. ex DC., Reg. Veg. Syst. Nat. 2: 478 (1821) (Chamaeplium runcinatum (Lag. ex DC.) Hayek). Like 14 but the lower cauline leaves subentire to sinuate-pinnatifid, the lobes oblong; flowers usually solitary; petals $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$; siliqua $10-35 \times 1-2 \mathrm{~mm}$, straight or slightly recurved; style $1-2 \mathrm{~mm}$, almost as thick as the siliqua. $2 n=56$. S.W. Europe; sometimes casual elsewhere. Bl Ga Hs *Lu.

Sect. Oxycarpus Paol. Inflorescence ebracteate; flowers pale yellow, the stamens longer than the petals; pedicels about as thick as the patent siliqua.
17. S. erysimoides Desf., Fl. Atl. 2: 84 (1798). Annual 1080 cm , glabrous or shortly pubescent. Leaves lyrate-pinnatifid, rarely entire, ovate-lanceolate, serrate. Pedicels $1-2 \mathrm{~mm}$ in flower, up to 5 mm in fruit. Petals $1-2.5 \mathrm{~mm}$; anthers $c .0 .5 \mathrm{~mm}$. Siliqua $25-50 \times c .1 \mathrm{~mm}$, attenuate into style; style not more than 1 mm . Seeds $c .1 \mathrm{~mm}$. W. Mediterranean region. Bl Hs *Lu Sa ?Si.

Sect. Velarum DC. Inflorescence ebracteate; flowers yellow; pedicels about as thick as siliqua; siliqua closely appressed to the stem.
18. S. officinale (L.) Scop., Fl. Carn. ed. 2, 2: 26 (1772) (Chamaeplium officinale (L.) Wallr.). Annual or biennial 590 cm . Lower leaves pinnatisect, more or less ovate in outline, with a large terminal lobe. Pedicels $1-2 \mathrm{~mm}$. Petals $2-4 \mathrm{~mm}$; anthers $c .0 .7 \mathrm{~mm}$; ovary with $10-20$ ovules. Siliqua (8-) $10-$ 20 mm , conical-cylindrical, straight, attenuate into style; style $0 \cdot 5-1 \mathrm{~mm}$. Seeds $c .1 \mathrm{~mm} .2 n=14$. Throughout Europe, northwards to $\mathrm{c} .68^{\circ} \mathrm{N}$. All except Fa Sb ; introduced in Is.
19. S. matritense P. W. Ball \& Heywood, Feddes Repert. 66 : 157 (1962) (S. corniculatum Cav., non Lam.). Like 18 but the lower leaves oblong in outline, the terminal lobe only slightly larger than the laterals; petals c. 1.5 mm ; ovary with $6-7$ ovules; siliqua $7-10 \mathrm{~mm}$, curved or contorted, the apex compressed. $2 n=14$. - C. Spain. Hs.

## 2. Lycocarpus O. E. Schulz ${ }^{1}$

Like Sisymbrium but the siliqua clavate at the apex, constricted in the middle; stigma sessile.

1. L. fugax (Lag.) O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 164 (1924) (Sisymbrium fugax Lag.). Glabrescent or pubescent annual $10-40 \mathrm{~cm}$. Leaves sinuate-pinnatifid. Racemes ebracteate; pedicels $2-5 \mathrm{~mm}$ in fruit, only slightly thinner than the siliqua. Petals $2 \cdot 5-4 \mathrm{~mm}$, yellow. Siliqua $8-20 \mathrm{~mm}, 1 \mathrm{~mm}$ in diameter at base, the apex up to 1.2 mm in diameter. Seeds $0.5-0.8 \mathrm{~mm}$. S.E. Spain. Hs.

## 3. Murbeckiella Rothm. ${ }^{2}$

Perennial herbs; glabrous, or with stellate or long, unbranched hairs. Leaves entire to pinnatisect. Sepals unequal, the inner more or less saccate at base; petals white, emarginate. Fruit a siliqua; valves with a distinct median vein; style very

[^101]${ }^{2}$ By A. O. Chater.
short; stigma slightly 2-lobed. Seeds small (not more than 1.5 mm ), often winged at apex. (Phryne sensu O. E. Schulz.)

Literature: W. Rothmaler, Bot. Not. 1939: 467-76 (1939). R. Fernandes, Mem. Soc. Broter. 6: 79-91 (1950). O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 169-75 (1924).
1 Basal leaves entire to crenate; fruiting pedicels $3-8 \mathrm{~mm}$
2 Cauline leaves 6-9; stems leafy to apex 1. pinnatifida
2 Cauline leaves 3-5; stems leafy only in lower half 1. 2. boryi
1 Basal leaves pinnatifid; fruiting pedicels $5-15 \mathrm{~mm}$
3 Cauline leaves 4-8, pinnatifid, with 4-6 lobes on each side
3 Cauline leaves $2-3$, subentire to dentate $\quad$ 4. zanonii

1. M. pinnatifida (Lam.) Rothm., Bot. Not. 1939: 469 (1939) (Braya pinnatifida (Lam.) Koch; Sisymbrium pinnatifidum (Lam.) DC.). Sparsely to densely covered with stellate hairs; stems more or less densely leafy throughout. Basal leaves $1-2 \mathrm{~cm}$, entire to repand-dentate; cauline 6-9, pinnatifid, with 4-6 lobes on each side. Pedicels $3-4 \mathrm{~mm}$ in fruit. Sepals $1 \cdot 5-2.5 \mathrm{~mm}$; petals $3 \cdot 5-$ 4 mm , slightly emarginate. Siliqua $10-30 \times 1 \mathrm{~mm}$; style 0.25 mm , conical. Seeds $1 \times 0.5 \mathrm{~mm}$, wingless or winged only at apex. $2 n=16$. Mountain rocks. W. Europe, from C. Pyrenees to c. $8^{\circ}$ E. in W.C. Alps. Ga He Hs It.
2. M. boryi (Boiss.) Rothm., loc. cit. (1939) (Braya pinnatifida sensu Willk. pro parte; incl. M. glaberrima (Rothm.) Rothm.). Sparsely to densely covered with stellate hairs, or with only unbranched hairs, sometimes subglabrous; stems sparsely leafy up to the middle. Basal leaves $1 \cdot 5-3 \mathrm{~cm}$, entire or sinuate-dentate; cauline 3-5, pinnatifid, with 1-6 lobes on each side. Pedicels $3-8 \mathrm{~mm}$ in fruit. Sepals $2-3.5 \mathrm{~mm}$; petals $3.5-8 \mathrm{~mm}$, deeply emarginate. Siliqua $10-35 \times 0.5-1 \mathrm{~mm}$; style 0.5 mm . Seeds 1 $1.5 \times 0.5-0.75 \mathrm{~mm}$, winged all round or only at the apex. C. \& $S$. Spain, C. Portugal. Hs Lu.
3. M. zanonii (Ball) Rothm., op. cit. 471 (1939) (Sisymbrium zanonii (Ball) Gay). Usually densely covered with stellate hairs; stems leafy to apex. Basal leaves $2-5 \mathrm{~cm}$, pinnatifid; cauline 4-8, pinnatifid, with $4-6$ lobes on each side. Pedicels $5-14 \mathrm{~mm}$ in fruit. Sepals 2.5 mm ; petals $5-7 \mathrm{~mm}$, emarginate. Siliqua $20-$ $50 \times 0.75 \mathrm{~mm}$, somewhat patent; style $0.5-1 \mathrm{~mm}$, cylindrical. Seeds $0.8 \times 0.5 \mathrm{~mm}$, wingless or winged only at apex. - $N$. Appennini. It.
4. M. sousae Rothm., op. cit. 474 (1939). Plant glabrous or with sparse stellate hairs; stems leafless or with 2-3 leaves. Basal leaves $4-7 \mathrm{~cm}$, pinnatifid with 2-4 lobes on each side; cauline subentire or sinuate-dentate. Pedicels $10-15 \mathrm{~mm}$ in fruit. Sepals $3-3.5 \mathrm{~mm}$; petals $6-7 \mathrm{~mm}$, slightly emarginate. Siliqua $40-55 \times$ 1 mm ; style 0.5 mm , conical. Seeds $1 \times 0.6 \mathrm{~mm}$, winged all round. C. \& N. Portugal (Serra de Lousã, Serra de Marão). Lu.

## 4. Descurainia Webb \& Berth. ${ }^{1}$

Annual or biennial; hairs of two kinds, branched and unbranched. Leaves 2- to 3-pinnatisect. Sepals not saccate; petals pale yellow, smaller than sepals. Fruit a siliqua; valves with a distinct median vein; style very short; stigma subcapitate. Seeds small (not more than 1 mm ), not mucilaginous when moistened.

1. D. sophia (L.) Webb ex Prantl in Engler \& Prantl, Natürl. Pflanzenfam. 3 (2): 192 (1891) (Sisymbrium sophia L.). Annual or biennial up to 100 cm . Cauline leaves with linear or oblong lobes. Pedicels $5-50 \mathrm{~mm}$ in fruit. Sepals $2-2.5 \mathrm{~mm}$; stamens usually
exceeding the sepals. Siliqua $8-45 \times 0.5-0.75 \mathrm{~mm}$, usually erectopatent, torulose; valves reticulate-veined. Seeds $0 \cdot 8-1 \mathrm{~mm}$. $2 n=28$. Throughout Europe northwards to c. $70^{\circ} \mathrm{N}$. All except Al Az Cr Fa Sa Sb.

## 5. Hugueninia Reichenb. ${ }^{1}$

Perennial herb; hairs more or less stellate. Leaves 2-pinnatisect. Sepals not saccate at base; petals yellow, exceeding sepals. Fruit a siliqua; valves 1 -veined; style very short; stigma slightly 2 -lobed. Seeds c. 2 mm , not winged, mucilaginous when moistened.

1. H. tanacetifolia (L.) Reichenb., Fl. Germ. Excurs. 691 (1832) (Sisymbrium tanacetifolium L.). Stout, tomentose, pubescent or glabrescent perennial $30-70 \mathrm{~cm}$. Lower leaves up to 30 cm , longpetiolate; segments $8-10$ pairs, broadly linear to lanceolate, serrate to pinnatifid, the ultimate lobes $4-10 \mathrm{~mm}$ wide. Petals c. 4 mm . Siliqua $6-15 \times 1.2-1.5 \mathrm{~mm}$, oblong-oblanceolate, erecto-patent; valves with a strong mid-vein. Seeds c. 2 mm . S.W. Alps, eastwards to c. $7^{\circ} 45^{\prime}$ E.; C. Pyrenees, mountains of N. Spain. Ga He Hs It.
(a) Subsp. tanacetifolia: Stem and lower surface of leaves greypubescent or glabrescent; segments of the lower leaves with $4-8(-10)$ pairs of teeth or lobes; pedicels $5-8 \mathrm{~mm}$ in fruit. S.W. Alps.
(b) Subsp. suffruticosa (Coste \& Soulié) P. W. Ball, Feddes Repert. 68: 194 (1963): Stem and lower surface of leaves greytomentose; segments of the lower leaves with $1-4(-5)$ pairs of teeth or lobes; pedicels $7-11 \mathrm{~mm}$ in fruit. Pyrenees and mountains of N. Spain.

## 6. Alliaria Scop. ${ }^{1}$

Biennial; hairs unbranched. Basal leaves undivided. Sepals not saccate at base; petals white. Fruit a siliqua; valves 3-veined; style distinct; stigma slightly 2 -lobed. Seeds large ( $3-3.5 \mathrm{~mm}$ ).

1. A. petiolata (Bieb.) Cavara \& Grande, Boll. Orto Bot. Napoli 3: 418 (1913) (A. officinalis Andrz. ex Bieb., Sisymbrium alliaria (L.) Scop.). Up to 120 cm , smelling of Allium spp. when crushed. Leaves reniform to triangular-ovate, cordate, sinuate-dentate, the basal long-petiolate. Pedicels $2 \cdot 5-13 \mathrm{~mm}$ in fruit, about as thick as siliqua. Petals 4-6(-9) mm. Siliqua $20-70 \times 1 \cdot 5-2 \cdot 5 \mathrm{~mm}$, patent or erecto-patent. $2 n=36,42$. Throughout Europe from about $68^{\circ}$ N. southwards, but less common in the extreme south. All except Az Bl Fa Is Sa Sb .

## 7. Eutrema R.Br. ${ }^{1}$

Perennial herb; glabrous or with very sparse unbranched hairs. Basal leaves simple. Sepals not saccate at base; petals white. Fruit a siliqua; valves 1 -veined; style distinct, stigma slightly 2-lobed. Seeds large (c. 3 mm ), winged.

1. E. edwardsii R. Br. in Parry, Jour. Voy. N.W. Pass. (Suppl. App.) 267 (1824). Up to 40 cm , rhizomatous. Basal leaves ovate to orbicular, truncate or cordate at base, usually entire, long petiolate; cauline leaves oblong-ovate to lanceolate, cuneate, more or less sessile; all fleshy. Petals 2-4 mm. Siliqua 6-20 $\times 1 \cdot 5-3$ mm , linear or oblong, erecto-patent; style $0 \cdot 25-0.75 \mathrm{~mm} . \quad 2 n=42$. Arctic Europe. Rs (N) Sb.

The species was originally described from arctic America. It is possible that the plants from Europe should be separated from the plants from America and Greenland, for which the chromosome number $2 n=28$ has been recorded.

[^102]
## 8. Arabidopsis (DC.) Heynh. ${ }^{1}$

Annual to perennial herbs; glabrous or hairs unbranched and branched. Leaves entire to pinnatifid. Sepals not saccate at base; petals white, pale purple or yellow, sometimes absent. Fruit a siliqua; valves 1 -veined; style short, stigma subcapitate. Seeds small (less than 1 mm ). (Stenophragma Čelak.)

Literature: O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 268-85 (1924).

The limits of this genus are uncertain. For a full discussion of the problem see N. Hylander, Bull. Jard. Bot. Bruxelles 27: 591604 (1957), F. Laibach, Planta 51: 148-66 (1958), and Á. Löve, Svensk Bot. Tidskr. 55: 211-17 (1961). It seems probable that Cardaminopsis should be combined with Arabidopsis, but some species of Arabidopsis may have to be removed from the enlarged genus. Schulz's delimitation is maintained here pending a full investigation of all the species of Arabidopsis.

1 Cauline leaves cuneate at base; hairs unbranched and 2-fid or
absent
2 Glabrous; petals absent; siliqua abruptly contracted into a
very short style
2 Pubescent or hispid, at least at the base; petals 2 mm or more;
3. parvala
siliqua $\pm$ attenuate into style
5. pumila

1. A. thaliana (L.) Heynh. in Holl \& Heynh., Fl. Sachs. 1: 538 (1842) (Sisymbrium thalianum (L.) Gay). Annual or biennial up to $40(-70) \mathrm{cm}$, sparsely pubescent in the lower parts with unbranched and 2 -fid hairs. Basal leaves entire to dentate; the cauline usually entire, sessile, cuneate at base. Petals 2-4 $(-4 \cdot 5) \mathrm{mm}$, white; anthers $0 \cdot 3-0 \cdot 5 \mathrm{~mm}$. Siliqua $5-20(-30) \mathrm{mm}$, glabrous, attenuate into style $0 \cdot 3-0.4 \mathrm{~mm} .2 n=10$. Open habitats. Throughout Europe northwards to $c .68^{\circ} \mathrm{N}$. All except Az Fa Is Sb .
2. A. suecica (Fries) Norrlin, Meddel. Soc. Fauna Fl. Fenn. 2: 12 (1878). Like 1 but the basal leaves dentate to pinnatifid; the lower cauline usually dentate; petals $4-8 \mathrm{~mm}$; anthers $0.5-0.8 \mathrm{~mm}$; siliqua $20-30 \mathrm{~mm}$; style $0.3-0.7 \mathrm{~mm} .2 n=26$. Gravelly places. Fennoscandia. Fe No Rs ( ${ }^{*} \mathrm{~B}, \mathrm{~N}$ ) Su.

This species is intermediate between 1 and Cardaminopsis arenosa (L.) Hayek, and is very probably an allopolyploid derived from these two species. It is often confused with C. arenosa but may be distinguished by the dentate to pinnatifid (not pinnatipartite) basal leaves, the always white flowers, the petals without teeth on the claw, and the siliqua not strongly compressed.
3. A. parvula (Schrenk) O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 269 (1924). Like 1 but stem 3-15 cm, glabrous; leaves fleshy; sepals 2 mm ; petals absent; siliqua $6-15 \mathrm{~mm}$, torulose, abruptly contracted into a very short style. Saline habitats. S.E. Russia (Ozero E̊l'ton). Rs (E). (C. \& S.W. Asia.)
4. A. toxophylla (Bieb.) N. Busch in Kusn., Busch \& Fomin, Fl. Cauc. Crit. 3 (4): 457 (1909). Biennial or perennial $10-45 \mathrm{~cm}$, subglabrous to densely tomentose with stellate hairs. Basal
leaves usually sinuate-dentate; cauline denticulate or entire, sagittate-amplexicaul. Petals $4-8 \mathrm{~mm}$, white; anthers c. 1 mm . Siliqua $10-25 \mathrm{~mm}$, glabrous; style $0.5-0.8 \mathrm{~mm} .2 n=24$. Saline habitats. U.S.S.R., from S.W. Ukraine to E. Russia and W. Kazakhstan. Rs (W, K, E).
5. A. pumila (Stephan) N. Busch in Kusn., Busch \& Fomin, Fl. Cauc. Crit. 3 (4): 457 (1909). Annual up to 50 cm , with 2- to multi-fid hairs. Basal leaves dentate to dentate-pinnatifid; cauline denticulate, sagittate-amplexicaul at base. Petals $2-3 \mathrm{~mm}$, yellow; anthers $c .0 .25 \mathrm{~mm}$. Siliqua $10-25(-35) \mathrm{mm}$, more or less pubescent with stellate hairs; style $0 \cdot 2-0 \cdot 8 \mathrm{~mm} .2 n=32$. Saline habitats. S.E. Russia, W. Kazakhstan. Rs (E). (S.W. Asia.)

## 9. Thellungiella O. E. Schulz ${ }^{1}$

Glabrous annual or biennial. Leaves usually entire. Sepals not saccate at base; petals white or pink. Fruit a siliqua; valves 1 -veined; style very short, stigma slightly 2 -lobed. Seeds in 2 rows in each loculus, small (c. 0.5 mm ).

1. T. salsuginea (Pallas) O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 252 (1924). Erect, divaricately branched, up to 35 cm . Cauline leaves oblong-ovate, obtuse with rounded auricles. Pedicels $4-8 \mathrm{~mm}$ in fruit, patent or erecto-patent. Petals $3-4 \mathrm{~mm}$. Siliqua 12-16×0.7-1 mm, linear. Saline habitats. S.E. Russia; perhaps only casual. *Rs (E). (N. \& C. Asia, W. North America.)

## 10. Braya Sternb. \& Hoppe ${ }^{1}$

Perennial herbs; hairs of two kinds, branched and unbranched. Leaves undivided. Sepals not saccate at base; petals white or purplish, truncate. Fruit a siliqua or silicula; valves 1 -veined; style short; stigma slightly 2 -lobed. Seeds in 1 or 2 rows in each loculus, small (c. 1 mm ).

Literature: O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 226-38 (1924).
1 Cauline leaves 0-1; siliqua 4-10×1-3 mm, elliptical or oblongovate
3. purpurascens

1 Cauline leaves 1 to several; siliqua $8-15 \times 1-1.7 \mathrm{~mm}$, linear or broadly linear
2 Siliqua $5-11 \times 1-1.7 \mathrm{~mm}, 4-7$ times as long as wide

1. alpina

2 Siliqua $8-15 \times 1-1.2 \mathrm{~mm}, 7-12$ times as long as wide
2. linearis

1. B. alpina Sternb. \& Hoppe, Denkschr. Bayer. Bot. Ges. Regensb.1:66(1815). Laxly caespitose; flowering stems up to 10 cm . Cauline leaves 1 to several; lower leaves lanceolate, entire or denticulate. Petals $3-4 \mathrm{~mm}$. Siliqua $5-11 \times 1-1.7 \mathrm{~mm}, 5-7$ times as long as wide, broadly linear; style $0.2-0.3 \mathrm{~mm}$. Seeds and ovules 12-18. Usually calcicole, 2000-3000 m. E. Alps. Au It.
2. B. linearis Rouy, Ill. Pl. Eur. Rar. 11: 84 (1899). Like 1 but flowering stems up to 20 cm ; lower leaves linear; siliqua 8$15 \times 1-1 \cdot 2 \mathrm{~mm}, 7-12$ times as long as wide, linear; style $0.2-$ 0.8 mm ; seeds and ovules up to $24.2 n=42$. Calcareous scree and gravel. Mountains of Norway and Sweden from $67^{\circ}$ to $70^{\circ} \mathrm{N}$. No Su.
3. B. purpurascens (R.Br.) Bunge in Ledeb., Fl. Ross. 1: 195 (1841). Laxly caespitose; flowering stems up to 10 cm . Cauline leaves $0-1$; lower leaves oblong-linear, entire or remotely dentate. Petals $3-4(-5) \mathrm{mm}$. Siliqua $4-10 \times 1-3 \mathrm{~mm}$, elliptical or oblongovate; style $0 \cdot 7-1 \mathrm{~mm} .2 n=56$. Calcicole. Arctic Europe. ?Is No Rs (N) Sb.

## 11. Chrysochamela (Fenzl) Boiss. ${ }^{1}$

Annual; hairs branched. Leaves undivided. Sepals not saccate at base; petals pale yellow. Fruit a siliqua or silicula; valves with a distinct median vein; style short, stigma subcapitate. Seeds in 2 rows in each loculus, small (c. 0.25 mm ), mucilaginous when moistened.

1. C. draboides Woronow, Acta Horti Petrop. 43: 397 (1931). $10-25 \mathrm{~cm}$, pubescent below, glabrous above. Leaves linear to oblong, the cauline sagittate, amplexicaul. Petals $c .1 \mathrm{~mm}$. Silicula $5-7 \times c .2 \mathrm{~mm}$, oblong to elliptic-oblong, obtuse; valves with a median vein and reticulate lateral veins. - S. Ural (near Sterlitamak). Rs (E).

## 12. Sobolewskia Bieb. ${ }^{1}$

Perennial herb; glabrous or with sparse unbranched hairs. Leaves simple. Sepals patent, not saccate at base; petals white. Fruit an indehiscent siliqua; valves with a median vein; style very short; stigma subcapitate. Seeds large (up to 5 mm ).

1. S. sibirica (Willd.) P. W. Ball, Feddes Repert. 68: 194 (1963) (S. lithophila Bieb., Cochlearia sibirica Willd.). Glabrous or papillose, with woody rhizome. Leaves suborbicular to ovatecordate, crenate or serrate. Petals $3 \cdot 5-5 \mathrm{~mm}$. Siliqua $5-10 \mathrm{~mm}$, $1.5-2.5 \mathrm{~mm}$ in diameter at apex, oblong-pyriform. Seeds 3.55 mm . Rocky and stony places. Krym. Rs (K).

## 13. Myagrum L. ${ }^{1}$

Glabrous annuals. Cauline leaves sessile, amplexicaul. Sepals erect, the inner slightly saccate at the base; petals yellow, not clawed; ovules 2 , one aborting. Fruit an indehiscent, 1 -seeded silicula with 3 loculi; the upper 2 loculi side by side, sterile, the lower containing the seed.

1. M. perfoliatum L., Sp. Pl. 640 (1753). Glaucous, 15100 cm . Basal leaves petiolate, oblanceolate, sinuate-dentate to pinnatifid; cauline leaves sessile, oblong-lanceolate, entire or denticulate, sagittate- to cordate-amplexicaul. Petals $3-5 \mathrm{~mm}$. Silicula 5-8 mm, more or less compressed, broadly clavate; seed c. 3 mm . Probably native in $S$. Europe, northwards to Hungary, and frequently naturalized or casual elsewhere. Al Bu Ga Gr Hs Hu It Ju Rm Rs (K) Sa ?Si Tu [Au Be Br Cz Fe Ge He Ho No ?Po Su].

## 14. Isatis L. ${ }^{1}$

Annual to perennial, glaucous herbs; glabrous or with unbranched hairs. Cauline leaves simple, entire, usually amplexicaul. Sepals not saccate; petals yellow, shortly clawed. Fruit an indehiscent, 1 -seeded silicula with a wide, often inflated, wing surrounding the loculus; loculus usually with a distinct longitudinal rib; stigma sessile.

A difficult genus urgently requiring revision. Species 4-9 are all very similar and some are probably better regarded as subspecies of 7 .
1 Cauline leaves attenuate at base, not amplexicaul 3. sabulosa 1 Cauline leaves amplexicaul
2 Silicula orbicular-elliptical, not more than twice as long as wide, rounded at base and apex or emarginate at apex
3 Perennial; cauline leaves cordate at base; silicula $15-25 \mathrm{~mm}$

1. allionii

3 Annual; cauline leaves sagittate at base; silicula $8-10 \mathrm{~mm}$
2. platyloba


4 Biennial or perennial; silicula 2-5 times as long as wide
5 Central rib of silicula conspicuously 3-ridged 5. costata
5 Central rib of silicula simple
6 Silicula 2-3 times as long as wide
7 Central rib of silicula very wide

## 4. laevigata

7 Central rib of silicula slender (cf. also 7)
6. praecox

6 Silicula mostly at least 3 times as long as wide
8 Silicula 5-8 mm wide, oblong; cauline leaves with obtuse auricles (Turkey)
9. arenaria

8 Silicula elliptical, obovate or oblanceolate, usually narrower; cauline leaves with acute auricles
9 Biennial without vegetative shoots; flowering stems usually at least 50 cm (widespread)
7. tinctoria

9 Perennial with vegetative shoots at base; flowering stems $20-40 \mathrm{~cm}$ (Áthos)
8. athoa

1. I. allionii P. W. Ball, Feddes Repert. 69: 57 (1964) (I. alpina All. et auct. mult., non Vill.). Perennial with branched rhizome and vegetative shoots; flowering stems $10-30 \mathrm{~cm}$. Cauline leaves with obtuse auricles. Petals (3-)4-5 mm. Silicula $15-25 \times 8-13 \mathrm{~mm}$, orbicular-elliptical, sometimes subcordate at base. - S.W. Alps; N. \& C. Appennini. Ga It.
2. I. platyloba Link ex Steudel, Nomencl. Bot. 1: 440 (1821). Annual $30-100 \mathrm{~cm}$; cauline leaves with acute auricles. Silicula $8-10 \mathrm{~mm}$, elliptical-orbicular, emarginate or obcordate. Granite cliffs. N.E. Portugal (Miranda do Douro). Lu.
3. I. sabulosa Steven ex Ledeb., Fl. Ross. 1: 212 (1841). Biennial $40-80 \mathrm{~cm}$. Cauline leaves attenuate at base, without auricles. Petals $4 \cdot 5-6 \mathrm{~mm}$. Silicula $17-30 \times 4-9 \mathrm{~mm}$, linearoblong to oblanceolate. Sandy soils. N.W. shore of Caspian Sea. Rs (E).
4. I. laevigata Trautv., Del. Sem. Horti Kiov. 1840: 6 (1840). Biennial $50-100 \mathrm{~cm}$. Cauline leaves with acute auricles. Petals 2-2.5 mm. Silicula 6-11 $\times 2.5-5 \mathrm{~mm}$, elliptical, $2-3$ times as long as wide, glabrous; central rib wide and thick. Steppes. S.E. Russia. Rs (E). (C. Asia.)
5. I. costata C. A. Meyer in Ledeb., Fl. Altaica 3: 204 (1831). Biennial up to 120 cm . Cauline leaves with acute auricles. Petals $2 \cdot 5-3 \mathrm{~mm}$. Silicula $9-14 \times 3-5 \mathrm{~mm}$, oblong-obovate, c. 3 times as long as wide, glabrous or pubescent; central rib wide, distinctly 3 ridged. Dry stony places. S.E. Russia. Rs (E).
6. I. praecox Kit. ex Tratt., Arch. Gewächsk. 1: 40 (1812) (incl. I. lasiocarpa Ledeb.). Biennial $50-100 \mathrm{~cm}$. Cauline leaves with acute auricles. Petals $2 \cdot 5-3 \mathrm{~mm}$. Silicula $7-14 \times 3-6 \mathrm{~mm}$, obovate-elliptical, 2-3 times as long as wide, glabrous or pubescent; central rib slender. E., C. \& S.E. Europe. Bu Cz Hu It Ju Rm Rs (W, E).

Plants intermediate between $\mathbf{6}$ and 7 are not infrequent.
7. I. tinctoria L., Sp. Pl. 670 (1753) (incl. I. canescens DC., I. litoralis Steven, I. taurica Bieb.). Biennial $50-120 \mathrm{~cm}$. Cauline leaves with acute auricles. Petals $2 \cdot 5-4 \mathrm{~mm}$. Silicula $11-27 \times 3-$ $7(-10) \mathrm{mm}$, usually oblong-obovate or elliptic-obovate, $\left(2 \frac{1}{2}\right) 3-$ 5 times as long as wide, glabrous to tomentose; central rib usually slender. $2 n=28$. Most of Europe but rare in the north; cultivated since ancient times as a source of dye and probably introduced in many parts. All except Az Bl Cr Fa Hb Is Sb .

[^103]As defined here this species is very variable, particularly in fruit shape and indumentum. Some of the more distinct component taxa are:
I. canescens DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 598 (1815). Silicula $18-25 \times 4-7 \mathrm{~mm}$, densely tomentose. Frequent in $S$. Europe.
I. tomentella Boiss. \& Balansa in Boiss., Diagn. Pl. Or. Nov. 3(5): 46(1856) (I. canescens auct. ross., et auct. balcan. pro parte). Silicula $11-20 \times 3.5-5 \mathrm{~mm}$, elliptic-oblong, with cuneate base, pubescent. S. part of Balkan peninsula; Krym.
I. littoralis Steven ex DC. Reg. Veg. Syst. Nat. 2: 568 (1821) Silicula $15-27 \times 5-10 \mathrm{~mm}$, emarginate and with a prominent central rib. Krym.
8. I. athoa Boiss., Fl. Or. suppl. 64 (1888). Like 7 but perennial with vegetative shoots, and stems $20-40 \mathrm{~cm}$; silicula 12 $16 \times 3-5 \mathrm{~mm}$, triangular-oblong, pubescent; central rib prominent. - N. Greece (Athos). Gr.
9. I. arenaria Aznav., Bull. Soc. Bot. Fr. 46: 138 (1899). Perennial with vegetative rosettes and flowering stems $30-70 \mathrm{~cm}$. Cauline leaves with obtuse auricles. Petals $3-4 \mathrm{~mm}$. Silicula $15-$ $25 \times(5-) 6-8 \mathrm{~mm}$, oblong, glabrous or pubescent; central rib slender. Maritime sands. - Turkey (near Kilyos, N. of Istanbul). Tu.
10. I. lusitanica L., Sp. Pl. 670 (1753) (I. aleppica Scop.). Annual $20-90 \mathrm{~cm}$. Cauline leaves with acute auricles. Petals $4-5 \mathrm{~mm}$. Silicula (12-) $15-28 \times(1-) 2 \cdot 5-4 \mathrm{~mm}$, linear-oblanceolate, 5-8 times as long as wide. Greece. Gr.

## 15. Tauscheria Fischer ex DC. ${ }^{1}$

Annual; hairs unbranched. Leaves simple, entire, the cauline amplexicaul. Sepals erect, not saccate; petals yellow, not clawed. Fruit an indehiscent, more or less hemispherical, 2 -seeded silicula.

1. T. lasiocarpa Fischer ex DC., Reg. Veg. Syst. Nat. 2: 563 (1821). Glabrous except for the inflorescence, glaucous, 1540 cm . Basal leaves cuneate, the cauline cordate-amplexicaul. Pedicels curved downwards in fruit. Silicula $3-5 \times 2 \cdot 5-4 \mathrm{~mm}$, pubescent, strongly compressed, convex beneath, concave with incurved margins above so as to be more or less hemispherical; apex with upwardly curving beak. Dry places. S.E. Russia (Lower Volga). Rs (E). (N. \& C. Asia.)

## 16. Bunias L. ${ }^{1}$

Annual to perennial herbs; glabrous or with glandular, unbranched or branched hairs. Leaves entire to pinnatifid. Sepals erectopatent, the inner not or scarcely saccate at base; petals white or yellow, not clawed. Fruit an indehiscent silicula with irregular longitudinal wings, ridges or protuberances, and with 1-4 1 -seeded loculi; style distinct; stigma capitate.

| 1 | Petals white; silicula $3-4 \mathrm{~mm}$ | 3. cochlearioides |
| :---: | :---: | :---: |
| 1 | Petals yellow; silicula $5-12 \mathrm{~mm}$ |  |
| 2 | Silicula $10-12 \mathrm{~mm}$, with 4 longitudinal wings; petals usually |  |
| $8-13 \mathrm{~mm}$ 1. erucago  <br> 2 Silicula $5-10 \mathrm{~mm}$, with irregular protuberances; petals 4 -  <br>  8 mm 2. orientalis |  |  |
|  |  |  |

1. B. erucago L., Sp. Pl. 670 (1753). Hispid, glandular annual or biennial $30-60(-100) \mathrm{cm}$. Lower leaves sinuate-pinnatifid, rarely almost entire; upper entire or dentate. Petals (6-)813 mm , yellow, obcordate. Silicula $10-12 \mathrm{~mm}$, quadrangular,
with irregularly dentate wings on the angles; loculi 4 ; style 35 mm . Ruderal. S. Europe; often introduced elsewhere. Al Bu Co Cr Ga Gr He Hs It Ju Lu Sa Si $\mathrm{Tu}[\mathrm{Au} \mathrm{Br} \mathrm{Cz} \mathrm{Ge} \mathrm{Hu} \mathrm{Po}$ *Rm].
2. B. orientalis L., Sp. Pl. 670 (1753). Glabrous or sparsely glandular biennial or perennial $25-120 \mathrm{~cm}$. Leaves usually all pinnatifid. Petals $4-8 \mathrm{~mm}$, yellow, entire or truncate. Silicula $5-10 \mathrm{~mm}$, asymmetrically ovoid and covered with irregular protuberances; loculi $1-2$; style $0 \cdot 5-2 \mathrm{~mm} .2 n=14$. E. Europe, extending westwards to Hungary; often naturalized as a weed elsewhere. Bu Hu Ju Po Rm Rs (N, C, W, K, E) [Au Be Br Cz Da Fe Ga Ge He Ho No Su].
3. B. cochlearioides Murray, Novi Comment. Gotting. 8: 42 (1778). Glabrous or sparsely pubescent biennial $15-30 \mathrm{~cm}$. Leaves dentate to lyrate-pinnatifid. Petals $3-4 \mathrm{~mm}$, white, entire or truncate. Silicula $3-4 \mathrm{~mm}$, orbicular-ovate with 4 longitudinal ridges; loculi 2; style c. 1 mm . S.E. Russia. Rs (E). (W. Asia.)

## 17. Goldbachia DC. ${ }^{1}$

Glabrous annuals. Leaves entire, sinuate, the cauline amplexicaul. Sepals erect, not saccate; petals white to purple, not clawed. Fruit an articulated silicula or siliqua, sometimes with only 1 segment; segments 1 -seeded; style distinct; stigma shortly 2-lobed.

1. G. laevigata DC., Reg. Veg. Syst. Nat. 2: 577 (1821). $5-40 \mathrm{~cm}$. Leaves oblong to obovate, the basal petiolate, the cauline with acute auricles. Pedicels curved downwards in fruit. Petals $4-6 \mathrm{~mm}$. Silicula $10-12 \times 2-4 \mathrm{~mm}$, erect, 4 -angled, attenuate at base and apex, with $1-3$ segments. Semi-deserts. S.E. Russia; rarely as a casual elsewhere in Europe. Rs (E). (C. \& S.W. Asia.)

## 18. Erysimum L. ${ }^{1}$

Annual to perennial herbs with branched hairs. Sepals erect, the inner usually saccate at base; petals yellow, rarely purple, longclawed; median nectaries present. Fruit a siliqua; valves usually 1 -veined, the hairs not lying transversely across the valves; style distinct, not more than $\frac{1}{3}$ as long as the rest of the siliqua, rarely absent; stigma usually more or less 2 -lobed. Seeds in 1 row in each loculus.

An extremely difficult genus containing many taxa of uncertain status. The species recognized here are not always clearly separable, so that the key alone should not be relied upon to identify all specimens.

Often cultivated for ornament, but the identity of many of these cultivated plants is obscure. The majority are probably hybrids between various species of Erysimum and species of Cheiranthus. These cultivated plants may escape and occur rarely on walls and similar habitats.
1 Annual, rarely biennial; anthers not more than 1.2 mm
2 Petals 6-10 mm; style 2-5 mm
36. repandum

2 Petals (2-)3-6 mm; style $0-1.5 \mathrm{~mm}$
3 Pedicels not more than 2 mm in flower, erect and almost as
wide as the siliqua in fruit
3 Pedicels 4-8 mm in flower, patent and very slender in fruit
38. cheiranthoides

1 Biennial or perennial; anthers $1-4 \mathrm{~mm}$
4 Petals purple or violet
10. linifolium

4 Petals yellow, rarely purple on the back
5 Lamina of basal leaves not more than 2 cm , with petiole up to 5 cm ; petals pale brown or purple on back 13. mutabile

5 Lamina of basal leaves much larger, the petiole equalling or shorter than the lamina, or basal leaves absent; petals not pale brown or purple on back
6 Anthers $1-2 \mathrm{~mm}$; plants always with numerous stellate hairs
7 Siliqua and pedicels patent or deflexed
27. aureum

7 Siliqua and pedicels erecto-patent
8 Caespitose perennial with numerous basal leaf-rosettes; flowering stems not more than 15 cm 26. pulchellum
8 Biennial or perennial with few leaf-rosettes; stems usually much taller
9 Siliqua $0.4-0.8 \mathrm{~mm}$ in diameter, $\pm$ circular in cross-section; valves without or with obscure median vein
28. leucanthemum

9 Siliqua (0.7-)1-2 mm wide, $\pm$ square in cross-section; valves with distinct median vein
(29-34). hieracifolium group
6 Anthers 2-4 mm; plants with medifixed or stellate hairs, or both
10 Siliqua strongly laterally compressed; valves keeled or narrowly winged on the back
35. cuspidatum

10 Siliqua square or circular in cross-section, or dorsally compressed; valves not keeled or winged
11 Siliqua erect, closely appressed to the axis of the inflorescence
12 Leaves filiform, canaliculate, grey (S. Spain) 7. myriophyllum

12 Leaves flat, green, the basal oblong-lanceolate (Kriti) 6. raulini

11 Siliqua patent or erect, but not closely appressed to the axis of the inflorescence
13 Siliqua dorsally compressed (Balkan peninsula)
14 Biennial, rarely short-lived perennial without numerous vegetative rosettes $(15-20)$. leptostylum group
14 Caespitose perennial with numerous vegetative rosettes
15 Siliqua erect or erecto-patent 11. pusillum
15 Siliqua patent
16 Siliqua $20-45 \mathrm{~mm}$; stems $10-30 \mathrm{~cm}$ 11. pusillum
16 Siliqua $30-90 \mathrm{~mm}$; stems $20-50 \mathrm{~cm}$ (Limnos)
12. rechingeri

13 Siliqua square or $\pm$ circular in cross-section
17 Hairs on leaves almost entirely medifixed
18 Mature siliqua patent or deflexed
(15-20). leptostylum group
18 Mature siliqua erect or erecto-patent
19 Sepals not or slightly saccate at base
20 Basal leaves linear or linear-lanceolate, entire or denticulate; siliqua $0 \cdot 5-1(-1 \cdot 1) \mathrm{mm}$ in diameter
14. diffusum

20 Basal leaves linear-lanceolate or oblong-lanceolate, sinuate-dentate or -pinnatifid; siliqua 11.3 mm in diameter $\quad(\mathbf{1 5}-\mathbf{2 0})$. leptostylum group

19 Sepals (at least the 2 inner) strongly saccate at base
21 Perennial with slender, elongate vegetative shoots 22 Petal-limb (5-)6-10 mm wide; seeds 3-4 mm 9. decumbens

22 Petal-limb 3-5.5 mm wide; seeds $1 \cdot 5-2 \mathrm{~mm}$
8. linariifolium

21 Biennial or caespitose perennial without elongate vegetative shoots
23 Hairs on siliqua and ovary mostly stellate
21. ucranicum

23 Hairs on siliqua and ovary $\pm$ all medifixed
(1-5). sylvestre group
17 Hairs on leaves all stellate or some medifixed
24 Petal-limb 4-8 mm wide; seeds $1 \cdot 5-2 \mathrm{~mm}$
(22-25). odoratum group
24 Petal-limb 2.5-4(-4.5) mm wide; seeds $1-1 \cdot 5 \mathrm{~mm}$
25 Cauline leaves pectinate-pinnatifid
(22-25). odoratum group
25 Cauline leaves entire to sinuate-dentate
(15-20). leptostylum group

[^104](1-5). E. sylvestre group. Biennial or caespitose perennial up to 60 cm ; hairs almost all medifixed. Sepals saccate at base; petals glabrous; anthers $2.5-4 \mathrm{~mm}$. Siliqua square in crosssection. Seeds $1 \cdot 5-2 \cdot 2 \mathrm{~mm}$.

1 Style 0-2(-2.5) mm in fruit
2 Caespitose perennial without or with sparse leaf-remains

1. sylvestre

2 Biennial or perennial with dense, persistent leaf-remains at base of stem
2. comatum

1 Style ( $1 \cdot 5-$ ) $2-6 \mathrm{~mm}$ in fruit
3 Cauline leaves $3-12 \mathrm{~mm}$ wide, lanceolate or oblong; plant with long stout woody stocks at base
4. suffruticosum

3 Cauline leaves $1-5(-8) \mathrm{mm}$ wide, linear or linear-lanceolate; plant without long stout woody stocks
4 Calyx (7-)8-12 mm; corolla 14-22×4-6(-7) mm; style ( $1 \cdot 5-$ ) $2-3 \mathrm{~mm}$ (Alps, Pyrenees, mountains of Balkan peninsula)
3. helveticum

4 Calyx $6-10 \mathrm{~mm}$; corolla $12-18 \times 3 \cdot 5-5 \cdot 5 \mathrm{~mm}$; style $2-6 \mathrm{~mm}$ (W. Mediterranean region and Italy) 5. grandiflorum

1. E. sylvestre (Crantz) Scop., Fl. Carn. ed. 2, 2: 28 (1772). Caespitose perennial. Lower leaves $1-7 \mathrm{~mm}$ wide, linear to linear-lanceolate, entire to sinuate-dentate. Pedicels $2-4 \mathrm{~mm}$ in flower, up to 7 mm in fruit. Sepals (9-) $10-15 \mathrm{~mm}$, saccate at base; petals $15-25 \times 5-10 \mathrm{~mm}$. Siliqua $40-90 \times 1-1.5 \mathrm{~mm}$, greygreen; style $0.5-2 \mathrm{~mm}$. - W. part of Balkan peninsula, extending to N.E. Italy and Austria. Al Au ?Gr It Ju.

The southern limits of this species are uncertain owing to confusion with 2 and 8.
2. E. comatum Pančić, Fl. Princ. Serb. 131 (1874). Biennial or perennial with very crowded leaf-remains at the base of the stem. Lower leaves $1-4 \mathrm{~mm}$ wide, linear to linear-lanceolate, white, grey or grey-green. Sepals (7-)8-11 mm; petals $15-25 \times 3 \cdot 5-6 \mathrm{~mm}$. Siliqua $60-100 \times 1.3-1.6 \mathrm{~mm}$, grey-green; style $0.5-2 \mathrm{~mm}$.
S. Romania to N. Greece. Bu Gr Ju Rm.

Variable in size, leaf-shape and density of indumentum. Possibly containing a number of subspecies.
3. E. helveticum (Jacq.) DC. in Lam. \& DC., Fl. Fr. ed. 3, 4: 658 (1805) (incl. E. pumilum auct.). Caespitose perennial. Lower leaves $1-6(-8) \mathrm{mm}$ wide, linear or linear-lanceolate, green or grey-green. Pedicels $2-4(-7) \mathrm{mm}$ in flower, up to $7(-11) \mathrm{mm}$ in fruit. Sepals (7-)8-11(-12) mm; petals $14-22 \times 4-6(-7) \mathrm{mm}$. Siliqua $30-90 \times 1-1.2 \mathrm{~mm}$, grey-green; style $(1.5-) 2-3 \mathrm{~mm}$. $2 n=56$. - Pyrenees, Alps, mountains of Balkan peninsula. ?A1 $\mathrm{Au} ? \mathrm{Bu} \mathrm{Ga} \mathrm{He} \mathrm{It} \mathrm{Ju}$.

The distribution in the Balkan peninsula is uncertain owing to confusion with 2 and 8.
4. E. suffruticosum Sprengel, Novi Provent. 17 (1819). Very like 3 but the plant with long stout woody stock at the base; leaves $3-12 \mathrm{~mm}$ wide, linear-lanceolate, grey-green; sepals $8-12 \mathrm{~mm}$; petals $15-23 \times 3.5-6 \mathrm{~mm}$; siliqua $60-100 \times 1-1.5 \mathrm{~mm}$, grey; style $1 \cdot 5-3 \mathrm{~mm}$. Sicilia; (?)S. Italy. ?It Si. (N.W. Africa.)

Originally described from a cultivated plant and not certainly identical with the plant described above.
5. E. grandiflorum Desf., Fl. Atl. 2: 85 (1798) (E. longifolium DC., E. australe Gay). Very like 3 but often white or grey; sepals $6-10 \mathrm{~mm}$; petals $12-18 \times 3 \cdot 5-5 \cdot 5 \mathrm{~mm}$; style ( $1 \cdot 5-$ )2-6 mm. $2 n=14$. S.W. Europe, extending eastwards to Italy. Bl Co Ga Hs It Lu Sa Si .

Not clearly separable from 3, particularly in France.
6. E. raulinii Boiss., Fl. Or. 1: 192 (1867). Biennial $15-50 \mathrm{~cm}$, the lower part of the stem sharply angled, the angles almost winged; hairs medifixed. Lower leaves $4-12 \mathrm{~mm}$ wide, oblonglanceolate, denticulate or sinuate, green. Pedicels $1-2.5 \mathrm{~mm}$ in flower, up to 6 mm in fruit, usually as thick as the siliqua. Sepals $6-10 \mathrm{~mm}$, saccate at base; petals $11-15 \times 3.5-5 \mathrm{~mm}$, sparsely pubescent on the back; anthers $1 \cdot 7-2.5 \mathrm{~mm}$. Siliqua $15-40 \times 1-$ 1.3 mm , square in cross-section, grey, closely appressed against the stem; style 2-3.5 mm. Seeds $c .1 \cdot 3 \mathrm{~mm}$. Kriti. Cr.
7. E. myriophyllum Lange, Vid. Meddel. Dansk Naturh. Foren. Kjøbenhavn 1881: 102 (1882). Caespitose perennial $15-40 \mathrm{~cm}$, the lower part of stem with dense leaf-remains; hairs medifixed. Lower leaves $0 \cdot 5-2 \mathrm{~mm}$ wide, linear or filiform, entire, grey or white. Pedicels $2-4 \mathrm{~mm}$ in flower, up to 10 mm in fruit, often almost as thick as the siliqua. Sepals $6-10 \mathrm{~mm}$, saccate at base; petals $12-18 \times c$. 2.5 mm , glabrous; anthers c. 2 mm . Siliqua $15-45 \times 0.8-1.5 \mathrm{~mm}$, square in cross-section, grey, closely appressed against the stem; style 3-5 mm. Seeds 1.5-2 mm. - S. Spain. Hs.
8. E. linariifolium Tausch, Flora (Regensb.) 14: 212 (1831) (E. linearifolium auct., non Moench). Perennial up to 40 cm with procumbent long leafy shoots; hairs almost all medifixed. Lower leaves $0 \cdot 5-3(-5) \mathrm{mm}$ wide, linear or rarely linear-lanceolate, green. Pedicels $2-3 \mathrm{~mm}$ in flower, up to 5 mm in fruit. Sepals $6-8 \mathrm{~mm}$, saccate at base; petals $12-17 \times 4-5.5 \mathrm{~mm}$, glabrous or sparsely pubescent on the back; anthers $c .3 \mathrm{~mm}$. Siliqua 55 $80 \times c .1 \mathrm{~mm}$, square in cross-section, grey-green; style $0.5-2 \mathrm{~mm}$. Seeds $1 \cdot 5-2 \mathrm{~mm}$. Limestone slopes, cliffs, rocks, etc. Mountains of W. part of Balkan peninsula. Al Gr Ju.

## Difficult to separate from 11 in N. Greece and Albania.

9. E. decumbens (Schleicher ex Willd.) Dennst., Hort. Belved. 1: 38 (1820) (E. ochroleucum DC., nom. illegit., E. dubium (Suter) Thell., non DC.). Perennial up to 40 cm with procumbent long vegetative shoots; hairs almost all medifixed. Lower leaves $1 \cdot 5-$ $5(-8) \mathrm{mm}$ wide, oblong or linear-lanceolate, green. Pedicels $2-$ 4 mm in flower, up to 8 mm in fruit. Sepals (9-) $10-15 \mathrm{~mm}$, saccate at base; petals $15-27 \times 6-10 \mathrm{~mm}$, glabrous; anthers $2 \cdot 5-$ 4 mm . Siliqua $35-80 \times 1 \cdot 5-2 \mathrm{~mm}$, square in cross-section, greygreen; style (1.5-)2-6 mm. Seeds 3-4 mm. Mountains of $N$. Spain, Pyrenees, S.W. Alps. Ga He Hs.
10. E. linifolium (Pers.) Gay, Erysim. Nov. 3 (1842). Caespitose perennial up to 80 cm ; hairs medifixed. Lower leaves filiform to linear, green or white. Pedicels $2-4 \mathrm{~mm}$ in flower, up to 6 mm in fruit. Sepals (5-)6-12 mm, saccate at base; petals $12-20 \mathrm{~mm} \times 4-$ 5 mm , purple or violet; anthers c. 2.5 mm . Siliqua $25-75 \times c$. 1.5 mm , square in cross-section, green or grey; style $1.5-6 \mathrm{~mm}$. Seeds 1.5-2 mm. Spain and Portugal. Hs Lu.
1 Infructescence shorter than the rest of the stem; petals 1216 mm ; stem branched and often flexuous; style $1.5-3 \mathrm{~mm}$
(a) subsp. linifolium

1 Infructescence equalling or longer than the rest of the stem; petals $14-20 \mathrm{~mm}$; stem simple or little-branched; style 2-6 mm
2 Lower leaves denticulate, not densely crowded into a rosette
(b) subsp. baeticum

2 Lower leaves entire, densely crowded into a rosette
(c) subsp. cazoriense
(a) Subsp. linifolium: N.C. Spain, N. Portugal.

Var. filifolium Coutinho from E. Portugal, with filiform leaves and the infructescence longer than the rest of the stem, is possibly another subspecies.
(b) Subsp. baeticum Heywood, Bull. Brit. Mus. (Bot.) 1: 100 (1954): S. Spain.
(c) Subsp. cazorlense Heywood, op. cit. 102 (1954): S.E. Spain (Sierra de Cazorla).
11. E. pusillum Bory \& Chaub. in Bory, Expéd. Sci. Morée 3: 190 (1832). Caespitose perennial up to 40 cm ; hairs medifixed. Lower leaves $0 \cdot 5-6 \mathrm{~mm}$ wide, filiform to lanceolate or oblong, green or grey-green. Pedicels $0 \cdot 5-3(-4) \mathrm{mm}$ in flower, up to 6 mm in fruit. Sepals $5-8(-9) \mathrm{mm}$, saccate at base; petals $10-15(-16) \times$ $3-4 \mathrm{~mm}$, pubescent on the back; anthers $2-2.5 \mathrm{~mm}$. Siliqua 20 $60(-70) \times 1-1 \cdot 6(-2) \mathrm{mm}$, dorsally compressed; style $0.5-4 \mathrm{~mm}$. Seeds $1 \cdot 5-3 \cdot 5 \mathrm{~mm}$. Cliffs and rocks. ? Balkan peninsula. Al Bu Gr Ju.

Often confused with 8 in the N . part of its range.
Very variable in habit, leaf-shape, siliqua-, style- and seedsize. Many local populations occur, often showing a unique combination of these characters, and these have variously been referred to as distinct species, or subspecies or varieties of E. pusillum. Only the following seem to merit recognition as subspecies.
1 Siliqua patent to erecto-patent; basal leaves linear-lanceolate
(c) subsp. hayekii

1 Siliqua erect to erecto-patent; basal leaves linear to linearlanceolate
2 Siliqua $1 \cdot 3-2 \mathrm{~mm}$ wide; seeds $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$. (b) subsp. parnassii
2 Siliqua 1-1.5 mm wide; seeds $1.5-2 \mathrm{~mm}$.
(a) subsp. pusillum
(a) Subsp. pusillum: Throughout the range of the species except Kikladhes.
(b) Subsp. parnassii (Boiss. \& Heldr.) Hayek, Prodr. Fl. Penins. Balcan. 1: 380 (1925): E.C. Greece; probably elsewhere.
(c) Subsp. hayekii Jáv. \& Rech. fil., Ann. Naturh. Mus. (Wien) 43: 295 (1929): Kikladhes.
12. E. rechingeri Jáv., Ann. Naturh. Mus. (Wien) $43: 296$ (1929). Very like 11 (a) but the base of the stem thick, long, woody; petals $15-16 \mathrm{~mm}$; siliqua $35-90 \times 1.2-1.6 \mathrm{~mm}$, patent. Cliffs. - Limnos. Gr.

Possibly only a subspecies of $\mathbf{1 2}$.
13. E. mutabile Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 24 (1849). Caespitose perennial with usually procumbent stems not more than 12 cm ; hairs mostly medifixed. Basal leaves up to $20 \times 4 \mathrm{~mm}$, with petiole up to 5 cm , oblong-spathulate, green. Pedicels $1-2 \mathrm{~mm}$ in flower, up to 3 mm in fruit. Sepals $4-6 \mathrm{~mm}$, slightly saccate at base; petals $7-11 \times 1.5-3.5 \mathrm{~mm}$, yellow, buff or purplish and pubescent on the back; anthers c. 1.5 mm . Siliqua $10-20 \mathrm{~mm}$; style $(1 \cdot 5-) 2-4 \mathrm{~mm}$. Cliffs and rocks above 1000 m . Kriti. Cr.
14. E. diffusum Ehrh., Beitr. Naturk. 7: 157 (1792) (E. canescens Roth). Biennial or short-lived perennial up to 120 cm ; hairs medifixed. Basal leaves $1-8 \mathrm{~mm}$ wide, filiform to linearlanceolate, entire or denticulate, green or grey. Pedicels $1-6 \mathrm{~mm}$ in flower, up to 9 mm in fruit. Sepals $5-7 \cdot 5(-9) \mathrm{mm}$, not or slightly saccate at base; petals $8-14(-17) \times 2 \cdot 5-4 \mathrm{~mm}$, pubescent on the back; anthers $2-3 \mathrm{~mm}$. Siliqua (20-) $35-80 \times 0.6-1 \mathrm{~mm}$, square in cross-section, erect or erecto-patent, green, or grey with green angles; style $0.5-1.5 \mathrm{~mm}$. Seeds $1-1.5 \mathrm{~mm} . \quad 2 n=c .32$. Dry places. C. \& S.E. Europe, extending to Italy. Al Au Bu Cz Gr Hu It Ju Po Rm Rs (C, W, K, E) ?Si Tu.

Sometimes confused with 19.
(15-20). E. leptostylum group. Biennial or short-lived perennial; hairs medifixed or stellate, or both, always with at least some
stellate hairs on the siliqua. Basal leaves oblong or oblonglanceolate, sinuate-dentate to -pinnatifid. Pedicels $1-6 \mathrm{~mm}$ in flower, up to $8(-10) \mathrm{mm}$ in fruit. Sepals usually only slightly saccate at base; petal-limb $2-5 \mathrm{~mm}$ wide, pubescent on back; anthers $2-3.5 \mathrm{~mm}$. Style of siliqua $0 \cdot 5-2(-4 \cdot 5) \mathrm{mm}$.
Taxonomically a very confused group. Within the group there is much variation in characters which have traditionally been used to delimit sections and other major divisions in the genus (e.g. hair-type, shape of the siliqua). With the material available it has not yet been possible to reassess critically the value of these characters, so that the treatment here is very tentative. In addition to the species included, $\mathbf{1 4}$ and 21 are also very like the group, and have often been confused with members of it.
1 Siliqua patent
2 Hairs on siliqua mostly medifixed
17. graecum
2 Hairs on siliqua mostly stellate
18. smyrnaeum
1 Siliqua erect or erecto-patent
3 Siliqua strongly dorsally compressed; seeds $1 \cdot 3-2 \mathrm{~mm}$

| 4 | Siliqua $60-100 \mathrm{~mm}$ | 15. olympicum |
| :---: | :---: | :---: |
| 4 | Siliqua $30-60 \mathrm{~mm}$ | 16. calycinum |
| 3 | Siliqua square or circular in cross-section; seeds $1-1.5 \mathrm{~mm}$ |  |
| 5 | Sepals $5-7.5(-9) \mathrm{mm}$; petal-limb oblong-ovate | 19. crepidifolium |
| 5 | Sepals $7-9 \mathrm{~mm}$; petal-limb orbicular-obovate | 20. leptostylum |

15. E. olympicum Boiss., Fl. Or. 1: 191 (1867). Biennial 1535 cm ; hairs nearly all medifixed. Sepals $6-8 \mathrm{~mm}$; petals $10-$ $16 \times c .2 .5 \mathrm{~mm}$. Siliqua $60-100 \times 1-1.2 \mathrm{~mm}$, dorsally compressed, grey with greenish angles, erect; style $1-3 \mathrm{~mm}$. Seeds $1 \cdot 3-1 \cdot 7 \mathrm{~mm}$. Montane woods. - N. Greece (Olimbos). Gr.
16. E. calycinum Griseb., Spicil. Fl. Rumel. 1: 260 (1843). Biennial up to 60 cm ; hairs medifixed with some stellate, particularly on the siliqua. Sepals $6-7 \mathrm{~mm}$; petals c. $10 \times 3 \mathrm{~mm}$. Siliqua $30-60 \times 1-1.4 \mathrm{~mm}$, dorsally compressed, grey with green angles, erect; style $1.5-2 \mathrm{~mm}$. Seeds $1.5-2 \mathrm{~mm}$. Rocks and woods. - N. Greece (Athos). Gr.
17. E. graecum Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 27 (1853). Biennial up to 55 cm ; hairs nearly all medifixed. Sepals $5-8 \mathrm{~mm}$; petals $8-12 \times 2-3 \mathrm{~mm}$. Siliqua $35-75 \times 0 \cdot 8-$ 1.2 mm , square in cross-section, grey with green angles, patent or deflexed at maturity; style $0.5-1.5 \mathrm{~mm}$. Seeds $1-1.5 \mathrm{~mm}$. - $S$. Greece, with a few scattered records from elsewhere in Greece, Albania and Turkey-in-Europe. Al Gr Tu.
18. E. smyrnaeum Boiss. \& Balansa in Boiss., Diagn. Pl. Or. Nov. 3 (5): 23 (1856). Biennial or perennial up to 60 cm ; hairs stellate or medifixed and stellate mixed. Sepals $5-9 \mathrm{~mm}$; petals $10-16 \times 2.5-5 \mathrm{~mm}$. Siliqua $35-75 \times 1-1.5 \mathrm{~mm}$, square in crosssection and usually concolorous; style $0 \cdot 5-2 \mathrm{~mm}$. Seeds 1 1.5 mm . Turkey-in-Europe and Aegean islands. Gr Tu. (Asia Minor.)
E. creticum Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 26 (1853) from Kriti is said to differ from 18 only in having the siliqua dorsally compressed. It is probably identical with $\mathbf{1 8}$ or intermediate between it and 19. It has also sometimes been confused with 17.
19. E. crepidifolium Reichenb., Pl. Crit. 1: 8 (1823) (incl. E. asperulum Boiss. \& Heldr.). Biennial or perennial 15-60(-80) cm ; hairs medifixed and stellate. Sepals $5-10 \mathrm{~mm}$; petals $10-18 \times$ 2-4 mm, the limb oblong-ovate. Siliqua $25-80 \times 1-1 \cdot 2 \mathrm{~mm}$, more or less square in cross-section, erect, usually concolorous; style $0 \cdot 8-2(-2 \cdot 5) \mathrm{mm}$. Seeds $1-1.5 \mathrm{~mm}$. - C. \& S.E. Europe. Au $\mathrm{Bu} \mathrm{Cz} \mathrm{Ge} \mathrm{Gr} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Rm}$.

The precise distribution of this species is uncertain owing to confusion with 14.
20. E. leptostylum DC., Reg. Veg. Syst. Nat. 2: 494 (1821). Biennial $30-100 \mathrm{~cm}$; hairs almost all stellate. Sepals $7-9 \mathrm{~mm}$; petals $15-18 \mathrm{~mm}$ with orbicular-obovate limb. Siliqua $30-$ 40 mm , square in cross-section, slightly compressed dorsally, erect; style 1-2 mm. Seeds $1-1.5 \mathrm{~mm}$. From Krym eastwards to the Caspian Sea. Rs (K, E).
E. krynkense Lavrenko, Ind. Sem. Horti Charkov. 1925: 7 (1926), from one locality in S.E. Ukraine (near Stalino); differs from $\mathbf{2 0}$ only in having the style of the siliqua up to 4.5 mm .
21. E. ucranicum Gay, Erysim. Nov. 3 (1842) (E. cretaceum Rupr.). More or less caespitose perennial $25-50 \mathrm{~cm}$; hairs medifixed and a few stellate. Leaves up to 3 mm wide, linear or linear-lanceolate, grey. Pedicels 6-15 mm, thin. Sepals 6-10 mm, saccate at base; petals $12-18 \times 3.5-6 \mathrm{~mm}$, pubescent on the back; anthers $c .2 .5 \mathrm{~mm}$. Siliqua $20-60 \times 1-1.3 \mathrm{~mm}$, square in crosssection, grey, erect, always with some stellate hairs; style 0.5 2.5 mm . Seeds $1 \cdot 8-3 \mathrm{~mm}$. Don basin. Rs (C, E).
(22-25). E. odoratum group. Biennial or perennial; hairs stellate with some medifixed. Sepals saccate at base; petals pubescent on the back; anthers (2-)2.5-3.5 mm. Siliqua square in cross-section, green, or grey with green angles; style 0.5 2.5 mm . Seeds $1 \cdot 5-2 \mathrm{~mm}$.

1 Petal-limb $2 \cdot 5-4 \mathrm{~mm}$ wide
25. pectinatum

1 Petal-limb 4-10 mm wide
2 Basal leaves entire to sinuate, usually dead at flowering time; petal-limb 4-6.5 mm wide; siliqua $20-70 \mathrm{~mm}$ 22. odoratum
2 Basal leaves sinuate-dentate to pinnatisect, persistent; petallimb 5-10 mm wide; siliqua (45-)60-110 mm
3 Lower cauline leaves distinctly petiolate; siliqua with mostly medifixed hairs on the angles 23. witmann
3 Lower cauline leaves sessile; siliqua with mostly 3- to 4-fid hairs on the angles
24. carniolicum
22. E. odoratum Ehrh., Beitr. Naturk. 7: 157 (1792) (E. pannonicum Crantz, E. erysimoides (L.) Fritsch ex Janchen, non (Kar. \& Kir.) O. Kuntze). Biennial (10-)20-90(-100) cm. Basal leaves lanceolate or oblanceolate, sinuate, dead at flowering time, grey-green; lower cauline dentate to sinuate-dentate. Pedicels $2-5 \mathrm{~mm}$ in flower, up to 8 mm in fruit. Sepals $6-8 \cdot 5(-9) \mathrm{mm}$; petals $12-18 \times 4-6.5 \mathrm{~mm}$, bright yellow; limb broadly obovate; anthers $2 \cdot 5-3 \mathrm{~mm}$. Siliqua $20-70 \times 1-1 \cdot 2 \mathrm{~mm}$, mostly erect; hairs on angles mainly medifixed. $2 n=24$. C. Europe extending to E. France, N. Italy, N. Greece and W. Russia. Al Au Bu Cz Ga Ge Gr He Hu It Ju Po Rm Rs (W).
E. pallescens Herbich, Stirp. Rar. Bucov. 49 (1853), from W. Ukraine, has the pedicels $5-8 \mathrm{~mm}$ in flower, up to 12 mm in fruit; sepals $8-11 \mathrm{~mm}$; and the petals $15-18 \mathrm{~mm}$. It is possibly a subspecies of 22.
23. E. witmannii Zawadzki, Enum. Pl. Galic. Bucow. 81, 194 (1835). Biennial $10-50 \mathrm{~cm}$. Basal leaves linear to linearoblanceolate, persistent, entire to sinuate-pinnatisect; cauline sinuate-dentate, rarely entire, the lower distinctly petiolate. Pedicels $3-6 \mathrm{~mm}$ in flower, up to 10 mm in fruit. Sepals $8-$ 12 mm ; petals $15-24 \times 5-9 \mathrm{~mm}$, yellow or greenish-yellow; limb orbicular to orbicular-obovate. Siliqua (40-) $60-110 \times 1-1.5 \mathrm{~mm}$; hairs on angles mainly medifixed. Calcicole. Carpathians, Hungary and N.W. Bulgaria. Bu Cz Hu Po Rm Rs (W).

[^105]1 Cauline leaves lanceolate or oblong-lanceolate, patent or erecto-patent; stems $20-50 \mathrm{~cm}$
2 Basal leaves sinuate-dentate or -pinnatifid; petals pale yellow
(a) subsp. witmannii

2 Basal leaves entire or denticulate; petals pale greenish-yellow
(c) subsp. pallidiflorum
(a) Subsp. witmannii (incl. E. baumgartenianum Schur): Carpathians; N.W. Bulgaria.
(b) Subsp. transsilvanicum (Schur) P. W. Ball, Feddes Repert. 69: 151 (1964). (E. transsilvanicum Schur): S. Carpathians.
(c) Subsp. pallidiflorum (Jáv.) Jáv., Magyar Fl. 438 (1924): N. Hungary.

The anomalous chromosome number $2 n=14$ has been recorded for this subspecies, but confirmation of this is required.
24. E. carniolicum Dolliner, Flora (Regensb.) 10: 254 (1827). Biennial $10-60 \mathrm{~cm}$. Basal leaves persistent, sinuate-dentate to sinuate-pinnatisect; cauline pinnatifid to entire, sessile. Pedicels $3-8 \mathrm{~mm}$ in flower, up to 11 mm in fruit. Sepals $8 \cdot 5-12 \mathrm{~mm}$; petals $16-24 \times 5-10 \mathrm{~mm}$, lemon-yellow; limb orbicular or orbicularobovate. Siliqua $70-110 \times c .1 .5 \mathrm{~mm}$; hairs on the angles stellate. Calcicole. - W. Jugoslavia, S.E. Austria. Au Ju.

The plants occurring in C. \& S. Jugoslavia and Albania are intermediate between this species and 25 , and cannot be satisfactorily referred to either. They are biennials, rarely short-lived perennials, with leaves pinnatisect or pinnatifid; flowers intermediate in size between 24 and 25 , petal-limb $3-8 \times 3-8 \mathrm{~mm}$, usually obovate-orbicular, and the siliqua $30-50 \times 1-1.3 \mathrm{~mm}$. They are included by Hayek under E. erysimoides forma pantocsekii G. Beck and var. carniolicum (Dolliner) G. Beck and under $E$. pectinatum.
25. E. pectinatum Bory \& Chaub. in Bory, Expéd. Sci. Morée 3:189 (1832). Perennial, very rarely biennial, 10-50(-80) cm. Basal leaves sinuate-pinnatisect or -pinnatifid; cauline pectinatepinnatifid, sessile. Pedicels $1 \cdot 5-4 \mathrm{~mm}$ in flower, up to 6 mm in fruit. Sepals $4.5-7 \mathrm{~mm}$; petals $11-13 \times 2.5-4 \mathrm{~mm}$; limb oblongovate. Siliqua $20-45 \times 0.8-1.2 \mathrm{~mm}$; hairs mostly stellate. Mountain cliffs. Greece. Gr.
26. E. pulchellum (Willd.) Gay, Erysim. Nov. 10 (1842) (incl. E. korabense Kümmerle \& Jáv.). Caespitose perennial $5-15 \mathrm{~cm}$; hairs medifixed and stellate. Basal leaves $3-6 \mathrm{~mm}$ wide, oblongspathulate or -lanceolate, entire or denticulate; cauline entire to sinuate. Pedicels $c .2 \mathrm{~mm}$ in flower. Sepals $5-7 \mathrm{~mm}$, saccate at base. Petals $11-16 \times 3.5-5 \mathrm{~mm}$, pubescent on back; anthers $1.5-2 \mathrm{~mm}$. Siliqua $20-30 \times c .1 \mathrm{~mm}$, more or less square in crosssection, green, sparsely stellate-pubescent; style $1 \cdot 5-4 \mathrm{~mm}$. High mountain grassland. $\bullet$ E. Albania, S. Jugoslavia, Bulgaria. Al Bu Ju.
27. E. aureum Bieb., Fl. Taur.-Cauc. 2: 117 (1808) (incl. E. sylvaticum Bieb.). Biennial $40-100 \mathrm{~cm}$; hairs nearly all stellate. Lower leaves elliptic-oblong or lanceolate-elliptical, green, sinuate-denticulate to serrate; cauline distinctly petiolate. Pedicels $6-15 \mathrm{~mm}$ in fruit, patent or deflexed. Sepals $4 \cdot 5-6 \mathrm{~mm}$, saccate at base; petals $8-12 \times c .3 \mathrm{~mm}$, golden-yellow, pubescent on back; anthers $1 \cdot 5-2 \mathrm{~mm}$. Siliqua $20-50 \times 1-2 \mathrm{~mm}$, more or less square in cross-section, grey-green, patent or deflexed; style $1 \cdot 5-3 \mathrm{~mm}$. Seeds c. 1.5 mm . C. \& S. Russia, Ukraine. Rs (C, W, E).

The European plant is usually called E. sylvaticum Bieb., Fl. Taur.-Cauc. 3: 441 (1819), which is said to differ from 27 only in having the style $2-3 \mathrm{~mm}$ not $(0 \cdot 5-) 1 \cdot 5-2 \mathrm{~mm}$. This distinction has not been confirmed on the material seen.
28. E. leucanthemum (Stephan) B. Fedtsch., Acta Horti Petrop. 23: 413 (1905) (E. versicolor Andrz. ex DC.). Biennial $10-65 \mathrm{~cm}$; hairs stellate. Lower leaves linear or linear-oblong, sinuate or serrate, grey-green. Pedicels $1 \cdot 5-3 \mathrm{~mm}$ in flower, up to 5 mm in fruit, erect. Sepals $4.5-6 \mathrm{~mm}$, saccate at base; petals $8-12 \times c .2 \mathrm{~mm}$, pale yellow or whitish, sparsely pubescent or glabrous on back; anthers $1.5-2 \mathrm{~mm}$. Siliqua $18-45 \times 0.4$ 0.8 mm , circular in cross-section, grey, erect; median vein absent or obscure; style $c .1 \mathrm{~mm}$. Seeds $0 \cdot 8-1 \cdot 5 \mathrm{~mm}$. E. \& S. Russia, Ukraine. Rs (C, W, K, E).
(29-34). E. hieracifolium group. Biennial or perennial up to 120 cm ; hairs stellate. Leaves entire or sinuate-dentate. Pedicels $2-5 \mathrm{~mm}$ in flower, up to $10(-12) \mathrm{mm}$ in fruit. Petals pubescent on the back; anthers $1-2.2 \mathrm{~mm}$. Siliqua square in cross-section; style $0 \cdot 5-2 \mathrm{~mm}$.

For a detailed account of this group see B. Pawłowski, Acta Soc. Bot. Polon. 17: 95-128 (1946).
1 Inner sepals not or scarcely saccate; siliqua $20-55 \mathrm{~mm}$; valves usually pubescent on the inside
2 Leaves sinuate-dentate; petals mostly $8-10 \mathrm{~mm}$; seeds 1.7 2.1 mm
29. hieracifolium

2 Leaves $\pm$ entire; petals $6-8.5 \mathrm{~mm}$; seeds $1.2-1.8 \mathrm{~mm}$ 30. durum
1 Inner sepals saccate at base; siliqua $45-95 \mathrm{~mm}$; valves glabrous on the inside
3 Leaves linear-lanceolate or narrowly oblong, the cauline at least 6 times as long as wide 31. virgatu
3 Leaves lanceolate or oblong, the cauline not more than 6 times as long as wide
4 Cauline leaves with 2-5 pairs of teeth 32. wahlenbergii
4 Cauline leaves with 5-9 pairs of teeth
5 Cauline leaves minutely sinuate-denticulate; petal-limb rounded at base
33. hungaricum

5 Cauline leaves serrate-dentate; petal-limb cuneate at base
34. pieninicum
29. E. hieracifolium L., Cent. Pl. 1: 18 (1755) (E. strictum Gaertner, Meyer \& Scherb., E. marschallianum Andrz. ex Bieb.). Leaves linear or oblong, sinuate-dentate, green or grey. Sepals $4-6 \mathrm{~mm}$, the outer not or scarcely saccate at base; petals mostly $8-10 \mathrm{~mm}$. Siliqua $30-55 \times 0.7-1 \cdot 5 \mathrm{~mm}$, erecto-patent, grey or grey with green angles; valves pubescent on the inside; style $1-2 \mathrm{~mm}$. Seeds $1 \cdot 7-2 \cdot 1 \mathrm{~mm} .2 n=32$. N., C. \& E. Europe, extending westwards to Belgium and E. France. ? Al Au Be Bu Cz Da Fe $\mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C}, \mathrm{W}, \mathrm{E)} \mathrm{Su}$.
30. E. durum J. \& C. Presl, Delic. Prag. 226 (1822). Leaves linear, more or less entire, grey. Sepals $2-5 \mathrm{~mm}$, the outer not or scarcely saccate at base; petals $6-8.5 \mathrm{~mm}$. Siliqua $20-35 \times 0.7-$ 1.2 mm , erect, often appressed to the axis, grey; valves pubescent on the inside; style $0.5-1.5 \mathrm{~mm}$. Seeds $1.2-1.8 \mathrm{~mm}$. E.C. Europe, extending eastwards to W. Ukraine. Au CzGePo Rs (W).
31. E. virgatum Roth, Catalecta Bot. 1: 75 (1797). Leaves linear-lanceolate, more or less entire, usually green. Sepals $5 \cdot 5-$ $8(-9) \mathrm{mm}$, the outer saccate at base; petals $11-14 \mathrm{~mm}$. Siliqua $40-70 \times 1-1.2 \mathrm{~mm}$, erecto-patent, usually grey with green angles; valves glabrous on the inside; style $1-2 \mathrm{~mm}$. Seeds $1 \cdot 7-2 \cdot 1 \mathrm{~mm}$. - W. Alps. Ga He.
32. E. wahlenbergii (Ascherson \& Engler) Borbás, Math. Term. Közl. 5 (6): 174 (1878). Leaves lanceolate or oblong, sinuate-dentate, the cauline with mostly 2-5 pairs of teeth, green; hairs on the lower surface (3-)4(-5)-rayed. Sepals 6-8•5(-10) mm, the outer saccate at base; petals $10-15(-20) \times 3-4 \mathrm{~mm}$; limb cuneate at base. Siliqua $50-80 \times 1 \cdot 2-1.9 \mathrm{~mm}$, erect or erecto-
patent, green; valves glabrous on the inside; style $0.5-2 \mathrm{~mm}$. Seeds ( $1 \cdot 8-$ ) $1 \cdot 9-2 \cdot 4(-2 \cdot 8) \mathrm{mm}$. $\quad$. Carpathians (Tatra). Cz.
33. E. hungaricum Zapał., Bull. Int. Acad. Sci. Cracovie Ser. B, 49 (1913). Like 32 but leaves sinuate-denticulate with $5-8$ pairs of teeth; petal-limb rounded at base; siliqua $60-90 \times 1 \cdot 3-2 \mathrm{~mm}$; seeds (2-)2•2-2•7(-2•9) mm. N.E. Carpathians. Rm ?Rs (W).
34. E. pieninicum (Zapał.) Pawł., Acta Soc. Bot. Polon. 17: 121 (1946). Like 32 but leaves serrate-dentate with 5-8 pairs of teeth, hairs on the lower surface (2-)3(-4)-rayed; siliqua 45$65 \times 0 \cdot 9-1 \cdot 3 \mathrm{~mm}$. - W. Carpathians (Pienini). Po.
35. E. cuspidatum (Bieb.) DC., Reg. Veg. Syst. Nat. 2: 493 (1821) (Syrenia cuspidata (Bieb.) Reichenb.; incl. Erysimum goniocaulon auct. bulg., E. pulchellum auct. turc.). Annual or biennial up to 70 cm ; hairs nearly all stellate. Lower leaves oblong- or ovate-lanceolate, sinuate-dentate or dentate, green. Pedicels $1-3 \mathrm{~mm}$ in flower, up to 5 mm in fruit. Sepals $5-6.5 \mathrm{~mm}$, slightly saccate at base; petals $9-13 \times 2.5-3.5 \mathrm{~mm}$, pubescent on back; anthers c. 3 mm . Siliqua $10-30 \mathrm{~mm}$, strongly laterally compressed, erect and appressed to the stem, grey with green angles; valves keeled or narrowly winged on the back; style 3-6(-10) mm, c. $\frac{1}{3}$ as long as the rest of the siliqua. Seeds $c .1 \cdot 2 \mathrm{~mm}$. S.E. Europe. Al Bu Gr Ju Rm Rs (W, K, E) Tu.

A distinct but much confused species, sometimes included in Syrenia or in a distinct genus of its own. E. tetovense Rohlena, Feddes Repert. 42: 199 (1937), described from Srbija, is probably this species.
36. E. repandum L., Demonstr. Pl. 17 (1753). Annual up to $35(-60) \mathrm{cm}$; hairs nearly all medifixed. Lower leaves linearlanceolate to lanceolate, sinuate-dentate to entire, green. Pedicels $1-5 \mathrm{~mm}$ in flower, up to 7 mm and almost as thick as the siliqua in fruit. Sepals $3-6 \mathrm{~mm}$, not or only slightly saccate at base; petals $6-10 \times 1.5-2 \mathrm{~mm}$, pubescent on the back; anthers 0.8 1.2 mm . Siliqua $45-100 \times 1-1.5 \mathrm{~mm}$, more or less circular in cross-section, patent, torulose, green; style $2-5 \mathrm{~mm}$, about as wide as the siliqua. Seeds $1 \cdot 2-1 \cdot 7 \mathrm{~mm}$. $2 n=16$. Ruderal. C., $E$. \& S. Europe. Al Bu Cz Ge Gr Hu Hs It Ju Po Rm Rs (C, W, K) Tu.

A casual in most other countries, sometimes frequent.
37. E. incanum G. Kunze, Flora (Regensb.) 29: 753 (1846) (E. aurigeranum Jeanb. \& Timb.-Lagr., E. kunzeanum Boiss. \& Reuter). Annual up to 45 cm ; hairs nearly all stellate. Basal leaves pinnatifid, cauline linear-lanceolate, entire or dentate, grey-green. Pedicels $1-2 \mathrm{~mm}$ in flower, up to 7 mm and erect in fruit, almost as wide as the siliqua. Sepals $2.5-4 \mathrm{~mm}$, not or slightly saccate; petals $3.5-6 \times 0.7-1 \mathrm{~mm}$, pubescent on back; anthers c. 0.7 mm . Siliqua $30-55 \times 0.7-1.1 \mathrm{~mm}$, square in cross-section, erect, torulose, grey; style $c .0 .5 \mathrm{~mm}$. Seeds c. 1 mm . C., S. \& E. Spain, extending northwards to the Pyrenees. Ga Hs.
38. E. cheiranthoides L., Sp. Pl. 661 (1753). Annual, rarely biennial, up to 100 cm ; hairs medifixed and stellate. Lower leaves oblong-lanceolate, acute, entire to sinuate-dentate, green. Pedicels $4-8 \mathrm{~mm}$ in flower, up to 16 mm in fruit, slender, patent. Sepals 2-4 mm, not or slightly saccate; petals (2-)3-6×1-2 mm, pubescent on back; anthers $0.5-1 \mathrm{~mm}$. Siliqua $10-50 \times 1-$ 1.5 mm , square in cross-section, not or only slightly torulose, erecto-patent, green; style $0-1.5 \mathrm{~mm}$. Seeds $0.8-1.3 \mathrm{~mm}$. Throughout much of Europe but absent from most of the south. Au Be Br $\mathrm{Cz} \mathrm{DaFe} \mathrm{Ge} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{?Hs} \mathrm{Hu} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm}$ Rs (N, B, C, W, E) Si Su.
(a) Subsp. cheiranthoides: Annual, usually $20-50 \mathrm{~cm}$, sparsely pubescent; base of the stem $2-6 \mathrm{~mm}$ in diameter, with $5-10$ internodes between the basal rosette and the inflorescence; cauline leaves acute or subacute, widest at the middle, erecto-patent. $2 n=16$. Throughout the range of species except the extreme north.
(b) Subsp. altum Ahti, Arch. Soc. Zool.-Bot. Fenn.Vanamo 16:24 (1962): Biennial usually $40-100 \mathrm{~cm}$, densely pubescent; base of the stem up to 15 mm in diameter, with 20-40 internodes between the basal rosette and the inflorescence; cauline leaves acuminate, widest at the base, appressed to the stem. $2 n=16$. Fennoscandia and N. Russia, southwards to $c .55^{\circ} \mathrm{N}$.

## 19. Syrenia Andrz. ${ }^{1}$

Like Erysimum but the median nectaries absent; hairs on the siliqua usually medifixed, lying transversely across the siliqua; style at least $\frac{1}{2}$ as long as the rest of the siliqua; seeds in 2 rows in each loculus.

1 Pedicels $3-5 \mathrm{~mm}$ in flower, up to 6 mm in fruit, about $\frac{1}{2}$ as long as the calyx and siliqua
3. siliculosa

1 Pedicels $0.5-2(-2 \cdot 5) \mathrm{mm}$ in flower, up to $3(-5) \mathrm{mm}$ in fruit, not more than $\frac{1}{3}$ as long as the calyx and siliqua
2 Siliqua compressed laterally; valves narrowly winged on the back; style $6-12 \mathrm{~mm}$, about as long as the siliqua
4. montana

2 Siliqua square in cross-section; valves keeled but not winged; style $3-7 \mathrm{~mm}$, usually shorter than siliqua
3 Siliqua $5-20(-25) \mathrm{mm}$; pedicels not more than 2 mm ; hairs medifixed

1. cana

3 Siliqua $15-40 \mathrm{~mm}$; pedicels $2-5 \mathrm{~mm}$; hairs medifixed and 3-fid
2. talijevii

1. S. cana (Piller \& Mitterp.) Neilr., Aufz. Nachtr. 73 (1870) (S. angustifolia (Ehrh.) Reichenb.). Biennial $25-80 \mathrm{~cm}$; hairs medifixed. Leaves linear, entire, grey or grey-green. Pedicels $0 \cdot 5-2 \mathrm{~mm}$. Sepals $6-10 \mathrm{~mm}$, saccate at base; petals (10-)12$22 \times 3-6 \mathrm{~mm}$, pale yellow, glabrous on back; anthers $2-3 \mathrm{~mm}$. Siliqua $5-25(-30) \times 1.5-4 \mathrm{~mm}$, square in cross-section, white, with green angles; valves keeled; style $3 \cdot 5-7 \mathrm{~mm}$. Seeds 1 1.8 mm . Sandy soils. E. \& E.C. Europe, from Czechoslovakia and Jugoslavia to S. Russia. ?Bu Cz Hu Ju Rm Rs (C, W, K, E).
2. S. talijevii Klokov, Trav. Inst. Bot. (Charkov) 1: 107 (1936). Like 1 but (35-) $50-90 \mathrm{~cm}$; hairs medifixed and 3 -fid; pedicels $1.5-2 \mathrm{~mm}$ in flower, up to 5 mm in fruit; siliqua 15-40 mm; style 3-7 mm. - E. Ukraine ; ? S. Russia. Rs (E).

Possibly more closely related to Erysimum cuspidatum.
3. S. siliculosa (Bieb.) Andrz. ex C. A. Meyer in Ledeb., Fl. Altaica 3: 162 (1831). Biennial $40-80 \mathrm{~cm}$; hairs medifixed. Leaves linear, entire, grey-green. Pedicels $3-5 \mathrm{~mm}$ in flower, up to 6 mm in fruit. Sepals $7-10(-12) \mathrm{mm}$, saccate at base; petals (13-)15-$18(-20) \mathrm{mm}$, pale yellow. Siliqua $5-10(-12) \times 2-3 \mathrm{~mm}$, square in cross-section; valves keeled; style $5-10(-12) \mathrm{mm}$, about as long as the siliqua. S. \& S.E. Russia; S. \& E. Ukraine. Rs (C, K, E).
4. S. montana (Pallas) Klokov in Klokov \& Wissjul., Fl. RSS Ucr. 5: 505 (1953) (S. sessiliflora Ledeb.). Biennial $30-90 \mathrm{~cm}$; hairs medifixed. Leaves linear, entire, grey-green. Pedicels $0 \cdot 5$ -$1(-2) \mathrm{mm}$ in flower, up to $2(-2 \cdot 5) \mathrm{mm}$ in fruit. Sepals $(6-) 8$ 13 mm , saccate at base; petals $15-21 \times 3-7 \mathrm{~mm}$, pale yellow. Siliqua $6-15 \times 2-4 \mathrm{~mm}$, laterally compressed, white with green angles; valves narrowly winged; style $6-12(-14) \mathrm{mm}$. Seeds $c$. 1 mm . S. Russia; S. Ukraine ; ?E. Bulgaria. ?Bu Rs (C, E).

[^106]
## 20. Hesperis L. ${ }^{1}$

Biennial to perennial herbs; glabrous or indumentum of one or more of the following kinds of hairs: unbranched, branched, glandular. Sepals erect, the inner saccate at base; petals yellow, purple or white, long-clawed. Fruit a siliqua; valves with a distinct median vein and lateral veins; style short; stigma deeply 2-lobed, the lobes erect, free. Seeds in 1 row in each loculus; radicle incumbent.

Literature: V. Borbás, Magyar Bot. Lapok 1: 161 et seq. (1902), 2: 12-23 (1903). N. Tzvelev, Not. Syst. (Leningrad) 19: 114-55 (1959).

1 Flowers yellow, sometimes suffused with purple
2 Lower pedicels usually $40-90 \mathrm{~mm}$ in fruit; petal-limb 2-4 mm wide, linear-lanceolate

1. tristis

2 Lower pedicels usually less than 20 mm in fruit; petal-limb 3-9 mm wide, usually ovate-oblong
2. laciniata

1 Flowers purple, pink or white
3 Stem hispid; pedicels usually much shorter than the calyx
2. laciniata

3 Stem not hispid; pedicels $\pm$ equalling calyx
(3-14). matronalis group

1. H. tristis L., Sp. Pl. 663 (1753). Stout hispid, biennial or perennial $25-50(-70) \mathrm{cm}$; indumentum of branched, unbranched and glandular hairs. Leaves ovate-lanceolate to lanceolate, entire to denticulate; cauline leaves subcordate. Lower pedicels $40-90 \mathrm{~mm}$ in fruit. Calyx $9-15 \mathrm{~mm}$; petals $20-25(-30) \mathrm{mm}$, yellow, rarely purplish; limb $2-4 \mathrm{~mm}$ wide, narrowly lanceolate. Siliqua $40-180 \times 2.5-4.5 \mathrm{~mm}$; valves flat; style $c .0 .5 \mathrm{~mm}$. Dry sunny places, scrub. C. \& E. Europe, a rare escape from cultivation elsewhere. $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Hu} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)}$.
2. H. laciniata All., Fl. Pedem. 1: 271 (1785) (incl. H. glutinosa Vis.). Biennial or perennial $10-80 \mathrm{~cm}$; indumentum of branched, unbranched and often glandular hairs. Leaves pinnatifid to sinuatedentate, cauline sessile. Pedicels shorter than the calyx in flower, up to 15 mm in fruit. Calyx $5-12 \mathrm{~mm}$; petals $15-30(-40) \mathrm{mm}$, yellow variably suffused with purple, or entirely purple; limb $3-9 \mathrm{~mm}$ wide, oblong to obovate. Siliqua $50-150 \times 1 \cdot 5-3(-4) \mathrm{mm}$; valves flat; style $c .1 \mathrm{~mm}$. Cliffs and rocks. S. Europe. Al Bu Ga Gr Hs It Ju Lu Si.
(a) Subsp. laciniata: Usually glandular-pubescent. Siliqua pubescent. Almost throughout the range of the species.

Variable and often divided into a number of subsidiary taxa. Var. spectabilis (Jordan) with the petals $25-40 \times 5-9 \mathrm{~mm}$, purple, is often confused with 3. It generally occurs only in the southern half of the range of subsp. (a).
(b) Subsp. secundiflora (Boiss. \& Spruner) Breistr., Mém. Soc. Bot. Fr. 1952: 84 (1952): Eglandular. Siliqua glabrous. - S. Balkan peninsula.
(3-14). H. matronalis group. Biennial or perennial $40-120 \mathrm{~cm}$; hairs branched, unbranched and sometimes glandular. Pedicels $5-20 \mathrm{~mm}$ in fruit, about equalling the calyx in flower. Calyx $5-8(-10) \mathrm{mm}$; petals $14-25 \mathrm{~mm}$, white or purple; limb $3-7 \mathrm{~mm}$ wide, oblong to obovate. Siliqua $25-100 \times 1 \cdot 5-3 \mathrm{~mm}$; valves rounded; style $1 \cdot 5-2.5 \mathrm{~mm}$.

This group contains a number of taxa which are generally not very difficult to identify but whose status is often unclear. Most of them differ from each other in only 1 or 2 characters, which, in other groups, are often considered to be of doubtful taxonomic value (e.g. flower-colour, type of indumentum, etc.).
1 Middle and upper cauline leaves $\pm$ shortly petiolate, never amplexicaul
3. matronalis

1 Middle and upper cauline leaves sessile, $\pm$ amplexicaul
2 Flowers white
3 Upper leaves and upper part of stem glandular
4 Leaves with numerous branched hairs, usually denselyglandular11. dinarica
4 Leaves with mainly unbranched hairs, sparsely glandular
12. vrabelyiana
3 Plant entirely eglandular
5 Stem and leaves green, glabrous or pubescent; leaves den-tate to entire13. nivea
5 Stem and leaves white-tomentose; leaves coarsely sinuate-dentate or serrate14. inodora
2 Flowers pink or purple
6 Plant eglandular
7 Calyx and pedicels glabrous7. oblongifolia
7 Calyx and pedicels pubescent
8 Stem and leaves with long unbranched hairs 8. steveniana
8 Stem and leaves without conspicuous, long unbranchedhairs
9 Hairs of 2 kinds, branched and short unbranched; calyx9. macedonica
9 Hairs almost all branched; calyx $6-7.5 \mathrm{~mm}$ 10. pyenotricha6 Plant glandular-pubescent
10 Plant without long unbranched hairs 5. sylvestris
10 Plant with long unbranched hairs
11 Plant grey-tomentose; siliqua usually glandular
6. theophrasti
11 Plant sparsely pubescent, green; siliqua eglandular ..... 4. elata
3. H. matronalis L., Sp. Pl. 663 (1753). Indumentum variable, glandular or eglandular, rarely glabrous. Lower leaves serrate to lyrate; upper leaves entire or dentate, shortly petiolate to subsessile, not amplexicaul. Petals purple or white. $2 n=24$. Damp or shaded habitats. Scattered through C. \& S. Europe but absent from the extreme south and much of the west. A frequent escape from cultivation throughout most of Europe. Al Au Cz Ga Hs Hu It Ju Po Rm Rs (W, K) [Be Br Da Fe Ge He Ho Is No Rs (B, N) $\mathrm{Su}]$.

## Often cultivated for ornament.

A variable species containing a number of subspecies which may be identified as follows. Glabrous variants of at least 2 of the subspecies occur.

## 1 Flowers white

2 Lower leaves with only unbranched hairs, or glabrous
(c) subsp. candida

2 Lower leaves with branched and unbranched hairs
(d) subsp. voronovii

1 Flowers purple
3 Lower leaves with numerous branched hairs
(b) subsp. cladotricha 3 Lower leaves with mainly unbranched hairs $\begin{aligned} & \text { (a) subsp. matronalis }\end{aligned}$
(a) Subsp. matronalis (incl. H. sibirica L.): Italy, S. France, ?N. Spain; widespread as an alien.
The plants from Italy are usually glandular-pubescent while those from France are eglandular. The latter is the plant usually cultivated and naturalized.
(b) Subsp. cladotricha (Borbás) Hayek, Prodr. Fl. Penins. Balcan. 1: 416 (1925) (incl. H. obtusa Moench): Balkan peninsula and Romania.
(c) Subsp. candida (Kit.) Hegi \& E. Schmid in Hegi, Ill. Fl. Mitteleur. 4 (1): 467 (1919) (incl. H. moniliformis Schur): Mountains, from the Carpathians to Pyrenees.
(d) Subsp. voronovii (N. Busch) P. W. Ball, Feddes Repert. 68 : 194 (1963): Krym.
4. H. elata Hornem., Hort. Hafn. suppl., 74 (1819) (H. sibirica auct. ross., non L.). Indumentum of numerous long and short
unbranched hairs, and glandular hairs; branched hairs more or less absent from the lower part of the plant. Lower leaves serrate to lyrate; upper sessile, semi-amplexicaul, entire to dentate. Pedicels glandular-pubescent. Petals purple. Siliqua glabrous or hairy. E. \& S. Russia, E. Ukraine. Rs (C, W, E).
5. H. sylvestris Crantz, Stirp. Austr. 1: 34 (1762). Indumentum dense, of short unbranched, branched, and glandular hairs. Lower leaves lyrate; upper sessile, semi-amplexicaul, more or less serrate. Petals purple or pinkish. Siliqua glabrous. Woods and scrub. - C. \& S.E. Europe. ?Al Au Bu Cz Hu Ju Po Rm Rs (W).
(a) Subsp. sylvestris: Pedicels glandular-pubescent. C. Europe, eastwards to the Carpathians and southwards to Macedonia.
(b) Subsp. velenovskyi (Fritsch) Borza, Consp. Fl. Roman. 124 (1947) (H. suaveolens (Andrz.) Steudel): Pedicels and often the whole inflorescence glabrous. S.E. Europe.
6. H. theophrasti Borbás, Magyar Bot. Lapok 1: 267 (1902). Like 6 but with long unbranched hairs; lower leaves dentate; pedicels and usually the siliqua densely glandular. Woods, grassy and rocky places. - C. \& N. Greece; S. Jugoslavia. Gr Ju.

Possibly only a subspecies of 5 .
7. H. oblongifolia Schur, Enum. Pl. Transs. 52 (1866). Indumentum of unbranched and branched hairs, eglandular. Leaves dentate, the cauline semi-amplexicaul, the lower often glabrous. Pedicels glabrous or hairy at the base. Petals purple. Siliqua glabrous. E. Carpathians. Rm.
8. H. steveniana DC., Reg. Veg. Syst. Nat. 2: 452 (1821). Indumentum of long and short unbranched and branched hairs, eglandular. Lower leaves usually lyrate; upper more or less sessile, semi-amplexicaul, dentate to entire. Pedicels densely pubescent. Petals pale purple, sometimes almost white. Siliqua more or less pubescent. Krym. Rs (K).
9. H. macedonica Adamović, Denkschr. Akad. Wiss. Math.Nat. Kl. (Wien) 74: 124 (1904). Indumentum of short unbranched and branched hairs, eglandular. Lower leaves crenulate to sinuate-lobed; cauline sessile, semi-amplexicaul, repand-dentate. Pedicels densely pubescent. Petals purple. Siliqua puberulent. Cliffs. Macedonia. Bu Ju.
10. H. pyenotricha Borbás \& Degen, Magyar Bot. Lapok 1: 269 (1902). Indumentum of short branched hairs, with a few unbranched hairs, eglandular. Leaves dentate to entire, the cauline sessile, slightly amplexicaul. Pedicels pubescent. Petals purple. Siliqua sparsely pubescent at the base, glabrous at the apex. U.S.S.R. from c. $30^{\circ}$ E. eastwards and c. $56^{\circ} \mathrm{N}$. southwards. Rs (C, W, K, E).

Possibly only a subspecies of 3 .
11. H. dinarica G. Beck in Dörfler, Jahreskat. Wien. Bot. Tauschver. 1894: 6 (1894) (incl. H. degeniana Borbás). Indumentum of long and short unbranched and branched hairs and glandular hairs. Leaves dentate; cauline sessile, semi-amplexicaul. Pedicels glandular-pubescent, rarely glabrous. Petals white. Siliqua glabrous. - Stony places and woods. W. \&. C. parts of Balkan peninsula. Al Bu Gr Ju.
12. H. vrabelyiana (Schur) Borbás, Magyar Bot. Lapok 2: 21 (1903). Indumentum of long and short unbranched hairs and
glandular hairs, with few branched hairs. Leaves dentate; cauline sessile, semi-amplexicaul. Pedicels pubescent. Petals white. Siliqua pubescent. $2 n=24$. - Mountains of N. Hungary (Bükk hegység). Hu.
13. H. nivea Baumg., Enum. Stirp. Transs. 2: 278 (1816). Indumentum of long and short unbranched and branched hairs, the latter absent from the lower part of the plant. Leaves dentate to entire, the cauline sessile, semi-amplexicaul. Pedicels pubescent. Petals white. Siliqua glabrous or pubescent. - Carpathians. Cz Po Rm Rs (W).
14. H. inodora L., Sp. Pl. ed. 2, 927 (1763) (H. subsinuata Borbás). Indumentum dense, of long and short unbranched and branched hairs, eglandular. Leaves coarsely sinuate-dentate or serrate, the cauline sessile, semi-amplexicaul. Pedicels densely pubescent or glabrous. Petals white. - Maritime Alps. ?Ga It.

## 21. Malcolmia R.Br. ${ }^{1}$

Annual to perennial herbs with branched hairs (rarely hairs of two kinds) branched and unbranched, or glabrescent. Sepals erect, the inner usually saccate at base; petals pink to violet, rarely white, long-clawed; median nectaries absent. Fruit a siliqua; valves 3 -veined; style absent; stigma deeply 2 -lobed, the lobes erect and connate. Seeds in 1 row in each loculus. (Wilckia Scop.)

1 Sepals not or only slightly saccate at base
2 Lower pedicels 2-7 mm in fruit; siliqua $12-35 \times 1 \mathrm{~mm}$, torulose, terete, with appressed hairs
3. ramosissima

2 Lower pedicels $0-2 \mathrm{~mm}$ in fruit; siliqua usually larger, not torulose, $\pm 4$-angled, glabrous or with patent hairs
3 Siliqua densely hispid; stigma acute; lower pedicels usually $1-2 \mathrm{~mm}$ in fruit
4. africana

3 Siliqua with short, sparse, patent hairs or glabrous; stigma retuse; lower pedicels $0-1 \mathrm{~mm}$ in fruit
5. taraxacifolia

1 At least 2 of the sepals strongly saccate at base
4 Cauline hairs with numerous rays, usually very crowded
5 Basal leaves $\pm$ sessile; siliqua $30-65 \mathrm{~mm}$, not torulose

1. littorea

5 Basal leaves shortly petiolate; siliqua $20-40 \mathrm{~mm}$, torulose
2. lacera

4 Cauline hairs with 2-4 rays, not crowded
6 Calyx (8-)10-17 mm; style $5-10 \mathrm{~mm}$ in fruit
12. macrocalyx

6 Calyx not more than 10 mm ; style not more than 5 mm in fruit
7 Racemes bracteate, at least in the lower part
8 Lower leaves cordate at base; calyx with 3- to 4 -fid hairs
11. angulifolia

8 Lower leaves cuneate at base; calyx with medifixed hairs
9 Flowers $10-15 \mathrm{~mm}$; siliqua $35-60 \mathrm{~mm}$ (N.W. Balkan peninsula)
9. illyrica

9 Flowers 4-10 mm; siliqua 25-35 mm (C. Italy)
10. orsiniana

7 Racemes ebracteate
10 Indumentum entirely of 3 - to 4 -fid hairs (each ray not more than 0.15 mm ) 8. graec
10 Indumentum including numerous medifixed hairs (each ray at least 0.25 mm )
11 Style more than 1.5 mm in fruit; petals $10-25 \mathrm{~mm}$; sepals $5-16 \mathrm{~mm}$
12 Pedicels in fruit $0.5-1 \mathrm{~mm}$ in diameter at their base, distinctly narrower than siliqua 6. maritima
12 Pedicels in fruit $\mathbf{1 - 2 . 5 \mathrm { mm }}$ in diameter at their base, about as wide as the siliqua
7. flexuosa
11. Style not more than 1.5 mm in fruit; petals $4.5-12 \mathrm{~mm}$; sepals $3-6 \mathrm{~mm}$
13 Petals pink or violet; siliqua (25-) $30-70 \mathrm{~mm}$, patent or erecto-patent
13. chia

13 Petals pink with yellow base; siliqua $10-35(-45) \mathrm{mm}$
14 Pedicels $3-5(-8) \mathrm{mm}$ in fruit, almost as wide as the siliqua; siliqua straight, rigid, erecto-patent 15. bicolor
14 Pedicels $5-15 \mathrm{~mm}$ in fruit, narrower than siliqua; siliqua curved and flexuous
14. hydraea

1. M. littorea (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 121 (1812). Perennial $10-40 \mathrm{~cm}$, woody, with numerous nonflowering stems, densely white-pubescent or -tomentose; hairs stellate. Leaves entire to sinuate-dentate, more or less sessile. Petals 14-22 mm, purple. Siliqua $30-65 \times 1-1.5 \mathrm{~mm}$, not torulose, apex attenuate; stigma $2-6 \mathrm{~mm} .2 n=20$. S.W. Europe. Ga Hs It Lu .
2. M. lacera (L.) DC., Reg. Veg. Syst. Nat. 2: 445 (1821) (incl. M. patula DC.). Annual or perennial up to 40 cm , greygreen, pubescent or tomentose; hairs stellate. Basal leaves entire to sinuate-pinnatifid, shortly petiolate. Petals $8-16 \mathrm{~mm}$, purple. Siliqua $20-40 \times 0.7-1.2 \mathrm{~mm}$, torulose; stigma $2.5-6 \mathrm{~mm}$. C. \& $S$. Spain and Portugal. Hs Lu.
3. M. ramosissima (Desf.) Thell., Fl. Adv. Montpellier 285 (1912) (M. parviflora (DC.) DC.). Annual $5-20 \mathrm{~cm}$; hairs stellate. Leaves oblong, entire or sinuate-dentate. Pedicels $2-7 \mathrm{~mm}$ in fruit. Sepals $2.5-5 \mathrm{~mm}$, not saccate; petals $4-8 \mathrm{~mm}$, violet or pink. Siliqua $15-35 \times c$. 1 mm , terete, torulose, pubescent; septum almost completely opaque; stigma $1-2 \mathrm{~mm}$. $2 n=14$. Mediterranean region and Portugal. Bl Co Ga Gr Hs It Lu Sa Si.

Often confused with Maresia nana (Cosson) Batt., from which it can most readily be distinguished by the stigma and the almost completely opaque septum of the siliqua.
4. M. africana (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 121 (1812). Annual up to 40 cm , with branched or stellate hairs; branches usually shorter than main stem. Leaves lanceolate, entire or sinuate-dentate. Pedicels $1-2 \mathrm{~mm}$ in fruit. Sepals 35 mm , not saccate; petals (5-)8-10(-12) mm, violet. Siliqua $25-$ $65 \times 1-1.5 \mathrm{~mm}$, patent, rigid, more or less 4 -angled, densely hispid; stigma $0.5-1.5 \mathrm{~mm}$, acute. Probably native in $S$. Europe and commonly occurring as a casual elsewhere. Co Cr Ga Gr Hs It Rm Rs (W, K) Si Tu.
5. M. taraxacifolia Balbis, Cat. Stirp. Hort. Bot. Taur. app. 4, 10 (1814). Like 5 but not more than 15 cm , with unbranched and branched hairs or glabrescent; branches often longer than main stem; leaves serrate to pinnatisect; pedicels $0-1 \mathrm{~mm}$; petals $6-8 \mathrm{~mm}$, white or pale bluish-pink; siliqua (15-) $30-60 \times$ (1-)1.5-2 mm, glabrous or with short patent hairs; stigma retuse. S.E. Russia. Rs (E).
6. M. maritima (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 121 (1812). Annual $10-35 \mathrm{~cm}$, with medifixed or 3 - to 4 -fid hairs. Leaves obovate to oblong, cuneate at base, entire or dentate. Inflorescence ebracteate; pedicels $4-15 \times 0.5-0.8(-1) \mathrm{mm}$ in diameter in fruit, thinner than siliqua. Sepals $6-10 \mathrm{~mm}$, with medifixed hairs; petals $12-25 \mathrm{~mm}$, pink to violet. Siliqua 35 $80 \times 1-2 \mathrm{~mm}$, with mostly medifixed hairs; stigma $2-5 \mathrm{~mm}$. - S. \& W. Greece, S. Albania; sometimes naturalized in maritime sand elsewhere in S. Europe. Al Gr [Bl Co Ga Hs It Si].

Widely cultivated for ornament and often occurring as a casual.
7. M. flexuosa (Sibth. \& Sm.) Sibth. \& Sm., Fl. Graeca 7: 33, t. 634 (1830). Like 6 but the pedicels $1-2.5 \mathrm{~mm}$ in diameter at the base, about as wide as siliqua; siliqua up to 3 mm in diameter; stigma $1 \cdot 5-4 \mathrm{~mm} . \quad 2 n=16$. Sea-shores and maritime cliffs. Coasts of Greece and the Aegean region; naturalized elsewhere in S. Europe, where it has been confused with 6 . $\mathrm{Cr} \mathrm{Gr} \mathrm{Tu}[\mathrm{Ga}$ It Lu].
8. M. graeca Boiss. \& Spruner in Boiss., Diagn. Pl. Or. Nov. 1 (1): 71 (1843). Annual $5-20 \mathrm{~cm}$, with 3- to 4 -fid hairs (each ray not more than 0.15 mm ). Leaves ovate-oblong, cuneate at base, entire to lyrate-pinnatifid. Inflorescence ebracteate; pedicels 410 mm in fruit. Sepals with 3- to 4 -fid hairs; petals $8-17 \times 3-$ 4.5 mm , purple or violet. Siliqua $25-75 \times 1-1.5 \mathrm{~mm}$, erectopatent; stigma 0.5-2.5 mm. Greece (Attiki). Gr.
9. M. illyrica Hayek, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 94: 150 (1917) (M. maritima var. serbica sensu Hayek, pro parte). Annual $10-35 \mathrm{~cm}$, with medifixed and 3- to 4 -fid hairs. Leaves oblong to obovate, cuneate. Inflorescence bracteate in the lower part. Sepals $5-10 \mathrm{~mm}$, with medifixed hairs; petals $10-$ $15 \times 2-4(-5) \mathrm{mm}$, pink or purple, emarginate. Siliqua $35-60 \times$ $1-2 \mathrm{~mm}$; stigma c. 2 mm . - Mountains of W. Jugoslavia and $N$. Albania. Al Ju.
10. M. orsiniana (Ten.) Ten., Fl. Nap. 5: 67 (1835). Very like 9 but the sepals $2.5-5 \mathrm{~mm}$; petals $4-10 \times 2-3 \mathrm{~mm}$, usually entire; siliqua $25-35 \mathrm{~mm}$. High mountains. C. Italy. It.
11. M. angulifolia Boiss. \& Orph. in Boiss., Diagn. Pl. Or. Nov. 3 (5): 19 (1856) (M. maritima var. serbica sensu Hayek pro parte). Annual $15-60 \mathrm{~cm}$, with medifixed and 3- to 4 -fid hairs. Leaves dentate to laciniate, suborbicular to ovate, the basal cordate but soon dead. Inflorescence bracteate in the lower part; pedicels $5-10 \mathrm{~mm}$ in fruit. Sepals (4-)6-10 mm with mainly 3to 4 -fid hairs; petals ( $7-$ ) $11-25 \mathrm{~mm}$; stigma 1-2.5 mm. Mountains of C. \& N. Greece, S. Albania, Srbija and W. Bulgaria. Al Bu Gr Ju.

Much confused with 9 and not always clearly separable from it in N.W. Greece and S. Albania.
12. M. macrocalyx (Halácsy) Rech. fil., Ann. Naturh. Mus. (Wien) 43: 29 (1929). Annual up to 40 cm , with medifixed and 3- to 4-fid hairs. Basal leaves ovate to ovate-orbicular, cuneate at base, entire or dentate. Sepals ( $8-$ ) $10-17 \mathrm{~mm}$, with medifixed hairs; petals $15-30 \times 5-10 \mathrm{~mm}$, pink or purple. Siliqua $50-80 \mathrm{~mm}$; stigma $5-10 \mathrm{~mm}$. Aegean region. Gr.
(a) Subsp. macrocalyx: Inflorescence ebracteate. Skiathos \& Skopelos.
(b) Subsp. scyria (Rech. fil.) P. W. Ball, Feddes Repert. 68: 181 (1963) (M. scyria Rech. fil.): Inflorescence bracteate, usually almost to the apex. Skiros and Evvoia.
13. M. chia (L.) DC., Reg. Veg. Syst. Nat. 2: 440 (1821). Annual up to 20 cm , with medifixed and 3- to 4 -fid hairs. Leaves ovate-oblong, the basal cuneate, entire or dentate. Inflorescence ebracteate; pedicels $4-10 \mathrm{~mm}$ in fruit. Sepals with 2 -fid hairs; petals $6-10 \times 1 \cdot 5-2(-2 \cdot 5) \mathrm{mm}$, pale pink to violet. Siliqua $25-70 \times c .1 \mathrm{~mm}$, erecto-patent; stigma $0.5-1.5 \mathrm{~mm}$. Greece and Aegean region, generally near the coast. Cr Gr Tu .
14. M. hydraea (Halácsy) Heldr. \& Halácsy, Bull. Herb. Boiss. 6: 234 (1898). Very like 13 but the pedicels $5-15 \mathrm{~mm}$ in fruit, distinctly narrower than the siliqua; sepals with some 3 - to 4 -fid

[^107]hairs; petals $8-12 \times 2.5-5 \mathrm{~mm}$, pink, with a yellow claw; siliqua up to 45 mm , patent, curved upwards and flexuous. Idhra and Evvoia. Gr.

Perhaps only a subspecies of 13.
15. M. bicolor Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 1 (6): 10 (1846/7) (incl. M. graeca sensu Hayek pro parte). Annual $7-35 \mathrm{~cm}$, with medifixed and 3- to 4 -fid hairs. Leaves ovate to oblong-lanceolate, usually more or less entire. Pedicels 3-$5(-8) \mathrm{mm}$ in fruit, about as wide as the siliqua. Sepals with mainly medifixed hairs; petals $4.5-11 \times 2-3.5 \mathrm{~mm}$, pink, with a yellow claw. Siliqua $10-30(-40) \times 1-1.5 \mathrm{~mm}$, erecto-patent, straight, rigid; stigma $0.5-1 \mathrm{~mm}$. Greece and S. Albania. Al Gr.

## 22. Torularia (Cosson) O. E. Schulz ${ }^{1}$

Like Malcolmia but always annual; hairs unbranched and 2-fid; inner sepals not saccate at base; style distinct; stigma capitate or retuse. Literature: O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 213-26 (1924).

Petals white; siliqua $10-25 \mathrm{~mm}$; pedicels $0.5-1 \mathrm{~mm}$ in fruit

1. torulosa

Petals pink; siliqua $20-35 \mathrm{~mm}$; pedicels (1-)2-8 mm in fruit
2. contortuplicata

1. T. torulosa (Desf.) O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 214 (1924). Stem up to 30 cm , hispid with unbranched and 2 -fid hairs. Basal leaves dentate or pinnatifid; the upper cauline sometimes pectinate-pinnatifid. Pedicels not more than 1 mm . Petals $2 \cdot 5-4 \mathrm{~mm}$, white. Siliqua $10-25 \mathrm{~mm}$, usually erect, straight or contorted, torulose; style up to 0.5 mm . Krym (Sudak). Rs (K). (C. \& S.W. Asia; N. Africa.)
T. rossica O. E. Schulz, op. cit. 217 (1924), described from E.C. Russia (near Uljanovsk), is said to differ from 1 in having the hairs all 2-fid; leaves entire or denticulate; petals absent; siliqua $c .10 \mathrm{~mm}$ and stigma minute, capitate.
2. T. contortuplicata (Stephan ex Willd.) O. E. Schulz, op. cit. 219 (1924). Stem $5-30 \mathrm{~cm}$, hispid. Basal leaves sinuate-pinnatifid; the upper cauline usually more or less entire. Pedicels (1-)2-8 mm in fruit. Petals $3-8 \mathrm{~mm}$, pink. Siliqua $20-35 \mathrm{~mm}$, erecto-patent, straight or spirally coiled; style $1-1.5 \mathrm{~mm}$. S.E. Russia (near Astrakhan'). Rs (E). (Caucasus; C. Asia.)

## 23. Maresia Pomel ${ }^{1}$

Like Malcolmia but always annual; hairs stellate; inner sepals slightly saccate at base; style distinct; stigma capitate or emarginate.

1. M. nana (DC.) Batt. in Batt. \& Trabut, Fl. Algér. (Dicot.) 68 (1888) (Malcolmia binervis (C. A. Meyer) Boiss., M. confusa Boiss.). Shortly pubescent, $5-20 \mathrm{~cm}$. Leaves oblong or linear-oblong, entire or sinuate-dentate. Petals $4-5 \cdot 5 \mathrm{~mm}$, violet to pink. Siliqua $10-28 \times c .0 .7 \mathrm{~mm}$, terete, torulose; style $0.5-$ 1 mm . Maritime sands. Shores of the Mediterranean and of the Black Sea northwards to S.E. Bulgaria. Al Bl Bu Co Ga Gr Hs It Si Tu.

Often confused with Malcolmia ramosissima (Desf.) Thell., from which it can be distinguished by the style and stigma, and by the septum of the siliqua being 2 -veined with broad hyaline margins.

## 24. Leptaleum DC. ${ }^{1}$

Annual; hairs of two kinds, branched and unbranched. Sepals erect, not saccate; petals white, becoming reddish, not clawed; filaments of the inner stamens connate in pairs. Fruit a tardily dehiscent siliqua; valves with a distinct median vein; style very short; stigma 2-lobed, lobes erect, connate at their tips. Seeds in 2 rows in each loculus.

1. L. filifolium (Willd.) DC., Reg. Veg. Syst. Nat. 2: 511 (1821). Sparsely pubescent or glabrescent annual $5-15 \mathrm{~cm}$. Leaves linear or filiform, entire or pinnatisect with $3-5$ filiform lobes. Pedicels $2-3 \mathrm{~mm}$ in fruit. Petals $6-10 \mathrm{~mm}$, linear. Siliqua $15-30 \times 1 \cdot 5-$ 3 mm , compressed; valves with distinct median vein and reticulatestriate lateral veins. Seeds c. 0.75 mm . Steppes. N. of Astrakhan', on borders of S.E. Russia and Kazakhstan. Rs (E). (C. \& S.W. Asia.)

## 25. Sterigmostemum Bieb. ${ }^{1}$

Annual; hairs branched. Sepals erect, not saccate; petals yellow, with a short broad claw; filaments of the inner stamens connate in pairs. Fruit an articulated siliqua, breaking irregularly into 2-seeded segments; style short; stigma 2-lobed, lobes erect. Seeds in 1 row in each loculus.

1. S. tomentosum (Willd.) Bieb., Fl. Taur.-Cauc. 3: 444 (1819). Grey-tomentose annual $20-40 \mathrm{~cm}$. Leaves entire to pinnatisect with lanceolate lobes. Pedicels $5-10 \mathrm{~mm}$. Petals $6-10 \times 3-5 \mathrm{~mm}$, truncate. Siliqua $20-60 \times 1 \cdot 5-2 \mathrm{~mm}$, cylindrical, torulose. Seeds c. 2 mm , olive-green. Saline or sandy soils. S.E. Russia, W. Kazakhstan. Rs (E). (C. \& S.W. Asia.)

## 26. Cheiranthus L. ${ }^{1}$

Perennial herbs; hairs branched. Sepals erect, the inner saccate at base; petals yellow, long-clawed; median nectaries absent. Fruit a siliqua; valves with a distinct median vein; style short; stigma 2-lobed, the lobes patent. Seeds in 1-2 rows in each loculus; radicle accumbent.

1. C. cheiri L., Sp. Pl. 661 (1753) (incl. C. senoneri Heldr. \& Sart.). Perennial up to 90 cm ; hairs medifixed. Lower leaves $2-10 \mathrm{~cm}$, oblong-lanceolate. Pedicels $5-15 \mathrm{~mm}$ in fruit. Petals $15-25 \mathrm{~mm}$, yellow. Siliqua $25-75 \times 2-4 \mathrm{~mm}$, more or less erect, compressed; style $2-3 \mathrm{~mm}$. Seeds $c .3 \mathrm{~mm} .2 n=14$. S. Greece and islands of the S. Aegean; widely cultivated for ornament and naturalized on walls, cliffs and rocks in C., W. \& S. Europe. Cr Gr [ $\mathrm{Au} \mathrm{Be} \mathrm{Bl} \mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Rm} \mathrm{Sa} \mathrm{Si} \mathrm{Tu]}$.

Very variable, especially in the Aegean region.
The flower-colour in cultivation varies from yellow and orange to red, purple or brown or some combination of these. Many of the modern cultivars are probably of hybrid origin.

## 27. Clausia Trotzky ${ }^{1}$

Perennial herbs; hairs unbranched, glandular or not. Sepals erect, the inner saccate at base; petals pale purple, long-clawed. Fruit a tardily dehiscent siliqua; valves with a distinct median vein and lateral veins; style short; stigma 2-lobed, the lobes erect, free. Seeds in 1 row in each loculus; radicle accumbent.

1. C. aprica (Stephan ex Willd.) Trotzky, Ind. Sem. Horti Casan. (1834). Rhizomatous perennial up to 40 cm . Leaves oblong to

[^108]oblanceolate, entire to dentate. Sepals $5-10 \mathrm{~mm}$; petals 10 $20 \times 4-9 \mathrm{~mm}$. Siliqua $30-80 \times 1.2-1.5 \mathrm{~mm}$; style $1.5-1.8 \mathrm{~mm}$. Calcareous hills. U.S.S.R. from N.E. Ukraine to C. Ural. Rs (C, E).

## 28. Parrya R.Br. ${ }^{1}$

Perennial herbs; glabrous, or hairs unbranched and sometimes glandular. Sepals erect, not saccate; petals white or purplish, clawed. Fruit a siliqua; valves with distinct median vein; style very short; stigma 2-lobed, the lobes erect, connate. Seeds in 2 rows in each loculus.

1. P. nudicaulis (L.) Boiss., Fl. Or. 1: 159 (1867). Glabrous or glandular-tomentose, with long, stout rhizome; flowering stems scapose, up to 40 cm . Leaves broadly spathulate to linearoblong, entire or serrate. Pedicels $1-5 \mathrm{~cm}$. Petals $12-20 \mathrm{~mm}$, obovate, emarginate. Siliqua $20-65 \times 3.5-5.5 \mathrm{~mm}$, compressed, shortly stipitate, attenuate at base and apex. Seeds $4-5 \cdot 5 \times 3-$ 4.5 mm (including wing), elliptical, broadly winged. Arctic Europe. Rs (N) Sb. (Arctic Asia and America.)

## 29. Matthiola R.Br. ${ }^{1}$

Annual to perennial herbs; hairs branched. Sepals erect, the inner saccate at base; petals purple, white, or yellowish, longclawed. Fruit a siliqua; valves 1 -veined; style absent; stigma deeply 2 -lobed, the lobes erect, each with a dorsal swelling or horn. Seeds in 1 row in each loculus.

A number of species are cultivated for ornament.
Literature: P. Conti, Mém. Herb. Boiss. 1 (18) (1900).
1 Siliqua with $3 \pm$ equal triangular horns at the apex, all at least 2 mm long
10. tricuspidata

1 Siliqua without conspicuous horns or with only 2 longer than 2 mm
2 Siliqua compressed, the maximum diameter at least 2 mm , without horns or with horns not more than 1.5 mm ; lower pedicels up to 25 mm in fruit
3 Siliqua with large conspicuous blackish or yellowish glands, easily visible even when immature 2. sinuata
3 Siliqua without conspicuous glands, but usually with minute glandular hairs
4 Stigma conical in fruit; petal-limb $2 \cdot 5-3 \mathrm{~mm}$ wide 5 . fragrans
4 Stigma 2-lobed in fruit; petal-limb usually $3-12 \mathrm{~mm}$ wide
5 Petals white, pink or purple; lower pedicels at least 7 mm in fruit; stigma narrower than siliqua 1. incan
5 Petals yellowish- or brownish-purple; lower pedicels usually less than 7 mm
6 Leaves $\pm$ sinuate to sinuate-pinnatisect; stigma as wide as or wider than siliqua; lower pedicels $3-5(-8) \mathrm{mm}$ in fruit 3. odoratissim
6 Leaves irregularly serrate or divided; stigma narrower than siliqua; lower pedicels $2-3(-4) \mathrm{mm}$ in fruit
4. tatarica

2 Siliqua $\pm$ cylindrical, usually not more than 2 mm in diameter; stigmatic horns usually more than 1.5 mm long (always so when the siliqua is more than 2 mm in diameter); pedicels not more than $3(-8) \mathrm{mm}$
7 Perennial, with vegetative rosettes of leaves and often a long woody stock; siliqua with obtuse horns not more than $2(-3) \mathrm{mm}$ long
6. fruticulosa

7 Annual, rarely biennial, without vegetative rosettes of leaves, but sometimes woody at base; siliqua with horns usually more than 2 mm
8 Petals $6-10(-12) \times 1-2 \mathrm{~mm}$; sepals $4-6 \mathrm{~mm}$ 9. parviflora
8 Petals (12-) $15-25 \times 2-7 \mathrm{~mm}$; sepals 6 mm or more
9 Petals linear, yellowish; siliqua with the horns recurved or patent
7. longipetala

9 Petals obovate or oblong, pink or purple; horns curved upwards
10 Nectaries filiform; siliqua not or only slightly torulose 7. longipetala

10 Nectaries small, inconspicuous; siliqua $\pm$ torulose 8. lunata

1. M. incana (L.) R.Br. in Aiton, Hort. Kew. ed. 2, $4: 119$ (1812). Stout perennial $10-80 \mathrm{~cm}$, woody at base. Leaves entire, rarely sinuate-pinnatifid. Lower pedicels $7-25 \mathrm{~mm}$ in fruit. Sepals $9-15 \mathrm{~mm}$; petals $20-30 \times 4-12 \mathrm{~mm}$, purple, pink or white. Siliqua $45-160 \times 3-5 \mathrm{~mm}$, erecto-patent, compressed; stigma narrower than siliqua, without conspicuous horns. Coasts of $S . \& W$. Europe; often casual elsewhere. Az Bl Br Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.
(a) Subsp. incana: Plant densely white-tomentose to glabrescent; lower leaves $5-22 \mathrm{~mm}$ wide, linear-lanceolate, rarely oblong-lanceolate, obtuse or subacute; sepals $9-13 \mathrm{~mm} .2 n=14$. Throughout the range of the species.
(b) Subsp. rupestris (Rafin.) Nyman, Consp. 30 (1878): Plant glabrescent or sparsely pubescent; lower leaves up to $25-40 \mathrm{~mm}$ wide, lanceolate, acute or acuminate; sepals $11-15 \mathrm{~mm}$. S. Italy, N. Sicilia.
2. M. sinuata (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 120 (1812). Densely white-tomentose, stout biennial (rarely annual or perennial) $8-60 \mathrm{~cm}$, woody at base. Leaves sinuate-dentate to pinnatifid, the lobes oblong, obtuse; uppermost leaves entire. Lower pedicels $4-15(-18) \mathrm{mm}$ in fruit. Sepals $8-12 \mathrm{~mm}$; petals $17-25 \times 3-8 \mathrm{~mm}$, pale purple. Siliqua $50-150 \times 3-5 \mathrm{~mm}$ erectopatent, compressed, the valves with large, conspicuous, stipitate yellow or black glands; stigma narrower than siliqua, without conspicuous horns. Coasts of S. \& W. Europe. Al Bl Br Co Ga Gr Hb Hs It Ju Lu Sa Si Tu.
3. M. odoratissima (Bieb.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 120 (1812). Densely white-tomentose perennial $15-75 \mathrm{~cm}$, woody at base. Leaves usually sinuate to sinuate-pinnatisect. Pedicels $3-5(-8) \mathrm{mm}$ in fruit. Sepals $6-15 \mathrm{~mm}$; petals $20-30 \times$ $3-5 \mathrm{~mm}$, brownish- or yellowish-purple. Siliqua $85-180 \times 2$ 4 mm , erecto-patent, compressed; stigma capitate, as wide as or wider than siliqua, without conspicuous horns. N.E. Bulgaria; Krym. Bu Rs (K). (Caucasus, Iran.)
4. M. tatarica (Pallas) DC., Reg. Veg. Syst. Nat. 2: 170 (1821). Like 3 but the stem glabrescent to grey-tomentose; leaves irregularly serrate or incised; pedicels $2-3(-5) \mathrm{mm}$ in fruit; siliqua 50 $150 \times 2-3 \mathrm{~mm}$, glabrous or sparsely pubescent; stigma narrower than siliqua. S.E. Russia, W. Kazakhstan. Rs (E).
5. M. fragrans (Fischer) Bunge, Del. Sem. Horti Dorpat. 8 (1839). Glabrescent to grey-tomentose perennial $20-50 \mathrm{~cm}$, woody at base. Leaves subentire to sinuate-pinnatisect. Pedicels $3-8(-18) \mathrm{mm}$ in fruit. Sepals $10-12 \mathrm{~mm}$; petals $18-25 \times 2.5-$ $3(-4) \mathrm{mm}$, pale purplish-yellow. Siliqua $75-130 \times 2 \cdot 5-3 \mathrm{~mm}$, erecto-patent, compressed; stigma conical, narrower than siliqua, without horns. S. Ukraine to W. Kazakhstan. Rs (W, E).
6. M. fruticulosa (L.) Maire in Jahandiez \& Maire, Cat. Pl. Maroc 2: 311 (1932) (M. tristis R.Br., Cheiranthus fruticulosus L.). Sparsely pubescent to densely white-tomentose perennial up to 60 cm , woody at base. Leaves linear or oblong, entire to sinuate-pinnatifid. Pedicels $0-3(-8) \mathrm{mm}$ in fruit. Sepals 614 mm ; petals $12-28 \mathrm{~mm}$, yellow to purple-red. Siliqua $25-120 \times$ $1-2(-3) \mathrm{mm}$, more or less cylindrical; stigma without horns or with horns up to 3 mm long. S. Europe. Al Bl Bu Ga Gr He Hs It Ju Lu Si Tu.
[^109]1 Siliqua 2-3 mm in diameter; valves 3 - to 5 -veined
(c) subsp. perennis

1 Siliqua 1-2 mm in diameter; valves 1 - to 3 -veined
2 Siliqua patent or deflexed, eglandular; plant with branched stock, lax
(a) subsp. fruticulosa

2 Siliqua $\pm$ erect with yellow glandular hairs; plant caespitose
(b) subsp. valesiaca
(a) Subsp. fruticulosa (incl. M. varia (Sibth. \& Sm.) DC. pro parte): Throughout the range of the species except the Alps.
(b) Subsp. valesiaca (Gay ex Gaudin) P. W. Ball, Feddes Repert. 66: 157 (1962) (M. varia DC. pro parte): S. Alps, Pyrenees, N. \& E. Spain, Balkan peninsula.
(c) Subsp. perennis (P. Conti) P. W. Ball, Feddes Repert. 66: 157 (1962) (M. perennis P. Conti): N. Spain (Picos de Europa).
7. M. longipetala (Vent.) DC., Reg. Veg. Syst. Nat. 2: 174 (1821). Annual, rarely persisting a further year, up to 50 cm . Lower leaves sinuate-dentate to pinnatifid. Lower pedicels not more than 3 mm in fruit. Sepals $8-12 \mathrm{~mm}$; petals $15-25 \times 2-$ 7 mm ; nectaries filiform. Siliqua (30-)50-150×1-2(-2.5) mm , cylindrical; horns (1-)2-10 mm. C. \& S. Greece, S. Aegean region; S. Ukraine. Gr Rs (W, K).
1 Siliqua $30-60 \times 1.5-2.5 \mathrm{~mm}$, erect or erecto-patent; horns $1-4 \mathrm{~mm}$, obtuse
(c) subsp. pumilio

1 Siliqua (50-)70-150×1-2 mm, erecto-patent to defiexed; horns $2-10 \mathrm{~mm}$, acute
2 Petal-limb 2-4 mm wide, yellowish; horns usually patent or recurved (a) subsp. longipetala
2 Petal-limb 3-7 mm wide, pink or purple; horns curved upwards
(b) subsp. bicornis
(a) Subsp. longipetala (M. oxyceras DC., Cheiranthus longipetalus Vent.): S. Ukraine.
(b) Subsp. bicornis (Sibth. \& Sm.) P. W. Ball, Feddes Repert. 68: 194 (1963) (M. bicornis (Sibth. \& Sm.) DC.): C. \& S. Greece, S. Aegean region.
(c) Subsp. pumilio (Sibth. \& Sm.) P. W. Ball, Feddes Repert. loc. cit. (1963) (M. pumilio (Sibth. \& Sm.) DC.) : S. Aegean region (once recorded from Sikinos). (Rodhos.)
8. M. lunata DC., Reg. Veg. Syst. Nat. 2: 176 (1821). Annual, $10-50 \mathrm{~cm}$. Leaves sinuate-dentate to entire. Pedicels up to 4 mm in fruit. Sepals $6-12 \mathrm{~mm}$; petals ( $12-$ ) $15-25 \times 3-6 \mathrm{~mm}$, oblongobovate, purple; nectaries very small. Siliqua $30-70 \times 1-2 \mathrm{~mm}$, cylindrical, patent or deflexed, torulose; horns $2-4 \mathrm{~mm}$, subobtuse, curved upwards. S. Spain. Hs.
9. M. parviflora (Schousboe) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 121 (1812). Annual up to 20 cm . Lower leaves sinuatedentate to pinnatisect. Sepals $4-6 \mathrm{~mm}$; petals $6-10(-12) \times 1-$ 2 mm , purple or brownish-purple; nectaries very small. Siliqua $25-70 \times 1.5-2 \mathrm{~mm}$, slightly torulose; horns $1-5 \mathrm{~mm}$, straight, acute. S. Spain, S. Portugal, Islas Baleares. Bl Hs Lu.
10. M. tricuspidata (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 120 (1812). Annual $7-40 \mathrm{~cm}$. Leaves sinuate-crenate to pinnatisect, the lobes ovate, rounded at apex. Lower pedicels $2-5 \mathrm{~mm}$ in fruit. Sepals $7-11 \mathrm{~mm}$; petals $15-22 \mathrm{~mm}$, purple. Siliqua $25-100 \times 2-3 \mathrm{~mm}$, patent or deflexed, cylindrical; stigma-lobes connate to form a third horn, the 3 horns equal, $2-6 \mathrm{~mm}$, triangular, acute. Mediterranean region. Bl Co Cr Ga Gr Hs It Sa Tu .

## 30. Notoceras R.Br. ${ }^{1}$

Annual; hairs medifixed. Sepals erecto-patent, not saccate; petals white, not clawed. Fruit a short, tardily dehiscent siliqua
with 2 horns at the apex; valves keeled or narrowly winged; style distinct; stigma capitate. Seeds in 1 row in each loculus.

1. N. bicorne (Aiton) Amo, Fl. Iber. 6: 536 (1873). Procumbent or erect, up to 30 cm . Leaves lanceolate or linear-lanceolate, entire. Racemes short, dense, leaf-opposed; pedicels up to 2 mm in fruit, stout. Siliqua $4-6 \times$ c. 1.5 mm , erect; valves torulose; horns 0.5-1 mm. Dry places. S.E. Spain. Hs. (N. Africa; S.W. Asia.)

## 31. Tetracme Bunge ${ }^{1}$

Annuals; hairs branched. Sepals patent, not saccate; petals yellow, clawed. Fruit a siliqua with 4 horns at the apex; valves 3 -veined; style very short; stigma more or less capitate. Seeds in 1 row in each loculus.

1. T. quadricornis (Willd.) Bunge, Del. Sem. Horti Dorpat. 8 (1836). Grey-tomentose, $5-20 \mathrm{~cm}$. Leaves linear-oblong, entire or remotely dentate. Pedicels $1-1.5 \mathrm{~mm}$ in fruit, clavate. Siliqua $6-10 \times 1-1.5 \mathrm{~mm}$, outwardly and downwardly curved, torulose; horns $0.5-2.5 \mathrm{~mm}$, divergent. S.E. Russia; rarely as a casual elsewhere. Rs (E). (C. Asia.)

## 32. Diptychocarpus Trautv. ${ }^{1}$

Annual; hairs unbranched. Sepals erect, the inner saccate at base; petals white or purplish, not clawed. Fruits dimorphic: the upper siliquae dehiscent, compressed, with winged seeds; the lower siliquae indehiscent, articulated, with the seeds not winged; style distinct; stigma 2-lobed.

1. D. strictus (Fischer) Trautv., Bull. Soc. Nat. Moscou 33 (1): 108 (1860). $10-50 \mathrm{~cm}$, sparsely pubescent. Leaves linear to oblong, the basal dentate to pinnatisect. Petals $7-10 \mathrm{~mm}$, linear. Upper siliquae $35-80 \times 2.5-4 \mathrm{~mm}$, obtuse, with style $3-5 \mathrm{~mm}$; lower siliquae $25-60 \times 2.5-4 \mathrm{~mm}$, fleshy, gradually attenuate into the style. Saline soils. W. Kazakhstan. Rs (E). (C. \& S.W. Asia.)

## 33. Chorispora R.Br. ex DC. ${ }^{1}$

Annual; hairs glandular, and sometimes also eglandular, branched or unbranched. Sepals erect, the inner saccate at base; petals purple, clawed. Fruit an articulated siliqua, breaking into 2 -seeded segments; style at least $\frac{1}{2}$ as long as the rest of the siliqua; stigma 2 -lobed. Seeds in 1 row in each loculus.

1. C. tenella (Pallas) DC., Reg. Veg. Syst. Nat. 2: 435 (1821). $10-60 \mathrm{~cm}$, with sparse glandular and sometimes longer unbranched and branched, eglandular hairs. Leaves lanceolate, entire or serrate, the lower often pinnatifid. Petals $10-12 \mathrm{~mm}$, entire. Siliqua $15-30 \times 2-3 \mathrm{~mm}$ (excluding beak), more or less cylindrical, torulose; beak $15-30 \mathrm{~mm}$. S.E. Europe; casual elsewhere. $\mathrm{Bu} \mathrm{Rm} \mathrm{Rs}(\mathrm{C}, \mathrm{W}, \mathrm{K}, \mathrm{E})$.

## 34. Euclidium R.Br. ${ }^{1}$

Annual; hairs of two kinds, branched and unbranched. Sepals erecto-patent, not saccate; petals white, not clawed. Fruit an indehiscent, 2 -seeded silicula, longitudinally 4 -veined; style long; stigma 2 -lobed.

1. E. syriacum (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 74 (1812). $10-40 \mathrm{~cm}$, densely grey-pubescent throughout. Leaves

[^110]lanceolate to ovate-oblong, sinuate-dentate, the basal often pinnatifid. Petals c. 1 mm , emarginate. Silicula $2 \cdot 5-4 \mathrm{~mm}$, obliquely ellipsoidal or ovoid; style $1-2 \mathrm{~mm}$. E. \& E.C. Europe, rarely casual elsewhere. $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Hu} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}$, W, K, E).

## 35. Litwinowia Woronow ${ }^{1}$

Like Euclidium but all the hairs unbranched; inner sepals slightly saccate at base; silicula compressed, longitudinally 6 -veined; stigma subentire.

1. L. tenuissima (Pallas) Woronow ex Pavlov, Fl. Centr. Kazahstana 2: 302 (1935). Slender hispid annual $10-30 \mathrm{~cm}$. Leaves linear- or oblong-lanceolate, the basal dentate to lyratepinnatisect. Petals $2 \cdot 5-5 \mathrm{~mm}$, entire. Silicula $2 \cdot 5-3 \times 2 \cdot 5-3 \mathrm{~mm}$, broadly obovate or almost orbicular, glabrous, with the 6 veins in two lateral groups of 3 which diverge from the base; style 2-3 mm, often persistent. Steppes. S.E. Russia. Rs (E). (W. \& C. Asia.)

## 36. Barbarea R.Br. ${ }^{1}$

Biennial to perennial herbs; glabrous or with unbranched hairs. Leaves pinnatifid or pinnatisect, the cauline amplexicaul. Inner sepals slightly saccate at base; petals yellow, clawed. Fruit a siliqua, 4 -angled; valves usually with a strong median vein and reticulate lateral veins; style distinct; stigma slightly 2 -lobed. Seeds in 1 row in each loculus.

All species occur usually in wet or damp habitats.
1 Inflorescence bracteate, at least in the lower half
7. bracteosa

1 Inflorescence $\pm$ completely ebracteate
2 Infructescence corymbose (Balkan peninsula)
3 Valves of siliqua with distinct median vein; petals c. 5 mm 9. conferta

3 Valves of siliqua without median vein; petals $7-8 \mathrm{~mm}$
10. balcana

2 Infructescence elongate, racemose
4 Siliqua with patent hairs; style (2-)3-5 mm 11. Iongirostris
4 Siliqua glabrous; style usually less than 3 mm
5 Uppermost leaves simple, dentate
6 Style 2-3 mm in fruit; buds glabrous

1. vulgaris

6 Style $0.5-1.5 \mathrm{~mm}$ in fruit; buds pubescent 2. stricta 5 Uppermost leaves pinnatifid or pinnatisect 7 Siliqua not more than 20 mm
8 Basal leaves simple; style $c .3 \mathrm{~mm}$ in fruit vide 2. stricta
8 Basal leaves pinnatisect with at least 1 pair of distinct lateral lobes; style 1-2 mm in fruit
9 Pedicels 3-5 mm in fruit, not more than $\frac{1}{4}$ of the length of siliqua; siliqua $c .2 \mathrm{~mm}$ in diameter; style $1-1.5 \mathrm{~mm}$ in fruit 4. intermedia
9 Pedicels $4-8 \mathrm{~mm}$ in fruit, $\frac{1}{4}-\frac{1}{\frac{1}{2}}$ of the length of the siliqua; siliqua $1-1.5 \mathrm{~mm}$ in diameter; style $1.5-2 \mathrm{~mm}$ in fruit
5. sicula

7 Siliqua more than 20 mm
10 Petals $7-10 \mathrm{~mm}$; lower leaves with 0-2 pairs of lateral segments
8. rupicola

10 Petals $5-7 \mathrm{~mm}$; lower leaves with 2 or more pairs of lateral segments
11 Basal leaves with 6-10 pairs of lateral segments; siliqua $30-70 \mathrm{~mm}$ 3. verna
11 Basal leaves with 2-5 pairs of lateral segments; siliqua $10-40 \mathrm{~mm}$
12 Style $1-1.5 \mathrm{~mm}$ in fruit; pedicels $3-5 \mathrm{~mm}$ long, as thick as the siliqua 4. intermedia
12 Style $2-3.5 \mathrm{~mm}$ in fruit; pedicels $4-6 \mathrm{~mm}$ long, much thinner than the siliqua
6. bosniaca

1. B. vulgaris R.Br. in Aiton, Hort. Kew. ed. 2, 4: 109 (1812) (incl. B. arcuata (Opiz ex J. \& C. Presl) Reichenb.). Glabrous
biennial or perennial up to 100 cm . Basal leaves with 2-5 pairs of lateral lobes; uppermost leaves simple, dentate. Pedicels $4-6 \mathrm{~mm}$ in fruit, thin. Buds glabrous; petals $5-7 \mathrm{~mm}$. Siliqua $15-30 \times$ $1-2 \mathrm{~mm}$; valves with distinct median vein; style $2-3 \mathrm{~mm} .2 n=16$. Throughout Europe except for some islands. All except Az Bl Cr Fa Sa Sb ; introduced in Is.
B. macrophylla Halácsy, Verh. Zool.-Bot. Ges. Wien 49: 130 (1899), from E. Greece (Pilion), with very large basal leaves with the terminal lobe up to 10 cm wide and pedicels almost as thick as the siliqua, which is $25-40 \times 1 \cdot 5-2 \mathrm{~mm}$, is probably only a variant of 1 .
2. B. stricta Andrz. in Besser, Enum. Pl. Volhyn. 72 (1822). Glabrous biennial up to 100 cm . Basal leaves with $1-2$ pairs of lateral lobes; uppermost leaves simple, sinuate-dentate. Pedicels $3-5 \mathrm{~mm}$ in fruit, stout. Buds pubescent; petals $3 \cdot 5-6 \mathrm{~mm}$. Siliqua $18-30 \times 1 \cdot 5-2 \mathrm{~mm}$; valves with distinct median vein; style $0.5-1.5 \mathrm{~mm}$. C., E. \& N. Europe; introduced elsewhere and of uncertain status in a number of countries. $\mathrm{Au} * \mathrm{Br} \mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Fe}$ Ge *Ho Hu It Ju No Po Rm Rs (N, B, C, W, E) Su [Ga Hb].
B. lepuznica E. I. Nyárády, Bul. Grăd. Bot. Cluj 14: 97 (1934), from Romania (Munţii Retezatului), is probably a variant of 2. It has the upper leaves pinnatifid, pedicels $6-8 \mathrm{~mm}$ in fruit, siliqua $15-20 \mathrm{~mm}$, and style c. 3 mm .
3. B. verna (Miller) Ascherson, Fl. Brandenb. 1: 36 (1860) (B. praecox (Sm.) R.Br.). Glabrous or sparsely pubescent biennial up to 75 cm . Basal leaves with $6-10$ pairs of lateral lobes; uppermost leaves pinnatifid. Pedicels $4-8 \mathrm{~mm}$ in fruit, stout. Petals $5-7 \mathrm{~mm}$. Siliqua $30-70 \times 1 \cdot 5-2 \mathrm{~mm}$; valves with distinct median vein; style $1-2 \mathrm{~mm}$. S.W. Europe; frequently introduced elsewhere. Az Co Ga Hs It Lu Sa [?Au Be Br Da Hb He Ho ].
4. B. intermedia Boreau, Fl. Centr. Fr. 2: 48 (1840). Glabrous or sparsely pubescent biennial up to 60 cm . Basal leaves with 3-5 pairs of lateral lobes; uppermost leaves pinnatifid. Pedicels $3-5 \mathrm{~mm}$ in fruit, stout. Petals $5-6 \mathrm{~mm}$. Siliqua $10-30 \times 2 \mathrm{~mm}$; valves with distinct median vein; style $1-1.5 \mathrm{~mm} . S . \& C$. Europe from S. Germany to N. Portugal and S. Jugoslavia; frequently introduced elsewhere. Au Ga Ge Hs It Ju Lu [Be Br Da Hb He Ho ].
5. B. sicula C. Presl in J. \& C. Presl, Del. Prag. 17 (1822). Like 4 but smaller (up to 40 cm ); basal leaves with (1-)2-4 pairs of lateral lobes; pedicels $4-8 \mathrm{~mm}$ in fruit, thin; siliqua $12-20 \times$ $1-1.5 \mathrm{~mm}$; style $1.5-2 \mathrm{~mm}$. ? S. Italy and Sicilia; doubtfully in Greece and Corse. ?Co ?Gr It Si.

Often confused with 4 but, although very similar, it appears to be distinct. The plants from Corse and Greece may be more correctly placed in 4.
6. B. bosniaca Murb., Lunds Univ. Arsskr. 27: 169 (1891). Like 4 but the pedicels $4-6 \mathrm{~mm}$ in fruit, slender; valves of the siliqua without a median vein; style 2-3.5 mm. C. Jugoslavia (Bosna). Ju.
7. B. bracteosa Guss., Fl. Sic. Prodr. 2: 257 (1828). Glabrous biennial or perennial up to 50 cm . Lower leaves with 2-4 pairs of lateral lobes; upper leaves pinnatifid. Racemes bracteate at least in the lower half; pedicels $2-4(-6) \mathrm{mm}$ in fruit. Petals $c$. 4 mm . Siliqua $15-30 \times 1-2 \mathrm{~mm}$; valves with distinct median vein;

[^111]style 1-2 mm. Italy, Sicilia; Balkan peninsula (mainly in the west); ?S.E. France. Al Bu ?Ga Gr It Ju Si.
8. B. rupicola Moris, Stirp. Sard. 1: 55 (1827). Glabrous perennial up to 45 cm . Lower leaves simple or with up to 2 pairs of lateral lobes; upper leaves pinnatifid. Pedicels 612 mm in fruit. Petals $7-10 \mathrm{~mm}$. Siliqua $30-60(-90) \times 1.5-$ 2.5 mm ; style $1-2 \mathrm{~mm} .2 n=16$. Corse, Sardegna. Co Sa.
9. B. conferta Boiss. \& Heldr. in Boiss., Fl. Or. suppl., 36 (1888). Glabrous biennial up to 30 cm . Upper leaves pinnatifid. Infructescence corymbose; pedicels $2-4 \mathrm{~mm}$. Petals c. 5 mm . Siliqua $24-30 \mathrm{~mm}$; valves with distinct median vein; style 23 mm . Mountains of C. \& S. Greece (Killini, Peristeri). Gr.
10. B. balcana Pančić, Srpska Kralj. Bot. Bašt. Beograd 1888: 6 (1888). Glabrous perennial up to 70 cm . Basal leaves with 0-2 pairs of lateral leaflets; upper leaves pinnatifid. Infructescence corymbose; pedicels $6-8 \mathrm{~mm}$. Petals $7-8 \mathrm{~mm}$. Siliqua $15-25 \times$ $1.5-2 \mathrm{~mm}$; valves without median vein; style $2-4 \mathrm{~mm}$. Mountains of Bulgaria, C. Jugoslavia and N. Albania. Al Bu Ju.
11. B. longirostris Velen., Sitz.-ber. Böhm. Ges. Wiss. 29: 1 (1898). Perennial up to 50 cm , hirsute. Basal leaves with 2-3 pairs of lateral lobes; upper pinnatifid. Pedicels $4-6 \mathrm{~mm}$ in fruit. Petals 6-9 mm. Siliqua $10-20 \times 1 \cdot 5-2 \mathrm{~mm}$, hirsute; style (2-)35 mm . Bulgaria, Macedonia, Albania. Al Bu Ju.

## 37. Sisymbrella Spach ${ }^{1}$

Annual to short-lived perennial herbs; glabrous or with unbranched hairs. Leaves lyrate to pinnatisect. Inner sepals saccate at base; petals yellow or white. Fruit a siliqua, attenuate at apex; valves without distinct median vein; style distinct; stigma capitate. Seeds in 1 or 2 rows in each loculus.

Differs from Nasturtium and Rorippa in the attenuate siliqua and in the seeds becoming mucilaginous when moistened.

Literature: V. H. Heywood, Bull. Brit. Mus. (Bot.) 1: 106-10 (1954). R. Virot, Cahiers Nat. Paris nov. ser. 15: 89-96 (1959).

## Petals white; stems with unbranched hairs, smooth Petals yellow; stems $\pm$ glabrous or scabrid <br> 1. dentata

1. S. dentata (L.) O. E. Schulz in Engler, Pflanzenreich 86 (IV. 105): 144 (1924). Stems with unbranched hairs. Leaves lyrate to deeply pinnatifid, the terminal lobe longer than the laterals. Petals white. Siliqua $50-60 \mathrm{~mm}$; pedicels short, thick. Seeds in 1 row in each loculus. - S. Italy (Calabria), Sicilia. It Si.
2. S. aspera (L.) Spach, Hist. Vég. (Phan.) 6: 426 (1838) (Nasturtium asperum (L.) Boiss.). Stems smooth or scabrid with white tubercles. Leaves pectinate-pinnatisect. Petals yellow. Siliqua $15-40 \mathrm{~mm}$; pedicels long or short. Seeds in 1 or 2 rows in each loculus. S.W. Europe. Ga Hs Lu.

The various characters used to recognize this species appear in different combinations, but can be used to give a fairly good pattern of geographical subspecific differentiation.
Seeds in 1 row in each loculus
(d) subsp. pseudoboissieri
1 Seeds in 2 rows in each loculus
2. Petals $7-12 \mathrm{~mm}$; pedicels ( $8-$ ) $10-12(-15) \mathrm{mm}$; siliqua $25-$ 45 mm
(c) subsp. boissieri

2 Petals 3-7 mm; pedicels 3-8(-10) mm; siliqua 15-25(-30) mm
3 Siliqua $15-20(-26) \times 2-2.5 \mathrm{~mm}$, relatively thick and short, narrowing from below the middle to the apex, $\pm$ scabrid as are the stems
(a) subsp. aspera

3 Siliqua $25-30 \times 1.7 \mathrm{~mm}, \pm$ linear, slightly attenuate at the apex, almost entirely smooth
(b) subsp. praeterita
(a) Subsp. aspera: Moist, sandy soil, often near streams. Most of Spain except the south; Portugal; S. \& W. France.
Highly polymorphic in Spain where populations are largely intermediate between (a) and (b).
(b) Subsp. praeterita Heywood, Feddes Repert 69: 143 (1964) (Sisymbrium laevigatum Willd.): Alluvial gravels and damp soils. - Pyrenees and S.W. France.
(c) Subsp. boissieri (Cosson) Heywood, Bull. Brit. Mus. (Bot.) 1 : 107 (1954) (Nasturtium boissieri Coss.): Damp grassy or rocky places, usually in mountains. S. Spain; Portugal (around Lisboa).
(d) Subsp. pseudoboissieri (Degen) Heywood, op. cit. 108 (1954) (Sisymbrium pseudoboissieri Degen): Damp turf and near streams, on calcareous soil in mountains. - S.E. Spain (Sierra de Cazorla).

## 38. Rorippa Scop. ${ }^{1}$

Annual to perennial herbs; glabrous or with unbranched hairs. Leaves simple to pinnate. Inner sepals saccate at base; petals yellow. Fruit a short siliqua or a silicula; valves veinless or with a weak median vein; style short; stigma slightly 2 -lobed. Seeds more or less in 2 rows in each loculus.
1 Petals shorter than or equalling sepals
2 Inflorescence with numerous branches, forming a corymb

2 Inflorescence not corymbose
6. prolifera

1 Petals longer than sepals
3 Leaves entire, with conspicuous auricles
3 Leaves $\pm$ divided, or without conspicuous auricles
4 Cauline leaves usually entire; fruits ovoid, less than half as long as the pedicel
2. amphibia

4 Cauline leaves $\pm$ divided
5 Basal leaf-rosette present at flowering time; cauline leaves usually auricled
6 Fruits 3-6 mm, broadly ellipsoidal 8. pyrenaica 6 Fruits more than 6 mm , lanceolate or linear-lanceolate
7 Fruits more than 10 mm , linear-lanceolate; petals $4-5 \mathrm{~mm}$
9. lippizensis

7 Fruits 6-10 mm, narrowly lanceolate; petals 2-2.5 mm
10. thracica

5 Basal leaf-rosette withered at flowering time; cauline leaves not or only slightly auricled
8 Fruits 3 mm , ellipsoidal or almost spherical 7. brachycarpa
8 Fruits more than 5 mm , often linear
9 Fruits $5-6 \mathrm{~mm}$; upper leaves $\pm$ sessile, not very deeply divided, sometimes entire 3. prostrata 9 Fruits usually more than 6 mm ; upper leaves petiolate, pinnate or pinnatifid
4. sylvestris

1. R. austriaca (Crantz) Besser, Enum. Pl. Volhyn. 103 (1822). Perennial $30-90 \mathrm{~cm}$, stoloniferous, more or less glabrous. Leaves elliptical, simple, irregularly toothed; the lower shortly petiolate, the upper sessile, deeply cordate and auriculate-amplexicaul. Petals slightly longer than sepals. Silicula $1 \cdot 5-3 \mathrm{~mm}$, globose; pedicels $7-15 \mathrm{~mm}$, slender; style about as long as silicula. $2 n=16$. C. \& E. Europe; frequently naturalized or casual further west. Au Bu Cz Ge Hu Ju Po Rm Rs (B, C, W, K, E) Tu [Be Br Da Ga Ge He Ho It No Su].
2. R. amphibia (L.) Besser, op. cit. 27 (1822) (Nasturtium amphibium (L.) R.Br.). Perennial $40-120 \mathrm{~cm}$, often stoloniferous, usually glabrous. Lower leaves shortly petiolate, very variable in shape, entire, toothed or pinnatifid, sometimes pectinate; the upper sessile, lanceolate, usually without auricles, entire or

[^112]irregularly toothed. Petals about twice as long as sepals. Silicula $3-6 \times 1-3 \mathrm{~mm}$, ovoid, straight; pedicels $6-17 \mathrm{~mm}$, horizontal or deflexed; style $1-2 \mathrm{~mm} .2 n=16,32$. Wet places. Most of Europe except the extreme north, but rare in the Mediterranean region. All except Al Az Bl Cr Fa Is Sa Sb .
3. R. prostrata (J. P. Bergeret) Schinz \& Thell., Viert. Naturf. Ges. Zürich 58: 62 (1913) (Nasturtium anceps (Wahlenb.) Reichenb.). Perennial $30-90 \mathrm{~cm}$. Leaves very variable, petiolate, coarsely lyrate-pinnatifid with lanceolate segments; the upper more or less sessile, less deeply divided, sometimes broadly lanceolate, entire, and variably lobed or toothed. Petals $c$. 4 mm , exceeding the sepals. Silicula $5-6 \mathrm{~mm}$, variable, usually narrowly ellipsoidal or linear-lanceolate, horizontal or ascending, slightly curved, compressed, sometimes imperfect or with few seeds; pedicels as long as fruit or somewhat longer; style $1-2 \mathrm{~mm}$. $C . \& E$. Europe and locally in the west and south. Au Cz Fe Ga Ge He Ho Hu It Ju Lu Po Rm Rs (C, W, K, E) Su [Be Br].
R. prostrata is more or less intermediate between 2 and 4 , and is generally considered to be of hybrid origin, though it sometimes occurs in the absence of one of the parents. It comprises a series of variants which range from those near R. amphibia at one end to those near R. sylvestris at the other (e.g. R. sylvestris subsp. stenocarpa (Godron)). It is however recorded as a species in many parts of Europe and is therefore given specific rank here. It may well consist of a mixture of first-cross and backeross hybrids of varying degrees of fertility, and may also include fertile allopolyploid derivatives.
4. R. sylvestris (L.) Besser, Enum. PI. Volhyn. 27 (1822) (Nasturtium sylvestre (L.) R.Br.). Perennial $20-50 \mathrm{~cm}$, stoloniferous, more or less glabrous. Leaves petiolate, pinnate (or pinnatifid); segments lanceolate, often toothed or lobed. Petals $4-5 \mathrm{~mm}$, twice as long as sepals. Siliqua $6-18 \mathrm{~mm}$, more or less ascending; pedicels horizontal or slightly deflexed; style $0.5-$ 1 mm . Almost throughout Europe. All except Az Bl Co Fa Sa Sb Si ; introduced in Is.
(a) Subsp. sylvestris: Leaf-segments toothed or lobed, those of the lower leaves often broadly lanceolate, those of the upper leaves narrower. Siliqua $8-18 \mathrm{~mm}$, linear, sometimes curved. $2 n=48$. Throughout the range of the species.
(b) Subsp. kerneri (Menyh.) Soó in Soó \& Javorka, Magyar Növ. Kéz. 2: 620 (1951): Leaf-segments entire, those of lower leaves oblanceolate, those of upper leaves linear-lanceolate. Siliqua 6-9mm, ellipsoid. Saline habitats. C.\&S.E. Europe.

This subspecies may be regarded as a saline ecotype; in cultivation it reverts to some extent to subsp. sylvestris. It has often been recorded as 7 , from which it is quite distinct.
5. R. islandica (Oeder) Borbás, Balaton Tav. Part. 2: 392 (1900) (Nasturtium palustre (L.) DC., non Crantz, Rorippa palustris (L.) Besser). Annual or biennial $10-60 \mathrm{~cm}$, more or less glabrous. Lower leaves petiolate, lyrate-pinnatifid with 3-6 irregularly toothed segments and a lobed or dentate terminal segment; upper leaves more or less sessile, with slight auricles, pinnatifid to entire. Petals $1-2 \mathrm{~mm}$, pale yellow, equalling or shorter than sepals. Siliqua $4-7(-9) \times c$. 2 mm , slightly curved, shortly cylindrical to oblong-ellipsoidal, about as long as the pedicel; styles $0 \cdot 5-1 \mathrm{~mm} .2 n=16,32$. Most of Europe, but less frequent in the Mediterranean region. Au Be Br Bu Cz Da Fa Fe Ga Ge Hb He Ho Hs Hu Is It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Su.
6. R. prolifera (Heuffel) Neilr., Aufz. Ung. Slav. Gefäss. 263 (1866). Annual or biennial $40-60 \mathrm{~cm}$. Leaves pinnate with 2-4
pairs of oblong-lanceolate segments which are coarsely toothed to entire. Racemes short, branched, numerous, forming a corymb. Petals 3 mm , equalling or slightly exceeding calyx. Siliqua 3-8 mm, linear or oblong-linear, about half as long as the pedicel; style about $\frac{1}{3}$ as long as the siliqua. Balkan peninsula, Romania. Al Bu Gr Ju Rm.

In addition to 3, at least ten other hybrids involving 1-6 have been recorded from Europe, and some are treated as species in Floras; their nomenclature is extensive and confused. Probably the most important are R. $\times$ astyla (Reichenb.) Reichenb. ( $R$. islandica $\times$ sylvestris), and $\mathbf{R} . \times$ armoracioides (Tausch) Fuss ( $R$. austriaca $\times$ sylvestris). Both are generally intermediate between the parents and reduced fertility is sometimes evident, though the fact that in both cases specimens resembling more strongly one or other of the parents are recorded suggests that the hybrids are partially fertile. A thorough investigation of these and other Rorippa hybrids is much needed.
7. R. brachycarpa (C. A. Meyer) Hayek, Prodr. Fl. Penins. Balcan. 1: 390 (1925), quoad syn. excl. descr. Annual or biennial c. 30 cm , erect, glabrous. Leaves lyrate-pinnate with 4-5 pinnae; upper leaves pinnate, segments linear, entire. Fruits c. $3 \times$ 1.5 mm , ellipsoidal, or almost globose; pedicels $5-10 \mathrm{~mm}$; style c. 1 mm . C., S. \& E. Russia, Ukraine. Rs (C, W, E).

This species appears to be absent from C. Europe and the Balkan peninsula, where 4 (b) has possibly been confused with it.
8. R. pyrenaica (Lam.) Reichenb., Icon. Fl. Germ. 2: 15 (1837) (Nasturtium pyrenaicum (Lam.) R.Br.). Perennial $5-40 \mathrm{~cm}$, shortly pubescent at base. Lower leaves in a rosette, with long petiole, ovate, entire, or lyrate-pinnate with roundish segments; cauline leaves more or less sessile, with narrow, amplexicaul auricles, pinnate with $2-8$ pairs of linear segments. Petals 34 mm . Fruits $2 \cdot 5-6 \mathrm{~mm} \times 1 \cdot 5-2 \mathrm{~mm}$, ellipsoidal, varying in shape, shorter than or equalling the pedicels; style $0.7-2 \mathrm{~mm} .2 n=16$.

- C. \& S. Europe, northwards to C. France. Al Bu Cz Ga Ge Gr He Hs It Ju Rm [Be].

A rather variable species as regards shape of capsule and length of style; it includes prol. microcarpa Rouy \& Fouc., Fl. Fr. 2: 198 (1895) (France), with subglobose fruits, and R. hispanica (Boiss. \& Reuter) Willk., Prodr. Fl. Hisp. 3: 845 (1880) (Spain and Pyrenees), with subcylindrical fruits equalling the pedicels.
9. R. lippizensis (Wulfen) Reichenb., Icon. Fl. Germ. 2: 15 (1837). Perennial $10-20 \mathrm{~cm}$, shortly pubescent at the base. Lower leaves in a rosette, with long petioles, orbicular-ovate, entire, or pinnatifid with 1-4 pairs of narrow lateral segments and a large terminal segment; cauline leaves sessile, with narrow amplexicaul auricles, pinnatifid, with 1-4 pairs of linear to lanceolate segments. Petals $4-5 \mathrm{~mm}$. Fruits ( $10-$ ) $12-20 \times 1 \mathrm{~mm}$, linear-lanceolate, longer than the ascending or erect pedicels; style $0.5-1 \cdot 5 \mathrm{~mm}$. $2 n=32$. Balkan peninsula and N.W. Jugoslavia. Al Bu Ju.
10. R. thracica (Griseb.) Fritsch, Verh. Zool.-Bot. Ges. Wien 44: 316 (1894). Perennial $15-40 \mathrm{~cm}$, shortly pubescent at the base; stem erect, somewhat branched above. Lower leaves in a rosette, petiolate, all lyrate-pinnatifid with an orbicular terminal lobe and few or no lateral segments; upper cauline leaves auriculate, with $4-8$ pairs of narrowly linear segments. Petals $2-2 \cdot 5 \mathrm{~mm}$. Fruits $6-10 \times 2 \mathrm{~mm}$, narrowly lanceolate; pedicels patent; style 2 mm . - Balkan peninsula. Bu Ju Gr Tu.
${ }^{2}$ By D. H. Valentine.

8-10 form a closely related group of species, with partially overlapping geographical distributions. Hybrids between them have not been recorded. Their status and relationship need further investigation.

## 39. Armoracia Gilib. ${ }^{1}$

Perennial herbs; glabrous. Leaves simple to pinnatifid. Sepals not saccate; petals white, shortly clawed. Fruit a subglobose to ellipsoidal silicula; valves weakly reticulate-veined; style short; stigma capitate to slightly 2 -lobed. Seeds in 2 rows in each loculus.
Silicula $4-6 \mathrm{~mm}$; seeds usually $4-6$ in each loculus

1. rusticana Silicula $10-15 \mathrm{~mm}$; seeds $c .10$ in each loculus
2. macrocarpa
3. A. rusticana P. Gaertner, B. Meyer \& Scherb., Fl. Wett. 2: 426 (1800) (A. lapathifolia Gilib., Cochlearia armoracia L.). Plant with stout branched stock and fleshy fusiform roots. Stems up to 1 m or more. Basal leaves $30-50 \mathrm{~cm}$, ovate or ovate-oblong, crenate-serrate; petiole up to 30 cm . Cauline leaves sessile or shortly petiolate, the lower often pinnatifid, the upper serrate or entire. Petals $5-7 \mathrm{~mm}$. Silicula $4-6 \mathrm{~mm}$, globose or ovoid; seeds 4-6 in each loculus. $2 n=32$. Cultivated for culinary purposes and now widely naturalized or casual throughout most of Europe; probably native in S. Russia \& E. Ukraine. Rs (C, W, E) [Au Be Br Cz DaFe Ga Ge Hb He Ho Hs Hu It Ju No Po Rm Su Tu].
4. A. macrocarpa (Waldst. \& Kit.) Kit. ex Baumg., Enum. Stirp. Transs. 2: 240 (1816). Like 1 but the basal leaves usually entire; cauline leaves lanceolate, the lower serrate, the upper crenate; silicula $10-15 \mathrm{~mm}$, ovoid or ellipsoidal; seeds c. 10 in each loculus. Marshes. C. Danube basin. Hu Ju ?Rm.

## 40. Nasturtium R.Br. ${ }^{2}$

Perennial herbs; glabrous or with few unbranched hairs. Leaves pinnate to pinnatisect. Inner sepals saccate; petals white, rarely pale purplish. Fruit a siliqua; valves with weak median vein; style short; stigma capitate, slightly 2 -lobed. Seeds in 1-2 rows in each loculus.

Siliqua $13-18 \mathrm{~mm}$; seeds in 2 rows in each loculus Siliqua $16-22 \mathrm{~mm}$; seeds in 1 row in each loculus

1. officinale 2. microphyllum
2. N. officinale R.Br. in Aiton, Hort. Kew. ed. 2, 4: 111 (1812) (Rorippa nasturtium-aquaticum (L.) Hayek). $10-60 \mathrm{~cm}$, procumbent below, often rooting, then ascending or floating. Leaves pinnate, leaflets more or less entire, round or broadly elliptical; lower leaves with 1-3, upper with 5-9 or more leaflets. Petals nearly twice as long as sepals. Siliqua $13-18 \mathrm{~mm}$, ascending, straight or curved; pedicels $c .10 \mathrm{~mm}$. Seeds in 2 distinct rows in each loculus, with c. 25 polygonal depressions on each face. $2 n=32$. Wet places. Europe, northwards to Scotland, S. Sweden and to $c .55^{\circ} N$. in U.S.S.R. All except Fa Fe Is Rs (N, B, K) Sb .
3. N. microphyllum (Boenn.) Reichenb., Fl. Germ. Excurs. 683 (1832) (Rorippa microphylla (Boenn.) Hyl.). Like 1 but flowers slightly larger; siliqua $16-24 \mathrm{~mm}$ and pedicels 11 15 mm , both more slender than in 1; seeds in 1 row in each loculus, with $c .100$ polygonal depressions on each face. $2 n=64$. Wet places. Mainly W. Europe. Be Br Da Ga Ge Hb He Ho Hs Su.

This taxon has only recently been shown to be a distinct species. It is probably widespread and is commoner than 1 in
the Netherlands, but its exact distribution is not yet known. The hybrid between 1 and $2(2 n=48)$ is fairly common and spreads vegetatively; both it and $\mathbf{1}$ are cultivated as a salad crop.

## 41. Cardamine L. ${ }^{1}$

Annual to perennial herbs; glabrous or with unbranched hairs. Leaves simple to pinnate. Inner sepals slightly saccate; petals white or purple (rarely pale yellow). Fruit a strongly compressed siliqua; valves coiling spirally from the base at dehiscence, veinless or with indistinct median vein; style short or distinct; stigma slightly 2 -lobed. Seeds in 1 row in each loculus. (Incl. Dentaria L.)
Literature: O. E. Schulz, Engl. Bot. Jahrb. 32: 280-623 (1903).
1 Petioles with small amplexicaul auricles
2 Petals pink or purplish, caducous; leaves ternate or pinnate, with large lanceolate leaflets
31. chelidonia

2 Petals white, not caducous (rarely absent); leaves various, with small, ovate or obovate leaflets
3 Lower leaves entire or trifoliate
26. resedifolia

3 Lower leaves pinnate
4 Petals $2-3 \mathrm{~mm}$, scarcely exceeding the sepals, sometimes absent; siliqua with a subsessile stigma 33. impatiens
4 Petals $4-11 \mathrm{~mm}$, at least twice as long as the sepals; siliqua with a flattened beak
5 Sepals apiculate; funicle of seeds slender
28. maritima

5 Sepals obtuse; funicle of seeds broad, flattened
30. graeca

1 Petioles without auricles
6 Petals not more than 3 mm , scarcely longer than the sepals, sometimes absent
7 Plant entirely glabrous; leaflets cuneate at the base, linear to oblong; petals less than 2.5 mm
32. parviflora

7 Plant at least sparsely hairy; leaflets cordate, ovate to reniform; petals more than 2.5 mm
8 Plant branched only from the base; stems straight; basal leaves many, in a distinct rosette; siliquae much overtopping unopened flowers
36. hirsuta

8 Plant branched above, as well as at the base; stems flexuous; basal leaves few, not in a distinct rosette; siliquae scarcely overtopping unopened flowers 35. flexuosa
6 Petals more than 4 mm , distinctly longer than the sepals
9 Leaves all similar in size and shape, in a whorl below the inflorescence
10 Leaves pinnate
11 Rhizome scale-leaves $2-3 \mathrm{~mm}$, appressed; petals purple
4. quinquefolia

11 Rhizome scale-leaves $5-8 \mathrm{~mm}$, concave; petals yellow
5. kitaibelii

10 Leaves ternate or digitate
12 Petals yellowish; stamens exserted, longer than the petalclaw
6. enneaphyllos

12 Petals purple; stamens included, about as long as the petal-claw
7. glanduligera

9 Leaves dissimilar in size or in shape, not in a whorl below the inflorescence
13 All leaves simple and entire
14 Leaves reniform, more than 10 mm wide
12. asarifolia

14 Leaves oblong-spathulate, less than 10 mm wide
27. bellidifolia

13 At least some leaves compound
15 Rhizome present, long and branched, or giving rise to slender stolons
16 Basal leaves simple, reniform
17 Middle cauline leaves trifoliate, with rounded segments
12. asarifolia

17 Middle cauline leaves, if present, with 1-3 pairs of narrowly ovate or oblong leaflets
23. tenera

16 Basal leaves compound

18 Axils of upper leaves with brownish-purple bulbils

## 1. bulbifera

18 Axils of leaves without bulbils
19 Cauline leaves trifoliate with linear-lanceolate leaflets (uppermost leaf often simple); some roots tuberous at their apices
10. trifida

19 Cauline leaves pinnate, digitately 5 -fid, simple or absent, or, if trifoliate, with broadly lanceolate to suborbicular leaflets; roots not tuberous (rarely completely tuberous and then crowded at base of stem)
20 Leaves all ternate or digitate
21 Leaflets serrate; petals more than 13 mm ; siliqua more than 2.5 mm wide 3. pentaphyllos
21 Leaflets obscurely dentate; petals less than 13 mm ; siliqua less than 2.5 mm wide
22 Rhizome with scale-leaves only; cauline leaves 3 or more; anthers violet
8. waldsteinii

22 Rhizome with foliage leaves (or withered petioles) as well as scale-leaves; cauline leaves $0-3$; anthers yellow
11. trifolia

20 At least some leaves pinnate
23 Rhizome 4-10 mm in diameter; petals $14-20 \mathrm{~mm}$; siliqua more than 3 mm wide $\quad$ 2. heptaphylla
23 Rhizome less than 4 mm in diameter or absent; petals $5-12 \mathrm{~mm}$; siliqua less than 3 mm wide
24 Leaflets crenate-apiculate or serrate, with appressed hairs; ovary and siliqua sparsely hairy
9. macrophylla

24 Leaflets crenate to entire, pubescent (especially on the margin) or glabrous; ovary and siliqua glabrous
25 Rhizome without slender stolons; leaves all lyrate-pinnate with reniform leaflets
16. raphanifolia

25 Rhizome with slender stolons; leaves dissimilar, at least the upper with oblong to lanceolate, subequal leaflets
26 Cauline leaves fewer than 5; anthers yellow; stigma conspicuous (17-22). pratensis group
26 Cauline leaves more than 5; anthers blackishviolet or rarely yellowish-white; stigma indistinct
(13-15). amara group
15 Rhizome absent, or short and unbranched, not giving rise to stolons
27 Ovary and siliqua with appressed hairs; seeds c. 3 mm ; funicle dilated
29. carnosa

27 Ovary and siliqua glabrous; seeds $1-2 \mathrm{~mm}$; funicle narrow
28 Lowest leaves simple, sometimes 3- to 5-lobed
29 Lowest leaves in a rosette; stems not flexuous; petals $8-18 \mathrm{~mm}$, white, pink or purple
(17-22). pratensis group
29 Lowest leaves not in a rosette; stems flexuous; petals 4-8 mm, white
30 Plant glaucous; leaflets of upper leaves entire; infructescence usually secund
25. glauca

30 Plant not glaucous; leaflets of upper leaves lobed; infructescence always symmetrical 24. plumieri
28 Lowest leaves ternate or pinnate
31 Leaflets with a few prominent apiculate teeth; petals less than 8 mm ; pedicels hairy 34. caldeirarum
31 Leaflets subentire; petals more than 8 mm ; pedicels glabrous
32 Leaves all similar, lyrate-pinnate, with the terminal leaflet at least twice as large as the lateral leaflets; all leaflets orbicular to reniform; siliqua without a thickened border
16. raphanifolia

32 Leaves dissimilar: the lower pinnate, with the terminal leaflet only a little larger than the lateral leaflets; at least the upper cauline leaves with oblong to linear-lanceolate leaflets; siliqua with a thickened border
(17-22). pratensis group

[^113]Subgen. Dentaria (L.) Bentham \& Hooker. Rhizome subterranean, with scale-leaves. Cotyledons petiolate.

1. C. bulbifera (L.) Crantz, Class. Crucif. 127 (1769) (Dentaria bulbifera L.). Perennial $35-70 \mathrm{~cm}$; rhizome $2-3 \mathrm{~mm}$ in diameter, with fleshy, deltate scale-leaves. Leaves alternate, more than 6; the lower pinnate with 1-3 pairs of lanceolate, serrate leaflets; the uppermost simple. Small brownish-purple bulbils present in the upper leaf-axils. Petals $12-16 \mathrm{~mm}$, pale purple. Siliqua $20-$ $35 \times 2.5 \mathrm{~mm}$ (formed occasionally and only in the southern part of its range). $2 n=96$. Europe except the south-west and the extreme north; rare in the Mediterranean region. Au Be Br $\mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(B}, \mathrm{C}, \mathrm{K}$, W) Su Tu .
2. C. heptaphylla (Vill.) O. E. Schulz, Feddes Repert. 46: 116 (1939) (C. pinnata (Lam.) R.Br.). Perennial $30-60 \mathrm{~cm}$; rhizome uniformly $4-10 \mathrm{~mm}$ in diameter, with lunate scale-leaves 1 2 mm . Leaves usually 3 or more, remote, pinnate; the lower with 3-5 pairs of ovate-lanceolate, serrate, sparsely hairy or glabrescent leaflets; the uppermost with 2-3 pairs of similar leaflets. Petals $14-20 \mathrm{~mm}$, white, pink or purplish. Siliqua $40-80 \times 3 \cdot 5-$ $5 \mathrm{~mm} .2 n=48 . W . \& C$. Europe, from the Pyrenees to S.W. Germany, W. Switzerland and S.E. Alps (Monte Baldo); Appennini. $\mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{[Be]}$.
C. $\times$ digenea Gremli (C. heptaphylla $\times$ pentaphyllos) occurs where the parents grow together. It is sterile and morphologically intermediate between the parents, and spreads vegetatively.
3. C. pentaphyllos (L.) Crantz, Class. Crucif. 127 (1769) (Dentaria pentaphyllos L., D. digitata Lam.). Like 2 but rhizome $1.5-2.5 \mathrm{~mm}$ in diameter, with triangular, trifid, concave scaleleaves $6-10 \mathrm{~mm}$; leaves all digitate or ternate, glabrous except for the margin; petals (14-)18-22 mm, white or pale purple; siliqua $2 \cdot 5-4 \mathrm{~mm}$ wide. $2 n=48$. - Mountains of W. \& C. Europe, from the Pyrenees to S. Germany and N. Jugoslavia. Au Ga Ge He Hs It Ju.
4. C. quinquefolia (Bieb.) Schmalh., Fl. Sred. Juž. Ross. 1: 51 (1895). Perennial $15-40 \mathrm{~cm}$; rhizome slender at apex but in older parts $5-7 \mathrm{~mm}$ in diameter, with deltate, membranous, appressed scale-leaves $2-3 \mathrm{~mm}$. Leaves usually 3, in a lax whorl, pinnate, with $2-3$ pairs of ciliate (rarely entirely glabrous), irregularly biserrate, lanceolate leaflets. Petals $14-18 \mathrm{~mm}$, deep purple, twice as long as the stamens. Siliqua $35-50 \times 2 \cdot 5 \mathrm{~mm}$. E. Europe. Bu Rm Rs (C, W, K, E) Tu.
5. C. kitaibelii Becherer, Ber. Schweiz. Bot. Ges. 43: 57 (1934) (C. polyphylla (Waldst. \& Kit.) O. E. Schulz, non D. Don). Perennial $20-30(-50) \mathrm{cm}$; rhizome $3-6 \mathrm{~mm}$ in diameter, with concave scale-leaves $5-8 \mathrm{~mm}$. Leaves $3(-5)$, more or less whorled, pinnate with 2-6 pairs of serrate, lanceolate leaflets. Petals 1522 mm , pale yellow, twice as long as the stamens. Siliqua $40-$ $65 \times 2.5-3 \mathrm{~mm} .2 n=48$. Isolated localities in Alps; Appennini; N. Jugoslavia. He It Ju.
C. $\times$ killiasii (Brügger) O. E. Schulz (C. kitabelii $\times$ pentaphyllos) is frequent where the parent species grow together.
6. C. enneaphyllos (L.) Crantz, Class. Crucif. 127 (1769). Perennial, $20-30 \mathrm{~cm}$; rhizome nodular, up to 6 mm in diameter, with insignificant scale-leaves $1-2 \mathrm{~mm}$. Leaves 2-4 in a lax whorl, ternate or sometimes digitate, with ovate-lanceolate, irregularly biserrate leaflets. Flowers somewhat pendent. Petals $12-16 \mathrm{~mm}$, pale yellow or white, scarcely exceeding the stamens. Siliqua 40$75 \times 3 \cdot 5-4 \mathrm{~mm} .2 n=52-54,80$. From the W. Carpathians
and E. Alps to S. Italy and Makedonija. Al Au Cz Ge Hu It Ju Po Rm.
7. C. glanduligera O. Schwarz, Feddes Repert. 46: 188 (1939) (Dentaria glandulosa Waldst. \& Kit.). Perennial $12-25 \mathrm{~cm}$; rhizome $4-6 \mathrm{~mm}$ in diameter, with deltate scale-leaves $2-3 \mathrm{~mm}$, but slender ( $1-2 \mathrm{~mm}$ ) and non-scaly in parts. Leaves usually 3 in a single whorl; ternate, with lanceolate, irregularly biserrate leaflets with ciliate margins. Petals $12-22 \mathrm{~mm}$, purple, twice as long as the stamens. Siliqua $35-60 \times 2-3 \mathrm{~mm}$. $2 n=48$. Carpathians and adjacent parts of E.C. Europe. Bu Cz Hu Ju Po $\operatorname{RmRs}(W)[A u]$.
8. C. waldsteinii Dyer, Kew Handlist Herb. Pl. 97 (1891) (Dentaria trifolia Waldst. \& Kit., Cardamine savensis O. E. Schulz). Perennial $10-40 \mathrm{~cm}$; rhizome $3-5 \mathrm{~mm}$ in diameter, brown, with distant, deltate scale-leaves $4-5 \mathrm{~mm}$. Leaves 3 or more, remote, ternate, with subsessile, obtuse, narrowly rhombic to ovate or almost lanceolate-acuminate leaflets, obscurely apiculate-dentate, glabrous or somewhat hairy. Petals 10 12 mm , white; anthers violet. Siliqua $20-35 \times 2 \mathrm{~mm}$. $N$. Jugoslavia, extending to S. Austria and ?Hungary. Au ?Hu Ju.

Subgen. Cardamine. Rhizome on the surface of the ground, with scale-leaves few or absent. Cotyledons sessile or subsessile.
9. C. macrophylla Willd., Sp. Pl. 3 (1): 484 (1800). Perennial $30-100 \mathrm{~cm}$, with a long horizontal rhizome $c .2 \mathrm{~mm}$ in diameter. Basal leaves large ( $10-25 \mathrm{~cm}$ ) with 2-4 pairs of subsessile, ovate lateral leaflets and a somewhat larger terminal leaflet; cauline leaves $5-8$, with narrower leaflets; leaflets apiculate-crenate to serrate, appressed-hairy. Petals ( $6-$ ) $8-11 \mathrm{~mm}$, pale pink to purple. Siliqua $25-40 \times 1 \cdot 5-2 \cdot 5 \mathrm{~mm}$, sparsely hairy; beak $1 \cdot 5-$ 3.5 mm . N.E. Russia. Rs (N, C).
10. C. trifida (Lam. ex Poiret) B. M. G. Jones, Feddes Repert. 69: 57 (1964) (C. tenuifolia (Ledeb.) Turcz.). Perennial $7-30 \mathrm{~cm}$; rhizome short, c. 5 mm in diameter, not scaly, bearing adventitious roots some of which are swollen at the apex to form flattened tubers. Basal leaves pinnate with 1-2 pairs of ovate to orbicular, stalked, crenate-lobed or 3 -fid leaflets, withered at anthesis; cauline leaves 1-4, mostly trifoliate with linear leaflets. Petals (6-)8-10(-13) mm, lilac or white. Siliqua $22-35 \times$ $1 \cdot 5-2 \mathrm{~mm}$. C. \& E. Russia; very local. Rs (C). (Altai and N.E. Asia.)
11. C. trifolia L., Sp. Pl. 654 (1753). Perennial $20-30 \mathrm{~cm}$; rhizome $2-4 \mathrm{~mm}$ in diameter, nodular, creeping, branched, with remote scale-leaves; stem simple. Rhizomal leaves ternate; leaflets broadly rhombic to suborbicular, obscurely dentate-apiculate, sparsely hairy above and purplish beneath, long-petiolate; cauline leaves $0-3$, small, sessile, simple or trifoliate. Petals $9-11 \mathrm{~mm}$, white or pink; anthers yellow. Siliqua $20-25 \times 2 \mathrm{~mm} .2 n=16$. - C. Europe from the French Jura to the Carpathians, extending southwards to C. Italy and C. Jugoslavia. Au Cz Ga Ge He Hu It Ju Po Rs (W).
12. C. asarifolia L., Sp. Pl. 654 (1753). Perennial $20-40 \mathrm{~cm}$; rhizome horizontal, short, stout, stoloniferous. Lower leaves reniform, sinuate or somewhat apiculate-crenate, long-petiolate; upper leaves similar, shortly petiolate; rarely some cauline leaves trifoliate with rounded segments. Petals $6-10 \mathrm{~mm}$, white; anthers violet. Siliqua $20-30 \times 1 \cdot 5-2 \mathrm{~mm}$. Pyrenees, Alps and Appennini. Ga He Hs It.
(13-15). C. amara group. Rhizome short, horizontal, stoloniferous. Upper and lower leaves similar in shape; leaflets bright
green, smooth. Petals usually white, anthers purplish. Style c. 0.3 mm wide in fruit, subulate; stigma indistinct.

1 Flowers 2-5(-7); leaves with 5-8 pairs of lateral leaflets 15. opizii
1 Flowers 9-24; leaves with 5 or fewer pairs of lateral leaflets
2 Terminal leaflet much larger than the 1-3 pairs of lateral
leaflets; stem terete
14. barbaraeoides

2 Terminal leaflet not much larger than the 2-5 pairs of lateral leaflets; stem angled
13. amara
13. C. amara L., Sp. Pl. 656 (1753). Perennial $10-60 \mathrm{~cm}$, usually almost glabrous (hairy throughout in vars.); stem angular; rhizome with numerous, slender stolons. Leaves thin, not in a rosette; lower cauline leaves pinnate with 2-4 pairs of ovate to orbicular, crenate, shortly stalked leaflets and a somewhat larger terminal leaflet; upper cauline leaves shortly petiolate with 2-5 pairs of lanceolate to ovate, angular leaflets. Flowers 9-24. Petals $7-9 \mathrm{~mm}$, white, rarely purplish; anthers blackish-violet or rarely yellowish-white. Siliqua $20-40 \times 1-2 \mathrm{~mm}$; style $0.5-$ 2.5 mm ; stigma narrower than style. $2 n=16,32$. Most of Europe, but rare in the north and extreme south. Au Be Br Bu Co $\mathrm{Cz} \mathrm{DaFeGaGe} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}$, C, W, E) Si Su.
14. C. barbaraeoides Halácsy, Denkschr. Acad. Wiss. Math.Nat. Kl. (Wien) 61: 228 (1894). Like 13 but $50-80 \mathrm{~cm}$, more robust; stem terete; basal leaves in a distinct rosette, lyratepinnatifid to pinnate with $1-3(-4)$ pairs of small lateral lobes or leaflets and a large terminal leaflet; lower cauline leaves similar to those of the rosette but with a deeply 3 -fid terminal leaflet; upper cauline leaves 3 -sect with a large, ovate, obtuse, dentate median lobe. Style $1-1.5 \mathrm{~mm}$ in fruit; stigma wider than style. - Balkan peninsula. Bu Gr Ju.
15. C. opizii J. \& C. Presl, Fl. Čechica 126 (1819). Like 13 but smaller, $10-50 \mathrm{~cm}$; stem terete or somewhat angled (hairy at least at the base); leaves thick, usually hairy, especially on the margin, with 5-8 pairs of entire to dentate, oblong to ovate leafiets; flowers $2-5(-7)$; petals $5-7 \mathrm{~mm}$. Style $1-2 \mathrm{~mm}$ in fruit; stigma narrower than style. $2 n=16$. Mountains of E.C. Europe. Au Cz Po Rm Rs (W).
16. C. raphanifolia Pourret, Mém. Acad. Toulouse 3: 310 (1788) (C. latifolia Vahl, non Lej.). Perennial $30-70 \mathrm{~cm}$; stem robust, glabrous; rhizome long, horizontal. Leaves large, thick, clear green, lyrate-pinnate, long-petiolate; the lower cauline with 1-5 pairs of ovate to orbicular-reniform, sinuate, lateral leaflets, decreasing in size from the very large, reniform, terminal leaflet $3-7 \mathrm{~cm}$ wide. Petals $8-12 \mathrm{~mm}$, reddish-violet, rarely white; anthers yellow. Siliqua $15-30(-40) \times 1 \cdot 4-2 \mathrm{~mm}$; style $2-5 \mathrm{~mm}$, gradually attenuate. Mountains of $S$. Europe. Al Bu Ga Gr Hs It Ju.
(a) Subsp. raphanifolia: Leaves glabrous, the lower with 1-3 pairs of lateral leaflets. Siliqua strict, about as long as pedicels; infructescence short and dense; stigma much wider than style. $2 n=44,46$. Cantabrian mountains to $N$. Italy.
(b) Subsp. acris (Griseb.) O. E. Schulz, Bot. Jahrb. 33: 497 (1903): Leaves often pubescent, the lower leaves with 2-4(-5) pairs of lateral leaflets. Siliqua patent, twice as long as pedicels; infructescence long and lax; stigma scarcely wider than style. Balkan peninsula.

Two usually glabrous variants in Italy are in some respects intermediate between (a) and (b) but possess other distinguishing features: the more widespread (Appennini, extending south to Calabria) has white flowers and dense compound racemes, siliqua $35-40 \times 1 \mathrm{~mm}$, patent; the other (endemic to Calabria) has violet
flowers and simple raceme; siliqua $14-25 \times 1.5 \mathrm{~mm}$, erectopatent. Both have been united by Schulz as prol. calabrica (DC.) O. E. Schulz.
(17-22). C. pratensis group. Rhizome usually short, oblique; usually non-stoloniferous. Upper and lower leaves dissimilar in shape; leaflets dull- or grey-green, rough-surfaced. Petals usually pink or purplish; anthers yellow. Style 0.6 mm wide, flattened, not attenuate; stigma conspicuous, enlarged.

For further information see B. Lövkvist, Symb. Bot. Upsal. 14 (2)(1956). The distributions of some of the species are incompletely known.
Rhizome stoloniferous; stem ascending; lower leaves not in
17. crassifolia
a rosette
17. C. crassifolia Pourret, Mém. Acad. Toulouse 3: 310 (1788). Perennial $10-15 \mathrm{~cm}$; stem ascending from a short horizontal stoloniferous rhizome. Lower leaves not forming a distinct rosette, simple, or trifoliate with a long-stalked, orbicular to reniform terminal leaflet; upper leaves $1-4$, with 1-3 pairs of unequal leaflets. Petals $6-8 \mathrm{~mm}$, purplish; anthers yellow, tinged with purple. Lower pedicels longer than siliqua. Siliqua 12-16× 1.2 mm . Pyrenees. Ga Hs.
18. C. nymanii Gand., Bull. Soc. Bot. Fr. 72: 1042 (1925). Perennial 5-16(-35) cm; stem erect. Rosette-leaves numerous, with 4-6 pairs of shortly stalked, lanceolate to orbicular, entire leaflets; cauline leaves $2-4(-7)$, pinnate or pinnatifid with $3-$ $7(-10)$ pairs of narrower leaflets; leaflets thick, with impressed veins and often bearing adventitious shoots. Petals $9-12 \times 5-$ 7 mm , pale lilac. Siliqua $10-18 \times 1.2 \mathrm{~mm} .2 n=60,62,64,68$, 72, 74, 80, 90. N. Europe. Fa Fe is No Rs (N) Sb Su.

The plants with lanceolate or oblong (not orbicular) leaflets on the rosette leaves, and narrower petals, are restricted to Sweden (Vasterbotten and Norrbotten). They preserve their differences in cultivation and are similar to C. pratensis subsp. angustifolia (Hooker) O. E. Schulz from arctic America.
19. C. matthiolii Moretti in Comolli, Fl. Comense 5: 157 (1847) (C. hayneana Welw.). Perennial $20-50 \mathrm{~cm}$; stem erect, usually much-branched from the base and with many inflorescences from the axils of cauline leaves. Rosette leaves with 3-6 pairs of obovate, shortly stalked, lateral leaflets and an orbicular to reniform terminal leaflet; cauline leaves 6-12, the lower pinnatifid with $8-12$ pairs of oblong to oblanceolate lobes. Petals $6-9 \times 3-$ 5 mm , cuneate with entire apex, white. Siliqua $18-30 \times 1-$ $1.2 \mathrm{~mm} .2 n=16$. C. Europe, N. part of Balkan peninsula, N. Italy. Al Au Bu Cz Ge ?Ga He Hu It Ju Rm.
20. C. pratensis L., Sp. Pl. 656 (1753). Perennial (15-)3055 cm ; stem erect, usually simple, glabrous. Rosette-leaves with

1-7 pairs of ovate to orbicular or reniform sessile or shortly stalked lateral leaflets and a larger terminal leaflet; cauline leaves 2-3(-5) shortly petiolate or sessile, with more numerous lanceolate to linear leaflets; leaves sparsely hairy, often bearing adventitious shoots. Sepals $3-4 \mathrm{~mm}$; petals ( $6-$ ) $8-13(-18) \mathrm{mm}$, emarginate, white, tinged with violet or pink. Siliqua $25-40 \times 1 \cdot 1$ $1 \cdot 5 \mathrm{~mm}$. $2 n=28-34,38-44$, 48. Widespread in Europe. Al Au $\mathrm{Be} \mathrm{Br} \mathrm{Co} \mathrm{Cz} \mathrm{Da} \mathrm{?Fa?} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu}$ No Po Rs (N, B, C, W, E) Su Tu.

Diploid plants $(2 n=16)$ occur in the French Jura and Alps. They are small $(15-30 \mathrm{~cm})$, with rosette leaves with only 1 or 2 pairs of leaflets, cauline leaves with a few pairs of leaflets and a few-flowered inflorescence (C. nemorosa Lej., Fl. Spa 2: 62 (1813)). Tetraploids with similar morphology but rather larger in all their parts, and with 1-3 pairs of leaflets on the rosette leaves occur in N. \& E. France (? and Belgium, Corse) (C. latifolia sensu Lej., non Vahl). An undescribed diploid with crowded tuberous roots at the base of the stem, and bulbils in the leafaxils of the lower cauline leaves occurs in maritime areas of C. \& N. Portugal, N. Spain and S.W. France.
C. granulosa All., Auct. Fl. Pedem. 16 (1789), described from N.W. Italy (Piemonte) and now possibly extinct, is like 20 but has the ends of some of the roots swollen, tuberous; basal leaves simple, hederiform to reniform; cauline leaves pinnate, with only 1-2 pairs of ovate leaflets; and petals obovate with rounded apex.
21. C. rivularisSchur, Verh.Siebenb.Ver. Naturw. 4(2):60(1853) (C. crassifolia auct., non Pourret). Like 20 but often branched below; rosette-leaves with 6-8 pairs of orbicular or ovate-cordate lateral leaflets and a subequal reniform terminal leaflet; cauline leaves 4 or more, with 4-6 pairs of ovate to oblong leaflets; petals always purple; anthers purplish before dehiscence. $2 n=16$. Mountains. C. Europe and parts of S. Europe. Au Bu He Rm.

Polymorphic. Plants which are similar in some respects and with $2 n=16$ occur in Ga Hu Hs It Ju. They may be referable to C. rivularis which requires further study.
22. C. palustris (Wimmer \& Grab.) Peterm., Bot. Cent. Deutschl. 1846: 47 (1846). Like 20 but often smaller; rosette-leaves with ovate to rhombic, stalked lateral and subequal terminal leaflet; cauline leaves usually more than 5 , with ovate to linear, stalked leaflets; sepals $4-6 \mathrm{~mm}$; petals $12-18 \mathrm{~mm}$; siliqua $30-55 \mathrm{~mm} .2 n=$ $56,64,72,76,80,84, c .96$. (Other numbers occur through hybridization.) N. W. \& C. Europe; Scandinavia; Balkan peninsula. Au $\mathrm{Be} \mathrm{Br} \mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Su}$.
23. C. tenera J. G. Gmelin ex C. A. Meyer, Verz. Pff. Cauc. 179 (1831). Almost glabrous perennial $25-40 \mathrm{~cm}$, with short slender rhizome; long stolons from the axils of the lowest leaves. Basal leaves $2-4 \mathrm{~cm}$ wide, simple, reniform; lower cauline leaves few, with $1-3(-4)$ remote pairs of narrowly ovate or oblong, sessile, lateral leaflets and a distinctly larger terminal leaflet; uppermost cauline leaf simple. Pedicels $12-15 \mathrm{~mm}$, patent to recurved at anthesis. Petals $8-14 \mathrm{~mm}$, narrowly cuneate, white, rose or violet. Siliqua $30-40 \times 1.2 \mathrm{~mm}$; pedicels patent; style $0.5-1 \mathrm{~mm}$. Krym. Rs (K).
24. C. plumieri Vill., Prosp. Pl. Dauph. 38 (1779). Biennial or perennial $5-12(-20) \mathrm{cm}$; almost glabrous but not glaucous. Lowest leaves hederiform with 3-5 obtuse lobes; intermediate cauline leaves ternate with stalked, obovate lateral leaflets and a long terminal leaflet; upper cauline leaves pinnate with ternate, obtuse leaflets. Petals $6-8 \mathrm{~mm}$, rounded or slightly emarginate at apex, white. Siliqua $18-25 \times 1-1.5 \mathrm{~mm}$, erect; beak $1-2 \mathrm{~mm}$. $W$. \& S.C. Alps; N. \& C. Italy; Corse : Albania. Al Co Ga It.
25. C. glauca Sprengel in DC., Reg. Veg. Syst. Nat. 2: 266 (1821). Annual to perennial (5-)12-25 cm; entirely glabrous and glaucous. Lowest leaves entire to 3-lobed; intermediate leaves pinnate with 1-3 pairs of elliptic-ovate, obtuse, equal, sessile lateral leaflets, and an obovate, entire or 3-lobed, subsessile terminal leaflet; upper leaves smaller, imparipinnate with 2-5 pairs of oblong to linear, entire and acute leafiets. Petals 58 mm , deeply emarginate, white. Siliqua (10-)20-35 $\times(1-) 1 \cdot 5-$ 1.8 mm , secund; beak $1-2 \mathrm{~mm}$. S. Europe, from the S. Carpathians to N.W. Greece and Sicilia. Al Bu Gr It Ju Po Rm Si.

Variable; some of the alpine plants are dwarf and smaller in all their parts, with leaves in perennial rosettes and strict infructescences. They may warrant subspecific status.
C. pancicii Hayek, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 94: 149 (1918) from S. Italy, Albania and Jugoslavia, with 4-8 pairs of leaf-segments and petals 4-5 mm, may also represent a subspecies.
26. C. resedifolia L., Sp. Pl. 656 (1753). Perennial (2-)5-$15(-23) \mathrm{cm}$; glabrous. Leaves thick, usually trifoliate, auriculate at the base of the petiole, the lowest spathulate; the intermediate leaves trifid or ternate with ovate-lanceolate lateral lobes and an ovate, obtuse terminal lobe; the upper 3- to 7 -lobed. Petals 56 mm , entire, white. Siliqua $12-22 \times 1-1.4 \mathrm{~mm}$, strictly erect, beak absent. Seed broadly winged. $2 n=16$. Mountains of $C . \&$ S. Europe. Au Bu Co Cz Ga Ge ? Gr He Hs It Ju Po Rm.
27. C. bellidifolia L., Sp. Pl. 654 (1753). Perennial $1-8(-11) \mathrm{cm}$; entirely glabrous. Leaves all similar in shape, thick, entire (occasionally 2 -lobed); rosette-leaves long-spathulate, cauline sometimes absent. Petals $3.5-5 \mathrm{~mm}$, white. Siliqua $10-25 \times 1-$ 1.5 mm , strictly erect; beak absent. Seeds wingless or narrowly winged. Arctic and subarctic Europe; Alps; Pyrenees. Au ?Bu Fe Ga Ge He Hs Is It No Rs (N) Sb Su.
(a) Subsp. bellidifolia: Cauline leaves $0-1(-3)$, on petioles longer than the lamina. Flowers 2-5; pedicels $1-1.5 \mathrm{~mm}$. Siliqua $12-25 \times$ c. 1.5 mm , purplish-brown. Seeds $1.5 \times 1 \mathrm{~mm}$, narrowly winged. $2 n=16$. Arctic and subarctic Europe.
(b) Subsp. alpina (Willd.) B. M. G. Jones, Feddes Repert. 69: 59 (1964) (C. alpina Willd.): Cauline leaves (1-)2-3(-4), subsessile or on petioles less than half as long as the lamina. Flowers $3-8$; pedicels $2-3 \mathrm{~mm}$. Siliqua $10-15 \times c$. 1 mm , brown. Seeds $1.2 \times 0.7 \mathrm{~mm}$, unwinged. $2 n=16$. Alps and Pyrenees.
28. C. maritima Portenschl. ex DC., Reg. Veg. Syst. Nat. 2: 266 (1821). Annual or biennial $12-30 \mathrm{~cm}$, subglabrous to pubescent. Leaves glabrous, pinnate with cuneate-obovate, subsessile leaflets, frequently lobed or incised, auriculate at the base of the petiole. Sepals glabrous, apiculate; petals (4-)7-11 mm, white. Siliqua $20-40 \times 2-3 \mathrm{~mm}$, glabrous, patent; beak (3-)5-$7(-10) \mathrm{mm}$. Seeds on a narrow funicle. ? ?N.E. Italy and N. \& W. Jugoslavia. ?It Ju.
C. fialae Fritsch, Österr. Bot. Zeitschr. 47: 44 (1897) from Jugoslavia (Hercegovina), with hairy stems, leaves, pedicels and sepals, leaflets deeply lobed with obtuse segments, petals $10-$ 12 mm , siliqua $40-55 \times 1.4-1.8 \mathrm{~mm}$ and beak $8-15 \mathrm{~mm}$, may deserve recognition as a subspecies.
29. C. carnosa Waldst. \& Kit., Pl. Rar. Hung. 2: 137 (1803). Perennial $20-30 \mathrm{~cm}$, hairy above. Leaves few (4-6), thick, with appressed hairs, pinnate with 3-7 pairs of entire obovate-cuneate leaflets. Sepals apiculate; petals $6-9 \mathrm{~mm}$, white. Siliqua $20-$ $30(-40) \times 2-3 \mathrm{~mm}$, strigose; beak $1-3 \mathrm{~mm}$. Seeds c. 3 mm , on a broad funicle. Mountains. Balkan peninsula, mainly in the west. Al Gr Ju.
30. C. graeca L., Sp. Pl. 655 (1753). Annual or biennial 1030 cm , glabrous or hairy. Leaves pinnate; lower leaves with 4 5 pairs of cuneate-obovate leaflets, each with 3 or more obtuse lobes; upper cauline leaves with 2-3 pairs of 3 -lobed or entire, lanceolate leaflets; petioles auriculate at the base. Sepals obtuse; petals (3-)4-6 mm, white. Siliqua $35-50 \times(2 \cdot 5-) 3-4 \mathrm{~mm}$, glabrous, papillose or setose, somewhat secund; beak $4-8 \mathrm{~mm}$, winged. Seeds on a broad funicle. $2 n=16$. $S$. Europe from Corse eastwards. Al Bu Co Cr Gr It Ju Rm Rs (K) Si.
31. C. chelidonia L., Sp. Pl. 655 (1753). Annual to perennial $20-50 \mathrm{~cm}$, almost glabrous. Leaves pinnate with $1-3$ pairs of lanceolate to ovate-lanceolate, incised or lobed leaflets $1.5-3 \mathrm{~cm}$ wide; petioles auriculate at the base. Petals $5-9 \mathrm{~mm}$, pink or violet, caducous. Siliqua $30-40 \times 1.5 \mathrm{~mm}$, setose; beak $2-3 \mathrm{~mm}$. Seeds on a broad funicle. - C. Mediterranean region. †Co It Ju Si.
32. C. parviflora L., Syst. Nat. ed. 10, 2: 1131 (1759). Annual $7-30(-40) \mathrm{cm}$, glabrous. Leaves pinnate, the lower with $3-5$ pairs, the upper with 5-8 pairs of linear to linear-oblong, cuneate, entire leaflets. Petals $1.8-2.5 \mathrm{~mm}$, white, obovate. Siliqua (8-) 12 $20 \times 0.8 \mathrm{~mm}$, erect on patent pedicels. Seeds $0.7-0.8 \times 0.5 \mathrm{~mm}$, narrowly winged. Widespread in Europe, but irregularly distributed and very local; rare in the Balkan peninsula and most of the west. $\mathrm{Au} \mathrm{Be} \mathrm{Bu} \mathrm{?} \mathrm{Co} \mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C}, \mathrm{W}$, $\mathrm{K}, \mathrm{E}) \mathrm{Su}$.
33. C. impatiens L., Sp. Pl. 655 (1753). Annual or biennial $25-60 \mathrm{~cm}$, glabrous. Rosette-leaves not persistent. Lower cauline leaves petiolate, with $3-5$ pairs of ovate, 2- to 5 -lobed leaflets; upper leaves sessile with 5-9 pairs of lanceolate, dentate, lateral leaflets and a somewhat larger terminal leaflet; leaves auriculate at the base; leaves ciliate, otherwise glabrous. Petals 23 mm , narrow, scarcely exceeding sepals, sometimes absent. Anthers greenish. Siliqua $18-30 \times 1-1.1 \mathrm{~mm}$, erecto-patent. Seeds $1 \cdot 1-1 \cdot 4 \times 0 \cdot 8-0 \cdot 9$, unwinged. $2 n=16$. Widespread in Europe, but absent from large areas of the west, south and north. Al Au Be Br Bu Co Cz Da Fe Ga Ge He Ho Hs Hu It Ju No Po Rm Rs (N, B, C, W, K, E) Su.
C. pectinata Pallas ex DC., Reg. Veg. Syst. Nat. 2: 264 (1821), from Bulgaria and N. Greece, is like 33 but has cauline leaves with 3-4 pairs of larger leaflets and the siliqua c. 0.8 mm wide, almost horizontal and often secund. It may deserve subspecific rank.
34. C. caldeirarum Guthnick in Seub., Fl. Azor. 43 (1844). Biennial or perennial $15-50 \mathrm{~cm}$, sparsely hairy. Lowest leaves in a rosette, pinnate with 5-6 pairs of obliquely ovate lateral leaflets, and an ovate, truncate, distinctly stalked terminal leaflet; cauline leaves 3-6, similar to the lowest leaves, but with 2-4 pairs of leaflets; leaflets coarsely crenate-dentate with apiculate teeth. Pedicels $4-8 \mathrm{~mm}$ at anthesis. Petals $4-7 \mathrm{~mm}$, white, much exceeding sepals. Siliqua $20-40 \times 1-1.2 \mathrm{~mm}$, on patent pedicels; style $1-2 \mathrm{~mm}$, cylindrical. Seeds $1.2 \times 0.8 \mathrm{~mm}$. Açores. Az.
35. C. flexuosa With., Arr. Br. Pl. ed. 3, 3: 578 (1796) (C. sylvatica Link). Biennial to perennial, occasionally annual, $10-50 \mathrm{~cm}$; stem flexuous, hairy, especially at the base. Lowest leaves pinnate with 3-6 pairs of ovate to reniform lateral leafiets and a somewhat larger terminal leaflet; cauline leaves 4-10, larger than the basal leaves, with 5 or more pairs of ovatelanceolate leaflets. Leaflets dentate to entire. Pedicels $2-3 \mathrm{~mm}$ at anthesis. Petals $2.5-3 \mathrm{~mm}$, not exceeding the sepals; stamens 6 (sometimes fewer). Siliqua $12-25 \times c .1 \mathrm{~mm}$, erecto-patent,

[^114]scarcely overtopping flowers; style $1-1.5 \mathrm{~mm}$, conical. Seeds $1-1.2 \times 0.8-0.9 \mathrm{~mm} .2 n=32$, c. 50 . Europe, from about $25^{\circ} \mathrm{E}$. westwards. All except Az Bl Cr Gr Is Rs (C, N, K, E) Sb Tu.
36. C. hirsuta L., Sp. Pl. 655 (1753). Annual $7-30 \mathrm{~cm}$; stems glabrous. Lowest leaves in a distinct rosette, pinnate, with 1-$3(-5)$ pairs of obovate to orbicular lateral leaflets and a larger, reniform terminal leaflet; cauline leaves $2-4$, smaller than the basal leaves, with 2-5 pairs of smaller leaflets; leaflets angular, hairy on the upper surface. Pedicels $1-2 \mathrm{~mm}$ at anthesis. Petals $2 \cdot 5-3 \mathrm{~mm}$ or absent, not exceeding the sepals; stamens $4(-6)$. Siliqua $18-25 \times c .1 \mathrm{~mm}$, erect, overtopping flowers; style $0.5-$ 1 mm , conical. Seeds $0.9-1 \times 0.7-0.8 \mathrm{~mm} .2 n=16$. Throughout Europe except the Arctic and N. Russia. All except Rs (N) Sb.

## 42. Cardaminopsis (C. A. Meyer) Hayek ${ }^{1}$

Annual to perennial herbs; glabrous or with hairs of two kinds, branched and unbranched. Leaves simple to pinnatisect. Inner sepals slightly saccate; petals white, pinkish or purplish. Fruit a strongly compressed siliqua; valves flat, with a distinct median vein; style short; stigma capitate. Seeds in 1 row in each loculus.

Several of the species in this genus are known to be interfertile.
1 Basal leaves orbicular, or pinnate with an orbicular terminal leaflet
5.
casal leaves lanceolate to obovate, subentire to pinnatisect
1 Basal leaves lanceolate to obovate, subentire to pinnatisect cauline somewhat larger)
4. croatica

2 Cauline and basal leaves dissimilar in shape and size
3 Basal leaves shallowly pinnatifid to serrate, or almost entire; cauline entire 2. petraea
3 Basal leaves pinnatisect; cauline pinnatifid or distinctly serrate-dentate
4 Stem hairy; pedicels $3-5 \mathrm{~mm}$ at anthesis 1. arenosa
4 Stem almost or quite glabrous; pedicels $5-8 \mathrm{~mm}$ at anthesis
3. neglecta

1. C. arenosa (L.) Hayek, Fl. Steierm. 1: 478 (1908) (Arabis arenosa (L.) Scop.). Annual to perennial, without stolons. Stems $5-80 \mathrm{~cm}$, erect, robust, usually branched above and below, hairy. Basal leaves pinnatisect; cauline leaves lanceolate, pinnatifid to dentate. Flowers numerous; pedicels $3-5 \mathrm{~mm}$ at anthesis. Petals $6-8 \mathrm{~mm}$, white (becoming pale pink after anthesis) to purplish or lilac, with a pair of small teeth on the claw. Siliqua 10-45× 1 mm ; pedicels $5-13 \mathrm{~mm}$, patent. $2 n=16,28,32$. Most of Europe except the south-west, the islands and part of the Mediterranean region. Au Be Bu Cz Da Fe Ga Ge He Ho Hu It Ju No Po Rm Rs (N, B, C, W, E) Su.

Often a ruderal near the limits of its area, so that its status is not always clear.

Sometimes confused with Arabidopsis suecica (Fries) Norrlin, which has the basal leaves dentate to pinnatifid, petals without teeth on the claw and the siliqua not strongly dorsally compressed.

White-flowered in Fennoscandia but with petals a vivid lilac in continental Europe. This and other differences are maintained in cultivation.
2. C. petraea (L.) Hiitonen in Hyl., Förteck. Scand. Växt. ed. 3, 62 (1941) (C. hispida (L.) Hayek). Perennial, stoloniferous; stems $5-30 \mathrm{~cm}$, sparsely branched, glabrous, or hairy below with simple and forked hairs. Basal leaves long-petiolate, pinnatifid to serrate, sparsely hairy or glabrous; cauline leaves few, lanceolate,
entire. Flowers few; pedicels $2-6 \mathrm{~mm}$ at anthesis. Petals $3-$ $7(-9) \mathrm{mm}$, white or purplish. Siliqua $14-45 \times 1.2-1 \cdot 5 \mathrm{~mm}$; pedicels $5-15 \mathrm{~mm}$, patent or ascending. $2 n=16$. Often in the mountains but sometimes at sea-level. N. \& C. Europe. Au Br Cz Fa Ge Hb Hu Is It No Po ?Rm Rs (N, W) Su.

Plants from C. Europe are sometimes regarded as a separate species, C. hispida (L.) Hayek, Fl. Steierm. 1: 478 (1908), and those from N.E. Russia are distinguished as C. septentrionalis (N. Busch) O. E. Schulz in Engler, Natürl. Pflanzenfam. ed. 2, 17b: 541 (1936), but the characters separating them from C. petraea are by no means clear.
3. C. neglecta (Schultes) Hayek, Fl. Steierm. 1: 480 (1908). Perennial; stems $5-20 \mathrm{~cm}$, sparsely branched, glabrous. Basal leaves petiolate, lyrate-pinnatifid, with few lobes or almost entire; cauline leaves ovate, entire or with one or two basal lobes; all leaves thick, coriaceous, glabrous or sparsely hairy. Flowers few; pedicels $5-8 \mathrm{~mm}$ at anthesis. Petals $5-6 \mathrm{~mm}$, purple, somewhat cuneate. Siliqua $15-25 \times c$. 1.5 mm ; pedicels $8-12 \mathrm{~mm}$, ultimately deflexed. Carpathians. Cz Po Rm Rs (W).
4. C. croatica (Schott, Nyman \& Kotschy) Jáv., Magyar Fl. 435 (1924). Perennial; stems $8-18 \mathrm{~cm}$, erect, flexuous, divaricately branched, glabrous. Leaves all long-petiolate, obovate, denticulate to entire (lowest sometimes lyrate-pinnatifid), glabrous or sparsely hairy, glaucous and fleshy. Flowers few; pedicels $4-8 \mathrm{~mm}$ at anthesis. Petals $4-6 \mathrm{~mm}$, pinkish or purple. Siliqua $18-50 \times 1 \mathrm{~mm}$, widely patent; pedicels $7-10 \mathrm{~mm}$, deflexed or horizontal. Rocks. - N.W. Jugoslavia (Velebit). Ju.
5. C. halleri (L.) Hayek, Fl. Steierm. 1 : 479 (1908). Perennial, stoloniferous. Stems $10-50 \mathrm{~cm}$, ascending, hairy or glabrous. Basal leaves long-petiolate, simple or pinnate, with 1-7 orbicular lateral leaflets, the terminal larger; cauline leaves shortly petiolate, oblong to ovate. Flowers rather numerous. Petals 4-6 mm, white or lilac. Siliqua $10-25 \times 1 \mathrm{~mm}$, patent; pedicels slender. $2 n=16$. Mountains of C. Europe, extending to S.W. Alps, N. Appennini and Crna Gora. Au Cz Ga Ge He It Ju Po Rm Rs (W) [Be].
(a) Subsp. halleri: Stolons few, short; flowering stems $20-$ 40 cm , numerous, branched at the base and frequently also above. Basal leaves usually pinnate; the lower cauline oblong, dentate. Petals white or lilac. Fruiting pedicels $5-10 \mathrm{~mm}$. Throughout the range of the species.
(b) Subsp. ovirensis (Wulfen) Hegi \& E. Schmid in Hegi, Ill. Fl. Mitteleur. 4 (1): 424 (1919): Stolons numerous, slender and elongate; flowering stems $10-20 \mathrm{~cm}$, few, only sparsely branched above. Basal leaves simple or pinnate with weakly developed lateral leaflets; lower cauline leaflets orbicular to ovate, entire or crenate. Petals lilac or purplish. Fruiting pedicels $10-14 \mathrm{~mm}$. Locally in the S. \& E. parts of the range of the species.

Intermediates between (a) and (b) occur in the Tatra.

## 43. Arabis L. ${ }^{1}$

Annual or perennial herbs; hairs of one or more of the following kinds: unbranched, branched or stellate, rarely the plant glabrous. Leaves simple. Inner sepals often slightly saccate at base; petals usually white, pink or purple. Fruit a siliqua; valves flat, sometimes with a median vein; style distinct; stigma capitate or emarginate. Seeds usually in 1 row in each loculus, usually winged. (Incl. Turritis L.)
${ }^{1}$ By B. M. G. Jones.

## 1 Cauline leaves absent

2 Plant conspicuously pubescent; petals $6-7 \mathrm{~mm}$; style up to 1 mm
25. bryoides

2 Plant subglabrous or glabrous; petals $3-4 \mathrm{~mm}$; style 1.5 2 mm
26. longistyla

1 Cauline leaves 1 to many
3 Basal leaves pubescent; all the cauline leaves glaucous and usually quite glabrous
4 Seeds biseriate in each loculus

1. glabra

4 Seeds uniseriate in each loculus
5 Cauline leaves sagittate at the base; petals yellowish; siliqua less than $70 \times 1.5 \mathrm{~mm}$
2. pseudoturritis

5 Cauline leaves cordate at the base; petals white; siliqua more than $70 \times 1.5 \mathrm{~mm}$
3. laxa

3 Basal and at least the lower cauline leaves with a similar indumentum, or glabrous
6 Siliqua more than 9 cm , distinctly arcuate at maturity
14. turrita

6 Siliqua less than 9 cm , straight or scarcely arcuate at maturity
7 All leaves (except the uppermost) long-petiolate, cuneate or truncate
8 Usually pubescent; basal leaves longer than broad, acute; petals $7-10 \mathrm{~mm}$, violet or white 34. cebennensi
8 Usually glabrous; basal leaves as broad as long, obtuse; petals $6-7 \mathrm{~mm}$, white
35. pedemontana

7 At least the upper cauline leaves sessile or shortly attenuatepetiolate
9 Infructescence conspicuously unilateral; siliqua pendent or deflexed 16. pendula
9 Infructescence not conspicuously unilateral; siliqua erect to patent
10 Basal leaves long-petiolate, ovate, cordate at the base, with large, obtuse teeth; margins of the siliqua sinuate
15. mollis

10 Basal leaves attenuate-petiolate; margins of the siliqua $\pm$ straight
11 Annuals; lower leaves withering during flowering
12 Cauline leaves attenuate at the base; siliqua puberulent 19. parvula
12 Cauline leaves cordate or auriculate-amplexicaul at the base; siliqua glabrous
13 Petals pale violet; siliqua 2 mm wide; pedicels short, thick
20. verna

13 Petals white; siliqua 1.5 mm wide or less; pedicels slender
14 Petals $2-4 \mathrm{~mm}$; siliqua less than 1 mm wide; pedicels up to 5 mm 17. re 14 Petals $4-6 \mathrm{~mm}$; siliqua more than 1 mm wide; pedicels more than 5 mm
18. nova

11 Biennials with leaves withering during the ripening of the fruit, or perennials with vegetative leaf-rosettes
15 Leaves entire, with medifixed hairs
16 Hairs covering both sides of the leaves; cauline leaves lanceolate 23. ferdinandi-coburgi
16 Hairs restricted to the margin and veins of the lower surface; cauline leaves ovate to oblong
17 Leaves acuminate; cauline leaves ovate, subcordate at the base 21. procurre
17 Leaves obtuse; cauline leaves oblong, attenuatepetiolate
22. vochinensis

15 Leaves dentate to entire, pubescent to glabrous, but never with medifixed hairs
18 Leaves apiculate; plant glabrous, except for unbranched, setiform hairs on the leaf-margins; siliqua 3-4 times as long as wide
24. scopoliana

18 Leaves acute to obtuse; plant pubescent, or if glabrous, the leaf-margin with some branched hairs; siliqua many times as long as wide
19 Cauline leaves cordate, auriculate or sagittate at the base
20 Flowers yellowish; siliquae patent onerect pedicels
28. subflava

20 Flowers white; siliquae not patent on erect pedicels
21 Fruiting pedicels erect; siliquae usually closely appressed to the axis of the infructescence
(5-9). hirsuta group
21 Fruiting pedicels patent; siliquae not appressed
22 Plant entirely glabrous and glaucous 4. pauciflora
22 Plant pubescent
23 Biennial without vegetative leaf-rosettes; petals $4-6 \mathrm{~mm}$ 18. nov
23 Perennial with vegetative leaf-rosettes; petals $6-18 \mathrm{~mm} \quad$ (32-33). alpina gr
19 Cauline leaves rounded at the base to attenuatepetiolate
24 Cauline leaves 1-4; flowers 3-10
25 Leaves sinuate-dentate, coriaceous; hairs mostly unbranched 27. strict
25 Leaves dentate towards the apex or entire, soft or brittle; hairs mostly branched
26 Basal leaves with 2-5 prominent apical teeth; petals blue; siliqua 2.5 mm or more wide, bluish when immature 29. caerule
26 Basal leaves with 1 or 2 obscure apical teeth, or $\pm$ entire; petals white or pink; siliqua up to 2.2 mm wide, green
27 Lowermost cauline leaf rounded at the base; infructescence compact; siliqua at least 1.5 mm wide
30. pumila

27 Lowermost cauline leaf attenuate at the base; infructescence lax; siliqua up to 1.2 mm wide 11. serpillifolia
24 Cauline leaves 4 or more; flowers more than 10
Plant glabrous, dark green and shining, rarely leaves somewhat hairy on the surface or margin; siliqua $25-50 \times 1.8-2.2 \mathrm{~mm}$; seed broadly winged all round 31. soyeri
28 Plant pubescent or, if glabrous, dull green; siliqua more than 50 mm long or less than 1.8 mm wide; seed unwinged or narrowly winged on edges or at apex
29 Fruiting pedicels $\pm$ patent; young siliquae overtopping open flowers; seed $\pm$ unwinged
30 Basal leaves in a compact rosette; hairs mostly unbranched or 2 -fid; axis of infructescence straight
10. corymbiflora

30 Basal leaves not in a compact rosette; hairs mostly stellate; axis of infructescence flexuous 11. serpillifolia
29 Fruiting pedicels erect; young siliquae not overtopping open flowers; seed winged at least at apex
31 Apex of leaves acute or obtuse; flowers usually more than 20 ; petals $4-6 \mathrm{~mm}$
(5-9). hirsuta group
31 Apex of leaves rounded; flowers not more than 20; petals $6-10 \mathrm{~mm}$
32 Cauline leaves narrow, oblong; petals 68 mm , cuneate; pedicels $4-8 \mathrm{~mm}$ in fruit
12. muralis

32 Cauline leaves broad, ovate; petals $8-10 \mathrm{~mm}$, spathulate; pedicels $8-12 \mathrm{~mm}$ in fruit
13. collina

1. A. glabra (L.) Bernh., Syst. Verz. Erfurt 1: 195 (1800) (A. perfoliata Lam., Turritis glabra L.). Biennial $60-120 \mathrm{~cm}$, unbranched and strictly erect, pubescent only at the base. Basal leaves sinuate-dentate to lyrate, with stellate hairs; cauline leaves ovate-lanceolate, sagittate, glabrous and glaucous. Petals 4 6 mm , pale yellow. Infructescence strict; siliqua $40-70 \times 1 \cdot 0$ 1.5 mm , tetragonous, with prominent median veins; pedicels $6-10 \mathrm{~mm}$, erect. Seeds in 2 rows in each loculus. $2 n=12,16,32$. Throughout Europe except the extreme north and south. Al Au

Br Bu ?Co Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Su Tu.
2. A. pseudoturritis Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 20 (1853) (Turritis pseudoturritis (Boiss. \& Heldr.) Velen.). Like 1 but $40-70 \mathrm{~cm}$; lower cauline leaves sparsely pubescent; infructescence lax; siliqua $50-80 \times 0.8-1.2 \mathrm{~mm}$, somewhat compressed; seeds in one row in each loculus. $C . \& S$. Italy, Sicilia and the Balkan peninsula. Al Bu Gr It Ju Si.
3. A. laxa Sibth. \& Sm., Fl. Graec. Prodr. 2: 28 (1813) (Turritis laxa (Sibth. \& Sm.) Hayek). Like 1 but $50-80 \mathrm{~cm}$, often branched above; cauline leaves oblong, cordate, often sparsely ciliate; petals c. 4 mm , white or lilac; siliqua $70-120 \times 1.5-2.0 \mathrm{~mm}$, compressed-tetragonous, patent or unilaterally deflexed; pedicels $10-15 \mathrm{~mm}$; seeds in $1-2$ rows in each loculus. Greece and S. Jugoslavia. Gr Ju. (S.W. Asia.)
4. A. pauciflora (Grimm) Garcke, Fl. Nord Mittel-Deutschl. ed. 4, 22 (1858) (A. brassicaeformis Wallr.). Perennial $30-100 \mathrm{~cm}$, glabrous and glaucous. Basal leaves ovate, entire, long-petiolate; cauline leaves sessile, panduriform; upper lanceolate, auriculate and amplexicaul. Petals 4-7 mm, white or pink. Siliqua $30-80 \times$ $1.5-2 \mathrm{~mm}$, somewhat compressed, erect; pedicels patent. S.W. \& S. Europe, extending to S. Italy and N. Jugoslavia. Au Be $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju}$.
(5-9). A. hirsuta group. Stiffly erect with stems tapering upwards. Basal leaves attenuate-petiolate, entire to dentate; cauline leaves ovate to linear-lanceolate, subentire to serratedentate. Flowers (15-)25-55; petals $4-6.5 \mathrm{~mm}$, white; infructescence compact. Siliquae 18-60 $\times 0.6-1 \cdot 9 \mathrm{~mm}$, erect, not exceeding the open flowers; pedicels up to 10 mm , erect; valves flat to somewhat torulose; style obconical or stigma sessile. Seeds winged at least at the apex.
1 Biennial; cauline leaves sagittate at the base
2 Auricles amplexicaul; base of stem with numerous 2- to 3-fid hairs and few or no unbranched hairs
3 Fruiting pedicels $3-12 \mathrm{~mm}$; seeds winged all round 7. borealis
3 Fruiting pedicels $3-7 \mathrm{~mm}$; seeds winged at apex 5. planisiliqua
2 Auricles spreading; base of stem with numerous unbranched hairs and few 2- to 3-fid hairs 6. sagittat
1 Usually perennial; cauline leaves cordate or rounded at the base
4 Stem hairy (rarely glabrous); petals up to 6 mm ; pedicels $3-8 \mathrm{~mm}$ in fruit 8. hirsuta
4 Stem glabrous; petals 6 mm or more; pedicels $6-12 \mathrm{~mm}$ in fruit
9. allionii
5. A. planisiliqua (Pers.) Reichenb., Ic. Fl. Germ. 2: 13 (1847) (A. gerardii Besser ex Koch). Biennial $50-80 \mathrm{~cm}$, branched above, frequently reddish; lower part of the stem with small, almost sessile 2- to 3 -fid hairs whose long branches are appressed; upper part glabrous. Cauline leaves 20-55, sagittate with appressed auricles; at least the lower leaves with 2 - to 3 -fid hairs whose branches are shorter than their stalks. Petals $4-5 \mathrm{~mm}$. Siliqua $30-50 \times 0.6-0.9 \mathrm{~mm}$, torulose; pedicels $3-7 \mathrm{~mm}$, erect; valves with weak median vein or almost veinless; style c. 1 mm , cylindrical. Seed winged at apex. $2 n=16$. Calcareous fens. Most of Europe except Scandinavia. Au Co Cz Ga Ge He Ho Hs Hu It Ju Po Rm Rs (N, B, C, W, K, E) [Su].
6. A. sagittata (Bertol.) DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 592 (1815). Biennial $35-80 \mathrm{~cm}$, branched above; lower part of the stem with mostly patent unbranched hairs, upper part
glabrous. Cauline leaves 15-30, cordate to sagittate with spreading auricles, pubescent with simple or 2 -fid hairs. Petals $5-6.5 \mathrm{~mm}$. Siliqua $25-50 \times 0.8-1 \cdot 1 \mathrm{~mm}$, erect; pedicels 4-6 mm; valves with a distinct median vein; style c. 0.5 mm , obconical, or stigma sessile. Seed narrowly winged, at least at apex. $2 n=16$. Dry calcareous slopes. C. \& S. Europe. Al Au ?Be Co Cz Ga Ge Gr He Ho Hs Hu It Ju Lu Rm Rs (N, B, C, K, E) Sa Si.

The hybrid between this species and 8 is sterile.
A. Iusitanica Boiss., Diagn. Pl. Or. Nov. 3 (1): 20 (1853), from Portugal is like 6 but is smaller, sparsely hairy, with small, mostly cruciform appressed hairs; infiorescence few-flowered and has $2 n=16$. It is perhaps a subspecies of 6 .
7. A. borealis Andrz. ex Ledeb., Fl. Altaica 3: 25 (1831). Like 6 but the lower part of the stem with numerous 2 - to 3 -fid and a few unbranched hairs; upper part of stem, and leaves, pubescent with 2 - to 5 -fid hairs; auricles amplexicaul; siliqua $40-65 \times 0.5-1.5 \mathrm{~mm}$; pedicels $5-20 \mathrm{~mm}$; style $0.5-0.8 \mathrm{~mm}$; seeds distinctly winged all round. Dry calcareous slopes. N. Russia. Rs (N) [Fe].
8. A. hirsuta (L.) Scop., Fl. Carn. ed. 2, 2: 30 (1772). Short-lived perennial, rarely biennial, (4-)10-60(-110) cm, often with several flowering stems and branched above; lower part of the stem with mostly patent, unbranched or 2 -fid hairs, sometimes glabrous, upper part usually with 2 - to 5 -fid hairs. Cauline leaves $10-$ $22(-30)$, subcordate, rounded or truncate at base. Petals 4 5.5 mm . Siliqua $15-35 \times 1-1.9 \mathrm{~mm}$; pedicels $3-8 \mathrm{~mm}$, erect; valves with distinct median vein; style c. 0.5 mm , conical, or stigma sessile. Seeds $0 \cdot 9-1.3 \mathrm{~mm}$, winged all round. $2 n=32$. Wet rocks on mountains; dry calcareous slopes; calcareous dunes. Most of Europe. Al Au Be Bl Br Bu Co Cz Da Fe Ga Ge Hb He Ho Hs Hu It ?Ju Lu No Po RmRs (N, B, C, W, K, E) Sa Si Su Tu.

A polymorphic species with numerous genetically distinct variants. At least three of these may warrant recognition as subspecies:
A. brownii Jordan, Ann. Soc. Linn. Lyon ser. 2, 7: 491 (1861). 20 cm , usually glabrous except for unbranched and 2-fid hairs on the leaf-margin. Cauline leaves few. Flowers few. Siliquae in a very compact cluster, shorter and broader than in typical $A$. hirsuta. $2 n=32$. Dunes in W. Ireland. Hb.
A. hornungiana Schur, Enum. Pl. Transs. 43 (1866). Shorter than 8 ; stems always unbranched. Cauline leaves smaller, narrower, oblong (not ovate), auriculate, dentate. Petals $5-7 \mathrm{~mm}$. Siliqua ( $25-$ ) $35-45(-60) \times 1 \cdot 2-1.7 \mathrm{~mm}$. Seeds $1.3-$ 1.7 mm . Carpathians and N. Balkan peninsula. Ju ?Po Rm Rs (W).
A. sadina (Samp.) Coutinho, Fl. Port. 253 (1913). Like 8 but hairs stellate and branched, appressed; siliqua erecto-patent. - C. Portugal (Estremadura).
9. A. allionii DC. in Lam. \& DC., Fl. Fr. ed. 3, 4: 676 (1805) (A. sudetica Tausch, A. constricta Griseb.). Perennial $20-45 \mathrm{~cm}$, usually unbranched; stems glabrous. Basal leaves glabrous, sometimes sparsely pubescent, with simple and 2 -fid hairs on the margin and veins beneath; cauline leaves $c .10$, subcordate, glabrous but ciliate on the margin. Petals $6-7 \mathrm{~mm}$. Siliqua $25-35 \times 1.2-1.8 \mathrm{~mm}$, erect; pedicels $6-12 \mathrm{~mm}$; valves with distinct median vein. Seeds almost unwinged. Wet alpine rocks. - ?Pyrenees, Alps, Carpathians and mountains of the Balkan peninsula. Al Au Bu CzGaGe Gr Hs It Ju Po Rs (W).
A. juressi Rothm., Agron. Lusit. 2: 79 (1940), from N. Portugal (Serra do Gerês), is like 9 but with siliqua $60-70 \times 1.5 \mathrm{~mm}$, rigid, torulose, obtuse; pedicels up to 15 mm . It may be a subspecies of 9 or even of 12 .
10. A. corymbiflora Vest., Steyerm. Zeitschr. 3: 161 (1821) (A. arcuata Shuttlew.). Biennial or perennial $6-30 \mathrm{~cm}$, stiffly erect, pubescent with mostly unbranched and 2 -fid hairs or glabrous. Stem robust, straight, unbranched, not tapering appreciably before the insertion of the first flowers. Basal leaves shortly attenuate-petiolate, obovate, denticulate, with unbranched or branched hairs, or glabrous and with branched hairs along the margin; cauline leaves $3-9$, rounded at the base, ovate to elliptic, entire or denticulate. Flowers $c .30$; petals $3 \cdot 5-$ 5 mm , white. Infructescence somewhat compact; siliqua 12-$22(-30) \times 1-1.3 \mathrm{~mm}$, more or less erect, exceeding the flowers when immature, often arcuate; pedicels $4-7 \mathrm{~mm}$, patent; valves somewhat rounded on the back, with a distinct median vein; style conical. Seeds unwinged. $2 n=16$. Alpine rocks, slopes and gravels. - Pyrenees, Appennini and mountains of C. Europe. $\mathrm{Al} \mathrm{Au} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{?Rm} \mathrm{[Da]}$.
11. A. serpillifolia Vill., Prosp. Pl. Dauph. 39 (1779) (incl. A. nivalis Guss.). Biennial or perennial $5-25 \mathrm{~cm}$, laxly caespitose; stems slender, usually flexuous, glabrous or minutely stellatepubescent. Basal leaves long-petiolate, oblong, stellate-pubescent or glabrous, with unbranched and 2 -fid hairs on the margin; cauline leaves $3-5$, oblong-ovate, entire, the lower attenuate, the upper rounded at the base. Flowers $7-16$; petals $4-6 \mathrm{~mm}$, white or rarely pink. Infructescence more or less lax; siliqua $15-30 \times 1-$ 1.2 mm , equalling the flowers when immature; pedicels $2-4 \mathrm{~mm}$; valves flat, with indistinct vein. Seeds unwinged. Mountains of S. Europe, extending northwards through the Alps to the French Jura. AlCr Ga He Hs It Ju.
(a) Subsp. serpillifolia: Stem pubescent at base. Leaves pubescent. Petals $5-6 \mathrm{~mm}$, white. Siliqua $20-30 \mathrm{~mm}$; pedicels $3-4.5 \mathrm{~mm}$. Pyrenees, Jura, Alps.
(b) Subsp. nivalis (Guss.) B. M. G. Jones, Feddes Repert. 69: 60 (1964) (A. nivalis Guss.): Stem glabrous. Leaves more or less glabrous with a ciliate margin. Petals $4-5 \mathrm{~mm}$, white or pink. Siliqua $15-25 \mathrm{~mm}$; pedicels $2-3 \mathrm{~mm}$. C. \& S. Appennini and $W$. Balkan peninsula.
(c) Subsp. cretica (Boiss. \& Heldr.) B. M. G. Jones, Feddes Repert. 69: 60 (1964) (A. cretica Boiss. \& Heldr.): Stem pilose. Leaves with mostly unbranched hairs. Petals $5-7 \mathrm{~mm}$, pink. Siliqua $35-50 \mathrm{~mm}$. Kriti.
12. A. muralis Bertol., Rar. Lig. Pl. 2: 37 (1806). Perennial $10-30 \mathrm{~cm}$, pale green, often branched from the base; stem pubescent below, glabrous above. Basal leaves shortly attenuatepetiolate, obovate, obtusely and deeply dentate, rounded at the apex, with branched hairs (sometimes setose on the margin); cauline leaves $6-14$, rounded at the base, oblong, the uppermost scarcely broader than the stem. Flowers $8-14$; petals $6-8 \times 2-3$ mm , erect, cuneate, white or rarely pink. Infructescence strict; siliqua $30-70 \times 1.2-1.8 \mathrm{~mm}$; pedicels $4-8 \mathrm{~mm}$; valves with an indistinct median vein; style $0 \cdot 5-1 \mathrm{~mm}$. - S. \& S.C. Europe. Al ?Bl Bu Co Cr Ga Gr He Hs It Ju Sa Si [Be].
13. A. collina Ten., Prodr. Fl. Nap. xxxix (1811). Like 12 but stems often branched above; basal leaves long-petiolate; lower cauline leaves broadly ovate, upper lanceolate, all much wider than the stem; flowers $10-18$; petals $8-10 \times 3-4 \mathrm{~mm}$, spathulate, with a somewhat patent limb, purplish, pink or white; siliqua
$60-90 \times 1 \cdot 6-2 \cdot 2 \mathrm{~mm}$, arcuate; pedicels $8-12 \mathrm{~mm}$; style $1-2 \mathrm{~mm}$. Mediterranean region. Co ? Ga Gr Hs It Si .

Although they are usually quite distinct, $\mathbf{1 2}$ and $\mathbf{1 3}$ are connected by intermediates and for this reason are often regarded as subspecies.
14. A. turrita L., Sp. Pl. 665 (1753). Biennial or perennial $20-$ 80 cm , pubescent. Basal leaves long-petiolate, obovate, regularly sinuate or denticulate; cauline leaves sessile, with a cordate, amplexicaul base, panduriform below to oblong above, apex obtuse. Petals $6-8 \mathrm{~mm}$, pale yellow. Infructescence elongate, unilateral; siliqua $100-140 \times 2.1-2.7 \mathrm{~mm}$, with thickened margins, at first erect, arcuate when ripe; pedicels erect. $2 n=16 . C . \& S$. Europe. Al Au Be Bu Co Cz Ga Ge Gr He Hs Hu It Ju Rm Rs (C, W, K) Si [Br].
15. A. mollis Steven, Mém. Soc. Nat. Moscou 3: 270 (1812) (A. christianii N. Busch). Perennial $15-40 \mathrm{~cm}$, densely pubescent with short, branched hairs. Basal leaves long-petiolate, cordate at the base, ovate, coarsely crenate; cauline leaves sessile, amplexicaul. Petals $7-10 \mathrm{~mm}$, white. Siliqua $25-55 \times 2-2.5 \mathrm{~mm}$, contracted between the seeds; pedicels patent. Bulgaria. Bu ?Rs (K).
16. A. pendula L., Sp. Pl. 665 (1753). Biennial $50-90 \mathrm{~cm}$, hispid. Lower leaves long-petiolate, rhombic; upper leaves sessile, auriculate and amplexicaul, oblong-lanceolate. Petals $3-4 \mathrm{~mm}$, white. Siliqua $50-80 \times 2-3 \mathrm{~mm}$, unilaterally deflexed; pedicels $15-25 \mathrm{~mm}$, slender, deflexed; valves with a prominent median vein. Seeds in 1-2 rows in each loculus. S.E. Russia. Rs (C, W, E). (Temperate Asia.)
17. A. recta Vill., Hist. Pl. Dauph. 3: 319 (1788) (A. auriculata sensu DC., non Lam.). Annual $10-30 \mathrm{~cm}$, pubescent; stem simple or branched above. Basal leaves petiolate, ovate or obovate, entire; cauline leaves $6-20 \mathrm{~mm}, 5-14$, sessile, auriculate, ovate to oblong, rounded at the apex. Flowers 7-40; pedicels up to 5 mm ; petals $2-3.5 \mathrm{~mm}$, white. Infructescence lax, flexuous; siliqua 10 $35 \times 0.6-1 \mathrm{~mm}$, glabrous to puberulent, patent; pedicels $2-5 \mathrm{~mm}$, style up to 0.5 mm . Seeds up to 1 mm , unwinged, brown. Europe, except the north. Al Au Bu Cr Cz Ga Ge Gr He Hs Hu It Ju Po Rm Rs (B, C, W, K, E) Sa Si [Be].
18. A. nova Vill., Prosp. Pl. Dauph. 39 (1779) (A. saxatilis All., A. auriculata Lam.). Like 17 but often biennial, $20-50 \mathrm{~cm}$, unbranched; cauline leaves $10-40 \mathrm{~mm}$, ovate to lanceolate, acute; pedicels more than 3 mm at anthesis; petals $4-6 \mathrm{~mm}$; infructescence straight; siliqua $25-70 \times 1.5 \mathrm{~mm}$; pedicels slender, $5-$ 16 mm ; style $0.5-1 \mathrm{~mm}$; seed $1.2-1.5 \mathrm{~mm}$, narrowly winged. - Pyrenees, Alps, Jura and Balkan peninsula. Au Bu Ga He Hs It Ju.
A. reverchonii Freyn in Willk., Suppl. Prodr. Fl. Hisp. 302 (1893) from E.C. Spain is like 18 but larger (to 70 cm ), branched above; leaves dentate; seeds $c .0 .5 \mathrm{~mm}$, unwinged. Its status is doubtful.
19. A. parvula Dufour in DC., Reg. Veg. Syst. Nat. 2: 228 (1821). Like 17 but smaller ( $10-20 \mathrm{~cm}$ ); cauline leaves $10-25 \mathrm{~mm}$, attenuate at the base, ovate; flowers subsessile at anthesis; infructescence rigid, weakly flexuous, more elongate; siliqua 20 $30 \times 1 \cdot 5-2 \mathrm{~mm}$, erect, stellate-puberulent; pedicels $2-4 \mathrm{~mm}$, as thick as the siliqua; seeds dark brown. C. \& S. Spain. Hs. (N.W. Africa.)
20. A. verna (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 105 (1812). Like 17 but 5-40 cm, frequently with several flowering stems from the rosette; cauline leaves few (often only 1 or 2 ), cordate at the base, ovate, serrate; flowers very few (up to 10); pedicels less than 2 mm at anthesis; petals $5-8 \mathrm{~mm}$, pale violet with a yellowish claw, or white; siliqua $45-60 \times 1.5-2 \mathrm{~mm}$; pedicels thick; stigma sessile; seeds narrowly winged. Mediterranean region. Al Bl Bu Co Cr Ga Gr Hs It Ju Sa Si Tu.
21. A. procurrens Waldst. \& Kit., Pl. Rar. Hung. 2: 154 (1803). Perennial $8-30 \mathrm{~cm}$, with long stolons; stems glabrous. Basal leaves $20-30 \mathrm{~mm}$, obovate to oblanceolate, acuminate, entire, glabrous except for the margin and the veins of the lower surface which have medifixed hairs; cauline leaves rounded at the base, ovate. Petals $8-10 \mathrm{~mm}$, white. Infructescence lax; siliqua 12$35 \times 1-1.5 \mathrm{~mm}$, patent; pedicels more than 10 mm . Carpathians and mountains of the Balkan peninsula. $\mathrm{Bu} \mathrm{Cz} \mathrm{Ju} \mathrm{Rm}$.
22. A. vochinensis Sprengel, Pl. Min. Cog. Pug. 1: 46 (1813). Like 21 but smaller (up to 15 cm ), lacking long stolons; stems with appressed 2-fid hairs; basal leaves up to 15 mm , obtuse, in compact rosettes, cauline leaves attenuate at the base, oblong; petals $5-7 \mathrm{~mm}$; siliqua $8-15 \times 1.5-2 \mathrm{~mm}$; pedicels not more than 10 mm . S.E. Alps. Au It Ju.
23. A. ferdinandi-coburgi J. Kellerer \& Sünd. in Sünd., Allgem. Bot. Zeitschr. 1903: 62 (1904). Like 21 but basal leaves longpetiolate, narrowly oblong to lanceolate; cauline leaves lanceolate; leaves pubescent on both sides; siliqua $15-20 \times 0.8 \mathrm{~mm}$.

- Bulgaria (Pirin). Bu.

24. A. scopoliana Boiss., Ann. Sci. Nat. ser. 2, 17: 56 (1842). Perennial 3-10 cm, without stolons, glabrous except for the leafmargins. Basal leaves up to 15 mm , attenuate-petiolate, obovate, acuminate, entire, setose-ciliate; cauline leaves attenuate at the base, oblong. Petals $7-11 \mathrm{~mm}$, white. Infructescence compact; siliqua 6-10×2-2.5 mm, subterete, erect; valves keeled. - S.E. Alps and mountains of W. Balkan peninsula. A1 It Ju.

This species has been placed in Draba, from which it differs in having the seeds in 1 row in each loculus. It has also been made the basis of a monotypic genus Dollineria Sauter.
25. A. bryoides Boiss., Ann. Sci. Nat. ser. 2, 17: 55(1842). Perennial $2-6 \mathrm{~cm}$, tomentose. Basal leaves attenuate at the base, ovate, acuminate, lamina usually densely pubescent, the hairs unbranched, ciliate at the apex; cauline leaves absent. Flowers 3-6; petals $6-7 \mathrm{~mm}$, white. Infructescence lax; siliqua $10-20 \times$ 1.5 mm ; style up to 1 mm . Mountains of the S. Balkan peninsula. Al Gr Ju.
26. A. longistyla Rech. fil., Feddes Repert. 43: 150 (1938). Perennial $6-15 \mathrm{~cm}$; almost glabrous; stems several from the rosette, glabrous except at the base. Basal leaves attenuatepetiolate, obovate-lanceolate, fleshy, denticulate, glabrous; cauline leaves absent. Petals $3-4 \mathrm{~mm}$, cuneate, white. Siliqua $12-18 \times$ c. 1.5 mm ; pedicels $3-6 \mathrm{~mm}$, patent; style $1.5-2 \mathrm{~mm}$. - Karpathos. Cr.
27. A. stricta Hudson, Fl. Angl. ed. 2, 292 (1778) (A. scabra All.). Perennial $5-25 \mathrm{~cm}$, scabrid, with a few unbranched hairs (sometimes with 2 -fid hairs on the leaf-margin). Flowering stems often several from the rosette, unbranched. Basal leaves coriaceous, dark green, glossy, attenuate-petiolate, oblong, sinuate-dentate with 2-8 teeth; cauline leaves $1-3$, rounded at the base. Flowers $3-9$; petals $5-8 \mathrm{~mm}$, yellowish. Siliqua $35-50 \times 1 \cdot 5-1 \cdot 8 \mathrm{~mm}$, erect;
pedicels patent. $2 n=16$. Mountains of N. Spain, Pyrenees, French Alps, Jura; also S.W. England. *Br Ga Hs.
28. A. subflava B. M. G. Jones, Feddes Repert. 69: 60 (1964) (A. ochroleuca Boiss. \& Heldr., non (Lam.) Lam.). Like 27 but $10-15 \mathrm{~cm}$; pubescent on the upper surface of leaves and on veins beneath, the hairs branched; basal leaves runcinate-pinnatifid; cauline leaves sagittate at the base; siliqua $20-30 \times c .1 \mathrm{~mm}$, patent; pedicels erect. - Mountains of Greece and Makedonija. Gr Ju.
29. A. caerulea (All.) Haenke in Jacq., Collect. Bot. 2: 56 (1789). Perennial $5-15 \mathrm{~cm}$, pubescent or glabrous. Basal leaves attenuate-petiolate, obovate, with $2-5$ distinct, obtuse, apical teeth; cauline leaves few (1-3), cuneate at base. Flowers 4-10; petals $4-5 \mathrm{~mm}$, pale blue. Infructescence compact; siliqua 10 $30 \times 2 \cdot 4-3 \cdot 2 \mathrm{~mm}$, strict, at first exceeding the flowers, bluish when immature. $2 n=16$. Alpine rocks and moraines. Alps. Au Ga Ge He It Ju.
30. A. pumila Jacq., Fl. Austr. 3: 44 (1775). Perennial $5-18 \mathrm{~cm}$, usually pubescent below. Leaves with branched hairs, at least on the margin; the basal attenuate-petiolate, obovate, with 1 or 2 faint teeth, or entire; the cauline $1-4$, rounded at the base, oblong-ovate. Flowers $3-10$; petals $6-7 \mathrm{~mm}$, white. Siliqua $20-$ $40 \times 2 \mathrm{~mm}$; at first exceeding the flowers; pedicels $4-9 \mathrm{~mm}$, erect. - Alps, Appennini. Au Ga Ge He It Ju.
31. A. soyeri Reuter \& Huet, Ann. Sci. Nat. ser. 3, 19: 251 (1853). Perennial $15-50 \mathrm{~cm}$, almost glabrous; leaves occasionally pubescent. Basal leaves dark green and glossy, attenuate-petiolate, obovate, denticulate; cauline leaves $4-10$, rounded at the base, ovate to oblong-lanceolate, entire. Flowers 10-20; petals 5.57 mm , white. Infructescence compact; siliqua $25-50 \times 1 \cdot 8-2 \cdot 2 \mathrm{~mm}$; pedicels $8-15 \mathrm{~mm}$; valves with a distinct median vein. Pyrenees, Alps, W. Carpathians. Au Cz Ga Ge He Hs It Ju Po Rm.
(a) Subsp. soyeri : Stem sparsely hairy. Leaves thin, ciliate on the margin with simple hairs; cauline leaves more or less amplexicaul. Pyrenees.
(b) Subsp. jacquinii (G. Beck) B. M. G. Jones, Feddes Repert. 69: 59 (1964) (A. bellidifolia Jacq., non Crantz, A. jacquinii G. Beck): Stem glabrous; leaves fleshy glabrous. Cauline leaves not amplexicaul. $2 n=16$. Alps, W. Carpathians.
(32-33). A. alpina group. Perennial, branched below, with vegetative rosettes and unbranched flowering stems. Basal leaves attenuate-petiolate, oblong or obovate, dentate; cauline leaves ovate to lanceolate. Outer sepals conspicuously saccate at base; petals $6-18 \mathrm{~mm}$, white (rarely pink). Infructescence lax; siliqua $20-70 \times 1 \cdot 5-2.5 \mathrm{~mm}$, patent.

The following 2 polymorphic species are connected by intermediates, but plants typical of the 2 species are not interfertile. Some populations and local races have been given specific status; they may represent isolated biotypes of a variable species once widespread in the N. Hemisphere, subsequently broken up during successive interglacial periods.
Cauline leaves $\pm$ cordate; petals $6-10 \mathrm{~mm}$; siliqua $20-35 \mathrm{~mm}$
32. alpina

Cauline leaves $\pm$ sagittate; petals $9-18 \mathrm{~mm}$; siliqua $40-70 \mathrm{~mm}$
33. caucasica
32. A. alpina L., Sp. Pl. 664 (1753). 5-40 cm, erect or ascending, with few rosettes, usually sparsely and coarsely stellatehairy. Basal leaves greenish, coarsely dentate with 4-7 acute

[^115]teeth on each side; cauline leaves cordate to auriculate at the base, the apex acute; axis of inflorescence and pedicels usually pubescent. Sepals $3-5 \mathrm{~mm}$; petals $6-10 \times 2-3.5 \mathrm{~mm}$, spathulate, somewhat patent. Siliqua $20-35 \times 1 \cdot 4-2 \mathrm{~mm}$; pedicels $6-15 \mathrm{~mm}$; valves with an indistinct median vein. Seeds conspicuously winged. $2 n=16,32$. Moist montane rocks and gravels; also arctic wastes. Much of Europe but rare or absent from most of the east. Al Au Br Bu Co Cz Fe Ga Ge ? Gr He Hs Hu Is It Ju No Po Rm Rs (N, W) Sb Su.
33. A. caucasica Schlecht. in Willd., Enum. Pl. Hort. Berol. suppl., 45 (1813) (A. albida Steven). $15-35 \mathrm{~cm}$, procumbent, with many rosettes, usually softly and densely pubescent. Basal leaves grey-green or whitish, with 2-5 obtuse teeth on each side; cauline leaves auriculate to sagittate at the base. Axis of inflorescence and pedicels usually glabrous; sepals $5-8 \mathrm{~mm}$; petals $9-18 \times 5-$ 8 mm , with a widely patent limb abruptly contracted into a long claw. Siliqua $40-70 \times 1.6-2.4 \mathrm{~mm}$, somewhat constricted between the widely spaced seeds; pedicels $10-20 \mathrm{~mm}$; valves with a distinct median vein. Seeds wingless or with a narrow inconspicuous wing. $2 n=16$. Dry rocks. S. Europe; often naturalized elsewhere. Al Bu Cr * Ga Gr It Ju Rs (K) Si [Au Be Br Ge Ho].

This species, which flowers earlier than 32, is widely cultivated in gardens and frequently escapes.
34. A. cebennensis DC., Reg. Veg. Syst. Nat. 1: 234 (1817). Perennial $40-80 \mathrm{~cm}$, sparsely pubescent, branched above. Basal leaves petiolate-ovate, longer than wide, coarsely dentate, with an acute apex and cuneate or truncate base; uppermost cauline leaves attenuate-petiolate. Petals $7-10 \mathrm{~mm}$, pale or deep violet or white, somewhat patent. Siliqua $30-45 \times 1-1.5 \mathrm{~mm}$; pedicels patent. - Mountains of S. France. Ga.
35. A. pedemontana Boiss., Diagn. Pl. Or. Nov. 1 (1): 69 (1843). Like 34 but $15-30 \mathrm{~cm}$, smaller in all its parts; glabrous or almost so; basal leaves lyrate-pinnatifid to hederiform or orbicular, as wide as long, with an obtuse apex; petals $6-7 \mathrm{~mm}$, white. - Mountains of Piemonte. It.

34 and 35 may belong to the genus Cardaminopsis.

## 44. Aubrieta Adanson ${ }^{1}$

Perennial herbs; hairs stellate or of two kinds, stellate and unbranched, rarely glabrous. Leaves simple. Inner sepals saccate; petals pink to violet, long-clawed; filaments of the outer stamens with a dentate appendage. Fruit a siliqua, rarely a silicula; valves with a median vein; style distinct, stigma capitate. Seeds in 2 rows in each loculus.

All the species are montane or alpine, occurring on rocks and screes and in coniferous woods.

## Several species are cultivated for ornament.

Species limits within the genus are critical, and the characters used to define the species require experimental investigation. Some are known to hybridize readily in cultivation, but the majority are allopatric, so that hybrids do not often occur in the wild.

Literature: J. Mattfeld, Blätt. für Staudenk. 1: fols. 1-7 (1937) and Bull. Alp. Gard. Soc. 7: 157-81, 217-27 (1939).

1 Siliqua with long unbranched hairs as well as branched hairs

1. deltoidea

1 Siliqua with stellate hairs only
2 Siliqua $20-35 \mathrm{~mm}, 6-15$ times as long as wide
2 Siliqua less than $20 \mathrm{~mm}, 2-6$ times as long as wide
3 Valves of the siliqua reticulate-veined
3 Valves of the siliqua without veins or with only a single median vein
4 Stem and leaves whitish-grey with very dense $\pm$ appressed hairs (Skiros)
3. scyria

4 Stem and leaves green or grey-green; hairs $\pm$ patent, or sparse
5 Sepals 4-5.5 mm; petals 8-11 mm, white, becoming pink or lilac (Athos)
4. erubescens

5 Sepals more than 6 mm ; petals usually more than 12 mm , purple or violet, rarely white
6 Siliqua usually not more than $12 \mathrm{~mm}, 2-4(-5)$ times as long as wide, usually not strongly compressed
2. columnae

6 Siliqua (12-)13-18(-20) mm, usually 4-6 times as long as wide, strongly compressed
5. intermedia

1. A. deltoidea (L.) DC., Reg. Veg. Syst. Nat. 2: 294 (1821). Variable in habit from caespitose to straggling. Leaves linearspathulate to obovate-cuneate or rhombic, entire or with 1-3 pairs of teeth. Sepals $6-10 \mathrm{~mm}$; petals $12-28 \mathrm{~mm}$, reddish-purple to violet, rarely white. Siliqua $6-16(-22) \times 2 \cdot 5-4 \cdot 5 \mathrm{~mm}, 2-5(-7)$ times as long as wide, with long unbranched and stellate hairs; style $4-8 \mathrm{~mm}$. S. Greece, Aegean region; Sicilia; naturalized in $S . \& W$. Europe. Cr Gr ?Ju Si [Br Ga Ho Hs].

A variable species with a number of geographical varieties which may merit subspecific rank. The more distinct of these may be recognized as follows:

1 Siliqua $20-22 \times 3 \mathrm{~mm}$ (E.C. Greece)
var. cithaeronea Mattf.
1 Siliqua not more than 16 mm
2 Plant usually straggling or laxly caespitose; leaves with 1-3 pairs of teeth; petals $15-28 \mathrm{~mm}$; siliqua with numerous unbranched hairs (Greece, Kriti)
var. deltoidea
2 Plant usually $\pm$ densely caespitose; leaves usually entire; petals $12-18 \mathrm{~mm}$; siliqua with few unbranched hairs
3 Leaves oblong-obovate; petals $15-18 \mathrm{~mm}$; siliqua $8-12 \times$ $3-4.5 \mathrm{~mm}$ (N. Sicilia) var. sicula Strobl
3 Leaves linear-spathulate; petals $12-15 \mathrm{~mm}$; siliqua $6-8 \times$ $3-3 \cdot 5 \mathrm{~mm}$ (Kefallinia, Karpathos) var. microphylla Boiss.
2. A. columnae Guss., Pl. Rar. 266 (1826). More or less caespitose to straggling. Leaves variable. Sepals $5 \cdot 5-8 \mathrm{~mm}$; petals $11-18 \mathrm{~mm}$, purple or violet. Siliqua $5-16 \times 2-4 \cdot 5 \mathrm{~mm}, 2 \cdot 5-$ 4 times as long as wide, the valves usually reticulate-veined; style 3-10 mm. - C. \& S. Italy, Sicilia, Albania, W. Jugoslavia, S.W. Romania. Al It Ju Rm Si.

1 Leaves oblong-spathulate, $\pm$ entire; style $7-10 \mathrm{~mm}$ in fruit
(a) subsp. columnae

1 Leaves obovate-cuneate or rhombic, usually with $1(-2)$ pairs of teeth; style $3-7 \mathrm{~mm}$ in fruit
2 Plant straggling; leaves with 1(-2) pairs of wide teeth near the apex, sometimes entire
(b) subsp. italica

2 Plant $\pm$ caespitose; leaves with a pair of small teeth near the apex
(c) subsp. croatica
(a) Subsp. columnae: More or less caespitose, with slender stems; leaves oblong-spathulate usually entire; petals $11-17 \mathrm{~mm}$; siliqua $5-12 \times 2-4.5 \mathrm{~mm}$; style $7-10 \mathrm{~mm}$.
C. \& S. Appennini.
(b) Subsp. italica (Boiss.) Mattf., Blätt. für Staudenk. 1: fols. 1-7 (1937): Straggling, with stout long stems; leaves broadly obovate-cuneate, with $1(-2)$ pairs of wide teeth near the apex or entire; petals $15-18 \mathrm{~mm}$; siliqua $8-11 \times 3-4 \mathrm{~mm}$; style $4-6 \mathrm{~mm}$. - S. Italy (Monte Gargano; ?Basilicata), Sicilia (Madonie).

[^116](c) Subsp. croatica (Schott, Nyman \& Kotschy) Mattf., loc. cit. (1937) (A. croatica Schott, Nyman \& Kotschy): More or less caespitose; leaves broadly obovate-cuneate or rhombic, with a pair of short teeth just below the apex, the central tooth wider than long; petals $12-18 \mathrm{~mm}$; siliqua $7-16 \times 2.5-4.5 \mathrm{~mm}$; style 3-7 mm. Albania; W. Jugoslavia; S.W. Romania.
3. A. scyria Halácsy, Österr. Bot. Zeitschr. 60: 115 (1910). Caespitose, the whole plant whitish-grey, with dense more or less appressed hairs. Leaves obovate-cuneate, entire or denticulate at the apex. Sepals $c .7 \mathrm{~mm}$; petals $c .11 \mathrm{~mm}$. Siliqua $6-10 \times 2 \cdot 5-$ 3.5 mm ; style $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$. W. Aegean region (Skiros). Gr.
4. A. erubescens Griseb., Spicil. Fl. Rumel. 1: 268 (1843). Habit variable. Leaves oblong-spathulate, entire or with a pair of small teeth. Sepals $4-5.5 \mathrm{~mm}$; petals $8-11 \mathrm{~mm}$, white, becoming pink or lilac. Siliqua $6.5-14 \times 3-4 \mathrm{~mm}, 2-4$ times as long as wide, strongly compressed; style 4-7 mm. - N. Greece (Athos). Gr.
5. A. intermedia Heldr. \& Orph. ex Boiss., Diagn. Pl. Or. Nov. 2 (1): 36 (1853). Habit variable. Leaves obovate to rhombic, with 1-3 pairs of teeth, sometimes spathulate, entire. Sepals 612 mm ; petals ( $12-$ ) $15-22 \mathrm{~mm}$. Siliqua ( $12-$ ) $13-18(-20) \times 2 \cdot 5-$ $4(-5) \mathrm{mm}, 4-6$ times as long as wide, strongly compressed; style $5-11 \mathrm{~mm}$. S. half of Balkan peninsula. Al Bu Gr Ju.

Very variable in habit, leaf-shape and the size of flowers.
6. A. gracilis Spruner ex Boiss., Diagn. Pl. Or. Nov. 1 (1): 74 (1843). More or less caespitose. Leaves linear-lanceolate to oblong-obovate, entire or with a pair of teeth. Sepals $5-7.5 \mathrm{~mm}$; petals $12-18 \mathrm{~mm}$. Siliqua $20-35 \times 2-5 \mathrm{~mm}, 6-15$ times as long as wide, the valves often reticulate-veined; style 4-7 mm. S. half of Balkan peninsula. Al Bu Gr Ju.

Variable in leaf-shape and indumentum of the siliqua.

## 45. Ricotia L. ${ }^{1}$

Annual or perennial herbs; glabrous or with hairs unbranched. Leaves simple, entire to pinnatisect. Sepals erect, the inner saccate at base; petals pink or pale violet, clawed. Fruit a siliqua or latiseptate silicula; style short; stigma capitate.

Literature: B. L. Burtt, Kew Bull. 1951: 123-32 (1951).
Petals $10-12 \mathrm{~mm}$, pink; fruit 5-8 times as long as wide, not winged

> 1. cretica

Petals $c .5 \mathrm{~mm}$, violet or with violet veins; fruit about twice as long
as wide, with a narrow marginal wing
2. isatoides

1. R. cretica Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 29 (1849). Annual $10-25 \mathrm{~cm}$. Leaves 2-pinnatifid or pinnatisect, the upper with ovate or elliptical segments. Petals $10-12 \mathrm{~mm}$, pink. Siliqua $30-50 \times 8-9 \mathrm{~mm}, 5-8$ times as long as wide, not winged. Seeds up to 10 . Cliffs. Kriti. Cr.
2. R. isatoides (W. Barbey) B. L. Burtt, Kew Bull. 1951: 131 (1951) (Peltaria isatoides W. Barbey). Fleshy perennial $15-20 \mathrm{~cm}$. Leaves entire, crenate or pinnatifid with 3-5 lobes. Petals $c .5 \mathrm{~mm}$, pale violet or with violet veins. Silicula $10-12 \times 6-8 \mathrm{~mm}$, about twice as long as wide, with very narrow ( $c .0 .75 \mathrm{~mm}$ ) marginal wing. Seeds usually solitary. Calcareous scree. Karpathos. Cr.

## 46. Lunaria L. ${ }^{1}$

Biennial or perennial herbs; hairs unbranched. Leaves simple, toothed. Sepals erect, the inner saccate at base; petals purple,
rarely white, long-clawed. Fruit a strongly compressed, latiseptate silicula; style short; stigma slightly lobed.
1 Biennial; upper leaves sessile or subsessile, irregularly and coarsely dentate 3. annua
1 Perennial; upper leaves distinctly petiolate, spinulose-dentate or crenate-dentate
2 Saccate base of sepals less than 1 mm ; carpophore of the silicula $25-40 \mathrm{~mm}$; leaves $\pm$ spinulose-dentate 1. rediviva
2 Saccate base of sepals $c .2 .5 \mathrm{~mm}$; carpophore of the silicula c. 1 mm ; leaves crenate-dentate
2. telekiana

1. L. rediviva L., Sp. Pl. 653 (1753). Perennial up to 140 cm . Leaves ovate, acuminate, spinulose-dentate, the uppermost distinctly petiolate. Saccate base of sepals less than 1 mm ; petals (10-) $12-20 \mathrm{~mm}$, pale purple to violet. Silicula $35-90 \times 15-$ 35 mm , elliptical, rarely ovate-elliptical, subacute at base and apex; valves glabrous on the margin; carpophore (20-)2540 mm ; style $1-5 \mathrm{~mm} .2 n=30$. Most of Europe except the extreme north and south. Al Au Be Bu Cz Da Ga Ge He Hs Hu It Ju Lu Po Rm Rs (B, C, W) Sa Su [Br].
2. L. telekiana Jáv., Magyar Bot. Lapok 19: 1 (1922). Like 1 but the leaves dentate-crenate; saccate base of sepals $c .2 .5 \mathrm{~mm}$; petals $c .12 \mathrm{~mm}$; silicula $30-50 \mathrm{~mm}$; valves densely ciliate on the margin; carpophore c. 1 mm . © N.E. Albania (Hekurave, Shkëlzen). Al.
3. L. annua L., Sp. Pl. 653 (1753) (L. biennis Moench). Biennial up to 100 cm . Leaves ovate to lanceolate, acuminate, coarsely and irregularly dentate, the upper sessile or subsessile. Petals $15-25 \mathrm{~mm}$, reddish-purple, rarely white. Silicula $20-70 \times(10-)$ $15-35 \mathrm{~mm}$, oblong-elliptical to suborbicular, rounded at base and apex; carpophore (3-)5-20 mm; style 4-8 mm. Native only in S.E. Europe and possibly Italy, but commonly naturalized or casual elsewhere in Europe. Al Bu Cr Gr It Ju Rm [Au Be Br Co $\mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{Lu} \mathrm{No} \mathrm{Po} \mathrm{Su]}$.

Frequently cultivated for ornament, particularly for the white, shining, persistent septum of the silicula.
(a) Subsp. annua: Plant without fusiform tubers. The cultivated plant, naturalized in many parts of Europe.
(b) Subsp. pachyrhiza (Borbás) Hayek, Prodr. Fl. Penins. Balcan. 1: 425 (1925): Plant with fusiform tubers. Balkan peninsula, Romania and S. Italy.

## 47. Peltaria Jacq. ${ }^{1}$

Perennial herbs; glabrous or with few medifixed hairs. Leaves simple, entire. Sepals patent, not saccate; petals white, shortly clawed. Fruit a pendent, strongly compressed, latiseptate silicula; style short; stigma capitate. (Incl. Leptoplax O. E. Schulz.)
Upper leaves amplexicaul, sessile; silicula rounded at apex

1. alliacea Upper leaves cuneate at base, shortly petiolate; silicula deeply emarginate
2. emarginata
3. P. alliacea Jacq., Enum. Stirp. Vindob. 117 (1762) (P. perennis Markgraf). Stem $20-60 \mathrm{~cm}$, glabrous. Cauline leaves ovate or lanceolate, cordate-sagittate, sessile, amplexicaul. Petals $3 \cdot 5-4.5 \mathrm{~mm}$. Silicula 6-10 $\times 5-9 \mathrm{~mm}$, orbicular to ovate-elliptical, distinctly reticulate-veined when mature. - From E. Austria to S. Romania and Albania. Al Au Hu Ju Rm.
4. P. emarginata (Boiss.) Hausskn., Mitt. Thür. Bot. Ver. nov. ser. 3-4: 111 (1893). Like 1 but often sparsely hairy; cauline

[^117]leaves oblong-spathulate, cuneate, shortly petiolate; petals $c$. 3 mm ; silicula deeply emarginate, obscurely reticulate-veined when mature. C. \& E. Greece. Gr.

## 48. Alyssoides Miller ${ }^{2}$

Perennial herbs; hairs branched or stellate. Sepals erect or erecto-patent, the inner saccate at base; petals yellow, longclawed. Fruit a latiseptate silicula; valves inflated, without a conspicuous median vein; style long; stigma capitate or emarginate. Seeds 4-8 in each loculus, usually winged. (Vesicaria Lam.)

All species occur on rocks, cliffs or on walls.
1 Silicula stipitate; sepals erect

## 1. utriculata

1 Silicula sessile; sepals erecto-patent
$\begin{array}{lll}2 & \text { Sepals } 7-11 \mathrm{~mm} \text {; silicula pubescent } & \text { 2. cretica }\end{array}$
2 Sepals 3-4 mm; silicula glabrous
3. sinuata

1. A. utriculata (L.) Medicus, Philos. Bot. 1: 189 (1789). Perennial with woody, much-branched stock; stems up to 40 cm , simple. Leaves green; those of non-flowering branches petiolate, densely crowded, rosulate, oblong-spathulate, with stellate hairs; those of flowering stems sessile, lanceolate, glabrous, sometimes ciliate. Sepals $8-12 \mathrm{~mm}$; petals 20 mm ; limb suborbicular, entire. Silicula $10-12 \mathrm{~mm}$, ovoid-globose; valves strongly inflated; style $7-10 \mathrm{~mm}$, filiform. Rocks and crevices. S.W. \& W.C. Alps, Appennini, Balkan peninsula, S. Romania. A1 Bu Ga Gr It Ju Rm.

Variable particularly in indumentum. The plants from the Alps are as described above. The plants from Italy (apart from the Alps), Romania and the Balkan peninsula, have bifurcate as well as stellate hairs in the indumentum of the rosette-leaves and are often distinguished as a separate species, A. graeca (Reuter) Jáv., Bot. Közl. 21: 73 (1923), or subspecies; in Bulgaria plants with bifurcate hairs on the cauline leaves and long patent hairs on the pedicels are regarded as var. bulgarica (Sagorski) Hayek.

Other variable characters in this complex are the shape of the petals and longer pedicels but they do not correlate with the indumentum characters.
2. A. cretica (L.) Medicus, Philos. Bot. 1: 189 (1789) (Alyssum creticum L.). Diffuse, woody and much-branched at the base with many rosettes of leaves, grey- or white-tomentose; flowering stems up to 20 cm . Leaves oblanceolate to obovate. Sepals $7-11 \mathrm{~mm}$; petals $12-20 \mathrm{~mm}$, entire. Silicula $10-15 \mathrm{~mm}$, globose or ovoid-globose, pubescent; valves strongly inflated. - Kriti and Karpathos. Cr.
3. A. sinuata (L.) Medicus, loc. cit. (1789) (Alyssum sinuatum L., Vesicaria sinuata (L.) Poiret). Stems $15-50 \mathrm{~cm}$, littlebranched, and woody only at the extreme base, sparsely to densely grey-pubescent. Leaves oblanceolate to lanceolate, the lower often sinuate-dentate. Sepals $3-4 \mathrm{~mm}$; petals $5-8 \mathrm{~mm}$, emarginate. Silicula $7-12 \mathrm{~mm}$, globose or ellipsoidal; valves strongly inflated; style $2-4 \mathrm{~mm}$. - N.W. Balkan peninsula and E. Italy. Al It Ju.

## 49. Degenia Hayek ${ }^{3}$

Perennial herbs; hairs stellate. Sepals erect, the inner slightly saccate at base; petals yellow, long-clawed. Fruit a latiseptate, ellipsoidal silicula; valves inflated; style long; stigma slightly 2 -lobed. Seeds 2 in each loculus, broadly winged.

1. D. velebitica (Degen) Hayek, Österr. Bot. Zeitschr. 60:93 (1910). Caespitose silver-grey perennial with non-flowering
rosettes. Stems up to 10 cm . Leaves few, linear-lanceolate. Flowers $10-12 \mathrm{~mm}$. Siliqua covered with dense, stellate hairs. $2 n=16$. Screes and loose rocks. - N.W. Jugoslavia (Velebit). Ju.

## 50. Alyssum L. ${ }^{1}$

Annual to perennial herbs; hairs branched or stellate, rarely mixed with unbranched hairs; rarely the indumentum lepidote. Sepals erecto-patent, not saccate at base; petals yellow, entire to shallowly bifid; filaments of the long stamens usually winged, of the short stamens usually with an appendage. Fruit a latiseptate silicula; valves without a conspicuous median vein; style distinct but often short; stigma capitate or emarginate. Seeds 1-2(-6) in each loculus, often winged or margined.

The indumentum is said to be dimorphic when it is composed of appressed stellate hairs mixed with long, patent, unbranched or branched hairs or with stellate hairs with some long, patent rays. The measurements given for the diameter of the stellate hairs are for the usually peltate tops of these hairs. Basal leaves are those at the bottom of non-flowering rosettes or stems.

Most species occur in dry, rocky, stony, or sandy places or on cliffs, although species 6-16 often occur as weeds.

A taxonomically difficult genus in which the status and circumscription of many of the taxa differ widely in previously published treatments. This is particularly true in the perennial species of Sect. Alyssum and in Sect. Odontarrhena.

Literature: J. Baumgartner, Jahresb. Landes-Lehrersem. Wiener-Neustadt 34: 1-35 (1907): 35: 1-58 (1908); 36: 1-38 (1909) (Sect. Alyssum). J. Baumgartner, Jahresb. LandesLehrersem. Baden bei Wien 48: 1-18 (1911) (Sect. Alyssum). E. I. Nyárády. Bul. Grăd. Bot. Cluj 7: 1-51, 65-160 (1927), 8: 152-156 (1928), 9: 1-68 (1929) (Sect. Odontarrhena). E. I. Nyárády, Anal. Acad. Române (Sect. Geol., Geogr., Biol.) ser. A, 1 (3): 1-133 (1949) (Sect. Odontarrhena).

1 Ovules and seeds 4 or more in each loculus
2 Annual; lower leaves linear; style $0.3-0.6 \mathrm{~mm} \quad$ 5. linifolium
2 Perennial; lower leaves oblong-oblanceolate to obovate; style $1-2 \mathrm{~mm}$
3 Sepals not more than 2.5 mm ; silicula (3.5-)4.5-5.5 mm

1. corymbosum

3 Sepals $3-3.5 \mathrm{~mm}$; silicula $7-10 \mathrm{~mm}$
2. leucadeum

1 Ovules and seeds 1-2 in each loculus
4 Ovules and seeds usually solitary in each loculus (sect. Odontarrhena)
5 Leaves bicolorous, green or grey-green on the upper surface, grey or white beneath
6 Silicula very densely pubescent, the hairs completely covering the valves
7 Style $1 \cdot 5-3 \mathrm{~mm}$ in fruit, glabrous (Krym) 60. longistylum
7 Style not more than $1 \cdot 5(-2) \mathrm{mm}$ in fruit, usually pubescent
8 Petals $3.5-4 \mathrm{~mm}$; hairs on the silicula c. 0.5 mm in diameter
44. argenteum

8 Petals $2-3 \mathrm{~mm}$; hairs on the silicula c. 0.3 mm in diameter
9 Leaves of the non-flowering stems flat 59. tortuosum 9 Leaves of the non-flowering stems plicate 62. serpyllifolium
6 Silicula glabrous or pubescent, the valves visible beneath the hairs
10 Silicula acute or subacute
11 Basal leaves $7-11(-15) \times 4-7 \mathrm{~mm}$, broadly obovate; plant with numerous non-flowering rosettes
49. smolikanum

11 Basal leaves not more than $3-4 \mathrm{~mm}$ wide, spathulate or obovate-spathulate; plant with long non-flowering stems

[^118]12 Seeds not winged; style of silicula $1 \cdot 5-3 \mathrm{~mm}$
60. longistylum

12 Seeds winged; style of silicula not more than 2 mm
13 Basal and cauline leaves similar, obovate-spathulate; silicula $\pm$ densely pubescent
48. robertianum

13 Basal and cauline leaves dissimilar, the basal spathulate, the cauline oblanceolate, larger than the basal; silicula glabrous or sparsely pubescent
50. bertolonii

10 Silicula obtuse, truncate or emarginate
14 Petals $3-3.5 \mathrm{~mm}$; sepals $2-2.5 \mathrm{~mm}$
15 Petals entire; silicula glabrous or sparsely pubescent 50. bertolonii

15 Petals retuse; silicula pubescent
42. murale

14 Petals $2-3 \mathrm{~mm}$; sepals $1 \cdot 5-2 \mathrm{~mm}$
16 Filaments with a multi-dentate appendage; septum of the silicula frequently asymmetrical in outline
45. fallacinum

16 Filaments with an entire or 1- to 2-dentate appendage; septum of the silicula symmetrical in outline
17 Valves of the silicula asymmetrically inflated
18 Ovary glabrous; silicula glabrous, orbicular to suborbicular; hairs on stem $1-3 \mathrm{~mm}$ in diameter
51. markgrafii

18 Ovary pubescent; silicula elliptical or obovate, rarely glabrescent; hairs on stem less than 1 mm in diameter 52. corymbosoid
17 Valves of the silicula flat or symmetrically inflated
19 Leaves broadly spathulate or obovate-spathulate; valves of silicula not undulate 43. tenium
19 Leaves linear-oblanceolate to obovate-spathulate; valves of silicula usually undulate
20 Branches of the inflorescence distant, very unequal; pedicels $\pm$ straight, rigid 42. murale
20 Branches of the inflorescence subumbellate; pedicels strongly curved, flexuous
21 Silicula $4-6 \times 3.5-4.5 \mathrm{~mm}$, sparsely pubescent or glabrescent; leaves of non-flowering stems linear-oblanceolate 47. heldreichii
21 Silicula smaller, pubescent; leaves of non-flowering stems obovate-spathulate to oblanceolatespathulate
42. murale

5 Leaves concolorous, but the cauline sometimes differing from the basal in colour
22 Silicula glabrous or glabrescent
23 Petals $2 \cdot 5-3 \mathrm{~mm}$; basal leaves orbicular-spathulate
46. corsicum

23 Petals $3-3.5 \mathrm{~mm}$; basal leaves spathulate or oblanceolate
50. bertolonii

22 Silicula pubescent
24 Hairs on the leaves at least 0.5 mm in diameter
25 Seeds winged; leaves all oblanceolate, the cauline $\pm$ decreasing in size towards the apex of the stem
55. caliacrae

25 Seeds not winged; cauline and basal leaves usually conspicuously different in shape, the cauline $\pm$ increasing in size towards the apex of the stem
26 Stellate hairs on silicula $0.4-0.7 \mathrm{~mm}$ in diameter; stellate hairs on leaves of non-flowering stems with unequal rays up to $1-5 \mathrm{~mm}$ long
54. sibiricum

26 Stellate hairs on silicula $0 \cdot 2-0 \cdot 4 \mathrm{~mm}$ in diameter; stellate hairs on leaves of non-flowering stems with equal rays not more than 0.5 mm long 56 . borzaeanum
24 Hairs on leaves not more than 0.4 mm in diameter
27 Silicula $2-2.5 \mathrm{~mm}$ wide
28 Plant 6-35(-60) cm, decumbent; largest cauline leaves $9-25 \times 2-5 \mathrm{~mm}$ (E. \& S.E. Europe)
59. tortuosum

28 Plant $1-3 \mathrm{~cm}$, procumbent; largest cauline leaves 3$4 \times 1.5 \mathrm{~mm}$ (Kriti)
64. fragillimum

27 Silicula 2.5 mm or more wide
29 Silicula sparsely pubescent, the valves easily visiblebeneath the hairs
30 Cauline leaves shorter than basal; racemes simple(Evvoia)53. euboeum
30 Cauline leaves longer than basal; racemes compound31 Seeds winged; silicula $4-6 \mathrm{~mm}$
50. bertolonii31 Seeds not winged; silicula $2 \cdot 3-3 \cdot 6 \mathrm{~mm}$ 57. obtusifolium29 Silicula very densely pubescent, the valves completelycovered by the hairs
32 Petals $3-3.5 \mathrm{~mm}$; sepals $2-2.5 \mathrm{~mm}$
33 Flowering stems $\pm$ erect or ascending; basal leaves$6-8 \times c .3 \mathrm{~mm}$, obovate-spathulate to suborbicular;petiole of cauline leaves $3-5 \mathrm{~mm}$ (U.S.S.R.)
58. obovatum
33 Flowering stems usually procumbent; basal leaves $4-8 \times 1.5-3.5 \mathrm{~mm}$, oblanceolate to obovatespathulate; petiole of cauline leaves not more than 2 mm (Alps)
61. alpestre
32 Petals 2-3 mm; sepals usually not more than 2 mm
34 Largest cauline leaves near the apex of the stem and distinctly larger than the basal
63. nebrodense
34 Largest cauline leaves near the base of the stem, smaller than or about equalling the basal
35 Leaves of non-flowering stems flat; hairs on the silicula 20 - to 25 -rayed (U.S.S.R.) 58. obovatum
35 Leaves on non-flowering stems plicate; hairs on the silicula mostly 12 - to 16 -rayed (S.W. Europe)

## 62. serpyllifolium

4 Ovules and seeds 2 in each loculus
36 Sepals with a tuft of long, divergent-rayed, stellate hairs at the apex
37 Fruiting raceme $\pm$ elongate; short stamens with a long $(1.5-2 \mathrm{~mm})$ appendage; style $c .4 \mathrm{~mm}$
39. doerfleri
37 Fruiting racemes corymbose; short stamens with a small appendage at the base; style not more than 3 mm
40. taygeteum
36 Sepals without a tuft of hairs at the apex
38 Silicula glabrous or glabrescent
39 Indumentum of leaves lepidote
37. idaeum
39 Indumentum of leaves consisting of branched or stellate hairs
40 Inflorescence corymbose or paniculate, each branch terminated by a raceme
41 Valves of silicula strongly inflated; wing of seeds $0 \cdot 1(-0.3) \mathrm{mm}$ wide 3. petraeum
41 Valves of silicula $\pm$ flat, or inflated with flat margin; wing of seeds $0 \cdot 3-1 \mathrm{~mm}$ wide
4. saxatile
40 Infiorescence a $\pm$ simple raceme

42 Style $1.5-3.5 \mathrm{~mm}$
43 Petals $3 \cdot 5-4 \mathrm{~mm}$; annual; leaves oblong-spathulate
11. smyrnaeum

43 Petals $6-7 \mathrm{~mm}$; perennial; leaves linear-oblong or linear-lanceolate, acute
19. lenense 42 Style not more than $1(-1 \cdot 5) \mathrm{mm}$
44 Upper leaves forming an involucre around the inflorescence; silicula ovate, the valves inflated; petals $3-3.5 \mathrm{~mm} \quad 10$. foliosum
44 Upper leaves not forming an involucre; silicula $\pm$ orbicular, the valves inflated in the middle; with strongly flattened margin; petals $2-3 \mathrm{~mm}$
45 Stellate hairs $0 \cdot 2-0.3 \mathrm{~mm}$ in diameter; sepals deciduous
9. desertorum

45 Stellate hairs ( $0 \cdot 4-$ ) $0 \cdot 5-0 \cdot 8(-1) \mathrm{mm}$ in diameter; sepals persistent
12. minutum

38 Silicula pubescent
46 Indumentum of the inflorescence or the silicula consisting of long patent hairs, often mixed with appressed stellate hairs
47 Anthers less than 0.5 mm ; annual
48 Filaments without appendages; indumentum dimorphic only on the silicula
8. granatense

48 Filaments winged or with appendages; indumentum $\pm$ dimorphic on all parts of the plant

49 Petals attenuate towards the base; style $0 \cdot 7-1 \cdot 3 \mathrm{~mm}$
15. strigosum

49 Petals constricted at the middle; style $1 \cdot 2-2.5 \mathrm{~mm}$
16. hirsutum

47 Anthers more than 0.5 mm ; biennial or perennial
50 Erect biennial up to 80 cm ; middle cauline leaves usually at least 10 mm wide; hairs 5 - to 7 -rayed, sparse
24. wierzbickii

50 Perennial up to $40(-60) \mathrm{cm}$; often procumbent or ascending; middle cauline leaves usually less than 10 mm wide, the hairs 8 - to many-rayed
51 Silicula 6 mm or more, the valves strongly inflated, without a flattened margin; racemes very short and crowded in fruit
36. lassiticum

51 Silicula up to $6(-6 \cdot 5) \mathrm{mm}$, the valves with a flattened margin; racemes very long in fruit
52 Petals entire; filaments of the long stamens entire; densely caespitose or pulvinate (Bulgaria and Romania)
26. pulvinare

52 Petals $\pm$ emarginate; filaments of the long stamens usually with 1-2 teeth; diffuse or laxly caespitose
53 Seeds $3-3.5 \mathrm{~mm}$; sepals $\pm$ persistent (Krym)
25. calycocarpum

53 Seeds $1.5-2 \mathrm{~mm}$; sepals deciduous
54 Silicula suborbicular to obovate; leaves on the non-flowering stems obovate-spathulate
18. repens

54 Silicula oblong-obovate or obovate; leaves on the non-flowering stems linear-oblong or linearlanceolate, acute
20. fischeranum

46 Indumentum of the inflorescence and silicula consisting of appressed hairs
55 Annual; petals 2-4(-6) mm
56 Pedicels $7-20 \mathrm{~mm}$ in fruit; petals $4 \cdot 5-6 \mathrm{~mm}$
17. rostratum

56 Pedicels not more than 5 mm ; petals $2-4 \mathrm{~mm}$
57 Fruiting racemes subumbellate; silicula ovate, the valves inflated 13 . umbella
57 Fruiting racemes elongating; valves of the silicula with a flattened margin
58 Style $1 \cdot 5-1.8 \mathrm{~mm}$, dilated at base; silicula elliptical to orbicular-ovate, with dimorphic indumentum
6. dasycarpum

58 Style not more than 1.3 mm , slender at base; silicula $\pm$ orbicular, with monomorphic indumentum
59 Sepals persistent; style $0.3-0.6 \mathrm{~mm}$
7. alyssoides

59 Sepals deciduous; style $0.7-1 \cdot 6 \mathrm{~mm}$ 14. minus
55 Perennial, rarely biennial; petals 5 mm or more
60 Silicula 8-9 mm; petals 7-8 mm (Olimbos) 38. handelii
60 Silicula less than 8 mm ; petals usually smaller
61 Hairs on the leaves 5- to 10 -rayed
62 Silicula elliptical or elliptic-orbicular, distinctly longer than wide
21. scardicum

62 Silicula $\pm$ orbicular
63 Basal leaves linear-lanceolate to oblanceolatespathulate; cauline linear or linear-spathulate; hairs on leaves usually not more than 0.5 $(-0.7) \mathrm{mm}$ in diameter
27. montanum

63 Basal leaves obovate to elliptical; cauline elliptical, cuneate; hairs on leaves $0.7-1 \mathrm{~mm}$ in diameter
29. diffusum

61 Hairs on leaves 10 - to many-rayed
64 Lower pedicels shorter than the silicula; valves of silicula dissimilar 41. densistellatum
64 Lower pedicels equalling or longer than silicula; valves of silicula similar
65 Lower pedicels $10-15 \mathrm{~mm}$ in fruit, often deflexed
35. sphacioticum

65 Lower pedicels less than 10 mm in fruit, patent or erecto-patent
66 Silicula 6 mm or more, elliptical or ellipticorbicular
67 Silicula densely grey-pubescent 30. cuneifolium
67
68
Silicula green, sparsely pubescent
Petals glabrous; silicula $6-6.5 \mathrm{~mm}$; basal leaves
oblong-obovate, gradually attenuate into
petiole

67 Silicula green, sparsely pubescent体s glabrous, silicula 6-6 mm , basal leava oblong-obovate, gradually attenuate into Petals pubescent on the back; silicula $6.5-8 \mathrm{~mm}$; basal leaves orbicular-obovate, abruptly contracted into petiole
23. ovirense
elliptic-orbicular
69 Basal leaves $\pm$ abruptly contracted into petiole diameter
in diameter
0 Hairs on the leaves $0.5-0.7 \mathrm{~mm}$ in diameter
71 Basal leaves suborbicular; cauline ovat spathulate 31. arenarium
cauline oblanceolate or spathulate Lower pedicels $1 \frac{1}{2}-2$ times as long as the silicula, silicula orbicular, non-lowering stir wer pedicels about equalling silicula; silicula elliptic-orbicular; non-flowering stems very short, terminated by a rosette $\mathbf{3 0}$. cuneifolium
Basal leaves gradually attenuate towards the base, not obviously petiolate
73 Petals 6-8 mm; leaves usually white or grey
32. atlanticum
$74 \quad$ green $\quad$ Silicula 3-5.5 mm
28. fastigiatum

Sect. Aurinia (Desv.) Koch. Perennials; inflorescence compound; filaments with a very small suborbicular appendage at the base; ovules 2-4 in each loculus.

1. A. corymbosum (Griseb.) Boiss., Fl. Or. 1: 265 (1867). Perennial $20-50 \mathrm{~cm}$; hairs branched or more or less stellate. Basal leaves oblanceolate or obovate, entire or sinuate-dentate. Inflorescence corymbose. Sepals (1.5-)2-2.5 mm; petals c. 4 mm , bifid. Silicula ( $3 \cdot 5-$ ) $4 \cdot 5-5 \cdot 5 \mathrm{~mm}$, orbicular to elliptic-orbicular, glabrous; valves strongly inflated; style $1-2 \mathrm{~mm}$. Seeds $1 \cdot 7-$ $2 \mathrm{~mm}, 4$ in each loculus; wing $c .0 .5 \mathrm{~mm}$ wide. $W . \& S$. Balkan peninsula. Al Gr Ju.
2. A. leucadeum Guss., Pl. Rar. 268 (1826) (incl. A. medium Host). Perennial, often woody at base, $10-40 \mathrm{~cm}$; hairs stellate. Basal leaves oblong-lanceolate, entire or sinuate-dentate. Inflorescence racemose. Sepals $3-3.5 \mathrm{~mm}$; petals $5-6 \mathrm{~mm}$, deeply emarginate. Silicula $7-10 \mathrm{~mm}$, globose or ovoid-globose, glabrous; valves inflated; style $1-2 \mathrm{~mm}$. Seeds $3-4 \mathrm{~mm}, 4$ in each loculus; wing $0.5-0.7 \mathrm{~mm}$ wide. - Shores of the Adriatic. It Ju.
3. A. petraeum Ard., Animadv. Bot. Spec. Alt. 2: 30 (1763) (A. gemonense L., A. edentulum Waldst. \& Kit.; incl. A. microcarpum Vis.). Short-lived perennial $15-60 \mathrm{~cm}$; hairs branched or more or less stellate. Basal leaves obovate-oblong, sinuate or pinnatifid. Inflorescence racemose. Sepals c. 2 mm ; petals $4-4.5 \mathrm{~mm}$, bifid. Silicula 3-5 mm, elliptic to obovate, glabrous; valves inflated but with narrow flattened margin; style $1-1.5 \mathrm{~mm}$. Seeds $1.5-1.8 \mathrm{~mm}$, 2 in each loculus; wing $0 \cdot 1(-0 \cdot 3) \mathrm{mm}$ wide. $\quad$. Balkan peninsula and N. Italy, northwards to S. Austria and Romania. Al Au Gr It Ju Rm [Ga].
4. A. saxatile L., Sp. Pl. 650 (1753). Perennial, often woody at base, $10-40(-50) \mathrm{cm}$; hairs branched. Basal leaves obovate to oblanceolate, sinuate-pinnatifid to entire. Inflorescence corymbose. Sepals $2-3(-4) \mathrm{mm}$; petals $3-6(-8) \mathrm{mm}$, emarginate or
bifid. Silicula glabrous; valves almost flat. Seeds $2-2.7 \mathrm{~mm}, 2$ in each loculus; wing $0 \cdot 3-1 \mathrm{~mm}$ wide. C. \& S.E. Europe. Al Au Bu $\mathrm{Cr} \mathrm{Cz} \mathrm{Ge} \mathrm{Gr} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)} \mathrm{?Tu} \mathrm{[Ge]}$.

1 Silicula mostly longer than wide, apex rounded
(a) subsp. saxatile

1 Silicula wider than long or as wide as long, apex emarginate or truncate
2 Style $1 \cdot 5-3 \mathrm{~mm}$; silicula 6-9×7-11 mm
(c) subsp. megalocarpum

2 Style c. 1 mm ; silicula $4-7.5 \times 4.5-8 \mathrm{~mm}$
(b) subsp. orientale
(a) Subsp. saxatile: $2 n=48$. C. Europe and N. Balkan peninsula.
(b) Subsp. orientale (Ard.) Rech. fil., Ann. Naturh. Mus. (Wien) 43: 200 (1929): S. Italy (Calabria); Balkan peninsula. (Asia Minor.)
(c) Subsp. megalocarpum (Hausskn.) Rech. fil., Beih. Bot. Centr. 54 в: 611 (1936): Aegean region (Amorgos). (W. Anatolia.)

Sect. Meniocus (Desv.) Hooker fil. Annuals; inflorescence a simple raceme; filaments with appendages; ovules 4-8 in each loculus.
5. A. linifolium Stephan ex Willd., Sp. Pl. 3 (1): 467 (1800) (Meniocus linifolius (Stephan) DC.). Erect or ascending, densely grey-pubescent annual up to 35 cm . Leaves linear. Fruiting racemes long; pedicels $2.5-7 \mathrm{~mm}$, patent or erecto-patent. Sepals $1.5-2 \mathrm{~mm}$; petals $2-3 \mathrm{~mm}$, emarginate. Silicula $4-7 \times 3-4.5 \mathrm{~mm}$, elliptical or obovate-elliptical, glabrous; valves slightly convex; style $(0 \cdot 1-) 0 \cdot 3-0.6 \mathrm{~mm}$. Seeds $1 \cdot 2-1 \cdot 3 \mathrm{~mm}, 4-6(-8)$ in each loculus, not winged. S.E. Europe; E. \& S. Spain. Hs Ju Rm Rs (C, W, K, E) Tu.

Sect. Psilonema (C. A. Meyer) Hooker fil. Annuals; inflorescence a simple raceme; filaments without appendages, sometimes the filaments of the longer stamens with a filiform nectary at the base; ovules 2 in each loculus.
6. A. dasycarpum Stephan ex Willd., Sp. Pl. 3 (1): 469 (1800). Erect grey-pubescent annual $10-25 \mathrm{~cm}$. Leaves oblong-lanceolate to obovate. Fruiting racemes short and dense. Sepals $c$. 2 mm , more or less persistent; petals $2.5-3 \mathrm{~mm}$. Silicula 3-3.5× $2 \cdot 5-3 \mathrm{~mm}$, elliptical or orbicular-elliptical, pubescent, the indumentum dimorphic; valves inflated, with flattened margin; style $(1-) 1 \cdot 5-1 \cdot 8(-2) \mathrm{mm}$. Seeds $1 \cdot 25-1 \cdot 5 \mathrm{~mm}$, not winged. S.E. Russia. Rs (E).
7. A. alyssoides (L.) L., Syst. Nat. ed. 10, 2: 1130 (1759) (A. calycinum L.). Erect or ascending, grey-pubescent, annual or biennial up to $30(-40) \mathrm{cm}$. Lower leaves obovate to oblanceolate, upper narrower. Fruiting racemes long, or short and dense; pedicels $2-4 \mathrm{~mm}$, patent. Sepals $2-2.5 \mathrm{~mm}$, persistent; petals ( $2 \cdot 5-$ )34 mm , emarginate. Silicula 3-4(-4.5) mm, orbicular, pubescent; valves inflated, with flattened margin; style $0 \cdot 3-0.6 \mathrm{~mm}$. Seeds $1 \cdot 2-2 \mathrm{~mm}$, narrowly winged. $2 n=32$. Throughout most of Europe, but a ruderal and probably introduced in the north. All except Az Bl Fa Hb Is Rs (N) Sb.
8. A. granatense Boiss. \& Reuter, Pugillus 9 (1852). Annual up to 20 cm ; indumentum monomorphic, dimorphic on the silicula, grey. Leaves elliptic-lanceolate or oblong. Sepals $2-3 \mathrm{~mm}$, persistent; petals $3-4 \mathrm{~mm}$, emarginate. Fruiting racemes long, dense; pedicels $2 \cdot 5-4 \mathrm{~mm}$, erecto-patent. Silicula $3-5 \mathrm{~mm}$, orbicular or orbicular-elliptic, obtuse or emarginate; valves inflated, with flattened margin; style $0.7-1.5 \mathrm{~mm}$. Seeds $1.5-1.9 \mathrm{~mm}$; wing $c .0 .2 \mathrm{~mm}$ wide. E. \& S. Spain; Portugal. Hs Lu.

Sect. Alyssum. Annuals or perennials; inflorescence a simple raceme; most filaments winged or with appendages; ovules 2 in each loculus.
9. A. desertorum Stapf, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 51: 302 (1886). Grey-green annual up to 20 cm . Cauline leaves linear-lanceolate. Sepals $1 \cdot 5-2 \mathrm{~mm}$, deciduous; petals 2 3 mm , entire or emarginate. Fruiting racemes long, dense; pedicels $2-5 \mathrm{~mm}$, erecto-patent. Silicula $3-4 \cdot 5(-5) \mathrm{mm}$, ovateorbicular or orbicular, emarginate, glabrous; valves inflated, with flattened margin; style $0.5-1 \mathrm{~mm}$. Seeds $1-1.4 \mathrm{~mm}$, narrowly winged. E., E.C. \& S.E. Europe. Au Bu Cz Gr Hu Ju Rm Rs (B, C, W, K, E) Tu.
10. A. foliosum Bory \& Chaub. in Bory, Expéd. Sci. Morée 3: 185 (1832). Grey-green annual up to 10 cm . Lower leaves ovateorbicular, long-petiolate, upper oblong. Sepals $2-2.5 \mathrm{~mm}$, persistent; petals $3-3.5 \mathrm{~mm}$, linear, emarginate. Fruiting racemes subumbellate; upper leaves forming an involucre. Silicula 4-5 $(-6.5) \mathrm{mm}$, ovate, glabrous; valves inflated; style $0.7-1 \mathrm{~mm}$. Seeds $2-2.5 \mathrm{~mm}$, narrowly winged. Greece, Kriti and S. Jugoslavia. Cr Gr Ju .
11. A. smyrnaeum C. A. Meyer, Bull. Sc. Acad. Pétersb. 7: 132 (1840). Grey-pubescent annual up to 10 cm . Leaves oblongspathulate. Fruiting racemes short. Sepals $2.5-3.5 \mathrm{~mm}$, persistent; petals $3.5-4 \mathrm{~mm}$, emarginate. Silicula $3.5-4.5 \mathrm{~mm}$, ovate or orbicular, glabrous, turgid; style $c .2 \mathrm{~mm}$. Seeds without or with narrow wing. Turkey-in-Europe; S.E. Greece. Gr Tu. (S.W. Asia.)
A. fulvescens Sibth. \& Sm., Fl. Graec. Prodr. 2: 13 (1813) is like 10 but has long fruiting racemes; petals up to 5 mm and silicula $4-6 \mathrm{~mm}$. It has been recorded from S. Greece (Peloponnisos), but there is no recent confirmation of these records.
12. A. minutum Schlecht. ex DC., Reg. Veg. Syst. Nat. 2: 316 (1821) (incl. A. psilocarpum Boiss., A. ponticum Velen.). Annual up to 12 cm ; indumentum dimorphic, grey-green. Leaves obovate to oblong. Fruiting racemes more or less long, dense; pedicels $4-6 \mathrm{~mm}$, erecto-patent or erect. Sepals c. 2 mm , persistent; petals $2 \cdot 3-3 \mathrm{~mm}$, emarginate, densely pubescent. Silicula 34 mm , orbicular, emarginate, glabrous; valves inflated, with flattened margin; style $0.5-1 \mathrm{~mm}$. Seeds $1.5-1.7 \mathrm{~mm}$, narrowly winged. S. \& E. Europe. Bu Cr Gr Hs It Ju Lu Rm Rs (C, W, K, E) Sa Si Tu .
13. A. umbellatum Desv., Jour. Bot. Appl. 3: 173 (1814). Grey annual up to 10 cm . Leaves linear or linear-oblong. Fruiting racemes subumbellate, dense; pedicels $3-5 \mathrm{~mm}$, erectopatent. Sepals 2-2.2 mm, deciduous; petals $c .3 \mathrm{~mm}$, emarginate. Silicula $4-5.5 \mathrm{~mm}$, ovate, pubescent; valves inflated; style 0.7 1.2 mm . Seeds $1 \cdot 7-2 \cdot 1 \mathrm{~mm}$, narrowly winged. $2 n=16$. S.E. Europe. Cr Gr Ju Rs (K) Tu.
14. A. minus (L.) Rothm., Feddes Repert. 50: 77 (1941) (A. campestre auct. pro max. parte; incl. A. parviflorum Bieb.). Grey-green annual up to 40 cm . Leaves oblong-obovate to oblong-lanceolate. Fruiting racemes long; pedicels $3-6 \mathrm{~mm}$, erecto-patent. Sepals $1.5-2.5 \mathrm{~mm}$, deciduous; petals $2-3.5 \mathrm{~mm}$, gradually attenuate towards the base, entire to emarginate; filaments of the short stamens $1 \cdot 5-2 \mathrm{~mm}$, with connate appendages half as long as the filament. Silicula $3 \cdot 5-6 \mathrm{~mm}$, suborbicular, pubescent, the hairs all stellate; valves inflated, with flattened margin; style $0.7-1.6 \mathrm{~mm}$, pubescent. Seeds $1.7-2 \mathrm{~mm}$; wing up to 0.4 mm wide. $2 n=16$. $\mathrm{S} . \& E$. Europe. Al Bu Cr Ga Gr Hs It Ju Lu Rs (C, W, K, E) Sa Si Tu.
15. A. strigosum Banks \& Solander in Russell, Nat. Hist. Aleppo ed. 2, 2: 257 (1794) (A. campestre auct., pro min. parte). Very like 14 but filaments of the short stamens up to 2.5 mm , with appendages up to $\frac{3}{4}$ as long as the filament; silicula with coarse, patent, bifid hairs as well as stellate hairs; style glabrous or sparsely pubescent. S.E. Europe. Al Bu Cr Gr It Ju Rm Rs (K) Tu [Hu].
16. A. hirsutum Bieb., Fl. Taur.-Cauc. 2: 106 (1808). Annual up to 40 cm . Leaves ovate-oblong to lanceolate-oblong. Fruiting racemes long, dense; pedicels $4-5 \mathrm{~mm}$, erecto-patent. Sepals $2-3.5 \mathrm{~mm}$, deciduous; petals $3-5 \mathrm{~mm}$, constricted at the middle, bifid; filaments of the short stamens $2 \cdot 5-3 \mathrm{~mm}$, with usually free appendages as long as the filament. Silicula $5-7 \mathrm{~mm}$, orbicular, with appressed stellate hairs and patent, tubercle-based, unbranched or bifid hairs with unequal branches; valves inflated, with flattened margin; style $1.2-2.5 \mathrm{~mm}$. Seeds $1.7-2.5 \mathrm{~mm}$; wing $0 \cdot 2-0 \cdot 5 \mathrm{~mm}$ wide. S.E. Europe. Bu Ju Rm Rs (W, K, E).
17. A. rostratum Steven, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) 3: 295 (1809-10). Grey or grey-green annual or biennial $20-60 \mathrm{~cm}$. Lower leaves obovate-spathulate, upper oblonglanceolate. Fruiting racemes very long, lax; pedicels $7-20 \mathrm{~mm}$, erecto-patent. Sepals $2.5-3.5 \mathrm{~mm}$, deciduous; petals $4.5-6 \mathrm{~mm}$, emarginate, densely pubescent on the back. Silicula $2 \cdot 5-5 \cdot 5 \mathrm{~mm}$, orbicular-ovate, pubescent; valves inflated, with flattened margin; style $2-3 \mathrm{~mm}$. Seeds c. 2 mm ; wing 0.3-0.5 mm wide. S.E. Europe. Bu Rm Rs (W, K, E).
18. A. repens Baumg., Enum. Stirp. Transs. 2: 237 (1816). Diffuse or erect perennial up to 60 cm , the non-flowering stems terminated by rosettes; indumentum dimorphic, grey-green. Basal leaves obovate-spathulate; cauline lanceolate or linearlanceolate, acute. Fruiting racemes long; pedicels $4.5-10 \mathrm{~mm}$, patent. Sepals $2 \cdot 5-4 \mathrm{~mm}$; petals $4 \cdot 5-7 \mathrm{~mm}$, emarginate, usually glabrous on the back. Silicula 3-6 mm, suborbicular to orbicularobovate, pubescent, truncate or emarginate; valves inflated, with a narrow flattened margin; style $1.5-3.5 \mathrm{~mm}$. Seeds $1.5-2 \mathrm{~mm}$; wing usually $0 \cdot 1-0.2 \mathrm{~mm}$ wide. S.E. \& E.C. Europe. Al Au Bu Gr Ju Rm Rs (K) Tu [Cz].
(a) Subsp. repens: Stems usually not more than 15 cm , procumbent or ascending; petals $5-7 \times 2-3 \mathrm{~mm}$; silicula up to 6 mm , suborbicular. $2 n=16$. S.E. Austria, N. Jugoslavia, E. Carpathians.
(b) Subsp. trichostachyum (Rupr.) Hayek, Prodr. Fl. Penins. Balcan. 1: 436 (1925): Stems up to 50 cm , erect or ascending; petals 4-6 $\times 1.5-2.5 \mathrm{~mm}$; silicula $3.5-4.5 \mathrm{~mm}$, orbicular-obovate. Balkan peninsula; Krym.
19. A. lenense Adams, Mém. Soc. Nat. Moscou 5: 110 (1817). Ascending perennial $10-30 \mathrm{~cm}$, grey; hairs long, patent. Leaves linear-oblong or linear-lanceolate, acute. Fruiting racemes short, dense; pedicels $5-9 \mathrm{~mm}$, erecto-patent. Sepals $3-4 \mathrm{~mm}$; petals $6-7 \mathrm{~mm}$, deeply emarginate; long stamens with a long tooth on the filament. Silicula (3-)4-7 mm, oblong-obovate or obovate, emarginate, glabrescent; valves inflated, flattened on the margin; style $1 \cdot 5-3(-3 \cdot 5) \mathrm{mm}$. Seeds $1 \cdot 5-2 \mathrm{~mm}$, not winged. E. Russia. Rs ( $\mathrm{N}, \mathrm{C}, \mathrm{E}$ ).
20. A. fischeranum DC., Reg. Veg. Syst. Nat. 2: 311 (1821). Very like 19 but the petals only slightly emarginate or entire; filaments of the long stamens with a very short tooth; silicula pubescent. S.E. Russia. Rs (E).
21. A. scardicum Wettst., Biblioth. Bot. (Stuttgart) 26:24(1892). Green or grey-green diffuse perennial $5-20 \mathrm{~cm}$, with short or long non-flowering stems. Lower leaves elliptic-oblanceolate, obtuse; cauline linear; hairs $0.4-0.6 \mathrm{~mm}$ in diameter, 5- to 9-rayed.

Fruiting racemes short or long; pedicels up to $5-8 \mathrm{~mm}$, patent. Sepals $2 \cdot 5-3.5 \mathrm{~mm}$; petals $4 \cdot 5-6 \mathrm{~mm}$, entire. Silicula 3-6(-7)× 2-4 mm, elliptical to elliptic-orbicular, densely pubescent; valves inflated, with flattened margin; style 3-4 mm. Seeds c. 1.7 mm ; wing c. 0.2 mm wide. Stony places and cliffs, 1700-2800 m. - Balkan peninsula. A1 Bu Ju.
22. A. wulfenianum Bernh. in Willd., Enum. Pl. Hort. Berol. suppl., 44 (1813). Erect or procumbent, diffuse, grey-green to almost white perennial up to 20 cm ; non-flowering stems with rosettes. Basal leaves oblong-obovate, obtuse, gradually attenuate into petiole; cauline oblanceolate, larger than basal; hairs c. 0.5 mm in diameter, 10 - to 20 -rayed. Fruiting racemes long; pedicels up to $6-8 \mathrm{~mm}$, patent. Sepals $2 \cdot 7-3 \cdot 2 \mathrm{~mm}$; petals $5 \cdot 5-$ 6.5 mm , obcordate, glabrous. Silicula 6-6.5 $\times 3-4 \mathrm{~mm}$, elliptic, obtuse, sparsely pubescent; valves inflated; style $2-3 \mathrm{~mm}$. Seeds c. 2.7 mm ; wing 0.2 mm wide. S.E. Alps. Au Ju.
23. A. ovirense Kerner, Sched. Fl. Exsicc. Austro-Hung. 2: 99 (1882). Procumbent, diffuse, green or grey-green perennial up to 12 cm ; non-flowering stems with rosettes. Basal leaves orbicularobovate, abruptly contracted into petiole; cauline oblonglanceolate, obtuse, about the same size as the basal; hairs $c$. 0.5 mm in diameter, 10 - to 16 -rayed. Fruiting racemes elongate; pedicels $6-7 \mathrm{~mm}$, erecto-patent. Sepals $3 \cdot 5-4 \mathrm{~mm}$; petals 6 8 mm , entire or emarginate, stellate-pubescent on back. Silicula $6 \cdot 5-8 \times 3 \cdot 5-6 \mathrm{~mm}$, elliptic or obovate, obtuse, sparsely pubescent; valves inflated, with flattened margin; style $2 \cdot 5-3 \mathrm{~mm}$. Seeds c. 2.5 mm . S.E. Alps and W. Jugoslavia. Au It Ju.
24. A. wierzbickii Heuffel, Flora (Regensb.) 18: 242 (1835). Robust, erect, green or grey-green biennial or short-lived perennial $40-80 \mathrm{~cm}$; non-flowering stems usually absent. Leaves ovateelliptic to lanceolate, acute, green; hairs $c .0 .5 \mathrm{~mm}$ in diameter, 5 - to 7 -rayed. Fruiting racemes dense; pedicels up to $10-13 \mathrm{~mm}$, erecto-patent, with long patent hairs. Sepals $2.5-4 \mathrm{~mm}$; petals $5-7 \mathrm{~mm}$, truncate. Silicula 4-6 mm, orbicular or orbicular-ovate, pubescent, emarginate; valves inflated, flattened on the margin; style $3-4.5 \mathrm{~mm}$. Seeds $c .3 \mathrm{~mm}$; wing $c .0 \cdot 1 \mathrm{~mm}$ wide. - C. Danube basin. Bu Ju Rm.
25. A. calycocarpum Rupr., Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) 15 (2): 103 (1869). Erect perennial 15-35 cm; indumentum dimorphic on the inflorescence, grey-white; nonflowering stems more or less long. Lower leaves obovate or obovate-orbicular, obtuse, upper oblanceolate. Fruiting racemes long; pedicels up to $7-9 \mathrm{~mm}$, patent or erecto-patent. Sepals $2 \cdot 5-4 \mathrm{~mm}$; petals $4-7 \mathrm{~mm}$. Silicula $4 \cdot 5-6.5 \mathrm{~mm}$, orbicular or or-bicular-ovate, densely pubescent; valves inflated, with flattened margin; style 2-3.5 mm. Seeds $c .3 \mathrm{~mm}$, winged. Krym. Rs (K).
26. A. pulvinare Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1889: 30 (1889). Caespitose perennial $6-15 \mathrm{~cm}$, with numerous rosettes and short non-flowering stems; indumentum dimorphic, grey. Basal leaves oblanceolate or spathulate, upper lanceolate-spathulate, long-petiolate; hairs $c .1 \mathrm{~mm}$ in diameter. Fruiting racemes long; pedicels up to $5-8 \mathrm{~mm}$. Sepals $3-4 \mathrm{~mm}$; petals $5-6 \mathrm{~mm}$, obovate, abruptly attenuate into claw. Silicula $4-5.5 \mathrm{~mm}$, elliptic to suborbicular, pubescent; valves inflated, with flattened margin; style $3-5 \mathrm{~mm}$. Seeds c. 1.5 mm , broadly winged. - Bulgaria and neighbouring parts of Romania and N. Greece. Bu Gr Rm.
27. A. montanum L., Sp. Pl. 650 (1753) (incl. A. thessalum Halácsy). Procumbent to erect, green to almost white perennial $5-25 \mathrm{~cm}$, with non-flowering rosettes or short stems. Basal leaves
oblong or oblanceolate-spathulate, upper linear or linearspathulate; hairs $0.4-0.7 \mathrm{~mm}$ in diameter, 6 - to 24 -rayed. Fruiting racemes long; pedicels $4-6 \mathrm{~mm}$, patent or erecto-patent. Sepals $2.5-3.5 \mathrm{~mm}$; petals emarginate. Silicula $3-5.5 \mathrm{~mm}$; valves inflated, with flattened margin. Seeds $1.5-2 \mathrm{~mm}$; wing $0 \cdot 2$ 0.4 mm wide. Most of Europe except the north and south-west. Al $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(B}, \mathrm{C}, \mathrm{W}, \mathrm{K}, \mathrm{E)}$.
(a) Subsp. montanum: Procumbent or ascending, with numerous non-flowering rosettes; petals $4.5-6 \mathrm{~mm}$; long stamens with a unilateral appendage; silicula $3.5-5.5 \mathrm{~mm}$, orbicular; style $1-$ $3 \mathrm{~mm} .2 n=16$. Stony or rocky places, usually montane. C. \& S. Europe.
Very variable and possibly divisible into a number of other subspecies.
(b) Subsp. gmelinii (Jordan) Hegi \& E. Schmid in Hegi, Ill. Fl. Mitteleur. 4 (1): 451 (1919): Ascending or erect with few nonflowering rosettes; petals usually $3.5-4 \mathrm{~mm}$; long stamens with a bilateral appendage; silicula $3-5 \mathrm{~mm}$, obovate-orbicular; style $2-3.5 \mathrm{~mm}$. Sandy places, usually lowland. C. \& E. Europe, extending westwards to N. France.

Dwarf plants from S. Spain (Sierra Nevada) with the basal leaves lanceolate or linear-lanceolate, the cauline linear and hairs $(0 \cdot 5-) 0 \cdot 7-1 \mathrm{~mm}$ in diameter, may represent a distinct species or subspecies of 27 .
28. A. fastigiatum Heywood, Bull. Brit. Mus. (Bot.) 1: 92(1954). Like 27 (a) but stems $15-25 \mathrm{~cm}$, numerous, erect, fastigiate; sepals 2-3 mm; petals 3-4.5 mm, deeply emarginate; silicula $2.5-3 \mathrm{~mm}$. - S.E. Spain (Sierra de Cazorla). Hs.
29. A. diffusum Ten., Cat. Pl. Hort. Neap. app., 58 (1815). Diffuse, grey-green perennial up to 10 cm , with long, procumbent non-flowering stems. Basal leaves obovate or elliptical; upper elliptical, cuneate, or lanceolate; hairs $0.7-1 \mathrm{~mm}$ in diameter, sparse. Fruiting racemes long; pedicels $4-5 \mathrm{~mm}$. Sepals $3-4 \mathrm{~mm}$; petals $5-7 \mathrm{~mm}$, emarginate. Silicula $4-6 \mathrm{~mm}$, orbicular to ovateorbicular; valves inflated, with flattened margin; style $2.5-$ 3.5 mm . Seeds $1.5-2 \mathrm{~mm}$; wing c. 0.3 mm wide, or absent. - Mountains of Italy, S.W. Alps, Pyrenees and N. Spain, Greece. Ga Gr Hs It.
30. A. cuneifolium Ten., Prodr. Fl. Nap. xxxvii (1811). Grey or almost white caespitose perennial $5-15 \mathrm{~cm}$ with numerous nonflowering rosettes, and diffuse flexuous flowering stems. Basal leaves oblong-obovate, attenuate into petiole; cauline usually narrower, obtuse or subacute; hairs $c .0 .6 \mathrm{~mm}$ in diameter, multiradiate, very crowded. Fruiting racemes very short and dense; pedicels up to $5-6 \mathrm{~mm}$, patent. Sepals $3-4 \mathrm{~mm}$; petals $5-8 \mathrm{~mm}$, emarginate. Silicula (3-)5-7 $\times 3 \cdot 5-4.5 \mathrm{~mm}$, orbicularelliptic, truncate, densely grey-pubescent; valves inflated, with flattened margin; style $2-4 \mathrm{~mm}$. Seeds $1 \cdot 5-3 \mathrm{~mm}$; wing $c$. 0.3 mm . Mountains of S. Europe, but rare, and absent from many areas. $\mathrm{Bu} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{It} \mathrm{Si}$.
31. A. arenarium Loisel., Fl. Gall. 401 (1807). Very like 30 but basal leaves suborbicular; cauline ovate-spathulate, obtuse; silicula 5-8 mm, suborbicular, retuse. Maritime sand. Coasts of S.W. France and N. Spain. Ga Hs.
32. A. atlanticum Desf., Fl. Atl. 2: 71 (1798). Greyish-white caespitose perennial $5-15 \mathrm{~cm}$, with numerous non-flowering rosettes. Basal leaves oblong-obovate or oblong-oblanceolate, obtuse or subacute, not obviously petiolate; cauline linearoblanceolate; hairs c. 0.6 mm in diameter, multiradiate, very crowded. Fruiting racemes short and crowded; pedicels

4-7 mm, patent or erecto-patent. Sepals $3 \cdot 5-5 \cdot 5 \mathrm{~mm}$; petals 6-8 mm. Silicula $3-5 \cdot 5 \mathrm{~mm}$, orbicular-truncate or emarginate, pubescent; valves inflated, with flattened margin; style $2 \cdot 5-3 \mathrm{~mm}$. Seeds c. 1.7 mm ; wing $0-0.1 \mathrm{~mm}$ wide. S. \& E. Spain. Hs.
33. A. moellendorfianum Ascherson ex G. Beck, Ann. Naturh. Mus. (Wien) 2: 73 (1887). Silvery- or grey-lepidote caespitose perennial $5-15 \mathrm{~cm}$, with non-flowering rosettes or short stems. Leaves oblong-spathulate to orbicular-obovate, petiolate; hairs $c .0 .4 \mathrm{~mm}$ in diameter. Fruiting racemes long; pedicels $5-7 \mathrm{~mm}$, patent or erecto-patent. Sepals $2-2.5 \mathrm{~mm}$; petals $5-6 \mathrm{~mm}$, emarginate. Silicula $4 \cdot 5-5 \mathrm{~mm}$, orbicular, truncate or emarginate, densely lepidote; valves inflated, with flattened margin; style $2-2.5 \mathrm{~mm}$. Seeds $c .1 .7 \mathrm{~mm}$; wing $c .0 .2 \mathrm{~mm}$ wide. - W. Jugoslavia. Ju.
34. A. stribrnyi Velen., Fl. Bulg. 640 (1891). Grey or silvery, diffuse perennial $6-20 \mathrm{~cm}$, with few long non-flowering stems. Basal leaves spathulate or obovate, subobtuse; cauline oblanceolate, subobtuse or acute; hairs $0.6-0.7 \mathrm{~mm}$ in diameter, multiradiate. Fruiting racemes long; pedicels up to $6-8 \mathrm{~mm}$, patent. Sepals $3 \cdot 5-4 \cdot 5 \mathrm{~mm}$, persistent; petals $5 \cdot 5-6 \cdot 5 \mathrm{~mm}$, emarginate. Silicula $4-5 \mathrm{~mm}$, orbicular, truncate, densely pubescent; valves inflated, with flattened margin; style $2-3.5 \mathrm{~mm}$. Seeds $c .1 .7 \mathrm{~mm}$; wing absent or narrow. E. Balkan peninsula; one locality in Romania. Bu Ju Rm Tu.
35. A. sphacioticum Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 35 (1849). Silvery or grey perennial, flowering stems $5-10 \mathrm{~cm}$, with procumbent non-flowering stems. Basal leaves obovate-orbicular to obovate; upper linear or oblong, imbricate and appressed to the stem; hairs c. 0.5 mm in diameter, multiradiate. Sepals $3-4 \mathrm{~mm}$; petals $5 \cdot 5-6 \mathrm{~mm}$, entire. Fruiting racemes short, dense; pedicels $10-15 \mathrm{~mm}$, patent or deflexed. Silicula 5-7 mm, obcordate to obovate or orbicular, emarginate, pubescent; valves inflated, with flattened margin; style 3-4 mm. Seeds $2.5-3 \mathrm{~mm}$, wider than long; wing $0 \cdot 2-0.5 \mathrm{~mm}$ wide. Screes. Kriti. Cr.
36. A. lassiticum Halácsy, Consp. Fl. Graec. suppl. 1, 10 (1908). White, dwarf shrub; flowering stems $10-20 \mathrm{~cm}$, stout, with procumbent non-flowering stems. Basal leaves obovate, acute; cauline linear-oblanceolate to obovate, obtuse; hairs $c .0 .5 \mathrm{~mm}$ in diameter, very dense. Fruiting racemes short, dense; pedicels $4 \cdot 5-6.5 \mathrm{~mm}$, erecto-patent, with dimorphic indumentum. Sepals 4.5 mm ; petals 6 mm , entire. Silicula $6-7 \mathrm{~mm}$, orbicular, obtuse or truncate, densely pubescent; valves inflated; style $3 \cdot 5-4 \mathrm{~mm}$. Seeds 2.5 mm , orbicular, narrowly winged. - Kriti (Lassithi). Cr.
37. A. idaeum Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 35 (1849). Diffuse, procumbent, grey-green to white perennial with simple flowering stems up to $c .5 \mathrm{~cm}$. Leaves obovate-orbicular to ovate-oblong; hairs $c .0 .3 \mathrm{~mm}$ in diameter, lepidote. Fruiting racemes short, dense; longest pedicels 4 5 mm , erecto-patent. Sepals $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$; petals 4-6 mm, entire. Silicula $5-7 \mathrm{~mm}$, orbicular or ovate-orbicular, retuse, glabrous or minutely lepidote; valves inflated, with scarcely flattened margin; style $c .2 \mathrm{~mm}$. Seeds $2-2.5 \mathrm{~mm}$; wing $0.1-0.2 \mathrm{~mm}$ wide. - Kriti. Cr.

## Incorrectly reported from Andros.

38. A. handelii Hayek, Beih. Bot. Centr. 45: 279 (1928). Laxly caespitose, silvery-grey or grey-green perennial $5-15 \mathrm{~cm}$, with elongate non-flowering stems. Leaves obovate, longpetiolate; hairs $c .0 .3 \mathrm{~mm}$ in diameter, multiradiate. Fruiting racemes short, dense; pedicels $6-9 \mathrm{~mm}$, patent. Sepals $3 \cdot 5-$

4 mm ; petals $7-8 \mathrm{~mm}$. Silicula $8-9 \mathrm{~mm}$, obovate or broadly elliptical, subacute to truncate, pubescent; valves inflated; style 2-3 mm. Above 2000 m . N. Greece (Olimbos). Gr.
39. A. doerfleri Degen, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 64: 708 (1897). Densely caespitose, white or silvery perennial up to 10 cm . Leaves linear-lanceolate to linear, acute, lepidote. Fruiting racemes slightly elongate; pedicels $3 \cdot 5-5 \mathrm{~mm}$, erecto-patent. Sepals $4-5 \mathrm{~mm}$, with a tuft of long, divergentrayed hairs at the apex; petals $c .9 \mathrm{~mm}$; short stamens with free appendage $1 \cdot 5-2 \mathrm{~mm}$. Silicula $4-7 \mathrm{~mm}$, elliptical, emarginate, white; valves inflated, with flat margin; style c. 4 mm . Seeds c. 2 mm , not winged. Makedonija (near Prilep). Ju.
40. A. taygeteum Heldr., Sched. Herb. Graec. Norm. no. 1405 (1897). Very like 39 but racemes not elongating in fruit; short stamens with a small appendage at the base; silicula elliptical to elliptic-orbicular, entire or shallowly emarginate; style up to 3 mm . S. Greece (Taiyetos). Gr.
41. A. densistellatum T. R. Dudley, Notes Roy. Bot. Gard. Edinb. 24: 160 (1962) (A. praecox auct. graec.). Diffuse to subcaespitose, grey or grey-green perennial up to 10 cm , non-flowering stems with rosettes of leaves. Basal leaves obovate-spathulate, acute, with petiole up to 4 mm ; cauline oblanceolate; hairs c. 0.7 mm in diameter, multiradiate. Fruiting racemes long; pedicels $3-5 \mathrm{~mm}$, patent. Sepals $3-4 \mathrm{~mm}$; petals $5-6 \mathrm{~mm}$, deeply emarginate or almost bifid. Silicula $4 \cdot 5-6 \mathrm{~mm}$, orbicular-elliptical, emarginate, grey-green; valves dimorphic, one strongly convex, with scarcely flattened margin, the other flat or slightly convex, with a wide flattened or deflexed margin; style $2.5-3.5 \mathrm{~mm}$. Seeds c. 2 mm ; wing $0-0.1 \mathrm{~mm}$ wide. Serpentine rocks and stones. Greece (C. \& N. Evvoia). Gr.

Sect. Odontarrhena (C. A. Meyer) Koch. Perennials; inflorescence a simple or compound raceme; filaments with wings or appendages; ovules solitary in each loculus.
42. A. murale Waldst. \& Kit., Pl. Rar. Hung. 1: 5 (1799). Caespitose perennial $25-70 \mathrm{~cm}$, with long non-flowering stems or dense rosettes of leaves. Basal leaves obovate-spathulate or oblanceolate-spathulate; cauline usually $10-20 \times 3-6 \mathrm{~mm}$, lanceolate or oblanceolate, grey-green above, white or grey beneath, larger than the basal leaves. Petals $2-3.5 \mathrm{~mm}$, entire, rarely emarginate. Silicula $2-5.5 \times 1.5-4 \mathrm{~mm}$, obtuse to emarginate, pubescent, the hairs with $6-10(-13)$ rays; valves flat, but often undulate; style $0.5-2 \mathrm{~mm}$. Seeds c. 3 mm ; wing $0.2-0.8 \mathrm{~mm}$ wide. S.E. Europe. Al Bu Cr Gr Ju Rm Rs (W, K).

Very variable. The following is a key to some of the more distinct variants that have been described, but many intermediates occur and their distributions do not allow of a satisfactory subspecific treatment.
1 Plant densely hirsute, hairs with long spreading rays

## A. pichleri

1 Plant appressed-pubescent, hairs with appressed rays
2 Style of silicula $0 \cdot 5-1 \mathrm{~mm}$; inflorescence subumbellate; pedicels filiform, flexuous A. chalcidicum
2 Style of silicula ( $0.8-$ ) $1-2 \mathrm{~mm}$; inflorescence corymbose, the branches not congested; pedicels stout, rigid
3 Hairs on the silicula 0.35 mm in diameter or more, $\pm$ dense; leaves acute A. mural
3 Hairs on the silicula $0 \cdot 2-0 \cdot 3 \mathrm{~mm}$ in diameter, sparse; cauline leaves $\pm$ obtuse
4 Decumbent; silicula elliptic-obovate to orbicular-obovate
A. degenianum

4 Usually erect; silicula elliptical or orbicular

5 Petals 2-2.5 mm, obtuse, sparsely pubescent; style glabrous
A. chlorocarpum

5 Petals 3-3.5 mm, emarginate; style sparsely pubescent
A. subvirescens
A. chalcidicum Janka, Österr. Bot. Zeitschr. 22: 175 (1872). W. \& C. Balkan peninsula
A. chlorocarpum Hausskn., Mitt. Thür. Bot. Ver. nov. ser., 3-4: 113 (1893). W. \& C. Balkan peninsula.
A. degenianum E. I. Nyárády, Bul. Grăd. Bot. Cluj 7: 74 (1927). S. Bulgaria (Rodopi), Thasos.
A. murale sensu stricto. Throughout the range of the species.
A. pichleri Velen., Fl. Bulg. 38 (1891). E. Balkan peninsula, S. Romania.
A. subvirescens Formanek, Verh. Naturf. Ver. Brünn 37: 195 (1898). C. Balkan peninsula.
43. A. tenium Halácsy, Consp. Fl. Graec. 1: 93 (1900). Like 42 but leaves obovate-spathulate or broadly spathulate, very obtuse; silicula usually broadly obovate; valves not undulate. S. Greece and Kikladhes. Gr.
44. A. argenteum All., Mélang. Philos. Math. Soc. Roy. Turin (Misc. Taur.) 5: 73 (1774). Erect perennial 15-50 cm, with long non-flowering stems. Cauline leaves $10-15(-20) \times 3-4 \mathrm{~mm}$, oblanceolate, greenish above, grey beneath, much larger than the basal leaves. Inflorescence lax. Petals $3 \cdot 5-4 \mathrm{~mm}$, entire. Silicula $3 \cdot 5-6 \times 2-4 \mathrm{~mm}$, variable in shape, apex usually obtuse, densely pubescent; hairs c. 0.5 mm in diameter, rays $15-22$; style $1-1.5$ $(-2) \mathrm{mm}$. Seeds c. 2.5 mm ; wing $0 \cdot 5-0.8 \mathrm{~mm}$ wide. S. Alps. It.
45. A. fallacinum Hausskn., Mitt. Thür. Bot. Ver. nov. ser. 3-4: 114 (1893). Perennial $20-50 \mathrm{~cm}$, with long, non-flowering stems. Cauline leaves $15-25 \times 2-2.5 \mathrm{~mm}$, oblanceolate, obtuse, greenish above, white beneath; basal leaves slightly smaller. Petals $2 \cdot 5-$ 3 mm ; filaments with a multidentate appendage. Silicula 4$4.5 \times 2.5-3.3 \mathrm{~mm}$, broadly elliptical to obovate, obtuse or emarginate, septum frequently asymmetrical in outline; valves asymmetrically inflated, sparsely pubescent; hairs with c. 15 rays; style $1-1.5 \mathrm{~mm}$. Seeds $1.5-2 \mathrm{~mm}$; wing c. 0.2 mm wide.
Greece and Kriti. Cr Gr.
46. A. corsicum Duby, Bot. Gall. 1: 34 (1828). Grey perennial $30-60 \mathrm{~cm}$, with numerous non-flowering rosettes on branched woody stems. Basal leaves up to $15 \times 7 \mathrm{~mm}$, orbicular-spathulate, obtuse or emarginate; cauline up to $25-35 \times 6-7 \mathrm{~mm}$, obovate to oblong-spathulate. Sepals c. 2 mm , subglabrous; petals $2.5-3 \mathrm{~mm}$. Silicula 3-4 mm, obovate, obtuse, glabrous; style $c .1 \mathrm{~mm}$. Seeds $1 \cdot 8-2 \mathrm{~mm}$, narrowly winged. $2 n=16$. Naturalized in Corse and Kriti. [Co Cr.] (W. Anatolia.)
47. A. heldreichii Hausskn., Mitt. Thür. Bot. Ver. nov. ser., 3-4: 113 (1893). Perennial $15-40 \mathrm{~cm}$, with numerous, long, non-flowering stems. Basal leaves linear-oblanceolate, obtuse, greyish-green above, silvery beneath; cauline up to $30 \times 3.5 \mathrm{~mm}$, similar but greenish. Sepals c. 2 mm ; petals $c .3 \mathrm{~mm}$. Silicula $4-6 \times 3 \cdot 5-$ 4.5 mm , obovate or orbicular, green, sparsely pubescent or glabrescent; hairs $c$. 9 -rayed; valves flat or symmetrically inflated; style $0.7-1.5 \mathrm{~mm}$. Seeds c. 2 mm ; wing $0.2-0.3 \mathrm{~mm}$ wide. - C. \& N. Greece. Gr.
48. A. robertianum Bernard ex Gren. \& Godron, Fl. Fr. 1: 117 (1847). Procumbent perennial $10-40 \mathrm{~cm}$, much-branched at base, with long, non-flowering stems. Leaves up to $8 \times 4 \mathrm{~mm}$, obovate-
spathulate, obtuse, greenish above, grey beneath. Sepals c. 2 mm , subglabrous; petals c. 3 mm . Silicula $5-6 \times 3-4 \mathrm{~mm}$, broadly obovate to rhombic, acute, sparsely pubescent, green; style c. 2 mm . Seeds $2.5-3 \mathrm{~mm}$; wing c. 0.25 mm wide. $2 n=16$. - Corse, Sardegna. Co Sa.
A. tavolarae Briq., Prodr. Fl. Corse 2: 58 (1913), described from Sardegna (Tavolara), is probably a variant of 48. It differs in having sepals $c .3 \mathrm{~mm}$, pubescent; petals $c .4 \mathrm{~mm}$; silicula greypubescent; and seeds $c .1 .5 \mathrm{~mm}$. It was originally said to have 2 seeds in each loculus, but this appears to have been an error.
49. A. smolikanum E. I. Nyárády, Bul. Grăd. Bot. Cluj 9: 43 (1928). Pulvinate perennial up to 15 cm ; the lower stem stout, woody, branched; non-flowering rosettes numerous. Basal leaves 7-11( -15 ) $\times 4-7 \mathrm{~mm}$, broadly obovate, obtuse or truncate, grey-green above, white beneath; cauline smaller. Sepals 22.5 mm ; petals $3-4 \mathrm{~mm}$, with orbicular limb. Silicula $5-6 \times 2.5-$ 3 mm , narrowly elliptical, truncate, green, glabrous or sparsely pubescent; style 1.7 mm . Seeds winged. - N.W. Greece and S. Albania. Al Gr.
50. A. bertolonii Desv., Jour. Bot. Appl. 3: 172 (1814). Erect perennial (10-)20-35 cm, woody at base; non-flowering stems long. Basal leaves up to $12 \times 3 \mathrm{~mm}$, spathulate, green above, almost white beneath, rarely green on both surfaces; upper cauline up to $25 \times 5 \mathrm{~mm}$, oblanceolate. Sepals c. 2 mm ; petals $3-3.5 \mathrm{~mm}$, entire. Silicula 4-6 mm, variable, usually elliptical or orbicular-obovate, subacute or truncate, glabrous or sparsely pubescent; hairs $0.2-0.3 \mathrm{~mm}$ in diameter; valves asymmetrically or symmetrically inflated; style $0.8-2 \mathrm{~mm}$. Seeds $1.8-2 \mathrm{~mm}$, winged. Italy and W. Balkan peninsula. Al Gr It Ju.
(a) Subsp. bertolonii: Silicula $2 \cdot 3-3 \mathrm{~mm}$ wide. Seed-wing $c$. 0.2 mm wide. Italy.
(b) Subsp. scutarinum E. I. Nyárády, Bul. Grăd. Bot. Cluj 7: 87 (1927): Silicula $2.8-5.5 \mathrm{~mm}$ wide. Seed-wing up to 0.5 mm wide. N.W. Balkan peninsula.
51. A. markgrafii O. E. Schulz, Ber. Deutsch. Bot. Ges. 49: 422 (1926). Erect perennial $20-50 \mathrm{~cm}$, with non-flowering rosettes or short stems; cauline hairs $1-3 \mathrm{~mm}$ in diameter, 3 - to $5(-9)$-rayed. Cauline leaves up to $22 \times 2-6 \mathrm{~mm}$, oblanceolate, greenish above, grey beneath, distinctly larger than the basal. Sepals c. 1.5 mm ; petals $2-2.5 \mathrm{~mm}$, entire. Silicula $2-3.4 \times 1.7-3.4 \mathrm{~mm}$, suborbicular, glabrous; valves symmetrically inflated; style $1-1.2 \mathrm{~mm}$. Seeds c. 1.7 mm ; wing $0.2-0.3 \mathrm{~mm}$ wide. Albania, and neighbouring mountains of Jugoslavia. A1 Ju.
52. A. corymbosoides Form., Verh. Naturf. Ver. Brünn 34: 329 (1895) ( $A$. rhodopense Form.). Erect, short-lived perennial (5-)15-35 cm, with long, non-flowering stems. Cauline leaves $12-16 \times 1.8-2.8 \mathrm{~mm}$, usually oblanceolate, acute or subobtuse, greenish above, grey-green beneath; basal leaves $4 \cdot 5-6 \times 1 \cdot 6-$ 2.3 mm , obtuse. Sepals $1.5-2 \mathrm{~mm}$, pubescent; petals $2-3 \mathrm{~mm}$. Silicula $2.5-4 \times 2-2.8 \mathrm{~mm}$, elliptical to obovate, obtuse or emarginate, pubescent, rarely glabrescent; hairs 0.3 mm in diameter, 5- to 7 -rayed; valves asymmetrically inflated; style $0.5-1 \mathrm{~mm}$. Seeds c. 1.5 mm , not or very narrowly winged. - S. \& E. Balkan peninsula; Romania. Bu Gr Ju Rm.
53. A. euboeum Halácsy, Consp. Fl. Graec. 1: 93 (1900). Erect perennial $8-25 \mathrm{~cm}$, woody and leafless at base, with long nonflowering stems. Basal leaves up to $18 \times 5 \mathrm{~mm}$, oblanceolate or obovate, greyish-white; cauline smaller, grey-green. Sepals $c$. 2 mm ; petals $c .3 .5 \mathrm{~mm}$. Silicula $3.5-4.5 \times 2.5-3 \mathrm{~mm}$, elliptical, obovate, or rarely suborbicular, obtuse, greyish-green; valves
asymmetrically inflated; style $1 \cdot 2-2 \mathrm{~mm}$. Seeds $1.5-1.7 \mathrm{~mm}$; wing absent or up to 0.3 mm wide. Greece (Evvoia). Gr.
54. A. sibiricum Willd., Sp.Pl. 3 (1) : 465 (1800) (A. suffrutescens (Boiss.) Halácsy, A. montanum subsp. epirotium (Baumg.) Hayek). Perennial $5-20 \mathrm{~cm}$, erect or procumbent, stout and woody at base, with non-flowering rosettes or short stems. Basal leaves up to $7(-15) \times 3.5 \mathrm{~mm}$, spathulate, grey-green to white; cauline oblanceolate to suborbicular, grey-green, the largest near the apex of the stem; hairs with unequal, often patent, rays up to 1.5 mm long. Sepals $1-1.5 \mathrm{~mm}$; petals $2-2.5 \mathrm{~mm}$. Silicula $3-4 \times 2-$ 3.5 mm , broadly obovate, obtuse or emarginate, grey; hairs 0.4 0.7 mm in diameter, with $10-14$ unequal rays; valves asymmetrically inflated; style $0.8-1.1 \mathrm{~mm}$. Seeds c. 1.5 mm , not winged. S.E. Europe. Al Bu Gr Ju Rs (K) Tu.
55. A. caliacrae E. I. Nyárády, Bul. Grăd. Bot. Cluj 6: 92 (1926). Procumbent or ascending perennial $10-30 \mathrm{~cm}$, woody at base, with short or elongate, non-flowering stems. Leaves up to $7 \times 3 \mathrm{~mm}$, the smallest near the apex of the stem, oblanceolate, white; hairs $0.5-1 \mathrm{~mm}$ in diameter. Sepals $1.9-2 \mathrm{~mm}$; petals $2-$ 2.8 mm . Silicula $3-5 \times 2.5-4 \mathrm{~mm}$, obovate to obovate-orbicular, emarginate, grey-green, punctate; hairs $0.4-0.5 \mathrm{~mm}$ in diameter, persistent; valves asymmetrically inflated; style $0.6-1.5 \mathrm{~mm}$. Seeds c. 1.5 mm ; wing 0.2-0.5 mm. S.E. Europe. Bu Gr Ju Rm Rs (K).
56. A. borzaeanum E. I. Nyárády, op. cit. 90 (1926). Ascending or erect perennial $10-30 \mathrm{~cm}$, with short or long, non-flowering stems. Basal leaves $6-7 \times 3-5 \mathrm{~mm}$, obovate-spathulate to suborbicular, obtuse; cauline oblanceolate, the largest near the apex of the stem, whitish; hairs $0.2-0.5 \mathrm{~mm}$ in diameter. Sepals $c$. 1.5 mm ; petals $2-2.3 \mathrm{~mm}$. Silicula $2-3 \times 2-3 \mathrm{~mm}$, obcordate, grey; hairs $0.2-0.4 \mathrm{~mm}$ in diameter, easily displaced; valves asymmetrically inflated; style $c .1 \mathrm{~mm}$. Seeds $c .1 .5 \mathrm{~mm}$, not winged. Black Sea coasts of Bulgaria and Romania. Bu Rm.
57. A. obtusifolium Steven ex DC., Reg. Veg. Syst. Nat. 2: 305 (1821). Ascending perennial up to $30(-35) \mathrm{cm}$ with long, nonflowering stems. Basal leaves (5-)7-10 $\times 4 \cdot 5-5(-6) \mathrm{mm}$, spathulate to suborbicular, obtuse; cauline $10-15 \times 3-4 \mathrm{~mm}$, oblance-olate-spathulate, white. Sepals $2-3 \mathrm{~mm}$; petals $2 \cdot 5-3 \cdot 5 \mathrm{~mm}$. Silicula $2.3-3.6 \times 2.5-3.3 \mathrm{~mm}$, elliptical to suborbicular, rarely obovate, obtuse or truncate, sparsely pubescent; valves asymmetrically inflated; style $1-1.5 \mathrm{~mm}$. Seeds not winged. S.E. Europe. Bu Gr RmRs (W, K, E).
(a) Subsp. obtusifolium: $10-30(-35) \mathrm{cm}$. Basal leaves $7-10 \mathrm{~mm}$, spathulate. Throughout the range of the species except Thasos.
(b) Subsp. helioscopioides E. I. Nyárády, Bul. Grăd. Bot. Cluj 7: 167 (1927): 5-10 cm. Basal leaves 5-7 mm, suborbicular, very crowded. Thasos.
58. A. obovatum (C. A. Meyer) Turcz., Bull. Soc. Nat. Moscou 1: 57 (1837). Like 57 (a) but plant not more than $10(-15) \mathrm{cm}$, with short non-flowering stems; basal leaves $6-8 \times c .3 \mathrm{~mm}$, obovate-spathulate to suborbicular; cauline smaller; silicula $3.5-5 \times 2.5-3.5 \mathrm{~mm}$, elliptical, densely white-pubescent; hairs c. 0.3 mm in diameter, 20 - to 25 -rayed. S. Ukraine, S.E. Russia. Rs (W, E).
59. A. tortuosum Willd., $S p$. Pl. 3 (1): 466 (1800). Procumbent or ascending perennial $6-35(-60) \mathrm{cm}$, with few, long, non-flowering stems. Largest leaves $9-25 \times 2-5 \mathrm{~mm}$, spathulate or oblanceolate, more or less acute, grey or white; cauline sometimes larger than
basal. Sepals c. 2 mm ; petals c. 2.5 mm . Silicula $3-4 \times 2-2.5 \mathrm{~mm}$, elliptical or elliptic-obovate, truncate or emarginate, densely greypubescent; valves usually asymmetrically inflated; style $0 \cdot 5$ 1 mm , pubescent. Seeds c. 1.5 mm , not winged. E.C. \& S.E. Europe. Bu Cz Gr Hu Ju Rm Rs (W, K, E) Tu.
60. A. longistylum (Sommier \& Levier) Grossh. in Grossh. \& Schischkin, Sched. Pl. Or. Exsicc. 1: 18 (1924) (A. tortuosum var. longistylum (Sommier \& Levier) N. Busch). Like 59 but the petals $3-3.5 \mathrm{~mm}$; silicula $4-6 \times 2.5-3 \mathrm{~mm}$, attenuate towards the apex; style $1.5-3 \mathrm{~mm}$, glabrous. Krym. Rs (K). (Caucasus.)
61. A. alpestre L., Mantissa 92 (1767). Usually procumbent perennial $5-15(-20) \mathrm{cm}$, with numerous non-flowering rosettes. Leaves $4-7 \times 1.5-3.5 \mathrm{~mm}$, oblanceolate or obovate-spathulate, white or rarely grey-green. Sepals $2-2.5 \mathrm{~mm}$; petals $3-3.5 \mathrm{~mm}$, entire. Silicula $2.5-4.5 \times 2.5-3.5 \mathrm{~mm}$, elliptical, subacute to emarginate, white pubescent; hairs 12- to 16 -rayed; valves asymmetrically inflated; style $0.7-1.7 \mathrm{~mm}$. Seeds $1 \cdot 5-2 \mathrm{~mm}$, not or narrowly winged. C. \& W. Alps. Ga Ge He It.
62. A. serpyllifolium Desf., Fl. Atl. 2: 70 (1798). Procumbent to erect perennial up to 30 cm , with numerous non-flowering rosettes or short stems. Leaves up to $18 \times 4 \mathrm{~mm}$, oblanceolate or obovate-spathulate, grey or white beneath, grey or grey-green above, plicate on the non-flowering stems. Sepals $1 \cdot 5-2 \mathrm{~mm}$; petals $2-2 \cdot 5(-3) \mathrm{mm}$, entire. Silicula $2 \cdot 5-4 \cdot 5 \times(1 \cdot 5-) 2-3 \cdot 5 \mathrm{~mm}$, broadly elliptical or elliptic-rhombic to obovate, usually subacute, densely white-pubescent; hairs 12 - to 16 -rayed; valves asymmetrically inflated; style $0.8-1.5 \mathrm{~mm}$. Seeds $1.3-1.8 \mathrm{~mm}$, not or only narrowly winged. S.W. Europe. Ga Hs Lu.

Very variable and possibly containing a number of subspecies.
63. A. nebrodense Tineo, Pl. Rar. Sic. Pug. 1: 12 (1817). Procumbent, caespitose perennial 3-12(-16) cm , with numerous, short, non-flowering stems. Basal leaves orbicular-spathulate, obtuse, white; cauline up to $8-9 \times 3 \mathrm{~mm}$, usually spathulate, grey-green. Sepals 2 mm ; petals $2 \cdot 5-3 \mathrm{~mm}$. Silicula $4-6 \times 3-$ 4 mm , elliptical, obtuse or emarginate, white pubescent; hairs 12- to 16 -rayed; valves asymmetrically inflated; style 0.71.5 mm . Seeds $c .1 .75 \mathrm{~mm}$, not winged. Sicilia. Si.
64. A. fragillimum (Bald.) Rech. fil., Denkschr. Akad. Wiss.
 mum (Bald.) Halácsy). Like 63 but $1-3 \mathrm{~cm}$; basal leaves lanceo-late-spathulate to orbicular-spathulate, subacute; cauline 3$4 \times 0.5-1.5 \mathrm{~mm}$, orbicular-spathulate to linear-spathulate; silicula $3 \cdot 5-5 \times 2-2.5 \mathrm{~mm}$, sparsely pubescent; hairs (16-)18- to 23 rayed. Kriti. Cr.

## 51. Fibigia Medicus ${ }^{1}$

Perennial herbs; hairs stellate, rarely mixed with some unbranched hairs. Sepals erect, the inner saccate or not saccate at base; petals yellow, shortly clawed. Fruit a strongly compressed latiseptate silicula; valves flat, not veined; style long; stigma more or less capitate. Seeds 2-8 in each loculus, winged.
1 Plant usually more than 30 cm , without numerous vegetative shoots at base; sepals $4 \cdot 5-7 \mathrm{~mm}$; petals $8-13 \mathrm{~mm}$; fruiting racemes usually more than 10 cm 1. clypeata
1 Plant usually less than 30 cm , with numerous vegetative shoots at base; sepals $7-10 \mathrm{~mm}$; petals $12-19 \mathrm{~mm}$; fruiting racemes up to $c .8 \mathrm{~cm}$
2 Leaves with ash-white, lanate indumentum; silicula at least 9 mm wide, not more than twice as long as wide
2. Iunarioides

2 Leaves with silver-grey, very closely appressed indumentum; silicula not more than 8 mm wide, usually at least twice as long as wide
3. triquetra

1. F. clypeata (L.) Medicus, Pflanzengatt. 1: 91 (1792) (Farsetia clypeata (L.) R.Br.). Stems $30-75 \mathrm{~cm}$. Lower leaves oblong or oblanceolate, usually green or grey-green, with lanate indumentum. Fruiting racemes $10-20 \mathrm{~cm}$; pedicels $2-5 \mathrm{~mm}$. Sepals $4.5-7.0 \mathrm{~mm}$; petals $8-13 \mathrm{~mm}$. Silicula $14-28 \times 9-13 \mathrm{~mm}$, elliptical. Italy; Balkan peninsula southwards to N.E. Greece; Krym. Al Bu Gr It Ju Rs (K) [Au Ga].
F. eriocarpa (DC.) Boiss., Fl. Or. 1: 258 (1867), from N.W., C. \& S. Greece differs from 1 only in the long unbranched hairs on the silicula, and is probably not specifically distinct.
2. F. Iunarioides (Willd.) Sibth. \& Sm., Fl. Graeca 7: 22 (1830). Stems $5-30 \mathrm{~cm}$, woody at base, subcaespitose, with numerous leafy shoots. Lower leaves obovate-lanceolate to linear-spathulate, with ash-white, lanate indumentum. Fruiting racemes not more than 5 cm ; pedicels $5-15 \mathrm{~mm}$. Sepals $7-9 \mathrm{~mm}$; petals $12-$ 16 mm . Silicula $12-22 \times 9-18 \mathrm{~mm}$, elliptical to orbicular. Cliffs. - Kikladhes. Gr.
3. F. triquetra (DC.) Boiss. ex Prantl in Engler \& Prantl, Natürl. Pflanzenfam. 3 (2): 196 (1891). Stem 5-20 cm, woody at base, subcaespitose, with numerous leafy shoots. Lower leaves obovate to oblanceolate, with very closely appressed silver-grey indumentum. Fruiting racemes up to 8 cm ; pedicels $3-10 \mathrm{~mm}$. Sepals $8-10 \mathrm{~mm}$; petals $13-19 \mathrm{~mm}$. Silicula $12-17 \times 5-8 \mathrm{~mm}$, elliptical or elliptic-oblong. Cliffs. W. Jugoslavia. Ju.

## 52. Berteroa DC. ${ }^{1}$

Annual to perennial herbs; hairs stellate or of 2 kinds, stellate and unbranched. Sepals erecto-patent, not saccate at base; petals white or pale yellow, sometimes becoming reddish, deeply bifid; outer filaments with a tooth at the base, inner broad towards the base or toothed. Fruit a latiseptate silicula; valves flat or somewhat inflated, without a conspicuous median vein; style distinct; stigma capitate. Seeds 2-6 in each loculus, sometimes winged.

All species occur in stony or rocky places, or as ruderals.
1 Petals pale yellow; silicula about as long as wide, orbicular or obovate-orbicular
3. orbiculata

1 Petals white or very pale cream, sometimes becoming reddish; silicula $1 \cdot 5-3$ times as long as wide, elliptical or ellipticorbicular
2 Style $0 \cdot 5-1 \mathrm{~mm}$ (Crna Gora) 5. gintlii
2 Style $1-4 \mathrm{~mm}$
3 Silicula inflated, the valves convex; seeds margined, but not conspicuously winged
4. incana

3 Silicula flat; seeds winged
4 Silicula pubescent with stellate hairs; style ( $1 \cdot 5-$ )2-4 mm

1. obliqua

4 Silicula $\pm$ glabrous; style $1-2 \mathrm{~mm}$
2. mutabilis

1. B. obliqua (Sibth. \& Sm.) DC., Reg. Veg. Syst. Nat. 2: 292 (1821) (incl. B. stricta forma pindicola (Halácsy)). Biennial or perennial $10-50 \mathrm{~cm}$; leaves lanceolate. Petals $5-8 \mathrm{~mm}$, white becoming reddish. Silicula $8-12 \times 4-5 \mathrm{~mm}$, elliptical, flat, pubescent with stellate and sometimes with unbranched hairs; style $1.5-4 \mathrm{~mm}$. Seeds broadly winged. Balkan peninsula southwards from c. $43^{\circ} N . ; S$. Italy. Al Bu Gr It Ju Tu.
2. B. mutabilis (Vent.) DC., loc. cit. (1821). Like 1 but leaves lanceolate to obovate-elliptical; petals $4-6 \mathrm{~mm}$; silicula 6-12×

[^119]${ }^{2}$ By V. H. Heywood.
3.5-5 mm, more or less glabrous; style 1-2 mm. Balkan peninsula, extending northwards to N.E. Italy. Al Bu Gr It Ju.

Possibly only a subspecies of $\mathbf{1}$.
3. B. orbiculata DC., op. cit. 293 (1821) (B. samolifolia sensu Hayek). Biennial or perennial $10-100 \mathrm{~cm}$; leaves oblong to ovate, entire or sinuate-dentate. Petals $4-7 \mathrm{~mm}$, pale yellow. Silicula 7$11 \times 6-9 \mathrm{~mm}$, orbicular to obovate-orbicular, flat, pubescent with stellate hairs; style $2-4 \mathrm{~mm}$. Seeds winged. Macedonia, E. Albania. Al Gr Ju.
4. B. incana (L.) DC., op. cit. 291 (1821) (incl. B. stricta Boiss. \& Heldr., Alyssum incanum L., Farsetia incana(L.) R.Br.). Annual to perennial up to 70 cm ; leaves lanceolate or oblong, usually entire. Petals $4.5-6 \mathrm{~mm}$, white. Silicula $4.5-8 \times 3-4.5 \mathrm{~mm}$, elliptical or ovate, inflated, with convex valves, pubescent; style $1 \cdot 5-4 \mathrm{~mm}$. Seeds not winged, sometimes margined. $2 n=16$. C. \& E. Europe, extending to Denmark and Italy, but precise native distribution uncertain owing to widespread introduction. Al Au Bu Da Ge Gr He Hu It Ju Po Rm Rs (N, B, C, W, K, E) Tu [Be Br Fe $\mathrm{Ga} \mathrm{Ho} \mathrm{No} \mathrm{Su]}$.
B. stricta Boiss. \& Heldr., Diagn. Pl. Or. Nov. 3 (1): 35 (1853) with the silicula usually ovate (not elliptical), and with long unbranched as well as stellate hairs, occurs only in the Balkan peninsula and there largely replaces 4 , of which it is possibly a subspecies.
5. B. gintlii Rohlena, Sitz.-Ber. Böhm. Ges. Wiss. 1904: 24 (1905). Like 4 but the silicula ovate-elliptical, pubescent with stellate hairs when young, more or less glabrous when mature; style $0.5-1 \mathrm{~mm}$; seeds winged. Crna Gora. Ju.

## 53. Lepidotrichum Velen. \& Bornm. ${ }^{1}$

Perennial herbs; hairs stellate. Sepals erecto-patent, not saccate at base; petals white, deeply bifid; outer filaments with a tooth at the base, inner broad towards the base. Fruit a latiseptate silicula; valves very inflated; style short; stigma capitate. Seeds 1 or 2 in each loculus, not winged.

1. L. uechtritzianum (Bornm.) Velen., Österr. Bot. Zeitschr. 39: 324 (1889). Perennial; stems $20-60 \mathrm{~cm}$, divaricately branched, grey-pubescent. Basal leaves oblong-lanceolate, entire, with persistent petioles; cauline linear. Inflorescence very lax in fruit; pedicels $4-6 \mathrm{~mm}$. Petals $4-5 \mathrm{~mm}$. Silicula $2-4 \times 2-2.5 \mathrm{~mm}$, elliptic-orbicular, appressed to the axis of the inflorescence; style c. 1 mm . Seeds not winged. Maritime sands. Black Sea coasts of Bulgaria and Turkey-in-Europe. Bu Tu.

## 54. Ptilotrichum C. A. Meyer ${ }^{2}$

Perennial herbs or small shrubs; hairs stellate or indumentum lepidote. Sepals erecto-patent, not saccate at base; petals white to purple, entire; filaments usually not toothed or winged. Fruit a latiseptate silicula; valves flat or inflated, without a conspicuous median vein; style short; stigma capitate or emarginate. Seeds 1 or 2 in each loculus, winged or not.
1 Petals purple; stems $2-5 \mathrm{~cm}$ 9. purpureum
1 Petals white or rarely pink; stems $15-30 \mathrm{~cm}$ or more
2 Branches becoming spiny at the apex
3 Spines simple; petals abruptly contracted into claw
7. macrocarpum
3 Spines branched; petals gradually narrowed into claw
8. spinosum
2 Branches not spiny at the apex

4 Stems 25-60 cm, fragile; basal leaves obovate-spathulate
6. longicaule

4 Stems $7-15 \mathrm{~cm}$, tough; basalleaves linear to oblong or obovatelanceolate
5 Silicula pubescent or lepidote
6 Basal leaves obovate-lanceolate; style $\pm$ equalling silicula 1. pyrenaicum

6 Basal leaves lanceolate or linear; style much shorter than silicula
5. cyclocarpum

5 Silicula glabrous
7 Petals $\pm$ orbicular; leaves broadly spathulate 2. reverchonii
7 Petals obovate or oblong; leaves oblong or linear
8 Seeds broadly winged; infructescence short, dense, corymbose 4. halimifolium
8 Seeds narrowly winged; infructescence lax, elongate
9 Stock without persistent leaf-bases; silicula patent or deflexed
3. lapeyrousianum

9 Stock covered with persistent leaf-bases; silicula erectopatent 5. cyclocarpum

1. P. pyrenaicum (Lapeyr.) Boiss., Voy. Bot. Midi Esp. 2: 45 (1839) (Alyssum pyrenaicum Lapeyr.). Small caespitose shrub up to 50 cm , with a woody stock branched above, and bearing clusters of leaves or erect flowering stems $7 \cdot 5-10 \mathrm{~cm}$. Leaves obovate-lanceolate, attenuate at base, silvery-tomentose. Flowers in dense corymbs; petals conspicuous, white, obovate-orbicular, abruptly contracted into claw. Silicula $6-8 \mathrm{~mm}$, rhomboidobovoid, compressed, pubescent; style about as long as the silicula. Seeds winged. Limestone cliffs. - E. Pyrenees (Font de Coms). Ga.
2. P. reverchonii Degen \& Hervier, Magyar Bot. Lapok 5: 2 (1906). Like 1 but leaves broadly spathulate; petals very shortly clawed; silicula glabrous; style $\frac{1}{2} \frac{1}{3}$ as long as silicula. Limestone cliffs. - S.E. Spain (Sierra de Cazorla and adjacent mountains). Hs.
3. P. lapeyrousianum (Jordan) Jordan in Jordan \& Fourr., Icon. Fl. Eur. 2: 47 (1903) (P. peyrousianum Willk., Alyssum lapeyrousianum Jordan). Small caespitose shrub up to 30 cm , with branched, woody stock. Flowering stems $\mathbf{7 \cdot 5 - 1 5} \mathrm{cm}$, erect. Leaves oblong to oblong-lanceolate, obtuse, attenuate at base, silvery-tomentose. Flowers racemose; petals conspicuous, white, obovate. Infructescence lax, elongate. Silicula obovoid, glabrous; style $\frac{1}{4}-\frac{1}{6}$ as long as silicula. Seeds narrowly winged. Limestone cliffs and screes. E. Pyrenees, E. Spain. Ga Hs.
4. P. halimifolium Boiss., Voy. Bot. Midi Esp. 2: 45 (1839). (Alyssum halimifolium auct., non L.). Like 3 but siliculae in short, dense, corymbose clusters; style $\frac{1}{2}-\frac{1}{3}$ as long as the silicula; seeds broadly winged. Rocks. - S.E. France, N.W. Italy. Ga It.
5. P. cyclocarpum Boiss., Ann. Sci. Nat. ser. 2, 17: 159 (1842) (Alyssum rupestre Ten., non Willd.). Caespitose perennial up to 20 cm , woody at the base and covered with persistent leafbases. Basal leaves lanceolate or linear; cauline leaves linear; all silvery-tomentose. Petals 5 mm , white. Silicula 5 mm , obovoidglobose, lepidote or glabrous; style 0.5 mm . Seeds very narrowly winged. Cliffs. Mountains of C. Italy and W. part of Balkan peninsula. Al Gr It Ju.
6. P. longicaule (Boiss.) Boiss., Elenchus 13 (1838). Laxly caespitose perennial, woody at the base. Stems $25-60 \mathrm{~cm}$, fragile. Basal leaves obovate-spathulate, attenuate into petiole; cauline leaves few, linear-lanceolate; all grey-tomentose. Petals white. Silicula obovoid, glabrous. Seeds broadly winged. Limestone rocks and cliffs. S. Spain. Hs.

[^120]P. cadevallianum (Pau) Heywood, Feddes Repert. 66: 55 (1962) with suborbicular or obovate-spathulate leaves, flowering stems 20 cm and silicula $9 \times 7 \mathrm{~mm}$, was described from S. Spain (El Maimón, near Vélez Rubio). It resembles 6 in some respects but is of very uncertain affinity.
7. P. macrocarpum (DC.) Boiss., Voy. Bot. Midi Esp. 2: 45 (1839) (Alyssum macrocarpum DC.). Small, much-branched shrub, the branches intertwined and becoming more or less spiny. Stems up to 20 cm . Leaves oblong to oblong-obovate, obtuse, crowded at the base of the flowering branches or forming non-flowering rosettes, all silvery-green to white-tomentose. Petals white, abruptly contracted into a claw. Silicula $8-10 \mathrm{~mm}$, suborbicular, inflated, glabrous; style $\frac{1}{2}-\frac{1}{3}$ as long as the fruit. Seeds 2-4 in each loculus, broadly winged. Limestone rocks. - S. France (from $1^{\circ} 30^{\prime}$ to $4^{\circ} 45^{\prime}$ E.) Ga.
8. P. spinosum (L.) Boiss., Voy. Bot. Midi Esp. 2: 46 (1839). Small convex, much-branched shrub, the branches becoming spiny with branched spines. Stems up to 60 cm . Leaves of nonflowering rosettes obovate-spathulate; those of the flowering branches linear-lanceolate; all silvery-lepidote. Petals white or purplish, gradually narrowing into claw. Silicula $4-6 \mathrm{~mm}$, obovoid, glabrous; style as long as the fruit. Seeds 2 in each loculus, broadly winged. Rocks and screes. E. \& S. Spain, S. France. Ga Hs.
9. P. purpureum (Lag. \& Rodr.) Boiss., Elenchus 12 (1838). Small, inconspicuous, densely caespitose, spineless perennial, half-hidden in screes. Stems $2-5 \mathrm{~cm}$. Leaves spathulate to linear, whitish- or greyish-lepidote. Petals purple. Silicula 4 mm , ellipsoid, stellate-hairy; style almost as long as the fruit. Screes. Mountains of S. \& S.E. Spain. Hs.

## 55. Bornmuellera Hausskn. ${ }^{1}$

Like Ptilotrichum but with hairs medifixed, or rarely plant glabrous; filaments with a tooth-like appendage at the base.
1 Leaves not more than 3 mm wide, linear to linear-lanceolate or oblanceolate
2. baldaccii

1 Leaves (3-)4-8 mm wide, oblong-spathulate
2 Leaves densely clothed with medifixed hairs; silicula $7-8 \mathrm{~mm}$, inflated 3. tymphaea
2 Leaves glabrous above, sparsely hairy beneath; silicula 4 mm , $\pm$ compressed

1. dieckii
2. B. dieckii Degen, Österr. Bot. Zeitschr. 50: 313 (1900) (Ptilotrichum dieckii (Degen) Hayek). Leaves oblong-spathulate, glabrous above, with sparse medifixed hairs beneath. Infructescence branched, dense. Silicula 4 mm , ovoid, somewhat compressed. Rocks. - S. Jugoslavia (near Prizren). Ju.
3. B. baldaccii (Degen) Heywood, Feddes Repert. 69: 61 (1964) (Ptilotrichum baldaccii Degen). Stems up to 10 cm , leafless. Leaves $10-17 \times 1-3 \mathrm{~mm}$, linear to linear-lanceolate, glabrous or almost so, densely crowded. Infructescence unbranched; pedicels patent or deflexed. Silicula 5 mm , ovoid, inflated. Seeds unwinged. Serpentine rocks, 1600-2000 m. - N.W. Greece, S. \& C. Albania. Al Gr.
4. B. tymphaea (Hausskn.) Hausskn., Mitt. Thür. Bot. Ver. nov. ser. 11: 72 (1897) (Ptilotrichum tymphaeum (Hausskn.) Halácsy). Stems up to 40 cm . Leaves $20-40 \times 3-8 \mathrm{~mm}$, oblong-spathulate, densely clothed with medifixed hairs. Infructescence branched; pedicels patent. Silicula $7-8 \mathrm{~mm}$, inflated. Seeds winged. Serpentine or schistose rocks. N. Greece. Gr.

## 56. Lobularia Desv. ${ }^{1}$

Annual or perennial herbs; hairs medifixed. Sepals patent, not saccate at base; petals white, entire; filaments not winged and without appendages. Fruit a latiseptate silicula; valves slightly inflated, with a more or less distinct median vein; style distinct; stigma capitate. Seeds 1-5 in each loculus.
Silicula obovate or suborbicular; valves convex; seed 1 in each loculus

1. maritima Silicula ovate; valves flat; seeds 4-5 in each loculus 2. libyca
2. L. maritima (L.) Desv., Jour. Bot. Appl. 3: 162 (1814) (Koniga maritima (L.) R.Br.). Greyish-white pubescent, or glabrescent perennial ( $5-) 10-40 \mathrm{~cm}$, branched at base. Leaves linear-lanceolate, acute, rarely obtuse. Petals c. 3 mm . Silicula $2-3.5 \mathrm{~mm}$, obovate or suborbicular; valves convex, pubescent or glabrescent. Seed 1 in each loculus. $2 n=24$. Dry, sunny places. S. Europe; widely cultivated for ornament elsewhere and often naturalized or casual. Az Bl Co Ga ?Gr Hs It Ju Lu Rs (K) Sa Si [ $\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Ho} \mathrm{Hu} \mathrm{No} \mathrm{Rm]}$.
3. L. libyca (Viv.) Webb \& Berth., Phyt. Canar. 1: 90 (1837) (Koniga libyca (Viv.) R.Br.). Like 1 but annual; leaves obtuse; silicula $3-7 \mathrm{~mm}$, ovate; valves flat; seeds 4-5 in each loculus. Maritime sands. S. Spain; Kikladhes (Thira). Gr Hs.

## 57. Clypeola L. ${ }^{1}$

Annual; hairs branched or stellate. Sepals erecto-patent, not saccate; petals yellow, shortly clawed. Fruit an indehiscent, compressed, 1 -seeded, pendent silicula; style short; stigma obtuse.

Literature: M. Breistroffer, Candollea 7: 140-66 (1936); 10: 241-80 (1946). D. A. Chaytor \& W. B. Turrill, Kew Bull. 1935: 1-24 (1935).
Silicula $2-5 \mathrm{~mm}$, glabrous or pubescent; petals $1-2 \mathrm{~mm}$ 1. jonthlaspi Silicula $5 \cdot 5-6 \mathrm{~mm}$, with a very dense, long, white indumentum;
petals c. 3 mm
2. eriocarpa

1. C. jonthlaspi L., Sp. Pl. 652 (1753) (incl. C. microcarpa Moris). Erect, up to $20(-30) \mathrm{cm}$, grey-pubescent. Leaves linearoblanceolate to obovate. Raceme elongate in fruit; pedicels $1 \cdot 5-3 \mathrm{~mm}$. Petals $1-2 \mathrm{~mm}$, glabrous. Silicula $2-5 \mathrm{~mm}$, obovateorbicular, elliptic-orbicular or orbicular, with a distinct wing, entire, pubescent or glabrous; style up to 0.25 mm . S. Europe. Al Bl Bu Co Cr Ga Gr He Hs It Ju Rm Rs (K) Sa Si Tu.

Variable in silicula size and pubescence but most of the variants occur sporadically throughout the range of the species. Some of these variants are recognized as subspecies by Breistroffer op. cit. $(1936,1946)$.
2. C. eriocarpa Cav., Descr. Pl. 401 (1802). Like 1 but petals c. 3 mm , stellate-pubescent on the back; silicula $5.5-$ 6 mm , orbicular, scarcely winged, crenulate, with a very dense, long, white indumentum; style $c .0 .5 \mathrm{~mm} . C . \& S$ Spain. Hs.

## 58. Schivereckia Andrz. ${ }^{2}$

Perennial herbs; hairs stellate, minute. Sepals patent, the inner slightly saccate at base; petals white; filaments of the inner stamens winged, the wing with a short tooth at the apex. Fruit a latiseptate silicula; valves convex; style distinct; stigma capitate or slightly 2 -lobed. Seeds $4-7$ in each loculus.

[^121]Literature: M. Alexeenko, Not. Syst. (Leningrad) 9 (4-12): 215-31 (1946).

Cauline leaves semi-amplexicaul, with $1-4$ teeth on each side; plant densely caespitose

1. podolica

Cauline leaves narrowed at base, not or scarcely amplexicaul, entire (or rarely with 1 tooth on each side); plant usually laxly caespitose
2. doerfleri

1. S. podolica (Besser) Andrz. in DC., Reg. Veg. Syst. Nat. 2: 300 (1821). Densely caespitose; flowering stems up to 25 cm , simple or branched. Basal leaves rosulate, oblanceolate to oblong-spathulate, usually with $2-5$ teeth on each side; cauline oblong-ovate, semi-amplexicaul, with $1-4$ teeth on each side. Racemes up to 30 -flowered. Sepals $2-2.5 \mathrm{~mm}$; petals $4-5 \times 1 \cdot 5-$ 2.25 mm . Silicula $3-6 \times 2-2.75 \mathrm{~mm}$; style $0.75-2 \mathrm{~mm}$; stigma capitate, entire. Seeds $0.75-1 \times 0.5-1 \mathrm{~mm}$, dark brown, rugulose.

- W. Ukraine, Moldavia, N.E. Romania. Rm Rs (W).

2. S. doerfleri (Wettst.) Bornm., Feddes Repert. 17: 36 (1921) (Draba doerfleri Wettst.). Laxly caespitose; flowering stems up to 15 cm , simple or branched. Basal leaves more or less rosulate, oblanceolate, entire (or rarely with 1-2 teeth on each side); cauline linear-lanceolate, attenuate at base, obtuse, entire (or rarely with 1 tooth on each side). Racemes up to 15 -flowered. Sepals $2-2.25 \mathrm{~mm}$; petals $4-6 \times 2-3 \mathrm{~mm}$. Silicula $4-5.5 \times 2-$ 4 mm ; style $c .1 \mathrm{~mm}$; stigma shortly 2-lobed. Seeds $c .1 \mathrm{~mm}$. Rocky and grassy places. S.W. Jugoslavia (S̆ar Planina). Ju. (Asia Minor.)

Three taxa described from Russia all resemble 2 very closely; the scarcity of specimens (particularly with ripe seeds) prevents an accurate assessment of their status.
S. mutabilis (Alexeenko) Alexeenko, Trudy Nauč.-Issled. Inst. Biol. (Har'kov) 13: 95 (1950). Like 2 but stems up to 30 cm ; basal leaves linear-lanceolate to oblong-spathulate; cauline ovate to oblong-elliptical, subacute; silicula 4-8.5 $\times 1.75-3.5 \mathrm{~mm}$; style up to 1.5 mm ; stigma capitate, entire; seeds $1-1.5 \mathrm{~mm}$, rugulose, not punctate. - S.C. Russia; N.E. Ukraine. Rs (C, E).
S. berteroides Fischer ex Alexeenko, Not. Syst., (Leningrad) 9: 218 (1946). Like 2 but stems up to 25 cm ; basal leaves linearor oblong-lanceolate; cauline oblong-elliptical; silicula 4-6.5× $2-3.25 \mathrm{~mm}$; style $c .1 .25 \mathrm{~mm}$; stigma capitate, emarginate or slightly 2 -lobed; seeds $c .1 .25 \mathrm{~mm}$, blackish-brown, rugulose. ? - S. Ural. Rs (C).
S.kuznezovii Alexeenko, Not. Syst. (Leningrad) 9: 227 (1946). Like 2 but basal leaves oblong-oblanceolate; cauline elliptical; silicula $3 \cdot 5-7.5 \times 2-2.5 \mathrm{~mm}$; style up to 1 mm ; stigma capitate, entire; seeds $1-1.25 \mathrm{~mm}$, smooth and not rugulose, but punctate. Calcareous and sandy places. N.C. Ural. Rs (C).

## 59. Draba L. ${ }^{3}$

Annual to perennial herbs. Leaves simple, entire or dentate. Sepals erecto-patent, the inner not or only slightly saccate at base; petals white or yellow, entire or emarginate; filaments not or only slightly dilated at the base. Fruit a latiseptate silicula or siliqua; valves more or less flat, with a median vein in the lower half; style absent to long; stigma capitate. Seeds in 2 rows in each loculus, not winged.

Most of the species are arctic or montane plants, growing in open, rocky or gravelly places. Several are common as rock-plants in gardens.

The nature and density of the indumentum is used a great deal in the taxonomy of Draba. The hairs may be unbranched, branched, stellate or medifixed. The leaves are nearly always ciliate even when they are otherwise glabrous. The length of the stem given in the description refers to the fruiting stage; there is often considerable elongation after flowering.

The limits and particularly the rank of many described taxa are disputable, and experimental work is needed in the genus.

## Literature: O.E.Schulz in Engler, Pflanzenreich 89 (IV. 105): 1-396 (1927).

1 Scapose perennials with yellow flowers
2 Plant with numerous long, procumbent leafy stems; hairs on leaves and base of stem medifixed
25. sibirica

2 Plant without long, procumbent leafy stems, often densely caespitose; hairs not medifixed
3 Leaves lanceolate to obovate, not keeled, soft in texture, without stiff cilia
4 Leaves with unbranched hairs only
42. crassifolia

4 Leaves with some branched and stellate hairs
(18-24). alpina group
3 Leaves linear or more rarely lanceolate, keeled, $\pm$ rigid, with stiff cilia
5 Scape hairy
6 Petals about equalling stamens
7 Scape villous, with some long hairs up to 1 mm
5. cuspidata 3. aspera

7 Scape hispid, with hairs not more than 0.5 mm
6 Petals distinctly longer than stamens
8 Silicula densely stellately hairy
14. cretica

8 Silicula with unbranched or branched hairs only
9 Scape villous with hairs c. 1 mm
10 Style $1-1.5 \mathrm{~mm}$
12. parnassica 10 Style 0.3-0.8 mm
15. dedeana 9 Scape hispid with shorter hairs, mostly not more than 0.75 mm

11 Style $2-4 \mathrm{~mm}$; silicula $\pm$ inflated at base
11. hispanica 11 Style $c .1 \mathrm{~mm}$; silicula flat
13. Ioiseleurii

5 Scape glabrous
12 Style not more than 1 mm in fruit
13 Plant laxly caespitose, with $\pm$ elongated stems clothed with scale-like leaf-remains below the rosette 16. sauteri
13 Plant densely caespitose or pulvinate, without obvious persistent scale-like leaf-remains
14 Infructescence $\pm$ elongate
15 Leaves less than 1 mm wide, incurved; silicula 3.55 mm , inflated
17. heterocoma

15 Leaves 1-2 mm wide, straight; silicula 6-9 mm , flat
9. lacaitae 14 Infructescence subcapitate
16 Silicula obviously hairy $\quad$ 8. compacta 16 Silicula subglabrous
2. hoppeana

12 Style more than 1 mm (and usually more than 1.5 mm ) in fruit
17 Style less than 3 mm in fruit 18 Leaves ( $1 \cdot 5-) 1 \cdot 75-4 \mathrm{~mm}$ wide
7. lasiocarpa 18 Leaves less than 1.5 mm wide
19 Leaves less than 1 mm wide; silicula densely hairy, $\pm$ inflated at base
10. haynaldii

19 Leaves 1 mm or more wide; silicula usually glabrous

1. aizoides

17 Style 3 mm or more in fruit
20 Silicula flat
21 Leaves ciliate, otherwise glabrous; silicula usually glabrous

1. aizoides

21 Leaves $\pm$ hispid-setose all over; silicula usually densely setose
6. athoa

20 Silicula inflated
22 Leaves less than 1.2 mm wide; silicula 4-7(-11) mm
3. aspera

22 Leaves $1 \cdot 2-2 \mathrm{~mm}$ wide; silicula $3-4 \mathrm{~mm}$
4. scardica

1 Annuals, biennials or perennials usually with $\pm$ leafy stems, sometimes scapose; flowers white or cream
23 Annual (sometimes overwintering); style less than 0.3 mm , or absent
24 Fruiting pedicels shorter than silicula 41. lutescens
24 Fruiting pedicels as long as or longer than silicula
25 Silicula glabrous; cauline leaves cordate at base, amplexicaul
39. muralis

25 Silicula usually hairy; cauline leaves cuneate at base, not or scarcely amplexicaul
40. nemorosa

23 Perennial, more rarely biennial; style usually more than 0.3 mm

26 Stem glabrous
27 Petals white; leaves $\pm$ oblong
35. fladnizensis

27 Petals yellow when young; leaves oblong-spathulate
42. crassifolia

26 Stem hairy (sometimes only sparsely so)
28 Style 1-2 mm in fruit
26. stellata

28 Style less than 1 mm in fruit
29 Stem robust, usually more than 10 cm , with more than 4 cauline leaves; silicula often somewhat twisted
38. incana

29 Stem more slender, often less than 10 cm , with $(0) 1-4(-7)$ cauline leaves; silicula usually straight
30 Leaves densely clothed with very small stellate hairs only; a few cilia present (Arctic) 27. nivalis
30 Unbranched and branched hairs present on leaves; stellate hairs present or not
31 Silicula hairy
32 Leaves linear, keeled, rigid (Spain) 15. dedeana
32 Leaves lanceolate to obovate, not keeled, soft in texture
33 Whole plant canescent with a dense stellate tomentum
34 Silicula with stellate hairs only, strongly inflated
37. cinerea

34 Silicula with many unbranched or branched hairs, only slightly inflated
34. tomentosa

33 Plant not canescent; stellate hairs relatively sparse
35 Often scapose; silicula $3-6(-7) \mathrm{mm} \quad$ 28. norvegica
35 Rarely scapose; silicula (6-)7-12 mm 36. daurica
31 Silicula glabrous (or with sparse cilia)
36 Stem with minute stellate hairs only (rarely with a few unbranched or branched hairs) 36. daurica
36 Stem with hairs of various types, always including some branched ones
37 Infructescence corymbose or subcapitate
38 Silicula glabrous 29. subcapitata
38 Silicula hairy
30. cacuminum

37 Infructescence $\pm$ elongate
39 Fruiting pedicels suberect; infructescence therefore very narrow (Arctic and mountains of N. Europe)
28. norvegica

39 Fruiting pedicels erecto-patent; infructescence therefore broader (mountains of C. \& S. Europe)
40 Pedicels and upper part of stem glabrous
31. carinthiaca

40 Pedicels and stem at least sparsely hairy
41 Rosette-leaves coarsely toothed
33. kotschyi
32. dubia

Sect. Aizopsis DC. Scapose, caespitose perennials, often densely pulvinate. Leaves rigid, entire, linear or narrowly spathulate, rosulate, ciliate. Flowers yellow (except in 15).

1. D. aizoides L., Mantissa 91 (1767). Caespitose; scapes usually $5-10 \mathrm{~cm}$, glabrous. Leaves up to 1.5 mm wide, linear, ciliate but otherwise glabrous. Inflorescence initially more or less condensed, later rather lax, 4 - to 18 -flowered; petals $4-6 \mathrm{~mm}$, yellow, obovate-cuneate, equalling stamens. Silicula $6-12 \mathrm{~mm}$, ellipsoid, flat, usually glabrous; style $1 \cdot 5-3(-6) \mathrm{mm} . \quad 2 n=16$. - Mountains of C. \& S. Europe from Pyrenees to Carpathians;
also in Britain (Wales). $\mathrm{Al} \mathrm{Au} \mathrm{Be} * \mathrm{Br} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{?} \mathrm{Gr} \mathrm{He} \mathrm{Hs}$ It Ju Po Rm Rs (W).

Variable in habit, size of flower and silicula, hairiness of silicula, style-length, etc., but the many named taxa are hardly sufficiently geographically differentiated to merit subspecific rank. A possible exception is subsp. zmudae Zapał., Rozpr. Wydz. Mat.-Przyr.Polsk. Akad. Um. (Biol.) ser. 3, 12 в: 230 (1912) from the Carpathians, with silicula up to 12 mm and style 6 mm .
D. brachystemon DC., Reg. Veg. Syst. Nat. 2: 334 (1821) (D. bertolonii sensu Thell. quoad pl. pyren., non Nyman), with stamens only $2-2.5 \mathrm{~mm}$, and small usually hairy siliculae, is recorded from the E. Pyrenees and the Alps (Monte Rosa). It is very rare and its relationship to 1 or to other species is very obscure.
2. D. hoppeana Reichenb. in Moessler, Handb. ed. 2, 2: 1132 (1828). Like 1 but very dwarf, densely caespitose; infructescence subcapitate; style $0 \cdot 5-1 \mathrm{~mm}$. Mountain rocks above 2200 m . - Alps from Haute Savoie and Piemonte to Kärnten. Au Ge He It.
3. D. aspera Bertol., Amoen. 384 (1819) (incl. D. longirostra Schott, Nyman \& Kotschy, D. bertolonii Nyman). Like 1 but leaves c. 1 mm wide; silicula inflated; style $3 \cdot 5-7 \mathrm{~mm}$. Mountain rocks. N. Balkan peninsula, Alpi Apuane, Appennini; Sicilia; Pyrenees (Haute Ariège). Al Ga It Ju Si.

Glabrous and hairy-fruited plants (var. eriocarpa (Guss.)) may occur in the same populations. The var. erioscapa (Caruel) with more or less hispid scape, occurs throughout the range and replaces the type in the single station in France.
4. D. scardica (Griseb.) Degen \& Dörfler, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 64: 70 (1897). Dwarf, rather slender and not densely caespitose perennial; scapes glabrous. Leaves 1-2-2 mm wide, linear, ciliate. Flowers small; petals $c .4 \mathrm{~mm}$, yellow. Silicula $3-4 \mathrm{~mm}$, inflated, usually glabrous; style $3 \cdot 5-7 \mathrm{~mm}$. - Mountains of the Balkan peninsula. Al Bu Gr Ju.
5. D. cuspidata Bieb., Fl. Taur.-Cauc. 3: 424 (1819). Dwarf, pulvinate; scapes rather lax-flowered, densely villous with some hairs up to 1 mm long. Flowers large, yellow; petals and stamens $6.5-8 \mathrm{~mm}$. Silicula 6-9 mm, more or less inflated, densely hairy with mostly unbranched hairs $c .0 .5 \mathrm{~mm}$; style 3-5 mm. Mountain rocks. Krym. Rs (K).
6. D. athoa (Griseb.) Boiss., Diagn. Pl. Or. Nov. 3 (1): 33 (1853). Rather robust, up to 12 cm . Leaves up to 2.5 mm wide, broadly linear, subobtuse, hispid-setose all over and strongly ciliate on margins. Flowers rather large, yellow; petals and stamens $6-7 \mathrm{~mm}$. Silicula $6-10(-12) \mathrm{mm}$, oblong-elliptic, not or scarcely inflated, usually setose; style more than 3 mm , persistent. $2 n=16$. Greece and W. Balkan peninsula. Al Gr Ju.
7. D. lasiocarpa Rochel, Sched. Pl. Hung. Exsicc. (1810) (D. aizoon Wahlenb.). Robust, and usually densely caespitose, up to 20 cm . Leaves up to $3(-4) \mathrm{mm}$ wide, broadly linear, acute. Petals 4.4 .5 mm , broadly obovate, deep yellow, longer than stamens. Silicula 6-8 $\times 2.5-3 \mathrm{~mm}$, oblong-elliptical, flat, hispidsetose especially on margins; style short, rarely more than 1.5 mm . $2 n=16$. Carpathians and mountains of Balkan peninsula; $E$. Austria. Al Au Bu Cz Gr Hu Ju Rm.
D. elongata Host, Fl. Austr. 2: 237 (1832), from the Balkan peninsula and the Carpathians, differs from 7 in its narrowly obovate petals $3 \cdot 5-4 \mathrm{~mm}$ long and equalling the stamens, and its narrower silicula $6-10 \times 2-3 \mathrm{~mm}$. It is often given specific rank.
D. boueana Zahlbr. ex O. E. Schulz, Pflanzenreich 89 (IV. 105): 47 (1927) described from Crna Gora and N. Albania, is a rather slender dwarf plant with shorter leaves and smaller flowers and fruit than 7, which it otherwise closely resembles. It needs further study.
8. D. compacta Schott, Nyman \& Kotschy, Analect. Bot. 50 (1854). Like 7 but very dwarf; infructescence subcapitate; style 0.5 mm . High mountains of the E. Carpathians and N. part of Balkan peninsula. Bu Ju Rm.

Appears to bear the same relation to 7 as does D. hoppeana to D. aizoides.
9. D. lacaitae Boiss., Fl. Or. suppl., 53 (1888). Densely caespitose perennial with filiform, ascending scapes up to 15 cm . Leaves $1.5-2 \mathrm{~mm}$ wide, broadly linear, obtuse, sparsely hispid or ciliate. Inflorescence at first dense, later elongating; pedicels (4-) $7-9 \mathrm{~mm}$, slender. Petals $c .4 \mathrm{~mm}$, obovate, rather pale yellow; stamens c. 2.5 mm . Silicula $6-9 \times 2.5-3 \mathrm{~mm}$, oblong-elliptical, setose; style $0.25-0.75 \mathrm{~mm}$. Mountain rocks. Greece. Gr.
10. D. haynaldii Stur, Österr. Bot. Zeitschr. 11: 186 (1861). Very dwarf, pulvinate perennial; scapes up to $6 \mathrm{~cm}, 3-$ to 8 flowered. Leaves $5-7 \times 1 \mathrm{~mm}$, linear, acute. Petals $4-4.5 \mathrm{~mm}$; stamens $3-3.5 \mathrm{~mm}$. Silicula $5-7 \times 2.3 \mathrm{~mm}$, broadly ovoid, inflated towards base, more or less densely hispid; style 1-2 mm. - S. Carpathians. Rm.
11. D. hispanica Boiss., Elenchus 13 (1838). Dwarf, pulvinate perennial with short, distinctly hairy scapes. Petals $5-9 \mathrm{~mm}$, yellow, distinctly longer than stamens. Silicula slightly inflated at base, densely hispid with unbranched and branched hairs; styles usually $2-4 \mathrm{~mm}$. Mountain rocks above 1400 m . - E. \& S. Spain. Hs.

Somewhat variable in size of flower and fruit, and length of style.
12. D. parnassica Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 3 (1): 34 (1853). Like 11 but scape with longer villous hairs, and style less than 1.5 mm . Mountains of Balkan peninsula. $\mathrm{Al} \mathrm{Gr} \mathrm{Ju}$.
13. D. loiseleurii Boiss., Diagn. Pl. Or. Nov. 3 (1): 34 (1853). Like 11 but style $c .1 \mathrm{~mm}$ and silicula flat, scabrid with hairs less than $0.25 \mathrm{~mm} .2 n=16$. Mountain rocks above 2300 m . Corse. Co.
14. D. cretica Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 27 (1849). Like 11 but petals $3 \cdot 5-4 \cdot 5 \mathrm{~mm}$; silicula densely stellately hairy; style 0.75 mm . Mountains of Kriti. Cr.
15. D. dedeana Boiss. \& Reuter in Boiss., Voy. Bot. Midi Esp. 2: 718 (1845) (incl. D. cantabrica Willk., D. zapateri Willk.). Densely pulvinate, with very woody stock; scapes villous, elongating after flowering, rather lax in fruit. Petals $4-6 \mathrm{~mm}$, white, broadly obovate, emarginate, much longer than stamens. Silicula hispid; style c. 0.5 mm . Mountains of N. \& E. Spain. Hs.
A variant with yellow petals has been described, apparently in error.
Species 11-15 appear to be closely related to each other and to D. atlantica Pomel, Nouv. Mat. Fl. Atl. 232 (1874), of the N. African mountains.
16. D. sauteri Hoppe, Flora (Regensb.) 6: 425 (1823). Laxly caespitose, with decumbent, rather elongated, branched stems, clothed with yellowish, appressed, scale-like, persistent leaf-bases,
and terminating in lax rosettes; scapes glabrous, usually less than 3 cm . Petals $4-5 \mathrm{~mm}$, yellow. Silicula 4-6 mm, flat, usually glabrous and often somewhat asymmetrical; style c. 0.5 mm . - E. Alps. Au Ge It.
17. D. heterocoma Fenzl, Pugillus 13 (1842). Densely pulvinate, with narrow, hairy, incurved leaves; scapes $3-10 \mathrm{~cm}$, glabrous; inflorescence becoming lax in fruit. Petals $5-6 \mathrm{~mm}$, yellow, obovate-cuneate, much longer than stamens. Silicula $3.5-5 \times 3 \mathrm{~mm}$, ovoid, inflated, densely hairy; style 0.5 mm . Karpathos. Cr. (Asia Minor.)

Sect. Chrysodraba DC. Scapose perennials. Leaves lanceolate to obovate, not rigid, often more or less densely hairy. Flowers yellow.
(18-24). D. alpina group. A taxonomically complex group almost confined to the Arctic, and particularly variable in Spitsbergen. All are densely rosulate, scapose perennials with ellipticlanceolate leaves and variably clothed with unbranched, branched and stellate hairs. The inflorescence is dense and the petals are yellow. $2 n=62-64,80$.

The following treatment attempts to utilize the work of Elis. Ekman, Svensk Bot. Tidskr. 35: 135 (1941), and A. Tolmatchev in Komarov, Fl. URSS. 8: 390-401 (1939).
1 Inflorescence elongating considerably after flowering

2 Petals c. 5 mm , bright yellow
23. glacialis

2 Petals $2-3 \mathrm{~mm}$, pale yellow or cream 22. oblongata

1 Inflorescence not or only slightly elongating after flowering
3 Silicula hairy
4 Branched and stellate hairs on underside of leaf obviously stalked; filaments slightly dilated at base 20. bellii
4 Branched and stellate hairs on underside of leaf nearly sessile; filaments broadly dilated at base 21. kjellmanii
3 Silicula glabrous or nearly so
5 Style 1 mm (Alps, local)
24. ladina

5 Style 0.5-0.75 mm (Arctic)
6 Petals bright yellow; leaves entire
18. alpina

6 Petals pale yellow; leaves often denticulate
19. gredinii
18. D. alpina L., Sp. Pl. 642 (1763). Scapes up to 20 cm , more or less dense in fruit. Leaves usually rather densely hairy, entire. Petals $3.5-5 \mathrm{~mm}$, bright yellow. Silicula glabrous; style $0.5-$ 0.75 mm . Arctic and subarctic Europe. Fe Is No Rs (N) Sb Su.
19. D. gredinii Elis. Ekman, Svensk Bot. Tidskr. 27: 102 (1933). Like 18 but leaves usually sparsely hairy and often denticulate; petals pale yellow. - Spitsbergen; ?mountains of Norway. ?No Sb.
20. D. bellii Holm, Feddes Repert. 3: 338 (1907). Leaves with long, rather rigid hairs on upper surface, and stalked, branched and stellate hairs on lower surface. Petals dull yellow; filaments slightly dilated at base. Silicula hairy. Spitsbergen. Sb.
21. D. kjellmanii Lid ex Elis. Ekman, Svensk Bot. Tidskr. 25: 478 (1931). Like 20 but lower surface of leaves with nearly sessile stellate hairs; filaments broadly dilated at base. Spitsbergen, Vajgač. Rs (N) Sb.
22. D. oblongata R.Br. ex DC., Reg. Veg. Syst. Nat. 2: 342 (1821). Fruiting scapes up to 20 cm , with more or less elongated infructescence. Petals $2-3 \mathrm{~mm}$, scarcely longer than sepals, pale yellow or cream. Silicula hairy. Spitsbergen. Sb.
23. D. glacialis Adams, Mém. Soc. Nat. Moscou 5: 106 (1817). Like 22 but leaves more densely stellately hairy; petals $c .5 \mathrm{~mm}$, bright yellow; silicula subglabrous. Arctic Norway, Spitsbergen, arctic Russia. No Rs (N) Sb.
24. D. ladina Br.-Bl., Verh. Schweiz. Naturf. Ges. 1919 (2): 117 (1920). Scapes up to 5 cm , subglabrous, not elongating in fruit. Leaves entire, rather sparsely hairy with branched and stellate hairs, particularly beneath, and with sparse cilia. Petals 4.5 mm , pale yellow, slightly pubescent. Silicula subglabrous, ciliate. Style 1 mm . Calcareous mountain rocks between 2600 and 3040 m. C. Alps (Engadin). He.

A remarkable endemic, which has been considered to be the hybrid $2 \times 34$, but which is clearly related to this otherwise wholly arctic complex.
25. D. sibirica (Pallas) Thell., Mitt. Bot. Mus. Zürich 28: 318 (1906). Stems long, slender, creeping, producing erect or ascending scapes with $8-20$ yellow flowers. Leaves oblonglanceolate, acute, variably clothed with appressed medifixed hairs (also present towards base of scape). Petals $4-6 \mathrm{~mm}$, obovate-cuneate, yellow with brownish veins; stamens $2-2.5 \mathrm{~mm}$. Silicula $4-7.5 \times 1.5-2 \mathrm{~mm}$, oblong-ellipsoid, often somewhat curved, glabrous. Style $0.5-0.75 \mathrm{~mm}$. E. Russia, extending westwards to the river Don. Rs (N, C, W). (Asia; E. Greenland.)

Very different in habit from all other species in Europe.
Sect. Draba. Caespitose biennials or perennials with erect flowering stems and variably hairy leaves, often canescent; cauline leaves usually present. Flowers usually rather small; petals white or cream, longer than stamens; filaments sometimes slightly dilated at base.
26. D. stellata Jacq., Enum. Stirp. Vindob. 113 (1762). Stems up to 8 cm , stellately hairy below. Basal leaves $4-8 \mathrm{~mm}$, oblanceolate, mostly entire, stellate-canescent and ciliate; cauline leaves 0-2, often toothed. Inflorescence 3- to 12 -flowered; petals $3 \cdot 5-6.5 \mathrm{~mm}$; filaments slightly dilated at base. Silicula $6-10 \mathrm{~cm}$, lanceolate-elliptical, glabrous; style $1-2 \mathrm{~mm}$; stigma capitate. Calcareous mountain rocks. E. Alps. Au It Ju.
D. simonkaiana Jáv., Bot. Közl. 9: 281 (1910), endemic to the S.E. Carpathians in Romania, differs from D. stellata in its smaller petals and its 2-lobed stigma. Its status is doubtful.
27. D. nivalis Liljeblad, Kung. Svenska Vet.-Akad. Handl. 1793: 208 (1793). Densely pulvinate, with flowering stems up to 5 cm . Basal leaves obovate-cuneate, usually entire, with a dense covering of uniform, minute stellate hairs, and variably developed cilia; cauline leaves often absent. Inflorescence dense, 2- to 5(-9)flowered; pedicels very short; petals $c .3 \mathrm{~mm}$. Silicula 4-9 mm, usually glabrous; style $0.3 \mathrm{~mm} .2 n=16$. Arctic Europe and mountains of Norway. Fe Is No Rs (N) Sb Su.
28. D. norvegica Gunnerus, Fl. Norvegica 2: 106 (1772) (incl. D. rupestris $\mathrm{R} . \mathrm{Br}$.). Very variable in habit, with somewhat hairy, slender, often flexuous stems up to 20 cm . Basal leaves oblonglanceolate, entire or 1 - to 3 -toothed, ciliate and variably covered with unbranched, branched and stellate hairs; cauline leaves 0-3. Inflorescence at first dense, but typically with remote basal flower, rather lax in fruit. Silicula 5-7 mm, glabrous (or hairy, var. hebecarpa (Lindblad) O. E. Schulz), suberect on short pedicels; style less than $0.5 \mathrm{~mm} .2 n=48$. Arctic and subarctic Europe southwards to Scotland. Br Fa Fe Is No Rs (N) Sb Su.
29. D. subcapitata Simmons, Vasc. Pl. Ellesmereland 87 (1906). Dwarf arctic plant with a scapose, subcapitate or corymbose infructescence. Leaves with numerous stellate hairs and long silky hairs, sometimes subglabrous on upper side. Siliculae glabrous. Arctic Islands (Spitsbergen, Björnöya, Vajgač). Rs (N) Sb.
30. D. cacuminum Elis. Ekman, Kung. Svenska Vet.-Akad. Handl. 57 (3): 59 (1917). Like 29 but silicula hairy. $2 n=64$. - Mountains of Norway. No.
31. D. carinthiaca Hoppe, Flora (Regensb.) 6: 437 (1823). Caespitose, often rather laxly so, with stems up to 15 cm . Stem glabrous above (sometimes glabrous throughout, var. glabrata (Koch) Sauter). Basal leaves lanceolate, usually entire, covered with branched and stellate hairs, ciliate towards base; cauline $0-3$. Inflorescence 4 - to 8 -flowered; petals $2-3 \mathrm{~mm}$. Silicula $3-8 \mathrm{~mm}$, rather narrowly oblong-elliptic, glabrous; style almost absent; stigma capitate. Mountains of C. \& S. Europe from Pyrenees to Carpathians. $\mathrm{Au} \mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.

Closely related to D. siliquosa Bieb., Fl. Taur.-Cauc. 2: 94 (1808), from the Caucasus, and perhaps best treated as conspecific, though retained as a separate species by O. E. Schulz.
32. D. dubia Suter, Fl. Helvet. 2: 46 (1802) (D. tomentosa sensu Hegi, non Clairv.). Laxly caespitose with stems up to 20 cm , stellately hairy throughout. Basal leaves narrowly obovate; cauline $0-3$. Petals $3-5 \mathrm{~mm}$. Silicula $6-14 \mathrm{~mm}$, oblong-elliptical, sometimes slightly hairy; style $0.3-0.5 \mathrm{~mm}$; stigma emarginate. - Mountains of C. \& S. Europe from Pyrenees to E. Alps and W. Carpathians (Tatra). Au Cz Ga Ge He Hs It Ju Po ?Rm.

A variable plant; in the Pyrenees mainly, but not exclusively, represented by subsp. laevipes (DC.) Br.-Bl., Commun. Stat. Int. Géobot. Médit. Alp. 87: 226 (1945), which is of a dwarfer and more slender habit than the typical plant, with rather large flowers and elongated fruiting pedicels.
33. D. kotschyi Stur, Österr. Bot. Zeitschr. 9: 33 (1859). Like 32 but stems lax, ascending, flexuous, and cauline leaves ovate, obviously toothed. - S. Carpathians; Austria (very local). Au Rm.
34. D. tomentosa Clairv., Man. Herb. 217 (1811). Like 32 but with dense indumentum of stellate hairs extending to the pedicels, and distinctly hairy silicula, which is often slightly inflated when ripe. Mountains of C. \& S. Europe from Pyrenees to Carpathians and Balkan peninsula. Au Bu Cz Ga Ge He Hs It Ju Po.

The typical plant occurs in the Alps, Carpathians and Rodopi Planina. Its occurrence in the Pyrenees seems doubtful. The plant from the E. Pyrenees has been distinguished as $\mathbf{D}$. subnivalis Br.-Bl., Commun. Stat. Int. Géobot. Médit. Alp. 87: 226 (1945). It is said to differ from $D$. tomentosa in its slender habit, narrower leaves, lanceolate (not ovate) silicula, and somewhat longer style. D. korabensis Kümmerle \& Degen ex Jáv., Bot. Közl. 19:22(1921), from mountains in the N. Balkan peninsula, seems very similar to 34 but differs mainly in the number of cauline leaves (up to 5 ) and in the somewhat twisted silicula. It is considered by some authors to be related to 38 .

Species 31 to 34 constitute a critical complex which obviously needs experimental study. Numerous varieties of these species and 'hybrids' inter se and with other species of this section are recorded.
35. D. fladnizensis Wulfen in Jacq., Misc. Austr. Bot. 1: 147 (1779) (D. wahlenbergii Hartman). Often dwarf; flowering stems rarely more than 8 cm , entirely glabrous. Cauline leaves $0-2$; basal leaves oblong-obovate, ciliate, otherwise glabrous, or variably but usually sparsely covered with unbranched, branched or stellate hairs. Inflorescence 2- to 12 -flowered; petals $2.5-4 \mathrm{~mm}$, white. Silicula elliptical, glabrous; style less than 0.5 mm . $2 n=16$. Arctic and mountains of Scandinavia and of S. \& C. Europe,
from Pyrenees (local) to S.E. Carpathians; absent from the Balkan peninsula. $\mathrm{Au} \mathrm{Cz} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Is} \mathrm{It} \mathrm{No} \mathrm{Rm} \mathrm{Rs} \mathrm{(N}, \mathrm{C)} \mathrm{Sb} \mathrm{Su}$.

This description covers a widespread arctic-alpine speciescomplex, which includes D. lactea Adams, Mém. Soc. Nat. Moscou 5: 104 (1817), treated in some northern Floras as specifically distinct in the following manner:
Cauline leaves usually present; basal leaves with unbranched hairs only D. fladnizensis sensu stricto Cauline leaves usually absent; basal leaves with some branched (sometimes irregularly so) hairs, occasionally with a few stellate ones D. lactea

This distinction, which seems to be reasonably satisfactory in the Arctic, where both species occur, is unworkable in the Alps, where the problem is further complicated by the occurrence of D. carinthiaca var. glabrata, and putative hybrids of D. fladnizensis with this species. O. E. Schulz considered such plants responsible for the 'erroneous' records of $D$. lactea from the Alps.
D. dorneri Heuffel, Österr. Bot. Zeitschr. 8: 25 (1858), endemic to the S.E. Carpathians (Munţii Retezatulii, Romania), differs from $D$. fladnizensis in its longer style $(0.5 \mathrm{~mm})$ and in its leafpubescence. The basal leaves have peculiar cilia, which are unbranched near the leaf-base and branched towards the leaf-apex; the lamina is glabrous.
36. D. daurica DC., Reg. Veg. Syst. Nat. 2: 350 (1821) (D. hirta auct., vix L.). More robust than the preceding species of this section; stems up to 25 cm , often flexuous, usually simple, stellate-canescent at least below, with ( $0-$ )1-4 cauline, toothed leaves. Basal leaves up to 2 cm , narrowly lanceolate, acute, entire or with 1-2 small teeth, ciliate and rather densely stellatecanescent. Inflorescence 8- to 20 -flowered; pedicels suberect. Petals c. 5 mm , cream; filaments dilated at base. Silicula 612 mm , glabrous (or more or less stellately hairy, var. hebecarpa Lindblad), ovate-lanceolate, flat. $2 n=64$. Arctic Europe and mountains of Scandinavia. Fe Is No Rs (N) Sb Su.

A very variable species, variously treated by different authors. It may be conspecific with D. glabella Pursh, Fl. Amer. Sept. 2: 434 (1814) from North America. The endemic taxa in Austria D. norica Widder, Sitz.-Ber. Akad. Wiss. Wien 140 (1): 620, (1931), and D. pacheri Stur, Österr. Bot. Wochenbl. 5: (49-50) 156 (1855), resemble 36. D. norica has stellate hairs with unbranched rays, 3-7 cauline leaves, and a glabrous, elliptical silicula $5-6 \times 2 \cdot 5-3 \mathrm{~mm} ;$ D. pacheri has stellate hairs with branched rays, 0-4 cauline leaves and a glabrous, lanceolate silicula 6-7(-9) $\times$ $2.5-3 \mathrm{~mm}$. Although these taxa are distinct in the Alps, their relationship to the arctic complex is obscure. D. norica has $2 n=64$.
37. D. cinerea Adams, Mém. Soc. Nat. Moscou 5: 103 (1817) (incl. D. arctica J. Vahl). Like 36 but densely stellately canescent in all parts; silicula inflated. $2 n=48$ (Ladogorskaja Ozera), 80 (Spitsbergen). Arctic Europe. Fe No Rs (N) Sb.

A variable arctic species. Plants from Spitsbergen are usually scapose, with siliculae $7-12 \mathrm{~mm}$; those from the island of Mäkisalo in Ladogorskaja Ozera have slender leafy stems and very short siliculae ( $3-4 \mathrm{~mm}$ ). The typical plant, with leafy stems and siliculae $c .6 \mathrm{~mm}$, occurs in arctic Finland, Norway and Russia. Ekman identified some material from the Alps as this species; the distinction between it and 38 seems to be difficult. D. dovrensis Fries, Summa Veg. Scand. 32 (1846) from Norway (Dovrefjell), a robust plant with hairy siliculae, is sometimes placed here; its relationships are obscure.
38. D. incana L., Sp. Pl. 643 (1753). Robust biennial, sometimes perennial, with erect simple or branched leafy stems up to 35 cm . Basal leaves up to 2.5 cm , lanceolate, subobtuse, canescent with unbranched or branched, rarely strictly stellate, hairs; cauline leaves typically numerous. Stem and inflorescencebranches stellate-canescent; inflorescence 10- to 40 -flowered; pedicels suberect. Petals $4-5 \mathrm{~mm}$, white; filaments not or little dilated at base. Silicula glabrous (or hairy, var. confusa (Ehrh.) Liljeblad), oblong-lanceolate, often somewhat twisted. $2 n=32$. Widespread in N. Europe and in the mountains of W. \& C. Europe from the Pyrenees to the E. Alps. Au Br Da Fe Ga Hb He Hs Is No Rs (N, B).

Very variable. Most plants from the Alps differ from northern plants as follows: usually perennial, with several stems; cauline leaves narrower, usually larger than basal leaves; silicula stellately hairy, with longer style. Such plants are called D. stylaris Gay ex Koch, Syn. Fl. Germ. ed. 2, 1: 70 (1843) (D. thomasii Koch); they could equally well be referred to 37 . Some plants from the Alps and the Pyrenees, however, with glabrous siliculae, seem to be very similar indeed to some Scandinavian variants of 38.

In Asia and North America there are other taxa related to D. hirta and D. incana. One of these, D. lanceolata Royle, Ill. Bot. Himal. Mount. 1: 72 (1834), a perennial with narrow, stellately hairy silicula, has recently been recorded from N. Russia (Poluostrov Kol'skiy). Another plant of this complex, a perennial with lanceolate, acute, glabrous silicula, has been described from N . Russia (Polyostrov Kol'skiy) as D. valida Pissjauk. in Pojark., Fl. Murmansk. 3: 370 (1956), non Goodding (1940).

Sect. Drabella DC. Annuals, sometimes overwintering, with leafy stems and small yellow or cream flowers (white in $D$. muralis). Style scarcely visible in fruit.
39. D. muralis L., Sp. Pl. 642 (1753). Erect, up to 30 cm , with slender tap-root; stems simple or branched, more or less stellately hairy. Cauline leaves broadly ovate, semi-amplexicaul; basal leaves obovate-cuneate. Inflorescence many-flowered; petals c. 2.5 mm , white. Silicula $3-6 \mathrm{~mm}$, oblong-elliptical, glabrous; pedicels patent, as long as or longer than silicula. $2 n=32$. - Throughout most of Europe from C. Fennoscandia southwards. All except $\mathrm{Az} \mathrm{Bl} \mathrm{Fa} \mathrm{Is} \mathrm{Rs} \mathrm{(N)} \mathrm{Sa} \mathrm{Sb} \mathrm{Si}$; casual in Ho Po Rs (C).
40. D. nemorosa L., Sp. Pl. 643 (1753). Like 39 but stem glabrescent above; cauline leaves oblong-ovate, cuneate at base, often remote; petals $c .2 \mathrm{~mm}$, pale yellow, fading to whitish; silicula rough with short simple hairs (rarely glabrous, var. leiocarpa Lindblad); pedicels very slender, much longer than silicula. Throughout most of Europe, but absent from much of the north-west, and local in the Mediterranean region. Au Cz Fe Ga Ge He Hs It Ju No Po Rm Rs (N, B, C, W, K, E) Su.
41. D. lutescens Cosson, Not. Pl. Crit. 147 (1852). Slender annual up to 12 cm , with simple or basally branched, hairy stems and very small pale yellow flowers. Cauline leaves sessile, ovate, cuneate at base. Silicula longer than pedicels, rough with unbranched hairs. S. Spain and S. France. Ga Hs. (Morocco.)

Closely related to D. huetii Boiss., Diagn. Pl. Or. Nov. ser. 2, 3 (5): 31 (1856), from Asia Minor and sometimes treated as conspecific.
42. D. crassifolia R. C. Graham in Jameson, Edinb. New Philos. Jour. 7: 182 (1829). Dwarf arctic perennial, with glabrous, usually leafless, flowering stems up to 6 cm , and rather thick oblong-

[^122]spathulate basal leaves with a few unbranched hairs. Inflorescence 3- to 9 -flowered; petals pale yellow, narrow, scarcely longer than sepals. Silicula $4-7 \mathrm{~mm}$, glabrous. Arctic Scandinavia. No Su. (Greenland, North America.)

Sometimes described as annual or biennial, but apparently always perennial. Included by O. E. Schulz in Sect. Drabella, but probably more closely related to Sect. Draba.

## 60. Erophila DC. ${ }^{1}$

Like Draba, but small annual or overwintering scapigerous herbs with basal leaf-rosette; petals deeply bifid.
A taxonomically difficult genus in which there is no general agreement as to specific limits. Many variants have been distinguished at specific or infra-specific rank. Local populations often consist of self-pollinating pure lines exhibiting some morphological distinctness, and in addition a range of chromosome numbers is known. The cyto-taxonomic investigations of Ö. Winge, Compt. Rend. Trav. Lab. Carlsb. (Sér. Physiol.) 23:41-73 (1940) apply mainly to material from N.W. Europe, and have not been correlated with the total variation in Europe; some attempt has, however, been made to correlate this work with the classical taxonomy in the following account.

The treatment adopted follows closely that of F. Markgraf in Hegi, Ill. Fl. Mitteleur. ed. 2, 4 (1): 320-7 (1960-62), where full references to literature are given.

Literature: O. E. Schulz in Engler, Pflanzenreich 89 (IV. 105): (1927).

$$
\begin{array}{ll}
\text { Leaves spathulate to lanceolate; seeds } 0 \cdot 3-0.5 \mathrm{~mm} & \text { 1. verna } \\
\text { Leaves linear; seeds } 0.75-1 \mathrm{~mm} & \text { 2. minima }
\end{array}
$$

1. E. verna (L.) Chevall., Fl. Gén. Env. Paris 2: 898 (1827) (Draba verna L.). Stems solitary or several, up to 20 cm . Leaves in a basal rosette, spathulate to lanceolate, obtuse or acute, entire or distally toothed, variably clothed with branched and stellate hairs, sometimes mixed with unbranched hairs. Inflorescence racemose, initially dense, later elongating. Pedicels slender, $1 \cdot 5-6 \mathrm{~mm}$ in flower, elongating in fruit. Sepals $1 \cdot 5-2 \cdot 5 \mathrm{~mm}$; petals $1.5-6 \mathrm{~mm}$, white or reddish. Silicula $3-25 \mathrm{~mm}$, usually flat, narrowly elliptical to obovate or suborbicular, glabrous. Seeds $0 \cdot 3-0 \cdot 5 \mathrm{~mm}$, numerous. $2 n=14-64$. Rocks, walls, sandy soils and disturbed ground. Throughout Europe except the arctic, northwards to $66^{\circ} \mathrm{N}$. in Norway. All except Az Fa Sb.

(b) subsp. macrocarpa
(a) Subsp. verna (E. krockeri Andrz., E. majuscula Jordan, Draba obconica (De Bary) Hayek): Stems solitary or several, up to 20 cm in fruit. Leaves broadly lanceolate or elliptical, more or less densely stellately-hairy on upper surface. Sepals $1 \cdot 5-2 \mathrm{~mm}$; petals c. 2.5 mm ; longer stamens exceeding stigma. Silicula 6-10 mm, elliptical or oblanceolate; fruiting pedicels $10-25 \mathrm{~mm}$. Widespread in W., C. \& N. Europe, and probably throughout the range of the species, but less common in S. \& S.E. Europe.
E. simplex Winge, Compt. Rend.Trav. Lab. Carlsb. (Sér. Physiol.) 23: 70 (1940), a dwarf plant with single stems up to 8 cm , nearly entire leaves, and subpyriform inflated silicula, almost certainly belongs here. It has $2 n=14$.
(b) Subsp. macrocarpa (Boiss. \& Heldr.) Walters, Feddes Repert. 69: 57 (1964) (Draba macrocarpa Boiss. \& Heldr.): Like (a) but silicula $7-12 \mathrm{~mm}$, linear, and fruiting pedicels $4-15 \mathrm{~mm}$. $E$. Mediterranean region.
(c) Subsp. praecox (Steven) Walters, loc. cit. (1964) (E. glabrescens Jordan; E. stenocarpa Jordan; Draba praecox Steven): Stems often solitary, up to 9 cm in fruit. Leaves obovate-lanceolate, more or less densely covered on upper surface with unbranched hairs, often with a few branched or stellate hairs. Sepals 1-1.5 mm ; petals $2-2.5 \mathrm{~mm}$; longer stamens exceeding stigma. Silicula $4-6 \mathrm{~mm}$, elliptical or oblanceolate; fruiting pedicels $2-12 \mathrm{~mm}$. Mainly in the Mediterranean region; rather rare in N. and C. Europe.
E. setulosa Boiss. \& Blanche in Boiss., Diagn. Pl. Or. Nov. 3 (5): 31 (1856), described from Syria, more sparsely hairy than 1 (c) and with narrower silicula, is recorded by Schulz from Thrace (near Alexandroupolis and Edirne). Schulz and Boissier treat it as a separate species, but it could be included under 1 (c).
(d) Subsp. spathulata (A. F. Láng) Walters, Feddes Repert. 69: 57 (1964) (E. spathulata A. F. Láng): Stems usually several, up to 10 cm in fruit. Leaves obovate-spathulate, more or less densely clothed with short branched hairs. Sepals c. 1 mm ; petals $c .2 \mathrm{~mm}$; stamens shorter than stigma. Silicula broadly obovate or suborbicular; fruiting pedicels 3-18 mm. Distribution like that of 1 (a) but apparently preferring more calcareous substrata.
E. duplex Winge, Compt. Rend. Trav. Lab. Carlsb. (Sér. Physiol.) 23: 71 (1940), with several stems up to 18 cm , more or less coarsely toothed leaves, and flat silicula, probably belongs here. It has $2 n=30-40$.

The other apparently widespread taxon described by Winge, E. quadruplex Winge, loc. cit. (1940), is a more robust plant than E. duplex, with a single stem. The leaves are narrowly cuneate and usually toothed. It has $2 n=52-64$. Such plants would seem to fall between 1 (a) and 1 (d).
2. E. minima C. A. Meyer, Verz. Pfl. Cauc. 184 (1831). Like 1 but stems not more than 10 cm ; leaves linear, clothed with unbranched hairs only; sepals $c .1 \mathrm{~mm}$; silicula $3-5 \times 2-$ 3 mm , obovoid, more or less inflated; seeds $0.75-1 \mathrm{~mm}$, few. Greece. Gr. (Asia Minor.)

## 61. Petrocallis R.Br. ${ }^{1}$

Like Draba but leaves digitately lobed; hairs all unbranched; ovary with 2 ovules in each loculus.

1. P. pyrenaica (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 93 (1812) (Draba pyrenaica L.). Caespitose, often pulvinate, resembling many species of Draba or Saxifraga in habit. Leaves $4-6 \mathrm{~mm}$, in compact rosettes, digitately $3(-5)$-lobed, ciliate, stiff and greyish. Scapes usually $2-3 \mathrm{~cm}$, hairy; corymbs fewflowered. Petals $4-5 \mathrm{~mm}$, pale lilac or pink, rarely white; anthers yellow. Ripe silicula obovate to elliptical, glabrous, with $1(-2)$ seeds in each loculus. $2 n=14$. Mountain rocks and screes; calcicole. Pyrenees, Alps, Carpathians. Au Cz Ga Ge He Hs It Ju Po ?Rm.

## 62. Andrzeiowskia Reichenb. ${ }^{2}$

Glabrous annuals. Leaves pinnate. Sepals erect, not saccate; petals white; stamens without appendages. Fruit an indehiscent

[^123]siliqua with 2 triangular wings at the apex; style long; stigma capitate. Seeds c. 5 in each loculus.

1. A. cardamine Reichenb., Pl. Crit. 1: 15 (1823) (A. cardaminefolia Prantl pro parte). Stems $25-60 \mathrm{~cm}$. Leaves with up to 4-5 pairs of ovate-oblong, crenate segments, and a large terminal segment; petiole with amplexicaul suborbicular auricles. Petals 2-2.5 mm. Siliqua $12-20 \mathrm{~mm}$, linear, keeled; style longer than wings. Wet places. Greece (Thraki). Gr.

## 63. Cochlearia L. ${ }^{3}$

Annual to perennial herbs, glabrous or with unbranched hairs. Leaves simple. Racemes bracteate or not. Sepals erecto-patent; petals short-clawed; filaments straight. Fruit a laterally compressed swollen silicula with convex valves. Seeds in 2 rows in each loculus, verrucose or papillose.

1 Stems fistular, often more than 50 cm ; cauline leaves oblong-
lanceolate
12. glastifolia

1 Stems not fistular, never more than 50 cm ; cauline leaves not oblong-lanceolate
2 Stems leafless 10. groenlandica
2 Stems $\pm$ leafy
5. aestuaria

3 Silicula truncate at apex, obovoid

1. danica

3 Silicula not truncate at apex
4 Cauline leaves all sessile; biennial or perennial, rarely annual
5 Silicula ovoid to globose
6 Petals $2-3 \mathrm{~mm}$, often purplish 11. scotica
6 Petals 4-6 mm, usually white (2-4). officinalis group
5 Silicula ovoid-ellipsoid, obovoid-ellipsoid or narrower
7 Petals pale yellow; silicula distinctly obovoid-ellipsoid
6. tatrae

7 Petals white or purplish, rarely yellowish; silicula ovoidellipsoid or oblong-ellipsoid
8 Silicula ovoid-ellipsoid
9 Leaves cuneate at base 7. anglica 9 Leaves not cuneate at base 10 Petals $2-3 \mathrm{~mm}$, often purplish 11. scotica 10 Petals 4-6 mm, usually white (2-4). officinalis group 8 Silicula narrowly oblong-ellipsoid or narrowly ellipsoid 11 Silicula twice as long as broad; style 1 mm
8. aragonensis

11 Silicula 3-4 times as long as broad; style 0.5 mm
9. fenestrata

1. C. danica L., Sp. Pl. 647 (1753). Slender, not fleshy, annual to biennial; stems $2-20 \mathrm{~cm}$, ascending. Basal leaves long-petiolate, lamina $c .1 \mathrm{~cm}$ wide, orbicular to triangular-cordate; cauline leaves mostly petiolate, the lower ones palmately 3 - to 7 -lobed. Flowers $4-5 \mathrm{~mm}$ in diameter, white or purplish. Silicula 3-6 $\times 2 \cdot 5-4 \mathrm{~mm}$, ovoid-globose to ellipsoid, often attenuate at both ends, finely reticulately-veined when mature. $2 n=42$. Coastal habitats and disturbed ground inland. - W. \& N. Europe, mainly coastal. Be Br Da Fe Ga Ge Hb Ho Hs Lu No Rs (B) Su.
(2-4). C. officinalis group. Biennial or perennial, rarely annual, usually somewhat fleshy. Basal leaves long-petiolate, reniform or ovate-cordate, sometimes ovate-truncate; cauline leaves sessile or only the lowest petiolate. Petals 4-9 mm, white. Silicula globose to ovoid-ellipsoid.

[^124]2. C. officinalis L., Sp. Pl. 647 (1753). Stems up to 50 cm . Basal leaves usually reniform. Fruiting racemes usually lax; pedicels usually longer than silicula. Petals $3-7 \mathrm{~mm}$; lateral veins free or anastomosing to form only one mesh on each side of the mid-vein. Silicula $4-7 \mathrm{~mm}$, ovoid to globose, rounded at both ends; style $0 \cdot 3-1 \mathrm{~mm} . \quad 2 n=24$. Coasts of N.W. Europe; Alps, and sometimes elsewhere on mountains inland. Be Da Fa Ga Ge $\mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{No} \mathrm{Po} \mathrm{Su}$.

Plants from Scotland with narrower fruits approach the following species; their status is uncertain.
3. C. pyrenaica DC., Reg. Veg. Syst. Nat. 2: 365 (1821) (C. officinalis subsp. pyrenaica (DC.) Rouy \& Fouc.; incl. C. alpina (Bab.) H. C. Watson, C. excelsa Zahlbr.). Basal leaves usually reniform. Fruiting pedicels equalling or shorter than the silicula. Petals $4-8 \mathrm{~mm}$; lateral veins usually anastomosing to form only one mesh on each side of the mid-vein. Silicula $4-7 \mathrm{~mm}$, ovoidellipsoid, attenuate at both ends; style $0 \cdot 2-1 \mathrm{~mm} .2 n=12,28$. - Mountains of C. Europe, extending to Belgium, the Pyrenees and the Ukrainian Carpathians. $\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.

Plants from Britain and Ireland that have been distinguished as C. alpina (Bab.) H. C. Watson, Cyb. Brit. 1: 127 (1847) are often indistinguishable morphologically from plants of $C$. pyrenaica from the Pyrenees and the mountains of C. Europe. The reported chromosome numbers are: C. pyrenaica $2 n=12$ and C. alpina $2 n=12,28$, the latter number being doubtful.

Slender, not fleshy, perennial plants with small, suborbicular basal leaves, petiolate lower cauline leaves, petals $c .5 \mathrm{~mm}$, and ellipsoidal siliculae $c .5 \times 2.5 \mathrm{~mm}$ from mountains in N. Britain have been called C. micacea E. S. Marshall, Jour. Bot. (London) 32: 289 (1894). They may best be considered a small, narrowfruited variant of C. pyrenaica.
4. C. polonica Fröhlich, Pl. Polon. Exsicc. ser. 2, cent. 3: 11 (1936). Basal leaves reniform or ovate-cordate. Fruiting pedicels usually about equalling the silicula. Petals $5 \cdot 5-9.5 \mathrm{~mm}$; veins anastomosing to form 2 or more meshes on each side of the midvein. Silicula $5-7 \mathrm{~mm}$, ovoid-ellipsoid, narrowed at both ends. Style $0 \cdot 5-1 \cdot 1 \mathrm{~mm} . \quad 2 n=36$. Damp sand by lowland streams. - S. Poland (near Olkusz). Po.
5. C. aestuaria (Lloyd), Heywood, Feddes Repert. 70: 5 (1964) Perennial. Basal leaves broadly ovate, truncate or cordate at base; often a few leaves cuneate at base. Fruiting racemes lax; pedicels longer than silicula. Petals $5-7 \mathrm{~mm}$. Silicula $5-6 \mathrm{~mm}$, obovoid, narrowed at base, truncate and sometimes slightly emarginate at apex; style $0 \cdot 3-0 \cdot 5 \mathrm{~mm} .2 n=12$. Atlantic coasts of France and N. Spain. Ga Hs.

This species is interpreted so as to cover plants related to 2 with usually obovoid-truncate fruits and with a few of the basal leaves cuneate at the base (in which character it approaches 7).
6. C. tatrae Borbás, Pallas Nagy Lexikona 10: 28 (1875). Perennial. Basal leaves ovate, cordate or truncate at base. Fruiting racemes lax; lower pedicels usually longer than but not more than twice as long as the silicula. Petals pale yellowish; lateral veins not anastomosing, or rarely forming a single mesh on each side of the mid-vein. Silicula obovoid-ellipsoid, narrowed at base, rounded at apex; style $0.5 \mathrm{~mm} .2 n=42$. Granite mountains. - Tatra. Cz Po.
7. C. anglica L., Syst. Nat. ed. 10, 2: 1128 (1759). Robust biennial to perennial up to 40 cm . Basal leaves long-petiolate,

[^125]ovate, obovate or oblong, cuneate at base, almost entire. Pedicels about equalling the silicula. Petals $5-7 \mathrm{~mm}$, normally white. Silicula $8-15 \mathrm{~mm}$, ellipsoid or ovoid-ellipsoid, strongly compressed laterally with long narrow septum. $2 n=48,54$. Muddy shores, estuaries, saline meadows. - N.W. Europe. Br DaGe Hb Ho No Su.

Hybrid swarms with 2 frequently occur.
8. C. aragonensis Coste \& Soulié, Bull. Géogr. Bot. (Le Mans) 21: 7 (1911). Biennial with slender branched stems up to 25 cm . Basal leaves $4-8 \mathrm{~mm}$, as broad as long, ovate-cordate, entire or with a small callose tooth on either side and at the apex. Petals 4-5 mm, white. Silicula $4 \times 2 \mathrm{~mm}$, elliptic-lanceolate, attenuate at both ends, with narrow septum; valves caducous; style 1 mm . Calcareous screes. - N.E. Spain (Sierra de Guara). Hs.
9. C. fenestrata R.Br. in J. Ross, Voy. Disc. Baffin app. 3, 163 (1819) (Incl. C. arctica Schlecht.). Biennial or perennial. Basal leaves usually ovate, cordate or truncate at base. Pedicels usually equalling silicula. Petals $2 \cdot 5-6 \mathrm{~mm}$, white, rarely purplish. Silicula 5-8 mm, oblong-ellipsoid or narrowly ellipsoid, 3-4 times as long as broad; style $0.2-0.5 \mathrm{~mm}$. Arctic and subarctic Europe. Fa Fe Is No Rs (N) Sb.

Wide-fruited variants of this species have been called C. arctica Schlecht. in DC., Reg. Veg. Syst. Nat. 2: 367 (1821).
10. C. groenlandica L., Sp. Pl. 647 (1753). Biennial or perennial with many procumbent or ascending, stout, leafless stems $3-10 \mathrm{~cm}$. Basal leaves reniform. Petals 3 mm , oblong, contracted at base into a distinct claw. Silicula $3 \cdot 5-5 \mathrm{~mm}$, ovoid, ellipsoidovoid or obovoid; style $0 \cdot 3-0.5 \mathrm{~mm} .2 n=14$. Arctic and subarctic Europe. Is Rs (N) Sb.

Very distinct on account of its leafless stems. Plants from several parts of Scotland have been referred to this species but have leafy stems, and petals more than 3 mm long.

There has been much confusion between 9 and 10; consequently their distribution is uncertain.
11. C. scotica Druce, Rep. Bot. Exch. Club Brit. Is. 8: 867 (1929). Compact dwarf perennial up to 5 cm . Basal leaves reniform or truncate at base. Petals $2-3 \mathrm{~mm}$, squarish, abruptly contracted into a short claw, often purplish. Silicula $3 \times 2 \mathrm{~mm}$, ovoid to broadly ellipsoid. $2 n=14$. Maritime sands. $N$. Scotland, ?N. \& W. Ireland. Br ? Hb .

Often confused with dwarf plants of 2.
12. C. glastifolia L., Sp. Pl. 648 (1753). Robust annual; stems up to 100 cm , fistular, leafy. Basal leaves oblong; cauline leaves oblong-lanceolate, auriculate-amplexicaul; all more or less coriaceous, shiny. Petals c. 4 mm , white, obovate. Silicula $4-$ $5 \times 4-5 \mathrm{~mm}$, globose. Iberian peninsula; Italy. Hs It $\mathrm{Lu}[\mathrm{Co} \mathrm{Ga}$ Ju].

## 64. Kernera Medicus ${ }^{1}$

Like Cochlearia but stamens sharply curved.

1. K. saxatilis (L.) Reichenb. in Moessler, Handb. ed. 2, 2: 1142 (1828). Perennial; stems $10-30 \mathrm{~cm}$, usually branched. Basal leaves petiolate, entire to deeply toothed, obovate-lanceolate to spathulate, obtuse or narrowed to the apex; cauline leaves lanceolate or ovate, narrowed to the base or sagittate and amplexicaul. Racemes many-flowered. Petals $2-4 \mathrm{~mm}$, white. Silicula $2-4.5 \mathrm{~mm}$, ovoid and stipitate, or ovoid-globose to ellip-soid-ovoid and sessile; valves smooth, with a more or less
prominent mid-vein. Septum hyaline and slender, or spongy. $2 n=16$, 32. Mountains of $S$. \& C. Europe. Al Au Bu Cz Ga Ge Gr Hs ?Hu It Ju Rm Po.
In S.E. Spain this species is represented by plants that have been distinguished as K. boissieri Reuter in Boiss. \& Reuter, Pugillus 9 (1852). They have the cauline leaves narrowed to the base, and ovoid, not stipitate, silicula; they also have spathulate, obtuse radical leaves and this is the only way in which they differ constantly from the other plants of the species.

In the W. Pyrenees some plants occur that have been distinguished as K. decipiens (Willk.) Nyman, Syll. 199 (1854). They have the cauline leaves sagittate and amplexicaul at the base, and ellipsoid-obovoid, not stipitate silicula. It is doubtful whether there is any way in which they differ from the rest of the species, but they tend to have somewhat showier petals $3 \cdot 5-4 \mathrm{~mm}$.
Plants which have been distinguished as K. auriculata (Lam.) Reichenb. in Moessler, Handb. ed. 2, 2: 1142 (1828), occur within the range of the species in many areas. In extreme cases they have both sagittate, amplexicaul cauline leaves and stipitate silicula, but many intermediates occur.

The status of these three variants is doubtful; further investigation is needed, especially on the plants from the Pyrenees and Spain.

## 65. Rhizobotrya Tausch ${ }^{1}$

Like Cochlearia but racemes bracteate; sepals persistent, surrounding the fruit; filaments of stamens curved; valves of the siliqua without dorsal vein.

1. R. alpina Tausch, Flora (Regensb.) 19: 34 (1836) (Cochlearia brevicaulis Facch.; Kernera alpina (Tausch) Prantl). Caespitose perennial; stems 2-4 cm. Leaves oblong-spathulate, obtuse, longpetiolate. Inflorescence condensed. Flowers white. Siliqua ovate, obtuse. $2 n=14$. Dolomitic rocks, 1900-2800 m. - S. Alps (Dolomiti occidentali). It.

## 66. Camelina Crantz ${ }^{2}$

Annual or biennial. Hairs unbranched or branched; cauline leaves sessile, often auriculate. Inflorescence ebracteate. Sepals erect; petals yellow or white. Fruit a more or less inflated silicula; style distinct. Seeds numerous.

Literature: N. Zinger, Trav. Mus. Bot. Acad. Pétersb. 6: 1-303 (1909).

1 Stems and leaves glabrous or very sparsely hairy
2 Silicula obovoid or pyriform, with a rounded apex, distinctly longer than wide; leaves entire or weakly toothed
3 Silicula usually less than $10 \times 5 \mathrm{~mm}$; fruiting pedicels short, ascending; raceme rather dense 1. sativa
3 Silicula usually $10-12 \times 5-7 \mathrm{~mm}$; fruiting pedicels elongate, often patent; raceme rather lax
5. macrocarpa

2 Silicula depressed-globose, almost as wide as long; raceme lax; leaves usually strongly toothed or lobed.
4. alyssum

1 Stems and leaves (at least in the lower half of the plant) $\pm$ densely pilose
4 Fruiting raceme lax; petals $6-9 \mathrm{~mm}$; stems usually muchbranched, with patent branches; basal leaf-rosette present at flowering time
3. rumelica

4 Fruiting raceme rather dense; petals up to $c .5 \mathrm{~mm}$; stems unbranched or with ascending or erect branches; basal leafrosette usually withered at flowering time
5 Silicula $7-9 \times$ c. 5 mm ; indumentum mostly of very slender, unbranched hairs

1. sativa

5 Silicula c. $5-7 \times 4-5 \mathrm{~mm}$; indumentum of long unbranched hairs mixed with short branched hairs
2. microcarpa

[^126]1. C. sativa (L.) Crantz, Stirp. Austr. 1: 17 (1762) (C. glabrata (DC.) Fritsch; C. pilosa (DC.) Vasilcz.). Erect unbranched or sparingly branched annual $30-80 \mathrm{~cm}$; stems and leaves subglabrous (or hairy, var. pilosa DC.). Leaves $3-9 \mathrm{~mm}$, lanceolate or narrowly oblong, entire or remotely denticulate, the cauline sessile, with acute auricles. Petals up to $c .5 \mathrm{~mm}$, yellow. Fruiting racemes elongate, rather dense; fruiting pedicels $1-2 \mathrm{~cm}$, ascending. Silicula usually $7-9 \mathrm{~mm}$; valves strongly convex, not very rigid or woody and often flattened in dried specimens. Seeds $1-2 \mathrm{~mm} .2 n=40$. Throughout Europe, but often only as a casual. All except $\mathrm{Al} \mathrm{Az} \mathrm{Bl} \mathrm{Fa} \mathrm{Is} \mathrm{Ju} \mathrm{Sb} \mathrm{Tu}$.
2. C. microcarpa Andrz. ex DC., Reg. Veg. Syst. Nat. 2: 517 (1821). Annual or biennial, like $\mathbf{1}$ in general appearance, but often less robust, with rather densely hairy stems and leaves; indumentum of long unbranched hairs mixed with short branched hairs. Petals pale yellow. Fruiting racemes very elongate and rigid with numerous siliculae; fruiting pedicels $1-1 \cdot 5(-2) \mathrm{cm}$, ascending. Silicula $c .5-7 \mathrm{~mm}$; valves less strongly convex than in 1, usually hard and woody and not flattened in dried specimens. Seeds $c .1 \mathrm{~mm} .2 n=40$. Throughout Europe, but in many regions only as a casual. All except Al Az Fa Hb Sb Tu .
3. C. rumelica Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1887: 448 (1887). Erect annual or biennial $14-30(-60) \mathrm{cm}$, usually with several patent or ascending branches; lower part of plant more or less densely hispidulous, upper part glabrous or subglabrous. Basal leaves forming a distinct rosette, usually persistent until anthesis or later. Petals $6-9 \mathrm{~mm}$, white or very pale yellow. Fruiting racemes elongate, often rather lax; fruiting pedicels $0 \cdot 7-1(-1 \cdot 4) \mathrm{cm}$, ascending or sometimes almost patent. Silicula $5-8 \mathrm{~mm}$, valves rather compressed, rigid and woody. Seeds $c$. 1.5 mm . $2 n=12$. S. \& E.C. Europe. Al Au Bu Gr Hs Hu It Ju Rm Rs (K).
4. C. alyssum (Miller) Thell., Verz. Tausch Säm. Früchte Zürich 1906: 10 (1906) (C. foetida (Schkuhr) Fries; C. linicola Schimper \& Spenner). A slender, erect, sparingly branched annual 15-50(-70) cm ; stems and leaves subglabrous. Leaves deeply toothed or lobed (rarely subentire, var. integrifolia (Fries) Hayek). Petals 4-5 mm, pale yellow. Fruiting racemes rather short and lax; fruiting pedicels $2-3(-4) \mathrm{cm}$, patent or sometimes flexuous. Silicula $6-$ 10 mm , depressed-globose, with a flattened apex; valves strongly convex, not hard or woody. Seeds $1 \cdot 5-2 \cdot 5 \mathrm{~mm} .2 n=40$. A weed of flax-fields. Widespread in Europe. All except Al Az Bl Br Fa Gr Hb Is Sb Tu .
5. C. macrocarpa Wierzb. ex Reichenb., Icon. Fl. Germ. 2: 10 (1837). Tall, erect annual, often more than 60 cm , with erect or sharply ascending branches; stems and leaves subglabrous. Leaves entire or very obscurely denticulate. Petals 4-5 mm, pale yellow. Fruiting racemes very lax, short or elongate; fruiting pedicels $1 \cdot 5-3 \mathrm{~cm}$, elongate, often patent or flexuous. Silicula $10-12 \times 5-7 \mathrm{~mm}$, obovoid or pyriform, rounded at apex; valves convex, not very hard or woody. Seeds $c .2 \mathrm{~mm}$. A weed of flaxfields. Chiefly in N. \& C. Europe. Br ?Cz Da Fe Hb ?Hu Rm Rs.

## 67. Neslia Desv. ${ }^{3}$

Annuals; hairs branched. Leaves simple. Inflorescence an ebracteate raceme. Sepals erect, not saccate; petals yellow; stamens without appendages. Fruit an indehiscent, latiseptate, silicula; style distinct; stigma minute, slightly 2 -lobed. Seeds 1-3. (Vogelia Medicus, non J. F. Gmelin.)

1. N. paniculata (L.) Desv., Jour. Bot. Appl. 3: 162 (1814) (Vogelia paniculata (L.) Hornem.). Pubescent annual $15-60 \mathrm{~cm}$.

Leaves oblong or lanceolate, entire or remotely dentate, the basal petiolate, the cauline sessile, amplexicaul, with acute auricles. Petals $c .2 \mathrm{~mm}$. Pedicels $5-12 \mathrm{~mm}$ in fruit. Silicula $1 \cdot 5-3 \mathrm{~mm}$ in diameter, subglobose or compressed and almost lenticular, reticulate-rugose. C., E. \& S. Europe; naturalized in the north. Al Au Bl Bu Co Cr Cz Ga Ge Gr He Hs Hu It Ju Lu Po Rm Rs (N, C, W, K, E) Sa Si Tu [Be Br Da Fe Ho No Su].
(a) Subsp. paniculata: Silicula usually broader than long, base truncate, not apiculate (excluding the often persistent style), and with only two longitudinal ribs on the margin. $2 n=14$. C. \& $E$. Europe, extending southwards to S. France, N. Italy and Bulgaria; naturalized in the north.
(b) Subsp. thracica (Velen.) Bornm., Österr. Bot. Zeitschr. 44: 125 (1894) (N. apiculata Fischer, Meyer \& Avé-Lall.): Silicula about as long as broad, apiculate, with carpophore and 4 longitudinal ribs. S. Europe; a rare casual elsewhere.

These two subspecies have been very much confused so that their precise distribution is uncertain. Subsp. paniculata occurs in the northern part and subsp. apiculata in the southern part of its range. Intermediate plants predominate where the two subspecies meet (approximately $43-48^{\circ} \mathrm{N}$.).

## 68. Capsella Medicus ${ }^{1}$

Annual or biennial; glabrous or with unbranched hairs. Basal leaves entire or pinnatifid; cauline sagittate-amplexicaul. Inflorescence racemose, ebracteate. Sepals erect, not saccate; petals white, pink or yellowish; stamens without appendages. Fruit an angustiseptate silicula, usually triangular-obcordate; valves keeled, reticulately veined. Style distinct; stigma minute, capitate. Seeds up to 12 in each loculus.

This account treats as species the five taxa most readily recognized in Europe. Within them there is extreme polymorphy; autogamy is frequent, and all are ruderals. 1 is especially polymorphic, and its variants incorporate many of the characters of the other four species, particularly as regards the shape and size of the silicula.

Literature: E. Almquist, Acta Horti Berg. 7: 41-95 (1921), G. H. Schull, Amer. Jour. Bot. 10: 221-8 (1923).

1 Petals not or scarcely exceeding sepals; petals and sepals usually reddish-tinged 2. rubella
1 Petals usually distinctly exceeding sepals; petals white or yellowish; sepals green
2 Petals pale yellowish; lower part of plant densely grey-hairy
5. orientalis

2 Petals white; whole plant green, sparsely hairy or glabrous
3 Petals 4-5 mm
4. grandiflora

3 Petals 2-3 mm (rarely 0)
4 Style more than 0.5 mm
3. thracica

4 Style less than 0.5 mm 1. bursa-pastoris

1. C. bursa-pastoris (L.) Medicus, Pflanzengatt. 85 (1792). Plant sparsely hairy, especially below, or glabrous. Flowers scentless. Sepals usually green, often pubescent. Petals $2-3 \mathrm{~mm}$, about twice as long as sepals, white (rarely absent). Silicula $6-9 \times 4-9 \mathrm{~mm}$, usually longer than wide, scarcely attenuate at base, usually only slightly emarginate; lateral margins usually straight or convex; apical lobes usually subacute; style c. 0.25 mm . $2 n=32$. Throughout Europe as a ruderal. Present in all territories.

Numerous variants of this species have been described by Almquist, op. cit.

[^127]C. heegeri Solms-Laub., Bot. Zeit. 58: 167 (1900), a profusely branched plant with an ellipsoid, not compressed silicula, is an atavistic mutant of $\mathbf{1}$; because of the remarkable shape of the silicula, it was at one time placed in a separate genus, as Solmsiella heegeri (Solms-Laub.) Borbás. It was first noted in 1897 in Germany (Landau, Pfalz), was cultivated in botanic gardens, became extinct in the original locality, but later was found naturalized near Berlin.
2. C. rubella Reuter, Compt. Rend. Soc. Hallér. 18 (1854). Plant sparsely hairy or glabrous. Flowers scentless. Sepals usually reddish at apex, glabrous. Petals $1 \cdot 5-2 \mathrm{~mm}$, scarcely exceeding sepals, usually reddish at least on margins. Silicula c. $6 \times 6 \mathrm{~mm}$, distinctly attenuate at base, usually fairly deeply emarginate at apex; lateral margins concave; apical lobes obtuse; style $c .0 .25 \mathrm{~mm}$. S. Europe, extending northwards to N. France; an occasional casual in C. Europe and Ukraine. $\mathrm{Al} \mathrm{Bl} * \mathrm{Br} \mathrm{CoCr}$ Ga Gr He Hs It Ju Lu Sa Si Tu [Au Ge].

Sterile plants intermediate between 1 and 2 have been called C. gracilis Gren., Mém. Soc. Émul. Doubs ser. 3, 2: 403 (1858) (C. gelmii J. Murr). Fertile intermediates also sometimes occur.
3. C. thracica Velen., Sitz.-Ber. Böhm. Ges. Wiss. 37: 11 (1893). Lower part of plant and leaves sparsely hairy; upper parts glabrous. Sepals green. Petals 2-3 mm, about twice as long as sepals, white. Silicula c. $6 \times 3-4 \mathrm{~mm}$, distinctly attenuate at base, deeply emarginate at apex; lateral margins concave; apical lobes subacute; style $c .0 .75 \mathrm{~mm}$. - S. Bulgaria. Bu.
4. C. grandiflora(Fauché \& Chaub.) Boiss., Diagn. Pl. Or. Nov. 1 (1): 76 (1843). Plant sparsely hairy. Flowers scented. Sepals green, glabrous. Petals $4-5 \mathrm{~mm}$, c. $2 \frac{1}{2}$ times as long as sepals, white. Silicula c. $6 \times 6 \mathrm{~mm}$, scarcely attenuate at base, deeply emarginate at apex; lateral margins straight; apical lobes very obtuse; style $0.25-0.7 \mathrm{~mm}$. Greece and Albania; naturalized in N.E. Italy (Trieste). Al Gr [It].
5. C. orientalis Klokov, Bull. Soc. Nat. Voronèje 1: 122 (1926). Plant densely hairy in lower part, greyish-green. Sepals green. Petals $1 \cdot 5-2 \mathrm{~mm}$, less than twice as long as sepals, pale yellowish. Silicula $5-6 \times 4-4.5 \mathrm{~mm}$, deeply emarginate at apex; style 0.25-0.5 mm. S. Russia, W. Ukraine. Rs (W, E).

## 69. Hutchinsia R.Br. ${ }^{2}$

Small perennial herbs, glabrous or with unbranched hairs. Inflorescence ebracteate. Petals white, clawed. Fruit an angustiseptate silicula, elliptical to lanceolate; seeds 1-2 in each loculus. (Noccaea Reichenb.)

Literature: G. Melchers, Österr. Bot. Zeitschr. 81 : 81 (1932).

1. H. alpina (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 82 (1812) (Noccaea alpina (L.) Reichenb.). Stock branched; stems up to 10 cm . Basal leaves pinnatisect. Petals 3-5 mm. Mountains of C. \& S. Europe, southwards to N. Spain, C. Italy and Macedonia. $\mathrm{Al} \mathrm{Au} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm}$.
1 Flowering stems flexuous, leafy
(c) subsp. auerswaldii
1 Flowering stems $\pm$ leafless, straight
2 Petals 3 mm wide, conspicuous, abruptly contracted into claw; style 1 mm
(a) subsp. alpina
2 Petals $1-2 \mathrm{~mm}$ wide, gradually attenuate into claw; style 0
(b) subsp. brevicaulis
(a) Subsp. alpina: Flowering stems $5-10 \mathrm{~cm}$, sparsely hairy. Leaves all basal, glabrous, with 5-9 ovate-lanceolate segments.

Petals $4-5 \times 3 \mathrm{~mm}$. Silicula $4-6 \times 1.5-2 \mathrm{~mm}$, ovate, acute. $2 n=12$. Calcicole. C. Europe; Pyrenees; N. \& C. Appennini.
(b) Subsp. brevicaulis (Hoppe) Arcangeli, Comp. Fl. Ital. 58 (1882): Flowering stems up to 5 cm , glabrous. Leaves with 3-7 ovate-lanceolate segments. Petals $3-4 \times 1-2 \mathrm{~mm}$. Silicula 3.5$4 \times 1-2 \mathrm{~cm}$, obtuse. $2 n=12$. On granite, igneous, and limestone rocks. C. Europe, Italy and Balkan peninsula.
(c) Subsp. auerswaldii (Willk.) Laínz, Anal. Inst. Bot. Cavanilles 14: 534 (1957): Like (a) but flowering stems up to 15 cm , flexuous, leafy. Cauline leaves with lanceolate to linear segments. - N. Spain (Cordillera Cantábrica).

Plants from the Pyrenees and S.W. Alps with leaves like subsp. (b) but fruits like subsp. (a) have been distinguished as H. affinis Gren. ex F. W. Schultz, Arch. Fl. Fr. Allem. 274 (1853), and are of uncertain status.

## 70. Hymenolobus Nutt. ex Torrey \& A. Gray ${ }^{1}$

Like Hornungia but hairs unbranched and seeds $3-10$ in each loculus.

Literature: R. Pampanini, Nuovo Gior. Bot. Ital. 16: 36 (1909).
Stems up to 30 cm ; inflorescence many-flowered 1. procumbens Stems not more than 5 cm ; inflorescence few-flowered 2. pauciforus

1. H. procumbens (L.) Nutt. ex Torrey \& A. Gray, Fl. N. Amer. 1: 117 (1838) (Hornungia procumbens (L.) Hayek; Hutchinsia procumbens (L.) Desv.). Annual or biennial with sparse unbranched hairs; stems $3-30 \mathrm{~cm}$, procumbent or erect. Lower leaves deeply lyrate-pinnatifid to entire; upper leaves entire. Inflorescence manyflowered. Petals $1-3 \mathrm{~mm}$, spathulate, equalling or slightly exceeding the sepals. Silicula 2-5 mm, elliptical to obovate; valves translucent, with reticulate veins. $2 n=12,24$. Frequently maritime. Mainly $S$. Europe. Bl Co Ga Ge Gr He It Ju Lu Rm Rs (W, K, E) Sa Si.

Extremely variable. A distinctive variant with leaves all ovateelliptical, entire, petals c. 1.5 mm , and silicula 3 mm occurs in Corse, Sardegna and Malta (var. revelieri (Pamp.)). Other variants, about which there is wide disagreement in their characters, make the distinction between $\mathbf{1}$ and 2 difficult.
2. H. pauciflorus (Koch) Schinz \& Thell., Viert. Naturf. Ges. Zürich 66: 285 (1921). Like 1 but stems not more than 5 cm , erect; leaves 3 -lobed or entire, spathulate; inflorescence fewflowered; silicula orbicular to elliptical. Cevennes; Alps; Calabria; isolated localities in E. Spain. Au Ga He Hs It.

## 71. Hornungia Reichenb. ${ }^{1}$

Small annuals; hairs stellate or absent. Inflorescence ebracteate. Petals white, shortly clawed. Fruit an angustiseptate silicula, elliptical to oblong-ovate. Seeds 1-2 in each loculus, not mucilaginous.
Petals scarcely exceeding the sepals; silicula $2-2.5 \mathrm{~mm}$ Petals twice as long as the sepals; silicula 3 mm

1. petraea
2. H. petrae (L) Reichenb Deutschl Fl. 1. H. petraea (L.) Reichenb., Deutsch1. Fl. 1: 33 (1837) (Hutchinsia petraea (L.) R.Br.). Stems $3-15 \mathrm{~cm}$, slender, slightly leafy. Leaves all pinnate; the basal rosulate, petiolate, with 3-15 or more ovate, lanceolate or obovate, acute segments; the cauline sessile. Petals $0.75-1 \mathrm{~mm}$, as long as or slightly longer than the sepals. Silicula 2-2.5 mm, narrowly elliptical to ovate or obovate; valves opaque, compressed, with distinct median vein. $2 n=12$.

[^128]S., W. \& C. Europe, extending to Sweden, Estonia and Ukraine. Al Au Be Bl Br Bu Co Cr Cz Da Ga Ge Gr He Hs Hu It Ju Lu No Rs (B, W, K) Sa Si Su.
2. H. aragonensis (Loscos \& Pardo) Heywood, Feddes Repert. 66: 155 (1962). Like 1 but petals twice as long as sepals, broadly obovate, long-clawed; silicula 3 mm , ovate-lanceolate. Mountains of N.E. Spain (Aragón, W. Cataluña). Hs.

## 72. Ionopsidium Reichenb. ${ }^{1}$

Slender glabrous annuals with rosettes of leaves. Inflorescence leafy, or bracteate at the base. Flowers white, purple or pink; sepals spreading; stamens free, edentate. Fruit a laterally compressed silicula, the valves keeled. Seeds 2-6 in each loculus, covered with transparent papilliform glands. (Incl. Pastorea Tod. and Minaea Lojac.)

Literature: A. Chiarugi, Nuovo Gior. Bot. Ital. nov. ser., 34 : 1452-96 (1928).
1 Petals equal
2 Petals usually lilac-purple, 2-3 times as long as calyx; petiole of basal leaves several times as long as lamina 1. acaule
2 Petals white, $1 \frac{1}{2}$ times as long as calyx; petiole of basal leaves not longer than lamina
2. albiflorum

1 Petals unequal
3 Sepals with a transparent margin; style $0.5 \mathrm{~mm} \quad$ 5. savianum
3 Sepals white-margined; style 1 mm
4 Silicula 5-7 $\times 5-7 \mathrm{~mm}$ (about as long as wide); $10-12$ siliculae developed on each side of the raceme 3. prolongo
4 Silicula $3-4 \times 2-2.5 \mathrm{~mm}$ (about $1 \frac{1}{2}$ times as long as wide); $16-20$ siliculae developed on each side of the raceme
4. abulense

Sect. Ionopsidium (Sect. Ionopsis (DC.) Cosson). Petals equal; inflorescence leafy; septum of the silicula with a membranous margin.

1. I. acaule (Desf.) Reichenb., Pl. Crit. 7: 26, t. 649 (1829). Caespitose, stemless or sometimes with short stem. Basal leaves rounded-ovate, entire or 3-lobed. Flowers usually solitary, borne on long pedicels in the axils of the basal leaves. Petals lilac or purple, sometimes white, 2-3 times as long as calyx. Silicula obovoid-orbicular; seeds $2-5$ in each loculus. $2 n=24$.
Portugal. Widely cultivated in gardens and naturalized in parts of S. Europe. $\mathrm{Lu}[\mathrm{Ga} \mathrm{Hs}$ ].

Sect. Pastoraea (Tod.) Cosson. Petals equal. Inflorescence with leaf-like bracts. Septum of silicula without a membranous wing.
2. I. albiflorum Durieu in Duchartre, Rev. Bot. 2: 433 (1847). Ephemeral; stem simple or branched from the base. Basal leaves entire or sinuate-dentate. Petals white, $1 \frac{1}{2}$ times as long as calyx. Silicula oblong, with 5-6 seeds in each loculus. S.E. Italy (Puglia), Sicilia. It Si. (N.W. Africa.)

Sect. Minaea (Lojac.) Batt. Septum of silicula with membranous margin. Petals unequal. Inflorescence bracteate at base only.
3. I. prolongoi (Boiss.) Batt., Bull. Soc. Bot. Fr. 43: 259 (1896). Many-stemmed, $7-15 \mathrm{~cm}$. Basal leaves in lax rosette, oblong-spathulate, shortly petiolate, irregularly toothed. Inflorescence racemose, the ultimate racemes sub-corymbose, becoming very lax. Pedicels horizontal, equalling or shorter than fruits. Sepals narrowly white-margined; petals white, $4-5 \mathrm{~mm}$.

Silicula 4-7 $\times 4-7 \mathrm{~mm}$, $\pm$ orbicular; style 1 mm ; seeds 2-3 in each loculus. Calcicole. S. Spain. Hs. (N.W. Africa.)
4. I. abulense (Pau) Rothm., Cavanillesia 7: 112 (1935) (I. heterospermum sensu Chiarugi, pro parte). Like 3 but flowers usually smaller; 16-20 siliculae developed on each side of the raceme (not $10-12$ ); siliculae smaller, $3-4 \times 2-2.5 \mathrm{~mm}$; pedicels $1 \frac{1}{2}-3$ times as long as fruits. Calcifuge. - N. \& C. Spain, N.E. \& C. Portugal. Hs Lu.
5. I. savianum (Caruel) Ball ex Arcangeli, Comp. Fl. Ital. 58 (1882). Like 3 and 4 but inflorescence racemose, the ultimate racemes not becoming very lax; sepals with transparent margin; fruiting pedicels slightly deflexed; silicula retuse at apex, attenuate at base; style 0.5 mm . $2 n=32$. Calcareous and serpentine rocky debris. C. Italy (Monte Calvi). It.

## 72 bis. Bivonaea DC. ${ }^{1}$

Like Ionopsidium but flowers yellow; valves of the silicula winged; seeds smooth, without papilliform glands.

1. B. lutea (Biv.) DC., Reg. Veg. Syst. Nat. 2: 555 (1821). Stem up to 10 cm , simple or branched from base. Basal leaves oblong-spathulate, shortly petiolate, entire or toothed. Petals equal, $1 \frac{1}{2}$ times as long as sepals. Silicula $5-7 \mathrm{~mm}$, obovoidoblong, emarginate; wing 1-2 mm wide. Sicilia. Si.

## 73. Teesdalia R.Br. ${ }^{2}$

Annual, glabrous or with unbranched hairs. Leaves usually pinnatifid, in a basal rosette or with 1-3 cauline leaves on lateral shoots. Sepals erecto-patent; petals white. Stamens 4 or 6, the filaments with a white basal scale. Fruit an angustiseptate silicula, obtuse or obcordate, with thin-walled valves, winged in the upper part; style very short or absent. Seeds 2 in each loculus.

> Basal leaves with obtuse lobes; petals unequal, the outer twice as long as the sepals; silicula 3-4 mm ; style short Basal leaves with acute lobes, or entire; petals $\pm$ equal, as long as the sepals; silicula less than 3 mm ; style absent 2. coronopifolia

1. T. nudicaulis (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 83 (1812). Stem $8-45 \mathrm{~cm}$, often with ascending basal branches. Basal leaves $2-5 \mathrm{~cm}$, petiolate, narrowly lyrate-pinnatifid, with few short, obtuse lateral lobes and a broader, often 3-lobed, terminal segment; cauline leaves (if present) less lobed or more or less entire. Flowers c. 2 mm in diameter. Inner petals slightly longer than the sepals, the outer twice as long. Silicula $3-4 \mathrm{~mm}$, with very short style. $2 n=36 . W . \& C$. Europe, extending to Sweden, White Russia, Jugoslavia and Sicilia. Au Be Br Cz Da Ga Ge Hb He Ho Hs Hu It Ju Lu No Po ?Rm Rs (B, C, W) Si Su Tu.
2. T. coronopifolia (J. P. Bergeret) Thell., Feddes Repert. 10: 289 (1912) (T. lepidium DC.). Like 1 but more slender, always glabrous; rosette-leaves narrowly lanceolate, usually pinnatifid with acute lobes; petals subequal, as long as the sepals; style absent; silicula not more than 3 mm . S. Europe. Bu Co Cr Ca Gr Hs It Ju Lu Sa Si Tu.

## 74. Thlaspi L. ${ }^{3}$

Annual or perennial herbs with sessile, $\pm$ amplexicaul cauline leaves. Hairs unbranched or absent. Inflorescence racemose, ebracteate. Sepals erect, not saccate; petals usually white or

[^129]purplish, shortly clawed; stamens without appendages. Fruit an angustiseptate silicula, with or without apical notch, the valves keeled and usually winged; stigma capitate, somewhat 2-lobed. Seeds 1-8 in each loculus.

In species described as having violet anthers, the violet coloration may not appear until a late stage of dehiscence.

1 Annual, without non-flowering leaf-rosettes
2 Style long, exceeding the notch of the ripe fruit
23. macranthum

2 Style very short, included within the notch of the ripe fruit
3 Upper cauline leaves ovate, cordate-amplexicaul at the base; seeds smooth
3. perfoliatum

3 Upper cauline leaves oblong, hastate- or sagittate-amplexicaul at the base; seeds ridged or alveolate
4 Glabrous; fruit $10-15 \mathrm{~mm}$ in diameter, flattened, orbicular; seeds with concentric ridges 1. arvense
4 Stem hairy below; fruit $6-7 \mathrm{~mm}$ in diameter, obcordate, convex beneath; seeds alveolate 2. alliaceu
1 Biennial to perennial, usually with non-flowering leaf-rosettes
5 Style included within the notch of the ripe fruit, or stigma sessile
6 Plants usually more than 10 cm and sometimes reaching 50 cm ; inflorescence usually elongating in fruit (lowland to alpine over much of Europe)
(4-7). alpestre group
6 Dwarf plants rarely more than 10 cm , often much smaller; inflorescence scarcely elongating in fruit (mountains of S. Europe)

7 Petals 5 mm (Greece)
(14-18). praecox group
7 Petals 2 mm
8 Apical notch of fruit rounded at base; stigma almost sessile 8. brevistylum 8 Apical notch acute at base; style $0.3-0.5 \mathrm{~mm}$ 9. rivale
5 Style equalling or exceeding the notch of the ripe fruit, or notch absent
9 Ripe fruit strongly keeled but not winged; notch very narrow or absent; inflorescence scarcely elongating in fruit
10 Petals white (Spain)
26. nevadense

10 Petals purple
11 Plant caespitose; rosette-leaves spathulate, dentate; all cauline leaves alternate 25. bellidifolium
11 Plant with long or short stolons; rosette-leaves elliptical to suborbicular; lower cauline leaves opposite
24. rotundifolium

9 Ripe fruit distinctly, though sometimes very narrowly winged; notch broad or absent; inflorescence usually elongating in fruit
12 Sepals $1-1 \cdot 5(-2) \mathrm{mm}$; petals $1-3(-4) \mathrm{mm}$; stamens about equalling or exceeding the petals; stock quite shortly branched
(4-7). alpestre group
12 Sepals $2-3 \mathrm{~mm}$; petals ( $3 \cdot 5-) 4-8 \mathrm{~mm}$, exceeding the stamens; plants perennial; stock with short or elongated branches
13 Roots tuberous, long-tapering; flowers bright violet (Greece)
13. bulbosum

13 Roots not tuberous; flowers white or purplish
14 Wing of fruit-valve usually c. 0.5 mm wide and never more than 1 mm wide, so forming a very shallow notch which is much exceeded by the style
(20-22). alpinum group
14 Wing of fruit-valve more than 1 mm wide and at least half as wide as the valve at its apex; notch very variable in depth and width
15 Stock with elongate stolon-like branches; plants matforming
19. montanum

15 Stock with short branches; plants $\pm$ caespitose
16 Anthers yellow
(14-18). praecox group
16 At least some anthers becoming violet
17 Inflorescence almost sessile; style $0.75-1 \mathrm{~mm}$
11. microphyllum

17 Inflorescence distinctly stalked; style $1.5-5 \mathrm{~mm}$
18 Flowers white; style $1 \cdot 5-3.5 \mathrm{~mm}$
10. graecum
18 Flowers purplish; style 3-5 mm
12. stylosum

Sect. Nomisma DC. Silicula suborbicular, strongly compressed, broadly winged, with a deep and narrow notch; stigma subsessile. Seeds concentrically ridged.

1. T. arvense L., Sp. Pl. 646 (1753). Annual $10-60 \mathrm{~cm}$, erect, glabrous, more or less foetid. Basal leaves oblanceolate to obovate, petiolate; upper cauline leaves oblong with sagittateamplexicaul base; all entire or sinuate-dentate. Sepals $1 \cdot 5-2 \mathrm{~mm}$, narrow; petals 3-4 mm, white; stamens shorter than the petals; anthers yellow. Silicula $10-15(-18) \mathrm{mm}$ in diameter, almost orbicular; pedicels $c .10 \mathrm{~mm}$, ascending; style $c .0 .3 \mathrm{~mm}$, included within the deep, narrow notch. Seeds 5-8 in each loculus, concentrically ridged. $2 n=14$. Weed of arable land and waste places. Throughout Europe, but rare in the extreme north and absent from much of the Mediterranean region. All except Al Az Co Cr Fa Gr Sa Sb Si Tu .

Sect. Thlaspi. Silicula widely to narrowly obovate, planoconvex, narrowly to broadly winged, with or without a notch; style included to exserted. Seeds alveolar to smooth.
2. T. alliaceum L., Sp. Pl. 646 (1753). Annual $20-60 \mathrm{~cm}$, erect, with a few long hairs at base of stem, smelling of garlic. Basal leaves not rosulate, lanceolate to oblong-obovate, petiolate, sinuate-dentate to almost lyrate; upper cauline leaves oblong with sagittate-amplexicaul base, entire to sinuate-dentate; all glabrous and glaucous. Sepals $c .1 \cdot 5 \mathrm{~mm}$; petals $2.5-3 \mathrm{~mm}$, white; stamens shorter than the petals; anthers yellow. Silicula $5-10 \mathrm{~mm}$, narrowly obcordate, convex beneath, narrowly winged; style c. 0.3 mm , included within the shallow notch. Seeds $3-5$ in each loculus, alveolate. Weed of arable land and waste places. C. \& S. Europe. Au Co Ga Ge Hs Hu It Ju Po Rm Rs (W) Si Tu [Br].
3. T. perfoliatum L., Sp. Pl. 646 (1753). Annual 5-20(-30) cm, glabrous, glaucous. Basal leaves rosulate, obovate, petiolate; upper cauline leaves ovate-cordate, sessile, with rounded, amplexicaul auricles; all entire or sinuate-denticulate. Sepals $1-1.5 \mathrm{~mm}$, with broad, white margins; petals $2-3 \mathrm{~mm}$, white; stamens shorter than the petals; anthers yellow. Silicula $5-7 \mathrm{~mm}$, broadly obcordate, convex beneath; wing broadening upwards; style c. 0.3 mm , included within the wide and fairly deep notch. Seeds $3-4$ in each loculus, almost smooth. $2 n=70$. In open vegetation on limestone, loess and base-rich loams, and a weed of arable land and waste places. Europe northwards to c. $60^{\circ} \mathrm{N}$. in Sweden. All except $\mathrm{Az} \mathrm{Fa} \mathrm{Fe} \mathrm{Hb} \mathrm{Is} \mathrm{No} \mathrm{Sb}$.
(4-7). T. alpestre group. Biennial or perennial $10-50 \mathrm{~cm}$, with shortly branched stock and crowded leaf-rosettes. Basal leaves rosulate, petiolate; cauline leaves sessile, auriculate-amplexicaul. Inflorescence a compact, almost corymbose raceme, usually much elongating in fruit. Sepals $1-1 \cdot 5(-2) \mathrm{mm}$; petals $1-3(-4 \cdot 5) \mathrm{mm}$, white or purplish; stamens about equalling or exceeding the petals. Silicula $5-10(-12) \times 3-6 \mathrm{~mm}$; wing narrow below, but usually broadening upwards and forming a notch variable in width and depth; style variable in length. Seeds (2-)4-6 in each loculus.

1 Petals $\pm$ equalling or up to $1 \frac{1}{3}$ times as long as the sepals
4. brachypetalum

1 Petals at least $1 \frac{1}{2}$ times as long as the sepals
2 Anthers reddish to dark violet, at least after dehiscence
5. alpestre

2 Anthers remaining yellowish even after dehiscence

3 Fruit very narrowly winged all round; style much exceeding the notch
6. stenopterum

3 Fruit broadly winged above; style included within or about equalling the notch
4 Raceme scarcely elongating in fruit 7. dacicum
4 Raceme elongating considerably in fruit
5. alpestre
4. T. brachypetalum Jordan, Obs. Pl. Crit. 3: 5 (1846). Biennial $20-50 \mathrm{~cm}$, glabrous, glaucous. Leaves entire or denticulate; the basal elliptical; the cauline oblong with obtuse to subacute auricles. Sepals $1-1.5 \mathrm{~mm}$; petals white, equalling or slightly exceeding the sepals; stamens somewhat exceeding the petals; anthers whitish. Raceme much elongating in fruit. Silicula 69 mm , narrowly obcordate, broadly winged above, with rounded apical lobes and a deep notch usually exceeding the short style. Seeds 4-6 in each loculus. Mountain woods and pastures; usually calcifuge. Pyrenees to S.W. Alps; Appennini. Ga He Hs It [Su].
5. T. alpestre L., Sp. Pl. ed. 2, 903 (1763). Biennial or perennial $10-50 \mathrm{~cm}$, glabrous, often glaucous. Leaves entire or denticulate; the basal elliptical to obovate-spathulate; the cauline oblong-cordate. Sepals $c .1 .5 \mathrm{~mm}$; petals white or purplish, $1 \frac{1}{2}-3$ times as long as the sepals and equalling or somewhat exceeding the stamens; anthers usually reddish to dark violet, at least after dehiscence, but sometimes remaining yellowish. Raceme much elongating in fruit. Silicula $5-7(-10) \mathrm{mm}$, narrowly to broadly obcordate with wing broadening upwards, with or without a notch; style included or exserted. Seeds usually 3-6 in each loculus. Often on metal-mine heaps. Upland regions of S., W. \& C. Europe, eastwards to Poland and Jugoslavia; naturalized in parts of N. Europe. Au Be Br Cz Ga Ge He Ho Hs Hu It Ju Po [Da Fe Is No Su].
(a) Subsp. alpestre: Usually biennial (fiowering only once). Petals $2-3(-4) \mathrm{mm}$, white or purplish. Silicula 5-9 mm, broadly winged above, with rounded or subacute apical lobes and a distinct notch, or truncate at apex; style $0.75-1.5 \mathrm{~mm}$, equalling or exceeding notch. $2 n=14$. Throughout the range of the species.

Very variable; many local variants have been given specific or subspecific status, among them T. Iereschii Reuter, Compt. Rend. Soc. Hallér. 17 (1854) (T. alpestre subsp. lereschii (Reuter) Thell.), T. salisii Brügger, Zeitschr. Ferdinand. Tirol ser. 3, 9: 45 (1860), T. sylvestre Jordan, Obs. Pl. Crit. 3: 9 (1846) (T. alpestre subsp. sylvestre (Jordan) Hooker) and T. calaminare (Lej.) Lej. \& Court., Comp. Fl. Belg. 2: 307 (1831) (T. alpestre subsp. calaminare (Lej.) O. Schwarz).
(b) Subsp. virens (Jordan) Hooker fil., Student's Fl. 38 (1870) (T. virens Jordan): Perennial (flowering more than once), laxly caespitose, not glaucous. Petals $3 \cdot 5-4 \mathrm{~mm}$, white. Silicula $5-6 \times 3-4 \mathrm{~mm}$, rather narrowly winged all round; apex truncate or with a very shallow notch; style (1.5-) $1 \cdot 75-2 \cdot 5(-4) \mathrm{mm}$, longexserted. Grassland. - W. Alps.
6. T. stenopterum Boiss. \& Reuter, in Boiss., Diagn. Pl. Or. Nov. 2(8): 40 (1849). Perennial $30-60 \mathrm{~cm}$, caespitose. Leaves entire; basal obovate; the cauline oblong, cordate. Petals white, twice as long as the sepals; anthers yellow. Silicula narrowly obcordate, cuneate below; wing narrow above, very narrow below; style more than twice as long as the shallow notch. Seeds 2 in each loculus. Grassland and wooded slopes of mountains. - N.\& C.Spain. Hs.
7. T. dacicum Heuffel, Österr. Bot. Zeitschr. 8: 26 (1858). Perennial 5-25(-35) cm, glabrous. Leaves entire; the basal elliptic or obovate; the cauline more or less broadly elliptic, sagittateamplexicaul. Petals white, at least $1 \frac{1}{2}$ times as long as the sepals; anthers yellow. Raceme scarcely elongating in fruit. Silicula broadly winged, with a wide, shallow notch; style at most equalling
the notch. Seeds 3-4 in each loculus. - E. \& S. Carpathians. RmRs (W).
(a) Subsp. dacicum: Petals 3 mm . Fruiting raceme $1-2(-5) \mathrm{cm}$. Silicula $6-9 \mathrm{~mm}$; style more than half as long as the notch. Throughout the range of the species.
(b) Subsp. banaticum (Uechtr.) Jáv., Magyar Fl. 406 (1924): Petals $c .4 .5 \mathrm{~mm}$. Fruiting raceme $2 \cdot 5-10 \mathrm{~cm}$. Silicula $9-12 \mathrm{~mm}$; style not more than half as long as the notch. S. Carpathians.
8. T. brevistylum (DC.) Jordan, Obs. Pl. Crit. 3: 27 (1846). Caespitose, glabrous biennial $2-10(-20) \mathrm{cm}$. Leaves small, thick, glaucous; rosette-leaves broadly elliptical to obovate, longpetiolate; cauline leaves oblong-cordate, obtuse, the lower petiolate, the upper sessile. Sepals c. 1 mm ; petals 2 mm ; stamens shorter than the petals; anthers white, becoming greyish. Fruiting raceme short and compact. Silicula narrowly obovate, the wing very narrow below but broadening upwards to become half the width of the valve; stigma subsessile at the base of the wide rounded apical notch. Seeds 3-4 in each loculus. High mountain rocks and pastures. - Corse and Sardegna. Co Sa.
9. T. rivale J. \& C. Presl, Del. Prag. 12 (1822). Like 8 buterect main stem often with long decumbent or ascending basal branches; petals $c .2 \cdot 5 \mathrm{~mm}, 1 \frac{1}{2}-2$ times as long as sepals and about equalling the stamens; anthers yellow; apical notch of ripe fruit acute (45-90 ); style $0 \cdot 3-0.5 \mathrm{~mm}$, included within the notch. Mountain rocks and pastures. S. Albania, N. Greece, S. Italy, Sardegna and Sicilia. Al Gr It Sa Si.
10. T. graecum Jordan, Obs. Pl. Crit. 3: 30 (1846). Caespitose perennial $2-10(-20) \mathrm{cm}$, with shortly branched stock, often emitting distinct stolons. Rosette-leaves oblong, long-petiolate; cauline oblong-amplexicaul; all sinuate-denticulate, rarely entire. Sepals 2 mm ; petals 6 mm , white, much exceeding the stamens; anthers violet. Racemes elongating in fruit. Silicula broadly winged; style $1 \cdot 5-3 \cdot 5 \mathrm{~mm}$, much exceeding the shallow apical notch. Seeds 4 in each loculus. Mountains of Greece and Kriti. Cr Gr.
11. T. microphyllum Boiss. \& Orph. in Boiss., Diagn. Pl. Or. Nov. 3 (6): 19 (1859). Dwarf, caespitose perennial $1-2(-4) \mathrm{cm}$. Rosette-leaves 3-6 mm, very small, obovate, entire or denticulate, petiolate. Inflorescence almost sessile. Sepals violet; petals 35 mm , white, c. 3 times as long as the sepals; anthers yellow, becoming violet. Racemes not or scarcely elongating in fruit. Silicula broadly winged; style $0.75-1 \mathrm{~mm}$, exceeding the shallow apical notch. Seeds 4 in each loculus. High mountains.
Albania, Greece and Kriti. Al Cr Gr.
12. T. stylosum (Ten.) Mutel, Fl. Fr. 1 : 99 (1834) (?T. minimum Ard.). Dwarf, caespitose perennial $1-2 \cdot 5(-6) \mathrm{cm}$. Rosetteleaves $5-10 \mathrm{~mm}$, elliptic-spathulate, petiolate. Petals 5 mm , purplish; anthers violet. Silicula rather broadly winged; style 3-5 mm, much exceeding the shallow apical notch. Italy (C. \& S. Appennini). It.
13. T. bulbosum Spruner ex Boiss., Diagn. Pl. Or. Nov. 1 (1): 74 (1843). Caespitose perennial $5-10 \mathrm{~cm}$, with stout woody stock and several tuberous, long-tapering roots. Stems many, ascending. Rosette-leaves broadly ovate, abruptly petiolate; cauline leaves ovate-oblong with obtuse auricles; all glabrous, glaucous. Petals $6-8 \mathrm{~mm}$; twice as long as the sepals, dark violet or dark lilac; anthers bright violet. Silicula obcordate, broadly winged above; style 1-2 mm exceeding the wide apical notch. Seeds 4-5, sometimes only 2 , in each loculus. Montane woods. ? Greece. Gr.
(14-18). T. praecox group. More or less densely caespitose perennials. Stock much-branched, with crowded leaf-rosettes and usually 2 or more flowering stems. Petals $5-7(-8) \mathrm{mm}$, white, 2 or more times as long as the sepals; stamens much shorter than the petals; anthers yellowish even after dehiscence. Silicula obcordate to triangular, broadly winged above; apex with a wide notch, or truncate. Seeds 2-10 in each loculus.
1 Style $3-5 \mathrm{~mm}$, more than half as long as the ripe fruit; petals white, becoming distinctly yellow when dry 18. ochroleucum 1 Style $1-3.5 \mathrm{~mm}$; petals white, not becoming distinctly yellow when dry
2 Inflorescence often branched; petals $7-8 \mathrm{~mm}$ 16. goesingense
2 Inflorescence simple; petals $5-7 \mathrm{~mm}$
3 Plants $3-5 \mathrm{~cm}$; style included within the notch of the ripe fruit 17. epirotu
3 Plants usually $10-20 \mathrm{~cm}$; style equalling or exceeding the notch
4 Ripe fruit usually $7-9 \mathrm{~mm}$, obcordate; angle at base of notch not more than $90^{\circ}$ 14. praecox
4 Ripe fruit usually $5-8 \mathrm{~mm}$, triangular-obcordate; angle at base of notch more than $90^{\circ}$ 15. jankae
14. T. praecox Wulfen in Jacq., Collect. Bot. 2: 124 (1789). Stems (5-)10-20(-35) cm, erect, glabrous, more or less glaucous. Rosette-leaves oblong to broadly ovate, petiolate, often violet beneath; cauline ovate-oblong, amplexicaul with obtuse auricles; all entire or sinuate-denticulate, coriaceous. Sepals $2-3 \mathrm{~mm}$, violet-tipped; petals $5-7 \mathrm{~mm}$, narrow, white. Inflorescence much elongating in fruit. Silicula usually $7-9 \mathrm{~mm}$, narrowly obcordate; angle at base of notch not more than $90^{\circ}$; style (1-)2-3.5 mm, always exceeding the notch at least slightly. Seeds 2-4 in each loculus. Stony, shaded slopes and dry grassland, especially on karstic limestone. S. Austria, Italy, Balkan peninsula. Al Au ? Bu Gr It Ju.
(a) Subsp. praecox: Rosette-leaves oblong to broadly ovate; cauline leaves ovate. Style (1-)2-3.5 mm. Throughout the range of the species.
(b) Subsp. cuneifolium (Griseb.) Clapham, Feddes Repert. 70: 4 (1964) (T. cuneifolium Griseb.): Rosette-leaves ovate-cuneate to spathulate; cauline leaves oblong. Style 2-4 mm. Jugoslavia (Hercegovina) and Albania.
15. T. jankae Kerner, Österr. Bot. Zeitschr. 17: 35 (1867) Like 14 but ripe fruit usually $5-8 \mathrm{~mm}$, triangular-obcordate; angle at base of notch more than $90^{\circ}$; style $1-1 \cdot 5(-2) \mathrm{mm}$, about equalling or only slightly exceeding the notch; seeds 3-10 in each loculus. Czechoslovakia, Hungary. Cz Hu .
16. T. goesingense Halácsy, Österr. Bot. Zeitschr. 30: 173 (1880) (incl. T. umbrosum Waisb.). Stock with many very short branches (longer in shade), the numerous leaf-rosettes densely crowded; stems up to 40 cm , erect. Rosette-leaves $4-10 \mathrm{~cm}$, elliptical to obovate-spathulate, petiolate; cauline leaves ovateoblong, sagittate-amplexicaul; all glaucous, entire or almost so. Inflorescence commonly branched. Petals $6-8 \mathrm{~mm}$, white. Silicula narrowly obovate to triangular, very narrowly winged below, the wing broadening upwards into apical lobes of varying form, with a notch between them, or into a broad truncate apex; style ( $1 \cdot 5-$ ) 3 mm , much-exserted. Seeds $3-6$ in each loculus. Stony and shady slopes or mountain grassland. Balkan peninsula and E.C. Europe. Al Au Bu Gr Hu Ju.
17. T. epirotum Halácsy, Consp. Fl. Graec. 1: 109 (1900). Stock with many short branches; stems $3-10 \mathrm{~cm}$, erect. Rosette-leaves oblong to ovate, shortly petiolate; cauline leaves oblong, with obtuse auricles. Petals white, twice as long as the yellowish
sepals. Inflorescence remaining compact in fruit. Fruit triangu-lar-obcordate; style $1.5-2 \mathrm{~mm}$, included within the shallow notch. Seeds 2 in each loculus. Stony mountain slopes. - N.W. Greece. Gr.
18. T. ochroleucum Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (8): 39 (1849). Stock with many short branches; stems c. $10-25 \mathrm{~cm}$, ascending. Rosette-leaves ovate to oblong, gradually and shortly petiolate; cauline leaves oblong, amplexicaul with obtuse auricles; all entire or somewhat denticulate. Petals 58 mm , white, becoming pale yellow when dry, 2-2 $\frac{1}{2}$ times as long as the reddish sepals; anthers yellow. Inflorescence elongating in fruit. Silicula $6-10 \mathrm{~mm}$, obcordate, broadly winged; style $2-$ 5 mm , long-exserted from the shallow notch. Seeds 4 in each loculus. Grassy mountain slopes. Balkan peninsula. Al Bu Gr Ju.
T. lutescens Velen., Sitz.-Ber. Böhm. Ges. Wiss. 1903: (28) 2 (1904), a non-stoloniferous, glaucescent, glabrous perennial, with erect stems $12-15 \mathrm{~cm}$, and obovate, abruptly petiolate rosetteleaves, is known only from the original collection (near Thessaloniki) and is possibly not distinct from 18.
19. T. montanum L., Sp. Pl. 647 (1753). Perennial, mat-forming, the branches of the stock usually elongated, but sometimes shorter and covered with dead leaf-bases; stems ( $7-$ ) $10-30 \mathrm{~cm}$, erect, glabrous. Rosette-leaves with lamina $1-2.5 \mathrm{~cm}$, ovate to orbicular, rather abruptly narrowed into the long petiole; cauline leaves ovate-oblong, amplexicaul with rounded or subacute auricles; all entire or sinuate-denticulate, more or less coriaceous, glabrous, somewhat glaucous. Sepals $2-3 \mathrm{~mm}$; petals $5-7 \mathrm{~mm}$, with limb 3 mm wide, and narrow claw, much exceeding the stamens, white; anthers pale yellowish. Inflorescence elongating in fruit. Silicula (4-)7-8 mm, obcordate, broadly winged above, with rounded apical lobes and a wide notch; style $1 \cdot 5-2 \mathrm{~mm}$, exceeding the notch. Seeds $1(-2)$ in each loculus, smooth, dull. $2 n=28$. Cliff-ledges, scree, shaded rocky slopes and open grassland, mainly on limestone. C. Europe, extending to France, N. Italy and S. Jugoslavia. Au Be Cz Ga Ge He ?Hs It Ju.
(20-22). T. alpinum group. Perennial, mat-forming to caespitose, the stock with elongated and stolon-like or quite short branches; stems erect, glabrous. Rosette-leaves $1-2.5 \mathrm{~cm}$, longpetiolate; the cauline amplexicaul; all glabrous, more or less coriaceous, entire or nearly so. Sepals $2-3 \mathrm{~mm}$; petals $4-8 \mathrm{~mm}$, much exceeding the stamens, white; anthers yellowish. Silicula about twice as long as wide; wing up to 0.5 mm wide, not or shallowly notched; style long-exserted. Seeds 2-8 in each loculus. Screes, rocky slopes and grassland.
1 Petals (3.5-)4-5 mm; seeds 3-8 in each loculus
22. avalanum
1 Petals $5-8 \mathrm{~mm}$; seeds ( $1-22-3$ in each loculus
2 Petals 5 mm ; style $1-1.5 \mathrm{~mm}$; inflorescence usually not more than 3 cm in fruit
21. kerneri
2 Petals 6-7 mm; style 2-3 mm; inflorescence usually more than 3 cm in fruit
20. alpinum
20. T. alpinum Crantz, Stirp. Austr. 1: 25 (1762). Stem usually $10-15 \mathrm{~cm}$. Petals $6-7 \mathrm{~mm}$. Inflorescence more than 3 cm in fruit. Silicula narrowly triangular-obcordate, with or without a very shallow notch; style $1 \cdot 5-3 \mathrm{~mm}$. Seeds (1-)2-3 in each loculus. $2 n=c$. 54 . Alps. Au Ga He It.
(a) Subsp. alpinum: Branches of stock long, stolon-like. Rosette-leaves ovate to suborbicular, often violet beneath; cauline leaves oblong, obtuse. Style 2 mm. E. \& C. Alps.
(b) Subsp. sylvium (Gaudin) Clapham, Feddes Repert. 70: 4 (1964) (T. sylvium Gaudin): Branches of stock usually quite short; plant caespitose. Rosette-leaves oblong-spathulate; cauline leaves broadly ovate. Style $2-3 \mathrm{~mm}$. C. \& S.W. Alps.
21. T. kerneri Huter in Kerner, Sched. Fl. Austro-Hung. 2: 94 (1882). Stock with elongated branches, plant laxly mat-forming; stems usually $5-10 \mathrm{~cm}$, erect. Rosette-leaves orbicular, abruptly contracted into petiole; cauline ovate, acute; all glaucous. Petals 5 mm . Inflorescence rarely more than 3 cm in fruit. Silicula 6 mm , narrowly obovate; apex truncate or with shallow notch; style $1-1.5 \mathrm{~mm}$. Seeds $1-3$ in each loculus. S.E. Alps, N. \& C. Jugoslavia. Au It Ju.
22. T. avalanum Pančić, Fl. Belgr. 92 (1865). Stock with stoloniferous branches; stems $8-25(-60) \mathrm{cm}$, erect. Rosetteleaves broadly elliptical to suborbicular, long-petiolate; cauline leaves ovate-oblong, obtuse, with obtuse auricles. Sepals 22.5 mm ; petals (3.5-)4-5 mm, white. Inflorescence much elongating in fruit. Silicula $5-7 \mathrm{~mm}$, narrowly obovate to triangularobcordate, emarginate above; style $1-2 \mathrm{~mm}$, exceeding the notch. Seeds $3-8$ in each loculus. $2 n=14$. Carpathians; Balkan peninsula. Al Bu ?It Ju ?Po Rm Rs (W).
T. pindicum Hausskn., Mitt. Thür. Bot. Ver. nov. ser. 3-4: 115 (1893), with a shorter fruiting raceme, fruits $10-11 \mathrm{~mm}$ and style as long as the notch, was described from Greece and may be a variant of this species.
T. cochleariforme DC., Reg. Veg. Syst. Nat. 2: 381 (1821), from near the boundary of Europe in C. Ural (Kyštym region) and possibly not occurring within European Russia, has larger, unequal petals (the outer $5-6.5 \mathrm{~mm}$, the inner $6-7.5 \mathrm{~mm}$ ), the silicula $5-9.5 \mathrm{~mm}$ and the style $1-2.25 \mathrm{~mm}$.
23. T. macranthum N. Busch, Acta Horti Bot. Univ. Jurjev. 6: 142 (1906). Annual $10-40 \mathrm{~cm}$, glabrous, glaucous; stems branched at the base. Basal leaves obovate-elliptical, usually entire, petiolate; cauline ovate-lanceolate, with amplexicaul auricles. Petals 67 mm ; anthers yellow. Silicula $7-10 \mathrm{~mm}$, obovate-oblong or -cuneate, emarginate at apex; style long, exceeding the notch. Seeds 2-6 in each loculus, smooth. Krym. Rs (K). (N.W. Caucasus.)

Sect. Apterygium Ledeb. Silicula narrowly obovate, strongly keeled but not winged, with or without a shallow notch. Style exserted from the notch. Seeds smooth.
24. T. rotundifolium (L.) Gaudin, Fl. Helv. 4: 218 (1829). Stock with usually long (rarely short) stolons. Petals purple. Style usually $1-2 \mathrm{~mm}$. Mountains from E. France to Italy and $N$. Jugoslavia. Au Ga Ge He It Ju.
(a) Subsp. rotundifolium: Basal leaves in a more or less distinct rosette; cauline distant, auricled, the lower opposite; all more or less entire. Inflorescence remaining compact in fruit. Seeds usually $1-3$ in each loculus. $2 n=14$. Throughout the range of the species.

In addition to the typical widespread calcicolous plant, several distinctive endemic variants occur on igneous rocks and siliceous soils in the W. Alps, among them var. limosellifolium Burnat, var. lereschianum Burnat, var. corymbosum (Gay) Gaudin (non $T$. corymbosum Molina), and subsp. cenisium Rouy \& Fouc.
(b) Subsp. cepaeifolium (Wulfen) Rouy \& Fouc., Fl. Fr. 2: 157 (1895). Stolons long. Basal leaves $c .1 \mathrm{~cm}$, not distinctly rosulate; upper cauline leaves numerous, crowded, not or very slightly auricled; all smaller than in subsp. (a), obovate to suborbicular, sinuate-dentate. Inflorescence elongating up to $c .3 \mathrm{~cm}$ in fruit. Style 1-2 mm. Seeds 4-6 in each loculus. On calcareous and metalliferous scree. - S.E. Alps.
25. T. bellidifolium Griseb., Spicil. Fl. Rumel. 2: 505 (1845). Stock with very short branches so that the plant is densely
caespitose. Basal leaves rosulate, oblong-spathulate, dentate; all cauline leaves alternate. Petals dark purple; anthers yellow. Silicula obovate-oblong, truncate. Seeds 2 in each loculus. Alpine pastures. E. \& N.E. Albania, and neighbouring regions of Jugoslavia. Al ?Bu ?Gr Ju.
26. T. nevadense Boiss. \& Reuter, Pugillus 11 (1852). Caespitose perennial with much-branched stock and crowded leafrosettes; stems $5-10 \mathrm{~cm}$. Basal leaves rosulate, $0.5-1.5 \mathrm{~cm}$, petiolate, elliptical to obovate; cauline leaves linear-oblong, acute, amplexicaul with short, rounded auricles, more or less erect; all more or less entire. Petals $6-7 \mathrm{~mm}$, twice as long as the sepals, white. Inflorescence up to 4 cm in fruit. Silicula $7-9 \mathrm{~mm}$, narrowly obovate-oblong with distinct but narrow wing, truncate or very slightly emarginate above; style $1.5-2.5 \mathrm{~mm}$, exserted. Seeds 2-4 in each loculus. Scree and rock-fissures. Spain (Sierra Nevada and Sierra de Guadarrama). Hs.

## 75. Aethionema R.Br. ${ }^{1}$

Glabrous, annual or perennial herbs, with entire, sessile leaves. Inflorescence racemose. Sepals erect, the lateral saccate at base; petals entire, of various colours; the 4 inner stamens with winged and bent filaments, the wing sometimes ending in a tooth above. Silicula flattened and winged, sometimes bilocular and angustiseptate, with 1-4 seeds in each loculus, opening by 2 valves; sometimes unilocular, 1 -seeded and indehiscent.

1 Petals 7 mm , yellow; style 3 mm or more 3. cordatum 1 Petals less than 7 mm , not yellow; style less than 3 mm 2 Silicula entire at apex
3 Leaves opposite; silicula subacute at apex $\quad$ 1. orbiculatum

3 Leaves alternate; silicula truncate at apex
2 Silicula emarginate at apex
4 Silicula 10 mm or more
2. polygaloides

4 Silicula less than 10 mm
5 Lower parts of stems densely covered with elliptical, acute
leaves $3-5 \mathrm{~mm} \quad$ 4. iberideum
5 Lower parts of stem with obtuse leaves more than 5 mm
6. saxatile

1. A. orbiculatum (Boiss.) Hayek, Prodr. Fl. Penins. Balcan. 1: 472 (1925) (Crenularia orbiculata Boiss.). Suffruticose perennial 2-5 cm. Leaves opposite, crowded, ovate-orbicular, thick. Petals white with purple stripes. Silicula 5 mm , ovate, cordate at base, narrowed to the subacute, entire apex, 1 -seeded; style less than 2 mm . Mountain rocks. Greece (Tailyetos; Athos). Gr.
2. A. polygaloides DC., Reg. Veg. Syst. Nat. 2: 562 (1821) (Crenularia polygaloides (DC.) Boiss.). Suffruticose perennial with short stems. Leaves alternate; the lower ovate; the upper oblong-linear. Petals pale purplish. Silicula 5 mm , suborbicular, truncate at apex, 1 -seeded; style less than 2 mm . E. Greece (Poros, Evvoia). Gr.
3. A. cordatum (Desf.) Boiss., Fl. Or. 1: 350 (1867). Suffruticose perennial with erect, simple stems $10-20 \mathrm{~cm}$. Lower leaves opposite, ovate, cordate-amplexicaul, obtuse; the upper alternate, acute. Sepals 4 mm ; petals 7 mm , yellow. Silicula obovate, truncate at apex, 4 -seeded; style 3-5 mm. C. Greece (Oiti). Gr. (S.W. Asia.)
4. A. iberideum (Boiss.) Boiss., Fl. Or. 1: 351 (1867). Suffruticose perennial with erect or ascending branched stems $5-7 \mathrm{~cm}$; lower part of stems densely clothed with leaves and their remains.
[^130]Leaves elliptical, acute; the lower $3-5 \mathrm{~mm}$; the upper $6-8 \mathrm{~mm}$. Sepals 2 mm ; petals 5 mm , white. Silicula 7 mm , ovate-obcordate and emarginate, 4 -seeded; style $0.5-0.7 \mathrm{~mm}$. Mountain rocks. E. Greece (C. Evvoia). Gr. (Asia Minor, Caucasus.)
5. A. arabicum (L.) Andrz. ex O. E. Schulz in Engler, Natürl. Pflanzenfam. ed. 2, 17b: 442 (1936) (A. buxbaumii (Fischer ex Hornem.) DC.). Annual with slender, simple or branched stems $c$. 10 cm . Lower leaves $c .15 \mathrm{~mm}$, ovate, acute; the upper ovate, acute, cordate-amplexicaul at base. Petals less than 4 mm , purplish. Siliculae $10-12 \mathrm{~mm}$, suborbicular, emarginate, with about 6 seeds, very densely crowded, imbricate; style $0 \cdot 5-1 \mathrm{~mm}$, shorter than notch. Dry rocky places. Thrace. Bu Tu. (S.W. Asia.)
6. A. saxatile (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 80 (1812) (incl. A. gracile DC., A. graecum Boiss. \& Spruner, $A$. monospermum R.Br., A. ovalifolium (DC.) Boiss., and A. pyrenaicum Bout.). Annual to perennial up to 30 cm , ascending or erect, simple or branched. Lower leaves more than 5 mm , usually ovate or oblong and obtuse; the upper narrower, often acute. Sepals $1 \cdot 5-3 \mathrm{~mm}$; petals $2-5 \mathrm{~mm}$, white, purplish or lilac. Siliculae $5-9 \mathrm{~mm}$, obovate to suborbicular, emarginate, sometimes a little broader than long, up to 8 -seeded, in lax or rather dense racemes; style $0.3-1.5 \mathrm{~mm}$, usually shorter than but sometimes equalling or exceeding notch. $2 n=48$. S. \& S.C. Europe, mainly in the mountains. Al Bu Cr Cz Ga Ge Gr He Hs Hu It Ju Rm Sa Si .
A. thomasianum Gay, Ann. Sci. Nat. ser. 3, 4: 81 (1845) from N.W. Italy (Valle d'Aosta), a small plant with large, closely imbricate, erect, membranous-winged siliculae in very dense racemes, and with large, quite smooth (not tuberculate) seeds, may perhaps merit subspecific status. Almost identical plants occur in the Atlas Mountains. Many other local variants have been described as species, or variously combined as subspecies; they differ from one another in leaf-shape, petal-length, the erose or entire margin of the wings of the silicula, and in style-length. None of these variants is discrete enough to merit specific status, and their distributions do not allow of a subspecific treatment.

## 76. Teesdaliopsis (Willk.) Gand. ${ }^{2}$

Inflorescence corymbose-racemose; flowers zygomorphic; outer petals large, white, radiating; inner petals small. Fruit an angustiseptate silicula, scarcely winged at the apex, emarginate. Seed single, pendent.

1. T. conferta (Lag.) Rothm., Feddes Repert. 49: 178 (1940) (Iberis conferta Lag.). Caespitose, suffruticose, glabrous perennial. Leaves in crowded rosettes, lanceolate, acute, entire. Flowering branches $5-15 \mathrm{~cm}$, leafless, lateral; non-flowering branches terminal. Silicula ellipsoid-obovoid; valves with a thick median vein; style very short; stigma bilobed. Mountains of N.W. Spain and N. Portugal. Hs Lu.

## 77. Iberis L. ${ }^{3}$

Annual or perennial herbs, rarely dwarf shrubs; glabrous or with unbranched hairs. Inflorescence corymbose or racemose, often elongating in fruit. Sepals not saccate; petals white, pink or purple, the 2 outer much larger than the 2 inner; median nectaries absent. Fruit an angustiseptate silicula; valves keeled and usually winged at the apex; style long; stigma capitate. Seeds solitary in each loculus, often winged.

Usually found in calcareous habitats.

The following key refers to well-developed plants only. The perennials sometimes flower in the first year and may then appear to be annual.

1 Silicula much wider than long; flowering in winter

1. semperflorens

1 Silicula longer than wide or suborbicular; flowering in spring and summer
2 Perennials with woody or herbaceous stems, usually with nonflowering rosettes
3 Siliculae in racemes
4 Leaves $2 \cdot 5-5 \mathrm{~mm}$ wide, oblong-spathulate, flat, obtuse; flowering stems lateral 2. sempervirens
4 Leaves $1-2 \mathrm{~mm}$ wide, linear, semi-cylindrical on the nonflowering shoots, $\pm$ flat on the flowering stems, acute, mucronulate; flowering stems terminal
3. saxatilis

3 Siliculae in corymbs
5 Plants $10-40 \mathrm{~cm}$, usually with erect stems (low altitudes, up to 800 m )
6 Cauline leaves linear to narrowly linear-spathulate, entire (cf. also 14. ciliata)
4. linifolia

6 Cauline leaves $\pm$ broadly spathulate, usually with a few teeth at apex
7 Corymbs $20-25 \mathrm{~mm}$ in diameter; outer petals $8-10 \mathrm{~mm}$; cauline leaves up to 6 mm wide 8. procumbens
7 Corymbs up to $40-50 \mathrm{~mm}$ in diameter; outer petals $15-$ 18 mm ; cauline leaves up to 12 mm wide 9. gibraltarica
5 Dwarf plants up to 15 cm , usually diffuse with ascending stems (from high mountains, $800-2800 \mathrm{~m}$ )
8 Silicula $6-8 \mathrm{~mm}$, rectangular-elliptical, with wide, erect, acute lobes
5. pruitii

8 Silicula $3-5 \mathrm{~mm}$, broadly ovate
9 Silicula with short, convergent, $\pm$ obtuse lobes 6. spathulata
9 Silicula with acute, very divergent lobes 7. aurosica
2 Annuals, without non-flowering rosettes
10 Siliculae in racemes
11 Leaves all pinnatifid to dentate (rarely entire), narrowly cuneate; silicula $3-5 \mathrm{~mm}$ 10. amara
11 Upper leaves entire, linear-lanceolate to linear, acuminate, silicula $6-9 \mathrm{~mm}$
11. intermedia

10 Siliculae in corymbs
12 Silicula with irregularly serrulate lobes
15. fontqueri

12 Silicula with entire lobes
13 Leaves entire or shallowly toothed
14 Leaves linear-spathulate to obovate-spathulate
15 Lower cauline leaves at least 3 mm wide, obovateoblong to oblong-spathulate, often toothed 5. pruitii 15 Lower cauline leaves not more than 3 mm wide, linear-spathulate
14. ciliata

14 Leaves narrowly linear to linear-lanceolate
16 Silicula $3-5 \mathrm{~mm}$, with small acute divergent lobes forming a shallow notch; leaves narrowly linear
12. stricta

16 Silicula $7-10 \mathrm{~mm}$, with erect acuminate lobes forming an acute deep notch; leaves linear-lanceolate
13. umbellata

13 Leaves all, or at least the lower ones, pectinate-toothed, pinnatifid or pinnatisect with linear segments
17 Stems erect, branched above; flowering-branches long, straight, leafless; corymbs convex
18 Leaves pinnatifid or pinnatisect with linear segments; silicula glabrous; plant rugose-papillose or scarcely pubescent
16. pinnata

18 Leaves pectinate-toothed; silicula papillose-verrucose; plant hispid
17. crenata

17 Stems diffuse and branched from the base; flowering branches flexuous and leafy, or leafless for a short distance only; corymbs flat
19 Lower leaves pinnatifid, with 1-2 pairs of segments; outer petals scarcely radiate
18. odorata

19 Lower leaves regularly pectinate-pinnatifid, with 3-4 pairs of segments; outer petals distinctly radiate
19. sampaiana

1. I. semperflorens L., Sp. Pl. 648 (1753). Small, evergreen, procumbent, diffuse, glabrous shrub up to 80 cm , branched above, with herbaceous flowering stems. Leaves thick, entire, flat; the lower $30-70 \times 7-18 \mathrm{~mm}$, broadly spathulate; the upper oblong-spathulate and much smaller. Inflorescence corymbose, but elongating in fruit. Petals white. Silicula $5-8 \times 10-14 \mathrm{~mm}$, ovate-rhombic, very narrowly winged; notch almost absent. $2 n=22$ (44). Rock-crevices on maritime cliffs. Sicilia and W. coast of Italy; cultivated elsewhere in gardens and rarely escaping. It Si [ Ga Hs Rm ].

## The only winter-flowering species.

2. I. sempervirens L., Sp. Pl. 648 (1753). Small, evergreen, procumbent, diffuse, glabrous shrub with herbaceous, flexuous, lateral shoots $10-25 \mathrm{~cm}$. Leaves $2 \cdot 5-5 \mathrm{~mm}$ wide, oblong-spathulate, obtuse, entire, thick, flat. Inflorescence racemose, elongating in fruit. Petals white. Silicula $6-7 \mathrm{~mm}$, orbicular-ovate, broadly winged from the base; lobes subobtuse; notch acute. Rockcrevices on high mountains. Mediterranean region; cultivated for ornament elsewhere and occasionally naturalized. Al Cr Ga Gr Hs It Ju [ Br Rm ].
3. I. saxatilis L., Cent. Pl. 2: 23 (1756). Small, evergreen, procumbent, diffuse shrub with straight, terminal flowering branches. Leaves up to 20 mm , semi-cylindrical on the non-flowering shoots but flat on the flowering stems, entire, linear, rather acute, mucronulate, at first ciliate but soon glabrous. Inflorescence corymbose in flower but elongating in fruit. Petals white. Silicula $5-8 \times 4.5-6 \mathrm{~mm}$, obovate, broadly winged from the base; lobes rounded. - S. Europe. Ga He Hs It Ju Rm Rs (K).
(a) Subsp. saxatilis: Glabrous, up to 15 cm , with reddish twigs. Leaves up to 1.5 mm wide. Silicula with a shallow notch. Rockcrevices. Throughout the range of the species.
(b) Subsp. cinerea (Poiret) P. W. Ball \& Heywood, Feddes Repert. 64: 62 (1961) (I. cinerea Poiret, I. subvelutina DC., I. latealata Porta \& Rigo): Greyish-green, velvety, small shrub up to 40 cm high. Leaves up to 2 mm wide. Notch acute. Gypsaceous hills. C. \& S. Spain.
4. I. linifolia Loefl., Iter Hisp. 78 (1758). Laxly caespitose perennial with a woody stock bearing numerous, erect, herbaceous, puberulent stems $15-30 \mathrm{~cm}$. Leaves up to $30 \times 2 \mathrm{~mm}$, rather fleshy, usually ciliolate at the base, the lower ones oblongcuneate, with a few teeth near the apex, the cauline ones linear to narrowly linear-spathulate, entire. Inflorescence corymbose. Silicula $4-6 \mathrm{~mm}$, orbicular-obovate, broadly winged from the base; lobes triangular, subacute; notch acute or obtuse. W. \& C. Iberian peninsula. Hs Lu. (N. Africa.)
(a) Subsp. linifolia (I. contracta Pers., I. reynevalii Boiss. \& Reuter): Petals deep purple. Dry calcareous places. - C. Spain and E. Portugal.
(b) Subsp. welwitschii (Boiss.) Franco \& P. Silva, Ind. Sem. Stat. Agron. Nat. Lusit. 1963: 5 (1963) (I. welwitschii Boiss.): Petals white or pink. Sandy acid soils near the sea. - S.W. Spain, W. \& S. Portugal.
5. I. pruitii Tineo, Pl. Rar. Sic. Pug. 1:11 (1817) (incl. I. carnosa Waldst. \& Kit., non Willd., I. lagascana DC., I. tenoreana DC., I. integerrima Moris, I. jordani Boiss., I. candolleana Jordan, I. spruneri Jordan, I. petraea Jordan, I. epirota Halácsy and I. thracica Stefanov). Low, caespitose, procumbent-ascending perennial or annual 3-15 cm. Leaves rather fleshy, entire or with a few teeth near the apex, obtuse, the lower obovate-spathulate, the upper narrower. Inflorescence corymbose, rather dense in fruit. Petals
white to lilac. Silicula $6-8 \mathrm{~mm}$, rectangular-elliptical, broadly winged; lobes triangular-acute, erect; notch deep, acute. $2 n=22$. Rock-crevices on high mountains. Mediterranean region. Al Bu Ga Gr Hs It Ju Sa Si.

Extremely variable in habit and duration. Many variants have received specific names and some appear to be of restricted distribution.
I. bernardiana Gren. \& Godron, Fl. Fr. 1: 138 (1847), from the Pyrenees is of uncertain affinity and may be related to 5 or 6 . It is annual or biennial, with linear-oblong, crenate or entire leaves, violet petals and broadly ovate, hispid siliculae contracted at the apex and with narrow, erect, acute lobes.
6. I. spathulata J. P. Bergeret, Phytonomat. 3: 3 (1784) (I. nana All., I. carnosa Willd.). Small, glabrous or more or less pubescent perennial with 1 or more erect or ascending, simple stems 310 cm , leafy to the apex. Leaves rather fleshy, entire to sub-lobulate-dentate, obtuse, the lower broadly spathulate, the upper obovate-spathulate. Inflorescence a short, dense corymb. Petals purplish to white. Silicula $4-5 \times 5-5.5 \mathrm{~mm}$, broadly ovate, narrowly winged; lobes short, subobtuse, convergent; notch very acute. Rock-crevices and gravelly places on high mountains (15002800 m). Pyrenees; Maritime Alps; Appennini Ligure. Ga Hs It.
(a) Subsp. spathulata: Stems, leaves and pedicels more or less pubescent; leaves entire or with 1 or 2 teeth near the apex. Pyrenees.
(b) Subsp. nana (All.) Heywood, Feddes Repert. 69: 61 (1964) (I. nana All.): Stems, leaves and pedicels glabrous; much of leafmargin distinctly and obtusely denticulate to sublobulate-dentate. Maritime Alps; Appennini Ligure.
I. bubanii Deville, Bull. Soc. Bot. Fr. 6: 69 (1859), from rockcrevices in the French Pyrenees, is rather like 6 but up to 18 cm , more robust, erect, with leaves all oblong-spathulate, petals twice as long, pink, and silicula $3-4 \times 4 \mathrm{~mm}$.
7. I. aurosica Chaix in Vill., Hist. Pl. Dauph. 1: 349 (1786). Small perennial with stems $4-15 \mathrm{~cm}$, leafless above. Leaves rather fleshy; the lower oblong-spathulate, entire or with 1-2 teeth on either side near the apex; the upper entire. Inflorescence a short dense corymb, even in fruit. Silicula $4-5 \mathrm{~mm}$, broadly ovate, broadly winged above; lobes acute, horned, very divergent, much shorter than the style; notch shallow. Gravelly places on mountains (800-2600 m). W. Alps; N. Spain. Ga Hs.
(a) Subsp. aurosica: Subglabrous; upper leaves linear-spathulate, acute, glabrous; petals purple-liac. - W. Alps.
(b) Subsp. cantabrica Franco \& P. Silva, Feddes Repert. 68 : 195 (1963): Sparsely hirsute; upper leaves oblong-spathulate, obtuse, strongly ciliate; petals white. - N. Spain (Vizcaya).
8. I. procumbens Lange, Ind. Sem. Horto. Haun. 1861: 29 (1861). Bushy puberulent perennial, with a woody stock from which arise both vegetative and flowering flexuous stems $10-$ 30 cm . Leaves up to $25 \times 6 \mathrm{~mm}$, broadly spathulate, fleshy, entire or with $1-2$ pairs of teeth near the apex, subobtuse, hispid or glabrous above. Inflorescence corymbose, flat in flower, contracted in fruit. Petals lilac or rarely white, the outer $8-10 \mathrm{~mm}$. Silicula ovate, broadly winged from the base; lobes triangular, acute or obtuse; notch acute. Portugal and N.W. Spain. Hs Lu.
(a) Subsp. procumbens: Usually pulvinate, flowering profusely; corymbs with $35-40$ flowers. Silicula $6-7.5 \mathrm{~mm}$. Sea-shores. Throughout the range of the species.
(b) Subsp. microcarpa Franco \& P. Silva, Feddes Repert. 68: 195 (1963): Lax, with fewer stems; corymbs with 20-25 flowers. Silicula 4-6mm. Hills near the sea. W. Portugal (from Cabo Mondego to Serra da Arrábida).
9. I. gibraltarica L. Sp. Pl. 649 (1753). Evergreen, densely caespitose perennial with a woody stock from which arise leafrosettes and numerous ascending flowering stems $15-30 \mathrm{~cm}$. Leaves fleshy, entire or with 1-4 teeth on either side near the apex, subobtuse; the lower up to $25 \times 12 \mathrm{~mm}$, broadly spathulate; the upper smaller. Inflorescence $40-50 \mathrm{~mm}$ in diameter, corymbose, flat in flower but contracted in fruit. Petals reddish-lilac to white, the outer $15-18 \mathrm{~mm}$ long. Silicula $c .8 \mathrm{~mm}$, ovate, broadly winged from the base; lobes triangular, acute; notch deep, acute. Rock-crevices in shady and cool places. Gibraltar. Hs. (Morocco.)

Cultivated for ornament.
10. I. amara L., Sp. Pl. 649 (1753). Erect, leafy annual 10 40 cm , corymbosely branched above, more or less hairy below. Leaves spathulate, distantly pinnatifid or toothed, sometimes entire, more or less ciliate. Inflorescence corymbose, elongating in fruit. Petals white or purplish. Silicula 3-5 mm, suborbicular; lobes triangular, erect or more or less divergent; notch acute or shallow. Cornfields and dry hillsides, mainly on calcareous or dolomitic soils. Mainly W. Europe. Be Br Ga Ge He Ho Hs It [ Au ? $\mathrm{Cz} \mathrm{Hu} \mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W}, \mathrm{K}, \mathrm{E)]}$.

A variable species of which a number of cultivars are used for ornament (e.g. I. coronaria hort.). Some of them probably arose through hybridization with 13. At least two subspecies can be recognized.
(a) Subsp. amara: Lobes of the silicula erect, forming a deep, narrow notch. Throughout the range of the species.
(b) Subsp. forestieri (Jordan) Heywood, Feddes Repert. 69: 61 (1964) (I. forestieri Jordan): Lobes of the silicula more or less divergent, forming a shallow, broad notch. Pyrenees; E.C. Spain.
11. I. intermedia Guersent, Bull. Soc. Philom. Paris 3: 269 [169] (1811). Erect, glabrous annual up to 80 cm , branched above. Leaves $15-25(-50) \times 3-4 \mathrm{~mm}$, linear-lanceolate to linear, acuminate, the basal somewhat toothed, the cauline entire. Inflorescence shortly racemose, more or less dense, elongating in fruit. Petals white to purplish, the outer usually strongly radiate. Silicula $5-9 \mathrm{~mm}$, ovate, more or less winged from the base; lobes acuminate, divergent; notch shallow. Bushy and rocky places and calcareous slopes. From S. Germany to N.E. Spain and W. Jugoslavia. Ga Ge Hs It Ju [Be].

## 1 Silicula c. 5 mm

(c) subsp. prostii

1 Silicula 6 mm or more
2 Silicula winged from the base; lobes long (a) subsp. intermedia 2 Silicula scarcely winged at the base; lobes short
(b) subsp. timeroyi
(a) Subsp. intermedia: Throughout the range of the species.
(b) Subsp. timeroyi (Jordan) Rouy \& Fouc., Fl. Fr. 2: 133 (1895): France.
(c) Subsp. prostii (Soyer-Willemet ex Godron) Rouy \& Fouc., op. cit. 134 (1895): France, Spain.
12. I. stricta Jordan, Diagn. 278 (1864). Erect, glabrous annual $30-60 \mathrm{~cm}$; stems slender, branched above. Leaves linear, the cauline narrower, mucronate. Inflorescence corymbose even in fruit, small, dense. Petals rather small, pink to lilac. Silicula 3-5 mm, suborbicular; notch shallow. Dry calcareous soils.

- S.E. France and Liguria. Ga It.
(a) Subsp. stricta: Basal leaves shallowly toothed. Silicula ovate, winged from about the middle, the lobes acuminate, half as long as the style. France (Hautes-Alpes).
(b) Subsp. leptophylla (Jordan) Franco \& P. Silva, Feddes Repert. 68: 195 (1963) (I. linifolia L. pro parte, non Loefl.): Basal leaves almost entire. Silicula suborbicular, winged only above the middle; lobes acute, much shorter than the style. Throughout the range of the species.

13. I. umbellata L., Sp. Pl. 649 (1753). Erect, glabrous annual $20-70 \mathrm{~cm}$, corymbosely branched above. Leaves linear-lanceolate, acuminate, entire or almost so. Inflorescence dense, umbellate even in fruit. Petals pink to purplish. Silicula up to 10 mm , ovate, broadly winged from the base; lobes triangular, acuminate, erect; notch deep, acute. Bushy and rocky places, on calcareous and serpentine soils. - Mediterranean region. Al Ga Gr It Ju [ $\mathrm{Au} \mathrm{Az} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{Lu} \mathrm{Po} \mathrm{Rm]}$.

Some cultivars and hybrids are cultivated for ornament.
I. violleti Soyer-Willemet ex Godron, Fl. Lorr. 1: 72 (1843) is probably a subspecies or variety with a smaller silicula.
14. I. ciliata All., Auct. Fl. Pedem. 15 (1789). Erect annual or short-lived perennial $20-30 \mathrm{~cm}$, often branched above. Leaves linear-spathulate, entire. Inflorescence dense, umbellate even in fruit. Petals white to pale purple. Silicula up to 6 mm , rectangularelliptical, broadly winged from the base; lobes triangular, acute or obtuse, erect; notch deep, acute. - S.E. France; ?N.W. Italy; C. Spain. Hs Ga ?It.
I. simplex DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 597 (1815) (I. taurica DC.) from Krym and S. Russia (near Taganrog) it appears to differ only in its more spathulate leaves.
15. I. fontqueri Pau, Mem. Mus. Ci. Nat. Barcelona (Bot.) 1 (1): 22 (1922). Annual, simple or branched from the base; stems up to 15 cm , erecto-patent, more or less branched, slender, very shortly puberulent. Leaves spathulate to linear-spathulate, with 1-2 pairs of teeth near the apex, or subentire, the lower obtuse, attenuate into a rather long petiole, caducous. Inflorescence a short dense corymb. Silicula 5 mm , broadly orbicular, truncate at base, winged from the base; lobes subacute, erect, irregularly serrulate (at least in the upper part); notch shallow; style much exserted. - Mountains. S. Spain (Málaga prov.). Hs.
16. I. pinnata L., Cent. Pl. 1: 18 (1755). Erect annual $10-$ 30 cm , rugose-papillose, scarcely pubescent, corymbose above; branches long, straight, leafless. Leaves obovate-oblong, pinnatifid or pinnatisect, with 1-3 pairs of linear segments. Inflorescence a short, usually dense, convex corymb, fragrant. Petals white to lilac. Silicula $5-6 \mathrm{~mm}$, almost square, glabrous; lobes entire, obtuse (or acute, var. rollii (Ten.) Fiori) erect; notch shallow. Cereal fields. S. Europe. Bl Ga Gr He Hs It Ju Rs (K) [ $\mathrm{Au} \mathrm{Be} \mathrm{Cz} \mathrm{Ge} \mathrm{Rm]}. \mathrm{(Asia} \mathrm{Minor)}$.
17. I. crenata Lam., Encycl. Méth. Bot. 3: 223 (1789) (I. pectinata Boiss., I. bourgaei Boiss.). Erect, hispid annual; stems 15-30 cm, one or several, corymbosely branched above; branches long, straight, leafless. Leaves all, or at least the lower, linearspathulate, pectinate-toothed, the upper narrower, entire. Inflorescence a many-flowered, dense, convex corymb. Petals white. Silicula $c .5 \mathrm{~mm}$, almost square, winged only in the upper part, papillose-verrucose; lobes broad, triangular, acute; notch deep,
acute. Dry calcareous or gypsaceous soils.
C. \& S. Spain. Hs.
18. I. odorata L., Sp. Pl. 649 (1753) (I. acutiloba Bertol.). Diffuse, very shortly hispid annual; stems $15-30 \mathrm{~cm}$, numerous, arising from the base, flexuous, leafy. Leaves linear-spathulate, pinnatifid with 1-2 pairs of segments near the apex. Inflorescence a flat, dense corymb, shortly stalked, and surrounded by the upper leaves. Petals white, the outer ones scarcely radiate. Silicula ovate, glabrous; lobes erect, acute, entire; notch acute. Limestone mountain slopes. Greece, Turkey and Kriti. Cr Gr Tu [Be]. (N. Africa, S.W. Asia.)
19. I. sampaiana Franco \& P. Silva, Feddes Repert. 68: 195 (1963). Procumbent, hispid annual; stems up to 20 cm , numerous. Leaves spathulate (except sometimes the upper), regularly pectinate-pinnatifid, with 3-4 pairs of oblong, subobtuse segments. Inflorescence a flat corymb, not very dense in fruit. Petals white, the outer ones strongly radiate. Silicula $5 \times 4 \mathrm{~mm}$, ovate-rectangular, glabrous or very rarely papillose-verrucose; lobes large, acute, entire, erect; notch obtuse. Calcareous soils. Coast of S.W. Portugal. Lu.

## 78. Biscutella L. ${ }^{1}$

Herbs or small shrubs with entire to pinnatifid leaves. Petals usually clawed, yellow. Fruit a strongly compressed didymous silicula, indehiscent but with the 1 -seeded loculi eventually breaking away from the axis; valves glabrous or with simple or clavate hairs; style long. Seeds unwinged.

The taxonomy of this genus is made difficult by the relative uniformity of most of the floral and fruiting characters and by the unreliability of those that do vary. Reliance has to be placed on vegetative features, but there is inadequate knowledge about their range of plasticity. The two available monographs differ widely in their treatment, the one lumping, the other splitting. A narrow species concept is adopted here, largely to force attention on the variation in the genus, so that a future synthetic treatment may be possible. Most of the species recognized here have a characteristic facies and a well-circumscribed distribution. Intermediates between some of them do occur but to treat them as subspecies would make the classification unwieldy and such treatment has been deferred until further information becomes available.

Literature: E. Malinowski, Bull. Int. Acad. Sci. Cracovie 1910: 111-39 (1910). B. Machatschki-Laurich, Bot. Arch. (Königsberg) 13: 1-115 (1926).
1 Petals up to 15 mm , conspicuous, long-clawed, patent; silicula with a diaphanous margin
2 Silicula not emarginate at apex, the wings excurrent with the style 40. auriculata
2 Silicula emarginate at apex, the wings not excurrent with the style 41. cichoriifolia
1 Petals not more than 8 mm , small or medium, short-clawed, erect; silicula with a narrow membranous margin
3 Petals abruptly contracted into a claw, auriculate-dilated above the base
4 Leaves glabrous to hirsute, not tomentose
5 Basal leaves ovate, slightly longer than wide
(4-6). variegata group
5 Basal leaves oblong, longer than wide
6 Leaves entire or slightly sinuate-dentate

1. laevigata

6 Leaves deeply toothed, lobed or pinnatifid
7 Dwarf plants ( $10-30 \mathrm{~cm}$ ); leaves $1-5 \mathrm{~cm}$ 8 Leaves less than 1 cm wide, $1-3 \mathrm{~cm}$ long 9 Silicula up to 6 mm wide; basal leaves narrowly linear to oblong
12. glacialis

9 Silicula more than 7 mm wide; basal leaves obovatelanceolate
13. brevifolia

8 Leaves more than 1 cm wide, usually 4 cm long or more 10 Silicula $5 \times 8-8.5 \mathrm{~mm}$
11 Basal leaves with 1-2 teeth on either side
14. cuneata

11 Basal leaves with 3-4 teeth on either side
15. rotgesii

10 Silicula 6-7 $\times 9-11 \mathrm{~mm}$
12 Basal leaves with few, weak lobes
31. intermedia

12 Basal leaves deeply lobed or toothed
13 Basal leaves subpinnatifid
21. brevicaulis

13 Basal leaves with 1-3 large teeth
19. divionensis

7 Medium to large plants ( $(20-) 30-60 \mathrm{~cm}$ or more); leaves $4-14 \mathrm{~cm}$
14 Basal leaves $0.2-0.5 \mathrm{~cm}$ wide, excluding teeth
33. valentina

14 Basal leaves more than 0.5 cm wide
15 Basal leaves pinnatifid
16 Petals 3 mm ; silicula $3.5-4 \times 7 \mathrm{~mm}$ 17. sclerocarpa
16 Petals at least 4 mm ; silicula $5-7 \times 8-13 \mathrm{~mm}$
17 Leaf-lobes more than 4 on each side, with some small lobes intermixed with the large ones 18 Leaves setose
29. mediterranea

18 Leaves pubescent but not setose
(22-27). coronopifolia group
17 Leaf-lobes 4 or fewer on each side, without smaller lobes intermixed
19 Lobes of basal leaves acute
20 Leaf-lobes recurved; cauline leaves numerous
(22-27). coronopifolia group
20 Leaf-lobes not recurved; cauline leaves few
30. nicaeensis

19 Lobes of basal leaves obtuse
21 Leaf-lobes broadly triangular, undulate
32. guillonii

21 Lobes narrower, not undulate
(22-27). coronopifolia group
15 Basal leaves with large and usually deep teeth, or sinuate-dentate, but not pinnatifid
22 Cauline leaves absent or all minute 2. scaposa
22 Cauline leaves well developed, decreasing in size towards apex of stem
23 Silicula 4-5 $\times 7-9 \mathrm{~mm}$
24 Stems densely leafy; flowers in dense corymbs
18. arvernensis

24 Stems sparsely leafy; flowers in long racemes
23 Silicula 6-12 $\times 9-14 \mathrm{~mm}$
25 Leaves deeply and regularly toothed 28. Iusitanica
25 Leaves sinuate-dentate, shallowly toothed or subentire
26 Cauline leaves wide, dilated at base 20. controversa
26 Cauline leaves not dilated
27 Leaves with 2 glands at base

1. laevigata

27 Leaves without glands at base
28 Basal leaves polymorphic, spathulate to lanceolate, sinuate or entire
7. gredensis

28 Basal leaves all $\pm$ spathulate, shallowly dentate 29 Stems $20-40 \mathrm{~cm}$, not flexuous 8. neustriaca 29 Stems 40-65 cm, flexuous
3. flexuosa

4 Leaves tomentose
30 Silicula 8-11×12-19 mm
10. vincentina

30 Silicula 3-6 $\times 7-10 \mathrm{~mm}$
31 Inflorescence $10-15 \mathrm{~cm}$, compound-paniculate 9. frutescens
31 Inflorescence less than 8 cm , compact
11. sempervirens

3 Petals gradually attenuate at base, not auriculate
32 Staminal filaments with a wide membranous wing
34. microcarpa

32 Staminal filaments unwinged
33 Leaves lyrate
34 Annual; silicula $3.5-5 \times 7-10 \mathrm{~mm}$
34 Perennial; silicula $6-7 \times 11-13 \mathrm{~mm}$
37. lyrata

33 Leaves toothed or entire, not lyrate
35 Infructescence lax; pedicels patent
39. radicata

35 Infructescence dense; pedicels erecto-patent
36 Silicula $4 \times 6-8 \mathrm{~mm}$
36 Silicula $4.5-7 \times 9 \cdot 5-12 \mathrm{~mm}$
36. eriocarpa
38. didyma

Sect. Biscutella (Sect. Thlaspidium DC.). Lateral sepals not saccate or spurred. Petals small or medium, short-clawed, or gradually attenuate at base, erect. Silicula with a narrow membranous margin.

Ser. Laevigatae Malinov. Perennial. Petals abruptly contracted into claw, auriculate-dilated above claw. All nectaries extrastaminal.

1. B. laevigata L., Mantissa Alt. 255 (1771). Stems $10-50$ $(-70) \mathrm{cm}$, simple or branched. Basal leaves $1 \cdot 5-13 \times 0 \cdot 3-2 \mathrm{~cm}$, forming an obvious rosette or not, linear- to ovate-lanceolate, ovate or rarely spathulate, entire, sinuate-dentate or denticulate, glabrous or hairy; cauline leaves 2-10, resembling the basal leaves or small, linear, entire. Flowers in lax or dense racemes. Petals 4-8 mm , clawed. Silicula 4-8( -15 ) $\times 8-14(-30) \mathrm{mm}$, glabrous or hairy; style 2-6 mm. Mainly in C. \& S. Europe, frequently on mountains. $\mathrm{Au} \mathrm{Be} \mathrm{Bu} \mathrm{Cr} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.

One of the most polymorphic species in the European flora. Studies by Manton (Zeitschr. Indukt. Abstamm. Vererbungslehre 47: 41-57 (1933); and Ann. Bot. nov. ser. 1: 439-62(1937)) have shown that the group contains a series of both diploid and tetraploid populations. The diploids with $2 n=18$ are known from few localities and found at low altitudes from France (? and Portugal and Spain) to the Balkan peninsula; the tetraploids, however, with $2 n=36$, are found mainly in the Alps and in the mountains of S. \& S.E. Europe. Morphological differentiation of the populations is weak, and they are best regarded as subspecies of a single species. Union of all the diploids into one species and all the tetraploids into another as suggested by Manton has not proved feasible.

The more distinct units are keyed below. Many others remain to be characterized, especially in the western part of the range. This treatment is a modification of that given by MachatschkiLaurich and is similar to the one adopted by Markgraf in Hegi, Ill. Fl. Mitteleur. ed. 2, 4 (1): 388-94 (1963).
1 Plant completely glabrous, shining; basal leaves up to $8(-13)$ $\times 0.8-1.5 \mathrm{~cm}$, petiolate, forming an obvious rosette; petals 7 mm
(m) subsp. lucida

1 At least the leaves hairy; petals usually less than 7 mm
2 Leaves hispid
3 Siliqua up to $15 \times 30 \mathrm{~mm}$; basal leaves rigid (I) subsp. montenegrina
3 Siliqua much smaller; basal leaves not rigid
4 Basal leaves up to 4 cm , ovate to cuneate-lanceolate, narrowed towards the base but not petiolate, forming a rosette which is $\pm$ appressed to the ground
5 Basal leaves ovate or spathulate, rounded; siliqua 6-7× $12-13 \mathrm{~mm}$ (k) subsp. illyri
5 Basal leaves cuneate-lanceolate or obovate, apiculate; siliqua $5(-8) \times 10(-12) \mathrm{mm} \quad$ (b) subsp. austria
4 Basal leaves lanceolate or linear-lanceolate, petiolate, erect
6 Stems pubescent or glabrous at base; cauline leaves 3-6, linear
(i) subsp. tirolensis

6 Stems hispid at base; cauline leaves few, minute
7 Basal leaves up to $13 \times 2 \mathrm{~cm}$, lanceolate, sinuate-dentate; stems branched
(a) subsp. laevigata

7 Basal leaves 3-5 c. 0.3 cm , linear-lanceolate, entire; stems unbranched
(j) subsp. angustifolia

2 Leaves finely pubescent
8 Leaves deeply sinuate-dentate
9 Basal leaves up to $8 \times 1.2 \mathrm{~cm}$, lanceolate (g) subsp. varia
9 Basal leaves 3-4×0.5-0.7(-1) cm , linear to oblong
8 Leaves dentate or subentire
(h) subsp. subaphylla

10 Basal leaves with acute teeth; cauline leaves few, minute
(c) subsp. kerneri

10 Basal leaves entire or somewhat denticulate; cauline leaves numerous
11 Basal leaves up to $8 \times 1.0-1.5 \mathrm{~cm}$, entire
(f) subsp. guestphalica

11 Basal leaves up to $5 \times 0.8(-1) \mathrm{cm}$, dentate
12 Basal leaves lanceolate, with acute teeth, $\pm$ long-petiolate; stems branched
(d) subsp. gracilis

12 Basal leaves oblong, with obtuse teeth, shortly petiolate; stems unbranched
(e) subsp. tenuifolia
(a) Subsp. laevigata (subsp. longifolia (Vill.) Rouy \& Fouc.): $2 n=36$. C. \& S. Europe. Au $\mathrm{Bu} ? \mathrm{Cr} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju}$ Lu Rm Rs (W).
(b) Subsp. austriaca (Jordan) Mach.-Laur., Bot. Arch. (Königsberg) 13: 67 (1926): $2 n=18$. N.E. Alps, S. \& E. Carpathians, N. Hungary. Au ?He Hu Rm.
(c) Subsp. kerneri Mach.-Laur., op. cit. 68 (1926), excl. descr.: $2 n=18$. E. Austria, S. Czechoslovakia, N. Hungary, S.W. Poland. $\mathrm{Au} \mathrm{Cz} \mathrm{Hu} \mathrm{Po}$.
(d) Subsp. gracilis Mach.-Laur., op. cit. 69 (1926): $2 n=18 . W$. Czechoslovakia, S.W. Poland, S.E. Germany (Sachsen), Austria, N.W. Jugoslavia. Au Cz Ge He Ju Po.
(e) Subsp. tenuifolia (Bluff \& Fingerh.) Mach.-Laur., op. cit. 69 (1926): $2 n=18$. C. Germany. ?Au Ge.
(f) Subsp. guestphalica Mach.-Laur., op. cit. 70 (1926): $2 n=18$. N. Germany (Wesergebirge). ?Au Ge ?Cz.
(g) Subsp. varia (Dumort.) Rouy \& Fouc., Fl. Fr. 2: 110 (1895) (B. varia Dumort., B. alsatica Jordan): $2 n=18$. W. Germany, N.E. France, S.E. Belgium. Be Ga Ge.
(h) Subsp. subaphylla Mach.-Laur., Bot. Arch. (Königsberg) 13: 70 (1926): $2 n=18$. E. France, S. \& W. Germany, Switzerland. $\mathrm{Ga} \mathrm{Ge} \mathrm{He}$.
(i) Subsp. tirolensis (Mach.-Laur.) Heywood, Feddes Repert. 69: 147 (1964) (B. laevigata var. tirolensis Mach.-Laur.): E. Alps. Au It.
(j) Subsp. angustifolia (Mach.-Laur.) Heywood, Feddes Repert. 69: 147 (1964): E. Alps, Hungary, Jugoslavia. Au Hu It Ju.
(k) Subsp. illyrica Mach.-Laur., Bot. Archiv 13: 67 (1926): Jugoslavia and isolated localities in Czechoslovakia and Hungary. Cz Hu Ju .
(1) Subsp. montenegrina Rohlena, Sitz.-mer. Böhm. Ges. Wiss. 1903: 17 (1903): Crna Gora. Ju.
(m) Subsp. lucida (DC.) Mach.-Laur., Bot. Arch. (Königsberg) 13: 66 (1926): $2 n=36$. E. Alps, Appennini, N.W. Jugoslavia. Au Ge He It Ju.
2. B. scaposa Sennen ex Mach.-Laur., Bot. Arch. (Königsberg) 13: 93 (1926). Stems $40-60 \mathrm{~cm}$, simple or branched. Basal leaves $5-10 \times 1-2 \mathrm{~cm}$, lanceolate, obovate-lanceolate or subspathulate, sinuate-dentate, with 3-5 acute or obtuse teeth on each side, more or less densely setose; cauline leaves few. Petals 4 mm . Silicula $4-8 \times 8-11 \mathrm{~mm}$. - C. \& N.W. Spain; E. Pyrenees. Ga Hs.
3. B. flexuosa Jordan, Diagn. 1: 300 (1864). Stems $40-65 \mathrm{~cm}$, simple or branched, robust. Basal leaves $6-11 \times 1 \cdot 5-2 \mathrm{~cm}$, subspathulate or oblong-obovate, remotely sinuate-dentate, petiolate, setose; apex somewhat obtuse; cauline leaves few, semi-amplexicaul, the lower like the basal leaves, the upper linear, entire. Silicula 6-7×9-12 mm. Schistose rocks. - E. \& C. Pyrenees. Ga Hs .
(4-6). B. variegata group. Glabrous or pubescent, rhizomatous perennials $40-100 \mathrm{~cm}$, with broadly obovate, more or less toothed basal leaves.

[^131]4. variegata

1 Silicula $8-11 \times 10-20 \mathrm{~mm}$; sepals $3-4 \mathrm{~mm}$
2 Cauline leaves few; silicula $11 \times 20 \mathrm{~mm}$
2 Cauline leaves numerous; silicula $8 \times 12 \mathrm{~mm}$
5. megacarpaea
6. foliosa
4. B. variegata Boiss. \& Reuter in Boiss., Diagn. Pl. Or. Nov. 3 (1): 44 (1853) (B. laevigata auct. hisp. pro parte, non L.). Rhizome woody, covered with remains of old leaves; stems $40-70 \mathrm{~cm}$. Basal leaves laxly rosulate, obovate to obovate-oblong, more or less abruptly contracted into petiole, regularly and deeply toothed or irregularly sinuate-dentate or crenate, pubescent or subglabrous; cauline leaves semi-amplexicaul. Sepals $2-2.5 \mathrm{~mm}$; petals 45 mm . Silicula $5-7 \times 7.5-10 \mathrm{~mm}$. Dry places and mountain rocks. - S. Spain. Hs.
5. B. megacarpaea Boiss. \& Reuter, loc. cit. (1853). Stems up to 1 m . Basal leaves $7-10(-20) \times 2-2 \cdot 5(-6) \mathrm{cm}$, densely rosulate, sinuate-dentate, attenuate into petiole, with long and short hairs on upper surface; cauline leaves few, the lower resembling the basal in shape and size, abruptly decreasing in size at about the middle of the stem, the upper linear, entire. Sepals $3-4 \mathrm{~mm}$. Petals $6-8 \mathrm{~mm}$. Silicula $8-13 \times 13-20 \mathrm{~mm}$. Limestone rocks. - S. Spain. Hs.
6. B. foliosa Mach.-Laur., Bot. Arch.(Königsberg) 13:97(1926). Like 5 but basal leaves not rosulate, up to $6 \times 1-2 \mathrm{~cm}$, remotely and regularly toothed; cauline leaves numerous; silicula $5-8 \times 10$ 12 mm . Crevices of limestone rocks. - S.W. Spain (Serrania de Ronda). Hs.
7. B. gredensis Guinea, Feddes Repert. 69: 147 (1964). Stem up to 30 cm , erect, pubescent. Basal leaves polymorphic, spathulate, triangular or lanceolate, entire, 2-dentate or 2- to 4-lobulate, apex obtuse; cauline leaves few, oblong to oblanceolate, entire or toothed. Racemes very long. Sepals 2 mm ; petals 4 mm . Silicula $6 \times 10 \mathrm{~mm}$. Granite rocks. -W.C. Spain (Sierra de Gredos). Hs.
8. B. neustriaca Bonnet, Naturaliste (Paris) no. 58 (1881). Stem 20-40 cm, simple or branched. Basal leaves 4-8 $\times 1-1 \cdot 5 \mathrm{~cm}$, erect, spathulate, slightly sinuate-dentate with 3 more or less equal teeth on each side, pubescent or villous, attenuate into long petiole; cauline leaves broad, entire or dentate. Raceme dense, compact in flower, elongating in fruit. Sepals 2.5 mm ; petals 4 mm . Silicula $6-7 \times 10-11 \mathrm{~mm}$. $\quad$ N.E. France (near Paris). Ga.
9. B. frutescens Cosson, Not. Pl. Crit. 27 (1849) (B. 'suffrutescens' Willk., sphalm.). Rhizome black, woody; whole plant covered with dense, white tomentum; stems simple or branched, up to 50 cm . Basal leaves $6 \times 20 \mathrm{~cm}$, ovate and sinuatedentate or lyrate; cauline leaves sessile or amplexicaul, the lower resembling the basal leaves. Inflorescence much-branched. Sepals 2 mm ; petals 4 mm . Silicula $3.5-4 \times 7 \mathrm{~mm}$, with oblique valves, the margin continuous, with small swellings. S.W. Spain; Islas Baleares. BI Hs.
B. incana Ten., Fl. Neap. Prodr. app. 5, 19 (1826) from S. Italy, which appears to be like 9, but with leaves oblong, regularly sinuate-dentate, with obtuse teeth, densely white-strigose, and silicula glabrous, with the margin subundulate, has been seldom collected; its status is not known.
10. B. vincentina (Samp.) Rothm. ex Guinea, Feddes Repert. 69: 148 (1964) (B. laevigata prol. vincentina Samp.). Rhizome thick, woody. Stem $20-30 \mathrm{~cm}$, erect. Basal leaves $5-6 \times 1 \cdot 5-$ 2.5 cm , numerous, densely rosulate, obovate to obovate-oblong, sinuate-undulate, tomentose; cauline leaves minute. Raceme dense, elongating in fruit. Sepals 4 mm ; petals 6 mm . Silicula
very large, $9-11 \times 16-19 \mathrm{~mm}$, with a membranous margin. Sandy soil. - S.W. Portugal (Cabo de S. Vicente). Lu.
11. B. sempervirens L., Mantissa Alt. 255 (1771) (incl. B. montana Cav., B. tomentosa Lag. ex DC., B. rosularis Boiss. \& Reuter, B. laevigata auct. hisp. pro parte). Rhizome thick, woody, simple or branched, producing a single rosette or several rosettes of leaves; stems up to 50 cm , simple or branched. Basal leaves $3-12 \times 1-5 \mathrm{~cm}$, variable in shape from oblong-lanceolate to broadly obovate or elliptical-spathulate, subentire to deeply sinuate-dentate, usually densely villous or tomentose; cauline leaves few, the lower resembling the basal in size and shape, the upper minute, linear. Raceme somewhat to very dense-flowered. Sepals $3-3.5 \mathrm{~mm}$; petals $5-7 \mathrm{~mm}$. Silicula $4-7 \times 7 \cdot 5-12 \mathrm{~mm}$. $2 n=18$. Limestone rocks. S. \& S.E. Spain; Islas Baleares. Bl Hs.
12. B. glacialis (Boiss. \& Reuter) Jordan, Diagn. 1 (1): 310 (1864) (B. sempervirens auct., non L.). Rhizome long, thick and woody; stems $7-15 \mathrm{~cm}$. Basal leaves $1-3 \times 0.5 \mathrm{~cm}$, densely rosulate, usually narrowly linear, rarely oblong, densely villous; apex obtuse; cauline leaves $1-3$, minute. Silicula $3 \times 6 \mathrm{~mm}$. $2 n=18$. - High mountains of S. Spain (La Sagra, Sierra Nevada, Sierra Tejeda). Hs.
13. B. brevifolia Rouy \& Fouc., Fl. Fr. 2: 107 (1895). Rhizomatous perennial $10-20 \mathrm{~cm}$. Basal leaves $2 \times 0.7 \mathrm{~cm}$, densely rosulate, obovate-lanceolate, sinuate-dentate (rarely subentire) with 2-3 obtuse teeth on each side, sparsely hairy; apex obtuse; cauline leaves few or absent. Silicula $4-3 \times 7-8 \mathrm{~mm}$. Pyrenees. Ga.
14. B. cuneata (Font Quer) Font Quer ex Mach.-Laur., Bot. Arch. (Königsberg) 13: 52 (1926). Rhizomatous perennial up to 20 cm . Basal leaves $4 \times 1 \cdot 5-2 \mathrm{~cm}$, sparsely pubescent, laxly rosulate, cuneate, with 1-2 teeth on either side and 3-lobed at the apex, narrowed to the base. Petals 4 mm . Silicula $5 \times 8-9 \mathrm{~mm}$. Limestone rocks and screes, 1300 m. N.E. Spain (near Tortosa). Hs.
15. B. rotgesii Fouc., Bull. Soc. Bot. Fr. 47: 85 (1900). Stems $18-26 \mathrm{~cm}$, slender, branched. Basal leaves $4-5 \times 1.5-1.7 \mathrm{~cm}$, obovate-oblong, deeply sinuate-dentate, with 3-4 obtuse, teeth on each side, sparsely hispid. Petals $4-4.5 \mathrm{~mm}$. Silicula $8.5 \times 5 \mathrm{~mm}$. $2 n=18$. Schistose rocks. Corse. Co.
16. B. lamottii Jordan, Diagn. 1: 302 (1864). Rhizome long, woody, producing rosette-bearing branches; stem $25-$ 40 cm , slender, simple or branched, hairy below, glabrous above. Basal leaves (4-)8-9×1-1.5 cm, pubescent to hirsute, more or less densely rosulate, linear-lanceolate to lanceolate-spathulate, sinuate-dentate, with $2-4$ remote teeth on each side, obtuse or subacute at the apex, attenuate into a long petiole at the base; cauline leaves few, semi-amplexicaul. Raceme long. Sepals 2 mm ; petals 4 mm . Silicula $4-6 \times 7-10 \mathrm{~mm}$; style 2.5 mm . $2 n=18$. Volcanic debris. - S.C. France (Monts d'Auvergne). Ga.
17. B. sclerocarpa Revel, Congr. Sci. Fr. (Rodez) 40 (1): 262 (1874). Rhizome long, woody, ending in a rosette or divided and producing rosette-bearing branches; stems up to 30 cm . Basal leaves $5-7 \times 1.5-2 \mathrm{~cm}$, more or less tomentose, laxly rosulate, subpinnatifid, with 3-6 large obtuse teeth on each side; cauline leaves several, semi-amplexicaul. Inflorescence branched, lax; sepals 1.5 mm ; petals 3 mm . Silicula $3.5-4 \times 7 \mathrm{~mm}$. $S$. France, Ga ,
18. B. arvernensis Jordan, Diagn. 1: 298 (1864). Like 16 but stems $10-30 \mathrm{~cm}$, leafy; raceme dense, corymbose; petals 6 mm ; style up to 4 mm . Volcanic debris and rocks. $2 n=18$. - S.C. France (Monts d'Auvergne). Ga.
19. B. divionensis Jordan, op. cit. 305 (1864). Rhizome long, woody, ending in a rosette or divided and producing rosettebearing branches; stems up to 25 cm . Basal leaves $50-70 \times 10-$ 15 mm , densely puberulent or canescent, densely rosulate, cuneate or spathulate, with 1-3 large, opposite, acute teeth on each side; apex subacute; cauline leaves few. Inflorescence branched, somewhat dense. Petals 6 mm . Silicula 6-7×9$11 \mathrm{~mm} .2 n=18$. Limestone rocks. - E.C. France (near Dijon). Ga.
20. B. controversa Boreau, Fl. Centre Fr. ed. 3, 2: 56 (1857). Like 19 but basal leaves $9-13 \times 1.5 \mathrm{~cm}$, obovate-oblong, with 3-5 subopposite teeth; silicula 6-7×10-12 mm. $2 n=18$. C. \& $S$. France. Ga.
21. B. brevicaulis Jordan, Diagn. 1: 303 (1864). Like 19 but basal leaves oblong or lanceolate-cuneate, subpinnatifid; apex subacute; inflorescence lax; petals 5 mm . French Alps. Ga.
(22-27). B. coronopifolia group. Stems (20-)30-60(-80) cm. Basal leaves pinnatifid or pinnatilobed, glabrous to hirsute but not tomentose.

1 Stems intricate-branched from the base, the branches patent; cauline leaves numerous
2 Leaves pinnatilobed, the lobes ovate; petals 4.5 mm ; silicula $4-5 \times 8.5-9 \mathrm{~mm}$
23. intricata

2 Leaves pinnatifid, the lobes ovate-oblong; petals $5-6 \mathrm{~mm}$; silicula $6-7 \times 9-11 \mathrm{~mm}$ 27. polyclada
1 Stems not intricate-branched from the base; cauline leaves few to several
3 Leaf-lobes large, numerous, 5-7 on each side, unequal
26. pinnatifida

3 Leaf-lobes small, few, 2-4(-5) on each side
4 Lobes narrow and deep, 2-3 on each side
22. coronopifolia

4 Lobes unequal, 3-5 on each side
5 Basal leaves $4-6 \mathrm{~cm}$; silicula $7 \times 10-11 \mathrm{~mm}$
24. apricorum
25. granitica
22. B. coronopifolia L., Mantissa Alt. 255 (1771). Stems up to 30 cm , hispid to hirsute. Basal leaves $3-4 \times 1.5 \mathrm{~cm}$, hispid or hirsute, laxly rosulate, pinnatifid, with 2-4 long, remote, somewhat acute lobes on each side; lower cauline leaves about as large as the basal leaves, with large teeth, the upper linear-setaceous. Inflorescence several times branched. Sepals 2.5 mm ; petals 5 mm . Silicula $5-7 \times 9-13 \mathrm{~mm} . \quad 2 n=18$. © S. \& S.C. France and E. Spain; Italy. Ga Hs It.
23. B. intricata Jordan, Diagn. 1: 308 (1864). Stems up to 50 cm , intricate-branched from the base, with the branches open and patent in a corymbose manner, hirsute below. Basal leaves $6-8 \times 1 \cdot 5-2 \mathrm{~cm}$, pubescent, oblong, pinnatilobed, with 3-5 ovate, slightly acute lobes on each side; cauline leaves lobed or dentate. Raceme quite dense, elongating during anthesis. Petals 4.5 mm . Silicula $5 \times 9 \mathrm{~mm}$. S.E. France (S. \& W. of Lyon). Ga.
24. B. apricorum Jordan, op. cit. 307 (1864). Stems 3540 cm , sparsely hispid or hirsute. Basal leaves $4-6 \times 1-1.5 \mathrm{~cm}$, hispid-setose, oblong-spathulate, with 3-4 large, obtuse teeth on each side; cauline leaves semi-amplexicaul, with large teeth. Sepals $2-3 \mathrm{~mm}$; petals $5-6 \mathrm{~mm}$. Silicula $7 \times 10-11 \mathrm{~mm}$. Dry places. C. \& S.E. France. Ga.
25. B. granitica Boreau ex Perard, Bull. Soc. Bot. Fr. 16: 353 (1869). Like 24 but basal leaves $6-9 \times 1 \cdot 5-2 \mathrm{~cm}$, lanceolate, with 3-5 large teeth on each side interspersed with smaller teeth; silicula $5 \times 9 \mathrm{~mm}$. Siliceous rocks. S.C. France; N.E. Spain. Ga Hs .
26. B. pinnatifida Jordan, Diagn. 1: 312 (1864). Stems $30-$ 50 cm , with erecto-patent branches. Basal leaves up to 6 cm , hispid, oblong, pinnatifid with 4-5(-7) very unequal, oblong lobes, interspersed with a few smaller lobes; cauline leaves similar. Raceme somewhat dense, elongating in fruit. Petals 5 mm . Silicula 5-8 mm. Dry places. S. France. Ga.
27. B. polyclada Jordan, loc. cit. (1864). Like 23 but basal leaves hispid; obovate-oblong to oblong-subpinnatifid with 3-5 ovate-oblong or oblong lobes on each side; petals $5-6 \mathrm{~mm}$; silicula 6-7×9-11 mm. Rocks. - S.E. France, westwards to Narbonne. Ga.
28. B. lusitanica Jordan, op. cit. 315 (1864). Stem $40-60 \mathrm{~cm}$, stout, erect, branched, hispid. Basal leaves up to 8 cm , regularly and deeply toothed with 3-6 teeth on each side; cauline leaves numerous or few. Sepals 2.5 mm ; petals 5 mm . Silicula 11$14 \times 6-10 \mathrm{~mm} .2 n=54$. Portugal; W. Spain. Hs Lu.

A large-fruited variant with silicula $14-18 \times 8-12 \mathrm{~mm}$ has been described from Portugal (Estremadura).
29. B. mediterranea Jordan, Diagn. 1: 313 (1864). Stems $40-70 \mathrm{~cm}$, robust, hispid below, branched from about the middle, with patent branches. Basal leaves rosulate, $6-8 \times 1-2 \mathrm{~cm}$, linearoblong, pinnatifid, with 3-6 remote teeth on each side, sometimes interspersed with smaller teeth; lower cauline leaves numerous, upper cauline leaves few. Raceme rather dense. Sepals 2.53 mm ; petals $4-5 \mathrm{~mm}$. Silicula $6-7 \times 9-12 \mathrm{~mm}$. Dry places. $2 n=18$. S. France, E. Spain. Ga Hs.
30. B. nicaeensis Jordan, op. cit. 314 (1864). Stems $40-$ 50 cm , strict, hirsute and scabrid below, with erecto-patent branches above. Basal leaves up to $13 \times 2 \mathrm{~cm}$, hispid, scabrid, lanceolate, acute, with 4-6 short lobes on each side; cauline leaves numerous. Petals 6 mm . Silicula 6-7×11-12. Dry places. - S.E. France; N.W. \& C. Italy; Sardegna. Ga It Sa.
31. B. intermedia Gouan, Obs. Bot. 42 (1773). Stems $10-$ 20 cm . Basal leaves $2-3.5 \times 1-1.5 \mathrm{~cm}$, hispid or rarely subglabrous, obovate, or cuneate, very obtuse and subentire or sinuate-lobed with 1-3 lobes on each side; cauline leaves few, small. Petals 4.5 mm . Silicula $5-6 \times 9-10 \mathrm{~mm}$. Pyrenees; N. \& C. Spain (Sierra de Moncayo, Sierra de Guadarrama). Ga Hs.
32. B. guillonii Jordan, Diagn. 1: 302 (1864). Stems $40-$ 60 cm , slightly pubescent, with patent branches. Basal leaves deeply sinuate-dentate, with triangular-acute, sinuate lobes; cauline leaves numerous, more or less pinnatifid or deeply toothed. Sepals $2.5-3 \mathrm{~mm}$; petals $4-6 \mathrm{~mm}$. Silicula $6-7 \times 10-$ 12 mm . Dry places. - W. France. Ga.
33. B. valentina (L.) Heywood, Feddes Repert. 66: 155 (1962) (B. stenophylla Dufour). Rhizome woody; stems $30-50 \mathrm{~cm}$, simple or slightly branched, hispid below. Basal leaves $6-8 \times 0 \cdot 2-$ 0.5 cm (excluding the teeth), linear, deeply toothed, with 1-2 acute teeth on each side (or entire) with setiform rigid hairs interspersed with short, soft hairs only or subglabrous; cauline leaves few, linear-setaceous. Sepals $2-3 \mathrm{~mm}$; petals $5-6 \mathrm{~mm}$. Silicula 3.5$6 \times 6-11 \mathrm{~mm}$. Dry places. C., E. \& S. Spain. Hs.

Widely variable in dimensions and toothing of leaves, and in indumentum.

Series Lyratae Malin. Annual (rarely perennial). Petals gradually attenuate at the base, not auriculate. Lateral nectaries intrastaminal.
34. B. microcarpa DC., Ann. Mus. Hist. Nat. (Paris) 18: 298 (1811). Annual; stems $15-40 \mathrm{~cm}$, slender, with divaricate branches as long as the main stem arising from the base. Raceme rather dense, elongating in fruit. Basal leaves few, up to $10 \times 1.5 \mathrm{~cm}$, lyrate or sinuate-dentate; apex obtuse. Sepals 2 mm ; petals 4 mm ; filaments with a wide membranous wing below or above the middle. Silicula $2.5-4 \mathrm{~mm}$. Schistose soils. S.W. Spain (Cádiz prov.). Hs. (N.W. Africa.)
35. B. baetica Boiss. \& Reuter in Boiss., Diagn. Pl. Or. Nov. 3 (1):42 (1853). Annual; stems 15-50 cm, simple or branched. Basal leaves $6(-10) \times 1.8-3 \mathrm{~cm}$, usually rosulate, obovate-cuneate, sinuate-dentate or denticulate, with acute teeth, roughly hairy, mainly on the veins. Raceme dense, elongating greatly in fruit; pedicels patent. Sepals 2 mm ; petals $4-4.5 \mathrm{~mm}$; filaments filiform. Silicula $3-5 \times 6-9.5 \mathrm{~mm}$. Dry places. S. Spain. Hs. (N.W. Africa.)
36. B. eriocarpa DC., Ann. Mus. Hist. Nat. (Paris) 18: 298 (1811). Annual; stems up to 25 cm , branched. Basal leaves up to $4.5 \times 1.5 \mathrm{~cm}$, rosulate, obovate-cuneate, entire or toothed. Raceme dense, even in fruit; pedicels suberect. Sepals 1.5 mm ; petals 3.5 mm ; filaments filiform, not winged. Silicula $4 \times 7.5 \mathrm{~mm}$. Dry places, screes, rocks. Italy, Corse. Co It.
37. B. lyrata L., Mantissa Alt. 254 (1771). Annual; stems up to 60 cm , simple or branched. Basal leaves up to $18 \times 5-$ 6 cm , numerous, densely rosulate, lyrate, attenuate into petiole; terminal lobe broadly ovate; all lobes entire or toothed, hairy. Raceme rather dense, long in fruit. Sepals 3 mm ; petals 6 mm ; filaments filiform. Silicula 3.5-5 $\times 7-10 \mathrm{~mm}$. Dry places. $2 n=16$. W. Italy, Corse, Sicilia. Co It Si.
38. B. didyma L., Sp. Pl. 653 (1753) (B. apula L., B. ciliata DC.). Annual; stems up to 40 cm , simple or branched. Basal leaves up to $8 \times 2.5 \mathrm{~cm}$, rosulate or not, obovate-cuneate, dentate or denticulate. Raceme dense even in fruit; pedicels erect. Sepals 2 mm ; petals 4 mm ; filaments filiform. Silicula $4.5-7 \times 9-12.5 \mathrm{~cm}$. $2 n=16$. Dry places. C. \& E. Mediterranean region. Al Co Cr Gr It Ju Sa Si.
39. B. radicata Cosson, Bull. Soc. Bot. Fr. 19: 224 (1872). Perennial with woody rhizome; stems up to 1 m , branched, hirsute below. Basal leaves up to $24 \times 6 \mathrm{~cm}$, laxly rosulate, lyrate-pinnatipartite, with a large terminal, ovate, toothed segment and 2-6 small, entire or sinuate-dentate lobes on either side. Raceme lax; pedicels erecto-patent; sepals 2 mm ; petals 5 mm ; filaments more or less filiform. Silicula 6-7 $\times 11-13 \mathrm{~mm}$. Sicilia. Si. (N.W. Africa.)

Sect. Iondraba Reichenb. Lateral sepals saccate or spurred at the base; petals large, long-clawed, with the limb patent. Silicula with a diaphanous margin.
40. B. auriculata L., Sp. Pl. 652 (1753). Stems $25-50 \mathrm{~cm}$, hispid below, glabrous or glabrescent above. Basal leaves oblong, sinuate-dentate (or subentire, var. erigerifolia DC.), longpetiolate; cauline leaves auriculate-amplexicaul, sessile. Racemes many-flowered, remaining compact in fruit. Sepals with a short
spur; petals up to 15 mm . Silicula $7-10 \times 12-18 \mathrm{~mm}$, broadly cordate, not emarginate at the apex, the wings decurrent with the style; style up to $1 \mathrm{~cm} .2 n=16$. Cultivated fields and dry places.

- W. Mediterranean region; Portugal. Bl Ga Hs It Lu ?Si.

41. B. cichoriifolia Loisel., Fl. Gall. 167 (1810). Like 40 but stems villous or hispid above; racemes elongating in fruit; spur of sepals long and slender; silicula emarginate at both the base and the apex, the wings not decurrent with the style. Rocks and dry places. Mountains of S. Europe, from the Pyrenees to Crna Gora. Ga Hs It Ju [He].

## 79. Megacarpaea DC. ${ }^{1}$

Perennial herbs with stiff or crisped, simple hairs. Sepals not saccate. Petals pink or white. Fruit a large, deeply 2-lobed silicula; lobes flat, broadly winged, 1 -seeded.

1. M. megalocarpa (Fischer ex DC.) Schischkin ex B. Fedstch. in Komarov, Fl. URSS. 8: 543 (1939). Stem 20-40 cm, branched above. Basal leaves up to 15 cm , petiolate, oblong-elliptical in outline, pinnatisect with many irregularly and acutely toothed lobes; cauline leaves similar but smaller and sessile. Inflorescence a panicle; branches erect in flower, divaricate in fruit. Flowers irregularly monoecious; those in the apical part of each branch male, in the basal part female. Female flowers without perianth; male flowers with sepals and linear-oblong, pale lilac-pink petals c. $10 \times 3 \mathrm{~mm}$. Intermediate flowers may occur, with smaller, white petals and variously developed stamens and gynoecium. Lobes of silicula $15-20 \mathrm{~mm}$ in diameter, suborbicular; wing 4-6 mm wide. Saline semi-deserts. S.E. Russia, W. Kazakhstan. Rs (E). (C. Asia.)

## 80. Lepidium L. ${ }^{2}$

Annual to perennial herbs, sometimes small shrubs, with usually unbranched hairs. Flowers small, in dense, terminal, ebracteate racemes. Sepals not saccate; petals white or rarely yellow (rarely absent). Stamens 2, 4 or 6 . Styles short or absent. Fruit an angustiseptate silicula; valves strongly keeled, winged. Seeds usually 1 , pendent from the apex of each loculus.

Literature: A. Thellung, Die Gattung Lepidium (L.) R.Br. Eine monographische Studie. Zürich. 1906.

> 1 Wing of the silicula connate with the lower part of the style
> 2 Pedicels 1-2 mm in fruit; middle and upper cauline leaves cuneate at the base
> 5. spinosum
> 2 Pedicels (2-)3-7 mm in fruit; middle and upper cauline leaves amplexicaul
> 3 Annual or biennial; silicula densely covered with small, scalelike vesicles; style usually not projecting beyond the apical notch of wing
> 1. campestre
> 3 Perennial; silicula with few or no vesicles; style projecting beyond the apical notch of wing
> 4 Silicula hairy, at least when young
> 4 Silicula glabrous even when young
> 5 Pedicels glabrous in fruit
> 5 Pedicels hairy in fruit
> 4. hirtum

Wing of the silicula not connate with the style
6 Silicula $\pm$ conspicuously winged and notched; style shorter than or equalling notch
7 Petals longer than sepals
8 All leaves pinnately divided or dentate
9 Upper cauline leaves dentate; silicula 3-4 $\times 2.5-3.5 \mathrm{~mm}$ 9. virginicum

9 Upper cauline leaves pinnately divided; silicula c. $1 \cdot 5 \times$ 1.5 mm
8. cardamines

[^132]8 At least the upper cauline leaves linear and entire
10 Greenish annual; lower leaves lyrate, with toothed lobes; silicula $5-6 \times 3-5 \mathrm{~mm}$
6. sativum
$\begin{array}{ll}10 \text { Small, glaucous shrub; all leaves linear and entire; silicula } \\ 2-2.5 \times 1 \cdot 5-2 \mathrm{~mm} & \text { 7. subulatum }\end{array}$

7 Petals shorter than sepals or absent
11 Silicula $2-3 \times 1-2.3 \mathrm{~mm}$
12 Style longer than notch; pedicels erecto-patent 16. schinzii 12 Style shorter than notch; pedicels patent
13 Stem covered with papillae
14. divaricatum

13 Stem glabrous or with a few smooth hairs
14 Stem often with a few unbranched hairs; upper cauline leaves linear, entire; silicula deeply notched
13. ruderale

14 Stem glabrous; upper cauline leaves oblanceolatespathulate; silicula with entire or rarely slightly emarginate apex
15. pinnatifidum

11 Silicula $2.5-4 \times 2.25-3 \mathrm{~mm}$
15 Stem hairy; upper cauline leaves pinnate 10. bonariense
15 Stem papillose; upper cauline leaves entire or dentate
16 Upper cauline leaves linear-lanceolate, the margins usually with remote teeth, lateral veins visible
11. densiflorum

16 Upper cauline leaves linear, entire, 1 -veined
12. neglectum

6 Silicula usually not winged, entire (or if slightly notched, then
always with an exserted style longer than notch)
17 Petals yellow; leaves strongly dimorphic, the lower 2- to 3 -pinnatifid, the upper suborbicular, entire, with broad, rounded lobes completely enclosing the stem and overlapping
17. perfoliatum

17 Petals white; leaves not strongly dimorphic; the upper leaves without broad, rounded lobes enclosing the stem
18 Cauline leaves either linear to linear-spathulate or pinnatisect, with narrow lobes
19 Basal leaves linear to linear-lanceolate, pinnatisect, with narrow lobes; petals about twice as long as sepals; silicula $c .2 \times 1-1.5 \mathrm{~mm}$
20. Iyratum

19 Basal leaves oblanceolate to oblong, dentate or pinnately lobed with broad lobes; petals equalling or up to $1 \frac{1}{2}$ times as long as sepals; silicula $2 \cdot 5-4 \times 1 \cdot 5-3 \mathrm{~mm}$
21. graminifolium

18 Cauline leaves ovate, elliptical or lanceolate, entire
20 Stem papillose; ripe silicula distinctly reticulatealveolate
18. cartilagineum

20 Stem glabrous; ripe silicula smooth or faintly reticulate
19. latifolium

Sect. Lepia (Desv.) DC. Silicula broadly winged above, the wing connate with lower part of the style; middle and upper cauline leaves amplexicaul. Stamens 6.

1. L. campestre (L.) R.Br. in Aiton, Hort. Kew. ed. 2, 4: 88 (1812). Annual or biennial $20-60 \mathrm{~cm}$, densely and shortly hairy. Basal leaves ovate to obovate, obtuse, entire to slightly lobed; upper cauline leaves numerous, ovate to oblong, more or less dentate, with narrow, acute auricles. Sepals $c .1 .5 \mathrm{~mm}$. Petals a little longer than the sepals. Anthers yellow. Fruiting pedicels $5-6 \mathrm{~mm}$, shortly hairy. Silicula $5-6 \times 4 \mathrm{~mm}$, densely covered with small, scale-like vesicles, otherwise glabrous; style not or only slightly projecting beyond the apical notch. $2 n=16$. Throughout Europe except for a few islands and arctic Russia. All except Az Bl Cr Rs (N) Sa; introduced in Fa Is.
2. L. villarsii Gren. \& Godron, Fl. Fr. 1: 150 (1847). Perennial $15-45 \mathrm{~cm}$, grey-green, sparsely hairy. Basal leaves long-petiolate, obovate or broadly elliptical, entire; middle and upper cauline leaves numerous, narrowly triangular. Sepals $2-2.5 \mathrm{~mm}$; petals almost twice as long as sepals. Anthers violet. Pedicels $5-7 \mathrm{~mm}$ in fruit, glabrous. Silicula 4-7 $\times 2.5-5 \mathrm{~mm}$, winged for about $\frac{1}{4}$ of
its total length; style at least 1 mm , projecting beyond the apical notch. - Alps of France and mountains of N.E. Spain. Ga Hs [ Br ].
(a) Subsp. villarsii (L. pratense (Serres ex Gren. \& Godron) Rouy \& Fouc.): Apex of silicula broad, distinctly notched even when young. Alps of France.
(b) Subsp. reverchonii (Debeaux) Breistr., Bull. Soc. Sci. Dauph. 61: 640 (1947): Apex of silicula gradually narrowed into the style when young, rarely with a slight notch when mature. - Mountains of E. \& N.E. Spain.

Plants up to 22 cm , with leaves glabrous or almost so, pedicels $5-6 \mathrm{~mm}$ in fruit and silicula about $7 \times 6 \mathrm{~mm}$, from S.E. Spain, are probably L. ramburei Boiss., Voy. Bot. Midi Esp. 2: 52 (1839) and may represent a third subspecies.
3. L. heterophyllum Bentham, Cat. Pl. Pyr. Bas-Languedoc 95 (1826). Perennial herb up to 45 cm , shortly hairy. Basal leaves oblanceolate or elliptical, entire; upper cauline leaves narrowly triangular-ovate, with narrow lobes; all shortly hairy to glabrous. Sepals c. 2 mm ; petals $1 \frac{1}{2}$ times as long as sepals. Anthers violet. Pedicels $3-6 \mathrm{~mm}$ in fruit, hairy. Silicula $4-7 \times 3-6 \mathrm{~mm}$, with few or no vesicles, winged for about one-third of the total length, usually with small apical notch, rarely entire; style c. 1 mm , projecting beyond notch. $2 n=16$. W. Europe, extending to Czechoslovakia. $\mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Ga} \mathrm{Hb} \mathrm{Hs} \mathrm{Lu}[\mathrm{Be} \mathrm{Ge}$ Ho No Su].
4. L. hirtum (L.) Sm., Comp. Fl. Brit. ed. 3, 98 (1818). Like 3 but usually grey-pubescent; anthers yellow (except in subsp. (d)); silicula hairy, at least when young; wings up to onehalf the total length of silicula. Mediterranean region. Co Cr Ga Gr Hs It $\mathrm{Si}[\mathrm{Br}]$.

1 Anthers blackish-red; pedicels not more than 3 mm in fruit; silicula with narrow wing; style c. $2 \mathrm{~mm} \quad$ (d) subsp. stylatum
1 Anthers yellow; pedicels more than 3 mm in fruit; silicula either with style not more than 1 mm or with a broad wing
2 Silicula about $4.5 \times 3.5 \mathrm{~mm}$, very narrowly winged
(e) subsp. oxyotum

2 Silicula $5-8 \times 3-5 \mathrm{~mm}, \pm$ distinctly winged
3 Style $1 \cdot 5-2 \mathrm{~mm}$, much exceeding the notched apex of silicula; sepals 2-2.5 mm
4 Silicula abruptly contracted towards apex; racemes short
(c) subsp. petrophilum

4 Silicula gradually narrowed towards apex; racemes long
(f) subsp. calycotrichum

3 Style not more than 1.5 mm and only just exceeding the notched apex of silicula; sepals $1 \cdot 5-2.0 \mathrm{~mm}$
5 Stems usually ascending; racemes short
(a) subsp. hirtum

5 Stems procumbent; racemes long
(b) subsp. nebrodense
(a) Subsp. hirtum: Stems usually ascending, very hairy; racemes short; sepals $1.5-2.0 \mathrm{~mm}$; anthers yellow; pedicels $5-6 \mathrm{~mm}$ in fruit; silicula 6-7 $\times 4-4.6 \mathrm{~mm}$, ovate, winged for about one-half its total length; style protruding just beyond the notched or truncate apex. Mediterranean region. Co Ga Gr Hs It [Br].
(b) Subsp. nebrodense (Rafin.) Thell., Viert. Naturf. Ges. Zürich 51: 154 (1906): Stems procumbent, glabrous to grey-pubescent; racemes long; sepals c. 1.5 mm ; anthers yellow; pedicels 4-6 mm in fruit; silicula $6-8 \times 4-5 \mathrm{~mm}$, elliptical, with wings rounded or obtuse, for about one-third of its total length; style short, just exceeding the notched apex. - Mediterranean region. Co Cr Gr It Si.
(c) Subsp. petrophilum (Cosson) Thell., op. cit. 154 (1906): Stems diffuse or ascending, hairy; racemes short; sepals 2 2.5 mm ; anthers yellow; pedicels $4-5 \mathrm{~mm}$ in fruit; silicula $5-$ $6 \times 3-4 \mathrm{~mm}$, ovate, acuminate, sharply keeled and winged above
the middle; style $c .2 \mathrm{~mm}$, exceeding the notched apex. - Spain (Granada prov.). Hs.
(d) Subsp. stylatum (Lag. \& Rodr.) Thell., op. cit. 155 (1906): Stems ascending, grey-pubescent (or rarely green and glabrous); racemes very short, often subcorymbose; sepals c. 1.5 mm ; anthers blackish-red; pedicels $2-3 \mathrm{~mm}$ in fruit; silicula $4-6 \times 2-$ 2.5 mm , narrowly elliptical, narrowly winged; style c. 2 mm and much exceeding the slightly notched apex.
S. Spain (Sierra Nevada). Hs.
(e) Subsp. oxyotum (DC.) Thell., op. cit. 156 (1906): Stems ascending, hairy; racemes short; sepals $1.5-2 \mathrm{~mm}$; anthers yellow; pedicels $3-4 \mathrm{~mm}$ in fruit; silicula $c .4 .5 \times 3.5 \mathrm{~mm}$, orbicularelliptical or obovate, very narrowly winged; style short, just exceeding the notched apex. Corse and Kriti. Co Cr.
(f) Subsp. calycotrichum (Kunze) Thell., op. cit. 156 (1906): Stems procumbent or ascending, hairy; racemes very long; sepals c. 2.5 mm ; anthers yellow; pedicels $4-6 \mathrm{~mm}$ in fruit; silicula c. $7 \times 4 \mathrm{~mm}$, narrowly elliptical or ovate, winged for a fifth to a half its total length; style $1 \cdot 5-2 \mathrm{~mm}$, much exceeding the slightly notched apex. Spain. Hs. (N. Africa.)

Sect. Lepiocardamon Thell. Silicula obovate, very deeply notched, broadly winged above.
5. L. spinosum Ard., Animadv. Bot. Spec. Alt. 34 (1763). Annual or biennial with glabrous stem. Basal and lower cauline leaves pinnately divided, the lobes linear and lobed again at base; middle and upper cauline leaves linear or linear-oblanceolate. Sepals 1 1.5 mm , white-margined; petals $1 \frac{1}{2}$ times as long as sepals. Pedicels $1-2 \mathrm{~mm}$ in fruit. Silicula $5-6 \times c .3 \mathrm{~mm}$, obovate, very deeply notched at apex, glabrous, the wings very long above, style not exceeding notch. E. Mediterranean region. Bu Cr Gr Tu [Bl Hs].

Sect. Cardamon DC. Silicula suborbicular, emarginate, narrowly winged above.
6. L. sativum L., Sp. Pl. 644 (1753). Annual with a single erect stem $20-40 \mathrm{~cm}$, glabrous. Basal leaves long-petiolate, lyrate, with toothed obovate lobes; upper cauline leaves linear, entire. Sepals $1-1.5 \mathrm{~mm}$; petals twice as long as sepals, sometimes reddish. Stamens 6 . Pedicels $3-4 \mathrm{~mm}$ in fruit. Silicula $5-6 \times 3-$ 5 mm , broadly elliptical, narrowly winged above, glabrous; style not projecting beyond the deep apical notch. Cotyledons deeply 3-lobed. Cultivated and naturalized throughout much of Europe. Naturalized in all except $\mathrm{Al} \mathrm{Bl} \mathrm{Co} \mathrm{Hb} \mathrm{Is} \mathrm{Tu}. \mathrm{(Egypt} \mathrm{and} \mathrm{W}$. Asia.)

Sect. Dileptium DC. Silicula either not winged, or, if narrowly winged above, then with the style quite free and not exceeding apical notch. Stamens 2-4. Cauline leaves not amplexicaul.
7. L. subulatum L., Sp. Pl. 644 (1753). Dwarf shrub $10-20 \mathrm{~cm}$, more or less glaucous and much-branched. All leaves linear, rigid, channelled and very acute, with varying amounts of short, stiff hairs. Sepals $c .1 \mathrm{~mm}$; petals $c .1 \frac{1}{2}$ times as long as sepals. Anthers yellow. Pedicels $2-4 \mathrm{~mm}$ in fruit, erecto-patent, glabrous or hairy. Silicula $2-2.5 \times 1.5-2 \mathrm{~mm}$; style not exceeding the apical notch. Cotyledons entire. Gypsicolous. Spain. Hs. (N.W. Africa.)

Plants from the south of Spain tend to be more hairy and glaucous and have smaller fruits and longer pedicels than those from the north.
8. L. cardamines L., Cent. Pl. 1: 17 (1755). Glaucous biennial; stem erect, branched, densely puberulent with short, crispate
hairs. Basal leaves lyrate-pinnatifid; cauline leaves numerous, pinnate with large terminal lobe and 1-2 lateral ones. Sepals c. 1 mm ; petals twice as long as sepals. Pedicels $c .4 \mathrm{~mm}$ in fruit, minutely hairy. Silicula c. $1.5 \times 1.5 \mathrm{~mm}$, ovate, glabrous; style very short, scarcely exceeding the small apical notch. Cotyledons entire. Saline soils. C. Spain. Hs.
9. L. virginicum L., Sp. Pl. 645 (1753). Unbranched annual or biennial; stem $30-50 \mathrm{~cm}$, erect, minutely hairy. Basal leaves up to 8 cm , rough with short bristles, lyrate; middle and upper cauline leaves sharply toothed and ciliate. Sepals $0.75-1 \mathrm{~mm}$; petals longer than sepals. Pedicels $4-5 \mathrm{~mm}$ in fruit. Silicula 3-4 $\times 2 \cdot 5-3 \cdot 5 \mathrm{~mm}$, orbicular-ovate, apical notch broad but shallow; style very short, not exceeding notch. Cotyledons entire. Widely introduced and naturalized in Europe. [ Al Az Be $\mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{?Rs} \mathrm{Su]}$. (North America.)
10. L. bonariense L., Sp. Pl. 645 (1753). Unbranched annual or biennial; stem with long, unbranched hairs. All leaves pinnate and more or less hairy. Sepals $c .0 .5 \mathrm{~mm}$; petals shorter than sepals. Pedicels $2-3 \mathrm{~mm}$ in fruit. Silicula $2-3 \cdot 5 \times 2-3 \mathrm{~mm}$, with narrow, shallow apical notch. Introduced and naturalized in W. Europe. [ $\mathrm{Be} \mathrm{Br} \mathrm{Ge} \mathrm{Ho} \mathrm{Hu} \mathrm{No]}. \mathrm{(S.E} .\mathrm{South} \mathrm{America)}$.
11. L. densiflorum Schrader, Ind. Sem. Horti Gotting. 4 (1832) (L. apetalum sensu N. Busch in Komarov, non Willd.). Annual or biennial; stem single, erect, branched above, papillose. Basal leaves long-petiolate, elliptical, usually deeply toothed; upper cauline leaves linear-lanceolate, remotely toothed and ciliate, lateral veins visible. Sepals c. 1 mm ; petals filiform, shorter than the sepals or absent. Pedicels $4-5 \cdot 5 \mathrm{~mm}$ in fruit. Silicula $3-4 \times 2 \cdot 5-3 \mathrm{~mm}$, orbicular-ovate, narrowly winged in the upper third, narrowly but shallowly notched; style very short. Widely introduced and naturalized in Europe. [ Be Br Cz Da Fe Ga Ge He Ho Hu It No Po Rs (C, W, E) Su.] (North America.)
12. L. neglectum Thell., Bull. Herb. Boiss. ser. 2, 4: 708 (1904). Annual or biennial. Stem papillose. Lower cauline leaves more or less hairy, the upper linear, entire, 1-veined, often papillose. Sepals c. 1.25 mm ; petals rudimentary. Pedicels c. 3 mm in fruit. Silicula $3 \times 3 \mathrm{~mm}$, orbicular, narrowly but deeply notched at apex. Widely introduced and naturalized in W. \& C. Europe. [Au $\mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{No} \mathrm{Po} \mathrm{Su]}. \mathrm{(North} \mathrm{America)}$.
13. L. ruderale L., Sp. Pl. 645 (1753). Annual or biennial, more or less foetid, with a single erect or ascending stem $10-$ 30 cm , usually with a few unbranched hairs. Basal leaves 57 cm , long-petiolate, pinnatisect or 2-pinnatisect; upper linear, entire. Sepals 0.75 mm ; petals absent or very inconspicuous. Pedicels $2-2.5 \mathrm{~mm}$ in fruit, hairy. Silicula $2-2.5 \times 1.5-2 \mathrm{~mm}$, ovate or broadly elliptical, narrowly winged above, deeply notched; style very short and not exceeding notch. $2 n=32$. Throughout Europe. All except Al Az Co Hb Si Tu.
14. L. divaricatum Solander in Aiton, Hort. Kew. 2: 441 (1789). Annual; stem papillose. Basal leaves subpinnate; upper lanceolateoblong, acute, dentate. Sepals $0.5-0.75 \mathrm{~mm}$; petals $\frac{1}{2}-\frac{2}{3}$ as long as sepals. Pedicels 2-4 mm in fruit. Silicula 2-3 $\times 1.5-2 \mathrm{~mm}$, apical notch shallow and narrow; style very short. Introduced and naturalized in W. Europe. [ $\mathrm{Be} \mathrm{Br} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho]}. \mathrm{(Africa} \mathrm{from}$ Abyssinia to the Cape.)
In Europe only as subsp. linoides (Thunb.) Thell., Viert. Naturf. Ges. Zürich 51: 167 (1906).
15. L. pinnatifidum Ledeb., Fl. Ross. 1: 206 (1841). Like 14 but stem entirely glabrous; cauline leaves almost entire, oblanceo-late-spathulate; silicula $2-2.75 \times 1.75-2.3 \mathrm{~mm}$, with an entire or rarely slightly notched apex. Saline places. S.E. Russia. Rs (E).
16. L. schinzii Thell., Viert. Naturf. Ges. Zürich 51: 167 (1906). Like 14 but cauline leaves pinnatifid, with entire or rarely toothed segments; petals absent; style exceeding notch. Introduced and naturalized in a few places in Europe. [Be Ge He.] (Transvaal and Basutoland.)

Sect. Lepidium. Silicula not or very slightly winged, not or slightly notched. Stamens 6.
17. L. perfoliatum L., Sp. Pl. 643 (1753). Annual or biennial with single erect, sparsely hairy stem $20-40 \mathrm{~cm}$. Leaves strongly dimorphic, the basal long-petiolate, 2- to 3-pinnatifid, with narrow segments, the upper cauline subrotund, more or less acute, entire, the broad rounded lobes completely enclosing the stem and overlapping. Sepals $c .1 \mathrm{~mm}$; petals pale yellow, narrowly spathulate, only a little longer than sepals. Pedicels $4-5 \mathrm{~mm}$ in fruit, ascending, glabrous. Silicula usually c. $4 \times 4 \mathrm{~mm}$, very narrowly winged above; style short, exserted from the small apical notch. $2 n=16$. Native in C., E. \& S.E. Europe; widely introduced and naturalized elsewhere. Al Au Bu Cz Gr Hu Ju Po Rm Rs (C, W, K, E) Tu [ $\mathrm{Be} \mathrm{Br} \mathrm{Da} \mathrm{Fa} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Is} \mathrm{It} \mathrm{No} \mathrm{Su]}$.
18. L. cartilagineum (J. Mayer) Thell., Viert. Naturf. Ges. Zürich 51: 173 (1906). Perennial; stems 7-25 cm, very flexuous, branched above, papillose. Leaves leathery-succulent, broadly elliptical, ovate, lanceolate or linear-lanceolate, more or less obtuse, entire, cuneate at base; the cauline sometimes with a sagittate base. Sepals c. 1.25 mm , petals about twice as long as sepals. Pedicels c. 4 mm , thick in fruit. Silicula $2 \cdot 5-3 \times 2 \cdot 5-3$ mm , ovate, when ripe distinctly reticulate-alveolate; style short, exserted. Saline areas of C. \& E. Europe. Au ?Bu ?Cz Ge Hu Po Rm Rs (C, W, K, E).
(a) Subsp. cartilagineum (incl. L. pumilum Boiss. \& Balansa): Plant usually $7-13 \mathrm{~cm}$; leaves lanceolate or linear-lanceolate, cauline without auricles at base. Ukraine and Krym.
(b) Subsp. crassifolium (Waldst. \& Kit.) Thell., Neue Denkschr. Schweiz. Ges. Naturw. 41: 153 (1906) (L. crassifolium Waldst. \& Kit.). Plant usually $20-25 \mathrm{~cm}$; leaves broadly elliptical or ovate, cauline with auriculate-sagittate base. $2 n=16$. Throughout the range of the species.
L. borysthenicum Kleopow, Jour. Inst. Bot. Acad. Sci. Ukr. 2122: 251 (1939), with stems $30-40 \mathrm{~cm}$, basal leaves $10-16 \mathrm{~cm} \times 3-$ 6 mm (C. \& E. Ukraine) and L. syvaschicum Kleopow, loc. cit. (1939), with stems up to 25 cm , basal leaves oblong-elliptical $4-$ $8 \mathrm{~cm} \times 5-13 \mathrm{~mm}$ (S. Ukraine; Krym), belong here and may represent further subspecies of 18.
19. L. Iatifolium L., Sp. Pl. 644 (1753). Perennial with stoloniferous rhizome; aerial stems $50-130 \mathrm{~cm}$, erect, glabrous, muchbranched above. Leaves coriaceous, the basal and lower cauline up to 30 cm , long-petiolate, ovate, toothed or sometimes pinnatilobed; upper sessile, ovate to lanceolate, entire and often bractlike. Flowers in a large panicle. Sepals c. 0.75 mm , broadly white-margined. Petals up to twice as long as sepals, with rounded-obovate limb. Pedicels $4-5 \mathrm{~mm}$ in fruit, silicula $2 \times$ 2 mm , suborbicular, not winged or notched; style very short with a large rounded stigma. $2 n=24$. Europe except the north. All except $\mathrm{Bl} \mathrm{Cr} \mathrm{Fa} \mathrm{Fe} \mathrm{Is} \mathrm{No} \mathrm{Rs} \mathrm{(N)}$.

Plants from near the Baltic in Sweden seem to differ in having dark purple sepals and narrower, more toothed upper cauline
leaves with a longer acute apex. Specimens seen from Greece and Sicilia have the underside of the leaves densely covered with stellate hairs and are apparently referable to var. velutinum Hayek ex Thell. Further study may indicate that both these variants should be regarded as subspecies.
20. L. Iyratum L., Sp. Pl. 644 (1753). Perennial up to 30 cm ; sometimes woody at base, stems very flexuous, glabrous. Leaves linear to linear-lanceolate, pinnate or pinnatisect, the upper cauline sometimes entire and bract-like. Sepals $c .1 \mathrm{~mm}$; petals about twice as long as sepals. Silicula c. $2 \times 1-1.25 \mathrm{~mm}$, ovate, acute. S.E. Russia and Krym. Rs (K, E).

In Europe only the following subspecies occur:
(a) Subsp. Iacerum (C. A. Meyer) Thell., Neue Denkschr. Schweiz. Ges. Naturw. 41: 166 (1906) (incl. L. turczaninovi Lipsky, L. meyeri Claus): Plant woody at base; basal leaves pinnatipartite, lobes remote, narrow; cauline small, often bract-like, linear and entire, or the lower with a few linear, obtuse pinnae; style $\frac{2}{3}-\frac{1}{4}$ as long as ovary when in flower, $\frac{1}{4} \frac{1}{8}$ as long as fruit. - Krym.
(b) Subsp. coronopifolium (Fischer) Thell., op. cit. 167 (1906) (L. coronopifolium Fischer): Perennial herb; basal and cauline leaves long-linear to narrowly linear-lanceolate, simply pinnatisect, with a long, narrow terminal lobe and 2 to many narrow lateral lobes, long-petiolate; numerous linear bract-like leaves on the branches; style $\frac{1}{2}-\frac{2}{3}$ as long as ovary when in flower, c. $\frac{1}{2}$ as long as fruit. S.E. Russia.
21. L. graminifolium L., Syst. Nat. ed. 10, 2: 1127 (1759). Perennial with erect glabrous or sparsely hairy stems, branched above. Basal leaves up to 10 cm , long-petiolate, oblanceolate to oblong, toothed or pinnately lobed; upper cauline leaves linear or linear-spathulate. Sepals 0.5 mm , narrowly white-margined above the middle; petals equalling or up to $1 \frac{1}{2}$ times as long as sepals, with obovate-spathulate limb. Pedicels $3-4 \mathrm{~mm}$ in fruit. Silicula $2.5-4 \times 1.5-3 \mathrm{~mm}$, acute to acuminate, not notched, not or scarcely winged; style short, exceeding the notch. S. \& C. Europe. $\mathrm{Al} \mathrm{Au} \mathrm{Bl} \mathrm{Bu} \mathrm{Ce} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{Lu} \mathrm{Rm} \mathrm{Rs} \mathrm{(K)} \mathrm{Sa}$ Si Tu [ $\mathrm{Be} \mathrm{Br} \mathrm{Ho]}$.
(a) Subsp. graminifolium: Perennial herb, sometimes woody; basal leaves incise-dentate to pinnately lobed, long-petiolate; sepals greenish; whole plant almost or quite glabrous. S. \& C Europe.
(b) Subsp. suffruticosum (L.) P. Monts., Feddes Repert. 69: 6 (1964) (L. suffruticosum L.): Plant with woody rhizome protruding above the surface of the ground; basal leaves very longpetiolate, with a few teeth near the apex; sepals usually purplish; stem, branches and pedicels minutely hairy. W. Mediterranean region.

## 81. Cardaria Desv. ${ }^{1}$

Like Lepidium but the inflorescence a dense corymbose panicle and the silicula cordate, indehiscent.

1. C. draba (L.) Desv., Jour. Bot. Appl. 3: 163 (1814) (Lepidium draba L.). Glabrous or sparsely pubescent perennial $15-90 \mathrm{~cm}$, producing adventitious buds on the roots. Leaves obovate to ovate-oblong, sinuate-dentate, the basal cuneate, petiolate, the cauline sessile, amplexicaul. Petals $c .4 \mathrm{~mm}$, white. Silicula 3-4.5 $\times 3.5-5 \mathrm{~mm}$, cordate, emarginate, inflated. $2 n=64$.
${ }^{2}$ By T. G. Tutin.

Probably native in S. Europe, but now established throughout most of Europe as a weed. $\mathrm{Al}{ }^{*} \mathrm{Au} \mathrm{Bl} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Gr} \mathrm{Hs} \mathrm{*Hu} \mathrm{It} \mathrm{Ju}$ ${ }^{*} \mathrm{Lu}$ Rm Rs (W, K, E) Sa Si Tu [Be Br Cz Da Fe Ge Hb He Ho No Po Rs (B, C) Su].

The plant described above is subsp. draba. Subsp. chalepensis (L.) O. E. Schulz in Engler \& Prantl, Natürl. Pflanzenfam. ed. 2, 17b: 417 (1936) (Lepidium draba subsp. chalepense (L.) Thell.) from S.W. Asia, with the fruit more or less cuneate at the base, occurs occasionally as a casual.

## 82. Coronopus Haller ${ }^{1}$

Glabrous or with unbranched hairs. Sepals patent; petals white, small or absent. Stamens 2-6. Fruit an angustiseptate silicula, indehiscent or breaking into 2 halves; valves subglobose, verrucose or reticulate. Seeds 2. (Senebiera DC.)
1 Silicula c. $1.5 \times 2-3 \mathrm{~mm}$, emarginate $\quad$ 3. didymus
1 Silicula 2-3 $\times 3-4 \mathrm{~mm}$, rounded or apiculate
2 Perennial; pedicels 2.5 mm or more, longer than the silicula (Spain)

1. navasii

2 Annual; pedicels not more than 2 mm , shorter than the silicula (widespread)
2. squamatus

1. C. navasii Pau, Butll. Inst. Catalana Hist. Nat. 22: 31 (1922). Diffuse perennial up to 30 cm . Leaves ovate or lanceolate, pinnatifid. Inflorescence elongate in fruit; pedicels 2.5 mm or more, longer than the silicula. Petals c. 2 mm . Silicula c. $2.5 \times$ 3 mm , ovoid. - S. Spain (Sierra de Gádor). Hs.

Possibly not distinct from C. violaceus (Munby) O. Kuntze, Revis. Gen. 1: 27 (1891), from N.W. Africa.
2. C. squamatus (Forskål) Ascherson, Fl. Brandenb. 1: 62 (1860) (C. procumbens Gilib., C. ruellii All., Senebiera coronopus (L.) Poiret). Procumbent annual or biennial up to 30 cm . Lower leaves pinnatipartite, the segments usually pinnatifid. Racemes usually crowded in fruit; pedicels up to 2 mm . Petals 11.5 mm , longer than sepals. Fertile stamens 6. Silicula $2-3 \times$ $3.5-4 \mathrm{~mm}$, almost reniform, apiculate, strongly reticulate or ridged or verrucose; style $c .0 .5 \mathrm{~mm}$. Ruderal. W., C. \&S. Europe, northwards to $c .66^{\circ} \mathrm{N}$. in Fennoscandia; status uncertain in the northern part of its range. All except Bl Fa Is $\mathrm{Rs}(\mathrm{N}, \mathrm{C}, \mathrm{E}) \mathrm{Sb}$.
3. C. didymus (L.) Sm., Fl. Brit. 2: 691 (1800) (Senebiera didyma (L.) Pers.). Procumbent or ascending biennial up to 30 cm . Lower leaves pinnatipartite, the segments usually pinnatifid. Racemes somewhat elongate in fruit; pedicels $1 \cdot 5-3 \mathrm{~mm}$, longer than the silicula. Petals $c .0 .5 \mathrm{~mm}$, shorter than the sepals, sometimes absent. Fertile stamens usually 2. Silicula c. $1.5 \times 2-$ 3 mm , emarginate, reticulate; style absent. $2 n=32$. Ruderal. Naturalized in W., C. \& S. Europe; a common casual elsewhere. [ Au Az Be Bl Br Cz Ga Ge Hb He Ho Hs Hu It Lu Po Rm Sa Si.] (?South America; widespread as a ruderal.)

## 83. Subularia L. ${ }^{2}$

Sepals erect; petals white, sometimes absent. Stamens 6, without appendages. Ovary surrounded by a fleshy ring. Fruit a latiseptate silicula, dehiscent; valves strongly convex. Seeds in 2 rows, 2-6 in each loculus.

1. S. aquatica L., Sp. Pl. 642 (1753). Glabrous, scapigerous annual. Leaves $2-7 \mathrm{~cm}$, numerous, rosulate, subulate, terete, entire. Flowers 2-12. Pedicels eventually $2-5 \mathrm{~mm}$. Silicula $2-$
$5 \times 1 \cdot 5-2 \cdot 5 \mathrm{~mm}$, elliptic-oblong. $2 n=c$. 36 . In shallow water in base-poor pools and lakes. N. Europe, extending locally southwards in the mountains to the Pyrenees and Bulgaria. Be Br Bu Da Fa $\mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Hs} \mathrm{Is} \mathrm{No} \mathrm{Rs} \mathrm{(N}, \mathrm{B}, \mathrm{C}, \mathrm{E)} \mathrm{Su}$.

## 84. Conringia Adanson ${ }^{1}$

Glabrous annuals. Leaves simple, glaucous. Inflorescence a raceme. Inner sepals saccate; petals pale yellow. Fruit a siliqua; valves 1 - or 3 -veined; style short, stigma slightly 2 -lobed. Seeds in 1 row in each loculus.

Literature: O. E. Schulz in Engler, Pflanzenreich 84 (IV. 105): 84-94 (1923).
$\begin{array}{ll}\text { Valves of the siliqua } 1 \text {-veined; petals }(7-) 8-13 \mathrm{~mm} & \text { 1. orientalis } \\ \text { Valves of the siliqua } 3 \text {-veined; petals } 6-8(-10) \mathrm{mm} & \text { 2. austriaca }\end{array}$

1. C. orientalis (L.) Dumort., Fl. Belg. 123 (1827). Plant $10-$ $50(-70) \mathrm{cm}$. Basal leaves obovate, petiolate; cauline obovate to elliptical, sessile, cordate-amplexicaul. Pedicels $4-9 \mathrm{~mm}$ in flower, $6-20 \mathrm{~mm}$ in fruit. Petals (7-)8-13 mm, yellowish- or greenish-white. Siliqua ( $4 \cdot 5-$ ) $6-14 \mathrm{~cm}, 4$-angled, the valves 1 veined; style cylindrical. Seeds $2-2 \cdot 9 \mathrm{~mm}$. $2 n=14$. C. \& E. Europe; frequently naturalized or casual elsewhere. Al Au Bu Cz Ge Gr Hu It Ju Po Rm Rs (C, W, K, E) Tu [Be Bl Br Cz Da Fe Ga He Ho Hs Is No Rs (N) Sb].
2. C. austriaca (Jacq.) Sweet, Hort. Brit. 25 (1826) (Goniolobium austriacum (Jacq.) G. Beck). Like 1 but up to 100 cm ; cauline leaves obovate-oblong; pedicels $2-5 \mathrm{~mm}$ in flower, $2-$ 9 mm in fruit; petals $6-8(-10) \mathrm{mm}$, lemon-yellow; siliqua $5-$ $8(-10) \mathrm{cm}, 8$-angled, the valves 3 -veined. S.E. \& E.C. Europe, extending westwards to Austria and Italy. Au Bu Gr Hu It Ju Rm Rs (K).

## 85. Moricandia DC. ${ }^{2}$

Glabrous annual or perennial herbs. Leaves simple, fleshy. Inflorescence corymbose. Inner sepals saccate at base; petals purple, rarely whitish. Fruit a siliqua; valves with a distinct median vein; style short, stigma 2-lobed. Seeds in 1 or 2 rows in each loculus.

Literature: O. E. Schulz in Engler, Pflanzenreich 84 (IV. 105): 64-72 (1923). A. de Bolós, Anal. Inst. Bot. Cavanilles 6 (2): 45161 (1946).
1 Upper cauline leaves minute, triangular-ovate, very acute to acuminate; petals 12 mm , whitish
3. foetida

1 Upper cauline leaves cordate, $\pm$ acute; petals $18-22 \mathrm{~mm}$, normally purple-violet
2 Outer sepals markedly cucullate at the apex; raceme 20- to 40 -flowered; seeds up to 2.5 mm , uniseriate
2. moricandioides

2 Outer sepals scarcely cucullate at the apex; raceme 10 - to $20(-25)$-flowered; seeds $c .1 \mathrm{~mm}$, biseriate 1. arvensis

1. M. arvensis (L.) DC., Reg. Veg. Syst. Nat. 2: 626 (1821). Short-lived perennial up to 65 cm , with branched stems. Lower leaves obovate, repand-crenate, obtuse at the apex, narrowed at the base; upper cauline leaves cordate, entire, widened and amplexicaul at the base, more or less acute. Raceme with $10-$ 20 large, showy flowers, becoming lax. Petals $c .20 \mathrm{~mm}$, violetpurple. Siliqua $3-8 \mathrm{~cm} \times 2-3 \mathrm{~mm}$, compressed, 4 -angled. Seeds c. 1 mm , biseriate, brown. Calcicole. Mediterranean region. Bl Co Gr Hs It Si.
${ }^{2}$ By V. H. Heywood.
M. Iongirostris Pomel, Nouv. Mat. Fl. Atl. 367 (1875), recorded from S. Italy and Sicilia, which differs in its longer siliquae (up to 12 cm ), with longer, often recurved beaks and very numerous seeds, may deserve recognition as a subspecies.
2. M. moricandioides (Boiss.) Heywood, Feddes Repert. 66 : 154 (1962) (Moricandia ramburei Webb, Brassica moricandioides Boiss.). Like 1 but racemes with more numerous flowers; outer sepals with a pronounced cucullate prolongation up to 1.2 mm ; siliqua more or less terete; seeds $2-2.5 \mathrm{~mm}$ ( $1-1.5$ in var. microsperma), uniseriate, distinctly winged, the wing narrow or broad. - S.C. \& E. Spain. Hs.

Two fairly well-marked variants sometimes cause difficulty in identifying this species; var. microsperma (Willk.) Heywood with more shortly cucullate sepals and seeds less than 2 mm , and var. cavanillesiana (Font Quer \& A. Bolós) Heywood with seeds broadly crispate-winged.
3. M. foetida Bourgeau ex Cosson, Not. Pl. Crit. 143 (1852). Stems much-branched from the base. Lower leaves obovate; upper cauline leaves minute, triangular-ovate, very acute to acuminate. Racemes few-flowered (5-12); sepals all obtuse; petals 12 mm , whitish. Siliqua $4-6 \mathrm{~cm} \times 1 \cdot 5-2 \mathrm{~mm}$, compressed, 4-angled, long pedicellate. Seeds $c .1 .5 \mathrm{~mm}$, brownish, uniseriate, distinctly white-margined. Base-rich soils. - S. \& S.E. Spain. Hs.

Plants combining the characters of 2 and 3 are found in the region of Murcia.

## 86. Euzomodendron Cosson ${ }^{2}$

Sepals erect, hispid. Petals very long-clawed. Filaments of the inner stamens united in pairs. Fruit a lanceolate-oblong siliqua, dorsally compressed; valves $\pm$ convex, with $3-5$ equidistant, parallel veins, attenuate into a triangular to lanceolate seedless beak.

1. E. bourgaeanum Cosson, Not. Pl. Crit. 145 (1852). Small erect shrub $20-50 \mathrm{~cm}$, much-branched at the base. Leaves crowded, pinnatisect into $2-3$ pairs of linear, obtuse, somewhat fleshy segments, rarely undivided, with scattered, patent, setiform hairs. Flowers in ebracteate racemes on short pedicels, showy; petals $12-16 \mathrm{~mm}$, whitish, with brown veins. Siliqua $20-40 \times 3-$ 4 mm , ascending, glabrous; beak up to 1 cm . Dry calcareous soils. - S. Spain (Almeria prov.). Hs.

## 87. Diplotaxis DC. ${ }^{2}$

Annual to perennial herbs. Leaves entire to pinnatipartite. Sepals erecto-patent; petals clawed, white, veined with violet, yellow or pink. Gynophore usually short. Fruit an elongate, linear siliqua with a short beak; valves compressed, with a prominent median vein. Seeds in 2 rows in each loculus, ovoid or rounded. (Incl. Pendulina Willk.)

Literature: O. E. Schulz in Engler, Pflanzenreich 70 (IV. 105): 149-80 (1919). R. Nègre, Mém. Soc. Sci. Nat. Phys. Maroc Bot. nov. ser., no. 1 (1960).
1 Mature siliqua pendent; gynophore $2 \cdot 5-7 \mathrm{~mm}$, conspicuous,
3. crassifolia

1 Mature siliqua erecto-patent or rarely patent; gynophore less than 2 mm
2 Petals white, violet-veined or violet after anthesis 6. erucoides
2 Petals yellow, sometimes violet-veined

3 Petals $3-4 \mathrm{~mm}$; outer stamens sterile
3 Petals at least 4.5 mm ; outer stamens fertile
4 Leaves almost all basal, rosulate
5 Stems densely setose-hispid below
5 Stems glabrous or sparsely hispid below
6 Leaves pinnatipartite or pinnatisect; gynophore 1 mm
5. cretacea

6 Leaves lyrate-pinnatifid or sinuate-dentate; gynophore 0
9. muralis

4 Stems and branches more or less leafy
7 Perennial, suffruticose at base, leaves glaucous, more or less fleshy, foetid when crushed 4. tenuifolia
7 Annual or biennial, herbaceous; leaves green, thin or membranous
8 Basal rosette present
9. muralis

8 Basal rosette absent
9 Stems densely setose-hispid below; basal leaves pinnatilobed or pinnatipartite with shallowly and irregularly denticulate segments; style less than 1 mm 7. virgata
9 Stems glabrous to hispid; basal leaves pinnatipartite with the segments laciniate-dentate, or bipinnatipartite; style 1 mm or more
10 Leaves glabrous or sparsely hispid at the margin; segments all $\pm$ equal, divided into linear or lanceolate lobes

1. catholica

10 Leaves with short conical hairs on both surfaces; segments unequal; with the terminal much larger than the laterals, $\pm$ entire or dentate
2. siifolia

1. D. catholica (L.) DC., Reg. Veg. Syst. Nat. 2: 632 (1821). Annual sometimes overwintering, $5-90 \mathrm{~cm}$, green (or subglaucous in maritime habitats). Stems glabrous or with deflexed hairs at the base. Leaves glabrous or sparsely hispid at the margin, variable in shape, the basal usually pinnatisect or bipinnatisect, with the segments more or less equal and divided into linear or lanceolate lobes. Petals $7-8(-12) \mathrm{mm}$, sulphur-yellow. Siliqua (14-)20-$25(-45) \mathrm{mm}$, torulose or not; beak $2-5 \mathrm{~mm}$ with $1-2$ seeds or seedless. S.W. Europe. Bl Hs Lu.
2. D. siifolia G. Kunze, Flora (Regensb.) 29: 685 (1846). Like 1 but leaves with short conical hairs on both surfaces, lyratepinnatisect with the segments unequal, more or less entire or dentate, the terminal much larger than the lateral. S. Portugal, S. Spain. Hs Lu.

Often united with 1 as a subspecies. D. vicentina (Coutinho) Rothm., Agron. Lusit. 2: 84 (1940), from Portugal, with more or less leafless stems, petals up to 6 mm and globose seeds, may be another related taxon.
3. D. crassifolia (Rafin.) DC., Reg. Veg. Syst. Nat. 2: 629 (1821) (incl. Pendulina lagascana (DC.) Amo, P. intricata Willk., P. webbiana Willk., P. hispida auct. hisp.). Subglaucous, more or less fleshy, suffruticose perennial, glabrous or hairy. Lower leaves oblong, toothed, lobed or pinnatipartite, the lobes entire or toothed. Petals $6-10 \mathrm{~mm}$, bright yellow. Siliqua $12-60 \times 1.8-$ 3 mm when mature; gynophore $2 \cdot 5-7 \mathrm{~mm}$, conspicuous. $W$. Mediterranean region. Hs Si.
4. D. tenuifolia (L.) DC., op. cit. 632 (1821). Perennial, but sometimes flowering the first year, $20-80 \mathrm{~cm}$, woody at the base. Lower leaves not rosulate, petiolate, pinnatipartite, with 4-8 segments, glabrous or with some hairs at the margin, foetid when crushed. Petals $7 \cdot 5-14 \mathrm{~mm}$, sulphur-yellow. Siliqua $20-60 \times 1-$ 2 mm , borne erect on long patent pedicels; gynophore 0.5 mm , more or less conspicuous. $2 n=22$. W., S. and C. Europe; naturalized in Scandinavia and western margin of U.S.S.R.; casual

[^133]further east and north. Al Au Be Bl Bu Co Cz Ga Ge He Ho Hs Hu It Ju Po Rm Rs (K) Su Si Tu [*Br Da Fe No Rs (B, W) Su].
5. D. cretacea Kotov, Ukr. Bot. Žur. 3: 17 (1926). Annual or biennial $40-60(-80) \mathrm{cm}$. Stems much-branched, with deflexed hairs in the lower part, glabrous above. Leaves mostly basal, pinnatipartite or pinnatisect; segments obtuse. Petals $7-9 \mathrm{~mm}$, yellow. Siliqua $30-40 \times 2-2.5 \mathrm{~mm}$, with short ( $0.5-1 \mathrm{~mm}$ ), fleshy style; gynophore 1 mm . Bare chalky slopes in Donets basin (N.E. Ukraine and adjacent parts of Russia). Rs (C, E).

The affinities of this species are uncertain.
6. D. erucoides (L.) DC., Reg. Veg. Syst. Nat. 2: 631 (1821) (incl. D. valentina Pau). Annual or overwintering, $5-50 \mathrm{~cm}$. Stems 1 or many, erect or ascending, leafy. Leaves of two types: the lower $5-15 \mathrm{~cm}$, in a lax basal rosette, oblong-lyrate or pinnatisect, with 6-10 lobes, or the lowermost more or less entire or irregularly toothed; the upper sessile, more or less amplexicaul; all with sparse, slender hairs. Petals (5-)7-13 mm, white, violet-veined or becoming violet after anthesis. Siliqua (10-) 18 $45 \times 1 \cdot 5-3 \mathrm{~mm}$, ascending, with a usually 1 -seeded, conical beak up to 6 mm and almost as wide as the valves. $2 n=14$. S.W. Europe, extending eastwards to Italy; one station in Danube delta. Often casual in C. Europe. Bl Co Ga Hs It Rm Sa Si.
7. D. virgata (Cav.) DC., loc. cit. (1821). Annual $5-90 \mathrm{~cm}$, yellowish- or reddish-green. Stems erect or ascending, densely setose-hispid below. Leaves almost all basal, rosulate; or stems and branches leafy. Leaves petiolate or sessile, pinnatipartite, pinnatilobed or sinuate-dentate. Petals $5-8 \mathrm{~mm}$, sulphur-yellow, often violet-veined. Siliqua $15-50 \times 1-2 \mathrm{~mm}$, erect or erectopatent; beak $3-7 \mathrm{~mm}$, long-attenuate (or $1-4 \mathrm{~mm}$, short, compressed, as broad as the valves, var. platystylos (Willk.) Willk.), 1 -seeded or seedless. C. \& S. Spain; Portugal. Hs Lu.
8. D. viminea (L.) DC., op. cit. 635 (1821). Slender annual, $5-30 \mathrm{~cm}$, glabrous or slightly hairy. Leaves confined to a basal rosette, petiolate, lyrate-pinnatilobed, the lobes entire (or spathulate and toothed, var. integrifolia Guss.). Petals sulphur- or lemon-yellow. Siliqua $10-35(-40) \times 1.25-1.75 \mathrm{~mm}$, erecto-patent, borne on spreading pedicels; beak short ( $1-2 \mathrm{~mm}$ ) narrow. S. Europe ; often casual in C. Europe and naturalized in W. Germany, Holland and Romania. Az Bl Bu Ga Gr Hs It Ju Lu Sa Si Rs (K) [Ge Ho Rm].
9. D. muralis (L.) DC. op. cit. 634 (1821) (incl. D. scaposa DC.). Annual, biennial or perennial, $10-50 \mathrm{~cm}$, usually manystemmed; stems glabrous or sparsely hispid below. Leaves usually more or less confined to a basal rosette, with petioles up to 3 cm , lyrate-pinnatipartite, pinnatifid or sinuate-dentate, sometimes spathulate, entire. Cauline leaves, when present, subsessile, coarsely toothed. Petals $4-7 \cdot 5(-8 \cdot 5) \mathrm{mm}$, bright sulphur-yellow or sometimes becoming violet. Siliqua (15-)18-45×1.5-2.5 $(-3) \mathrm{mm}$, erecto-patent; beak more or less conical, seedless. $2 n=44$. C. \& S. Europe; naturalized or casual elsewhere. Al Bl Co Ga Ge Gr He Hs Hu It Ju Po Rm Rs (K) Sa Si [Br Hb Ho Su].

Extremely variable in habit and leaf-shape.

## 88. Brassica L. ${ }^{1}$

Herbs or small shrubs. Leaves entire to pinnatipartite. Sepals erect or patent, the inner larger than the outer. Petals yellow or white, clawed. Lateral nectaries prismatic, intense green. Ovary sometimes with a short gynophore. Fruit a siliqua with a long or
short beak; valves convex, with a prominent median vein. Seeds in 1-2 rows in each loculus, globose or rarely ovoid.

Literature: O. E. Schulz, Pflanzenreich 70 (IV. 105): 21-84 (1919). M. Onno, Österr. Bot. Zeitschr. 82: 309-34 (1933).

## 1 Cauline leaves very few or absent

2 Small shrub with long, thick, woody stock
2. balearica

2 Perennial herb, usually caespitose
3 Leaves all basal; seeds ovoid
21. repanda

3 A few cauline leaves present; seeds globose
20. gravinae 1 Stems $\pm$ leafy
4 Upper cauline leaves amplexicaul at the base
5 Siliqua $5-13 \mathrm{~mm}$; beak filiform
18. souliei

5 Siliqua more than 15 mm ; beak stout, conical
6 Siliqua $6-12 \mathrm{~mm}$ wide, with thick, woody valves; seeds $\pm$ biseriate 3. macrocarpa
6 Siliqua 2-5 mm wide, with herbaceous valves; seeds uniseriate
7 Sepals erecto-patent; slender annual with herbaceous stems
8 Open flowers not overtopping the buds of the inflorescence; leaves glabrous or with sparse hairs, glaucous
10. napus

8 Open flowers overtopping the buds of the inflorescence; leaves setose-ciliate, bright green
11. rapa

7 Sepals connivent; biennial or perennial with woody stems 9 Lower leaves pubescent to tomentose
10 Siliqua 25-40(-55) mm, tetragonal, abruptly contracted into a beak 6. villosa
10 Siliqua $30-100 \mathrm{~mm}$, terete, gradually attenuate into beak
7. incana 9 Leaves glabrous or with sparse hairs
11 Basal leaves $\pm$ undivided, broadly ovate, spathulate or suborbicular, sinuate-crenate or -dentate
12 Petiole at least half as long as the lamina; cauline leaves usually truncate at base $\quad 8$. insularis
12 Petiole not more than $\frac{1}{3}$ as long as the lamina; cauline leaves usually auriculate at base 9. cretica
11 Basal leaves lyrate-pinnatipartite
13 Terminal lobe of basal leaves pinnatipartite, $\pm$ acute; petiole $\pm$ equalling the lamina; siliqua tetragonal
5. rupestris

13 Terminal lobe of basal leaves entire or pinnatifid, obtuse; petiole shorter than the lamina; siliqua terete
4. oleracea

4 Upper cauline leaves sessile or petiolate, not amplexicaul
14 Siliqua appressed to the stem; beak filiform
19. nigra

14 Siliqua erecto-patent or recurved; beak attenuate to cylindrical
15 Siliqua distinctly stipitate (stalk $1.5-4.5 \mathrm{~mm}$ ); beak $0.5-$ 2.5 mm

1. elongata

15 Siliqua sessile or very shortly stipitate (stalk not more than 1.2 mm ); beak $3-23 \mathrm{~mm}$

16 Lower part of the inflorescence bracteate; siliqua distinctly hairy
17. procumbens

16 Inflorescence ebracteate; siliqua glabrous
17 Beak of the siliqua nearly as long as the valves; flowers nodding after anthesis
14. barrelieri

17 Beak of the siliqua shorter than the valves; flowers remaining erect after anthesis
18 Petals $5-7 \times 1.5 \mathrm{~mm}$, small and narrow; beak of the siliqua $10-23 \mathrm{~mm}$ 15. tourneforti
18 Petals 6-12 $\times 2-3 \mathrm{~mm}$, conspicuous; beak of siliqua $3-10 \mathrm{~mm}$
19 Lower leaves runcinate-pinnatifid, with 7-10 pairs of lobes
14. barrelieri

19 Lower leaves lyrate-pinnatifid or pinnatipartite, with 3-8 pairs of lobes
20 Sepals glabrous or with few scattered hairs at the apex
21 Biennial or perennial; sepals erect; siliqua stipitate; beak 3-6 mm
13. fruticulosa
21 Annual; sepals erecto-patent; siliqua sessile; beak 5-10 mm
12. juncea
20 Sepals shortly villous
22 Lower leaves with 3-5 pairs of lobes; terminal lobe unequally crenate-callose; petals 6.5 mm ; beak of siliqua $3-5 \mathrm{~mm}$
16. cadmea
22 Lower leaves with 5-8 pairs of lobes; terminal lobe sinuate-dentate, not callose; petals 8 mm ; beak of siliqua $4-8 \mathrm{~mm}$
13. fruticulosa

1. B. elongata Ehrh., Beitr. Naturk. 7: 159 (1792). Biennial or short-lived perennial. Lower leaves petiolate, obovate to elliptical, sinuate-pinnatifid, covered with curved bristles on both surfaces. Petals $7-10 \mathrm{~mm}$, yellow. Siliqua $1 \cdot 5-2 \cdot 2 \mathrm{~cm}$, attenuate into a seedless beak $0 \cdot 5-2.5 \mathrm{~mm}$, obviously stipitate, the stalk $1 \cdot 5-4 \cdot 5 \mathrm{~mm}$. S.E. Europe, westwards to Hungary and Czechoslovakia; naturalized elsewhere as a weed or ruderal. Au Bu Cz Hu Ju Rm Rs (W, K, E).
(a) Subsp. elongata: Leaves sinuate-pinnatifid. In the western part of the range of the species; introduced elsewhere. Au Bu Cz Ju Rm [Ga Ge Ho It].
(b) Subsp. integrifolia (Boiss.) Breistr., Bull. Soc. Sci. Dauph. 60: 139 (1944) (as preprint p. 13 (1942)) (B. elongata subsp. persica (Boiss. \& Hohen.) Thell., B. persica Boiss. \& Hohen.): Leaves entire. S. Russia, Ukraine. Rs (W, K, E) [Au Da Hu It Ju Rm Rs (C)].
B. jordanoffii O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 10: 111 (1927), described from Bulgaria (Pirin Planina), is like 1 but is said to have a woody stock, unbranched stems and few cauline leaves.
2. B. balearica Pers., Syn.Pl. 2:206(1806). Completely glabrous small shrub with long, thick, woody stock. Leaves mostly basal, long-petiolate, lyrate or pinnatilobed, resembling those of Quercus robur. Flowering stems up to $25(-30) \mathrm{cm}$. Petals $10-$ 15 mm , yellow. Siliqua $20-60 \times 2-2.5 \mathrm{~mm}$, linear, terete, constricted at intervals, terminating in a 1 -seeded or seedless beak $1 \cdot 5-3 \mathrm{~mm}$ long. Mallorca. Bl.
3. B. macrocarpa Guss., Ind. Sem. Boccad. 1824/5: 3 (1825). Completely glabrous small shrub; stems $30-60 \mathrm{~cm}$. Basal leaves $10-18 \times 4-10 \mathrm{~cm}$, lyrate-pinnatifid or pinnatilobed, the lobes crenate-dentate; petioles up to 8 cm ; cauline leaves oblong to lanceolate, entire or shallowly toothed. Petals up to 20 mm , yellow. Siliqua $20-55 \times 5-12 \mathrm{~mm}$, very thick and fleshy; valves thick and woody, 1 -veined, boat-shaped, attenuate into a conical, 0 - to 2 -seeded beak $8-15 \mathrm{~mm}$ long. Maritime rocks. - Isole Egadi. Si.
B. drepanensis (Caruel) Damanti, Nat. Sicil. 10 (4): 91 (1891), from the adjoining mainland of Sicilia at Trapani, differs conspicuously in its densely tomentose leaves and its smaller fruits with a slender beak. Its status is doubtful.
4. B. oleracea L., Sp. Pl. 667 (1753) (B. sylvestris (L.) Miller). Glabrous biennial to perennial herb up to 300 cm ; lower part of stems becoming woody and covered with leaf-scars. Basal leaves up to 40 cm , usually petiolate, lyrate-pinnatipartite, crenate; cauline leaves ovate-lanceolate or oblong, entire, sessile (petiolate in some cultivars). Inflorescence paniculate, 20- to $50(-300)$ flowered, soon elongating. Petals $15-20 \mathrm{~mm}$, yellow. Siliqua 50 $70(-100) \times 2-4(-5) \mathrm{mm}$, linear-terete, with a short conical beak $4-8(-10) \mathrm{mm}$ long, as wide as the valves at the base. Maritime cliffs. West coasts of Britain, France, N. Spain; Mediterranean and Adriatic coasts from N.E. Spain to N. Italy. Widely cultivated as a vegetable. ${ }^{*} \mathrm{Br} \mathrm{Ga} \mathrm{Hs} \mathrm{It}[\mathrm{Bu} \mathrm{Cz} \mathrm{Ge} \mathrm{Ho} \mathrm{Ju]}$.

Many cultivars have been derived from this and related species. There is great diversity in the taxonomic treatment of them, some authors regarding the wild plants as forming a separate species, B. sylvestris (L.) Miller (vide M. Onno, Österr. Bot. Zeitschr. 82: 309-34 (1933)), while others regard the cultivars as subspecies and varieties of B. oleracea. Lizgunova (Bull. Appl. Bot. Pl.-Breed. (Leningrad) 32: 37-70 (1959)) recognizes five separate cultivated species with numerous subspecies. Some of the cultivars occur as escapes.
(a) Subsp. oleracea: Terminal lobe of basal leaves usually entire. West coasts of France, N. Spain and Britain, probably native ; naturalized elsewhere. $2 n=18 .{ }^{*} \mathrm{Br}{ }^{*} \mathrm{Ga} * \mathrm{Hs}[\mathrm{Bu} \mathrm{Cz} \mathrm{Ge}$ Ho Ju].
(b) Subsp. robertiana (Gay) Rouy \& Fouc., Fl. Fr. 2: 53 (1895) (incl. B. montana Pourret): Terminal lobe of basal leaves usually pinnatifid. $2 n=18$. S. Europe, from N.E. Spain to S. Italy, mainly coastal. Ga Hs It.
5. B. rupestris Rafin., Caratt. 77 (1810). Glabrous, branched small shrub; stems up to 150 cm . Basal leaves $20-40 \mathrm{~cm}$, lyrate-pinnatipartite with terminal lobe pinnately divided, more or less acute; petiole about as long as the lamina. Siliqua $35-50(-70) \times 3-5 \mathrm{~mm}, 4$-angled, attenuate into a slender beak 36 mm long ( $7-12 \mathrm{~mm}$ in var. longirostris Guss.). $2 n=18$. Sicilia; S. Italy. It Si.
6. B. villosa Biv., Stirp. Rar. Sic. Descr. 4: 20 (1816) (incl. B. tinei Lojac.). Like 5 but terminal lobe of basal leaves more or less undivided, obtuse, pubescent, villous, or whitetomentose; petiole shorter than the lamina; siliqua 25-40 (-55) mm , abruptly contracted into beak 5 mm long. Sicilia. Si.

Usually very distinct from 5 although the geographical range and habitat is nearly identical; some transitional forms are, however, known.
7. B. incana Ten., Prodr. Fl. Nap. xxxix (1811). Woody at base, branched; stems up to 100 cm glabrous except at base. Basal leaves up to 40 cm , pubescent to tomentose, shortly petiolate, lyrate, with the terminal lobe undivided, usually obtuse. Siliqua $40-80 \times 2-3 \mathrm{~mm}$, linear, constricted at intervals, terete, gradually attenuate into beak. W. \& S. coasts of Italy, Sicilia and Jugoslavia. It Ju Si.

In the islands of the Adriatic a number of endemic variants, distinguished principally by fruit characters, have been recognized as species: B. botteri Vis., Fl. Dalm. 3: 135 (1850) with siliqua $30-40 \times 4-5 \mathrm{~mm}$; B. cazzae Ginzberger \& Teyber, Österr. Bot. Zeitschr. 19: 238 (1921) with siliqua $35-50(-60) \times 3-3 \cdot 5 \mathrm{~mm}$, and B. mollis Vis., Fl. Dalm. 3: 359 (1852) with siliqua $40-60 \times 3-$ 4 mm . Their status is uncertain.
8. B. insularis Moris, Fl. Sard. 1: 168 (1837). Perennial up to 150 cm . Basal leaves $10-15 \mathrm{~cm}$, lyrate or spathulate; terminal lobe broad and rounded or narrowly elongate, crenate or dentate, glabrous or with a few hairs on margins; petiole usually half as long as the lamina or more. Cauline leaves usually truncate at the base. Petals white or pale yellow. Siliqua $30-70(-90) \times 3-$ 5 mm , linear, attenuate into beak $5-10 \mathrm{~mm}$ long, which is narrower than siliqua. $2 n=18$. Corse, Sardegna. Co Sa.
9. B. cretica Lam., Encycl. Méth. Bot. 1: 747 (1785). Like 8 but petioles of basal leaves a third as long as the lamina or less; cauline leaves usually auriculate at the base; beak usually as
broad as the siliqua at the base.

- S.E. Greece and Aegean region. Cr Gr.

This species has been divided into a number of local geographical variants, one of which (var. nivea (Boiss. \& Spruner) O. E. Schulz) is somewhat transitional to B. insularis in leafshape and in having usually white petals. The cauliflower (subsp. botrytis (L.) O. Schwarz) is regarded as having been derived from this species.
10. B. napus L., Sp. Pl. 666 (1753). Annual or biennial, with slender or stout, often fusiform or tuberous taproot; stems up to 150 cm . Basal leaves lyrate, sometimes ciliate, petiolate, glaucous and glabrous, or with few bristly hairs especially along veins; upper cauline leaves sessile, more or less entire, amplexicaul. Open flowers not overtopping buds of inflorescence. Sepals erecto-patent. Petals $10-18 \mathrm{~mm}$, yellow. Siliqua $50-100 \times 2 \cdot 5$ 4 mm , suberect, attenuate into a long slender beak $5-25(-30) \mathrm{mm}$. $2 n=38$. Cultivated in most European countries and naturalized in many of them.

In addition to subsp. napus a large number of cultivars are extensively cultivated. There are numerous different classifications of these cultivars and interpretations of their relationship to the wild subspecies. A summary is given in E. N. Sinskaja, Bull. Appl. Bot. Pl.-Breed. (Leningrad) 33: 233-50 (1960). The principal ones are the following which occasionally occur as escapes: subsp. pabularia (DC.) Janchen ('primitive' leaf rape), with a slender, annual root and crispate, dissected leaves, subsp. oleifera DC. (rape), biennial with a non-tuberous root, lyrate-pinnatifid leaves, and subsp. rapifera Metzger, biennial with a thickened, more or less globose, fleshy, edible stem-base and a taproot. Var. napobrassica (L.) Reichenb. (swede) $(2 n=38)$, with pale buff-coloured flowers and an edible swollen stem-base and yellowfleshed taproot, has been derived from B. oleracea $\times B$. napus by dibasic polyploidy.

It is thought that crosses of $B$. oleracea subsp. oleracea ( $2 n=18$ ) with B. rapa $(2 n=20)$ gave rise to subsp. pabularia ( $2 n=38$ ), from which subsp. napus $(2 n=38)$ and subsp. rapifera $(2 n=38)$ and other cultivars were derived.
11. B. rapa L., Sp. Pl. 666 (1753) (B. campestris L.). Like 10 but basal leaves bright green, with setiform hairs; upper cauline leaves glaucous; open flowers overtopping buds of the inflorescence; sepals patent; petals $6-10 \mathrm{~mm}$, yellow.
(a) Subsp. sylvestris (L.) Janchen in Janchen \& Wendelberger, Kleine Fl. Wien 55 (1953), (B. campestris L. pro parte): $2 n=20$. Weed or ruderal in much of Europe; native distribution not known with certainty. *[?Al Bl Bu Co Cz Da Fe Ge Gr Ho Hs Hu Is It Ju No Rm Rs (E) Sa Si Su.]
(b) Subsp. rapa: (turnip), is cultivated for its tuberous taproot and sometimes occurs as an escape.

Another cultivated race is subsp. oleifera DC. (turnip rape), grown as a fodder crop; it differs from subsp. sylvestris in its larger, reddish-brown seeds, and non-tuberous taproot.
12. B. juncea (L.) Czern., Consp. Pl. Charc. 8 (1859). Annual up to 100 cm . Branches long, erecto-patent. Lower leaves petiolate, lyrate-pinnatisect with 1-2 pairs of lobes on each side and a larger, sparsely setose, terminal lobe; upper leaves subentire, shortly petiolate, glabrous. Sepals erecto-patent; petals $6-9 \mathrm{~mm}$. Siliqua $30-60 \times 2-3.5 \mathrm{~mm}$, constricted at intervals, sessile, attenuate into a tapering, seedless beak $5-10 \mathrm{~mm}$ long. Cultivated for its seeds in S. Russia; a casual or established weed in other parts of Europe. [Bu Cz Ge Ho Hs Hu Rm Rs (E).] (S. \& E. Asia.)
13. B. fruticulosa Cyr., Pl. Rar. Neap. 2: 7 (1792). Annual to perennial, usually becoming woody at base; stems up to 50 cm , erect. Lower leaves long-petiolate, lyrate-pinnatifid, with 2-3 pairs of rounded or obtuse lobes, the terminal lobe much larger than lateral, suborbicular, hispid; upper leaves smaller, pinnatilobed to entire. Sepals suberect; petals $9-10 \mathrm{~mm}$, yellow. Siliqua $15-40 \times 1 \cdot 5-2 \mathrm{~mm}$, constricted at intervals, stipitate, the stalk $1-3 \mathrm{~mm}$; beak $2-7 \mathrm{~mm}, 0-1$-seeded. Mediterranean region. Ga * Gr Hs It Sa Si. [Br He ?Ju.]
(a) Subsp. fruticulosa: Usually biennial to perennial, woody at base. Sepals glabrous or sparsely hairy. Throughout the range of the species.
(b) Subsp. cossoniana (Boiss. \& Reuter) Maire in Jahandiez \& Maire, Cat. Pl. Maroc 2: 287 (1932) (B. cossoniana Boiss. \& Reuter): Annual, scarcely woody at base. Sepals densely villous. S. Spain. (N.W. Africa.)
14. B. barrelieri (L.) Janka, Term. Füz. 6: 179 (1882) (B. laevigata Lag., B. sabularia Brot.). Annual, rarely perennial; stems up to 50 cm . Lower leaves numerous, rosulate, very shortly petiolate, runcinate-pinnatifid, with 7-10 pairs of lanceolate, acuminate lobes, hispid, especially along the thick, white rhachis, and ciliate. Cauline leaves few, sessile, more or less entire, glabrous. Sepals erect, sparsely hispid or glabrous; petals 712 mm , obovate, yellow with livid veins, or whitish. Siliqua $25-$ $60 \times 1.5-2.5 \mathrm{~mm}$, constricted at intervals, very shortly stipitate, attenuate into a 0 - to 2 -seeded beak $5-30 \mathrm{~mm}$ long. Sandy soils. Spain and Portugal. ?B1 Hs Lu.
(a) Subsp. barrelieri: Petals $9-12 \mathrm{~mm}$. Beak much shorter than valvar portion of siliqua, 0 - to 1 -seeded. C. \& S. Spain, Portugal.
(b) Subsp. oxyrrhina (Cosson) P. W. Ball \& Heywood, Feddes Repert. 66: 154 (1962) (B. oxyrrhina Cosson): Petals $7-8 \mathrm{~mm}$. Beak nearly as long as valvar portion of siliqua or longer, usually 2-seeded. S. Spain, S. Portugal.
15. B. tournefortii Gouan, Obs. Bot. 44 (1773). Like 14 but leaf-lobes obtuse; sepals suberect; petals $5-7 \mathrm{~mm}$, narrowly oblong-obovate, pale yellow, usually violaceous at base, becoming whitish; siliqua $35-65 \times 2.5-3 \mathrm{~mm}$; beak $10-20 \mathrm{~mm}, \frac{1}{3}-\frac{1}{2}$ as long as the valvar portion. Mediterranean region. CrGrHs It ? $\mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.
16. B. cadmea Heldr. ex O. E. Schulz, Pflanzenreich 70 (IV. 105): 63 (1919). Annual; stems $30-60 \mathrm{~cm}$. Basal and lower cauline leaves shortly petiolate, pinnatipartite, with 3-5 pairs of irregularly crenate, callose-tipped lobes; cauline leaves much smaller and less divided; all sparsely hispid with appressed tuberclebased hairs. Petals 6.5 mm , yellow. Siliqua $15-30 \times 1.5-2 \mathrm{~mm}$, terminated by a short, broad, 1 -seeded beak $3-5 \mathrm{~mm}$ long. Clayey hills. -Greece (near Thivai). Gr.
17. B. procumbens (Poiret) O.E.Schulz, Bot.Jahrb. 54 Beibl. 119 : 55 (1916) (Sinapis procumbens Poiret). Annual; stems 20-50 mm, spreading or ascending. Lower leaves sessile, lyrate-pinnatifid, with acute dentate or entire lobes, sparsely hairy or glabrous. Sepals sparsely hairy; petals 8 mm , yellow. Siliqua $15-25 \times$ 1.8 mm , erect, hairy, patent or sometimes deflexed, constricted at intervals, attenuate into a 0 - to 1 -seeded beak $5-8 \mathrm{~mm}$ long. Arcipelago Toscano (Giglio). It. (N.W. Africa.)
18. B. souliei (Batt.) Batt., Bull. Soc. Bot. Fr. 40: 262 (1893) (B. amplexicaulis (Desf.) Pomel, non Hochst.). Annual $10-40 \mathrm{~cm}$, many-stemmed and branched from the base. Lower leaves petiolate, obovate or oblong, sinuate-dentate, obtuse at apex, glabrous or sparsely hairy, ciliate; upper leaves amplexicaul at the base. Petals $5-7 \mathrm{~mm}$, yellow. Siliqua $5-12 \times 1-2 \mathrm{~mm}$,
attenuate into a filiform, seedless beak, and borne on patent or recurved pedicels $5-15(-40) \mathrm{mm}$ long. Dry places and arable land. Sicilia. Si. (N.W. Africa.)
19. B. nigra (L.) Koch in Röhling, Deutschl. Fl. ed. 3, 4: 713 (1833). Annual; stems up to 100 cm or more, branched from the middle or from near the base. Lower leaves lyrate-pinnatisect, with 1-3 pairs of lateral lobes and a much larger terminal lobe, hispid on both surfaces; upper leaves linear-oblong, entire or sinuate, glabrous; all leaves petiolate. Petals $7-9 \mathrm{~mm}$, yellow. Siliquae $10-20 \times 1.5-2 \mathrm{~mm}$, attenuate into a slender, seedless beak, on short ( $2 \cdot 5-6 \mathrm{~mm}$ ) pedicels appressed to the stem. $2 n=16$. Most of Europe but commonest in the centre and south; usually as an alien but its range as a native is uncertain. *All except Al Bl Is Sb .
20. B. gravinae Ten., Prodr. Fl. Nap. xxxix (1811). Caespitose perennial; stems $10-30(-50) \mathrm{cm}$, usually simple, hispid or pubescent. Basal leaves densely rosulate, shortly petiolate, oblong or obovate, lyrate, sinuate-dentate or pinnatifid; terminal lobe obovate, obtuse, crenate-dentate, somewhat fleshy; cauline leaves few, subsessile, slightly dentate. Racemes 25 - to 40 -flowered. Petals 9 mm , yellow. Siliqua $20-50 \times 2 \cdot 5-3 \mathrm{~mm}$, subterete, attenuate into a seedless beak $2 \cdot 5-4 \mathrm{~mm}$ long. Seeds globose. Rocks and stony places. C. \& S. Appennini. It.
21. B. repanda (Willd.) DC., Reg. Veg. Syst. Nat. 2: 598 (1821) (Diplotaxis saxatilis DC.). Laxly to densely caespitose; stems up to 50 cm , usually leafless, glabrous or hairy. Basal leaves $1-15 \mathrm{~cm}$, entire to pinnatipartite. Racemes 2 - to $35-$ flowered. Petals $7-30 \mathrm{~mm}$, yellow. Siliqua $10-80 \times 1-4.5 \mathrm{~mm}$, variable in shape and proportions, gradually or abruptly attenuate into a seedless beak. Usually in rocky or stony places. S.W. Europe. Ga Hs It.

A very complex species which may be divided into three main groups, subsp. repanda (S.W. Alps, Italy), subsp. saxatilis (S. France) and a series of subspecies in Spain, S. France and N. Africa. A key is given below to the more important geographical variants, but anomalous populations occur in the Pyrenees and neighbouring regions and a number of taxa remain to be adequately characterized and described.
1 Petals $15-25 \mathrm{~mm}$
2 Petals cuneate; apex truncate; leaves glaucous, fleshy (S.E. Spain)
(d) subsp. maritima

2 Petals obovate; apex rounded; leaves green, membranous (Pyrenees)
(c) subsp. galissieri

1 Petals 14 mm or less
3 Siliqua 1-2 mm wide
4 Plants laxly caespitose, with the stock $\pm$ unbranched; leaves pinnatipartite, with oblong segments (low hills in C. Spain)
(j) subsp. nudicaulis

4 Plants densely caespitose with woody, branched stock; leaves sinuate-dentate to pinnatifid (mountains of S. and S.E. Spain)
(e) subsp. confusa

3 Siliqua $2 \cdot 5-4.5 \mathrm{~mm}$ wide
5 Racemes 2- to 8(-12)-flowered; siliqua $20-30(-60) \times 3$ 3.5 mm , abruptly contracted into the beak; leaves sinuatedentate (France, Italy) (a) subsp. repand
5 Racemes with 12-35 flowers, or, if fewer-flowered, siliqua less than 3 mm wide; siliqua $25-80 \times 2-4.5 \mathrm{~mm}$, gradually attenuate into the beak
6 Siliqua not more than 2.5 mm wide (S. France)
(b) subsp. saxatilis

6 Siliqua at least 2.5 mm wide
7 Leaves $2-5(-6) \mathrm{cm}$ long, entire or slightly toothed, or, if pinnatipartite, $1 \cdot 5-2 \mathrm{~cm}$ (S. Spain) (i) subsp. latisiliqua
7 Leaves $4.5-10 \mathrm{~cm}$, sinuately lobed, pinnatifid to pinnatipartite

8 Leaves $4.5-8 \mathrm{~cm}$, deeply pinnatipartite, the lobes rounded, denticulate; siliqua $50 \times 3-4 \mathrm{~mm}$ (N.W. Spain)
(f) subsp. cantabrica

8 Leaves 6-10 cm, sinuate-lobed to pinnatifid with the lobes entire
9 Siliqua $40-60 \times 3.5-4 \mathrm{~mm}$, pendent (N.E. Spain)
(g) subsp. cadevallii

9 Siliqua $50-80 \times 2.5-3 \mathrm{~mm}$, patent or ascending (S. Spain)
(h) subsp. blancoana
(a) Subsp. repanda: Stems $2-10 \mathrm{~cm}$. Leaves $5-40 \mathrm{~mm}$, spathulate or obovate, sinuate-dentate, rarely pinnatifid. Racemes 2 - to 12 -flowered. Siliqua $20-30(-60) \times 3-3 \cdot 5 \mathrm{~mm}$. © S.W. Alps, Italy.
(b) Subsp. saxatilis (DC.) Heywood, Feddes Repert. 69: 151 (1964) (Diplotaxis saxatilis (Lam.) DC.): Stems 2-16 cm. Leaves $2-6 \mathrm{~cm}$, usually pinnatipartite. Racemes 2 - to 10 -flowered. Siliqua $20-50 \times 2-2.5 \mathrm{~mm}$. $\quad$. France (near Aix and Montpellier).
(c) Subsp. galissieri (Giraud.) Heywood, Feddes Repert. 69 : 150 (1964) (Diplotaxis galissieri Giraud.): Stems $30-40 \mathrm{~cm}$. Leaves $6-10 \mathrm{~cm}$, pinnatipartite; petiole usually longer than lamina. Racemes up to 35 -flowered, dense. Siliqua $40-55 \times 2 \cdot 5-$ 3 mm . S. France (Ariège).

Similar plants occur in the Aragonese Pre-Pyrenees.
(d) Subsp. maritima (Rouy) Heywood, Feddes Repert. 66: 153 (1962) (Diplotaxis maritima Rouy): Distinguishable from the other subspecies by its fleshy, glaucous leaves, and compact, many-flowered corymb of showy flowers, with broad, cuneate petals, truncate at apex. Maritime rocks. - E. Spain (Montgó and Puig Campana, Alicante prov.).
(e) Subsp. confusa (Emberger \& Maire) Heywood, Feddes Repert. 66: 153 (1962) (Brassica saxatilis subsp. confusa Emberger \& Maire, Brassica humilis sensu Willk. pro parte): Densely caespitose with woody branched stock; stems $10-35 \mathrm{~cm}$. Leaves $3-8 \mathrm{~cm}$, sinuate-dentate to pinnatifid. Racemes 10 - to $30-$ flowered. Siliqua $30-50 \times 1-2 \mathrm{~mm}$. Mountains of S. and S.E. Spain.

Plants similar but with wider fruits occur in the Spanish Pyrenees.
(f) Subsp. cantabrica (Font Quer) Heywood, Feddes Repert. 69: 151 (1964): Stems $10-20 \mathrm{~cm}$. Leaves $4.5-8 \mathrm{~cm}$, pinnatipartite or pinnatisect. Racemes 15 - to 25 -flowered. Siliqua $25-35 \times 3$ 4 mm . Limestone rocks. $\quad$ N.W. Spain (Peña Mayor).
(g) Subsp. cadevallii (Font Quer) Heywood, Feddes Repert. 66: 154 (1962): Stems $30-35 \mathrm{~cm}$. Leaves $8-10 \mathrm{~cm}$, pinnatifid or pinnatipartite. Racemes 10 - to 30 -flowered. Siliqua $40-60 \times$ 3.5-4 mm, pendent. Limestone rocks. - N.E. Spain.
(h) Subsp. blancoana (Boiss.) Heywood, Feddes Repert. 66: 153 (1962) (Brassica blancoana Boiss.; Diplotaxis saxatilis var. longifolia (Rouy) Willk.): Stems $30-45 \mathrm{~cm}$. Leaves $6-10 \mathrm{~cm}$, sinuate to pinnatifid. Racemes 10 - to 20 -flowered. Siliqua $50-$ $80 \times 2 \cdot 5-3 \mathrm{~mm}$. Rocks and screes. - Mountains of S.E. Spain.
(i) Subsp. latisiliqua (Boiss. \& Reuter) Heywood, Feddes Repert. 66: 153 (1962) (Brassica latisiliqua Boiss. \& Reuter): Stems $10-30 \mathrm{~cm}$. Leaves $2-4(-6) \mathrm{cm}$, entire, slightly toothed or pinnatipartite. Racemes 8 - to 20 -flowered. Siliqua $25-50 \times 2.5-$ 3.5 mm . Mountains of S. Spain (Sierra Nevada, Sierra Tejeda).
(j) Subsp. nudicaulis (Lag.) Heywood, Feddes Repert 69: 151 (1964) (Brassica barrelieri auct. hisp. mult., non (L.) Janka): Differs from the other subspecies in its slightly caespitose habit and slender stock. Leaves pinnatipartite. Racemes 10 - to 30 -flowered. Siliqua $10-30 \times 1-2(-2 \cdot 5) \mathrm{mm}$. C. Spain.

## 89. Sinapis L. ${ }^{1}$

Annual or perennial herbs. Leaves pinnatifid or pinnatisect. Sepals patent, equal or subequal; petals yellow, clawed. Lateral

[^134]nectaries not prismatic. Fruit a siliqua with a long beak; valves distinctly 3 - to 7 -veined. Seeds in 1 row in each loculus, globose.

1 Siliqua with 8-17 seeds; beak cylindrical or conical, not or scarcely compressed
2 Ripe siliqua 25 mm or more, glabrous or with short, stiff, deflexed hairs 1. arvensis
2 Ripe siliqua not more than 25 mm , densely covered with long, fine, ascending hairs
2. pubescens

1 Siliqua with $4-8$ seeds; beak strongly compressed
3 Fruiting pedicels usually 6-15 mm; petals more than 10 mm ; sepals more than 4.5 mm ; leaves variably covered with short, stiff hairs, but scarcely scabrid
3. alba

3 Fruiting pedicels usually $3-9 \mathrm{~mm}$; petals less than 8 mm ; sepals less than 4.5 mm ; leaves scabrid with short, stiff hairs
4. flexuosa

1. S. arvensis L., Sp. Pl. 668 (1753) (incl. S. orientalis L., S. schkuhriana Reichenb.). Annual; stems up to 80 cm , usually hispid at least below, sometimes glabrous. Leaves up to 20 cm , usually hispid; lower stalked, lyrate, with large, coarsely toothed terminal lobe, usually with several smaller lateral lobes; upper leaves sessile, usually simple, lanceolate. Siliqua $25-45(-55) \times$ (1.5-)2.5-4 mm, patent; valves glabrous (or with short, stiff, deflexed hairs, var. orientalis (L.) Koch \& Ziz); beak $10-15 \mathrm{~mm}$, straight. Seeds usually 8-13, reddish-brown or blackish. $2 n=18$. $A$ weed of arable land. Native probably in the Mediterranean region, but introduced throughout Europe, becoming rarer in the north. All except Az Sb ; only casual in Fa Is.

Var. orientalis (L.) Koch \& Ziz is as widespread as the type.
2. S. pubescens L., Mantissa 95 (1767). Perennial; stems up to 80 cm , densely pubescent or villous. Leaves appressedpubescent; lower stalked, lyrate-pinnatisect; upper sessile, oblong, less divided or simple. Siliqua $15-25 \times 2-2.5 \mathrm{~mm}$, erect, covered to the apex with long, fine, ascending hairs; beak $9-12 \mathrm{~mm}$, curved. Seeds usually 12-17, blackish. C. \& S. Italy, Sardegna and Sicilia; formerly in S.E. France. †Ga It Sa Si [Ge].
3. S. alba L., Sp. Pl. 668 (1753). Annual; stems up to 80 cm , usually with stiff, deflexed hairs, sometimes glabrous. Leaves usually hispid but not scabrid, all petiolate. Siliqua $20-40 \times 3-$ 6.5 mm , patent; beak $10-30 \mathrm{~mm}$, attenuate. Seeds $4-8$. Native in the Mediterranean region and Krym; naturalized throughout the rest of Europe but becoming rare or only casual in the north. All except $\mathrm{Az} \mathrm{Sb} \mathrm{Tu;} \mathrm{only} \mathrm{casual} \mathrm{in} \mathrm{Fa} \mathrm{Fe}$ Is Rs (N).
(a) Subsp. alba: Leaves lyrate-pinnatifid or lyrate-pinnate. Siliqua $20-40 \times 3-4 \mathrm{~mm}$; valves usually hispid; beak $10-30 \mathrm{~mm}$. Seeds yellow or pale brown. $2 n=24$. Usually a weed of cultivated land. Throughout the range of the species.
Widely cultivated as a forage crop and for the condiment obtained from the seeds.
(b) Subsp. dissecta (Lag.) Bonnier, Fl. Compl. Fr. 1: 58 (1912) (S. dissecta Lag.): Leaves twice pinnatifid, not lyrate; terminal lobe oblong-ovate, not or scarcely larger than the oblong-linear lateral lobes. Siliqua $25-30 \times 3.5-6.5 \mathrm{~mm}$; valves slightly hairy or glabrous; beak $10-20 \mathrm{~mm}$. Seeds greyish-brown. A weed of cultivated land, usually of flax-fields. Mediterranean region and Krym; naturalized in several territories northwards to Britain and Romania.
4. S. flexuosa Poiret in Lam., Encycl. Méth. Bot. 4: 341 (1797) ( $S$. hispida Schousboe). Like 3 but stems more strongly hispid; leaf-surfaces scabrid with very rough, short hairs; fruiting pedicels shorter; sepals and petals smaller; siliqua $25-50 \times 2 \cdot 5-4 \mathrm{~mm}$; beak $15-30 \mathrm{~mm}$, often curved, scarcely attenuate. Seeds usually 7 or 8, greyish-brown. S. Spain. Hs.

## 90. Eruca Miller ${ }^{1}$

Like Sinapis but sepals erect, the inner somewhat saccate at base; valves of the siliqua 1 -veined; seeds in 2 rows in each loculus.

1. E. vesicaria (L.) Cav., Descr. Pl. 426 (1802). Usually hispid annual $20-100 \mathrm{~cm}$. Leaves lyrate-pinnatifid (rarely pinnate), with large terminal lobe and 2-5 narrow lateral lobes on each side. Petals $15-20 \mathrm{~mm}$, whitish or yellowish with violet veins. Siliqua $12-25 \times 3-6 \mathrm{~mm}$, erect; beak ensiform; pedicels short. Mediterranean region; cultivated as a salad plant and often naturalized, so that the native distribution is obscured. Bl Bu Co Cr Ga * Gr He Hs Hu It *Ju Lu RmRs (C, W, K, E) Sa Si Tu [Au Br Cz Ge No Po].
(a) Subsp. vesicaria: Sepals all cucullate, persistent until the fruit is nearly ripe; anthers subacute. Spain, Islas Baleares.
(b) Subsp. sativa (Miller) Thell. in Hegi, Ill. Fl. Mitteleur. 4 (1): 201 (1918): Sepals caducous, the inner not cucullate; anthers obtuse. $2 n=22$. Throughout the range of the species.

## 91. Erucastrum C. Presl ${ }^{1}$

Annual or perennial. Flowers in terminal racemes. Sepals erecto-patent, the inner somewhat saccate. Petals yellow, clawed. Lateral nectaries semilunar or bilobed. Fruit a linear, torulose siliqua; valves keeled, strongly 1 -veined, with a lateral network of smaller veins; beak more or less conical, with $0-3$ seeds. Seeds in 1 row in each loculus, ovoid or oblong.

## 1 Leaves somewhat fleshy; the upper cauline small, linear, conspicuously different from the basal

2 Basal leaves densely hispid; hairs $0.1-0.4 \mathrm{~mm}$; ovules 17-24; siliqua not contracted at base of beak 1. laevigatu
2 Basal leaves sparsely hispid; hairs $0.5-0.75 \mathrm{~mm}$; ovules 11-18; siliqua distinctly contracted at base of beak $\quad$ 2. virgatum
1 Leaves membranous; the upper cauline similar to basal
3 Raceme bracteate below; sepals erect; siliqua not stipitate
5. gallicum

3 Raceme ebracteate; sepals patent; siliqua stipitate
4 Somewhat hairy; lower cauline leaves lyrate-pinnatisect, with 6-8 lobes on each side; petal-limb broadly obovate
3. nasturtiifolium

4 Entirely glabrous; lower cauline leaves pectinate-pinnatisect, with 16-18 lobes on each side; petal-limb narrowly elliptical
4. palustre

1. E. laevigatum (L.) O. E. Schulz, Bot. Jahrb. 54 Beibl. 119: 56 (1916) (E. baeticum (Boiss.) Nyman, E. pseudosinapis Lange, Sinapis laevigata L.). Perennial $40-150 \mathrm{~cm}$. Basal leaves lyratepinnatifid with 3-5 lobes on each side, densely hispid; hairs $0 \cdot 1$ 0.4 mm ; upper cauline leaves much smaller than basal leaves, linear or filiform, glabrous. Racemes corymbose, elongating after flowering. Sepals 4.4 .5 mm , erecto-patent; petals $8-11 \mathrm{~mm}$, pale yellow; limb oblong-obovate. Ovules 17-24. Siliqua 15$40 \times 1-1.5 \mathrm{~mm}$, not contracted at base of beak; beak $6-8 \mathrm{~mm}$, with 1-2 seeds. - C. \& S. Spain. Hs.
2. E. virgatum (J. \& C. Presl) C. Presl, Fl. Sic. 1: 94 (1826). Like 1 but basal leaves not or shallowly lobed, sparsely hispid at the margin and on the veins; hairs $0.5-0.75 \mathrm{~mm}$; sepals 5.5 mm ; petals $7 \cdot 5-8 \mathrm{~mm}$; ovules $11-18$; siliqua up to 2 mm wide, distinctly contracted at base of beak. S. Italy, N.E. Sicilia. It Si.

Possibly not specifically distinct from 1.
3. E. nasturtiifolium (Poiret) O. E. Schulz, Bot. Jahrb. 54 Beibl. 119: 56 (1916). Biennial or perennial 20-80 cm, densely

[^135]hispid with deflexed hairs, at least below. Basal leaves lyratepinnatisect with c. 3 lobes on each side; cauline similar to basal but smaller, and the upper with $6-8(-12)$ lobes on each side, the two basal lobes deflexed and clasping the stem. Racemes ebracteate or rarely the lowest flower with a bract. Sepals 5 mm , patent; petals $c .9 \mathrm{~mm}$, yellow; limb broadly obovate. Ovules 28-38. Siliqua $23-45 \times 1.2-1.5 \mathrm{~mm}$, stipitate; beak 3-6 mm, with 1(-2) seeds. S.W. Europe, extending to N. France and S. Germany; doubtfully native farther east, but widely naturalized. *Al Ga Ge He Hs *Hu It *Ju Lu [Au Br Cz Po Rm Rs (W, C)].
4. E. palustre (Pirona) Vis., Linnaea 28: 365 (1857). Like 3 but entirely glabrous; lower cauline leaves pectinate-pinnatisect, with 16-18 lobes on each side; sepals 6.5 mm ; petal-limb narrowly elliptical; ovules $25-28$; siliqua $30-55 \mathrm{~mm}$.
N. Italy. It.

Perhaps not specifically distinct from 3.
5. E. gallicum (Willd.) O. E. Schulz, Bot. Jahrb. 54 Beibl. 119: 56 (1916). Like 3 but basal lobes of cauline leaves not deflexed or clasping the stem; racemes bracteate below; sepals erect; petals pale yellow or whitish; siliqua not stipitate; beak without seeds. $2 n=30$. C. \& S.W. Europe. Au Cz Ga Ge He Ho Hs He Hu ?It [ Br Da No Po Rm Rs (N, B) Su].

## 92. Rhynchosinapis Hayek ${ }^{2}$

Annual or perennial, with fusiform taproots or rhizomatous; glabrous or with unbranched hairs. Inflorescence ebracteate. Sepals erect, the inner saccate at the base; petals yellow, rarely whitish, sometimes with violet veins. Fruit a linear siliqua terminating in an ensiform or attenuate beak with $0-6$ seeds; valves convex, 3 -veined. Seeds in 1 row in each loculus, numerous. (Brassicella Fourr. ex O. E. Schulz.)

Literature: O. E. Schulz in Engler, Pflanzenreich 70 (IV. 105): 106-16 (1919) (sub Brassicella).
1 Leaves undivided, oblong-elliptical or spathulate, entire or repand-dentate, completely glabrous

1. richeri

1 Leaves $\pm$ deeply pinnately divided, with at least the petioles or sepals hairy, or if undivided then hispid
2 Rhizome large, much-branched; sepals 4 mm ; lamina of petals oblong-elliptical 2. nivalis
2 Slender taproots or somewhat divided rootstock; sepals 510 mm ; lamina of petals obovate
3 Siliqua pendent; beak up to $2 \frac{1}{2}$ times as long as the valvar portion
8. longirostra

3 Siliqua erect, patent or slightly recurved; beak shorter than the valvar portion
4 Leaves pinnatipartite, with 6-10 pairs of lobes
5 Sparsely hispid or $\pm$ glabrous $\quad$ 9. pseuderucastrum
5 Setose, especially below 6. hispida
4 Leaves pinnatipartite, with 3-5 pairs of lobes
6 Petals pale yellow, or whitish with violet veins, whitishviolaceous in defloration
7 Perennial, stout and woody at base; stems procumbent when present; racemes arising from central rosette
10. johnstonii

7 Annual, slender at base; stems $\pm$ erect; racemes not arising from central rosette
8 Stem and leaves sparsely hispid or glabrous; siliqua 3-6(-7) cm; beak attenuate 9. pseuderucastrum 8 Stems and leaves with long dense hairs; siliqua $7-9 \mathrm{~cm}$; beak scarcely attenuate, as broad as the valvar portion
7. granatensis

6 Petals bright yellow with darker or greenish veins, not whitish-violaceous in defloration
9 Whole plant, except sepals, glabrous, or occasionally with sparse hairs, especially on the petioles; leaves deeply pinnatifid
5. monensis

# 9 At least the lower part of the stem with $\pm$ dense patent or recurved hairs; leaves hairy at least beneath, lyrate or lyrate-pinnatipartite <br> 10 Perennial with stout stems; siliqua $3-4 \mathrm{~mm}$ wide 

4. wrightii

10 Biennial to perennial with slender stems; siliqua up to 2 mm wide 3. cheiranthos

1. R. richeri (Vill.) Heywood, Feddes Repert. 68: 196 (1963) (Brassicella richeri (Vill.) O. E. Schulz). Perennial with branched stock. Leaves mainly with the petioles equalling or longer than the lamina, undivided, oblong, obovate, elliptical or spathulate, entire or repand-dentate. Racemes densely corymbose. Sepals 8 mm , obtuse at apex. Siliqua $4.5-8 \mathrm{~cm} \times 2 \cdot 5-3 \mathrm{~mm}$, erectopatent or slightly pendent. Alpine meadows and rocks. S.W. Alps. Ga It.
2. R. nivalis (Boiss. \& Heldr.) Heywood, loc. cit. 196 (1963) (Brassicella nivalis (Boiss. \& Heldr.) O. E. Schulz). Caespitose perennial with much-branched rhizome, forming clumps up to 30 cm in diameter. Leaves sublyrate-pinnatipartite, with 3-4 pairs of obtuse segments. Racemes few-flowered. Sepals 4 mm , obtuse at apex. Siliqua $4-6 \mathrm{~cm} \times 1.5-2 \mathrm{~mm}$, somewhat curved; pedicels erecto-patent; beak $2-3 \mathrm{~mm}$, without seeds. Seeds $10-18$. Limestone screes and rocks. - N. Greece (Olimbos). Gr.
3. R. cheiranthos (Vill.) Dandy, Watsonia 4: 41 (1957) (Brassicella erucastrum O. E. Schulz pro parte, Brassica cheiranthos Vill.). Annual to short-lived perennial with a slender more or less perpendicular taproot or somewhat divided stock; stems more or less hispid below. Leaves pinnatipartite or pinnatisect, with 3-5(-9) pairs of lobed or toothed segments, or sometimes simple, dentate, sparsely hairy or densely hispid on both surfaces. Sepals $5-10 \mathrm{~mm}$; petals bright yellow with darker or rarely reddish veins. Siliqua 3-8 $\mathrm{cm} \times 1.5-2 \mathrm{~mm}$, ascending, patent or somewhat recurved; pedicels $2-15 \mathrm{~mm}$, patent or arcuate; beak $8-22 \mathrm{~mm}$, attenuate, with $1-3$ seeds. $2 n=48$. W. Europe extending to $C$. Italy; mainly in the mountains. Be Ga Ge Hs It Lu [ $\mathrm{Br} \mathrm{He} \mathrm{Ho]}$.

An extremely variable species divisible into at least two subspecies and a number of distinctive local geographical races. In addition sporadic but distinctive variants in habit, leaf, fruit, etc. occur in various parts of its range and make an overall delimitation of the species difficult.
(a) Subsp. cheiranthos: Habit various. Leaves regularly pinnatipartite or pinnatisect with the terminal lobe not much larger than the laterals. Petals $15-20 \mathrm{~mm}$. Seeds $1-1.5 \mathrm{~mm}$ diameter. Throughout the range of the species.

Variable in most characters. The following variations seem worth recognition and may deserve subspecific rank: var. petrosa (Jordan) Heywood, from Corse and Sardegna, with a perennial somewhat divided rootstock and very patent or recurved siliquae with the beak sometimes as long as the valvar portion; and var. montana (DC.) Heywood, from French Alps, Pyrenees, and mountains of C. Spain, with a perennial rootstock and scapiform stems.
(b) Subsp. nevadensis (Willk.) Heywood, Feddes Repert. 66: 154 (1962) (Brassica cheiranthos var. nevadensis Willk.): Caespitose perennial with scapiform stems. Leaves simple, lobed or toothed, or lyrately divided, with a large terminal lobe. Petals $10-12 \mathrm{~mm}$. Seeds 0.75 mm in diameter. S. Spain (Sierra Nevada).

This very distinctive subspecies is geographically isolated from the other races of the species and may deserve specific rank.
4. R. wrightii (O. E. Schulz) Dandy ex Clapham in Clapham, Tutin \& Warburg, Fl. Brit. Is. 157 (1952). Very like typical plants of 3 (a) but with stout, perennial habit and leaves usually broader, ovary glabrous (not hairy) and siliqua 3-4 mm. wide. $2 n=24$. Cliff's and slopes. S.W. England (Lundy Island, Devon). Br.
5. R. monensis (L.) Dandy ex Clapham in Clapham, Tutin \& Warburg, Fl. Brit. Is. 157 (1952). Biennial with a slender, perpendicular taproot and ascending glabrous, rarely sparsely hairy, stems. Leaves mainly basal, glabrous and glaucous, pinnatifid. Petals yellow, with darker veins. Ovary glabrous. Siliqua $4-9 \mathrm{~cm} \times$ 2 mm , patent; beak $8-18 \mathrm{~mm}$, with $3-5$ seeds. $2 n=24$. Sandy places. West coast of Britain and some adjacent islands. Br .
6. R. hispida (Cav.) Heywood, Feddes Repert. 66: 154 (1962) (Brassicella valentina O. E. Schulz pro parte, Brassica valentina DC., Sisymbrium valentinum auct., non L.). Annual, setose, especially below. Leaves hairy, pinnatipartite or pinnatisect with 6-10 pairs of segments, the terminal segment equalling the laterals. Petals pale yellow or whitish, violet-veined. Siliqua $3.5-5 \mathrm{~cm}$; beak $1.5-1.8 \mathrm{~cm}$, with $1-2$ seeds. Spain, Portugal. Hs Lu.
(a) Subsp. hispida: Leaf-segments dentate. Anthers purplish. Beak of siliqua straight. Sandy and rocky places. N. \& C. Spain.
(b) Subsp. transtagana (Coutinho) Heywood, Feddes Repert. 68: 196 (1963) (Brassicella valentina subsp. transtagana (Coutinho) Coutinho): Leaf-segments subentire. Anthers yellow. Beak of siliqua curved. Rocky places. Portugal (Alentejo).
7. R. granatensis (O. E. Schulz) Heywood, Feddes Repert. 66: 154 (1962) (Brassicella valentina var. granatensis O. E. Schulz). Like 6, with which it has previously been confused, but leaves lyrate-pinnatipartite, with 4-5 pairs of lobes, the terminal much larger than the laterals, and siliqua $8-9 \mathrm{~cm}$. Dolomitic rocky soil. - S. Spain (Sierra de Mijas, near Granada). Hs.
8. R. Iongirostra (Boiss.) Heywood, Feddes Repert. 66: 154 (1962) (Brassica longirostra Boiss., Brassicella valentina O. E. Schulz pro parte). Annual. Leaves pinnatipartite or pinnatisect, hairy. Petals $20-22 \mathrm{~mm}$, pale yellow, with lilac veins. Siliquae pendent from curved pedicels; beak considerably longer than the valvar portion (up to 3 times). - S. Spain. Hs.

Clearly distinguished from all other species by its siliquae.
9. R. pseuderucastrum (Brot.) Franco, Anais Inst. Sup. Agron. (Lisboa) 22: 172 (1959) (Brassicella pseuderucastrum (Brot.) O. E. Schulz). Short-lived perennial (rarely annual); stems sparsely hairy. Leaves pinnatipartite, with 3-5(-9) pairs of lobes, more or less glaucous beneath, glabrous or more or less hairy. Sepals $5-8 \mathrm{~mm}$; petals up to 1.5 cm , pale yellow with darker veins, whitish in defloration. Siliqua $3-7 \mathrm{~cm} \times 2 \mathrm{~mm}$.

1 Densely hispid
(a) subsp. pseuderucastrum

1 Subglabrous
2 Leaves lyrate-pinnatipartite
(b) subsp. setigera

2 Leaves obovate, pinnatisect
(a) Subsp. pseuderucastrum: Densely hispid. Leaves up to 15 cm , more or less regularly pinnatipartite. Siliqua $3.5 \mathrm{~cm} \times$ 2 mm . Mountains. C. \& N.E. Portugal, N.W. Spain.
(b) Subsp. setigera (Gay ex Lange) Heywood, Feddes Repert. 66: 154 (1962) (Sinapis setigera Gay ex Lange, Brassica setigera (Gay ex Lange) Willk.): Subglabrous. Leaves up to 20 cm (including the petiole), lyrate pinnatipartite, with a large terminal obovate lobe; lobes with setigerous teeth. Siliqua (4-)5-6(-7) cm. Lower altitudes than (a). N.W. Portugal, N.W. Spain.
(c) Subsp. cintrana (Coutinho) Franco \& P. Silva, Feddes Repert. 68: 197 (1963) (Brassicella pseuderucastrum f. cintrana P. Cout.): Glabrescent. Leaves up to 10 cm , obovate, pinnatisect with 6-8 pairs of lobes. Portugal (Serra de Sintra).
10. R. johnstonii (Samp.) Heywood, Feddes Repert. 68: 196 (1963) (Brassica johnstonii Samp.). Woody perennial with stout stems spreading along the ground, or stemless. Leaves mainly basal, fleshy, hairy, lyrate-pinnatisect with the terminal lobe very much larger than the undivided lateral lobes. Racemes arising from central rosette. Siliqua 2-2.5 mm wide. Maritime sands. N. Portugal. Lu.

## 93. Hirschfeldia Moench ${ }^{1}$

Like 89. Sinapis but sepals almost erect, the inner pair slightly saccate; siliqua with a short, swollen beak and valves 3 -veined when young but obscurely veined when ripe; seeds ovoid.

1. H. incana (L.) Lagrèze-Fossat, Fl. Tarn Gar. 19 (1847) (Sinapis incana L.). Annual to perennial; stem up to 1 m , usually branched, leafy, densely white-hairy below. Lower leaves runci-nate-pinnatifid, with an ovate, obtuse, shallowly dentate terminal lobe; the upper simple, sessile. Flowers c. 5 mm in diameter. Petals pale yellow, often with dark veins. Siliqua $8-17 \times 1$ 1.5 mm , erect and appressed to the stem, 2-valved; beak c. $\frac{1}{2}$ as long as valves, swollen at base. Seeds 3-6 in each loculus. $S$. Europe. Al Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu [Au Be Br Da Ge He Ho .

## 94. Hutera Porta ${ }^{2}$

Biennial or perennial herbs. Flowers in corymbose racemes. Petals clawed, yellow, with violet veins. Fruit a transversely articulate siliqua; the lower segment dehiscent, bilocular, with $1-8$ seeds; the upper segment indehiscent, bilocular or $\pm$ unilocular, with $1-6$ seeds, ventricose-obovate or $\pm$ moniliform, terminating in an ensiform or attenuate beak. (Coincya Rouy.)

Literature: J. González-Albo, Cavanillesia 6: 175-7 (1934).
Upper segment of the fruit $12-20 \mathrm{~mm}, 5-6 \mathrm{~mm}$ in diameter, ventricose; the lower segment $2-5 \mathrm{~mm}$ long

1. rupestris Upper segment of the fruit $16-28 \mathrm{~mm}, 2-4 \mathrm{~mm}$ in diameter, $\pm$ moniliform; the lower segment $4-15 \mathrm{~mm}$ long $\quad$ 2. leptocarpa
2. H. rupestris Porta, Atti Accad. Agiati 9: 6 (1891) (Coincya rupestris Rouy). Biennial; stems erect, branched, pubescent with recurved hairs. Leaves $10-20 \mathrm{~cm}$, lyrate-pinnatipartite, the lobes sinuate-dentate, the terminal lobe larger than the laterals. Fruit glabrous, the lower segment stalk-like, dehiscent, with 1-4 seeds in 2 rows; the upper segment obovate, inflated, longitudinally striate, with 1-3 seeds; beak ensiform. Limestone rocks. - S.E. Spain (Sierra de Alcaraz). Hs.
3. H. leptocarpa González-Albo, Cavanillesia 6: 176 (1934). Like 1 biennial to perennial but indumentum denser and fruit structure very distinct; the lower segment 4-15 mm, cylindrical, with 5-8 seeds; the upper segment more or less constricted between the seeds, becoming moniliform when mature, with 4-6 seeds; beak slender, attenuate. Siliceous rocks, $800-1000 \mathrm{~m}$. - S.C. Spain (E. part of Ciudad Real prov.). Hs.
[^136]
## 95. Carrichtera DC. ${ }^{2}$

Annual; hairs unbranched. Sepals erect; filaments free. Fruit a transversely articulate, deflexed silicula; the lower segment ellipsoidal, with 2 naviculiform, 3-veined valves; upper segment sterile, strongly compressed, foliaceous, cochleariform.

1. C. annua (L.) DC., Mém. Mus. Hist. Nat. (Paris) 7: 250 (1821) (C. vellae DC., Vella annua L.). Stems $5-40 \mathrm{~cm}$, branched from the base, with setiform, deflexed hairs; hairs and branches pungent in fruit. Leaves 2- to 3-pinnatisect, with obtuse linear segments. Racemes with $10-15$ flowers. Petals yellow, violet-veined. Siliculae deflexed, on short pedicels; lower segment bilocular. Seeds 3 in each loculus. Mediterranean region. $\mathrm{Bl} \mathrm{Gr} \mathrm{Hs} \mathrm{Sa} \mathrm{Si} \mathrm{[Co]}$.

## 96. Vella L. ${ }^{2}$

Small, much-branched shrubs with sessile, entire leaves; hairs unbranched. Flowers in lax, spicate racemes. Sepals erect; petals long-clawed, yellow, sometimes violet-veined; filaments of inner stamens connate in pairs. Fruit a transversely articulate silicula; the lower segment 2 -valved, ellipsoidal, subdidymous; valves convex, 3-veined; the upper segment sterile, strongly compressed, in the form of a foliaceous, lingulate beak, 5 -veined.

Literature: O. E. Schulz, Pflanzenreich 84 (IV. 105): 44-7 (1923).
$30-100 \mathrm{~cm}$, spineless, with obovate leaves; raceme with $10-35$ flowers 1. pseudocytisus $10-30 \mathrm{~cm}$, very spiny, caespitose, with narrowly lanceolate leaves; racemes with 3-5 flowers
2. spinosa

1. V. pseudocytisus L., Sp. Pl. 641 (1753). Stem densely covered with very short rigid hairs and with scattered longer hairs (except in var. badalii (Pau) Heywood), densely leafy. Leaves $1 \cdot 5-2 \times 0.5-1 \mathrm{~cm}$, obovate or obovate-lanceolate, somewhat coriaceous, setose-hispid on both surfaces (except in var. badalii). Petal-limb $3-4 \mathrm{~mm}$ wide, orbicular or shortly obovate, with indistinct veins. Lower segment of silicula $3.5-4.5 \times 3 \mathrm{~mm}$, sparsely setose or hispid, bilocular; upper segment obtuse. Seed $1(-2)$ in each loculus.

- C. \& S. Spain. Hs.

2. V.spinosa Boiss., Biblioth. Univ. Genève ser. 2, 13:407 (1838). Very spiny, low, intricate-branched shrub. Stems with scattered long, patent hairs, the upper branches dichotomously branched and transformed into rigid, patent spines. Lower leaves linearlanceolate; upper leaves linear; all setose-ciliate at the margin. Petals with the limb $4-6 \mathrm{~mm}$, obovate, strongly violet-veined. Lower segment of silicula $4.5-5 \cdot 5 \times 2 \cdot 5-3 \mathrm{~mm}$, glabrous, bilocular; upper segment acuminate. Seeds $1(-2)$ in each loculus. Limestone mountains. - S. \& S.E. Spain. Hs.

## 97. Succowia Medicus ${ }^{3}$

Hairs unbranched. Sepals erect, not saccate; petals shortly clawed, yellow. Fruit a 2 -seeded silicula, covered with long, conical spines; style long, conical.

1. S. balearica (L.) Medicus, Pflanzengatt. 1: 65 (1792). Glabrous or scabrid annual $20-70 \mathrm{~cm}$. Leaves ovate, pinnatisect, the segments dentate to 2 -pinnatifid. Petals $7-10 \mathrm{~mm}$. Silicula $3-6 \mathrm{~mm}$ in diameter, spines $1-3 \mathrm{~mm}$; style $4-8 \mathrm{~mm}$. Seeds $c$. 2 mm , pitted. W. Mediterranean region. Bl Co Hs It Sa Si .

## 98. Boleum Desv. ${ }^{1}$

Hairs unbranched. Flowers in short, dense, later elongating racemes. Sepals erect; petals long-clawed, pale yellow with reddish-brown veins and claw. Stamens without appendages, the inner united in pairs. Fruit transversely articulate, the lower segment ovoid-globose, 2 -valved, septate, indehiscent, the upper in the form of a sterile, lingulate beak.

1. B. asperum (Pers.) Desv., Jour. Bot. Appl. 3: 163 (1814). Densely setose shrub up to 40 cm with a woody stock and erect, fasciculate, leafy stems and branches. Leaves $10-25 \times 2-3.5 \mathrm{~mm}$, linear-lanceolate, entire, or sometimes deeply pinnatifid with 1 or 2 pairs of narrow lobes. Lower segment of fruit deeply sculptured and covered with long, white, setiform, unicellular hairs, 2 -locular, with 1 seed in each loculus. Saline soils. - E. Spain. Hs.

## 99. Erucaria Gaertner ${ }^{1}$

Annual or biennial; hairs unbranched. Sepals erect; petals lilac, with a long claw. Fruit a transversely articulate siliqua with both segments fertile; the lower 2 -valved and dehiscent; the upper abruptly contracted into the style.

1. E. hispanica (L.) Druce, Rep. Bot. Exch. Club Brit. Is. 3: 418 (1914) (E. myagroides (L.) Halácsy, E. tenuifolia DC., E. aleppica Gaertner). Annual or biennial; stem erect, glabrous or slightly hairy at base. Leaves petiolate, pinnatisect with linear to oblong lobes, pinnatifid, or entire. Petals $10-15 \mathrm{~mm}$. Siliqua $1-2 \mathrm{~cm}$, longitudinally veined, appressed to the axis; lower segment elongate, cylindrical, with 2-4 seeds; upper segment compressed, ensiform, obtuse or truncate at apex, with 1-3 seeds; style 24 mm , filiform. Cultivated land and waste places. S. Greece and Aegean region; naturalized in Italy and Spain. Cr Gr [Hs It].

## 100. Cakile Miller ${ }^{2}$

Annual, glabrous and glaucous, with succulent leaves. Petals clawed, violet, pink or white. Fruit a transversely articulate siliqua; the upper segment larger, ovoid, more or less 4 -angled, not attenuate into style, with a single seed; the lower obconical, not evidently 2 -valved, usually with a single seed, indehiscent.
Literature: O. E. Schulz in Engler, Pflanzenreich 84 (IV. 105): 18-28 (1923). E. G. Pobedimova, Not. Syst. (Leningrad) 15: 6277 (1953).
Upper segment of silicula expanding into a membranous margin at the base; lower segment usually with 2 lateral, $\pm$ deflexed projections at the apex

1. maritima

Upper segment of silicula contracted towards the base, without membranous margin; lower segment without projections
2. edentula

1. C. maritima Scop., Fl. Carn. ed. 2, 2: 35 (1772). Plant $15-$ 60 cm . Leaves variable. Petals $4-14 \mathrm{~mm}$. Silicula $10-25 \mathrm{~mm}$; lower segment with 2 lateral, more or less deflexed projections at the apex; upper segment expanding into a broad membranous margin at the base. Coasts of Europe northwards to c. $65^{\circ} \mathrm{N}$. in Finland and Norway. $\mathrm{Al} \mathrm{Bl} \mathrm{Br} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Da?} \mathrm{Fa} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr}$ Hb Ho Hs It Ju Lu No Po Rm Rs (N, B, C, W, K, E) Sa Si Su $\mathrm{Tu}[\mathrm{Cz}]$.
A variable species divisible into at least 4 subspecies in Europe. Characters of the fruit appear to be the most reliable for distinguishing the subspecies.
[^137]1 Lower segment of the silicula $\pm$ concave at the apex (when viewed in the plane of the projections)
2 Lower segment of the silicula with conspicuous, deffexed projections (often more than 1 mm ); leaves entire to pinnatisect, the primary segments rarely more than 6 times as long as wide
(c) subsp. aegyptiaca

2 Lower segment of the silicula with very small projections; leaves 1 -to 2 -pinnatisect, the primary segments up to 15 times as long as wide
(d) subsp. euxina

1 Lower segment of the silicula not concave
3 Lower segment of the silicula with very small projections; leaves entire to pinnatisect, the primary segments not more than 5 times as long as wide
(a) subsp. maritima

3 Lower segment of the silicula with conspicuous deflexed projections (often more than 1 mm ); leaves 1- to 2-pinnatisect, the primary segments $10-20$ times as long as wide
(b) subsp. baltica
(a) Subsp. maritima: $2 n=18$. Coasts of W. \& N.W. Europe from C. Portugal to C. Norway.
(b) Subsp. baltica (Jordan ex Rouy \& Fouc.) Hyl. ex P. W. Ball, Feddes Repert. 69: 37 (1964):2n=18. Coasts of Baltic region.
(c) Subsp. aegyptiaca (Willd.) Nyman, Consp. 29 (1878): Coasts of Mediterranean region, extending to S. Portugal.
(d) Subsp. euxina (Pobed.) E. I. Nyárády in Săv., Fl. Rep. Pop. Române 3: 480 (1955): Black Sea coasts.
The populations in the Aegean region are intermediate between subspp. (c) and (d).
2. C. edentula (Bigelow) Hooker, Fl. Bor.-Amer. 1: 59 (1830). Very like 1 but leaves subentire to pinnatifid; lower segment of the silicula without projections, apex flat; upper segment contracted at the base, without a membranous margin. Açores, Iceland, Faeröer, N. Norway, N. Russia. Az Fa Is No Rs (N).
(a) Subsp. edentula: Petals $4-7 \mathrm{~mm}$; apex of silicula rounded to emarginate. Açores. (W. North America.)
(b) Subsp. islandica (Gand.) Á. \& D. Löve, Bot. Not. 114: 52 (1961): Petals $6-10(-11) \mathrm{mm}$; apex of silicula acute to subobtuse. $2 n=18$. Iceland, Faeröer, N. Norway, N. Russia.

Recorded from N.W. Scotland, but in error for 1 (a).

## 101. Rapistrum Crantz ${ }^{3}$

Annual to perennial herbs with unbranched hairs. Sepals erectopatent; petals yellow, with a short claw. Fruit a transversely articulate silicula; the lower segment cylindrical, with 1-3 seeds, or seedless; the upper segment ovoid to globose, wider than the lower, indehiscent, caducous at maturity, with a single erect seed; beak conical or filiform.
Biennial or perennial; upper segment of fruit gradually attenuate into a beak $0.5-1 \mathrm{~mm}$ 1. perenne Annual; upper segment of fruit abruptly contracted into a beak $1-3 \mathrm{~mm}$
2. rugosum

1. R. perenne (L.) All., Fl. Pedem. 1: 258 (1785). Biennial or perennial $30-80 \mathrm{~cm}$, densely hispid below, glabrous above. Lower leaves pinnate or pinnatipartite, coarsely serrate; upper pinnatifid or dentate, sessile or shortly petiolate. Petals $5-7 \mathrm{~mm}$, bright yellow. Silicula $7-10 \mathrm{~mm}$; upper segment $3-4.5 \mathrm{~mm}$ (including beak), ovoid, strongly longitudinally ribbed, gradually attenuate into a beak $0 \cdot 5-1 \mathrm{~mm}$; lower segment narrower, usually more or less cylindrical, about $\frac{1}{2}$ as long as the pedicel. Probably native in parts of C. \& E. Europe; casual and often naturalized elsewhere in C. \& W. Europe. Au Bu Cz Ge Hu It Ju Rm Rs (C, W, E) [?Az Be Br Ga He Ho Po].
2. R. rugosum (L.) All., Fl. Pedem. 1: 257 (1785). Annual 1560 cm , hispid below, often glabrous above. Lower leaves pinnate; upper usually dentate, petiolate. Petals $6-10 \mathrm{~mm}$, pale yellow. Silicula 3-10 mm; upper segment 3-6 mm (including beak), ovoid to globose, abruptly contracted into a beak $1-3 \mathrm{~mm}$; lower segment cylindrical. S. Europe; naturalized or casual in much of C. \& N. Europe. Al Az Bl Bu Co Cr Ga Gr Hs It Ju Lu Rs (K, E) $\mathrm{Sa} \mathrm{Si} \mathrm{Tu}[\mathrm{Au} \mathrm{Be} \mathrm{Br} \mathrm{Cz} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{Hu} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(C}, \mathrm{W)]}$.

The following subspecies are often treated as distinct species:
1 Pedicels 2-4 times as long as the lower segment of the fruit; upper segment only slightly ribbed and rugose
(c) subsp. linnaeanum

1 Pedicels 1-3 times as long as the lower segment of the fruit; upper segment strongly ribbed and rugose
2 Pedicels $1-1 \frac{1}{2}$ times as long as the lower segment; upper segment ovoid
(a) subsp. rugosum

2 Pedicels $1 \frac{1}{2}-3$ times as long as the lower segment; upper segment globose
(b) subsp. orientale
(a) Subsp. rugosum: $2 n=16$. S. Europe; commonly naturalized elsewhere.
(b) Subsp. orientale (L.) Arcangeli, Comp. Fl. Ital. 49 (1882) (R. orientale (L.) Crantz): C. \& E. Mediterranean region; a frequent casual elsewhere.
(c) Subsp. linnaeanum Rouy \& Fouc., Fl. Fr. 2: 73 (1895) (R. hispanicum (L.) Crantz, R. linnaeanum Boiss. \& Reuter, nom. illegit.): Mediterranean region; sometimes casual elsewhere.

## 102. Didesmus Desv. ${ }^{1}$

Like Rapistrum but petals white; upper segment of silicula as wide as the lower segment, tetragonal; beak long, pungent.

1. D. aegyptius (L.) Desv., Jour. Bot. Appl. 3: 160 (1814). Erect annual $10-40 \mathrm{~cm}$, sparsely hispid. Leaves oblong-elliptical, dentate to lyrate-pinnatisect with $2-5$ pairs of lobes, or rarely 2 -pinnatisect. Pedicels $3-5 \mathrm{~mm}$ in fruit. Sepals $3 \cdot 5-4 \cdot 5 \mathrm{~mm}$; petals 6 10 mm , slightly emarginate. Silicula 6-10 mm ; the lower segment with 4-6 swellings at the base; the upper segment ovoid, often tetragonal; beak $2 \cdot 5-4 \mathrm{~mm}$ long. $S$. Aegean region. Cr Gr.

## 103. Crambe L. ${ }^{1}$

Annual to perennial. Glabrous or with unbranched hairs. Sepals erecto-patent; petals white, with a short claw or cuneate at base; filaments of inner stamens usually with a tooth-like appendage. Fruit a transversely articulate silicula; the lower segment short, sterile, forming a stalk together with the gynophore; upper segment ovoid to globose, indehiscent, caducous, with a single pendent seed; stigma sessile.

Several species of this genus are cultivated as vegetables.
Literature: O. E. Schulz in Engler, Pflanzenreich 70 (IV. 105): 228-49 (1919).
1 Lower segment of silicula longer than the upper segment; filaments of the inner stamens without appendage 8. filiformis
1 Lower segment of silicula shorter than the upper segment; filaments of the inner stamens usually with a tooth-like appendage
2 Annual; lower leaves with a large, $\pm$ reniform terminal lobe and 0-2 pairs of small lateral lobes
7. hispanica

2 Stout perennials; lower leaves entire to 2 -pinnatisect, the terminal lobe neither reniform nor much larger than the lateral lobes

3 Plant densely hispid
(2-5). tataria group
3 Plant glabrous or sparsely hispid
4 Petals 6-10 mm; upper segment of silicula 7-12 mm
5 Upper segment of silicula not 4 -angled; lower cauline leaves pinnatifid or irregularly toothed 1. maritima
5 Upper segment of silicula 4-angled; lower cauline leaves 1- or 2-pinnatisect
(2-5). tataria group
4 Petals not more than 6 mm ; upper segment of silicula less than 7 mm
6 Upper segment of silicula $2-3.5 \mathrm{~mm}$; pedicels slender (c. 0.3 mm in diameter)
6. koktebelica

6 Upper segment of silicula (3-)3.5-7 mm; pedicels relatively stout ( $c .0 .5 \mathrm{~mm}$ or more in diameter)
(2-5). tataria group

1. C. maritima L., Sp. Pl. 671 (1753). Stout glabrous perennial $30-75 \mathrm{~cm}$, with branched fleshy stock. Lower leaves sinuatedentate to irregularly pinnatifid. Petals $6-10 \mathrm{~mm}$. Lower segment of silicula $1-4 \mathrm{~mm}$; upper segment $7-12 \mathrm{~mm}$, globose to ovoid; pedicels $8-26 \mathrm{~mm}$; seeds $4-5 \mathrm{~mm} .2 n=30$, 60 . Shores of the Baltic, Atlantic and Black seas; sometimes naturalized elsewhere. Be Br Bu Da Fe GaGe Hb Ho Hs No Rm Rs (B, W, K, E) $\mathrm{Su} \mathrm{Tu}[\mathrm{Au} \mathrm{Cz} \mathrm{Hu} \mathrm{It]}]$.
(2-5). C. tataria group. Stout perennials up to 150 cm , with a fleshy fusiform stock branched at the apex. Petals (3-)3.57 mm . Lower segment of silicula c. 1 mm ; upper segment (3-) $3.5-8 \mathrm{~mm}$; pedicels relatively stout ( $c .0 .5 \mathrm{~mm}$ or more in diameter); seeds $2-3 \cdot 5 \mathrm{~mm}$.

## 1 Upper segment of silicula $7-8 \mathrm{~mm}$; petals $5 \cdot 5-7 \mathrm{~mm}$ <br> 2 Plant glabrous or sparsely hispid; upper segment of silicula 4 -angled 4. grandiflora <br> 2 Plant densely hispid; upper segment of silicula not 4-angled

5. aspera

1 Upper segment of silicula $3-7 \mathrm{~mm}$; petals $3.5-6 \mathrm{~mm}$
3 Leaves pinnatifid or pinnatisect, the ultimate divisions obtuse
2. tataria

3 Leaves 2-pinnatisect, the ultimate divisions acute 3. steveniana
2. C. tataria Sebeók, Medico-Bot. Tatar. 7 (1779) (incl. C. pin-nati-fida R.Br., C. litwinowii Grossh.). Subglabrous to densely hispid. Lower leaves pinnatifid to pinnatisect, the ultimate divisions obtuse, primary segments ovate to triangular in outline. Petals (3-)3.5-6 mm; inner stamens with appendage not more than 0.8 mm . Upper segment of silicula 3-6(-7) mm, 4-angled or not; pedicels usually less than 12 mm . E. Europe extending westwards to Austria and Czechoslovakia. Au Bu Cz Hu Ju Rm Rs (W, K, E).
3. C. steveniana Rupr., Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 7, 15 (2): 136 (1869). Like 2 but the leaves 2-pinnatisect, the ultimate divisions acute, the primary segments oblong or linear in outline; inner stamens with appendage c. 1 mm long; upper segment of silicula $6-7 \mathrm{~mm}$, apiculate. Krym, doubtfully in S. Ukraine. Rs (?W, K). (Caucasus.)
4. C. grandiflora DC., Reg. Veg. Syst. Nat. 2: 652 (1821). Like 2 but the ultimate divisions of the leaves acute; petals $5 \cdot 5-7 \mathrm{~mm}$; upper segment of the silicula $7-8 \mathrm{~mm}$; pedicels up to 18 mm . Krym. Rs (K). (Caucasus.)
5. C. aspera Bieb., Fl. Taur.-Cauc. 2: 90 (1808). Densely hispid. Leaves deeply pinnatifid to 2 -pinnatisect. Petals 57 mm . Upper segment of silicula $7-9 \mathrm{~mm}$, not 4-angled; pedicels up to 13 mm . - S.E. Russia, E. Ukraine and Krym. Rs (K, E).

This species has been erroneously recorded from a number of other territories. Such plants usually have the upper segment of the silicula smaller and 4 -angled and are included here in 2.
C. gibberosa Rupr., Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.) ser. 7, 15 (2): 136 (1869) has been recorded from S.E. Russia (Chelbasskaja and Kizljar). It is like 5 but $30-50 \mathrm{~cm}$ (not $40-100 \mathrm{~cm}$ ); upper segment of silicula smooth, obtuse (not rugose-tuberculate and slightly apiculate) but it is doubtful if it is specifically distinct from 5 .
6. C. koktebelica (Junge) N. Busch in Kusn., N. Busch \& Fomin, Fl. Cauc. Crit. 3 (4): 294 (1908). Stout perennial $150-250 \mathrm{~cm}$, hispid at the base; stock fusiform. Lower leaves subentire to sinuate, with dentate lobes, sparsely setose to glabrous beneath. Petals $4-6.5 \mathrm{~mm}$. Lower segment of silicula $0.5-1 \mathrm{~mm}$; upper segment $2-3.5 \mathrm{~mm}$, more or less globose, very obscurely angled; pedicels slender (c. 0.3 mm in diameter). S.E. Krym. Rs (K). (N.W. Caucasus.)

Possibly a subspecies of C. orientalis L., Sp. Pl. 671 (1753), which is widespread in Asia Minor.
7. C. hispanica L., Sp. Pl. 671 (1753). Slender, usually densely hispid annual $25-100 \mathrm{~cm}$. Lower leaves lyrate-pinnatisect, with large reniform-orbicular terminal lobe, and $0-2$ pairs of small lateral lobes. Petals $3-4 \mathrm{~mm}$. Lower segment of silicula c. 1 mm ; upper segment $3-4.5 \mathrm{~mm}$, globose; pedicels $4-12 \mathrm{~mm}$. Mediterranean region, S. Portugal. Co Gr Hs It Ju Lu Sa Si.
8. C. filiformis Jacq., Icon. Pl. Rar. 3: 8 (1795) (C. reniformis Desf.). Slender, densely hispid perennial $30-100 \mathrm{~cm}$. Lower leaves lyrate-pinnatifid, with more or less orbicular terminal lobe and 3-6 or more pairs of lateral lobes. Petals $3-6 \mathrm{~mm}$. Lower segment of silicula $2-3 \mathrm{~mm}$; upper segment $1-2 \mathrm{~mm}$, globose; pedicels 2-3 mm. S. Spain. Hs. (N. Africa.)

## 104. Calepina Adanson ${ }^{1}$

Glabrous annual or biennial; like Crambe but filaments without appendages; silicula ovoid-globose ending in a short, thick beak; lower segment absent.

1. C. irregularis (Asso) Thell. in Schinz \& Keller, Fl. Schweiz ed. 2, 1: 218 (1905) (C. corvini (All.) Desv.). Up to 80 cm . Basal leaves obovate, entire to lyrate-pinnatifid, petiolate; cauline amplexicaul with acute, patent auricles. Petals unequal, the outer c. 2 mm , the inner $2 \cdot 5-3 \mathrm{~mm}$. Silicula $2 \cdot 5-4 \times 2-3 \mathrm{~mm}$, ovoidglobose to ellipsoid, shortly beaked, 4 -veined and reticulaterugose when dry. S. Europe and parts of C. \& W. Europe; naturalized elsewhere. Al Az Be Bu Co Ga Gr He Hs Hu It Ju $\mathrm{Lu} \mathrm{Rm} \mathrm{Rs}(\mathrm{K}) \mathrm{Sa} \mathrm{Tu}$ [ $\mathrm{Au} \mathrm{Br} \mathrm{Cz} \mathrm{Ge} \mathrm{Ho]}$

## 105. Morisia Gay ${ }^{2}$

Sepals suberect; petals yellow. Stamens without appendages. Fruit a transversely articulate silicula; the lower segment bilocular, larger than the upper.

1. M. monanthos(Viv.) Ascherson in W. Barbey, Fl. Sard. Comp. 173 (1884). Pubescent perennial; stock stout. Leaves rosulate, oblong-lanceolate in outline, pinnatisect. Flowers solitary. Pedicels $5-25 \mathrm{~mm}$, erect at flowering, elongating up to 60 mm , curving downwards and burying the fruit. Lower segment of fruit subglobose, bilocular, eventually dehiscing by 2 valves, with $3-5(-12)$ seeds; the upper segment $3 \times 3 \mathrm{~mm}$ ovoid-conical, indehiscent, with $1-2$ seeds. $2 n=14$. Sandy places, $0-1200 \mathrm{~m}$. Corse, Sardegna. Co Sa.
[^138]
## 106. Guiraoa Cosson ${ }^{3}$

Racemes narrow, ebracteate. Sepals erecto-patent; petals yellow, with long claw; filaments without appendages. Fruit a transversely articulate silicula; the upper segment bilocular, larger than the lower.

1. G. arvensis Cosson, Not. Pl. Crit. 98 (1851). Annual, with erect, simple or branched stems up to 60 cm , with deflexed white hairs below. Lower leaves oblong, irregularly toothed or pinnatifid; upper leaves linear. Racemes elongating during flowering. Lower segment of fruit cylindrical, as thick as the pedicel, bilocular, with 1 seed in each loculus; upper segment large, eventually deciduous, subglobose, with 8 prominent, winged ribs, bilocular, indehiscent, with 1-2 seeds, attenuate into conical beak. Dry places. S.E. Spain. Hs.

## 107. Enarthrocarpus Labill. ${ }^{3}$

Annual, with unbranched hairs. Racemes bracteate. Sepals erecto-patent; petals clawed, yellow, with violet veins. Fruit a transversely articulate, non-septate siliqua; the lower segment 2 -valved, indehiscent, seedless or with 1-2 seeds; the upper segment linear, elongate, caducous, with 3-15 seeds, constricted between the seeds and separating into 1 -seeded portions.

Literature: O. E. Schulz in Engler, Pflanzenreich 70 (IV. 105): 210-18 (1919). A. Béguinot, Nuovo Gior. Bot. Ital. nov. ser., 21: 361 (1914).
Petals $10-12 \mathrm{~mm}$; racemes bracteate only at base; lower segment of fruit $1-6 \mathrm{~mm}$, seedless or with 1 seed 1. arcuatu Petals $6-7 \mathrm{~mm}$; racemes bracteate almost to apex; lower segment of fruit $7-14 \mathrm{~mm}$, with $2-3$ seeds
2. Iyratus

1. E. arcuatus Labill., Icon. Pl. Syr. 5: 4 (1812). Stems up to 50 cm , hispid; branches procumbent or ascending. Lower leaves usually rosulate, petiolate, lyrate- or runcinate-pinnatipartite; lateral lobes alternate, oblong, with few teeth. Racemes bracteate at base only. Petals $10-13 \mathrm{~mm}$. Siliqua 3-9 cm , recurved, shortly setose; lower segment $1-6 \mathrm{~mm}$, usually 1 -seeded; upper segment much longer, with 3-15 seeds; beak $5-10 \mathrm{~mm}$, conical. Maritime sands and rocks. Bulgaria, Greece and Aegean region. Bu Cr Gr .
2. E. lyratus (Forskål) DC., Reg. Veg. Syst. Nat. 2: 661 (1821). Like 1 but racemes bracteate almost to the apex; petals 6-7 mm; lower segment of siliqua $7-14 \mathrm{~mm}$, with $2-3$ seeds; upper segment twice as long, with 3-6 seeds; beak $4-5 \mathrm{~mm}$. Cultivated ground. S. Greece (Methoni, S. Peloponnisos). *Gr [Ho]. (E. Mediterranean.)

## 108. Raphanus L. ${ }^{4}$

Annual to perennial herbs. Racemes ebracteate. Sepals erect; petals abruptly contracted into claw; filaments without appendages. Fruit a transversely articulate siliqua; the lower segment very short, slender, seedless, indehiscent; the upper circular in section, indehiscent, straight-sided, or lomentaceous (at least in part), or constricted between the seeds but not breaking up into 1 -seeded portions; beak narrow, seedless.

Literature: A. Thellung in Hegi, Ill. Fl. Mitteleur. 4 (1): 272-86 (1918). O. E. Schulz in Engler, Pflanzenreich 70 (IV. 105): 194210 (1919).

The following treatment is largely based on that of Thellung; the distribution-pattern, especially in the cases of subspp. (a) and (e), is confused by widespread introductions.
R. sativus L., Sp. Pl. 669 (1753) cultivated for its edible root, is of unknown origin; many cultivars exist, and the plant is a frequent casual over much of Europe. The root is thick, napiform or cylindrical and the siliqua is $20-90 \times 8-15 \mathrm{~mm}$, not lomentaceous, and not or scarcely constricted between the (1-)5-12 seeds. Some of its variants are transitional to the wild plants in Europe.

1. R. raphanistrum L., Sp. Pl. 669 (1753). Plant usually more or less hispid; stem $15-150 \mathrm{~cm}$, erect, branched. Basal and lower cauline leaves lyrate; upper usually entire. Sepals $5-10 \mathrm{~mm}$, elliptic-lanceolate, obtuse; petals about twice as long as sepals, white, yellow, lilac or violet. Fruiting pedicels $1-5 \mathrm{~cm}$; siliqua erecto-patent. Seeds $1.5-4 \mathrm{~mm}$, ovoid to subglobose, usually reticulate. Throughout Europe, but only as an alien in the extreme north. All territories.
1 Siliqua less than 5 mm in diameter
2 Siliqua 4 mm in diameter; seeds 2-5
(c) subsp. rostratus

2 Siliqua $1 \cdot 5-4 \mathrm{~mm}$ in diameter; seeds 4-11
$\begin{array}{lll}3 & \text { Siliqua } 3 \cdot 5-4 \mathrm{~mm} \text { in diameter } & \text { (a) subsp. raphanistrum } \\ 3 & \text { Siliqua } 1 \cdot 5-2 \mathrm{~mm} \text { in }\end{array}$
3 Siliqua $1 \cdot 5-2 \mathrm{~mm}$ in diameter
(b) subsp. microcarpus

1 Siliqua 5 mm or more in diameter
4 Leaves with contiguous lateral lobes; petals c. 20 mm
(d) subsp. maritimus

4 Leaves with distant lateral lobes
5 Petals 15-25 mm, pale lilac with darker veins
(c) subsp. rostratus

5 Petals 10-15 mm, white or yellowish
(e) subsp. landra
(a) Subsp. raphanistrum ( $R$. raphanistrum subsp. segetum Clavaud): Annual or biennial; lateral lobes of basal and lower cauline leaves distant. Petals $12-20 \mathrm{~mm}$, usually white or yellow, usually dark-veined. Siliqua $30-90 \times 3-4 \mathrm{~mm}$, lomentaceous at least above, with 3-8 segments separated by irregular, long, rather shallow constrictions; segments usually longer than wide, strongly veined; beak $10-30 \mathrm{~mm} . \quad 2 n=18$. A weed of cultivated fields. Throughout Europe, but probably not native in N. Europe and becoming rare or absent in the extreme north.

The petals are usually yellow in the northern, and white in the southern part of the range.
(b) Subsp. microcarpus (Lange) Thell. in Hegi, Ill. Fl. Mitteleur. 4 (1): 275 (1918): Like (a) but leaves and petals smaller; petals white or reddish; siliqua $25-35 \times 1 \cdot 5-2 \mathrm{~mm}$, with deeper constrictions and beak $5-10 \mathrm{~mm}$. A weed of cultivated fields. C. \& W. Spain; Portugal; Açores.

Plants from France with the siliqua c. 3 mm wide are intermediate between subspp. (a) and (b).
(c) Subsp. rostratus (DC.) Thell. in Hegi, op. cit. 279 (1918) ( $R$. rostratus DC.): Annual; lateral lobes of basal and lower cauline leaves very small and distant. Petals $15-25 \mathrm{~mm}$, pale lilac, with darker veins. Siliqua $30-130 \times 4-6 \mathrm{~mm}$, lomentaceous at least above, with $2-7$ segments separated by irregular, very long, rather shallow constrictions; segments usually longer than wide, strongly veined; beak $15-75 \mathrm{~mm}$. Sea-shores. Aegean region.
(d) Subsp. maritimus (Sm.) Thell. in Hegi, op. cit. 278 (1918) ( $R$. maritimus Sm.): Usually perennial; root napiform. Basal leaves usually in a distinct rosette; lateral lobes interspersed with smaller lobes, thus contiguous. Petals $15-25 \mathrm{~mm}$, yellow, scarcely veined. Siliqua $15-45 \times 5-8 \mathrm{~mm}$, lomentaceous at least above, with 1-6 segments separated by deep constrictions of irregular length; segments as wide or wider than long; beak $8-20 \mathrm{~mm}$. $2 n=18$. Sandy and rocky sea-shores. Coasts of W. Europe northwards to N. Britain and the Netherlands; coasts of W. Mediterranean region; coasts of Black Sea.
(e) Subsp. landra (Moretti ex DC.) Bonnier \& Layens, Fl. Fr. 21 (1894) ( $R$. landra Moretti ex DC.): Like (d) but sometimes annual; root slender; lateral lobes of basal leaves distant, not interspersed with smaller lobes; petals $10-15 \mathrm{~mm}$, white or yellowish; siliqua $25-60 \times 5-8 \mathrm{~mm}$; beak $15-40 \mathrm{~mm}$. $2 n=18$. $A$ weed of fields and waste places, rarely on the coast. Mediterranean region and Açores, but absent from most of the Aegean region. Probably only casual in several localities further north and on the W. Black Sea coast.

## LXIX. RESEDACEAE ${ }^{1}$

Annual to perennial herbs, rarely woody, with alternate, simple or pinnatifid leaves. Flowers in terminal, bracteate racemes or spikes. Sepals 4-8; petals 4-8, free, entire or laciniate; stamens $7-25$, inserted on a hypogynous or perigynous, often excentric disc. Carpels 3-7, superior, free and uniovulate or united into a unilocular ovary which is open above, with numerous ovules on parietal placentae. Fruit a capsule open at the top or consisting of 4-71-seeded, radiating carpels. Seeds suborbicular or reniform, without endosperm.
Fruit a unilocular capsule with numerous seeds
Fruit of 4-7, $\pm$ free, stellate-patent, 1 -seeded carpels

1. Reseda
2. Sesamoides

## 1. Reseda L. ${ }^{2}$

Annual to perennial. Leaves entire, toothed or pinnatifid. Sepals $4-8$; petals $4-8$, usually with dilated base (claw) and lobed distal portion (limb); stamens $10-25$, their bases forming a disc which is often produced dorsally; carpels and stigmas 3 or 4; ovary unilocular, open above; ovules numerous; capsule opening more widely at maturity.

[^139]${ }^{2}$ By P. F. Yeo.

Leaf-shape is very plastic in most species. It is necessary to observe carefully the shape and dissection of the petals when using the key and care should be taken to distinguish between the upper and the lateral petals.
1 All leaves entire or with a few minute, hyaline teeth near the base
2 Pedicels not more than 2.5 mm
3 Sepals and petals 4 ; leaves entire, at least some of them more than 4 mm wide

1. luteola

3 Sepals and petals 6 ; leaves less than 3 mm wide, mostly with some minute teeth near the base
4 Leaves with 2-5 pairs of teeth near the base (always some leaves with more than 2 pairs)
5. virgata

4 Leaves with 1 or 2 pairs of teeth near the base
5 Sepals $1-1.5 \mathrm{~mm}$; petals $2-3 \mathrm{~mm}$; capsule $1.5-3 \times 2$ 3.5 mm 4. complicat

5 Sepals $1.5-2 \mathrm{~mm}$; petals $3 \cdot 5-5 \mathrm{~mm}$; capsule 3-4×4-5 mm
6 Leaves up to 6 cm , linear; leaves of lateral branches not forming axillary fascicles on the main stems 2. glauca
6 Leaves up to $c .1 .2 \mathrm{~cm}$, lanceolate; stems with axillary fascicles of leaves
3. gredensis

2 Pedicels 5 mm or more
7 Leaves linear, up to 1 mm wide
5. virgata

7 Leaves oblanceolate to spathulate, 4 mm wide or more

8 The two upper petals 3-lobed; capsule cylindrical, 3-5 times as long as wide
18. lanceolata

8 Upper petals with numerous divisions; capsule subglobose, or up to twice as long as wide
9 Capsule 13-14 $\times 5 \cdot 5-9 \mathrm{~mm}$, obovoid-cylindrical; leaves spathulate
10. phyteuma

9 Capsule 9-11×7-11 mm, subglobose; leaves oblanceolate to obovate
14. odorata

1 Some leaves ternate or pinnatifid
10 Filaments persistent until fruit is ripe
11 Leaves with up to 2 lobes on each side; carpels 3 20. arabica
11 Leaves with (3-)5-25 lobes on each side; carpels 4
12 Sepals and petals 6; petal-limb rectangular or triangular, up to twice as long as the claw 9. suffruticos
12 Sepals and petals 5, rarely 6; petal-limb cuneate, at least 3 times as long as the claw
13 Petals without a distinct claw
8. decursiva

13 Petals (at least the two upper) with a distinct claw
14 Capsule $8-15 \mathrm{~mm}$; inflorescence rarely longer than the leafy part of the stem 6. alba
14 Capsule $4-5 \mathrm{~mm}$; inflorescence usually much longer than the leafy part of the stem
7. undata

10 Filaments caducous long before fruit is ripe
15 Limb of the two upper petals appearing (5-)9- to 19-lobed
16 Bracts caducous; pedicels capillary; flowers pendent 16. stricta

16 Bracts persistent; pedicels not capillary; flowers not pendent
17 Petal-lobes spathulate
18 Capsule $9-11 \times 7-11 \mathrm{~mm}$, subglobose
18 Capsule 7-13 $\times 5-6 \mathrm{~mm}$, ovoid or obovoid
14. odorata

17 Petal-lobes linear or linear-oblanceolate
19 Capsule almost square in outline
20 Leaf-segments oblanceolate to narrow-lanceolate; pedicels $3.5-8.5 \mathrm{~mm}$; capsule $8-10 \mathrm{~mm}$ 12. inodora
20 Leaf-segments broadly lanceolate; pedicels $3-4.5 \mathrm{~mm}$; capsule $10-12 \mathrm{~mm}$
13. tymphaea

19 Capsule obovoid or broadly cylindrical
21 Sepals strongly accrescent in fruit, finally 5-13 $\times 1.25-$ $1.5(-3.5) \mathrm{mm}$; lateral lobes of upper petals pinnatifid
10. phyteuma

21 Sepals not strongly accrescent in fruit, finally 4-6x $0.3-1.25 \mathrm{~mm}$; limb of upper petals digitate
22 Leaves or leaf-segments mostly 8 mm wide or less; few leaves entire and petiolate; terminal lobe of pinnatifid leaves usually less than half as long as the leaf
11. media

22 Leaves or leaf-segments up to $7-12 \mathrm{~mm}$ wide; many leaves entire and petiolate; terminal lobe of ternate or pinnatifid leaves at least half as long as leaf
23 Pedicels $5-8 \mathrm{~mm}$
12. inodora

23 Pedicels $3-4.5 \mathrm{~mm}$
13. tymphaea

15 Limb of the upper petals 3-lobed, the lateral lobes entire or shallowly cleft
24 Lateral lobes of upper petal shorter than claw; capsule 3-5 times as long as wide
18. lanceolata

24 Lateral lobes of upper petals longer than claw; capsule less than $2 \frac{1}{2}$ times as long as wide
25 Most of the leaf-segments obovate or obovate-lanceolate; bracts persistent; capsule $12-15 \mathrm{~mm}$, nodding
19. jacquinii

25 Many of the leaf-segments oblanceolate or linear; bracts usually caducous; capsule $7-12 \mathrm{~mm}$, rarely nodding
17. lutea

Sect. Luteola Dumort. Biennial. Leaves entire. Sepals and petals 4. Filaments persistent. Carpels 3.

1. R. luteola L., Sp. Pl. 448 (1753). Erect, $50-130 \mathrm{~cm}$. Leaves mostly $25-120 \times 4-15 \mathrm{~mm}$. Pedicels $c .1 \mathrm{~mm}$. Petals yellow, the upper one clawed, with 4 - to 8 -lobed limb; the two laterals and the lower one clawed or clawless with entire or 4-lobed limb. Capsule
$3-4 \times 5-6 \mathrm{~mm} .2 n=28$. Stony and sandy places. S., W. and parts of C. Europe but formerly cultivated as a source of dyes, and naturalized northwards to $S$. Sweden. Al Az Be Bl Br Bu Co Cr Cz Da Ga Gr Hb Ho Hs It Ju Lu Rm Rs (K) Sa Si Su Tu *[Au Ge He Hu Po Rs (B)].

Sect. Glaucoreseda DC. Perennial. Leaves entire, with small whitish teeth near base. Sepals 6; petals white or whitish, the limb cuneate; the two upper 3- or 5-lobed; the two laterals narrower, entire to 3-lobed; the two lower entire or 2-lobed; claw distinct in upper petals. Filaments persistent. Carpels 4; capsule wider than long.
2. R. glauca L., Sp. Pl. 449 (1753). Stems $10-40 \mathrm{~cm}$, numerous, with short branches. Leaves $15-60 \times 1-2 \mathrm{~mm}$, linear, with $0-2$ pairs of teeth, glaucous. Bracts $1-3 \mathrm{~mm}$; pedicels $1 \cdot 5-2 \cdot 5 \mathrm{~mm}$. Sepals 2 mm ; petals $3.5-5 \mathrm{~mm}$, with the limbs of the upper ones wide, 3 -lobed to $\frac{1}{3}$ of their length, the lobes toothed. Capsule $3-4 \times 4-5 \mathrm{~mm}$. Alpine and subalpine pastures, rocks and screes. - E. \& C. Pyrenees, Sierra Cantábrica. Ga Hs.
3. R. gredensis (Cutanda \& Willk.) Müller Arg. in DC., Prodr. 16 (2): 582 (1868). Like 2, but stems $10-25 \mathrm{~cm}$, with axillary fascicles of leaves; leaves $3-12 \times 0 \cdot 5-0.75(-1.5) \mathrm{mm}$, lanceolate or narrow-lanceolate. Montane pastures and gravelly places. - W.C. Spain (Sierra de Gredos). Hs.
4. R. complicata Bory, Ann. Gén. Sci. Phys. (Bruxelles) 3: 13 1820). Like 2 but stems $40-70 \mathrm{~cm}$; stems and branches arcuateascending; leaves $15-25 \times 2.5 \mathrm{~mm}$; bracts 0.5 mm ; sepals $1-1.5$ mm ; petals $2-3 \mathrm{~mm}$, the upper with (3-)5 deeper and narrower lobes; capsule $1.5-3 \times 2-3.5 \mathrm{~mm}$, subsessile. Montane pastures and damp gravelly places. - S. Spain (Sierra Nevada). Hs.
5. R. virgata Boiss. \& Reuter, Diagn. Pl. Nov. Hisp. 6 (1842). Stems $20-60 \mathrm{~cm}$, erect, branched above. Leaves $15-40 \times 0 \cdot 5-$ 1 mm , with $2-5$ pairs of teeth. Bracts 2 mm ; pedicels 1.5 $2(-5.5) \mathrm{mm}$. Sepals 1.5 mm ; petals 3 mm , the upper as in 2 but with proportionately narrower limb and smaller claw. Capsule $3 \times 4 \mathrm{~mm}$. Waste sandy fields and roadsides. - C. Spain, N. Portugal. Hs Lu.

Sect. Leucoreseda DC. Leaves pinnatifid; lobes usually varying irregularly in length. Sepals 5 or 6 ; petals 5 or 6 (two upper, two lateral, one or two lower), white, more or less clawed. Filaments persistent. Carpels 4.
6. R. alba L., Sp. Pl. 449 (1753). Annual to perennial (10-) $30-80 \mathrm{~cm}$, erect, branching above. Leaf-lobes $5-15$ on each side, entire. Pedicels $1-8 \mathrm{~mm}$. Sepals 5 or $6,(1 \cdot 5-) 3-4 \mathrm{~mm}$; petals 5 or $6,3 \cdot 5-6 \mathrm{~mm}$; limb $3-5$ times as long as claw, lobed to $\frac{1}{3}-\frac{2}{3}$ its length; lobes 3 , the lateral often again lobed. Capsule $8-15 \mathrm{~mm}$, narrowly obovate or elliptical, constricted at apex. Disturbed ground. S. Europe, eastwards to Jugoslavia and Kriti; occasionally cultivated for ornament and naturalized in parts of C. \& N.W. Europe. Bl Co Cr Ga Gr Hs It Ju Lu Sa Si [ $\mathrm{Br} \mathrm{Cz} \mathrm{Ge} \mathrm{Ho} \mathrm{Rm]}$.
7. R. undata L., Syst. Nat. ed. 10, 2: 1046 (1759) (R. gayana Boiss.). Like 6 but stems less leafy above; pedicels $1.5-3 \mathrm{~mm}$; sepals $5,1 \cdot 5-2.5 \mathrm{~mm}$; petals $5,3-4.5 \mathrm{~mm}$, the lower bilobed; capsule $4-5 \times 3.5 \mathrm{~mm}$, turbinate or subglobose. Dry places. $S$., E. and C. Spain. Hs.
8. R. decursiva Forskål, Fl. Aegypt. Ixvi (1775) (R. propinqua R.Br.). Annual or biennial up to 20 cm . Leaf-lobes $5-15$ on each side, entire. Pedicels $1-2.5 \mathrm{~mm}$. Sepals 5, $2-2.5 \mathrm{~mm}$; petals $5,3-4.5 \mathrm{~mm}$; dilation of claw indistinct or
absent; lower petal retuse or shallowly bilobed. Capsule 4.5$7 \times 4.5 \mathrm{~mm}$, turbinate or elliptical, usually constricted below the prominent stigmatic lobes. Maritime sands. S. Spain (near Gibraltar). Hs. (N. Africa, S.W. Asia.)
9. R. suffruticosa Loefl., Reise Span. Länd. 113 (1766) ( $R$. baetica (Müller Arg.) Gay ex Lange; R. macrostachya Lange). Biennial or perennial $25-220 \mathrm{~cm}$, papillose. Leaf-lobes c. 25 on each side, usually pinnatifid or toothed. Pedicels $0.5-1.5 \mathrm{~mm}$. Sepals 6; petals 6; claw and limb rectangular or triangular; limb subentire or 1-2 cleft, 1-2 times as long as claw. Capsule $11 \times 6-$ 8 mm , obovoid. Dryplaces. - S., C. \& E. Spain, N.E. Portugal. Hs Lu.

Sect. Reseda (Sect. Resedastrum Duby). Leaves entire or pinnatifid. Sepals 6; petals 6, clawed, the two upper with limb 3-lobed; lateral lobes multifid or subentire; mid-lobe narrow, often indistinct; the two lateral petals similar, but with the lower lateral lobe wanting or reduced; the two lower petals with the limb usually entire. Filaments caducous except in 20. Carpels 3.
10. R. phyteuma L., $S p$. Pl. 449 (1753). Annual or biennial 1050 cm , with ascending branches near the base. Leaves $50-100 \times$ $5-15 \mathrm{~mm}$, spathulate, long-cuneate, sometimes some with $1(-2)$ lobes on each side. Bracts $2 \cdot 5-3 \mathrm{~mm}$. Sepals accrescent, 3$4.5 \times c .0 .75 \mathrm{~mm}$ at anthesis, $5-13 \times 1.25-1.5(-3.5) \mathrm{mm}$ in fruit; petals $3-5 \mathrm{~mm}$, white, the upper with claw investing disc; limb inserted dorsally on the claw below the middle, stipitate, the lateral lobes pinnatifid, each with 5-9 linear-oblanceolate segments. Capsule 13-14 $\times 5.5-9 \mathrm{~mm}$, nodding, obovoid-cylindrical. Cultivated and disturbed ground. S. Europe, extending northwards to $47^{\circ}$ N. in France. Al Bl Co Ga Gr He Hs Hu It Ju Lu Po Rm [ $\mathrm{Au} \mathrm{Br} \mathrm{Cz} \mathrm{Ge} \mathrm{Ho]}$.
11. R. media Lag., Gen. Sp. Nov. 17 (1816). Like 10 but many leaves with $1-4(-8)$ pairs of lobes and small terminal lobe; the entire leaves $30-50 \times 4-8 \mathrm{~mm}$; the intermediate and upper leaves more shortly cuneate or rounded at the base; bracts $1.5-2.5 \mathrm{~mm}$; sepals finally 6 mm ; upper petals with claw less incurved and limb sessile, digitate; capsule $13 \times 8 \cdot 5-16 \times 6 \mathrm{~mm}$, nodding. Dry places. S.W. Europe. Az Bl Hs Lu.
12. R. inodora Reichenb., Icon. Fl. Germ. 2: 22 (1838). Biennial or perennial $20-60 \mathrm{~cm}$. Stems erect, branched above. Leaves mostly $50-80 \times 7-12 \mathrm{~mm}$, lanceolate, erect, some of the upper with 1-2 pairs of lateral lobes and a large terminal lobe. Bracts 3 mm ; pedicels $5-8 \mathrm{~mm}$, patent. Sepals finally 5 mm ; petals 3 mm , the upper with limb inserted dorsally on the claw above the middle; limb sessile, digitate, with $c$. 11-17 linearoblanceolate segments. Orientation of capsule variable. Tilled ground and waste places. S.E. Europe, westwards to N.E. Italy. Bu Hu It Ju Rm Rs (C, W, K, E) [Ho].

Similar plants from S. Jugoslavia and N. Greece (R. inodora var. macrocarpa Fischer \& Meyer), which perhaps deserve specific rank, differ in often being papillose and in having stems $20-30 \mathrm{~cm}$, sometimes ascending. They also resemble 13 and $R$. alopecuros Boiss. from S.W. Asia.
13. R. tymphaea Hausskn., Mitt. Thür. Bot. Ver. 1887: 10 (1887). Perennial, like 12 but stems ascending or erect; inflorescence longer; pedicels $3-4.5 \mathrm{~mm}$; capsule $10-12(-17) \times 8-9 \mathrm{~mm}$, slightly nodding, obovoid or almost square in outline above the abruptly tapered base; stigmatic lobes smaller. Gravelly places and rocks. - Greece (local and mainly in the west). Gr.
14. R. odorata L., Syst. Nat. ed. 10, 2: 1046 (1759). Like 10 in habit but leaves oblanceolate to obovate, usually some with

1-2 lateral lobes. Sepals attaining 4-5 mm; petals $4-4.5 \mathrm{~mm}$, the upper with claws flat; limb inserted near apex of claw, digitate; segments $c$. 9-15, spathulate. Capsule $9-11 \times 7-11 \mathrm{~mm}$, nodding, subglobose. Commonly cultivated for its fragrant flowers and locally naturalized in $S$. \& C. Europe. Sometimes found as a casual further north. [ $\mathrm{Au} \mathrm{Bl} \mathrm{Cz} \mathrm{Ga} \mathrm{Hs} \mathrm{It} \mathrm{Rm} \mathrm{Rs]}. \mathrm{(Libya)}$.
15. R. orientalis (Müller Arg.) Boiss., Fl. Or. 1: 427 (1867). Annual up to 70 cm . Lower leaves up to $100 \times 11 \mathrm{~mm}$, oblanceolate, obtuse, petiolate; the upper pinnatifid with 1 or 2 pairs of lobes, the lobes mostly $1.5-3.5 \mathrm{~mm}$ wide, ovate-lanceolate to linear. Sepals $3-4.5 \mathrm{~mm}$; petals like those of 14 but $3-3.5 \mathrm{~mm}$. Capsule $7-13 \times 5-6 \mathrm{~mm}$, nodding, ovoid or obovoid. Greece (island of Salamis) and Kriti (Khora Sfakion and island of Gavdhos). Cr Gr. (E. Mediterranean.)
16. R. stricta Pers., Syn. Pl. 2: 10 (1806). Biennial, stems $30-$ 45 cm , erect, with long erect branches. Leaves with 1-2 pairs of often bifid pinnae, segments up to 6 mm wide. Bracts caducous; pedicels filiform; flowers pendent. Sepals $1-1.5 \mathrm{~mm}$, ovate; petals 2-3 mm, yellow; limb of the upper shorter than claw, 5-partite, of the lower bilobed, with lobes 1- to 2-lobulate at base. Capsule 7-13 mm, erect, obovoid or cylindrical. Gypsaceous soils. E. \& C. Spain. Hs.
17. R. lutea L., Sp. Pl. 449 (1753) (R. ramosissima Pourret ex Willd.). Annual to perennial, bushy. Leaves mostly pinnatifid, with 1-2(-4) pairs of pinnae (or leaves sometimes bi- or ternate); segments elongate. Bracts usually caducous. Petals yellow; lateral lobes of the upper falcate, subentire; mid-lobe shorter; limb of the lower entire or with 2-3 linear-spathulate lobes. Capsule $7-12 \times 4.5-5.5 \mathrm{~mm}$, rarely nodding, oblong, oblongobovoid or ellipsoid. Cultivated and disturbed ground. S. \& W. Europe; probably a naturalized alien further north and east. Al Au Bl Br Bu Co Cr Ga Gr Hb Ho Hs It Ju Lu Po Rm ?Sa ?Si Tu *[Be Cz Da Ge He Hu Rs (N, C, W, K, E)].
R. truncata Fischer \& Meyer, Ind. Sem. Horti Petrop. 4: 45 (1837) is said to occur in the Balkan peninsula and to differ from 17 in its ternate-incised leaves, papillose inflorescence-axis, papillose-hairy stamen filaments and ellipsoid-cylindrical capsule, with truncate base and apex, and inconspicuous stigmatic lobes. However, though plants with the capsules truncate at the apex are perhaps commoner in S.E. Europe than elsewhere, this character and that of the papillose inflorescence-axis usually occur independently and are found fairly widespread through the range of 17 and do not appear to justify the recognition of a separate species.
18. R. lanceolata Lag., Gen. Sp. Nov. 17 (1816) (R. constricta Lange). Erect annual or biennial, $40-120 \mathrm{~cm}$; leaves mostly $20-$ $90 \times 4-18 \mathrm{~mm}$, oblanceolate or spathulate, sometimes some with $1-2$ lateral lobes. Bracts caducous; pedicels $3-7(-18) \mathrm{mm}$. Sepals $6-8$; petals yellow, similar to those of 17 , but limb of the upper with lateral lobes wide, shorter than claw; limb of the lower entire. Capsule 16-28×5-6 mm. Dry places. S. \& E. Spain. Hs.
R. crystallina Webb \& Berth., Phyt. Canar. 1: 102 (1837), a leafy annual, resembling 17 in foliage, but with the capsule 14 $20 \times 3.5-4.5 \mathrm{~mm}$, and native in the Canary Isles, is sometimes introduced and may be locally naturalized.
19. R. jacquinii Reichenb., Icon. Fl. Germ. 2: 22 (1838). Annual or biennial, branched at the base. Leaves $20-50 \times 5-$ 20 mm , subsessile, spathulate, obtuse, some with $1(-2)$ pairs of oblong to narrowly triangular lobes. Bracts persistent. Petals 4 mm , the upper with lateral lobes shallowly to deeply crenate.

Capsule $12-15 \times 6.5 \mathrm{~mm}$, nodding, obovoid. Dry places.
S. France (Cevennes, ?E. Pyrenees). Ga.
20. R. arabica Boiss., Diagn. Pl. Or. Nov. 1 (1): 6 (1843). Annual, $10-30 \mathrm{~cm}$. Leaves mostly $2-5 \mathrm{~cm}$, the lower spathulate to lanceolate, some of the upper with 1-2 pairs of narrow lobes. Upper petals with limb inserted near apex of claw and lateral lobes cut to $\frac{1}{3}-\frac{1}{2}$ their length into $6-9$ short lobes. Filaments persistent. Capsule $6-7 \mathrm{~mm}$, subglobose, or up to 10 mm and broadly oblong, nodding. Once recorded from Kriti (Sitia). *Cr. (Deserts of N. Africa and S.W. Asia.)

## 2. Sesamoides Ortega ${ }^{1}$

Usually perennial, often woody at the base, with simple leaves. Flowers in terminal, bracteate racemes. Calyx 5- to 6-lobed. Petals 5-6, the upper two multilaciniate, the others less divided. Stamens 7-15 on an excentric, urceolate, hypogynous disc. Carpels on a short gynophore, 4-7, more or less free, stellate-patent in fruit, more or less dorsally gibbous making the style lateral or subterminal. (Astrocarpus DC.)
Calyx-lobes narrow, obtuse, more than half as long as the calyx, with narrow sinuses

1. pygmaea Calyx-lobes broadly triangular, acute, less than half as long as the calyx, with broad sinuses
2. canescens
3. S. pygmaea (Scheele) O. Kuntze, Revis. Gen. 39 (1891)(Reseda sesamoides L., Astrocarpus sesamoides (L.) DC.). Many-stemmed perennial with a more or less woody base; stems $5-15 \mathrm{~cm}$; leaves lanceolate to linear-lanceolate, the basal ones in dense rosettes. Calyx divided to at least half-way into narrow, obtuse, lobes, with the sinuses between the lobes narrow. Stamens 7-9; filaments usually glabrous. Carpels 4-6, obovoid, the style subterminal,
overtopping the dorsal gibbosity of the carpel. Rocks, moist screes, alpine meadows. S.W. Europe, from N.W. Spain to C. France, Corse and Liguria. Co Ga Hs It.
(a) Subsp. pygmaea: Stamens 7-8, with glabrous filaments; carpels 4-6. From the Pyrenees to Auvergne, the Cevennes and Corse.

The plants from Auvergne and the Cevennes form a wellmarked variant characterized by their taller leafy stems with broader leaves (var. firma (Müller Arg.) Heywood).
(b) Subsp. minor (Lange) Heywood, Feddes Repert. 69: 43 (1964) (Astrocarpus minor Lange): Stamens 10-12, with papillosehairy filaments; carpels 6-7. N.W. Spain.

Intermediates with (a) occur in the Pyrenees.
2. S. canescens (L.) O. Kuntze, loc. cit. (1891) (Astrocarpus purpurascens (L.) Rafin., A. clusii Gay). Like 1 but rosettes lax; calyx-lobes broadly triangular, acute, with broad sinuses, less than half the length of the calyx; stamens (10-)12-14(-15); carpels 4-5; style lateral, not overtopping the dorsal gibbosity of the carpel. S.W. Europe, extending to N.W. France and Italy. Co Ga Hs It Lu Sa.
(a) Subsp. canescens: Biennial or perennial with simple or slightly branched stems. W. Mediterranean region and Portugal.

Plants with obovate-spathulate or orbicular-spathulate leaves are found, especially on maritime sands. A distinctive variant in S. Spain (mainly Sierra Nevada and neighbouring ranges) which is like 1 (a) in shape and number of the carpels, may deserve recognition as a subspecies.
(b) Subsp. suffruticosa (Lange) Heywood, Feddes Repert. 69: 43 (1964) (Astrocarpus suffruticosus Lange): Woody perennial to small shrub, with the stems 2-3 times branched. W.\& N.W. Spain, Portugal.

## SARRACENIALES

## LXX. SARRACENIACEAE ${ }^{2}$

Perennial, insectivorous herbs. Flowers regular, hermaphrodite. Sepals and petals free; stamens numerous, hypogynous; ovary superior. Fruit a capsule.

## 1. Sarracenia L. ${ }^{3}$

Leaves all basal, each in the form of a hollow, curved, inverted cone, with the orifice partly covered by a broad flap or hood. (In the fluid contained in the leaf insects are trapped, and the organic matter released by their decay is absorbed.) Flowers solitary on long peduncles, closely subtended by 3 bracts. Sepals and petals 5 ; ovary 5 -celled; style expanded at the apex into a large, peltate disc which fills the centre of the flower. Seeds numerous.

Literature: J. M. Macfarlane in Engler, Pflanzenreich 34 (IV. 110): 27-38 (1908).

1. S. purpurea L., Sp. Pl. 510 (1753). Leaves up to 20 cm , numerous, green, suffused or marbled with dark red, the outer ones spreading almost horizontally, all strongly winged on the adaxial side; terminal flap reniform, nearly erect, covered on the inner side with downwardly pointing hairs. Peduncles $20-60 \mathrm{~cm}$; flowers nodding. Sepals $3 \times 2 \mathrm{~cm}$, ovate to rhombic, dark purplered outside, pale green inside. Petals $3 \times 1.5 \mathrm{~cm}$, obovate, tapered to a short claw, purple-red on both surfaces. Apical disc of style $c .3 \mathrm{~cm}$ in diameter, pentagonal, greenish. Wet peat-bogs. Planted and thoroughly naturalized in a few places in W. Switzerland and C. Ireland. [Hb He.] (North America.)

## LXXI. DROSERACEAE ${ }^{2}$

Perennial, insectivorous herbs. Flowers regular, hermaphrodite, usually 5 -merous. Sepals united at base; petals free; stamens; hypogynous ovary superior, 1-celled; styles 2-5. Fruit a capsule.

[^140]
## Literature: L. Diels in Engler, Pflanzenreich 26 (IV. 112) : (1906).

2 Flowers white; stamens equal in number to the petals
2. Drosera

2 Flowers yellow; stamens twice as many as petals
3. Drosophyllum

## 1. Aldrovanda L. ${ }^{1}$

Stems submerged, rootless; leaves whorled. Flowers axillary; stamens 5; styles 5 .

1. A. vesiculosa L., Sp. Pl. 281 (1753). Leaves $10-15 \mathrm{~mm}$, in crowded whorls of $6-9$; each with a cuneate basal part, and terminating in 4-6 setaceous segments and an orbicular lobe, hinged along the midrib, which can close rapidly to entrap and digest small animals. Flowers shortly pedicellate, rarely produced in Europe and usually cleistogamous; petals $4-5 \mathrm{~mm}$, greenishwhite. Perennation by persistent terminal buds. Usually in shallow, still water. Dispersed irregularly and sparsely over a large part of Europe, mainly in the centre and east. ?Au Bu Ga Ge *He Hu It Ju Po Rm Rs (C, W, E).

## 2. Drosera L. ${ }^{1}$

Small plants of wet places. Leaves all basal; upper surface of lamina covered with long, red, gland-tipped, motile hairs, which entrap and digest insects. Scape slender, bearing a few-flowered, ebracteate cyme. Flowers usually 5 -merous, sometimes 4 - or 6to 8 -merous, open for a short time only, sometimes cleistogamous. Petals white, persistent. Stamens equal in number to the petals. Carpels usually 3 ; styles free, deeply bifid.
1 Scape lateral, scarcely longer than leaves
3. intermedia

1 Scape apparently terminal, considerably longer than leaves
2 Lamina orbicular; petiole hairy

1. rotundifolia
2. anglica
3. D. rotundifolia L., Sp. Pl. 281 (1753). Plants solitary. Leaves usually spreading horizontally, sometimes semi-erect; lamina $5-8 \mathrm{~mm}$, orbicular or slightly wider than long; petiole $15-30 \mathrm{~mm}$, hairy. Scape 4-8 cm, apparently terminal, arising from the axil of the highest leaf, bearing $6-10$ flowers. Petals 5 mm . Capsule smooth. Testa reticulate, very loose-fitting. $2 n=20$. Usually on peat or Sphagnum. Europe, except for some
of the islands and the extreme south. All except Al Az Bl Cr Cr Sa Sb Si Tu .
4. D. anglica Hudson, Fl. Angl. ed. 2, 135 (1778) (D. longifolia L.). Plants solitary, larger than in 1 and 3. Leaves erect or inclined; lamina c. $30 \times 7 \mathrm{~mm}$, linear-oblanceolate; petiole 510 cm , glabrous. Scape apparently terminal, as in 1, but 10 18 cm , bearing 3-6 flowers. Petals 6 mm . Capsule smooth. Testa reticulate, loose-fitting. $2 n=40$. More tolerant of basic conditions than the other species. N. \& C. Europe, and very rarely in the south. Au Be Br Cz Da Fe Ga Ge ? Gr Hb He Ho Hs $\dagger \mathrm{Hu}$ It Ju No Po Rm Rs (N, B, C, W, K, E) Su.
D. $\times$ obovata Mert. \& Koch in Röhling, Deutschl. Fl.ed. 3, 2: 502 (1826) ( $D$. anglica $\times$ rotundifolia) is fairly frequent, but sterile. Its leaves are rather like those of 3 , but the scape is apparently terminal, the capsule very small, and the seeds empty.
5. D. intermedia Hayne in Dreves, Bot. Bilderb. 3: t. 3, fig. B (1798) (D. longifolia auct.). Plants gregarious, from pseudodichotomous branching of the stem with subsequent decay; sometimes forming floating mats. Leaves inclined or almost erect; lamina $c .7 \times 4 \mathrm{~mm}$, obovate; petiole $2.5-4 \mathrm{~cm}$, glabrous. Scape $2-3 \mathrm{~cm}$, scarcely as long as the leaves, ascending, obviously lateral, from the axil of one of the lower leaves of the current year, bearing 3-7 flowers. Petals $4-5 \mathrm{~mm}$. Capsule longitudinally grooved. Testa granular, close-fitting. $2 n=20$. Usually on peat or Sphagnum, or in shallow bog-pools. N., W. \& C. Europe. Au Be Br Cz Da Fe Ga Ge Hb He Ho Hs It Ju Lu No Po Rm Rs ( $\mathrm{N}, \mathrm{B}, \mathrm{C}$ ) Su .

## 3. Drosophyllum Link ${ }^{1}$

Leaves with glandular hairs, as in Drosera. Flowers 5-merous, in a corymbose cyme. Petals yellow. Stamens 10; styles 5.

1. D. lusitanicum (L.) Link in Schrader, Neues Jour. Bot. 1 (2): 53 (1805). Stem slender, ascending, sometimes branched. Leaves $10-20 \mathrm{~cm} \times 2-3 \mathrm{~cm}$, numerous, alternate, crowded, narrowly linear, tapering from the sheathing base to the filiform apex, covered throughout with red-tipped, glandular, digestive hairs. Scape 15-30 mm , erect, bearing a corymb of 5-10 flowers. Petals $18-25 \mathrm{~mm}$, broadly obovate, bright yellow. Dry places; calcifuge. S. Spain and Portugal. Hs Lu.

## ROSALES

## LXXII. CRASSULACEAE ${ }^{2}$

Annual, biennial or perennial herbs, rarely small shrubs. Leaves undivided, exstipulate, more or less succulent. Flowers regular, usually in cymes, less often in spikes or racemes or solitary in the leaf-axils. Sepals 3 to $c$. 20, united or free; petals as many, united or free; stamens hypogynous or epipetalous, equal in number to the petals or, more frequently, twice as many. Carpels superior, equal in number to the petals, free or slightly connate at the base, developing into follicles. Scale-like nectaries usually present between the stamens and carpels.

No really satisfactory basis for the division of the family into genera has yet been proposed; Berger's treatment (in Engler, Natürl. Pflanzenfam. ed. 2, 18a: 352-483 (1930)) has been followed with slight modifications.

[^141]1 Stamens equal in number to the petals
2 Leaves opposite, connate; petals 3-4

1. Crassula

2 Leaves not connate; petals 5 (rarely 4) (see also 3)
10. Sedum

1 Stamens twice as many as the petals
3 Corolla-tube longer than, or only slightly shorter than the lobes
4 Annual
5 Stamens and style included; corolla-tube nearly as wide as long
5. Mucizonia

5 Stamens and style exserted; corolla-tube very long and narrow
4. Pistorinia

4 Perennial
6 Leaves mostly cauline; inflorescence cymose 2. Bryophyllum
6 Leaves mostly basal; cauline leaves much smaller; inflorescence racemose
7 Basal leaves suborbicular, with long petioles
3. Umbilicus

7 Basal leaves oblong-spathulate, sessile
3 Petals free, or fused to form a tube for considerably less than
half their length
8 Petals 4-5
9 Leaves mostly basal; cauline leaves much smaller; inflore-
scence racemose
10 Basal leaves petiolate, not spiny; corolla tubular, with erect lobes
10 Basal leaves sessile, with a terminal spine; corolla-lobes spreading
12. Orostachys
9 Leaves mostly cauline; inflorescence cymose
11 Flowers usually 5-merous, hermaphrodite; rhizome slender and leafless, or absent 10. Sedum
11 Flowers usually 4-merous, unisexual; rhizome stout, with persistent scale-leaves
11. Rhodiola
8 Petals more than 5
12 Annual
13 Flowers yellow; leaves flat
9. Aichryson
13 Flowers pink, white or blue; leaves $\pm$ terete
10. Sedum 12 Perennial
14 Leaves subulate
10. Sedum
14 Leaves broad, flat on upper surface
15 Soft-wooded shrub with erect, perennial stems 8. Aeonium 15 Acaulescent in vegetative phase; flowering stems annual
16 Petals entire, patent
6. Sempervivum
16 Petals $\pm$ fimbriate, erect
7. Jovibarba

## 1. Crassula L. ${ }^{1}$

Small, glabrous annuals, with opposite, connate, often reddish leaves. Flowers 4- or 3-merous. Petals free. Stamens equal in number to the petals.

The characteristic habitat of all European species is ground flooded in winter and dry in summer.
1 Leaves ovate, concave, crowded; flowers usually 3-merous 1. tillaea

1 Leaves broadly linear, flat, patent; flowers usually 4-merous

2 Flowers subsessile
2 Pedicels exceeding the subtending leaves
2. aquatica
3. vaillantii

1. C.tillaea Lester-Garland, Fl.Jersey 87 (1903)(C. muscosa(L.) Roth, non L., Tillaea muscosa L.). A minute, moss-like plant with prostrate or ascending stems. Leaves 2 mm , ovate, concave, crowded, almost imbricate. Flowers 3- (rarely 4-)merous, sessile in small groups in the leaf-axils. Petals 1 mm , shorter than the sepals, narrowly lanceolate, white or pale pink. Follicles usually 2 -seeded. S. \& W. Europe, extending locally to N.E. Germany. $\mathrm{Az} \mathrm{Be} \mathrm{Bl} \mathrm{Br} \mathrm{Bu} \mathrm{Co} \mathrm{Cr} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{Ho} \mathrm{Hs} \mathrm{It} \mathrm{Lu} \mathrm{Sa} \mathrm{Si}$.
2. C. aquatica (L.) Schönl. in Engler \& Prantl, Natürl. Pflanzenfam. 3 (2a): 37 (1890) (Tillaea aquatica L.). Stems 2-5 cm, decumbent, rooting. Leaves $4-6 \mathrm{~mm}$, linear, acute, patent, not crowded. Flowers usually 4 -merous, subsessile, solitary in the leaf-axils. Petals rather longer than the sepals, ovate-oblong, obtuse, white. Follicles with numerous seeds. $2 n=42$. N. \& C. Europe. Au Cz Da Fe Ge Is No Po Rs (N, B, C) Su [Lu].
3. C. vaillantii (Willd.) Roth, Enum. 1: 992 (1827) (Tillaea vaillantii Willd.). Stems $2-6 \mathrm{~cm}$, erect or ascending. Leaves linear-oblong, obtuse, patent, not crowded. Flowers 4-merous, on slender pedicels longer than the leaves, forming small, irregular cymes. Petals longer than the sepals, ovate-lanceolate, acute, pink. Follicles with numerous seeds. S. Europe, extending northwards to N. France, S. Ukraine and the lower Volga; rare and local over most of its range. Bl Co Cr Ga Gr Hs It Lu Rs (W, E) Sa Si.

[^142]C. bonariensis (DC.) Camb. in St-Hil., Fl. Bras. Mer. 2: 140 (1829), introduced from South America, has recently been reported as naturalized in rice-fields in C. Portugal. It is like 3, but with pale, hyaline petals and much longer pedicels.

## 2. Bryophyllum Salisb. ${ }^{1}$

Perennials with opposite leaves. Flowers 4 -merous, in cymes; corolla tubular, with short lobes; stamens 8 , inserted near the base of the corolla.

1. B. pinnatum (Lam.) Oken, Allgem. Naturgesch. 3: 1966 (1841) (B. calycinum Salisb.). Stems 1 m or more, erect, woody at the base. Leaves petiolate, simple, ternate or pinnate; leaflets up to 10 cm , ovate, crenate, often with young plants arising on the margins between the crenations. Flowers pendent, in compound cymes. Calyx 3 cm , tubular, with short, triangular lobes; corolla similar but $4-5 \mathrm{~cm}$, and with longer, more acute lobes; both pale green mottled with red. Follicles erect. Widely cultivated, and naturalized in many tropical and subtropical countries, also in Açores. [Az.] (Madagascar.)

## 3. Umbilicus DC. ${ }^{1}$

Perennials, with tuberous or rhizomatous rootstock. Basal leaves petiolate, usually suborbicular, at least 2 cm in diameter, glabrous. Cauline leaves much smaller. Flowers 5-merous, numerous, in a terminal, bracteate raceme or panicle. Calyx small. Corolla tubular or campanulate, distinctly sympetalous; lobes more or less erect. Stamens 10 (rarely 5), epipetalous; filaments short. Follicles slender; styles rather short or absent.
1 Lobes of corolla as long as or longer than the tube
2 Flowers $9-13 \mathrm{~mm}$; lobes of corolla about equalling the tube
3. erectus

2 Flowers $3-6 \mathrm{~mm}$; lobes of corolla considerably longer than the tube
3 Flowers 4-6 mm, obconical; carpels gradually tapered to a straight, fairly long style 1. parviflorus
3 Flowers $3-4 \mathrm{~mm}$, campanulate or subglobose; carpels abruptly narrowed to a very short, curved style 2. chloranthus
1 Lobes of corolla considerably shorter than the tube
4 Corolla bright yellow, conspicuously constricted at the mouth of the tube; stamens usually 5
6. heylandianus

4 Corolla pale yellow, greenish or reddish, scarcely constricted at the mouth of the tube; stamens 10
5 Flowers usually pendent; raceme occupying more than half the stem; corolla-lobes ovate, mucronate 4. rupestris
5 Flowers horizontal; raceme occupying not more than half the stem; corolla-lobes lanceolate, acute
5. horizontalis

1. U. parviflorus (Desf.) DC., Prodr. 3: 400 (1828) (Cotyledon parviflora Desf.). Stem $10-35 \mathrm{~cm}$, erect or ascending, often flexuous. Basal leaves $2-5 \mathrm{~cm}$ in diameter, orbicular, cordate or subpeltate, sinuate or subentire. Flowers $4-6 \mathrm{~mm}$, erect or horizontal, obconical, in a dense, usually narrow panicle. Bracts minute, about equalling pedicels. Sepals half as long as corolla. Corolla yellow, with lanceolate, acute lobes $1 \frac{1}{2}-2$ times as long as the tube. Carpels gradually tapered to a nearly straight style. Rocks. S. Greece; Kriti. Cr Gr.
2. U. chloranthus Heldr. \& Sart. ex Boiss., Fl. Or. 2: 768 (1872) (Cotyledon chlorantha (Heldr. \& Sart. ex Boiss.) Halácsy). Like 1, but with leaves more often peltate; flowers shorter (3-4 mm), campanulate or subglobose, horizontal or somewhat drooping, in a laxer and more diffuse panicle; and carpels abruptly narrowed to a very short, deflexed style. Rocks and
walls. S. \& W. parts of Balkan peninsula, Aegean region. Cr Gr Ju.
3. U. erectus DC. in Lam. \& DC., Fl. Fr. ed. 3, 4: 384 (1805) (Cotyledon umbilicus-veneris L.). Stem $20-60 \mathrm{~cm}$, stout, erect, simple. Basal leaves up to 7 cm in diameter, deltateorbicular, cordate, sinuate-crenate; cauline leaves progressively smaller, with shorter petioles, dentate. Flowers very numerous, more or less erect, in a dense raceme $8-25 \mathrm{~cm}$ long, sometimes branched at the base; pedicels $1-3 \mathrm{~mm}$. Bracts usually narrowlanceolate, small, entire or with a tooth on each side, but sometimes (var. lassithiensis (Gand.) Stoj.) broad, leafy, dentate. Sepals linear-lanceolate. Corolla $9-13 \mathrm{~mm}$, tubular, greenishyellow, drying red-brown; lobes narrow-lanceolate, acuminate, about equalling the tube. Damp or shady rocks. S. part of Balkan peninsula; Calabria. Al Bu Cr Gr It Ju.
4. U. rupestris (Salisb.) Dandy in Riddelsd., Hedley \& Price, Fl. Gloucestershire 611 (1948) (U. pendulinus DC., Cotyledon pendulina (DC.) Batt.). Stem $20-50 \mathrm{~cm}$, erect. Basal leaves orbicular, peltate, concave above, sinuate-crenate; cauline leaves progressively smaller, mostly reniform, dentate, the uppermost sometimes linear. Bracts usually linear, about equalling the pedicels, but occasionally large and leaf-like. Pedicels $3-9 \mathrm{~mm}$. Flowers $7-10 \mathrm{~mm}$, tubular, usually pendent; raceme fairly dense, sometimes branched at the base, occupying more than half the stem. Sepals ovate, acuminate. Corolla whitish-green or strawcoloured, sometimes tinged with pink; tube about 4 times as long as the ovate, mucronate lobes. Carpels tapered to a fairly long style. S. \& W. Europe, northwards to Scotland. Al Az Bl Br ?Bu Co Cr Ga Gr Hb Hs It Ju Lu Sa Si ?Tu.

A very variable species; some of the variants resemble 3,5 and 6 in single characters and have caused much confusion. The most distinct is $\mathbf{U}$. neglectus (Coutinho) Rothm. \& P. Silva, Agron. Lusit. 2: 88 (1940), from Portugal, S. Spain and Islas Baleares, which possibly deserves subspecific status. It is a robust plant, with basal leaves often cordate rather than peltate, and a narrow corolla approaching that of 5 .
5. U. horizontalis (Guss.) DC., Prodr. 3: 400 (1828) (Cotyledon horizontalis Guss.). Like 4, but with the raceme occupying not more than half the stem; cauline leaves more numerous and crowded, many of them usually linear; flowers narrower and somewhat shorter (c. $7 \times 3 \mathrm{~mm}$ ), subsessile, horizontal; and corolla-lobes triangular, lanceolate, acuminate. $2 n=24$. Mediterranean region, Bulgaria, Açores. Al Az Bl Bu Cr Gr Hs It Ju ?Sa Si.

The plants of the W. Mediterranean region are sometimes separated as U. gaditanus Boiss., Diagn. Pl. Or. Nov. 1 (6): 58 (1846), and are in some features transitional to 4, but neither their taxonomic status nor their correct name can be ascertained with certainty from the material available.
U. intermedius Boiss., Fl. Or. 2: 769 (1872) (Cotyledon intermedia (Boiss.) Stefanov), has been recorded for the Balkan peninsula (Bulgaria and Thrace), but its occurrence in Europe is doubtful. It is a plant of S.W. Asia, differing from 4 in its shorter raceme, short pedicels and slightly more pointed corolla-lobes, and from 5 by the usually drooping flowers and corolla with broader tube and lobes.
6. U. heylandianus Webb \& Berth., Phyt. Canar. 1: 176 (1840). Stem $60-100 \mathrm{~cm}$, stout, erect. Leaves as in 4. Raceme 1235 cm , dense, simple, somewhat secund. Bracts 6-10 mm, linear.

[^143]Flowers horizontal or drooping; pedicels $2-4 \mathrm{~mm}$ at flowering time, often longer in fruit. Sepals small, ovate-lanceolate. Corolla $10-12 \mathrm{~mm}$, bright yellow; tube distinctly 5 -angled and constricted at the mouth; lobes ovate-lanceolate, acuminate, about $\frac{1}{3}$ as long as the tube. Stamens usually reduced to 5. Carpels obtuse, with a short style. N., W. \& C. Spain; Portugal; very local. Hs Lu.

## 4. Pistorinia DC. ${ }^{1}$

Erect annuals with alternate leaves. Flowers 5 -merous, shortly stalked, in a dense, subcorymbose cyme. Corolla infundibuliform, with a long, narrow tube. Stamens 10, exserted.
Corolla-lobes pink; tube cylindrical, expanded suddenly into the limb

1. hispanica

Corolla-lobes yellow; tube somewhat conical, expanded gradually into the limb
2. breviflora

1. P. hispanica (L.) DC., Prodr. 3: 399 (1828). $5-15 \mathrm{~cm}$, glabrous below, glandular-pubescent above. Leaves $6-10 \mathrm{~mm}$; oblong, terete, very obtuse, suberect. Sepals 2.5 mm , linear, acute. Corolla (12-)20-25 mm, reddish-brown outside, pink inside, pubescent; tube of uniform diameter (c. 1.5 mm ), expanded suddenly into the deeply 5 -lobed limb. Styles long and slender, equalling the stamens. Spain and Portugal. Hs Lu.
2. P. breviflora Boiss., Elenchus 74 (1838). Like 1 but more robust and more densely hairy; leaves up to 20 mm , subacute; and corolla yellow, tinged with brownish-red on the tips of the lobes and the outside of the tube, with a broader, conical tube 3 mm wide at its upper end. S. Spain. Hs. (N.W. Africa.)

## 5. Mucizonia (DC.) A. Berger ${ }^{1}$

Diffuse or erect annuals with alternate leaves. Flowers 5-merous. Corolla campanulate, with the lobes about equalling the tube. Stamens 10, included.
Leaves $2-4 \mathrm{~mm}$, imbricate; stem seldom branched 1. sedoides Leaves $12-18 \mathrm{~mm}$, patent, distant; bushy, with freely branched stem
2. hispida

1. M. sedoides (DC.) D. A. Webb, Feddes Repert. 64: 22 (1961) (Umbilicus sedoides (DC.) DC.). Glabrous; usually gregarious, forming dense tufts. Stem $2-6 \mathrm{~cm}$, erect. Leaves 2-4 mm, numerous, oblong, obtuse, concavo-convex, imbricate. Flowers erect, subsessile, in a crowded terminal cyme, their lower part concealed by leaves. Corolla 6-7 mm, purplish-pink; lobes erect, longer than the tube. Pyrenees, and higher mountains of Spain and Portugal. Ga Hs Lu.
2. M. hispida (Lam.) A. Berger in Engler \& Prantl, Natürl. Pflanzenfam. ed. 2, 18a: 420 (1930). Usually glandularpubescent, at least in the inflorescence, but sometimes glabrous. Stem 8-15 cm, diffuse, branched from the base. Leaves 12-18 mm, oblong, terete, streaked with red. Flowers long-stalked, in lax cymes. Corolla $8-13 \mathrm{~mm}$, yellowish-green tinged with pink; lobes rather shorter than the tube. C. \& S. Spain and Portugal. Hs Lu.

## 6. Sempervivum L. ${ }^{2}$

Perennials with monocarpic rosettes; vegetative reproduction by axillary stolons. Leaves alternate, entire, sessile, ciliate, very fleshy. Hairs, if present, glandular. Flowers 8 - to 16 -merous, in a terminal cyme. Sepals lanceolate, pubescent. Petals yellowish, pink or purple, patent, narrow-lanceolate, entire, pubescent on margins and lower surface. Stamens twice as many as petals; filaments usually pubescent at least at the base. Carpels equal in
number to the petals; ovary pubescent; style distinct, outwardly curved. Seeds pyriform, finely striate.

The habitat of all species, unless otherwise indicated, is in rocky places, mainly in the mountains.

Hybrids in this genus are very common both in natural habitats and in cultivation. The most widespread are $S . \times$ barbulatum Schott $(\mathbf{1 0} \times 11)$, S. $\times$ fauconnettii Reuter ( $\mathbf{1 0} \times \mathbf{2 2}$ ), and $S . \times$ schottii C. B. Lehm. \& Schnittspahn $(\mathbf{1 1} \times \mathbf{2 2})$. The hybrids usually occur only in the presence of both parents, but in the French Jura, the locus classicus of S. $\times$ fauconnettii, one of the parents (10) is not now present.

Literature: R. L. Praeger: An Account of the Sempervivum Group. London. 1932.
1 Upper surface of petals yellowish, at least in the apical half
2 Leaves glaucous, glabrous except for marginal cilia 1. wulfenii 2 Leaves not glaucous, with glandular-pubescent surface 3 Plant with resinous odour
4 Filaments purple
2. grandiflorum

4 Filaments pale yellow or whitish
11. montanum

3 Plant without distinctive odour
5 Cilia of rosette-leaves 2-4 mm, stiff, interwoven with those of neighbouring leaves
3. ciliosum

5 Cilia less than 2 mm , not interwoven
6 Petals tinged with pink or purple towards the base; filaments $\pm$ purple
7 Flowering stem 10 cm or less
8 Petals with white margin; otherwise mainly pink, but yellow towards the apex 4. thompsonianum
8 Petals without white margin; mainly yellow, but with a lilac spot near the base
5. octopodes

7 Flowering stem 12-25 cm
9 Petals bright greenish-yellow; filaments entirely purple
6. zeleborii

9 Petals pale yellow or cream-coloured; filaments pale yellow, striped with red
7. kindingeri

6 Petals not tinged with purple or pink; filaments usually pale
10 Stolons $5-8 \mathrm{~cm}$ 8. leucanthum
10 Stolons 2-3 cm
9. pittonii

1 Upper surface of petals predominantly red, pink or purple
11 Mature leaves pubescent on both surfaces
12 Apical cilia of leaves very long and flexuous, interwoven to form an arachnoid tomentum over the rosette
10. arachnoideum

## 12 Apical cilia short, not arachnoid

13 Plant with resinous odour; cilia of rosette-leaves scarcely longer than the other hairs; petals $12-20 \mathrm{~mm} \mathrm{11}$. montanum
13 Plant without distinctive odour; cilia of rosette-leaves at least twice as long as the other hairs; petals $7-11 \mathrm{~mm}$
14 Rosette-leaves sparsely pubescent
15 Stem usually more than 20 cm , bearing at least 40 flowers
23. tectorum

15 Stem $8-16 \mathrm{~cm}$, bearing $12-30$ flowers
16 Rosette-leaves $10-15 \mathrm{~mm}$, acuminate, bright green; flowers deep pink
12. dolomiticum

16 Rosette-leaves $c .35 \mathrm{~mm}$, mucronate, dark green; flowers dark reddish-purple
13. cantabricum

14 Rosette-leaves densely pubescent
17 Petals almost entirely pink or red (sometimes with a very narrow white border)
18 Stolons $4-12 \mathrm{~cm}$; rosettes well-spaced
19 Rosettes $6-8 \mathrm{~cm}$ in diameter; stolons stout 14. kosaninii
19 Rosettes $3-5 \mathrm{~cm}$ in diameter; stolons slender
15. macedonicum

18 Stolons c. 2 cm ; rosettes crowded
20 Leaves velvety with soft, short hairs; cilia straight; flowering stem $15-20 \mathrm{~cm}$, stout 16. erythraeum
20 Hairs on leaves rather stiff; cilia sharply bent; flowering stem $c .12 \mathrm{~cm}$, slender
17. giuseppii

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            17 Petals with a conspicuous white margin, or greenish beneath
21 Petals dark crimson on both surfaces, with a white margin
(vide 19). reginae-amaliae
21 Petals chiefly pale pink, but yellowish at apex and greenish beneath
4. thompsonianum
11 Mature leaves glabrous apart from marginal cilia (or rarely puberulent)
22 Young leaves puberulent on both surfaces
23 Mature leaves not ciliate in apical third
18. ballsii
23 Mature leaves ciliate to the apex
24 Rosettes c. 3 cm in diameter (S. Spain) 20. nevadense
24 Rosettes \(c .6 \mathrm{~cm}\) in diameter (C. \& S.E. Europe)
19. marmoreum
22 Young leaves glabrous except for marginal cilia
25 Stem c. 12 cm , bearing less than 30 flowers
26 Inner leaves of rosette connivent, forming a cone; anthers yellow 21. andreanum
26 Inner leaves of rosette erect; anthers reddish-brown
20. nevadense
25 Stem usually more than 20 cm , bearing more than 30 flowers
27 Rosettes flattened or concave; leaves with a well-defined, reddish-brown spot near the apex 23. calcareum
27 Rosettes not flattened or concave; leaves variably suffused with red towards the apex, but without a well-defined spot
22. tectorum
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1. S. wulfenii Hoppe ex Mert. \& Koch in Röhling, Deutschl. Fl. ed. 3, 3: 386 (1831). Stolons long, stout, woody. Rosettes $4-5 \mathrm{~cm}$ in diameter; inner leaves connivent. Leaves $c .30 \times 12 \mathrm{~mm}$, oblongspathulate, cuspidate, glabrous except for cilia, glaucous; margins somewhat revolute towards the apex. Flowering stem $15-25 \mathrm{~cm}$. Flowers 11 - to 15 -merous; petals $10 \times 1-2 \mathrm{~mm}$, lemon-yellow with a basal purple spot; filaments purple. $2 n=36$. $1700-2700 \mathrm{~m}$; usually calcifuge. E. Alps, extending locally to C. Alps. Au He It.
2. S. grandiflorum Haw., Revis. Pl. Succ. 66 (1821) (S. gaudinii Christ). Stolons $10-20 \mathrm{~cm}$, stout. Rosettes $2-5 \mathrm{~cm}$ in diameter, rather lax and flat. Leaves oblong-cuneate, cuspidate, densely pubescent, dark green with a red-brown apex, with strong resinous and valerian-like odour. Flowering stem $10-20 \mathrm{~cm}$. Flowers $12-$ to 14 -merous; petals $10-18 \times 2-3 \mathrm{~mm}$, yellow with a basal purple spot; filaments purple. $2 n=80$. Calcifuge. - W.C. part of S. Alps, from Susa to Simplon. He It.
3. S. ciliosum Craib, Kew Bull. 1914: 379 (1914) (S. borisii Degen \& Urum.). Stolons slender. Rosettes $2-3.5 \mathrm{~cm}$ in diameter, flattened-globose. Leaves $c .10 \times 4 \mathrm{~mm}$, oblong-oblanceolate, acute, strongly incurved, pubescent, bearing towards the apex stiff cilia 2-4 mm long, which are interwoven with those of adjoining leaves. Flowering stem $4-10 \mathrm{~cm}$. Flowers 12- to $14-$ merous; petals $10-12 \times 1.5 \mathrm{~mm}$, lemon-yellow; filaments whitish. $2 n=34$. Macedonia. Bu Gr Ju.

The plants from the western end of the range (mountains S.E. of Ohrid) show some approach to 5.
4. S. thompsonianum Wale, Quart. Bull. Alp. Gard. Soc. 8: 210 (1940). Stolons slender. Rosettes $c .2 \mathrm{~cm}$ in diameter, subglobose; leaves $c .14 \times 4 \mathrm{~mm}$, elliptic-lanceolate, broadest near the middle, minutely pubescent, unequally ciliate; outer leaves reddish at the apex. Flowering stem $c .8 \mathrm{~cm}$. Flowers few, 10 -merous; petals c. $9 \times 2 \mathrm{~mm}$, pink in lower part, but with a broad white margin, yellowish towards the apex and greenish beneath; filaments purple. Limestone rocks at 2150 m . - S.W. Makedonija (near Debar). Ju.
5. S. octopodes Turrill, Gard. Chron. ser. 3, 102: 303 (1937). Stolons long, slender. Rosettes $2-2.5 \mathrm{~cm}$ in diameter; leaves
$7 \times 3 \mathrm{~mm}$, more or less erect, oblanceolate to obovate, pubescent, with cilia becoming longer towards the reddish-brown apex. Flowering stem up to 9 cm , slender. Flowers few, 9 -merous; sepals purplish; petals $8 \times 1.5 \mathrm{~mm}$, pale yellow, tinged with lilac at the base; filaments purple. $2 n=34$. S.W. Makedonija (Baba Planina). Ju.
6. S. zeleborii Schott, Österr. Bot. Wochenbl. 7: 245 (1857) (S. ruthenicum (Koch) Schnittspahn \& C. B. Lehm.). Stolons short. Rosettes $c .3 \mathrm{~cm}$ in diameter, more or less globose. Leaves $c$. $15 \times 8 \mathrm{~mm}$, oblong-obovate, shortly apiculate, unequally ciliate, grey-green. Flowering stem $12-20 \mathrm{~cm}$. Flowers $9-$ to 12 -merous; petals $c .9 \times 1.5 \mathrm{~mm}$, bright greenish-yellow, tinged with lilac at the base; filaments purple. $2 n=64$. Dry places; mainly lowland. ?- E. Europe, from Macedonia to C. Russia. Bu ?Ju Rm Rs (C, W, K, E).
7. S. kindingeri Adamović, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 74: 125 (1904). Stolons short, few. Rosettes 4-6.5 cm in diameter, open. Leaves $20-25 \times 5-8 \mathrm{~mm}$, spathulate, shortly acuminate, pale green, glandular-hairy, unequally ciliate. Flowering stem 25 cm , stout, softly hairy. Flowers numerous, 12 - to 14 -merous; petals c. $10 \times 2 \mathrm{~mm}$, pale yellow or creamcoloured, tinged with pink or purple towards the base; filaments pale, with purple streaks. Macedonia. Gr Ju.
8. S. leucanthum Pančič, Elem. Fl. Bulg. 30 (1883). Stolons $5-8 \mathrm{~cm}$, stout; rosettes $2.5-5 \mathrm{~cm}$ in diameter, subglobose, forming a loose mat. Leaves c. $20 \times 8 \mathrm{~mm}$, oblong-spathulate, apiculate, finely pubescent, unequally ciliate, dark green with a dark red apex. Flowering stem $15-20 \mathrm{~cm}$. Flowers 11 - to 13 -merous; petals c. $10 \times 1 \mathrm{~mm}$, pale greenish-yellow; filaments pale (rarely pink), almost glabrous. $2 n=64$. Mountains of Bulgaria. Bu.
9. S. pittonii Schott, Nyman \& Kotschy, Analect. Bot. 19 (1854). Very like 8, but with much shorter ( $2-3 \mathrm{~cm}$ ) stolons, and rosettes crowded in dense tufts; leaves somewhat smaller, more densely pubescent and often grey-green; cilia mostly tipped with a red gland; flowering stem $12-15 \mathrm{~cm}$; flowers 9 - to 12 -merous. $2 n=64$. Serpentine rocks. E. Alps (near Kraubath in C. Steiermark). Au.
10. S. arachnoideum L., Sp. Pl. 465 (1753). Rosettes small, compact, crowded, more or less covered above by an arachnoid veil of long, flexuous, interwoven hairs, which are the greatly elongate apical cilia of the leaves. Leaves $7-12 \times 3-5 \mathrm{~mm}$, oblanceolate to oblong-obovate, apiculate, pubescent. Flowering stem 4-12 cm; cauline leaves red-tipped, with an apical tuft of arachnoid hairs. Flowers usually 8 - to 10 -merous; petals $7-$ $10 \times 3 \mathrm{~mm}$, broadly lanceolate or rhombic, bright reddish-pink with a purple mid-vein; filaments purple. Calcifuge. Alps, Appennini, Pyrenees; (?)Cordillera Cantábrica. Au GaGeHeHs It.

Very variable. Two rather ill-defined subspecies may be recognized; they have some geographical basis but show considerable overlap, and intermediates are common.
(a) Subsp. arachnoideum (subsp. doellianum (C. B. Lehm.) Schinz \& Keller): Rosettes not more than 1.5 cm in diameter, ovoid or globose; arachnoid hairs variable in quantity, sometimes rather scanty. $2 n=32$. Mainly in the eastern part of the range.
(b) Subsp. tomentosum (C. B. Lehm. \& Schnittspahn) Schinz \& Thell. in Schinz \& Keller, Fl. Schweiz ed. 4, 325 (1923): Rosettes $1.5-2.5 \mathrm{~cm}$ in diameter, somewhat flattened above; arachnoid hairs always abundant and persistent. Leaves broader towards the apex than in subsp. (a). $2 n=32,64$. Mainly in the southwestern part of the range.
11. S. montanum L., Sp. Pl. 465 (1753). Stolons slender, with persistent leaves. Rosette-leaves usually c. $10 \times 3 \mathrm{~mm}$, rarely larger, oblanceolate, acute, pubescent above and beneath and ciliate with very short, subequal hairs, dull green, viscid. Flowering stem $5-10(-20) \mathrm{cm}$, bearing $2-8(-13)$ flowers, which are usually 11 - to 13 -merous. Petals $12-20 \times 2 \mathrm{~mm}$, vinous red (rarely yellowish); filaments nearly glabrous, pale. Calcifuge. - Pyrenees, Alps, Appennini, Carpathians, Corse. Au Co Cz Ga He Hs It Po Rm Rs (W) [No].
1 Rosettes not more than 2 cm in diameter (a) subsp. montanum
1 Rosettes usually more than 2 cm in diameter
2 Leaves entirely green, obovate-cuneate, up to 6 mm wide
(b) subsp. burnatii

2 Leaves tipped with red, oblanceolate, c. 3 mm wide
(c) subsp. stiriacum
(a) Subsp. montanum: Rosettes not more than 2 cm in diameter; leaves oblanceolate, not acuminate, entirely green; cilia scarcely longer than hairs on leaf-surface. Petals $12-15 \mathrm{~mm}$. $2 n=42$. Throughout most of the range of the species.
(b) Subsp. burnatii Wettst. ex Hayek in Hegi, Ill. Fl. Mitteleur. 4 (2): 554 (1922): Rosettes up to 8 cm in diameter; leaves obovatecuneate, up to 6 mm wide, entirely green. $2 n=42$. S.W. Alps.
(c) Subsp. stiriacum Wettst. ex Hayek in Hegi, loc. cit. (1922): Rosettes $2-4.5 \mathrm{~cm}$ in diameter; leaves oblanceolate, distinctly acuminate, reddish at the apex; cilia distinctly longer than hairs on leaf-surface. Petals $16-20 \mathrm{~mm} .2 n=84$. E. Austria.

Plants from the Carpathians, somewhat intermediate in appearance between subspp. (b) and (c) and with $2 n=42$, have been named subsp. carpaticum Wettst. ex Hayek, loc. cit. (1922). Their status is uncertain.
12. S. dolomiticum Facch., Zeitschr. Ferdinand. Tirol ser. 3, 5: 56 (1855). Stolons 2 cm , slender. Rosettes $2-4 \mathrm{~cm}$ in diameter, subglobose. Leaves $10-15 \times 3-5 \mathrm{~mm}$, oblong-lanceolate, acuminate, sparsely pubescent, bright green with a brownish apex; apical cilia coarser than the lateral. Flowering stem $c .10 \mathrm{~cm}$, bearing 12-20 flowers; cauline leaves $10-20 \times 3-5 \mathrm{~mm}$. Flowers usually 10 -to 12 -merous; petals $9-10 \times 2 \mathrm{~mm}$, deep reddish-pink, with a central stripe of reddish-brown above and of green beneath; filaments glabrous. $2 n=72$. Dolomite and basalt rocks, 16002500 m . E. Alps. It.
13. S. cantabricum J. A. Huber, Feddes Repert. 33: 364 (1934). Stolons up to 6 cm , stout. Rosettes $4-5 \mathrm{~cm}$ in diameter, open. Leaves $35 \times 10 \mathrm{~mm}$, oblong-obovate, mucronate, puberulent, dark green with a red apex, cilia about twice as long as other hairs. Flowering stem up to 16 cm ; flowers $15-30,9$ - to 12 merous. Sepals obtuse; petals $9-10 \times 2 \mathrm{~mm}$, deep red; filaments glabrous. - N. Spain (Picos de Europa). Hs.
14. S. kosaninii Praeger, Bull. Inst. Bot. Univ. Beograd 1: 210 (1930). Stolons up to 12 cm , stout, leafy. Rosettes $4-8 \mathrm{~cm}$ in diameter, open. Leaves $15-30 \times 7-9 \mathrm{~mm}$, oblanceolate, shortly acuminate, densely pubescent, dark green with a red apex; cilia as in 13. Flowering stem c. 15 cm ; cauline leaves $20-35 \times 5-$ 8 mm . Sepals very hairy; petals $10 \times 1 \mathrm{~mm}$, purple, paler beneath and with a narrow white margin; filaments slightly hairy at the base. Calcicole. Mountains of S.W. Jugoslavia. Ju.
15. S. macedonicum Praeger, op. cit. 212 (1930). Stolons $4-$ 7 cm , giving a loose mat of flattish rosettes $3-5 \mathrm{~cm}$ in diameter. Leaves $15-20 \times 5 \mathrm{~mm}$, broadly oblanceolate, shortly acuminate, densely but minutely pubescent, reddish towards the apex; cilia as in 13. Flowering stem 7-10 cm; inflorescence compact, corymbose. Flowers 11- or 12-merous; petals $8-10 \mathrm{~mm}$, dull pinkish-
lilac; filaments lilac, almost glabrous. $2 n=34$ - Jugoslavia (N.W. Makedonija). Ju.
16. S. erythraeum Velen., Fl. Bulg. suppl., 111 (1898). Stolons short, giving compact tufts of open rosettes $2-4.5 \mathrm{~cm}$ in diameter. Leaves $10-20 \times 5-10 \mathrm{~mm}$, obovate-spathulate, apiculate, densely pubescent with short, velvety hairs, unequally ciliate, tinged with greyish-purple. Flowering stem $15-20 \mathrm{~cm}$, purple; cauline leaves $30-35 \times 15 \mathrm{~mm}$; inflorescence rather broad. Flowers 11- to 13 -merous; sepals acuminate, hairy, reddish; petals $10 \times 1 \mathrm{~mm}$, deep reddish-purple; filaments hairy at the base. 1000-2500 m. $2 n=34$. Mountains of Bulgaria. Bu.
S. balcanicum Stoj., Bull. Inst. Bot. (Sofia) 2: 263 (1951), from C. Bulgaria, appears to differ principally in its pale lilac petals and more or less glabrous leaves. It is not clear from the information available whether it should be considered a distinct species or a variant of 16,18 or 19 .
17. S. giuseppii Wale, Quart. Bull. Alp. Gard. Soc. 9: 115 (1941). Stolons c. 2 cm , slender; rosettes 2 cm in diameter. Leaves $12-16 \times 7 \mathrm{~mm}$, obovate, mucronate, pale green with a small brown patch at the apex, densely pubescent with rather stiff hairs; cilia long, stout, recurved. Flowering stem 12 cm , slender; cauline leaves cuspidate, purple. Inflorescence compact, with $c .15$ 9 -merous flowers; buds pointed. Petals $10 \times 3 \mathrm{~mm}$, red, with a very narrow white margin; filaments red, slightly pubescent at the base. $2 n=72$. Limestone rocks, $1500-1850 \mathrm{~m}$. - N.W. Spain (Peña de Espiguete). Hs.
18. S. ballsii Wale, Kew Bull. 1940: 143 (1940). Stolons 11.5 cm , stout; rosettes $c .3 \mathrm{~cm}$ in diameter, open. Leaves obovate, mucronate, very thick, shining green, glabrous at maturity except for rather sparse cilia on the basal two-thirds; young leaves pubescent on the vein and ciliate to the apex. Flowering stem 10 cm ; cauline leaves pubescent on lower side. Inflorescence compact, globose. Flowers 12 -merous; petals $8 \times 1.5 \mathrm{~mm}$, pink with a broken, central crimson stripe, greenish beneath; filaments red, hairy towards the base. $2000-2600 \mathrm{~m} .2 n=34$. N.W. Greece (Smolikos, Grammos). Gr.
19. S. marmoreum Griseb., Spicil. Fl. Rumel. 1: 329 (1843) (S. schlehanii Schott). Stolons long, stout; rosettes $c .6 \mathrm{~cm}$ in diameter, open. Leaves $25 \times 12 \mathrm{~mm}$, obovate, mucronate, puberulent when young but glabrous at maturity except for stout, deflexed marginal cilia, olive-green, often tinged with red. Flowering stem c. 20 cm ; cauline leaves 3 cm , oblong-lanceolate, acuminate; inflorescence up to 7 cm wide. Flowers 12 -merous; petals 10 mm , red with white margins; filaments hairy at the base. $2 n=34$. Balkan peninsula, extending northwards to Moldavia and S.E. Czechoslovakia. $\mathrm{Al} \mathrm{Bu} \mathrm{Cz} \mathrm{Gr} \mathrm{Hu} \mathrm{Ju} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.
S. reginae-amaliae Heldr. \& Guicc. ex Halácsy, Consp. Fl. Graec. 1: 580 (1901), from Greece and S.E. Albania (? and S. Italy), appears to differ only in being more compact and smaller in most of its parts, and in retaining a fine pubescence on its leaves even at maturity. It is probably best regarded as a subspecies or variety of 19 .
20. S. nevadense Wale, Quart. Bull. Alp. Gard. Soc. 9: 109 (1941). Stolons short, slender; rosettes c. 2.5 cm in diameter. Leaves $12-18 \times 5-7 \mathrm{~mm}$, obovate, mucronate, glandular-puberulent when young, usually glabrous at maturity; cilia stout, often bent. Flowering stem 12 cm , stout; cauline leaves imbricate; inflorescence compact, but sometimes with additional flowers in

[^144]axils of upper leaves. Flowers 9- to 11-merous; calyx puberulent, with some longer hairs; petals reddish-pink, with a darker central band; filaments hairy in lower half; anthers reddish-brown. $2 n=108$. 1650-2150 m. $\quad$ S. Spain (Sierra Nevada). Hs.
21. S. andreanum Wale, op. cit. 116 (1941). Like 20 but rosette-leaves somewhat fewer, the inner ones connivent to form a central cone as in 1; flowering stem less robust; petals pale pink and anthers yellow. - E. Pyrenees (Sierra del Cadi). Hs.
22. S. tectorum L., Sp. Pl. 464 (1753) (incl. S. arvernense Lecoq \& Lamotte, S. glaucum Ten.). Stolons up to 4 cm , stout; rosettes usually large ( $3-8 \mathrm{~cm}$ in diameter), open. Leaves $20-40 \times 10-$ 15 mm , oblong-lanceolate to obovate, with a stout, pungent mucro, glabrous or with a very few scattered hairs on the surface, dark or somewhat glaucous green, variably tinged with red; cilia conspicuous, white, tending to coalesce in groups. Flowering stem $20-50 \mathrm{~cm}$, stout, hairy; lower cauline leaves glabrous apart from cilia, the upper ones pubescent. Inflorescence large, with from 40 to over 100 usually 13 -merous flowers. Sepals acute; petals $9-10 \times 2 \mathrm{~mm}$, ciliate and pubescent beneath, dull pink or purple; filaments purple, glabrous or slightly pubescent at base. $2 n=36,72$. - Mountains of W., C. \& S. Europe, from C. Pyrenees to S.E. Alps. Au Ga Ge He Hs It Ju [Rm Rs (W)].

Extremely variable, and divided variously by different authors into species, subspecies and varieties. Much of the variation is purely phenotypic; of the genetically determined variation a large part, both in wild and cultivated plants, may be presumed to arise from hybridization. Further analysis by modern methods is required before any comprehensible and consistent subdivision of the species is possible.

A cultivar to which the Linnean type is referable, distinguished by its large size and frequent partial sterility, has been extensively cultivated in most of Europe, especially on the roofs of cottages, and is locally naturalized.
S. italicum Ricci, Ann. Bot. (Roma) 27: 7 (1961), recently described from C. Italy (Monti Lepini), is rather like 22, but has leaves densely pubescent on both surfaces. It requires further investigation.
23. S. calcareum Jordan, Obs. Pl. Crit. 7: 26 (1849) (S. arvernense sensu Coste, pro parte). Like 22, in which it is sometimes included, but apparently distinct from all varieties of the latter in its usually broad, glaucous leaves with a well-defined purplebrown apical spot on both surfaces, its broad-based, subamplexicaul cauline leaves, all glabrous, and its pale pink, 10 - to 12 -merous flowers with obtuse sepals and petals $7-8 \mathrm{~mm} .2 n=38$. Limestone rocks. - French Alps; perhaps elsewhere. Ga ?Hs ?It.

## 7. Jovibarba Opiz ${ }^{1}$

Perennials, like Sempervivum in habit, but with 6-merous (rarely 5 - or 7 -merous), campanulate flowers, and erect, pale yellow petals, keeled dorsally and fringed with glandular hairs. (Diopogon Jordan \& Fourr.)

In this genus, in striking contrast to Sempervivum, natural hybrids have never been reported. The pattern of variation is, however, at times suggestive of introgression; and, since all species appear to possess the same chromosome number, the possibility of hybridization cannot be excluded.
1 Plant without stolons; petals ciliate but scarcely fimbriate; styles 2 mm
5. heuffelii

1 Plant with short, fragile stolons arising from the lower leafaxils of the rosette; petals fimbriate; styles $c .4 \mathrm{~mm}$

2 Flowering stem 18 cm or less; cauline leaves long-acuminate, narrower than the rosette-leaves
3 Rosette-leaves yellowish-green, with glandular-pubescent surface 1. allion
3 Rosette-leaves fresh green, reddish towards the apex, with glandular hairs only on the margins $\quad$ 2. arenaria
2 Flowering stem $20-30 \mathrm{~cm}$; cauline leaves at least as wide as the rosette-leaves
4 Rosette-leaves widest at or below the middle, patent or erect, forming an open rosette
3. hirta

4 Rosette-leaves widest above the middle, incurved, giving a closed, globose rosette
4. sobolifera

1. J. allionii (Jordan \& Fourr.) D. A. Webb, Feddes Repert. 68: 197 (1963) (Sempervivum allionii (Jordan \& Fourr.) Nyman, S. hirtum sensu Coste, non L.). Rosettes $2-3 \mathrm{~cm}$ in diameter, closed, with incurved leaves $12-15 \times 4-7 \mathrm{~mm}$, oblong-lanceolate, acuminate, pale yellowish-green, covered on both surfaces with short, glandular hairs. Cauline leaves similar but narrower. Sepals finely glandular-pubescent. Petals 15 mm , strongly fimbriate. $2 n=38$. Mountain rocks. S.W. Alps. Ga It.
2. J. arenaria (Koch) Opiz, Seznam 55 (1852) (Sempervivum arenarium Koch). Rosettes $1-2 \mathrm{~cm}$ in diameter, with erect or incurved leaves $8-12 \times 3-5 \mathrm{~mm}$, lanceolate, bright green, glabrous except for marginal glandular hairs. Cauline leaves $12-13 \times 3-$ 4 mm , long-acuminate, covered with very small glands. Sepals minutely glandular-pubescent. Petals $12-15 \mathrm{~mm}$, fimbriate. $2 n=38$. E. Alps, eastwards from c. $11^{\circ} 45^{\prime}$. Au It.
3. J. hirta (L.) Opiz, Seznam 54 (1852) (Sempervivum hirtum L.). Rosettes $3-7 \mathrm{~cm}$ in diameter, open, with patent or suberect leaves $15-20 \times 5-6 \mathrm{~mm}$, broadly lanceolate, dark green not tipped with red, glandular-ciliate but otherwise glabrous. Cauline leaves $15-20 \times 7-10 \mathrm{~mm}$, subamplexicaul. Sepals ciliate. Petals $15-$ 17 mm , fimbriate. - C. Europe and N.W. part of Balkan peninsula, mainly in the mountains. Al Au Cz Hu It Ju Po Rm Rs (W).
(a) Subsp. hirta: Cauline leaves and sepals hairy on lower surface, at least on the veins. $2 n=38$. From N. Italy and the middle Danube to Albania.
(b) Subsp. glabrescens (Sabr.) Soó \& Jáv., Magyar Növ. Kéz. 304 (1951): Cauline leaves and sepals glabrous except for marginal cilia. $2 n=38$. Carpathians and N. Hungary.
4. J. sobolifera (J. Sims) Opiz, Seznam 54 (1852) (Sempervivum soboliferum J. Sims). Rosettes $2 \cdot 5-3(-4) \mathrm{cm}$ in diameter, subglobose, closed, with incurved leaves $10-15(-20) \times 5-7(-10)$ mm , obovate-oblanceolate, shortly acuminate, ciliate with stiff, glandular hairs but otherwise glabrous, greyish- or olive-green, often tipped with red. Cauline leaves $20 \times 10 \mathrm{~mm}$, glabrous except for marginal cilia. Sepals ciliate-pectinate. Petals c. 1517 mm , fimbriate. $2 n=38$. Sandy ground and dry grassland, mostly at fairly low altitudes; usually calcifuge. - C. \& E. Europe, from C. Germany to the E. Carpathians and N.C. Russia. $\mathrm{Au} \mathrm{Cz} \mathrm{Ge} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(B}, \mathrm{C}, \mathrm{?W)}$.
5. J. heuffelii (Schott) Á. \& D. Löve, Bot. Not. 114: 39 (1961) (Sempervivum heuffelii Schott). Rosettes 5-7(-12) cm in diameter, open, with patent leaves $25-60 \times 10-15 \mathrm{~mm}$, oblong-obovate, spinose-mucronate, dark or glaucous green with white margins, ciliate with stiff, often deflexed hairs. Stolons absent; vegetative reproduction by division of the rosette. Flowering stem $10-$ 20 cm . Sepals glandular-ciliate. Petals $10-12 \mathrm{~mm}$, oblongobovate, usually tricuspidate, ciliate but scarcely fimbriate,

[^145]keeled, but not dorsally winged as in the other species. Styles 2 mm , relatively stout. $2 n=38$. Calcicole. E. Carpathians and mountains of Balkan peninsula. Al Bu Gr Ju Rm.

## 8. Aeonium Webb \& Berth. ${ }^{1}$

Perennial, with erect, subligneous stems and alternate leaves crowded into terminal rosettes. Flowers 9- to 11-merous, in a panicle. Petals free, yellow. Stamens twice as many as the sepals.

1. A. arboreum (L.) Webb \& Berth., Phyt. Canar. 1: 185 (1840). Stem $50-80 \mathrm{~cm}$, stout, with suberect branches, marked by conspicuous leaf-scars. Leaves $c .6 \times 2 \mathrm{~cm}$, oblanceolate-cuneate, ciliate-denticulate but otherwise glabrous, bright shining green. Flowers numerous, in a compact, ovoid panicle. Petals 6-7 mm, bright yellow. Rather widely naturalized on the coasts of the Mediterranean and of Portugal. [Bl ?Cr Ga Gr Hs Lu Sa Si.] (Morocco.)

## 9. Aichryson Webb \& Berth. ${ }^{1}$

Annuals; leaves alternate, entire, petiolate, caducous. Flowers 6 - to 10 -merous, in a dichotomous cyme. Petals free, yellow. Stamens twice as many as the petals.
Petals usually 8; branches $\pm$ horizontal
Petals usually 10 ; branches suberect, pseudodichotomous
2. dichotomum

1. A. villosum (Aiton) Webb \& Berth., Phyt. Canar. 1: 181 (1840). Up to 15 cm ; bushy, with horizontal branches. Stem and leaves softly and densely glandular-hairy. Leaves spathulaterhomboid; lamina $c .15 \mathrm{~mm}$. Flowers usually 8 -merous, pedicellate, in a lax cyme. Petals $5-6 \mathrm{~mm}$, ovate, bright goldenyellow. Rocks. Açores. Az. (Atlantic islands.)
2. A. dichotomum (DC.) Webb \& Berth., loc. cit. (1840). Like 1 but often up to 30 cm ; stems usually reddish, with suberect, pseudodichotomous branches; and petals usually 10, paler yellow. Naturalized in Portugal (Serra de Sintra). [Lu.] (Canarias.)

## 10. Sedum L. ${ }^{1}$

Leaves usually alternate, seldom crowded into rosettes, and hardly ever (in European species) into the dense, globose rosettes characteristic of Sempervivum. Inflorescence usually cymose. Flowers hermaphrodite, usually 5 -merous, but sometimes 4 - or 6 - to 9 -merous. Petals free or slightly connate at the base, usually patent. Stamens usually twice as many as the petals, sometimes equal in number. Carpels equal in number to the petals.

The habit of most species is characteristic, but it is difficult to frame a formal definition of the genus which delimits it clearly from Crassula, Sempervivum, and other genera, and the assignment of some species is still disputed.

In addition to those described below several cultivated species are locally naturalized near gardens.

Most European species favour dry, rocky or stony ground, and where no ecological information is provided this habitat may be presumed.

Literature: R. L. Praeger, Jour. Roy. Hort. Soc. 46: 1-314 (1921). H. Fröderström, Acta Horti Gothob. 5-7 and 10 (1930-5).

1 Leaves flat, at least 8 mm wide; perennial
2 Petals bright yellow
3 Erect shrub with very stout stems

1. praealtum
3 Stems herbaceous except at the extreme base, fairly slender
4 Stems erect, usually all flowering
2. aizoon
4 Stems procumbent at base, bearing non-flowering and flowering shoots
3. hybridum
2 Petals red, purple or whitish
5 Petals $10-12 \mathrm{~mm}$, erect
4. spurium
5 Petals $3-5 \mathrm{~mm}$, patent
6 Flowers whitish
6 Flowers pink or purple
7 Leaves dentate
7 Leaves entire
$\begin{array}{ll}8 & \text { Leaves alternate } \\ 8 & \text { Leaves opposite }\end{array}$
5. anacampseros
6. ewersii
1 Leaves less than 8 mm wide, often $\pm$ terete; perennial or annual
9 Petals yellow, cream-coloured or greenish-white
10 Follicles erect; leaves usually mucronate or apiculate; flowers often 6 - to 9 -merous; stems $8-60 \mathrm{~cm}$
11 Flowers few, in lax, unilateral cymes
12 Leaves of non-flowering shoots amplexicaul, with a membranous base; petals $6-8 \mathrm{~mm}$
7. tenuifolium
12 Leaves not amplexicaul; petals $8-10 \mathrm{~mm}$
8. pruinatum
11 Flowers numerous, in crowded cymes
13 Living leaves on non-flowering shoots confined to a terminal, tassel-like cluster; dead leaves persistent on lower part of shoot
9. forsteranum
13 Living leaves on non-flowering shoots not confined to a terminal cluster; dead leaves not persistent
14 Sepals 5-7 mm, glandular-puberulent; cymes flat-topped in bud and fruit 9. ochroleucum
14 Sepals $2 \cdot 5-4.5 \mathrm{~mm}$, glabrous; cymes subglobose in bud, concave in fruit
15 Inflorescence erect in bud; sepals ovate; leaves c. 4 mm wide 8. sediforme
15 Inflorescence drooping in bud; sepals lanceolate; leaves
c. 2 mm wide
10. reflexum
10 Follicles $\pm$ patent; leaves obtuse; flowers 5-merous; stems $3-20 \mathrm{~cm}$
16 Perennial
(14-24). acre group
16 Annual or biennial
17 Petals scarcely exceeding the sepals; stamens usually 5
11. litoreum
17 Petals 2-3 times as long as sepals; stamens 10
12. annuum
Petals blue, pink or pure white
18 Stamens twice as many as the petals
19 Perennial, with leafy non-flowering shoots
20 Plant glabrous throughout
21 Flowers 4-merous
13. stefco
21 Flowers 5- to 9-merous
22 Leaves distinctly flattened, at least on upper side
23 Styles c. 0.75 mm
14. hispanicum
23 Styles c. 0.25 mm
24 Inflorescence racemose, elongate; follicles erect
15. magellense
24 Inflorescence a small, congested cyme; follicles stellate-patent
16. idaeum 22 Leaves $\pm$ terete
25 Leaves of non-flowering shoots opposite, 4-ranked 32. brevifolium
25 Leaves of non-flowering shoots alternate
26 Leaves subulate, acuminate
26 Leaves linear to ovoid-globose, obtuse
27 Leaves spurred; stems $2-6 \mathrm{~cm}$; cymes with 2-3 branches 29. anglicum
27 Leaves scarcely spurred; stems 5-18 cm ; cymes with several branches
28 Petals white; inflorescence rather dense
17. album
28 Petals pink; inflorescence lax
18. serpentini
20 Plant pubescent or puberulent-papillose in part
29 Leaves mostly opposite or whorled

30 Leaves oblong-lanceolate, the upper ones whorled
33. monregalense

30 Leaves ovoid, never whorled
31. dasyphyllum

29 Leaves all alternate
31 Leaves glabrous
36. hierapetrae

31 Leaves pubescent or puberulent-papillose
32 Leaves not much longer than wide
33 Leaves flat, glandular-pubescent, the lower ones stalked
35. alsinefolium

33 Leaves semiterete, puberulent-papillose, sessile
27. gypsicola

32 Leaves at least twice as long as wide
34 Flowers 6-to 9-merous; follicles stellate-patent
55. hispanicum

34 Flowers 5-merous; follicles erect
35 Peduncles arising from axils of rosette-leaves
37. tristriatum

35 Peduncles terminal
36 Buds drooping; carpels white; plant of dry rocks
38. hirsutum

36 Buds erect; carpels green or purple; plant of wet places
39. villosum

19 Annual or biennial; no non-flowering shoots present at flowering season
37 Petals sky-blue
57. caeruleum

37 Petals white, pink or purple
38 Leaves dentate or crenate
47. stellatum

38 Leaves entire
39 Leaves mostly opposite or whorled 41. cepaea
39 Leaves alternate
40 Leaves pubescent
41 Flowers 6- to 9-merous; follicles stellate-patent
55. hispanicum

41 Flowers 5-merous; follicles erect
42 Biennial; inflorescence rather compact and narrow; flowers stellate, erect 39. villosum
42 Annual; inflorescence lax and broad; flowers campanulate, drooping
42. lagascae

40 Leaves glabrous
43 Leaves 2-6 mm, terete, at least in apical half
44 Pedicels much longer than calyx 43. pedicellatum
44 Pedicels equalling or shorter than calyx
45 Leaves oblong or obovoid-clavate, flattened towards the base; branches erect 45. atratum
45 Leaves ovoid or ellipsoidal; branches diffuse, ascending
44. arenarium

43 Leaves $7-20 \mathrm{~mm}$, flat at least on upper surface
46 Leaves oblong-spathulate 40 . creticum
46 Leaves linear
47 Flowers 6- or 9-merous; follicles stellate-patent
55. hispanicum

47 Flowers 5 -merous; follicles $\pm$ erect
48 Sepals united for half their length; petals subacute
46. confer
epals free almost to base; petals acuminate
48 Sepals free almost to base; petals acuminate
49 Follicles dark red
51. rubens

49 Follicles pale pink or whitish
56. pallidum

18 Stamens equal in number to petals
50 Flowers sessile or subsessile
51 Leaves ciliate-denticulate
50. aetnense

51 Leaves glabrous, entire
52 Leaves obovoid, imbricate
52 Leaves linear, patent
52. caespitosum
51. rubens

50 Flowers distinctly pedicellate
53 Biennial; leaves glandular-pubescent
39. villosum

53 Annual; leaves glabrous
54 Leaves ovoid or subglobose
54 Leaves linear-oblong
53. andegavense
54. nevadense

1. S. praealtum A.DC. in DC. \& A.DC., Not. Pl. Rar. Bot. Jard. Genève 10: 21 (1847). Bushy, evergreen, glabrous shrub up to 75 cm . Stems thick, terete, green above, grey and woody below. Leaves c. $6 \times 1.5 \mathrm{~cm}$, oblanceolate, obtuse, thick but flattened. Flowers 5 -merous, subsessile, in large, terminal panicles. Petals 6-9 mm, lanceolate, acute, bright yellow; stamens

10; follicles suberect, yellowish. Cultivated for ornament in parts of the Mediterranean region, and naturalized on coastal rocks in S.E. France and N.W. Italy. [Ga It.] (Mexico.)
2. S. aizoon L., Sp. Pl. 430 (1753). Perennial; stems $30-40 \mathrm{~cm}$, few, erect. Leaves $5-8 \mathrm{~cm}$, alternate, lanceolate-cuneate, subacute, unequally serrate or dentate. Flowers 5 -merous, in dense, compound, terminal cymes, subtended by leaves. Sepals tapered to a subulate apex. Petals $7-10 \mathrm{~mm}$, acuminate, golden-yellow. Stamens 10. Locally naturalized from gardens in N. \& C. Europe. [Cz Fe Ga Ge No Su.] (N. Asia.)
3. S. hybridum L., Sp. Pl. 431 (1753). Perennial; stems woody, branched, creeping and rooting, with short non-flowering shoots and ascending flowering stems of $15-20 \mathrm{~cm}$. Leaves $2-3 \mathrm{~cm}$, oblong-cuneate, obtuse, obtusely dentate; teeth reddish. Flowers 5 -merous, numerous, in lax, terminal corymbs. Sepals obtuse. Petals $6-9 \mathrm{~mm}$, acute, golden-yellow. Stamens 10. Native in C. \& S. Ural; naturalized from gardens elsewhere in N. \& C. Europe. Rs (C) [Au Cz Da Fe Ga Ge Hu No Su]. (N. Asia.)
4. S. telephium L., Sp. Pl. 430 (1753). Perennial, with tuberous roots. Stems $15-80 \mathrm{~cm}$, usually simple. Leaves $2-7 \mathrm{~cm}$, suborbicular to narrow-oblong. Flowers 5 -merous, in large, dense, terminal corymbs. Petals $3-5 \mathrm{~mm}$, ovate-lanceolate, acute. Stamens 10, equalling or slightly exceeding the petals. Follicles erect; styles rather short. $2 n=24,36,48$ (other numbers reported from garden plants). Almost throughout Europe. All except Az Bl Cr Fa ? Gr Is Sb Si Tu .

A polymorphic complex which may be divided in Europe into 4 subspecies. Intermediates, some of them garden hybrids subsequently naturalized, are not uncommon, and the considerable confusion in taxonomy and nomenclature does not yet permit precise distributional data for the subspecies to be given. Typical members of subspp. (b), (c) and (d) infra appear to be characterized by chromosome numbers of $2 n=24,48$, and 48 respectively, but no counts are available for plants with intermediate characters; counts of 36 and 48 have been reported for (a). A cytological study of intermediate plants might eventually provide a basis for the elevation of the subspecies to specific rank.
1 Leaves $\pm$ ovate, sessile, often amplexicaul, usually subentire; flowers usually greenish- or yellowish-white
2 Stems 30-80 cm, erect; leaves $5-10 \mathrm{~cm}$, oblong-ovate, green or glaucous
(c) subsp. maximum

2 Stems decumbent or procumbent, $15-40 \mathrm{~cm}$; leaves 2-4 cm, suborbicular, pruinose-glaucous
(d) subsp. ruprechtii

1 Leaves $\pm$ oblong, usually strongly dentate, not amplexicaul, the lower ones, at least, cuneate at the base; flowers usually purplish-red or lilac
3 Upper leaves truncate at the base, sessile; follicles dorsally grooved
(a) subsp. telephium

3 Upper leaves cuneate at the base, sometimes stalked; follicles not grooved
(b) subsp. fabaria
(a) Subsp. telephium ( $S$. purpurascens Koch): Stems 25-60 cm, erect. Leaves $5-8 \mathrm{~cm}$, narrowly ovate-oblong, irregularly dentate, the upper ones truncate, the lower cuneate; not glaucous, often red-spotted. Flowers purplish-red or lilac, rarely white. Carpels grooved on outer side. Chiefly in C. \& E. Europe.
(b) Subsp. fabaria (Koch) Kirschleger, Fl. Alsace 1: 284 (1852) (S. fabaria Koch): Stems $20-40 \mathrm{~cm}$, erect. Leaves $4-7 \mathrm{~cm}$, oblong-lanceolate, dentate, cuneate, the lower ones stalked; not glaucous. Flowers purplish-red or lilac. Carpels not grooved. Chiefly in W. \& C. Europe.
(c) Subsp. maximum (L.) Krocker, Fl. Siles. 2: 64 (1790) (S. maximum Suter): Stems $30-80 \mathrm{~cm}$, erect. Leaves $4-10 \mathrm{~cm}$, ovate or broadly oblong, bluntly dentate or subentire, truncate or
cordate-amplexicaul, alternate, opposite or whorled, sometimes glaucous. Flowers greenish- or yellowish-white, rarely purple. Most of Europe, but local in the west.
(d) Subsp. ruprechtii Jalas, Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo 26: 33 (1954) (S. telephium sensu Borissova in Komarov): Stems $15-40 \mathrm{~cm}$, decumbent or procumbent. Leaves $2-5 \mathrm{~cm}$, suborbicular, dentate or subentire, cordate-amplexicaul, opposite, glaucous-pruinose. Flowers whitish. N.E. Europe.
5. S. ewersii Ledeb., Ic. Pl. Fl. Ross. 1: 14 (1829). Perennial, with procumbent woody stems from which arise ascending non-flowering and flowering shoots $10-20 \mathrm{~cm}$ long. Leaves $15-20 \mathrm{~mm}$, broadly ovate to orbicular, subentire, cordate, opposite, glaucous, spotted. Flowers 5 -merous, in a dense, convex corymb. Petals $4-5 \mathrm{~mm}$, acute, pink or mauve. Stamens 10. Follicles erect, with short, out-turned styles. Naturalized from gardens in Fennoscandia. [Fe No Su.] (C. Asia and Himalaya.)
6. S. anacampseros L., Sp. Pl. 430 (1753). Perennial; nonflowering shoots procumbent, with terminal leaf-rosettes; flowering stems $15-25 \mathrm{~cm}$, ascending. Leaves $12-25 \mathrm{~mm}$, alternate, elliptical-ovate, obtuse, entire, glaucous. Inflorescence and flowers as in 5 , but flowers sometimes 4 -merous; petals glaucouslilac outside and dull, deep red inside; styles straight. $2 n=36$. Calcifuge. - Pyrenees, S.W. Alps, Appennini. Ga He ?Hs It [ No ].
7. S. spurium Bieb., Fl. Taur.-Cauc. 1: 352 (1808). Perennial; stems procumbent, rooting; non-flowering shoots short; flowering stems longer, procumbent or ascending. Leaves $c .25 \times 12 \mathrm{~mm}$, obovate or rhombic-cuneate, shortly petiolate, crenate or bluntly dentate towards apex. Flowers 5 -merous, subsessile, in rather dense corymbs. Sepals subulate, obtuse; petals $10-12 \mathrm{~mm}$, erect, linear-oblong, acuminate, reddish-purple, pink or white. Stamens 10. Naturalized from gardens in many parts of Europe. [Au Be $\mathrm{Br} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \mathrm{Ho} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{No} \mathrm{Po} \mathrm{Rs} \mathrm{Su]}. \mathrm{(Cau-}$ casus.)
8. S. sediforme (Jacq.) Pau, Act. Mem. Prim. Congr. Nat. Esp. Zaragoza 246 (1909), non Hamet (S. altissimum Poiret, S. nicaeense All.). Robust, somewhat glaucous perennial with ascending flowering stems $25-60 \mathrm{~cm}$ and shorter non-fiowering shoots, both woody at the base. Leaves oblong or narrowly ellipsoidal, thick but somewhat flattened on upper surface, usually apiculate or mucronate, shortly spurred, suberect, closely imbricate in spiral rows on the non-flowering shoots. Inflorescence erect and subglobose in bud, with strongly recurved branches, concave in fruit. Flowers 5- to 8 -merous, on very short pedicels. Sepals $c .2 .5 \mathrm{~mm}$, ovate, obtuse or mucronate, glabrous. Petals $4-7 \mathrm{~mm}$, patent, greenish-white or straw-coloured. Stamens 10-16. Follicles erect, pale yellow or greenish-white. $2 n=32$. Mediterranean region, extending to Portugal, N. Spain and C. France. Al Bl Co Cr Ga Gr Hs It Ju Lu Sa Si Tu.
9. S. ochroleucum Chaix in Vill., Hist. Pl. Dauph. 1: 325 (1786). Like 8 in habit but less robust; flowering stems $15-30 \mathrm{~cm}$. Leaves terete, linear-cylindrical, acuminate, distinctly spurred, suberect, loosely imbricate on the non-flowering shoots. Inflorescence erect in bud, corymbose, with branches scarcely recurved. Flowers 5 - to 8 -merous, subsessile. Sepals $5-7 \mathrm{~mm}$, triangular-lanceolate, acuminate, glandular-puberulent. Petals $7-10 \mathrm{~mm}$. Follicles greenish, erect. S. Europe, northwards to S.W. Romania, S. Switzerland and C. France, but rare in the W. Mediterranean region. $\mathrm{Al} \mathrm{Bu} \mathrm{Cr} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Rm?} \mathrm{Si}$.
(a) Subsp. ochroleucum (S. anopetalum DC.): Petals $8-10 \mathrm{~mm}$, erect, cream or greenish-white. Throughout the range of the species.
(b) Subsp. montanum (Song. \& Perr.) D. A. Webb, Feddes Repert. 64: 21 (1961) (S. montanum Song. \& Perr.): Petals 78 mm , patent, bright yellow. Leaves slenderer. - S.W. Alps, E. Pyrenees.

Intermediate plants, with erect, bright yellow petals, are reported from N.W. Jugoslavia.
10. S. reflexum L., Sp. Pl. ed. 2,618 (1762) (S. rupestre auct.). Perennial; stems procumbent, intricate, somewhat woody; flowering stems $15-35 \mathrm{~cm}$, ascending; non-flowering shoots much shorter. Leaves linear-terete, suberect (the upper ones sometimes recurved), apiculate, spurred, evenly distributed on the nonflowering shoots; dead leaves not persistent. Inflorescence drooping and subglobose in bud, concave in fruit. Flowers (5-)7(-9)-merous. Sepals 3-4 mm, lanceolate, subacute, glabrous. Petals $6-7 \mathrm{~mm}$, linear-lanceolate, patent, bright (rarely pale) yellow. Stamens $10-14$. Follicles yellow, erect. $2 n=108$. - Widespread in C. Europe, extending locally to C. Norway, Finland (Ahvenanmaa), W. Ukraine, Athos, Sicilia and W. France. Al Be Cz Da Fe Ga Ge Gr He Ho Hs Hu It Ju No Po Rm Rs (B, C, W) Sa Si Su [Br Hb].
11. S. forsteranum Sm. in Sowerby, Engl. Bot. 26: t. 1802 (1808) (S. elegans Lej., S. pruinatum auct., non Link ex Brot.). Like 10 but with the leaves flat on the upper surface and aggregated on the non-flowering shoots into dense, cone-like terminal rosettes, the rest of the shoots being clothed with persistent dead leaves; inflorescence sometimes flat-topped; sepals 2.5 mm , oblong-lanceolate, obtuse. Often in damper places than 10. W. Europe. *Az $\mathrm{Be} \mathrm{Br} \mathrm{Ga} \mathrm{Ge} \dagger \mathrm{Ho} \mathrm{Hs} \mathrm{Lu}$.
12. S. tenuifolium (Sibth. \& Sm.) Strobl, Österr. Bot. Zeitschr. 34: 295 (1884) (S. amplexicaule DC.). Slender perennial with ascending non-flowering shoots covered with erect, imbricate, terete, acuminate, glaucous leaves, expanded at the base into a broad, 3-lobed, amplexicaul, membranous spur, withering early and persisting dead through the summer. Flowering stems $7-$ 20 cm , erect; leaves less crowded and with a smaller spur. Flowers 5 - to 8 -merous, rather few, subsessile, in lax, unilateral cymes. Sepals conspicuously spurred. Petals 6-8 mm, yellow with red mid-vein. Stamens 10-16. Follicles yellow, erect. Mediterranean region, extending to Bulgaria, Portugal and N. Spain. Bu Cr Ga Gr Hs It Ju Lu Sa Si Tu.
13. S. pruinatum Link ex Brot., Fl. Lusit. 2: 209 (1804). Perennial; non-flowering shoots long, wiry, decumbent, eventually rooting, bearing at the apex a dense tuft of glaucous, terete, shortly spurred leaves $12-20 \mathrm{~mm}$ long. Inflorescence and flowers like those of $\mathbf{1 2}$, but flowers fewer; sepals not spurred; petals 8 12 mm , straw-coloured; and follicles whitish. $\quad N . \& C$. Portugal. Lu.
(14-24). S. acre group. Perennials with short non-flowering shoots and flowering stems up to 20 cm , but often less. Leaves $3-10(-15) \mathrm{mm}$, obtuse, usually thick, often more or less terete. Flowers 5-merous, in terminal cymes; petals yellow, patent; stamens 10.

This group represents a complex that is very imperfectly understood. The treatment given here is of necessity somewhat arbitrary, and much more observation of the very varied populations of the Balkan peninsula, both in cultivation and in the field, is needed before the true status and relationships of the various taxa can be understood.
1 Leaves furnished with a group of hyaline tubercles at the apex 2 Petals $2.5-3 \mathrm{~mm}$, broadly elliptical 21. kostovii 2 Petals $4-5 \mathrm{~mm}$, oblong 20. flexuosum

1 Leaves without hyaline tubercles at the apex
3 Lower part of stem clothed with persistent dead leaves
4 Dead leaves entirely white, soft and papery 14. acre
4 Dead leaves white at the base, grey or black towards the apex, rather coriaceous
15. sartorianum

3 Dead leaves not persistent
5 Leaves ovoid (broadest towards the base) 14. acre
5 Leaves cylindrical or oblanceolate (parallel-sided or broadest at or above the middle)
6 Stems arising from an underground tuber 23. tuberiferum 6 Plant without tubers
7 Styles very short
8 Stems flexuous-ascending; petals $3-3.5 \mathrm{~mm}$, subacute
19. alpestre

8 Stems straight, erect; petals 5 mm , acuminate
22. idaeum

7 Styles long and slender
$\begin{array}{lll}9 & \text { Leaves broadest above the middle } & \text { 24. zollikoferi }\end{array}$ 9 Leaves parallel-sided or slightly ellipsoidal 10 Axillary flowers or flower-clusters present below the terminal cyme 18. laconicum

10 Flowers confined to the terminal cymes 11 Leaves bright green; seeds subglobose 16. sexangulare 11 Leaves bluish-green, minutely papillose; seeds three times as long as wide
17. borissovae
14. S. acre L., Sp. Pl. 432 (1753). Glabrous, laxly caespitose, with short non-flowering shoots and flowering stems $5-12 \mathrm{~cm}$. Leaves 3-6 mm, thick, elliptical in section, broadest below the middle (usually triangular-ovoid, rarely subconical), obtuse, shortly spurred, rather densely imbricate on the non-flowering shoots; usually deciduous (if persistent after death, then pure white, soft and papery). Flowers pedicellate or subsessile, in small cymes with usually spreading branches. Petals $6-8 \mathrm{~mm}$, acute to acuminate, bright yellow, patent. Follicles gibbous, stellate-patent, with long slender styles. $2 n=40,48,80$. Almost throughout Europe. All except Az Bl ? Co Sa Sb Tu .

Very variable in size, leaf-shape, and size of inflorescence and flowers. Many local populations have been given specific or subspecific rank, but their supposedly diagnostic features can usually be matched in regions very remote from those from which they were described.
15. S. sartorianum Boiss., Diagn. Pl. Or. Nov. 3 (2): 62 (1856). Glabrous; stems $5-20 \mathrm{~cm}$, erect or ascending. Leaves conical to oblong-linear, spurred, rather densely imbricate on the usually clavate non-flowering shoots; lower part of stems clothed with rather coriaceous dead leaves which are white in their basal half but black or grey towards the apex. Follicles as in 14. $2 n=64$. Danube basin and Balkan peninsula. Al Au Bu Cz Gr Hu Ju Rm Tu.
1 Stems 2-3 mm in diameter, woody; inflorescence compact
(a) subsp. sartorianum

1 Stems $1-1.5 \mathrm{~mm}$ in diameter, not markedly woody; inflorescence usually lax
$\begin{array}{lll}2 & \text { Leaves } 10-15 \mathrm{~mm} & \text { (b) subsp. stribrnyi }\end{array}$
2 Leaves seldom more than 7 mm
3 Cyme-branches $\pm$ erect, with 6-15 flowers
(c) subsp. hillebrandtii

3 Cyme-branches spreading, with 3-7 flowers
(d) subsp. ponticum
(a) Subsp. sartorianum. Stems $5-15 \mathrm{~cm}$, usually erect, woody or corky and very stout. Leaves $5-8 \mathrm{~mm}$, oblong-conical. Cymes with 2-3 short, somewhat spreading branches, each bearing 3-7 nearly contiguous, sessile flowers. Petals $4 \cdot 5-6 \mathrm{~mm}$, acuminate, bright yellow. Seeds deep reddish-brown. Mountains of $C . \& N$. Greece; probably elsewhere in Balkan peninsula.
(b) Subsp. stribrnyi(Velen.) D. A. Webb, Feddes Repert. 68: 198 (1963): Stems $8-20 \mathrm{~cm}$, slender, flexuous-ascending. Leaves 10 15 mm , linear-oblong. Cyme-branches long ( $4-8 \mathrm{~cm}$ ), spreading, often flexuous, with 4-8 remote flowers, the lower ones often stalked. Petals 5-6.5 mm, acuminate. Seeds deep reddish-brown. S. Bulgaria and N.E. Greece, usually at fairly low altitudes.
(c) Subsp. hillebrandtii (Fenzl) D. A. Webb, Feddes Repert. 68: 198 (1963): Stems $7-12 \mathrm{~cm}$, slender, erect. Leaves 4-5 mm, narrow-ovoid or oblong, glaucous. Cymes with 1-2 suberect branches, each with 7-15 fairly remote flowers. Petals c. 6 mm , narrow, acuminate. Seeds pale yellow-brown. Sandy ground in Danube basin, from E. Austria (Neusiedlersee) to the Black Sea.
(d) Subsp. ponticum (Velen.) D. A. Webb, Feddes Repert. 68: 198 (1963): Stems $4-10 \mathrm{~cm}$, slender, ascending. Leaves $4-5 \mathrm{~mm}$, ovoid-conical. Cymes with usually 2 short, flexuous, spreading branches, each with 3-7 fairly remote flowers. Petals c. 5 mm , subacute, pale yellow. Seeds deep reddish-brown. Maritime sands of Bulgaria.

Plants intermediate between (a) and (b) are found in Albania, S.W. Jugoslavia and N.E. Greece, and plants intermediate between (a) and (c) in Srbija and S.W. Romania.
16. S. sexangulare L., Sp. Pl. 430 (1753) (S. boloniense Loisel., $S$. mite Gilib.). Glabrous, laxly caespitose. Leaves $3-6 \mathrm{~mm}$, bright green, cylindrical-linear, spurred, closely imbricate on the non-flowering shoots, usually in 5 or 6 regular rows. Flowering stems $6-15 \mathrm{~cm}$; flowers subsessile in moderately lax cymes with spreading branches. Petals $4-5 \mathrm{~mm}$, acute or acuminate, bright yellow. Follicles nearly symmetrical, erecto-patent; styles long and slender. Seeds $0 \cdot 3 \mathrm{~mm}$, subglobose. $2 n=74$. C. Europe, extending more locally to Finland (Ahvenanmaa), Lithuania, Moldavia, C. Greece and C. France. Al Au Be Cz *Da Fe Ga Ge Gr He Ho Hu It Ju Po Rm Rs (B, W) Su [Br].
17. S. borissovae Balk., Not. Syst. (Leningrad) 15: 85 (1953). Like 16, but with leaves grey-green and minutely papillose, somewhat ellipsoidal-oblong and not spurred; petals pale yellow; follicles larger; and seeds $0.7 \mathrm{~mm}, 2-3$ times as long as wide. Granite rocks. - S. Ukraine (near Dolinsky). Rs (W).
18. S. laconicum Boiss., Diagn. Pl. Or. Nov. 1 (6): 55 (1845). Glabrous; leaves $5-8 \mathrm{~mm}$, more or less terete, broadly linear or narrowly ellipsoidal, rather loosely imbricate. Flowering stems $4-10 \mathrm{~cm}$, simple, bearing below the usually small and crowded terminal cyme one or more small, subsidiary, axillary cymes of 1-3 flowers. Petals 3-4 mm, apiculate-aristate, bright yellow with red mid-vein. Stamens 10 . Follicles erecto-patent; styles long and slender. Mountains of Greece. Gr.
19. S. alpestre Vill., Prosp. Pl. Dauph. 49 (1779). Glabrous; non-flowering shoots very short; flowering stems $5-8 \mathrm{~cm}$, ascending. Leaves $4-6 \mathrm{~mm}$, somewhat flattened, narrow-oblong to elliptical-oblanceolate, very shortly spurred, often streaked with red. Flowers in short, dense, terminal cymes. Petals 3.5 mm (somewhat exceeding the sepals), oblong, subacute, dull yellow. Stamens 10. Follicles dark red, gibbous, stellate-patent, with a double wing on the adaxial side; styles very short, deflexed. $2 n=16$. Somewhat calcifuge. Mountains of C. \& S. Europe, from the Vosges and the Carpathians to the Pyrenees, Sardegna and Macedonia. Au Bu Co Cz Ga Ge He Hs It Ju Po Rm Rs (W) Sa.
S. erythraeum Griseb., Spicil. Fl. Rumel. 1: 326 (1843), described from W. Macedonia and recorded elsewhere in the Balkan peninsula, is a plant of obscure affinities, perhaps related to 19. It differs in its dwarf habit (c. 2 cm ), small leaves ( $c .2 .5 \mathrm{~mm}$ ),
mucronate, reddish-purple petals, and erecto-patent follicles with longer styles. S. horakii Rohlena, Acta Bot. Bohem. 2: 19 (1923), described from Crna Gora, has been wrongly identified with 20 and with 48 but seems to be intermediate between 16 and 19 , resembling the latter in habit and leaf, but with mucronate petals, often streaked with red, and fairly long styles. Plants referable to this complex are also recorded from Albania.
20. S. flexuosum Wettst., Biblioth. Bot. 26:43(1892). Glabrous, with numerous, slender, erect flowering stems of $2-4 \mathrm{~cm}$, and a few short non-flowering shoots. Leaves $5-6 \mathrm{~mm}$, linear-oblong to oblanceolate, semiterete, bearing at the apex a few large, hyaline tubercles. Flowers as in 19, but petals acuminate or apiculate and pale yellow, and styles somewhat longer. Seeds reddish-brown. - Makedonija (Śar Planina, Korab). ?A1 Ju.
21. S. kostovii Stefanov, Bull. Inst. Bot. (Sofia) 1: 359 (1950). Like 19 in habit; leaves as in 20, but slightly smaller; flowers and follicles as in 19, but petals $2 \cdot 5-3 \mathrm{~mm}$, pale yellow. Seeds pale olive-brown. Mountains of S.W. Bulgaria. Bu.
22. S. idaeum D. A. Webb, Feddes Repert. 64: 20 (1961). Glabrous; stems and often leaves tinged with deep red. Nonflowering shoots very short. Flowering stems $1.5-4 \mathrm{~cm}$, simple, erect, densely leafy. Leaves $3 \cdot 5-7 \mathrm{~mm}$, elliptical-oblong to linearoblanceolate. Flowers 2-6 in a small crowded cyme, sometimes with 1 or 2 axillary flowers below it. Sepals united in their lower part. Petals 5 mm , lanceolate, acuminate, cream-coloured or whitish, irregularly striped with red. Follicles stellate-patent, with very short styles. - Mountains of Kriti. Cr.
23. S. tuberiferum Stoj. \& Stefanov, Notizbl. Bot. Gart. Berlin 11: 1013 (1934). Stems up to 12 cm , sparingly branched, arising from a globose or oblong, subterranean, tuberous rhizome. Leaves almost flat, minutely hyaline-papillose; on the nonflowering shoots 3-4 mm , lanceolate-spathulate; on the flowering stems $6-8 \mathrm{~mm}$, oblong-linear, spurred. Flowers shortly pedicellate, in a rather lax cyme. Petals oblong-lanceolate, acuminate, at least twice as long as the sepals, pale yellow. Follicles stellatepatent; styles fairly long, upturned. Seeds grey-green. Mountains of W. Bulgaria. Bu.
24. S. zollikoferi F. Hermann \& Stefanov, Notizbl. Bot. Gart. Berlin 12: 563 (1935). Like 19 but rather more robust, with leaves $5-10 \mathrm{~mm}$, grey-green; petals acuminate, twice as long as the sepals; and styles fairly long. - S.W. Bulgaria (Ali Botuš). Bu.
25. S. album L., Sp. PI. 432 (1753). Glabrous, laxly caespitose perennial with creeping, woody stems which bear short nonflowering shoots and erect flowering stems $5-18 \mathrm{~cm}$ high. Leaves $4-12 \mathrm{~mm}$, subterete but somewhat flattened on upper surface, obtuse, scarcely spurred, varying from linear-cylindrical to ovoidglobose, usually reddish, patent or suberect, alternate. Flowers 5 -merous, shortly stalked, in a freely branched, rather dense, subcorymbose cyme. Sepals united at the base. Petals $2-4 \mathrm{~mm}$, subacute, white (rarely pink). Stamens 10 . Follicles pink, erect. $2 n=68,136$. Europe, except for parts of the north and east. All except Az Fa Is Rs (N, C, E) Sb; only as naturalized alien in Hb .

A very variable plant, especially in size and shape of leaf. Some segregates, especially S. micranthum Bast., Essai Fl. Maine Loire 167 (1809), with short stems, small flowers and rather short leaves (S.W. \& S.C. Europe), and S. athoum DC., Prodi., 3: 407 (1828), with short, subglobose leaves and more acute petals (Greece and adjoining regions) are sufficiently striking to have been given
specific or subspecific rank, but intermediate plants are so numerous as to make their diagnosis impossible.
26. S. serpentini Janchen, Österr. Bot. Zeitschr. 69: 173 (1920). Like 25, but distinct in the much laxer and more distinctly corymbose inflorescence, and the small, bright pink petals. Leaves oblong-cylindrical. Serpentine rocks. $-N . \& E$. Albania; S.E. Greece (Evvoia). Al Gr.
27. S. gypsicola Boiss. \& Reuter, Diagn. PI. Nov. Hisp. 13 (1842). Very like 25 in general habit, inflorescence and flowers, but with flatter, ovate-rhombic, greyish, densely puberulent leaves, closely imbricate in 5 rows on the sterile shoots. C. \& S. Spain. Hs.
28. S. subulatum (C. A. Meyer) Boiss., Fl. Or. 2: 783 (1872). Rather like the larger variants of 25 , but often taller, with linearsubulate, acuminate leaves $10 \times 1.5 \mathrm{~mm}$; inflorescence more compact, with shorter pedicels; petals $5-6 \mathrm{~mm}$; and styles almost equalling the ovaries. S.E. Russia. Rs (E). (S.W. Asia.)
29. S. anglicum Hudson, Fl. Angl. ed. 2, 196 (1778). Glabrous, laxly caespitose perennial with creeping stems bearing short nonflowering shoots and flowering stems up to 15 cm , but usually much less. Leaves $3-5 \mathrm{~mm}$, cylindrical, ovoid or subglobose, gibbous, spurred, alternate, often pink. Flowers 5 -merous, usually rather crowded in a small cyme with $2-3$ branches. Sepals free, spurred; petals $2.5-4.5 \mathrm{~mm}$, acute to acuminate, pink or white; stamens 10 , with blackish anthers; follicles red, suberect. Calcifuge. W. Europe, extending to S.W. Sweden. Br Ga Hb Hs Lu No Su.
Variable in the southern part of its range: three subspecies, differing chiefly in size can be recognized.
1 Flowering stems $10-15 \mathrm{~cm}$; leaves $c .5 \mathrm{~mm}$; cymes lax
(b) subsp. pyrenaicum

1 Flowering stems seldom more than 7 cm ; leaves $3-4(-5) \mathrm{mm}$; cymes short, dense
2 Flowering stems $2-3.5 \mathrm{~cm}$, very slender; petals c. 3 mm
(c) subsp. melanantherum

2 Flowering stems $3-7 \mathrm{~cm}$, stouter; petals $4-4.5 \mathrm{~mm}$
(a) subsp. anglicum
(a) Subsp. anglicum: $2 n=120 c .144$. $\quad$. Spain to Sweden.
(b) Subsp. pyrenaicum Lange, Ind. Sem. Hort. Acad. Hafn. 1857: 27 (1857):2n=24-36. - S. France, N. Spain, Portugal.
(c) Subsp. melanantherum (DC.) Maire in Jahandiez \& Maire, Cat. Pl. Maroc 2: 324 (1932): Mountains of S. Spain.
30. S. stefco Stefanov, God. Sof. Univ. (Agro.-Les. Fak.) 24 (2): 105 (1946). Small, glabrous perennial; flowering stems $c .7 \mathrm{~cm}$. Leaves $4-5 \times 1.5 \mathrm{~mm}$, cylindrical, alternate, bright pink. Flowers 4 -merous, shortly stalked, in a rather dense cyme. Petals $4-$ 5 mm , acute, suberect, pale pink. Stamens 8 . Follicles patent; styles very short. - Mountains of S.W. Bulgaria (W. Rodopi). Bu.
31. S. dasyphyllum L., $S p$. Pl. 431 (1753). Perennial $3-8 \mathrm{~cm}$, glandular-pubescent at least on the inflorescence and sometimes all over, usually pruinose and tinged with greyish-pink. Leaves ovoid or suborbicular, flattened on upper surface, mostly opposite, loosely imbricate on the non-flowering shoots. Flowers 5 - or 6 merous, stalked, in small cymes. Petals 3 mm , white streaked with pink. Stamens 10 or 12. Follicles nearly erect; style short, turned sharply outwards. $2 n=28,42,56$. S. Europe and parts of C. Europe; naturalized in the north-west. Al Au Bl Bu Co Cr Ga Ge Gr He Hs It Ju Rm SaSi [ $\mathrm{Be} \mathrm{Br} \mathrm{Da} \mathrm{Hb} \mathrm{Ho]}$.
32. S. brevifolium DC., Rapp. Voy. Bot. 2: 79 (1808). Like 31 but quite glabrous, with wiry, somewhat woody stems; globose leaves, usually closely imbricate in 4 rows on the non-flowering shoots; and longer styles. S.W. Europe. Co Ga Hs Lu Sa.
33. S. monregalense Balbis, Mém. Acad. Sci. Turin 7: 339 (1804) (S. cruciatum Desf.). Perennial, with suberect nonflowering shoots and erect flowering stems $7-15 \mathrm{~cm}$ high, glandular-pubescent above. Leaves 6 mm , opposite below, in whorls of 4 above, oblong-lanceolate, flat on upper surface, obtuse, glabrous. Flowers 5 -merous, on long pedicels in a lax panicle. Petals white, lanceolate, acuminate, with pubescent mid-vein. Stamens 10. Follicles suberect, with long, straight styles. Shady mountain rocks. S.W. Alps; Appennini; Corse. Co Ga It.
34. S. magellense Ten., Prodr. Fl. Nap. xxvi (1811). Glabrous perennial with ascending flowering stems $6-15 \mathrm{~cm}$ high. Leaves $6-10 \mathrm{~mm}$, alternate or opposite, obovate-oblong, flat, obtuse. Flowers 5-merous, pedicellate; inflorescence simple, racemose. Petals lanceolate, acute, whitish. Stamens 10. Follicles erect, obtuse, shortly mucronate. Mountains of S.E. Europe, extending to C. Italy. Al Bu Cr Gr It Ju.
35. S. alsinefolium All., Fl. Pedem. 2: 119 (1785). Delicate, glandular-pubescent perennial; flowering stems $10-15 \mathrm{~cm}$, weak and spreading; non-flowering shoots few, rosette-like. Leaves $10-15 \mathrm{~mm}$, alternate, rhombic to obovate-spathulate, relatively thin, the lower ones petiolate. Flowers 5 -merous, on long, slender pedicels, in a leafy, very lax panicle. Petals 5 mm , ovaterhombic, shortly acuminate, white. Stamens 10 . Follicles erect, pubescent. Shady rocks and caves. - S.W. Alps. Ga It.
36. S. hierapetrae Rech. fil., Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 105 (2): 86 (1943). Perennial, with caespitose, rosettelike non-flowering shoots; flowering stems $3-7 \mathrm{~cm}$, arising terminally from a rosette of the previous year, suberect, flexuous, glandular-hairy, branched above. Rosette-leaves 7-12 $\times 3-5 \mathrm{~mm}$, oblong-spathulate, nearly flat, glabrous; cauline leaves alternate, smaller, glandular-hairy. Flowers 5 -merous, few, pedicellate, in a lax cyme. Petals 3 mm , shortly mucronate, purple. Stamens 10. Rock-crevices. Kriti. Cr.
37. S. tristriatum Boiss., Diagn. Pl. Or. Nov. 2 (10): 16 (1849). Perennial, with caespitose, rosette-like non-flowering shoots; glandular-pubescent all over. Rosette-leaves oblong-spathulate, almost flat; cauline leaves obovate, semiterete, alternate. Flowering stems $2-10 \mathrm{~cm}$, ascending, arising in the axils of lower leaves of the rosette, each bearing 4-7, 5-merous flowers in a lax cyme. Petals aristate, pale pink with darker stripes, or white. Stamens 10. ? Mountains of Greece and Kriti. Cr Gr.
38. S. hirsutum All., Fl. Pedem. 2: 122 (1785). Densely glandular-hairy perennial with caespitose non-flowering shoots and terminal, erect flowering stems $5-12 \mathrm{~cm}$ high. Leaves $5-$ 15 mm , alternate, terete, oblanceolate. Flowers 5-(6-)merous, pedicellate; buds nodding. Petals $5-7 \mathrm{~mm}$, ovate, acuminate or apiculate, white or pinkish. Follicles erect, pubescent on inner side, white. Usually calcifuge. S.W. Europe, extending to $N$. France and N. Italy. Ga Hs It Lu.
(a) Subsp. hirsutum: Leaves not more than 10 mm ; cyme with not more than 15 flowers; petals not more than $6 \times 2.5 \mathrm{~mm}$, usually with a red mid-vein, free or scarcely united at the base; styles straight. Throughout the range of the species.
(b) Subsp. baeticum Rouy, Bull. Soc. Bot. Fr. 34: 441 (1887) (Umbilicus winkleri Willk.): Leaves up to 15 mm , forming large,
densely caespitose rosettes, almost with the habit of a Sempervivum; cyme with up to 24 flowers; petals c. $9 \times 4.5 \mathrm{~mm}$, pure white or with green veins, united for $\frac{1}{4}$ of their length; styles curved outwards. S. Spain.

Very distinct in its extreme form, but apparently connected to (a) in S. \& C. Spain by a full range of intermediates.
39. S. villosum L., Sp. PI. 432 (1753). Usually perennial with small leafy offsets, but sometimes biennial; usually glandularpubescent all over (but occasionally glabrous in subarctic Europe, var. glabratum Rostrup). Stem 5-15 cm, erect. Leaves 4-7 mm, alternate, erect, linear-oblong, semiterete. Flowers 5 -merous, stalked, in a small, lax panicle; buds erect. Petals 4-5 mm, acute, lilac or pale pink. Stamens 10, rarely 5. Follicles erect, green or purple. $2 n=30$. Wet places. W. \& C. Europe, extending to $W$. Finland, White Russia and N. Italy. Au Br Cz Fa Fe Ga Ge He Hs Is It Ju No Po ?Rm Rs (B, C) Sa Su.
40. S. creticum Boiss., Diagn. Pl. Or. Nov. 2 (10): 16 (1849). Biennial, or sometimes annual; stem $5-8 \mathrm{~cm}$, erect, branched from near the base, glandular-pubescent. Leaves alternate, mostly in a basal rosette, oblong-spathulate, flat, glandularpubescent or glabrous. Flowers 5 -merous, on short pedicels, in a narrow panicle which occupies most of the stem. Petals lanceolate, acute, pink. Stamens 10 . Follicles erect, pubescent. - Kriti; Karpathos. Cr.
41. S. cepaea L., Sp. Pl. 431 (1753). Annual or biennial, perhaps sometimes perennial. Stem $15-30 \mathrm{~cm}$, weak, erect or ascending, pubescent. Leaves mostly opposite or whorled, obovate or oblanceolate-spathulate, flat, glabrous, the lower ones petiolate. Flowers 5 -merous, pedicellate, in a long, diffuse panicle. Petals 5 mm , oblong-ovate, aristate, pale pink with a red, pubescent mid-vein. Follicles erect, longitudinally grooved. $2 n=22$. Shady places. - S. \& S.C. Europe, mainly in the mountains. Al Bu Co Cr Ga Gr He Hs It Ju Rm Sa Si [Ge Ho].
42. S. lagascae Pau, Not. Bot. Fl. Esp. 6: 53 (1895). Bushy annual $6-15 \mathrm{~cm}$ high and about as wide, glandular-pubescent all over. Leaves 6-9 mm, alternate, broadly linear, terete. Flowers 5 -merous, numerous, drooping, on rather long pedicels. Sepals 2 mm , ovate-lanceolate; petals $c .7 \mathrm{~mm}$, ovate-oblong, pale pink, yellowish at the base. Stamens 10. Follicles erect; styles fairly long. C. \& S. Spain, Portugal. Hs Lu.
43. S. pedicellatum Boiss. \& Reuter, Diagn. Pl. Nov. Hisp. 13 (1842). Glabrous annual; stem 3-12 cm, erect. Leaves 2-5 mm, alternate, patent, ovoid-cylindrical, glaucous. Flowers 5-merous, rather few, pedicellate, in a lax cyme. Petals 3 mm , elliptical, white with a pink dorsal line. Stamens 10. Follicles erect; styles straight, rather short. Gravelly places in mountains. - N. Portugal \& C. Spain. Hs Lu.

Plants from Portugal differ from those from C. Spain in their smaller, more strongly ridged seeds, and their usually more compact habit, and have been separated as $\mathbf{S}$. willkommianum R. Fernandez, Bol. Soc. Brot. ser. 2, 34: 121 (1960).
44. S. arenarium Brot., Fl. Lusit. 2: 212 (1804). Glabrous annual, branched from the base, with ascending branches. Leaves 3-5 mm, ovoid, spurred. Flowers 5 -merous, subsessile, in short, spreading cymes. Sepals often unequal. Petals $c .3 \mathrm{~mm}$, white tinged with pink. Stamens 10. Styles straight, rather short. - Portugal, W. \&. C. Spain. Hs Lu.

Often included under 29 but apparently quite distinct in its annual habit.
45. S. atratum L., Sp. Pl. ed. 2, 1673 (1763). Glabrous annual. Stem 3-10 cm, with erect branches. Leaves $4-6 \mathrm{~mm}$, alternate, oblong or obovoid-clavate, tapered and flattened towards the base. Flowers 5- or 6 -merous, shortly pedicellate, in a crowded corymb. Stamens 10-12. Follicles stellate-patent; styles short, deflexed. $2 n=16$. Somewhat calcicole. Mountains of C. \& S. Europe, from the French Jura and Carpathians to N. Spain, Calabria and Greece. Al Au Bu Cz Ga Ge Gr He Hs It Ju Po Rm Rs (W).
(a) Subsp. atratum: Dwarf; stem unbranched below; petals cream-coloured, lined or suffused with red, acute, only slightly exceeding the sepals. Plant usually dark red. Throughout the range of the species, but rare in the Balkan peninsula.
(b) Subsp. carinthiacum (Hoppe ex Pacher) D. A. Webb, Feddes Repert. 69: 62 (1964): Taller; stem usually branched from the base; petals pale greenish-yellow, scarcely tinged with red, obtuse, twice as long as the sepals. Plant greenish, only slightly flushed with red. E. Alps and Balkan peninsula.
46. S. confertiflorum Boiss., Diagn. Pl. Or. Nov. 1 (3): 15(1843). Annual; stems 2-8 cm, ascending. Leaves $10-18 \mathrm{~mm}$, alternate, oblong-linear, semiterete. Flowers 5-merous, subsessile, in a crowded corymb. Sepals glandular-papillose, united in their lower half. Petals $3-4 \mathrm{~mm}$, subacute, white. Stamens 10. Follicles suberect, glandular-papillose; styles fairly long, straight. N.E. Greece. Gr. (Asia Minor.)
47. S. stellatum L., Sp. Pl. 431 (1753). Glabrous annual; stem $3-15 \mathrm{~cm}$, stout, erect or ascending. Leaves $10-15 \mathrm{~mm}$, flat, with a short, broad petiole and suborbicular lamina, crenate or bluntly dentate, the upper alternate, the lower often opposite. Flowers 5- (rarely 4-)merous, sessile. Sepals broadly linear, accrescent, papillose at the apex. Petals $4-5 \mathrm{~mm}$, acute, pink. Stamens 8 or 10 . Follicles stellate-patent; styles very short. Mediterranean region. Al Bl Co Cr Ga Gr It Ju Sa Si.
48. S. annuum L., Sp. Pl. 432 (1753) (incl. S. grisebachii Boiss.). Glabrous annual or biennial, often spotted or streaked with red; stem branched from the base with ascending, eventually flexuous branches $4-12 \mathrm{~cm}$ long. Leaves c. 6 mm , alternate, distant, linear-oblong, thick but flattened on both surfaces, with a whitish, truncate spur. Flowers 5 -merous, subsessile or on short pedicels, in a lax, compound cyme. Petals oblanceolate, acute to acuminate, twice as long as the sepals, yellow. Stamens 10. Follicles green or red, stellate-patent. $2 n=22$. N. Europe, and in most of the mountain-ranges of $C . \& S$. Europe. Al Au Bu Co Cr CzFe Ga Ge Gr He Hs Is It Ju No Rm Rs (N, B, W) Su.

Normally biennial in Fennoscandia; apparently annual in C. Europe. A variety (var. perdurans Murb.) has been reported from the Balkan and Carpathian mountains in which the decumbent branches root on touching the soil and thus transform the plant into a perennial, but the status of this plant is open to question.
49. S. litoreum Guss., Pl. Rar. 185 (1826). A glabrous annual; stem $4-15 \mathrm{~cm}$; branches erect. Leaves $10-20 \mathrm{~mm}$, alternate, obovate-spathulate, flattish, shortly spurred. Flowers 5 -merous, subsessile, in long, lax cymes. Petals $2 \cdot 5-4 \mathrm{~mm}$, equalling or slightly exceeding the sepals, lanceolate, acute, pale yellow. Stamens 5, rarely 10. Follicles erecto-patent; styles short. Mainly littoral. E. \& C. Mediterranean region. Co Cr Gr It Ju $\mathrm{Su} \mathrm{Si}[\mathrm{Ga}$.
50. S. aetnense Tineo in Guss., Fl. Sic. Syn. 2: 826 (1845). Somewhat glaucous annual; stem $2-6 \mathrm{~cm}$, erect, with short,
ascending branches. Leaves $3-4 \mathrm{~mm}$, alternate, erect-appressed, terete, conical-oblong, ciliate-denticulate, with a scarious spur at the base. Flowers 4 - or 5 -merous, sessile, axillary. Sepals ciliate. Petals 2 mm , white or pink. Stamens 4 or 5 . Follicles erect, dark red. - S. Europe; very local. ?Al Bu Ju Hs Rs (W, K) Si.
51. S. rubens L., Sp. Pl. 432 (1753) (Crassula rubens L.). Erect annual $5-12 \mathrm{~cm}$, glandular-pubescent above, somewhat glaucous and usually reddish. Leaves $10-20 \mathrm{~mm}$, alternate, patent, linear, semiterete. Flowers 5 -merous, sessile, in a leafy, corymbose cyme. Petals 5 mm , sharply acuminate, white or pink. Stamens 5 , rarely 10 . Follicles divergent at the base but suberect in upper part, glandular-tuberculate. Styles long, straight. S. \& W. Europe, extending to Switzerland and S.W. Germany. Al Be Bl Bu Co Cr ? Cz Ga Ge Gr He Hs It Ju Lu Rm Rs (K) Sa Si.
52. S. caespitosum (Cav.) DC., Prodr. 3: 406 (1828) (S. rubrum (L.) Thell., non Royle ex Edgew.). Glabrous, usually reddish annual; stem 2-5 cm, erect. Leaves 3-6 mm, alternate, imbricate, subterete, broadly ovoid. Flowers 4 - or 5 -merous, sessile, in short cymes. Petals 3 mm , mucronate, white tinged with pink. Stamens 4 or 5. Follicles patent, glabrous. S. \& S.C. Europe. Bu Co Cr Ga Gr Hs Hu It Ju Rm Rs (K) Sa Si.
53. S. andegavense (DC.) Desv., Obs. Pl. Env. Angers 150 (1818). Glabrous annual; stem 3-7 cm, usually erect, branched above. Leaves alternate (or lower ones opposite), ovoid or subglobose, imbricate, shortly spurred. Flowers 4 - or 5 -merous, on short pedicels in a corymbose cyme. Petals broadly ovate, mucronate, whitish or pink. Stamens 4 or 5 . Follicles erect, rugulose; styles short. S.W. Europe, extending to N.W. France and C. Italy (Capraia). Co Ga Hs It Lu Sa.
54. S. nevadense Cosson, Not. Pl. Crit. 2: 163 (1849). Glabrous annual; stem $4-10 \mathrm{~cm}$, erect. Leaves erect, semiterete, linearoblong, not spurred. Flowers 5 -merous, pedicellate, in a racemelike cyme. Petals $3-4 \mathrm{~mm}$, acute, connate at the base, white or pale pink. Stamens 5. Follicles erect, with short, straight styles. Mountains of S., E. \& N. Spain. Hs.
55. S. hispanicum L., Amoen. Acad. 4: 273 (1759) (S. glaucum Waldst. \& Kit., S. sexfidum Bieb.). Usually annual, but sometimes biennial or perennial; glabrous or wholly or partly covered with glandular hairs. Stem 7-15 cm, branched, ascending. Leaves 718 mm , alternate, linear, semiterete, subacute, glaucous. Flowers 6- (to 9-)merous, subsessile, numerous, in unilateral cymes. Petals 5-7 mm, lanceolate, acuminate, white with pink mid-vein. Follicles stellate-patent, smooth or with glandular hairs, pale pink or whitish. $2 n=40$. S.E. Europe, extending to Sicilia, Switzerland and E. Carpathians; occasionally naturalized further north. Al Au Bu Cr Gr He Hu It Ju Rm Rs (W) Si Tu [ Ge Su ].
56. S. pallidum Bieb., Fl. Taur.-Cauc. 1: 353 (1808). Like 55 but usually glabrous; flowers 5 -merous; petals rather smaller, pink, suberect; follicles usually suberect, dark red, glandulartuberculate. S. part of Balkan peninsula; Aegean region; Krym. $\mathrm{Al} \mathrm{Bu} \mathrm{Cr} \mathrm{Gr} \mathrm{Ju} \mathrm{Rs} \mathrm{(K)} \mathrm{Tu}$.
57. S. caeruleum L., Mantissa Alt. 241 (1771). A bushy, erect annual $5-20 \mathrm{~cm}$, often pubescent above, usually strongly tinged with red. Leaves c. 10 mm , alternate, terete, linear-oblong. Flowers numerous, usually 7-merous, on slender pedicels in a

[^146]broad, lax panicle. Petals lanceolate, sky-blue, white at the base. Stamens twice as many as the petals. Follicles erecto-patent; style long, straight. Islands of W. Mediterranean. Co Sa Si.

## 11. Rhodiola L. ${ }^{1}$

Dioecious perennials with a thick, fleshy rhizome, bearing persistent, broad-based scale-leaves and flowering stems with alternate leaves and flowers in terminal cymes. Flowers usually 4-merous; petals free; stamens 8; carpels 4. Follicles erect.
Leaves at least 5 mm wide, flat

1. rosea
Leaves less than 2 mm wide, terete
2. quadrifida
3. R. rosea L., Sp. Pl. 1035 (1753) (Sedum rosea (L.) Scop., S. rhodiola DC.; incl. R. arctica Boriss. and R. iremelica Boriss.). Rhizome fragrant when cut. Flowering stems $5-35 \mathrm{~cm} \times 2$ 6 mm , erect, not persistent when dead. Leaves orbicular-ovate to linear-oblong, usually dentate, broad-based, sometimes amplexicaul, glabrous, rather glaucous. Cymes somewhat corymbose. Petals $3-4 \mathrm{~mm}$, usually dull yellow, sometimes absent. Male flowers with conspicuous but abortive carpels. Follicles reddish. $2 n=22$. N. Europe, and in most of the mountains of C. Europe, southwards to the Pyrenees, C. Italy and Bulgaria. Au Br Bu CzFa Fe Ga Hb He Hs Is It Ju No Po Rm Rs (N, C, W) Sb Su .

Very variable. Variation in leaf-shape shows some geographical consistency (long and narrow in the south, usually short and broad in the north), but variation in other features is poorly correlated, and a satisfactory basis for division into subspecies is not yet apparent.
2. R. quadrifida (Pallas) Fischer \& C. A. Meyer, Enum. Pl. Nov. 1: 69 (1841). Flowering stems $3-12 \mathrm{~cm} \times 0 \cdot 5-1 \mathrm{~mm}$, erect, wiry, numerous, persistent when dead. Leaves $5-10 \mathrm{~cm} \times 1-1.5 \mathrm{~mm}$, narrowly linear, terete, acute. Cymes small, few-flowered. Petals 4 mm , yellow, often tipped with red. Follicles dark red. N.E. Russia. Rs (N, C). (N. Asia.)

The plants from Tibet and Himalaya often cited under this name appear to be very different.

## 12. Orostachys (DC.) Fischer ex Sweet ${ }^{1}$

Glabrous biennials with leaves in a compact, subglobose, basal rosette, from the centre of which an unbranched flowering stem arises in the second year. Leaves with a whitish cartilaginous border towards the apex, and a terminal spine. Flowers 5 -merous, in a long, dense, thyrsoid raceme. Petals slightly connate at the base, patent. Stamens 10. Follicles free, erect; styles slender, straight.
Flowers subsessile, petals greenish-yellow; anthers yellow 1. spinosa Pedicels of lower flowers $3-8 \mathrm{~mm}$; petals white or pink; anthers dark purple
2. thyrsiflora

1. O. spinosa (L.) Sweet, Hort. Brit. ed. 2, 225 (1830). Rosetteleaves $15-25 \times 3-5 \mathrm{~mm}$, oblong, tapered suddenly to a terminal spine $2-4 \mathrm{~mm}$ long. Stem $10-30 \mathrm{~cm}$; cauline leaves alternate, similar to the basal leaves but smaller. Raceme $5-20 \mathrm{~cm}$, very dense; pedicels $0-1 \mathrm{~mm}$. Petals 4 mm , lanceolate, acute, greenishyellow. Anthers yellow. Follicles $5-6 \mathrm{~mm}$. Dry rocks or stony ground. E. Russia (S. Ural). Rs (E). (N. \& C. Asia.)
2. O. thyrsiflora (DC.) Fischer ex Sweet, loc. cit. (1830). Like 1 but rosette-leaves $6-8 \mathrm{~mm}$, broadly elliptical or suborbicular, with a shorter spine; cauline leaves strongly keeled, almost
triquetrous; raceme broader and laxer, with the lower flowers clearly pedicellate; petals white or pinkish; and anthers dark purple. Dry rocks or stony ground. E. Russia. Rs (C, E). (C. Asia.)

## 13. Rosularia (DC.) Stapf ${ }^{1}$

Perennial, with a basal rosette of sessile leaves and several peduncles arising from their axils. Flowers as in Umbilicus.

1. R. serrata (L.) A. Berger in Engler \& Prantl, Natürl. Pfanzenfam. ed. 2, 18A: 465 (1930) (Cotyledon serrata L.). Leaves $20-30 \times 5-8 \mathrm{~mm}$, oblong-spathulate, obtuse or subacute, glabrous; margin cartilaginous, verrucose-denticulate or almost entire. Peduncles $10-18 \mathrm{~cm}$, ascending, hairy above. Flowers c. 6 mm , pedicellate, in narrow panicles. Corolla purplish-red, tubular-campanulate, with erect, lanceolate, acuminate lobes somewhat longer than the tube. Styles slender, straight. Kriti and Karpathos. Cr. (E. Aegean and Asia Minor.)

## LXXIII. SAXIFRAGACEAE ${ }^{2}$

Herbs, mostly perennial. Flowers 4- or 5 -merous, usually in cymes (rarely solitary or in racemes). Petals usually 4-5; sometimes 0 . Stamens twice as many as the sepals, or rarely equal in number or fewer. Carpels 2 ; united below but usually divergent above; styles free. Ovary superior, semi-inferior or almost inferior. Fruit a capsule; seeds numerous.

Representatives of several genera from North America are cultivated in gardens, and at least two of these appear to be becoming naturalized in damp, shady places in Britain, Ireland, perhaps elsewhere. Tolmiea menziesii (Pursh) Torrey \& A. Gray, Fl. N. Amer. 1: 582 (1840) has long-petiolate, cordate leaves (often with adventitious buds arising from the sinus) and somewhat zygomorphic flowers in a narrow raceme, with 5 dark red, filiform petals and only 3 stamens. Tellima grandiflora (Pursh) Douglas ex Lindley, Bot. Reg. t. 1178 (1828) is similar in habit but without adventitious buds; the flowers are regular, with pale green, laciniate petals and 10 stamens.
1 Petals absent
3. Chrysosplenium
1 Petals present
2 Rhizome stout, fleshy; leaves $10-15 \mathrm{~cm}$ wide $\quad$ 2. Bergenia
2 Rhizome, if present, thin or very short; leaves not more than 6 cm wide

1. Saxifraga

## 1. Saxifraga L. ${ }^{1}$

Herbs, sometimes rather woody at the base; usually perennial, rarely annual or biennial. Leaves simple, but often deeply dissected and sometimes apparently ternate; usually alternate or basal, rarely opposite; foliar glands, if present, superficial or on hairs, not immersed as in Bergenia. Flowers 5-merous, usually in cymes or panicles, rarely solitary in leaf-axils. Petals present; stamens 10 ; ovary superior or, more often, semi-inferior.
The sections into which this genus is customarily divided cannot be concisely diagnosed, and the assignment of several species is in doubt. Arbitrary divisions, based on characters which are easily observed, have therefore been used.

Plants of this genus are frequently cultivated, especially in N.W. Europe. The majority of garden plants are complex hybrids, often of uncertain origin; among the species which have certainly contributed to such hybrids are $44,45,51,62,70,71,72,86,96$, 102,103 . The species or primary hybrids most commonly seen in cultivation are $9,10,12,13,15,24,36,93$ and 119 ; also $103 \times 96$ and $104 \times 103$.

The only non-European species commonly cultivated is $S$. stolonifera Meerb. (S. sarmentosa L.), from China and Japan, with orbicular leaves, long, filiform stolons and strongly zygo-

[^147]${ }^{2}$ Edit. D. A. Webb.
morphic flowers. It is reported as occasionally naturalized on walls in C. \& S. Europe.

Literature: A. Engler \& E. Irmscher, Pflanzenreich 67 \& 69 (IV. 117) (1916-19). H. W. Pugsley, Jour. Linn. Soc. London (Bot.) 50 : 267 (1936). D. A. Webb, Proc. Roy. Irish Acad. 53 B: 207 (1950).
1 Flowers absent, replaced by bulbils or leafy buds
2 Leaves reniform; petiole slender
92. cernua

2 Leaves oblong-cuneate; petiole broad, scarcely distinct
6. foliolosa

1 Flowers present (sometimes intermixed with bulbils or leafy buds)
3 Monocarpic, without leafy shoots, stolons or bulbils
4 Perennial; leaves coriaceous, in a dense rosette
5 Leaves obtuse, lime-encrusted; petals white 122. longifolia
5 Leaves apiculate, not lime-encrusted; petals flesh-coloured
123. florulenta

4 Annual or biennial; leaves soft
6 Ovary superior, or very nearly so; plant glabrous or slightly hairy
7 Petals white
23. hederacea

7 Petals yellow or orange
8 Sepals deflexed early
25. sibthorpii

8 Sepals patent, even in fruit
24. cymbalaria

6 Ovary clearly semi-inferior; plant usually hairy
9 Basal leaves deeply lobed; petiole long
10 Petals emarginate; panicle very diffuse and leafy
30. petraea

10 Petals obtuse, entire; panicle fairly compact, not very leafy
26. latepetiolata

9 Basal leaves entire or shortly 3- to 5-lobed; petiole broad, usually short
11 Capsule longer than wide, somewhat tapered at the base 12 Pedicel much longer than capsule 28. osloensis 12 Pedicel equalling or only slightly longer than capsule
29. adscendens

11 Capsule subglobose, not tapered at the base
13 Biennial; basal leaves 3- to 5 -toothed, subsessile, in a compact rosette, persisting till flowering season
29. adscendens

13 Annual; basal leaves entire, stalked, not in a rosette, usually withered before the flowers open
27. tridactylites

3 Polycarpic, perennating by bulbils, stolons, leafy shoots or an underground stock
14 Bulbils present in axils of basal leaves, at or below groundlevel
15 Petals glandular-hairy on upper surface
16 Bulbils present in axils of cauline leaves and bracts
85. bulbifera

16 Bulbils confined to the axils of basal leaves
17 Inflorescence diffuse; flowering stems usually branched from the middle or below it
18 Lower leaves rhombic-suborbicular, broadly crenate; lower bracts broadly cuneate, toothed 88. cintrana

18 Lower leaves obovate-cuneate, deeply lobed; lower bracts linear-lanceolate, entire
81. haenseleri

17 Inflorescence compact; flowering stems usually branched only in the uppermost quarter (82-84). dichotoma group 15 Petals glabrous
19 Basal leaves deeply dissected
20 Petals $4-10 \mathrm{~mm}$
21 Caespitose; bulbils all at ground level 80. gemmulosa
21 Stems decumbent, spreading; bulbil-like buds present in axils of cauline leaves
78. boissieri

20 Petals $15-20 \mathrm{~mm}$
79. biternata

19 Basal leaves divided for less than $\frac{2}{3}$ of the distance to base or midrib
22 Leaves palmately lobed, with 5-9 entire, ovate or triangular lobes
23 Bulbils present in the axils of cauline leaves 92. cernua
23 Bulbils confined to axils of basal leaves
24 Petals $8-14 \mathrm{~mm}$
89. sibirica

24 Petals $3-7 \mathrm{~mm}$
25 Lobes of cauline leaves ovate-lanceolate, obtuse; petals $3-5 \mathrm{~mm} \quad 91$. rivularis
25 Lobes of cauline leaves triangular, acute; petals 5$7 \mathrm{~mm} \quad 90$. carpathica
22 Leaves crenate, with more than 9 crenations; or divided into $3-5$ obovate-cuneate, usually crenate lobes
26 Leaves distinctly 3-lobed
87. corsica

26 Leaves crenate but scarcely lobed
86. granulata

14 Bulbils absent, or present only in the axils of cauline leaves or bracts
27 Petals bright yellow or orange
28 Larger leaves $6-15 \mathrm{~mm}$ wide
121. mutata

28 Leaves not more than 5 mm wide
29 Leaves soft
30 Leaves fleshy
35. aizoides

30 Leaves thin, not fleshy
31 Long, filiform stolons present
21. flagellaris

31 Plant $\pm$ caespitose; stolons short, leafy
22. hirculus

29 Leaves stiff and hard
32 Ovary superior
20. bronchialis

32 Ovary semi-inferior
33 Stamens as long as the petals; leaves apiculate, pungent 103. juniperifolia
33 Stamens shorter than the petals; leaves obtuse or mucronate
34 Leaves $\pm$ obtuse, with cartilaginous margin
105. aretioides

34 Leaves with incurved mucro, without cartilaginous margin 104. ferdinandi-cobur
27 Petals white, greenish, pale yellow, pink or purple-red
35 Ovary superior
36 Sepals deflexed
37 Leaves with a narrow, hyaline, cartilaginous margin
38 Petals usually spotted with red; ovary pink; leaves toothed or crenate almost to base of lamina
(8-13). umbrosa group
38 Petals without red spots; ovary almost white; leaves usually entire in basal third of lamina 7. cuneifolia
37 Leaves without hyaline margin
39 Basal leaves sessile, or with a short, broad petiole
40 Flowers few; inflorescence largely composed of leafy buds crowded towards the ends of the branches
6. foliolosa

40 Flowers usually numerous; leafy buds, if present, distributed throughout a lax panicle
41 Lower bracts large and leaf-like; branches of panicle fragile, usually divaricate 4. clusii
41 Bracts usually small; branches of panicle not fragile, usually suberect
5. stellaris

39 Basal leaves with a long, slender petiole
14. nelsoniana

36 Sepals erect or patent, even in fruit
42 Leaves reniform or orbicular, petiolate
43 Larger leaves c. 25 mm wide, with 7-11 crenations
17. taygetea
43 Larger leaves more than 25 mm wide, with at least 15 crenations or teeth
44 Leaves with a narrow hyaline margin; petiole not broadened above 15. rotundifo
44 Leaves without hyaline margin; petiole expanded gradually into lamina
16. chrysosplenifolia
42 Leaves linear-oblong, sessile
45 Axillary buds on leafy shoots conspicuous at flowering season
46 Leaves of non-flowering shoots straight, much longer than axillary buds; lower leaves of flowering stems $c .10 \mathrm{~mm}$, patent 18. aspera
46 Leaves of non-flowering shoots incurved, scarcely longer than axillary buds; lower leaves of flowering stems c. 5 mm , suberect
19. bryoides
45 Axillary buds on leafy shoots not conspicuous at flowering season
20. bronchialis
35 Ovary semi-inferior
47 Leaves coriaceous, sessile, not lobed, usually encrusted with a calcareous secretion
48 Leaves opposite
49 Sepals ciliate
50 Upper leaves flat; inflorescence with 2 or more flowers
95. biffora
50 Upper leaves keeled; flowers solitary
93. oppositifolia
49 Sepals not ciliate
94. retusa
48 Leaves alternate or basal
51 Petals white, yellowish, or pale pink
52 Petals greenish-yellow, shorter than the sepals
108. luteoviridis
52 Petals white (rarely pale pink or pale yellow), longer than the sepals
53 Larger leaves at least 15 mm long
54 Leaves finely serrate or crenate
55 Panicle diffuse; flowers on long, slender pedicels, not crowded at the ends of the branches
118. cotyledon
55 Flowers on stout, usually short pedicels, crowded towards the ends of the panicle-branches
56 Leaves tending to curve upwards at the apex; branches of panicle 1 - to 3 -flowered
119. paniculata
56 Leaves tending to curve downwards at the apex; branches of panicle 3- to 9 -flowered
120. hostii
54 Leaves entire or slightly erose-sinuate
57 Leaves with distinct hyaline margin outside the lime-secreting glands 96. marginata
57 Leaves without hyaline margin; lime-secreting glands marginal
58 Lower branches of panicle bearing 4 or more flowers 115. callosa
58 Branches of panicle all 1 - to 3 -flowered
59 Leaves spathulate 116. cochlearis
59 Leaves linear 117. crustata
53 Leaves less than 15 mm long
60 Leaves obtuse or subacute
61 Leaves serrate in apical half 119. paniculata
61 Leaves entire in apical half
62 Upper surface of leaf irregularly pitted
114. valdensis
62 Upper surface of leaf smooth, except for marginal row of lime-secreting glands
63 Leaves glandular-hairy on lower surface 98. spruneri
63 Leaves glabrous except for marginal cilia on basal half
64 Leaves with a hyaline margin; petals $7-13 \mathrm{~mm}$
65 Leaves not more than 1.5 mm wide, parallelsided or widest below the middle
99. diapensioides
65 Leaves $1 \cdot 5-3 \mathrm{~mm}$ wide, usually widest above the middle
96. marginata

64 Leaves without hyaline margin; petals 4 6 mm
66 Leaves arcuate-recurved from near the base; upper part of flowering stems more hairy than lower part
106. caesia

66 Leaves erect in lower part, recurved only near the apex; lower part of flowering stems more hairy than upper part
107. squarrosa

60 Leaves mucronate or apiculate
67 Flowers solitary
102. burserana

67 Peduncles bearing 2 or more flowers
68 Leaves flat, glaucous-grey
69 Leaves serrate in apical half
119. paniculata

69 Leaves entire in apical half
70 Leaves $2-3 \mathrm{~mm}$, obtuse but shortly mucronate
96. marginata

70 Leaves 4-8 mm, acute 97. scardica
68 Leaves acicular, green or slightly glaucous
71 Leaves $8-11 \mathrm{~mm}$, pungent
101. vandellii

71 Leaves $3-5 \mathrm{~mm}$, with an incurved mucro
100. tombeanensis

51 Petals deep pink or purple
72 Petals longer than the sepals, conspicuous
73 Flowers solitary on short peduncles; leaves green
93. oppositifolia

73 Flowers 3 or more, in a panicle; leaves glaucousgrey
97. scardica

72 Petals about equalling the sepals, inconspicuous
74 Flowers distinctly stalked; inflorescence often branched
75 Petals 2-3 mm
113. media

75 Petals $4-5 \mathrm{~mm}$
112. stribrnyi

74 Flowers subsessile, in a simple spike
(109-111). porophylla group
47 Leaves soft, or stalked, or lobed; seldom lime-encrusted
76 Leaves all entire
77 Leaves opposite
95. biflora

77 Leaves alternate or basal
78 Petals conspicuous, larger than the sepals and usually pure white
79 Dormant axillary buds on leafy shoots conspicuous at flowering season
80 Leaves obovate, obtuse
77. erioblasta

80 Leaves linear-oblong, apiculate
73. conifera

79 Leafy shoots without conspicuous dormant, axillary summer-buds
81 Leaves glabrous except for short marginal cilia
82 Leaves obtuse
37. glabella

82 Leaves apiculate
36. tenella

81 Leaves hairy
83 Habit not cushion-like (leaves nearly all basal); leaf-hairs mostly long and eglandular
53. androsacea

83 Habit cushion-like; leaf-hairs mostly short and glandular
84 Dead leaves greyish-white towards the apex when dry 60 . muscoides
84 Dead leaves entirely brown 62. moschata
78 Petals inconspicuous, dull in colour and scarcely longer than the sepals
85 Petals acute or mucronate
86 Petals linear
58. aphylla

86 Petals ovate 57. sedoides

85 Petals obtuse or emarginate
87 Leaves at least 12 mm wide; flowering stems leafless 1. hieracifol
87 Leaves not more than 5 mm wide; some leaves present on flowering stems
88 Petals emarginate, linear-oblong 59. presolanensis
88 Petals obtuse, ovate-oblong
89 Leafy shoots very short; leaves mostly $\pm$ basal
54. seguieri

89 Stems of leafy shoots apparent; habit cushionlike
90 Dead leaves entirely brown 62. moschata
90 Dead leaves greyish-white towards the apex when dry
61. facchinii

76 Some of the leaves toothed, crenate or lobed
91 Petals white or pale pink
92 Mature leaves glabrous (though often viscid with sessile glands)
93 Leaf-segments $4-8 \mathrm{~mm}$ wide at the base 41. cuneata
93 Leaf-segments $1-3 \mathrm{~mm}$ wide at the base
94 Leaves soft; stem scarcely woody; foliage forming a flat mat 52. wahlenbergii
94 Leaves somewhat coriaceous; stems woody at the base; foliage forming a thick cushion
(42-46). pentadactylis group
92 Mature leaves hairy, at least on the margin or petiole
(hairs sometimes visible only under a strong lens)
95 Petals emarginate
96 Inflorescence compact, of 1-3 flowers 53. androsacea
96 Inflorescence diffuse, leafy, with numerous flowers
97 Lower leaves deeply dissected into lobes which are again lobed or strongly toothed 30 . petraea
97 Lower leaves dentate or crenate, or divided less than half-way to the base into entire lobes
31. berica

95 Petals acute or obtuse
98 Leaves dentate or crenate, not lobed, all in basal rosettes
99 Flowers subsessile, in a dense, capitate cyme
2. nivalis

99 Flowers distinctly stalked, in a rather lax cyme
3. tenuis

98 Leaves lobed
100 Leafy shoots very short; most of the leaves basal, $\pm$ rosulate
101 Upper surface of leaves covered with short, glandular hairs
102 Leaves 6-9 mm wide
56. depressa

102 Leaves $3-4 \mathrm{~mm}$ wide
55. italica

101 Leaves bearing long, usually eglandular hairs, mainly on the margins
53. androsacea

100 Leafy shoots fairly long, forming a cushion or mat; leaves not mostly basal
103 Hairs on leaves and calyx very short ( 0.1 mm or less), scarcely longer than the diameter of the terminal gland, and giving a finely verrucose appearance
104 Leaves $18-25 \mathrm{~mm}$ wide, with triangularovate, acute lobes; petals $9-15 \mathrm{~mm}$
47. geranioides

104 Leaves $3-15 \mathrm{~mm}$ wide, with linear-oblong, obtuse or subacute lobes; petals $4-6 \mathrm{~mm}$
105 Leaves dark green, rather coriaceous, 3(rarely 5)-lobed
50. nervosa

105 Leaves fresh green, soft, many of them 5or 7-lobed
106 Leaf-segments oblong-lanceolate, not sul-
106 Leaf-segments linear, sulcate
49. vayredana
48. moncayensis

103 Hairs, at least on petiole, 0.3 mm or longer
107 Dormant axillary buds on shoots or lower part of flowering stems conspicuous at flowering season
108 Leaf-segments mucronate or apiculate
109 Dormant summer-buds stalked, their outer scales entirely scarious 72. continentalis
109 Dormant summer-buds sessile, their outer scales partly herbaceous 71. hypnoides
108 Leaf-segments obtuse to acute
110 Leaves deeply divided ternately, the lobes narrowed at the base
111 Petals $12-15 \mathrm{~mm}$ 79. biternata
78. boissieri
110 Leaves palmately lobed, with 3-5(-7) lobes,not narrowed at the base
112 Petals $12-15 \mathrm{~mm}$74. rigoi
112 Petals $4-7 \mathrm{~mm}$
113Flowering ste$3-5 \mathrm{~cm}$, with $1-3$flowers; sepals $4 \times 3 \mathrm{~mm}$ 76. reuterana
113 Flowering stems $7-20 \mathrm{~cm}$, with usuallymore than 3 flowers; sepals $2 \times$1.5 mm75. globulifera
107 Plant without conspicuous dormant buds atflowering season
114 Leaves hairy only on lower surface
52. wahlenbergii
114 Hairs present on petiole, margin, and some-times upper surface of leaves
115 Hairs very long, arachnoid; stems weak,decumbent; petals greenish- or yellowish-white33. arachnoidea
115 Hairs not arachnoid; stems $\pm$ erect; petalsusually pure white
116 Peduncles axillary,
cumbent stems
117 Peduncles stout; leaves $10-15 \mathrm{~mm}$ wide
40. $\times$ capitata
117 Peduncles slender; leaves 4-7 mm wide
38. praetermissa
116 Peduncles terminal, or subterminal from$\pm$ erect stems
118 Aquatic; flowering stems usually morethan 30 cm118 Not aquatic; flowering stems rarelyattaining 30 cm
119 Flowering stems $10-30 \mathrm{~cm}$, branchedfrom the middle or below; inflore-scence a broad, pyramidal panicle
32. irrigua
119 Flowering stems short, or (if over 10 cm ) branched in upper part only; inflorescence a compact, often corymbose cyme
120 Petals 3 times as long as wide; sepals linear-oblong, much longer than the hypanthium 51. pedemontana
120 Petals $1 \frac{1}{2}-2 \frac{1}{2}$ times as long as wide; sepals triangular or ovate, scarcely longer than the hypanthium
121 Leaves with rather short, mostly glandular hairs
122 Leaf-segments sulcate on upper surface
123 Leaves furnished with rather short glandular hairs, sometimes rather sparsely; petals about twice as long as broad, seldom contiguous
64. exarata
123 Leaves densely covered with rather long glandular hairs; petals $\pm$ contiguous, about $1 \frac{1}{2}$ times as long as wide
124 Foliage fresh green; cauline leaves usually and rosetteleaves occasionally undivided
65. cebennensis
124 Foliage dark green; cauline leaves seldom and rosetteleaves never (on well-grown shoots) undivided 66. pubescens

## 122 Leaf-segments not sulcate

 125 Flowers $5-8 \mathrm{~mm}$ in diameter 126 Cauline leaves mostly lobed; petals contiguous 67. nevadensis> |  | 126 | $\begin{array}{c}\text { Cauline leaves mostly simple; } \\ \text { petals narrow, not contiguous } \\ \text { 62. moschata }\end{array}$ |
| :---: | :---: | :---: | :---: |

(a) Scapose perennials without bulbils; leaves all in a basal rosette; ovary semi-inferior.

1. S. hieracifolia Waldst. \& Kit., Pl. Rar. Hung. 1: 17 (1800). Stem underground, usually simple. Leaves $3-7 \mathrm{~cm}$, ovate-oblong, acute, cuneate, entire or somewhat dentate, more or less hairy on margins and beneath; petiole broad. Scape $10-40 \mathrm{~cm}$, densely glandular-pubescent, bearing a narrow, congested panicle of numerous subsessile flowers; bracts rather large and leaf-like. Sepals deflexed in fruit; petals $1.5-3 \mathrm{~mm}$, ovate-oblong, about equalling sepals, greenish tinged with purple-red. $2 n=112,120$. Damp rocks or moraines, or by mountain streams. Arctic Europe; W. \& C. Carpathians; very locally in mountains elsewhere (Norway, Ural, Steiermark, Auvergne). Au Cz Ga No Po Rs (N) Sb.
2. S. nivalis L., Sp. Pl. 401 (1753). Rhizome often branched, with several leaf-rosettes. Leaves $15-35 \mathrm{~mm}$, ovate-oblong to rhombic, crenate or bluntly dentate, hairy on margins only, often dark red beneath; petiole broad, usually short. Scape $5-20 \mathrm{~cm}$, densely glandular-pubescent, with some longer, white, crisped hairs; inflorescence a small, often capitate, congested panicle of almost sessile flowers; bracts small. Sepals erect; petals $c .3 \mathrm{~mm}$, suborbicular, somewhat exceeding sepals, white or pink. $2 n=60$. Arctic and subarctic Europe; very locally in mountains elsewhere. $\mathrm{Br} \mathrm{CzFaFe} \mathrm{Hb} \mathrm{Is} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(N)} \mathrm{Sb} \mathrm{Su}$.
3. S. tenuis (Wahlenb.) H. Smith ex Lindman, Syensk Fanerogamfl. 300 (1918). Very like 2 but scape slenderer, less densely pubescent, and without the longer hairs; bracts somewhat larger;
and flowers distinctly pedicellate, in a lax, subcorymbose cyme. $2 n=20$. Arctic and subarctic Europe. Fa Fe Is No Rs (N) Sb Su.
(b) Perennials without underground bulbils; ovary superior.
4. S. clusii Gouan, Obs. Bot. 28 (1773). Stem very short. Leaves $6-15 \mathrm{~cm}$, suberect or spreading, in a lax rosette, obovatecuneate, coarsely and irregularly dentate, with rather numerous long, eglandular hairs; petiole broad but distinct. Flowering stems $12-30 \mathrm{~cm}$, fragile, divaricately branched from the middle or below, to give a broad, diffuse panicle of numerous flowers; lower bracts usually large and leaf-like. Sepals deflexed; petals unequal (the 3 longer with a conspicuous claw), white with two yellow spots. Damp, shady rocks and by mountain streams. - S.W. Europe. Ga Hs Lu.
(a) Subsp. clusii: Not viviparous. Cevennes, Pyrenees, N. Spain.
(b) Subsp. lepismigena (Planellas) D. A. Webb, Feddes Repert. 68: 199 (1963) (S. lepismigena Planellas): Viviparous, with many of the flowers replaced by leafy buds. N. Portugal and N.W. Spain.

Intermediates, with the leafy buds few and inconstant, are found in N. Spain (Asturias).
5. S. stellaris L., Sp. Pl. 400 (1753). Densely or laxly caespitose; stem horizontal, usually short. Leaves usually in rosettes, obovate or somewhat spathulate, tapered to the base but scarcely with distinct petiole, hispid, slightly fleshy but not coriaceous. Flowering stems $4-20 \mathrm{~cm}$, leafless, not fragile, branched in upper part, with usually suberect branches, giving a lax but fairly narrow panicle; bracts small. Sepals deflexed; petals $3-7 \mathrm{~mm}$, lanceolate, occasionally unequal as in 4 , white with two yellow spots; anthers pink. $2 n=28$. By mountain streams and other damp places. In all the major mountain-ranges of Europe, and at low altitudes in the extreme north. ? Al Au Br Bu Co Cz Fa Fe Ga Ge Gr Hb He Hs Is It Ju Lu No Po Rm Rs (N, W) Su.

Very variable in habit. Two rather ill-defined subspecies may be recognized, but transitional forms are found in the Carpathians and elsewhere.
(a) Subsp. stellaris: Densely caespitose, with few rosettes; leaves rather hairy; petals $5-7 \mathrm{~mm}$; pedicel not more than twice as long as capsule. N. Europe.
(b) Subsp. alpigena Temesy, Phyton (Austria) 7: 40 (1957): Laxly caespitose, with more numerous rosettes and with creeping, sometimes leafy stems; leaves almost glabrous, usually smaller; petals $3-5 \mathrm{~mm}$; pedicel more than twice as long as capsule. Mountains of C. \& S. Europe, from the Vosges and the Carpathians to S. Spain, N. Appennini and N. Greece.

In both subspecies viviparous plants are known, in which many of the flowers are replaced by leafy buds; these are, however, less fleshy and bulbil-like than in 6, and are dispersed throughout the lax panicle. Such plants are known from E. Austria \& Slovenija, W. Ireland, and possibly elsewhere.
6. S. foliolosa R.Br. in Parry, Jour. Voy. N.W. Pass. (Suppl. App.) 275 (1824). Like smaller forms of 5, but rosettes usually solitary; leaves rather narrower, glabrous except at the margins; and inflorescence narrow, with few, rather short branches bearing usually a single, terminal flower (sometimes several or none), the remaining flowers being replaced by small, reddish bulbils with fleshy, incurved leaves, densely crowded towards the ends of the panicle branches. $2 n=56$. Arctic and subarctic Europe. Fe Is No Rs (N) Sb Su.
7. S. cuneifolia L., Sp. Pl. ed. 2, 574 (1763). Laxly caespitose, with procumbent stems bearing small rosettes of glabrous, rather
fleshy and coriaceous, orbicular-spathulate leaves, entire or bluntly toothed in upper half, tapered gradually to a broad, sparsely ciliate petiole. Peduncles 15 cm , glandular-pubescent, slender, leafless. Flowers in a small panicle; sepals deflexed; petals $2 \cdot 5-4 \mathrm{~mm}$; styles very short, erect. $2 n=28$. Woods and shady rocks, mostly from 800 to 1700 m . - Pyrenees and N . Spain; Cevennes; Alps; N. Appennini; E. Carpathians; N.W. Jugoslavia. Au Ga He Hs It Ju Rm.
(8-13). S. umbrosa group. Laxly or somewhat densely caespitose, with short, procumbent stems bearing leaves mainly in basal rosettes; peduncles leafless. Leaves often somewhat fleshy and coriaceous, petiolate, reniform to obovate-cuneate, dentate or crenate. Flowers rather numerous, in a fairly lax panicle. Sepals deflexed; petals c. 4 mm , white, with two yellow and usually several deep red spots; anthers and ovary pink.

The three species comprised in this group are not difficult to distinguish, but the situation is confused by their hybrids, which are common in nature and widely diffused from garden culture. Secondary hybrids certainly occur, and introgressive hybridization has taken place in several areas.
1 Petiole subcylindrical, not much wider than thick; leaves hairy on both surfaces 10. hirsuta
1 Petiole distinctly flattened; leaves usually glabrous at least on lower surface
2 Petiole densely ciliate but glabrous on upper surface, usually shorter than the oblong, slightly crenate lamina 9. umbrosa
2 Petiole rather sparsely hairy, usually at least as long as the lamina
3 Lamina sharply dentate; petiole very sparsely ciliate, glabrous on upper surface 8. spathularis
3 Lamina crenate or obtusely dentate; petiole rather densely ciliate, or with some hairs on upper surface
4 Leaves rather deeply dentate or crenate, without conspicuous cartilaginous margin 11. $\times$ polita
4 Teeth or crenations broad and low; cartilaginous margin conspicuous
5 Petiole narrow, considerably longer than lamina; lamina sometimes slightly hairy $\quad$ 12. $\times$ geum
5 Petiole very broad, only slightly longer than the glabrous lamina
13. $\times$ urbium
8. S. spathularis Brot., Fl. Lusit. 2: 172 (1804). Rather laxly caespitose; leaves rather coriaceous, erecto-patent, orbicular, spathulate or obovate-cuneate, coarsely dentate; petiole broad and flat, longer than lamina, very sparsely ciliate. Petals with numerous red spots; ovary large; styles divergent. $2 n=28$. - N. Portugal and N.W. Spain; Ireland. Hb Hs Lu.
9. S. umbrosa L., Sp. Pl. ed. 2, 574 (1762). Densely caespitose, with flat rosettes. Leaves rather coriaceous, patent, obovateoblong, with broad, rather low crenations and a conspicuous cartilaginous border; petiole broad and flat, scarcely as long as lamina, densely ciliate. Petals with numerous red spots; ovary rather small; styles suberect. $2 n=28$. - W. \& C. Pyrenees. $\mathrm{GaHs}[\mathrm{Br}$ ? It$]$.
10. S. hirsuta L., Syst. Nat. ed. 10, 2: 1026 (1759) (S. geum auct.). Laxly caespitose; leaves scarcely coriaceous, reniform, orbicular or ovate-oblong, crenate or rarely serrate-dentate, usually hispid on both surfaces, often red beneath; petiole narrow, hairy. Petals usually with few, rather weak red spots; ovary pale pink. $2 n=28$. Pyrenees and N. Spain; S.W. Ireland; occasionally naturalized elsewhere. Ga Hb Hs [ Au Br ? It$]$.
(a) Subsp. hirsuta: Lamina reniform or orbicular, cordate, much shorter than petiole, with 17-25 crenations or teeth. Shady places, or by mountain streams. Throughout the range of the species.
(b) Subsp. paucicrenata (Gillot) D. A. Webb, Feddes Repert. 68: 201 (1963): Leaves $10-30 \mathrm{~mm}$, oblong-elliptical, with only 7-11 crenations; petiole equalling or shorter than lamina. $2 n=28$. Exposed limestone rocks and screes. W. Pyrenees \& N. Spain.

A dwarf, very distinct ecotype, but connected to subsp. hirsuta by intermediates.
11. S. $\times$ polita (Haw.) Link, Enum. Hort. Berol. Alt. 1:414(1821) ( $S$. hirsuta $\times$ spathularis). Leaves usually suborbicular to broadly obovate, slightly hairy; petiole moderately narrow, rather hairy. $2 n=28$. Common wherever the parent species grow together, and grading imperceptibly into both species. - N. Spain and W. Ireland (including districts in Ireland where S . hirsuta does not now exist). Hb Hs .
12. S. $\times$ geum L., Sp. Pl. 401 (1753) (S. hirsuta $\times$ umbrosa) . Intermediate between the parents and variable, but usually with the lamina nearer that of $S$. umbrosa (broadly oblong, with low crenations and a conspicuous cartilaginous border) and the petiole nearer that of S. hirsuta (long, hairy, and fairly narrow). $2 n=28$. - Occasional, with the parents, in the Pyrenees; widely cultivated and naturalized in many places in W.\&C. Europe. Ga Hs [ $\mathrm{Au} \mathrm{Be} \mathrm{Ga} \mathrm{Ge} \mathrm{It]}$.
13. S. $\times$ urbium D. A. Webb, Feddes Repert. 68: 199 (1963) (S. spathularis $\times$ umbrosa). Exactly intermediate between the parents; usually sterile and therefore constant, but fertile forms are known. Unknown in nature, as the parent species are allopatric, it is of obscure garden origin, widely cultivated in Britain and Ireland, less often elsewhere. $2 n=28$. Naturalized in Britain, Ireland and France. [ Br Ga Hb .]
14. S. nelsoniana D. Don, Trans. Linn. Soc. 13: 355 (1821) ( $S$. punctata auct., non L.). Rhizome underground; leaves all basal, reniform, coarsely crenate, slightly fleshy, subglabrous; petiole long. Flowering stems $20-40 \mathrm{~cm}$, glandular-hairy above, bearing a usually lax panicle of small flowers. Sepals deflexed; petals 3 mm , oblong, white or pale pink. Stamens often partly replaced by petaloid staminodes. N.E. Russia. Rs (N). (N. Asia and N.W. America.)

The European plant belongs to subsp. aestivalis (Fischer \& C. A. Meyer) D. A. Webb, Feddes Repert. 69: 12 (1964).
15. S. rotundifolia L., Sp. Pl. 403 (1753) (incl. S. heucherifolia Griseb. \& Schenk). Stem short, rhizomatous, bearing lax rosettes of reniform-orbicular, crenate or coarsely serrate leaves, usually somewhat hairy, with a very narrow but distinct cartilaginous border. Petiole long, slender, not enlarged at top. Flowering stems $15-40 \mathrm{~cm}$, rather stout, with a few dentate or slightly lobed cauline leaves and a rather narrow panicle of numerous flowers. Sepals erecto-patent, even in fruit; petals $6-11 \mathrm{~mm}$, narrowly oblong, with a distinct claw, white, usually spotted with yellow at the base and with red higher up. Styles very short, divergent. $2 n=22$. Damp or shady places in or near the mountains of $C . \& S$. Europe. Al Au Bu Co Cr Cz Ga Ge Gr He Hs It Ju Rm Sa Si [Be].

Variable in size, hairiness and leaf-shape. The supposedly distinctive characters of S. heucherifolia Griseb. \& Schenk, Acrh. Naturgesch. (Berlin), 18:317 (1852), from the E. Carpathians and Balkan peninsula (cauline leaves regularly dentate, not lobed; petals more than 9 mm ), are scarcely constant enough for it to be recognized even as a subspecies.
16. S. chrysosplenifolia Boiss., Diagn. Pl. Or. Nov. 1 (3): 20 (1843). Very like 15, but without a cartilaginous border to the leaves, and with the lamina of the basal leaves decurrent along the petiole, which is broadened at the top. $2 n=22$. - S. part of Balkan peninsula and Aegean region. Al Bu Cr Gr Ju.
17. S. taygetea Boiss. \& Heldr. in Boiss., Diagn. Pl. Or. Nov. 2 (10): 19 (1849). Like 15, but smaller (stem seldom 20 cm ); basal leaves $15-25 \mathrm{~mm}$ wide, with $5-9$ broad, shallow crenations, or rarely somewhat 5-lobed; cauline leaves few and small; petals c. 8 mm , narrowly oblong, white, spotted with red towards the base. Exposed mountain rocks. - Albania and Greece; ?S. Italy (Monte Sirino). Al Gr ?It.
18. S. aspera L., Sp. Pl. 402 (1753). Leafy shoots long, procumbent, forming a loose mat; leaves patent, oblong-lanceolate, aristate, glabrous except for stiff marginal cilia; axillary buds conspicuous but considerably shorter than leaves. Flowering stems $8-20 \mathrm{~cm}$, erect, nearly glabrous, with 2-5 (rarely more) flowers in a lax cyme; lower cauline leaves $c .10 \mathrm{~mm}$, patent. Petals $5-8 \mathrm{~mm}$, with a very short but distinct claw, white or cream-coloured, yellow towards the base and sometimes with red spots. $2 n=c .26$. Rocks and stony places, mostly from 1500 to 2200 m ; somewhat calcifuge. - Alps; N. Appennini; E. \& C. Pyrenees. Au Ga He Hs It.
19. S. bryoides L., Sp. Pl. 400 (1753). Rather like 18, but with shorter and much more densely matted leafy shoots, bearing smaller, incurved leaves with axillary buds as long as the leaves; and flowers solitary, on stems $3-8 \mathrm{~cm}$, with lower leaves $c .5 \mathrm{~mm}$, suberect. $2 n=26$. More strictly calcifuge than 18, and usually at a greater altitude. Mountains of Europe, from Auvergne and the Carpathians to the Pyrenees, S. Alps and Bulgaria. Au $\mathrm{Bu} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{It} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.
20. S. bronchialis L., Sp. Pl. 400 (1753) (incl. S. spinulosa Adams). Leafy shoots procumbent or decumbent, forming a dense mat or low cushion. Leaves $8-15 \mathrm{~mm}$, loosely imbricate, linear-subulate to oblong-lanceolate, mucronate, shortly ciliate, without conspicuous axillary buds. Flowering stems $6-15 \mathrm{~cm}$, nearly glabrous, bearing several flowers in a corymbose cyme. Petals 3-6 mm, elliptical, without claw, pale yellow with red spots in upper half. N. Ural. Rs (N). (N. Asia; North America.)
21. S. flagellaris Sternb. \& Willd. in Sternb., Revis. Saxifr. 25 (1810). Stem $5-20 \mathrm{~cm}$, erect, emitting from its base filiform, epigeal stolons up to 15 cm long, each terminating in a leaf-rosette. Leaves mainly in a basal rosette, oblong-lanceolate, sessile, the upper densely, the lower sparsely glandular-hairy. Flowers few, pedicellate, in a lax cyme. Sepals suberect; petals $7-9 \mathrm{~mm}$, obovate-oblong, bright yellow, without basal callosities; ovary tending towards semi-inferior. $2 n=32$. Spitsbergen; Vajgač. Rs (N) Sb.

The European plant, whose distribution is circumpolar-arctic, has been separated as S. platysepala (Trautv.) Tolm., Not. Syst. (Leningrad) 19: 172 (1959). On this interpretation S. flagellaris sensu stricto is confined to Asia, from the Caucasus to the Behring Straits. Other plants of the same complex occur in the Himalaya.
22. S. hirculus L., Sp. Pl. 402 (1753). Laxly caespitose or shortly stoloniferous. Leaves $10-25 \mathrm{~mm}$, lanceolate, obtuse, tapered to a long, sheathing petiole, hairy, especially towards the base, with long, red-brown hairs. Stem $20-35 \mathrm{~cm}$, erect, leafy below, with a single flower or 2-4 in a loose corymb. Sepals deflexed in fruit. Petals $12-15 \mathrm{~mm}$, bright yellow, sometimes with red spots, and with two prominent callosities near the base. $2 n=32$. Bogs and other wet places. N., E. \& C. Europe, rapidly becoming rarer in the western and southern parts of its range. Au $\mathrm{BrCzDaFe} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{He} \dagger$ Ho Is No Po Rm Rs (N, B, C, W, E) Su .
(c) Delicate annuals with small flowers in diffuse, leafy cymes; ovary superior.
23. S. hederacea L., Sp. Pl. 405 (1753). Stems ascending or decumbent. Leaves mainly basal, reniform to ovate, petiolate, crenate or slightly lobed, sparingly glandular-hairy. Flowers solitary on filiform pedicels; sepals erect or patent; petals 3 mm , white. Damp or shady rocks. E. Mediterranean region, westwards to Sicilia. Cr Gr Ju Si.
24. S. cymbalaria L., Sp. PI. 405 (1753). Stems weak, sometimes decumbent, slightly hairy below. Leaves glabrous, somewhat fleshy, shining, reniform or orbicular, petiolate, with 7-9 triangular, subacute teeth. Flowers axillary, pedicellate; sepals patent; petals 5 mm , yellow. Romania ( $E$. Carpathians, near Васău). Rm. (S.W. Asia, N. Africa.)

The plant from Romania belongs to subsp. cymbalaria. Subsp. huetiana (Boiss.) Engler \& Irmscher, Pflanzenreich 67 (IV. 117): 203 (1916), which has smaller flowers and bluntly crenate or subentire leaves and is native to S.W. Asia, is often cultivated and is locally naturalized in parts of Europe. It has $2 n=18$.
25. S. sibthorpii Boiss., Diagn. Pl. Or. Nov. 1 (3): 22 (1843). Stems decumbent, glabrous or with a few glandular hairs. Leaves fleshy, shining, reniform, broadly crenate, stalked. Flowers axillary, pedicellate, often deflexed in fruit. Sepals deflexed; petals $5-7 \mathrm{~mm}$, orange-yellow. Damp or shady rocks above 1500 m. Greece. Gr.
(d) Annuals or biennials with semi-inferior ovary.
26. S. latepetiolata Willk. in Willk. \& Lange, Prodr. Fl. Hisp. 3: 120 (1874). Biennial, forming first a very convex rosette of recurved leaves, from which arises in the second year a broad, lax, leafy panicle $15-30 \mathrm{~cm}$ high, branched from the base. Stem and petioles reddish; plant densely glandular-hairy throughout. Leaves up to 25 mm wide, reniform in outline, divided about halfway to the base into obtuse, cuneate, entire or crenate lobes, which are broadest near their apex; petiole long and broad. Flowers numerous, somewhat campanulate; petals $8-9 \mathrm{~mm}$, narrowly obovate, white. $2 n=c .66$. Limestone rocks. $\quad$. Spain. Hs.
27. S. tridactylites L., Sp. Pl. 404 (1753). A slender annual, usually somewhat glandular-hairy; stem up to 20 cm but often only $3-8 \mathrm{~cm}$, branched except in depauperate plants. Basal leaves spathulate, entire, very small, not forming a rosette and withered at flowering time; cauline leaves cuneate, usually divided distally into 3 triangular-oblong lobes. Flowers in a lax, somewhat leafy cyme or panicle; pedicels much longer than flowers or fruits. Petals $2 \mathbf{- 3} \mathrm{~mm}$, emarginate, white, about twice as long as the sepals. Capsule subglobose, with a rounded or truncate base. Seeds coarsely papillose. $2 n=22$. Somewhat calcicole. Europe, except the extreme north and C. \& E. Russia. All except Az Fa Is $\mathrm{Rs}(\mathrm{N}, \mathrm{E}) \mathrm{Sb}$.
28. S. osloensis Knaben, Nytt Mag. Bot. 3: 118 (1954). A natural amphidiploid hybrid between 27 and 29, resembling 27 in its usually annual habit, long pedicels and coarsely papillose seeds, but closer to 29 in shape of leaves and capsule and in size of petals. $2 n=44$. Sweden and E. Norway. No Su.
29. S. adscendens L., Sp. Pl. 405 (1753) (S. controversa Sternb.). Biennial. Stem up to 25 cm , branched or almost simple. Basal leaves forming a compact rosette which persists till flowering season, sessile, cuneate, with 2-5 broad, short, triangular teeth near the apex. Cauline leaves similar. Pedicels not more than twice as long as the flowers, often shorter. Petals $3-5 \mathrm{~mm}$,
emarginate, white (rarely yellowish). Seeds very finely tuberculate. Scattered through a large part of Europe, mainly in the mountains; absent from the west (except the Pyrenees) and most of the islands. Al Au Bu Cz Fe Ga Gr He Hs It Ju No Po Rm Rs (N, B, W) Si Su.

Distinct and fairly constant in N. \& C. Europe, but in the Carpathians and Balkan peninsula aberrant variants are found, some of which come very close to 27 . Three subspecies may be recognized, but they cannot be very clearly defined.
1 Petals c. 5 mm , at least 3 times as long as sepals (c) subsp. blavii
1 Petals $3-4 \mathrm{~mm}, 2-2 \frac{1}{2}$ times as long as sepals
2 Capsule pyriform or obovoid, tapered at the base
(a) subsp. adscendens

## 2 Capsule subglobose, rounded at the base <br> (b) subsp. parnassica

(a) Subsp. adscendens: Usually robust, with leaves up to 25 mm . Petals c. $2 \frac{1}{2}$ times as long as the sepals. Capsule tapered to a fairly narrow base. $2 n=22$. Throughout the range of the species except the extreme south.
(b) Subsp. parnassica (Boiss. \& Heldr.) Hayek, Prodr. Fl. Penins. Balcan. 1: 638 (1925). Rather smaller ( $10-15 \mathrm{~cm}$ ), with smaller leaves. Petals twice as long as sepals. Capsule as in 27. - S. part of Balkan peninsula; S. \& C. Italy; Sicilia.
(c) Subsp. blavii (Engler) Hayek, loc. cit. (1925): Fairly tall, and usually very freely branched, forming a pyramidal panicle. Petals at least three times as long as the sepals. Capsule as in 27. - N.W. part of Balkan peninsula, from Bosna to N. Albania.
30. S. petraea L., Sp. Pl. ed. 2, 578 (1762). Biennial, perhaps rarely perennial, covered with soft, glandular hairs. Leaves of basal rosette petiolate, semicircular or rhombic in outline, divided almost to the base into numerous toothed lobes; cauline leaves much less deeply divided. Stems $10-20 \mathrm{~cm}$, weak, often decumbent, with numerous, long, divaricate, interwoven branches, forming a very lax, wide, leafy panicle. Petals $8-10 \mathrm{~mm}$, contiguous, sometimes slightly unequal, emarginate, white. Seeds papillose. Shady rocks; calcicole. Southern foothills of the E. Alps. It Ju.
(e) Evergreen perennials without underground bulbils; leaves seldom lime-encrusted; hydathodes only at apices of leafsegments (or absent); ovary semi-inferior.
31. S. berica (Béguinot) D. A. Webb, Feddes Repert. 68: 202 (1963) (S. petraea, var. berica Béguinot). Like 30 in general appearance, but regularly perennial; hairs shorter; basal leaves regularly crenate or dentate, or divided less than half-way to the base into 5-11 entire lobes; leaves often tinged with brown; petals $4-8 \mathrm{~mm}$, not contiguous, usually very unequal; seeds smooth. Shady recesses in limestone rocks. - N. Italy (Colli Berici, near Vicenza). It.
32. S. irrigua Bieb., Fl. Taur.-Cauc. 2: 460 (1808). Leafy shoots few, forming a dense tuft. Leaves up to 40 mm wide, with usually numerous, rather long hairs, 3-lobed almost to the base, the lobes again divided, giving 9-25 elliptical, oblong or triangular, subacute segments. Petiole long and broad. Flowering stem $10-30 \mathrm{~cm}$, usually branched in upper half only, bearing a panicle of numerous flowers. Sepals $4-5 \mathrm{~mm}$, linear-oblong; petals $11-14 \mathrm{~mm}$, oblanceolate, white. $2 n=44$. Damp or shady places in the mountains. - Krym. Rs (K).
33. S. arachnoidea Sternb., Revis. Saxifr. 22(1810). Stems weak, decumbent; whole plant covered with an intricate tomentum of long, viscid, arachnoid hairs. Leaves rhombic or ovate-cuneate, very variable, mostly palmately 3- to 7-lobed; lobes obtuse. Flowers on long pedicels in small terminal cymes; petals 3 mm ,
greenish-white or straw-coloured, slightly exceeding the sepals. $2 n=56$. Caverns in limestone rocks. - S. Alps (a small region N.W. of Lago di Garda). It.
34. S. paradoxa Sternb., Revis. Saxifr. 22 (1810) (Zahlbrucknera paradoxa (Sternb.) Reichenb.). Nearly glabrous, with fragile, ascending or decumbent stems. Leaves reniform, palmately lobed or crenate, petiolate, shining, thin. Flowers in small, lax, axillary cymes. Petals linear-oblong, pale green, similar to the sepals but slightly smaller. Ovary largely inferior. Shady recesses in non-calcareous rocks. - Foothills of S.E. Alps (Kärnten, Steiermark, Slovenija). Au Ju.
35. S. aizoides L., Sp. Pl. 403 (1753). Laxly caespitose, with leafy, ascending flowering stems up to 25 cm , but often much less; non-flowering shoots much shorter. Leaves $10-25 \times 2-4 \mathrm{~mm}$, linear-oblong, sessile, entire or with a few marginal teeth, acute, glabrous, or ciliate in lower half, fleshy. Flowers in a terminal, somewhat leafy cyme. Petals $3-6 \mathrm{~mm}$, not contiguous, bright yellow or orange, often spotted with red, rarely dark red all over. $2 n=26$. Usually in damp places. Arctic and subarctic Europe, and through the mountains of N. \& C. Europe southwards to the Pyrenees, C. Italy, Albania and the S. Carpathians. Al Au Br Cz Fe Ga Ge Hb He Hs Is It No Po Rm Rs (N, W) Sb Su.
36. S. tenella Wulfen in Jacq., Collect. Bot. 3: 144 (1790). Leafy shoots $5-10 \mathrm{~cm}$, procumbent, forming a rather dense mat. Leaves $10 \times 1-2 \mathrm{~mm}$, linear-subulate, aristate, with a narrow hyaline margin, usually ciliate, especially near the base. Flowering stems $5-15 \mathrm{~cm}$, erect, slender, glabrous, with 2-8 flowers. Petals 3 mm , creamy-white, obovate. Shady rocks and screes; calcicole. - S.E. Alps. Au It Ju.
37. S. glabella Bertol., Gior. Arcad. Sci. (Roma) 21: 192 bis (1824). Shoots short, decumbent, laxly caespitose. Leaves 8 mm , glabrous, narrowly spathulate, entire, obtuse. Flowering stems $3-10 \mathrm{~cm}$, with several flowers in a corymbose panicle. Sepals glabrous. Petals 2.5 mm , obovate-orbicular, white. Balkan peninsula; C. Appennini. Al Gr It Ju.
38. S. praetermissa D. A. Webb, Feddes Repert. 68: 204 (1963) (S. ajugifolia auct., non L.). Stems procumbent, forming a lax mat or low cushion, clothed with persistent dead leaves, terminating in decumbent leafy shoots of $3-6 \mathrm{~cm}$ and bearing, near the base of the latter, erect, slender, axillary flowering stems 612 cm , with 1-3 flowers and a few very small and usually entire leaves. Leaves of decumbent leafy shoots up to $15 \times 10 \mathrm{~mm}$ (including petiole), sparsely hairy; lamina obovate-cuneate to semi-circular in outline, rather deeply 3 - to 5 -lobed; segments oblong, acute or mucronate. Petals $4-5 \mathrm{~mm}$, oblong-elliptical, white. $2 n=44$. Snow-patches and damp or shady screes above 1500 m . - Pyrenees; Cordillera Cantábrica. Ga Hs.
39. S. aquatica Lapeyr., Fig. Fl. Pyr. 53 (1801) (S. adscendens auct., non L.). Leafy shoots ascending, laxly caespitose, forming large, deep cushions of foliage. Leaves up to 4 cm wide, shining, somewhat fleshy, rather sparsely hairy, semicircular in outline, deeply divided into numerous acute, triangular segments; petiole up to 5 cm . Flowering stems $25-60 \mathrm{~cm}$, erect, stout ( $3-4 \mathrm{~mm}$ in diameter), bearing numerous sessile, deeply divided leaves and a narrow panicle of numerous flowers. Petals $6-9 \mathrm{~mm}$, obovateoblong, white. $2 n=28,66$. Margins of streams above 1500 m . - E. \& C. Pyrenees. Ga Hs.
40. S. $\times$ capitata Lapeyr., op. cit. 55 (1801) (S. aquatica $\times$ praetermissa). Somewhat variable; intermediate between the parent species in most respects, but tending to resemble 39 more
closely. Leaves $12-20 \mathrm{~mm}$ wide, usually rhombic in outline, mostly 5 - to 7 -lobed. Flowering stems $15-25 \mathrm{~cm}$, sometimes few; cauline leaves lobed, but smaller than those of leafy shoots. Panicle lax, often nodding, with $7-25$ flowers. Petals $6-7 \mathrm{~mm}$. - Margins of mountain streams; frequent wherever the parent species grow together, and sometimes found in the vicinity of one parent only. Ga Hs.
41. S. cuneata Willd., Sp. Pl. 2 (1): 658 (1799). Similar in habit to 42-46, but easily distinguished by its characteristic leaf-shape. Glabrous, except for a very few hairs on leaf-margins. Leaves $15-30 \mathrm{~mm}$ long and wide, coriaceous, shining, somewhat viscid with sessile glands, broadly cuneate, petiolate, divided for about $\frac{1}{3}$ the distance to the base into $3-5$ broadly triangular-ovate, obtuse or mucronate lobes. Flowering stems $10-15 \mathrm{~cm}$; petals $6-7 \mathrm{~mm}$, white. Shady rocks, screes and walls; calcicole. $2 n=28$. - W. Pyrenees and N. Spain, westwards to $4^{\circ} 30^{\prime} W$. Ga Hs.
(42-46). S. pentadactylis group. Stems somewhat woody. Leafy shoots laxly caespitose, forming rounded cushions of foliage. Plant entirely glabrous, except sometimes for young leaves on rapidly growing shoots or on seedlings; leaves, pedicels and calyx bearing numerous sessile glands and usually more or less viscid. Leaves coriaceous, persistent when dead, palmately or pedately divided or lobed. Peduncles terminal or axillary, bearing a few leaves and a terminal, fairly compact, usually corymbose cyme. Petals white.
A confusing group, distributed through most of Spain and extending to the E. Pyrenees and Corbieres in France. The form of the leaves varies widely, but specific limits are hard to define, owing partly to the distinctive appearance acquired by each separate population in an isolated mountain-range, and partly, it would appear, to convergent evolution. The group is sharply distinguished from all other species of similar habit, except 41, by the complete absence of hairs from normal adult plants.
1 All leaf-segments obtuse, subacute or very slightly mucronate
2 Leaf-segments $1-1 \cdot 5(-2 \cdot 5) \mathrm{mm}$ wide, linear or oblong, parallelsided, sulcate; plant calcifuge
42. pentadactylis

2 Leaf-segments more than 2.5 mm wide, usually with curved margins, not sulcate; plant calcicole 43. corbariensis
1 At least some of the leaf-segments apiculate or conspicuously mucronate
3 Larger leaves 15 - to 25 -fid; segments sometimes falcate, often crowded, overlapping and somewhat crisped 45. trifurcata
3 Larger leaves 7 - to 11 -fid; segments not crowded, seldom overlapping, all in one plane
4 Leaves very viscid in spring and summer; segments linear, 3-6 times as long as wide 46. canaliculata
4 Leaves only slightly viscid; segments oblong or elliptical, $1 \frac{1}{2}$ to $2 \frac{1}{2}$ times as long as wide
44. camposii
42. S. pentadactylis Lapeyr., Fig. Fl. Pyr. 64 (1801). Leaves only slightly viscid, deeply 3 - to 5 -lobed; median lobe $5-12 \mathrm{~mm}$, linear, obtuse, undivided; all segments sulcate. Flowering stems $6-20 \mathrm{~cm}$. Petals $c .4 \mathrm{~mm}$, broadly obovate-oblong, contiguous. Distinct in its small flowers and narrow, sulcate leaf-segments. Rocks and screes, usually above 1800 m ; calcifuge. Pyrenees, and mountains of C. and N.C. Spain. Ga Hs.

Specimens from the Sierra de Gredos and Sierra de Guadarrama, which constitute var. willkommiana (Boiss. ex Leresche \& Levier) Engler \& Irmscher, differ from the Pyrenean specimens in their more robust habit, lighter green, softer, more viscid and less conspicuously sulcate leaves, with broader segments and petiole; they show some approach to 43 (b) and perhaps deserve subspecific status.
S. losana Sennen, Butll. Inst. Catalana Hist. Nat. 32: 113 (1932), a little-known plant from N. Spain (provinces of Alava and Logroño), resembles 42 in its obtuse leaf-segments with sessile glands; but in habit and leaf-shape (leaves 3 -fid with short segments and broad petiole) it is more like 50.
43. S. corbariensis Timb.-Lagr., Mém. Acad. Toulouse ser. 7, 7: 469 (1875). Leaves 12-35 mm wide, scarcely viscid, deeply 3-lobed, the lobes usually further divided so as to give 5-11 triangular, elliptical or oblong segments, which are obtuse, subacute or rarely slightly mucronate, not sulcate. Flowering stems $6-25 \mathrm{~cm}$. Petals $7-13 \mathrm{~mm}$. Limestone rocks and screes, usually shaded. - E. Spain; S. France (Corbières). Ga Hs.

The populations from the northern and southern ends of the range are very different, and are best distinguished as subspecies, but intermediate plants are found in the central part (between $40^{\circ} 30^{\prime}$ and $42^{\circ} \mathrm{N}$.) and a sharp separation is not possible. It is to such intermediates that the name S. paniculata Cav., non Miller, is usually given.
(a) Subsp. corbariensis: Leaves usually at least 18 mm wide, with 7-11 segments; median lobe of larger leaves lobed or boldly 3-toothed. Flowering stems $10-25 \mathrm{~cm}$; petals $10-13 \mathrm{~mm}$, oblanceolate; stamens much longer than sepals. $2 n=60-66$. Corbières and mountains of N.E. Spain.
(b) Subsp. valentina (Willk.) D. A. Webb, Feddes Repert. 68: 205 (1963) (S. valentina Willk.): Leaves $12-25 \mathrm{~mm}$ wide, with usually 5 , rarely $7-11$ segments; median lobe usually entire. Flowering stems $6-15 \mathrm{~cm}$; petals $7-10 \mathrm{~mm}$, obovate-elliptic; stamens scarcely exceeding sepals. $2 n=64$. E. Spain, from $C$. Teruel to E. Jaén.
44. S. camposii Boiss. \& Reuter, Pugillus 47 (1852). Leaves $12-25 \times 4-10 \mathrm{~mm}$ (including petiole), slightly viscid, with 5-11 oblong, usually apiculate segments, not more than $2 \frac{1}{2}$ times as long as wide, not crowded and seldom overlapping. Flowering stems $6-15 \mathrm{~cm}$. Petals $8-11 \mathrm{~mm}$, narrowly obovate. Limestone rocks. - Mountains of S.E. Spain from near Ronda to the Sierra de Alcaraz. Hs.
(a) Subsp. camposii: Lamina cuneate, considerably longer than wide, usually 5 -lobed, tapered gradually to a broad petiole. Throughout the range of the species.
(b) Subsp. leptophylla (Willk.) D. A. Webb, Feddes Repert. 68: 204 (1963): Lamina semicircular, wider than long, usually 7- to 11-lobed, contracted abruptly to a narrower petiole. Sierra de Segura and adjoining ranges.

Some plants of subsp. (b) approach 45, but the segments lie in one plane and seldom overlap. Specimens from the Sierra de Jabalcon near Baza ( $2 n=64$ ) are somewhat intermediate between the two subspecies, and have many of the leaf-segments obtuse. Specimens from the Sierra de Maria approach 43 (b).
45. S. trifurcata Schrader, Hort. Gotting. 13 (1809). Leaves 10-20(-30) mm wide; lamina reniform or semicircular in outline, divided into numerous triangular, apiculate segments (seldom less than 15 on the larger leaves) of which the lateral ones are often falcate-recurved, and which are often crowded and overlapping so as to give the leaf a crisped appearance. Flowering stems $8-30 \mathrm{~cm}$. Petals $8-10 \mathrm{~mm}$, elliptic-oblong. $2 n=28$. Limestone rocks and walls. - N. Spain, from Asturias to Navarra. Hs.
46. S. canaliculata Boiss. \& Reuter ex Engler, Monogr. Gatt. Saxifr. 169 (1872). Leaves very viscid; lamina $8-15 \mathrm{~mm}$ wide, rhombic to semicircular in outline, deeply divided into 5-11
linear-oblong, straight, apiculate segments, not crowded or overlapping. Flowering stems $8-15 \mathrm{~cm}$. Petals c. 9 mm , obovate. $2 n=52$. Limestone rocks. - N. Spain (Cordillera Cantábrica). Hs.
47. S. geranioides L., Amoen. Acad. 4: 271 (1759). Like 43 in habit, but with softer, scarcely coriaceous leaves, and with numerous glandular hairs, very short but distinctly visible under a lens, on the leaves, pedicels and calyx. Leaves $15-30 \mathrm{~mm}$ wide, reniform to suborbicular in outline, rather deeply divided into 9-27 acute, triangular-lanceolate segments, which are fairly closely apposed but not overlapping. Flowering stems $7-20 \mathrm{~cm}$; cauline leaves few; flowers in a compact corymb, with a few arising from lower on the stem, narrowly campanulate, slightly scented. Petals c. 12 mm , oblanceolate, white. $2 n=c .42$. Rocks and screes; calcifuge. - E. Pyrenees and N.E. Spain. Ga Hs.
48. S. moncayensis D. A. Webb, Feddes Repert. 68: 201 (1963). Intermediate in most features between 42 and 49, differing from 42 in the larger cushions of soft, lighter coloured foliage, the indumentum of numerous very short glandular hairs, and the slightly larger petals; from 49 in the linear, strongly sulcate leafsegments up to 10 mm long and the much fainter scent. $2 n=60$. Shaded siliceous rocks at 1500-1600 m. - N.E. Spain (Sierra del Moncayo). Hs.
49. S. vayredana Luizet, Bull. Soc. Bot. Fr. 60: 413 (1913). Shoots numerous, small, suberect, forming a large, soft but rather dense cushion. Leaves covered with very short glandular hairs, with a strong aromatic, resinous scent. Lamina $5-15 \mathrm{~mm}$ wide, semicircular or cuneate in outline, deeply divided into 3-7 oblong-lanceolate, subacute, plane (not sulcate) segments. Flowering stems $6-10 \mathrm{~cm}$, bearing 3-10 flowers in a corymbose cyme. Petals $5-6 \mathrm{~cm}$, broadly obovate, white. $2 n=c .64$. Shaded siliceous rocks and screes. - N.E. Spain (near Montseny, N.N.E. of Barcelona). Hs.
50. S. nervosa Lapeyr., Fig. Fl. Pyr. 63 (1801) emend. Sternb., Revis. Saxifr. 52 (1810) (S. mixta Lapeyr., pro parte; incl. $S$. intricata Lapeyr.). Shoots suberect, forming small, lax but rather hard cushions. Leaves dark green, coriaceous, covered (as are pedicels and calyx) with very short glandular hairs, so as to appear almost verruculose under a lens; scented, but not as strongly as in 49. Lamina $5-10 \mathrm{~mm}$ wide, divided into 3-5 linear-oblong, obtuse, sulcate segments. Flowering stems 4 10 cm , bearing $3-12$ flowers. Petals $4-5 \mathrm{~mm}$, obovate, white. $2 n=34$. Exposed siliceous rocks. - C. (? and E.) Pyrenees. GaHs .
51. S. pedemontana All., Fl. Pedem. 2: 73 (1785) (incl. S. cervicornis Viv., S. prostii Sternb. and S. cymosa auct.). Shoots suberect, forming fairly dense cushions; leaves scarcely coriaceous, somewhat hairy, cuneate to semicircular in outline, divided palmately into $5-11$ segments. Flowers in a fairly compact, corymbose cyme; sepals linear-oblong, much longer than the hypanthium; petals $11-14 \times 3-5 \mathrm{~mm}$, white. Siliceous rocks, usually shaded. - S. Europe, mainly in the mountains, extending northwards to the C. Alps and the Ukrainian Carpathians. Bu Co Ga ? Gr It Ju Rm Rs (W) Sa.

Very variable, and composed of four geographically isolated populations. Each of these has a generally distinctive facies, but variation is sufficient to bring about overlap of all characters, and they are therefore given subspecific rather than specific rank.
1 Lamina cuneate; segments forwardly directed, usually not more than twice as long as wide; petiole usually broad

2 Leaves somewhat fleshy or coriaceous
2 Leaves thin and soft
(a) subsp. pedemontana
(b) subsp. cymosa

1 Lamina semicircular to cuneate; lateral segments often divaricate; segments usually long and narrow; petiole usually narrow
3 Rosette-leaves incurved in bud; petiole shorter than lamina
(c) subsp. cervicornis

3 Rosette-leaves not incurved in bud; petiole usually longer than lamina
(d) subsp. prostii
(a) Subsp. pedemontana: Leaves slightly fleshy or subcoriaceous, covered with short glandular hairs. Lamina flabelliformcuneate, not deeply divided, tapered gradually to a broad petiole; segments about twice as long as wide, acute. Flowering stems 6-15 cm. - S.W. Alps, just extending into C. Alps.
(b) Subsp. cymosa Engler in Engler \& Prantl, Natürl. Pflanzenfam. 3 (2a): 55 (1890): Very like (a) but with softer leaves, which have usually wider and more obtuse segments, and with flowering stems seldom more than 8 cm . E. Carpathians and mountains of Balkan peninsula.
(c) Subsp. cervicornis (Viv.) Engler in Engler \& Prantl, loc. cit. (1890) (S. cervicornis Viv.): Usually distinct from (a) and (b) in the leaves with few or no glandular, but often some longer, eglandular hairs; lamina wider, tending to semicircular in outline, with linear-oblong segments $2 \frac{1}{2}-4$ times as long as wide; petiole narrower, more distinct from lamina; and panicle sometimes more diffuse, $2 n=26,44$. Corse, Sardegna.
(d) Subsp. prostii (Sternb.) D. A. Webb, Feddes Repert. 68: 205 (1963) (S. ajugifolia L., nomen ambiguum, S. prostii Sternb., S. pedatifida auct., vix Sm. .): Leaves very variable in shape and indumentum; usually glandular-hairy, more or less cuneate, with acute or apiculate segments varying from broadly triangular to narrow-linear. Rosette-leaves not incurved in bud as in subsp. (c), and usually with petiole at least as long as lamina. $2 n=32$. - S. France (Cevennes and westwards to $2^{\circ} 30^{\prime}$ E.).
52. S. wahlenbergii Ball, Bot. Zeit. 4: 401 (1846) (S. perdurans Kit.). Glabrous except for a few peculiar, fleshy, appressed hairs on lower side of leaves and in inflorescence. Stems decumbent, forming a mat or low cushion. Leafy shoots short; leaves 7$12 \times 3-5 \mathrm{~mm}$, petiole broad, confluent with the cuneate lamina, which is divided distally into $3-5$ short, oblong-triangular, obtuse lobes. Flowering stems $4-7 \mathrm{~cm}$, slender, axillary, arising at the base of the leafy shoots. Petals $4-5 \mathrm{~mm}$, white. Damp, grassy slopes. - W. Carpathians. Cz Po.
53. S. androsacea L., $S p$. Pl. 399 (1753). Leafy shoots caespitose, very short; nearly all the leaves apparently basal, in lax rosettes. Leaves $10-20 \times 2-5 \mathrm{~mm}$ (including the scarcely distinct petiole), oblanceolate-spathulate, entire or very shortly 3-lobed, with a few long, mostly eglandular hairs on the margins and sometimes on the upper surface. Flowering stems $2-8 \mathrm{~cm}$, bearing 1-3 flowers. Petals $5-7 \mathrm{~mm}$, obovate-cuneate, obtuse or slightly emarginate, white. $2 n=16, c .128$. Snow-patches and damp, stabilized screes. Mountains of Europe, from Auvergne and C. Pyrenees to the Carpathians and S.W. Bulgaria. Al Au Bu $\mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.
54. S. seguieri Sprengel, Mant. Fl. Hal. 40 (1807). Very like 53 in habit, but leaves always entire and rather densely covered with short, glandular hairs; and petals $c .3 \mathrm{~mm}$, scarcely exceeding the sepals, dull yellow. Snow-patches and damp, stabilized screes. - C. \& E. Alps, from the Col du Petit St Bernard eastwards to $11^{\circ} 50^{\prime}$ E. Au Ga He It.
55. S. italica D. A. Webb, Feddes Repert. 68: 209 (1963) (S. tridens (Jan ex Engler) Engler \& Irmscher, non Haworth). Like

53 in habit, but dwarfer and more densely caespitose; leaves constantly 3 -toothed at apex, and with indumentum as in 54 ; flowering stems $2-4 \mathrm{~cm}$; petals $5-7 \mathrm{~mm}$, obovate-oblong, obtuse, white. C. Italy (Appennini Abruzzesi). It.
56. S. depressa Sternb., Revis. Saxifr. 42 (1810). Leafy shoots short, but slightly longer than in 53-55. Leaves $8-20 \times 7-$ 10 mm , cuneate, tapered to a broad, scarcely distinct petiole, divided above into 3 (rarely 5) triangular, subobtuse lobes, covered with numerous very short, glandular hairs. Flowering stems $5-10 \mathrm{~cm}$, bearing $3-8$ flowers. Petals $4-5 \mathrm{~mm}$, white. Shady ledges and damp screes, 2000-2850 m, mostly on porphrytic volcanic rock. - S. Alps (Alpi dolomitiche). It.
57. S. sedoides L., Sp. Pl. 405 (1753). Leafy shoots usually decumbent, rarely suberect, forming a loose cushion or mat. Leaves $c .8 \times 3 \mathrm{~mm}$, lanceolate-spathulate, often apiculate, usually glandular-hairy, tapered to a broad petiole. Flowering stems 24 cm , few-flowered. Petals $2-3 \mathrm{~mm}$, narrower than the sepals and about as long, dull yellow. Snow-patches and shady screes; calcicole. - E. Alps; Appennini; mountains of Jugoslavia and Albania. Al Au Ge It Ju.
(a) Subsp. sedoides: Leaves all entire; petals acute or apiculate. E. Alps; Appennini.
(b) Subsp. prenja (G. Beck) Hayek, Prodr. Fl. Penins. Balcan. 1: 640 (1925): Some of the leaves 3 -toothed; petals truncate or emarginate, often with excurrent mid-vein. From N.W. Jugoslavia (Velebit) to N. Albania.

Plants from Slovenija (? and S.E. Austria) with linear-oblong (instead of ovate) petals, and flowering stems with usually 2-4 (instead of $0-1$ ) cauline leaves have been distinguished as $\mathbf{S}$. hohenwartii Sternb., Revis. Saxifr. 20 (1810). Whether they should be treated as a variety of subsp. (a), a third subspecies, or an independent species is not clear.
58. S. aphylla Sternb., Revis. Saxifr. 40 (1810). Like 57 in habit, but leaves c. $10 \times 5 \mathrm{~mm}$, mostly 3-lobed, with triangular, subacute lobes, subglabrous or sparsely glandular-hairy; petals 2.5 mm , linear, slightly longer than the sepals but very much narrower, pale greenish-yellow. Snow-patches, screes and stony ground, usually above $2000 \mathrm{~m} . \quad$ E. \& C. Alps, westwards to $8^{\circ} E$. Au Ge He It.
59. S. presolanensis Engler, Pflanzenreich 67 (IV. 117): 302 (1916). Leafy shoots numerous, erect, columnar, with numerous persistent dead leaves, forming a deep, soft, dense cushion. Leaves $c .15 \mathrm{~mm}$ including petiole, elongate-spathulate or oblanceolate, entire, obtuse to acute, pale green, rather densely covered with long, viscid, glandular hairs; dead leaves greyish-white in apical half when dry. Flowering stems $6-12 \mathrm{~cm}$, slender, weak, viscid, bearing 2-4 flowers in a lax cyme. Petals $3-4 \mathrm{~mm}$, widely separated, oblong-cuneate, emarginate, often with excurrent nerve, dull greenish-yellow. $2 n=16$. Vertical, shaded limestone rocks, 1750-2000 m. - N. Italy (Alpi Bergamasche). It.
60. S. muscoides All., Mélang. Philos. Math. (Misc. Taur.) Soc. Roy. Turin 5: 87 (1774) (S. planifolia auct., non Lapeyr.). Shoots short, erect, crowded, forming a dense, soft cushion. Leaves $6 \times 1.5 \mathrm{~mm}$, linear-lanceolate, entire, obtuse, glandular-pubescent but not very viscid; dead leaves persistent, conspicuously silverygrey in apical half when dry. Flowering stems 5 cm or less, with several leaves and 1-3 flowers. Petals 4 mm , broadly obovate, contiguous, obtuse or truncate, white or pale lemon-yellow. Rocks and screes, usually above 2200 m ; somewhat calcicole. Alps, from Monte Viso to Hohe Tauern. Au Ga He It.
61. S. facchinii Koch, Flora (Regensb.) 25: 624 (1842). Like 60 but forming smaller cushions; flowering stems very short, scarcely projecting above leafy shoots, and often 1 -flowered; petals oblong-cuneate, $2 \times 1 \mathrm{~mm}$ or less, scarcely exceeding the sepals, dull yellow tinged to a variable extent with dull purple-red. Rocks and screes above 2200 m ; calcicole. - S. Alps (Alpi Dolomitiche). It.
62. S. moschata Wulfen in Jacq., Misc. Austr. Bot. 2: 128 (1781) (S. muscoides Wulfen, non All., S. varians Sieber; incl. S. tenuifolia Rouy \& Camus). Leafy shoots small, numerous, suberect, forming fairly dense but sometimes rather flat cushions. Leaves very variable, $3-15 \times 1-7 \mathrm{~mm}$, stalked or sessile; lamina linear to broadly flabelliform-cuneate, usually 3 -fid but sometimes entire or 5 -fid; segments obovate, oblong or broadly linear, obtuse, not sulcate; usually with fairly numerous, short glandular hairs. Flowering stems $1-10 \mathrm{~cm}$, bearing $1-7$ flowers. Petals usually $3-4 \mathrm{~mm}$, elliptical-oblong, not contiguous, dull yellow or cream-coloured, less often deep red or nearly white. $2 n=26,52$. Mountains of C.\& S. Europe, from C. France and the Carpathians to N.W. Spain, C. Italy and the Balkan peninsula. ?Al $\mathrm{Au} ? \mathrm{Bu} \mathrm{Cz}$ Ga Ge He Hs It Ju Po Rm.

Extremely variable in form of leaf, indumentum, and size and colour of petals. About 30 local populations in Europe have been given specific or subspecific rank, but it seems impossible to find any broad pattern of variation which would permit of the division of the species on a continental scale. It hybridizes freely with 64 and 66, and less commonly with a large number of other species.
63. S. hariotii Luizet \& Soulié, Bull. Soc. Bot. Fr. 58: 638 (1911). Like 62 in habit, and in the small, dull yellow or creamcoloured petals, but differing in the leaves, which are mostly 3 -fid, shining, nearly glabrous, with at least some of the segments strongly mucronate and all of them sulcate. $2 n=34$. Calcicole. - W. Pyrenees, 1600-2300 m. Ga Hs.
64. S. exarata Vill., Prosp. Pl. Dauph. 47 (1779) (incl. S. adenophora C. Koch). Leafy shoots numerous, erect, forming a fairly dense, soft cushion. Leaves $4-15 \mathrm{~mm}$, very variable in size and shape, usually with a 3 - or 5 -lobed, cuneate lamina tapered gradually to a broad petiole; usually rather densely covered with short glandular hairs, rarely subglabrous; segments oblong or linear, obtuse, sulcate, subparallel. Flowering stems $3-10 \mathrm{~cm}$; cauline leaves few, usually undivided; flowers (1-)3-8, in a lax cyme; petals c. $4 \times 2 \mathrm{~mm}$, oblong-obovate, not or barely contiguous, white or pale cream, rarely reddish. Alps; Jura; Appennini; mountains of Balkan peninsula. $2 n=20-22$. ? Al Au Bu Ga Ge Gr He It Ju .

Easily confused with 62, and almost as variable; hybrids between the two are not uncommon. 64 can usually be distinguished by the larger, whiter petals and the sulcate leaves, but plants occur in the Appennini and Macedonia which combine typical leaves of 64 with flowers very like those of 62 . Some varieties from the W. Alps are scarcely distinguishable from 65.
65. S. cebennensis Rouy \& Camus, Fl. Fr. 7: 55 (1901) (S. prostiana (Ser.) Luizet). Very like 64, and perhaps reducible to a subspecies, but usually with more compact, deeper cushions of rather pale green foliage; leaves always rather densely furnished with long glandular hairs; and petals wider, contiguous or overlapping. Cauline leaves usually undivided; rosette-leaves normally 3-lobed, occasionally undivided or 5 -lobed. $2 n=26,32$. Shady limestone rocks. - S. France (Cevennes). Ga.
66. S. pubescens Pourret, Mém. Acad. Toulouse 3: 327 (1788) (S. mixta Lapeyr., pro parte). Very variable in habit; usually
densely caespitose in compact cushions, but sometimes lax and spreading. Rosette-leaves rather deeply 5 -fid (less often 3 -fid) with parallel-sided, obtuse segments, rather dark green, densely covered with long glandular hairs. Cauline leaves usually divided into narrow segments, rarely entire. Petals broadly obovate, usually contiguous or overlapping. - Pyrenees; ?Cordillera Cantábrica. Ga Hs.

Divisible into two subspecies, which are often given specific rank; plants of subsp. (a) from exposed positions can, however, resemble very closely those of subsp. (b).
(a) Subsp. pubescens: Usually rather laxly caespitose, with relatively short, scarcely columnar leafy shoots; leaves $10-$ 20 mm , with long, rather narrow petiole and segments four times as long as wide, deeply sulcate; flowering stems $3-10 \mathrm{~cm}$; petals 4-6 mm, pure white. E. Pyrenees.
(b) Subsp. iratiana (F. W. Schultz) Engler \& Irmscher in Engler, Pflanzenreich 67 (IV. 117): 401 (1916) (S. iratiana F. W. Schultz): Densely caespitose, with long, narrow, columnar leafy shoots, on which the dead leaves persist for many years; leaves $4-10 \mathrm{~mm}$, with broad, scarcely distinct petiole and segments about twice as long as wide, rather less strongly sulcate; flowering stems $2-6 \mathrm{~cm}$; petals usually veined with red, at least when young; calyx, anthers and style-base reddish. $2 n=26$. Exposed rocks, usually above 2400 m. C. Pyrenees, ?Cordillera Cantábrica.
67. S. nevadensis Boiss., Diagn. Pl. Or. Nov. 3 (2): 67 (1856) (S. pubescens subsp. nevadensis (Boiss.) Engler \& Irmscher). Like 66, and intermediate in habit between the two subspecies, the leafy shoots being long and columnar, as in subsp. (b), but wider and less densely packed; but quite distinct from both in its nonsulcate leaves, with usually 3 (rarely 5 lobes). Petals $c .4 \times 2 \mathrm{~mm}$, usually narrower than those of 66 , sometimes red-veined. - S.Spain (Sierra Nevada, above 2600 m). Hs.
68. S. cespitosa L., Sp. Pl. 404 (1753). Leafy shoots short, caespitose, more or less erect, forming lax or rather dense cushions. Leaves mostly 3 -lobed (rarely simple or 5-lobed), cuneate, with a broad but distinct petiole and oblong, obtuse or subacute lobes, densely covered with rather short glandular hairs; youngleaves somewhat incurved. Flowering stem (1-)2•5-8(-12) cm, bearing $1-3(-5)$ protogynous flowers. Petals $4-5 \mathrm{~mm}$, dull white, often slightly greenish or cream-coloured. Seeds very finely verruculose. $2 n=80$. Arctic and subarctic Europe, extending locally southwards in the mountains to $53^{\circ} \mathrm{N}$. in Britain and $50^{\circ} \mathrm{N}$. in C. Ural. Br Fa Fe Is No Rs $(\mathrm{N}, \mathrm{C}) \mathrm{Sb} \mathrm{Su}$.
69. S. hartii D. A. Webb, Proc. Roy. Irish Acad. 53в: 219 (1950). Intermediate between 68 and 70, and perhaps the relict of a hybrid population. Differs from 70 in the dense covering of short, glandular hairs on the leaves; from 68 in the flatter rosettes, the leaves often with 5-7 or even more relatively acute lobes, the protandrous flowers, and the slightly larger, pure white petals. Seeds as in 68. $2 n=$ ?50. Grassy maritime cliffs. - N.W. Ireland (Arranmore Island). Hb .
70. S. rosacea Moench, Meth. 106 (1794) (S. decipiens Ehrh., S. cespitosa subsp. decipiens (Ehrh.) Engler \& Irmscher). Very variable in foliage and habit; leafy shoots varying from short and suberect, forming a compact cushion, to procumbent and rather long, forming a loose mat. Leaves $8-25 \mathrm{~mm}$, stalked; lamina rhombic-cuneate, usually 5 -lobed, densely hairy to nearly glabrous, but always with some hairs, at least on the petiole; hairs on the leaves normally eglandular and rather long. Flowering stem $6-25 \mathrm{~cm}$, slender, almost leafless, bearing 2-5 flowers.

Buds erect. Petals $6-10 \times 3-8 \mathrm{~mm}$, pure white.

- N.W. \& C. Europe; local. $\mathrm{Be} \dagger \mathrm{Br} \mathrm{CzFa} \mathrm{Ga} \mathrm{Ge} \mathrm{Hb} \mathrm{Is} \mathrm{Po}$.

In spite of the very disjunct distribution and great variability of this species only one subspecies distinct from the type can be satisfactorily defined; even this occurs in two distinct areas in which it may have arisen independently.
(a) Subsp. rosacea: Leafy shoots erect or procumbent; leaves with obtuse, acute or slightly mucronate lobes. Seeds variable. $2 n=56,64 . S . \& C$. Germany and E. France; Ireland; Iceland and Faeröer. Extinct in Britain.
(b) Subsp. sponhemica (C. C. Gmelin) D. A. Webb, Feddes Repert. 68:210 (1963) (S. sponhemica C. C. Gmelin): Leafy shoots more or less erect; leaves with strongly mucronate or apiculate narrow lobes. Seeds coarsely papillose. $2 n=50$, 52. Belgium, E. France and W. Germany; Czechoslovakia and S.W. Poland.
71. S. hypnoides L., Sp. Pl. 405 (1753) (S. hypnoides subsp. boreali-atlantica Engler \& Irmscher). Leafy shoots long, slender, procumbent, bearing widely-spaced leaves, entire and linearlanceolate or 3-lobed, and terminating in a rosette of 3 - to 7 -lobed leaves, with straight, linear, strongly apiculate-aristate lobes, the lateral lobes, at least of 3 -lobed leaves, directed somewhat forwards. Summer-dormant buds sometimes present in lower leaf-axils, sessile, their outer scales partly scarious but partly green and leaf-like. Flowering stems $10-30 \mathrm{~cm}$, slender, with 3-7 flowers; buds nodding. Petals $7-10 \mathrm{~mm}$, narrowly obovate or elliptical, pure white. Seeds coarsely papillose. $2 n=c .30,48$, 64. N.W. Europe, south-eastwards to the Vosges. Be Br Fa GaHb Is No.
72. S. continentalis (Engler \& Irmscher) D. A. Webb, Proc. Roy. Irish Acad. 53в: 222 (1950) (S. hypnoides auct. eur. merid.; S. hypnoides subsp. continentalis Engler \& Irmscher). Like 71, but with the leaf-lobes often ovate-lanceolate and sometimes arcuaterecurved; and with stalked summer-dormant buds, covered by completely scarious, silvery scales, always present in many of the leaf-axils. $2 n=52$. Calcifuge (except in S.E. France). - $S$. France, N. Spain, N. Portugal. Ga Hs Lu.
73. S. conifera Cosson \& Durieu, Bull. Soc. Bot. Fr. 11: 332 (1864). Shoots $1-3 \mathrm{~cm}$, procumbent, forming a close mat. Leaves 3-7 mm, linear-lanceolate, strongly apiculate, pale, silvery green; those of the dormant buds fimbriate and ciliate with long arachnoid hairs, the remainder ciliate with short, glandular hairs. Summer-dormant buds numerous, oblong-conical. Flowering stems $6-10 \mathrm{~cm}$, slender, bearing $3-5$ flowers. Petals $3-4 \mathrm{~mm}$, white. Limestone rocks. - N. Spain (Cordillera Cantábrica). Hs.
74. S. rigoi Porta, Atti Accad. Agiati 9:26(1891). Leafy shoots short, ascending, rather densely caespitose. Leaves with a long petiole, ciliate with subarachnoid hairs; lamina with 3-5 obtuse or subacute lobes furnished with shorter glandular hairs. Summer-dormant buds numerous, obovoid, stalked; their outer leaves ciliate with long white hairs. Flowering stems $c .6 \mathrm{~cm}$, bearing 2-3 large, campanulate flowers. Petals $12-15 \times 5 \mathrm{~mm}$, white. Mountains of S.E. Spain. Hs.
75. S. globulifera Desf., Fl. Atl. 1: 342 (1798) (incl. S. granatensis Boiss. \& Reuter and S. gibraltarica Boiss \& Reuter). Leafy shoots erect or somewhat spreading, forming a loose cushion. Leaves semicircular in outline, deeply 3- to 7-lobed with acute lobes, glandular-hairy; petiole long. Summerdormant axillary buds numerous, obconical, stalked or sessile, moderately hairy but not white-villous. Flowering stems
$7-12 \mathrm{~cm}$, slender, bearing $3-7$ flowers. Petals $4-5 \times 2-3 \mathrm{~mm}$, white. Limestone rocks and cliffs. S. Spain. Hs.
76. S. reuterana Boiss., Voy. Bot. Midi Esp. 2: 730 (1845). Very like 75 in habit, but with shorter flowering stems ( $4-6 \mathrm{~cm}$ ) bearing $1-2$ larger flowers with sepals 4 mm and petals $6-7 \times 4 \mathrm{~mm}$. Vertical limestone rocks. S.W. Spain.

A little-known plant, seldom collected. Possibly not distinct from 75.
77. S. erioblasta Boiss. \& Reuter in Boiss., Diagn. Pl. Or. Nov. 3 (2): 67 (1856). Leafy shoots short, densely caespitose, forming a compact cushion. Leaves $3-6 \mathrm{~mm}$, entire or shortly 3-lobed with obtuse lobes, glandular-hairy. Summer-dormant buds very numerous, subglobular, sessile, usually densely white-villous at the apex. Flowering stems $c .5 \mathrm{~cm}$, slender, with 3-5 flowers. Sepals and petals as in 75. $2 n=34$. Limestone rocks and screes. Mountains of S.E. Spain. Hs.

Often united with 75, but its distinctive characters are constant in cultivation. It is possibly, however, a subspecies of S. spathulata Desf., Fl. Atl. 1: 342 (1798), from N. Africa, which has similarly shaped leaves, but is much laxer and less hairy.
78. S. boissieri Engler, Verh. Zool.-Bot. Ges. Wien 19: 16 (1869). Stems laxly caespitose, erect or decumbent, branched, forming a loose cushion, with reddish, winter-dormant, bulbillike buds at the base and in the lower leaf-axils. Leaves glandularhairy, ovate or semicircular in outline, very deeply ternatisect (usually appearing ternate), the principal divisions crenate, dentate or ternately lobed; ultimate lobes fairly broad-based; petiole long, with a broad, sheathing base. Flowers rather numerous, cup-shaped, in lax, leafy cymes. Petals $4-7(-10) \mathrm{mm}$, white, glabrous. $2 n=64$. Damp, shady, limestone rocks. S.W. Spain (mountains west of Ronda). Hs.
79. S. biternata Boiss., Voy. Bot. Midi Esp. 2: 231 (1839). Rather like 78 but with stems almost woody, decumbent or procumbent, bearing numerous bulbil-like buds along their basal part; leaves fern-like in form, biternate, with segments lobed or deeply toothed and narrow-based, velvety with numerous, rather long, glandular hairs; flowers fewer but much larger, narrowly campanulate, with petals $15-20 \mathrm{~mm}$, suberect. $2 n=66$. Dry limestone cliffs. - S. Spain (El Torcal de Antequera). Hs.
( $f$ ) Perennials, dormant in summer, perennating by means of underground bulbils in the axils of the basal leaves; ovary semiinferior.
80. S. gemmulosa Boiss., Bibloth. Univ. Genève, nov. ser. 13:409 (1838). Rather densely caespitose; stem and leaves often reddish. Leaves mostly basal, with their axillary bulbils at ground-level, glabrous or somewhat hairy. Petiole long, slender; lamina up to $15 \times 18 \mathrm{~mm}$, but usually much less, ternately lobed or divided, with the ultimate segments oblanceolate-cuneate and tapered to a narrow, stalk-like base. Flowering stems $5-12 \mathrm{~cm}$, erect. Petals $4-6 \mathrm{~mm}$, broadly obovate, white, glabrous. $2 n=c$. 64 . Limestone rocks. S. Spain. Hs.
81. S. haenseleri Boiss. \& Reuter, Diagn. Pl. Nov. Hisp. 13 (1842). Leaves mostly basal, forming small tufts; bulbils underground. Lamina glandular-hairy, cuneate-obovate, rather deeply divided into 3-5 oblong lobes, tapered at the base to a short petiole. Stem $5-12 \mathrm{~cm}$, slender. Flowers few, on long pedicels, in a very lax cyme which recalls that of 27. Petals $c .5 \mathrm{~mm}$, white, glandular-hairy on the upper surface near the base. Mountains of S. Spain. Hs.
(82-84). S. dichotoma group. Stem $10-40 \mathrm{~cm}$, erect, usually arising from a single, rather large bulb. Basal leaves glandularhairy, petiolate; cauline leaves usually rather numerous, sessile. Flowers rather few, in a fairly compact cyme. Petals $6-12 \mathrm{~mm}$, white, sometimes tinged with pink, glandular-hairy on upper surface.

A group of 3 species which are fairly distinct in most of Europe, but are connected in N. Africa and Sicilia by confusing intermediates, many of which are probably referable to S. atlantica Boiss. \& Reuter, Pugillus 48 (1852); this has been usually treated as a variety of 83 , but is difficult to distinguish clearly from 84. Further investigation may perhaps justify the reduction of 84 to a subspecies of 83 .

1 Lamina of basal leaves deeply divided into linear-oblong or cuneate-oblanceolate lobes
82. dichotoma

1 Lamina of basal leaves crenate or somewhat pinnatifid but not deeply lobed
2 Basal leaves $\pm$ ovate, truncate at base; petiole not much longer than lamina
83. carpetana

2 Basal leaves $\pm$ reniform, cordate; petiole considerably longer than lamina
84. graeca
82. S. dichotoma Sternb., Revis. Saxifr. 51 (1810) (incl. S. arundana Boiss. and S. kunzeana Willk.). Stem $10-30 \mathrm{~cm}$. Basal leaves glandular-hairy, petiolate; lamina up to $20 \times 30 \mathrm{~mm}$, but often much less, reniform or broadly ovate in outline, deeply divided into several linear-oblong or cuneate-oblanceolate lobes. Cauline leaves similar but smaller and sessile. Inflorescence less compact than in 83 and 84 ; petals $6-10 \mathrm{~mm}$, white, veined or tinged with pink. $2 n=32+2$ B. Spain and Portugal. Hs Lu.
(a) Subsp. dichotoma: Basal leaves $10-30 \mathrm{~mm}$ wide; stem 1230 cm , fairly stout. Mountains of S. \& E. Spain.
(b) Subsp. albarracinensis (Pau) D. A. Webb, Feddes Repert. 68: 207 (1963): Basal leaves 4-10 mm wide, rather less deeply divided than in (a); stem 6-20 cm, slender. - E. \& C. Spain; N.E. Portugal.

Like 86 (b) in habit, but easily distinguished by the glandularhairy petals.
83. S. carpetana Boiss. \& Reuter, Diagn. Pl. Nov. Hisp. 12 (1842) (incl. S. blanca Willk.). Stem $10-25 \mathrm{~cm}$, branched only near the top. Basal leaves ovate, deeply crenate or somewhat pinnatifid, truncate at base, hairy; petiole short. Cauline leaves fairly numerous, similar but sessile-amplexicaul. Flowers in a rather compact cyme. Petals $7-12 \mathrm{~mm}$, white. $2 n=20$.
Spain. Hs ?Si.
84. S. graeca Boiss., Fl. Or. 2: 87 (1872) (S. granulata subsp. graeca (Boiss.) Engler). Stem $20-40 \mathrm{~cm}$, branched only near the top. Basal leaves reniform, cordate, glandular-hairy; petiole usually much longer than lamina. Cauline leaves usually 7-12, ovate, incised-dentate, cuneate at base, the lower shortly petiolate, the upper sessile. Flowers in a fairly compact cyme. S. part of Balkan peninsula; S. Italy and Sicilia. Al Bu Gr It Ju Si.

Often included in 86, but distinct not only in the shape and number of the cauline leaves and the more compact inflorescence, but also in the glandular-hairy petals. Often very like 85 in habit, but usually with fewer cauline leaves and a rather less compact cyme, and never with bulbils in the upper part of the plant.
85. S. bulbifera L., Sp. Pl. 403 (1753). Stem $20-40 \mathrm{~cm}$, erect, simple, arising from a rather large bulb. Basal leaves reniform, crenate, cordate, petiolate, glandular-hairy. Cauline leaves $10-$ 20 , ovate, incised-dentate, cuneate, the lower shortly stalked, the
upper sessile. Small bulbils present in the axils of all leaves and bracts. Flowers rather few, in a small, compact cyme. Petals $7-10 \mathrm{~mm}$, white, glandular-hairy on upper surface. $2 n=28$. - C. \& S. Europe, from Czechoslovakia to Sicilia and from Corse to the E. Carpathians and European Turkey. Al Au Bu Co Cz Gr He Hu It Ju Rm Rs (W) Sa Si Tu.
86. S. granulata L., Sp. Pl. 403 (1753). Leaves mostly basal, petiolate, reniform, crenate, rarely dentate, often rather fleshy, hairy at least on the petiole, subtending numerous small, subterranean, axillary bulbils. Cauline leaves usually absent; if present, similar to basal leaves but with shorter stalks and without bulbils. Stem up to 50 cm , erect, usually simple in lower half, branched above; lower bracts usually large and leaf-like. Flowers in a lax cyme. Sepals triangular-ovate or oblong; petals 9$16 \times 3-8 \mathrm{~mm}$, white, glabrous. N., C. \& W. Europe, extending eastwards to N.W. Russia, N.W. Ukraine, W. Hungary and Sicilia. Au Be Br Cz Da Fe Ga Ge Hb He Ho Hs Hu It Ju Lu No Po Rs (N, B, C) ?Sa Si Su.

Very variable, especially in size, degree of hairiness, extent of branching of stem, and width of petals; variable also in habitat, growing often in dry, rocky situations in S. Europe and mainly in damp grassland in N. \& C. Europe. Although many local populations have a characteristic facies, there is little constant correlation of characters over wide areas, nor is habitat consistently correlated with form. One regional population of very distinct facies is here recognized as a subspecies, but intermediate forms, linking it to the variable subsp. granulata, are not uncommon.
(a) Subsp. granulata (incl. S. glaucescens Boiss. \& Reuter): Basal leaves $18-40 \mathrm{~mm}$ wide, rarely less, crenate or obtusely dentate (rarely slightly 3-lobed), glabrous or hairy. Stem usually stout; branching variable, but most often from about the middle; branches suberect, giving a rather narrow inflorescence. Sepals triangular-ovate; petals $11-16 \times 4-8 \mathrm{~mm} .2 n=32-60$, perhaps usually 52. Throughout the range of the species.
(b) Subsp. graniticola D. A. Webb, Feddes Repert. 68: 207 (1963) (S. granulata var. gracilis Lange, pro parte): Leaves 812 mm wide, regularly and rather deeply crenate, hairy. Stem $7-25 \mathrm{~cm}$, slender; branching very variable; branches usually flexuous, somewhat patent. Sepals oblong; petals $9-13 \times 3-$ 5 mm . Calcifuge, usually on granite. - C. Spain, N. Portugal.
87. S. corsica (Duby) Gren. \& Godron, Fl. Fr. 1: 642 (1849) (S. russii auct., non J. \& C. Presl; incl. S. cossoniana Boiss.). Like 86 (a), but basal leaves more or less 3-lobed, with deeply crenate lobes, and stems branched at least from the middle and often from near the base, with rather patent branches, giving a much more diffuse inflorescence. Shady rocks, walls and screes. $W$. Mediterranean region, from Corse and Sardegna to E. Spain. Bl Co Hs.
(a) Subsp. corsica: Rather delicate in habit; basal leaves seldom divided more than half-way to base; stems branched almost from base. $2 n=52,62-66$. Corse, Sardegna. Co Sa.
(b) Subsp. cossoniana (Boiss.) D. A. Webb, Feddes Repert. 68: 203 (1963) (S. cossoniana Boiss.): Rather robust; basal leaves divided about $\frac{2}{3}$ the distance to the base with overlapping lobes; lower $\frac{1}{3}$ of stem often unbranched. $2 n=64-66$. E. Spain. Hs.

Plants from the Islas Baleares are intermediate between the two subspecies. Some of those from Sardegna are intermediate between 86 (a) and 87 (a).
88. S. cintrana Kuzinsky ex Willk., Österr. Bot. Zeitschr. 39 : 318 (1889) (S. granulata L. subsp. hochstetteri (Engler) Engler \&

Irmscher). Stem $10-17 \mathrm{~cm}$, erect, branched, rather stout. Basal leaves suborbicular or rhombic, rounded or cuneate at the base, obscurely crenate, hairy, with rather large, subterranean, axillary bulbils. Cauline leaves similar in shape but subsessile, few, sometimes absent. Petals $c .10 \mathrm{~mm}$, white, glandular-hairy on upper surface. Limestone rocks and walls. - Portugal (N. \& W. of Lisboa), from Sintra to Bombarral. Lu.
(g) Perennials, dormant in winter, perennating by means of bulbils usually produced in the axils of the basal leaves; ovary superior or very slightly immersed.
89. S. sibirica L., Sp. Pl. ed. 2, 577 (1762). Stems $7-20 \mathrm{~cm}$, erect or ascending, flexuous. Leaves reniform, petiolate, palmately 5 - to 9 -lobed, with triangular-ovate lobes, glabrous or slightly hairy, the basal ones with axillary bulbils. Flowers few, in a terminal cyme. Petals $8-14 \times 4-6 \mathrm{~mm}$, white, glabrous. Ovary superior or very slightly immersed in receptacle. E. Russia; S.E. Bulgaria and N.E. Greece. Bu Gr Rs (C, E). (N. \& C. Asia.)
90. S. carpathica Reichenb., Fl. Germ. Excurs. 552 (1832). Stems 6-15 cm, erect, rather densely caespitose. Basal leaves up to $15-25 \mathrm{~mm}$ wide, reniform to orbicular, palmatifid, with usually 5-7 orbicular to triangular-ovate, obtuse or subacute lobes, glabrous except for a few hairs on the long petiole; cauline leaves similar, but with shorter petioles and with acute, triangular lobes. Flowers 1-6; petals $5-7 \times 2-3 \mathrm{~mm}$, white, veined or tinged with pink, glabrous; ovary as in 89. Damp, rocky places in the mountains. - Carpathians; S.W. Bulgaria. Bu Cz Po Rm Rs (W).
91. S. rivularis L., Sp. Pl. 404 (1753). Like 90 but usually smaller in all its parts and with underground, shortly creeping stolons arising from the bulbils; basal leaves usually $10-15 \mathrm{~mm}$ wide, 3 - to 5 -lobed; lobes of cauline leaves ovate-lanceolate, obtuse; petals $3-5 \mathrm{~mm}$; ovary immersed for $\frac{1}{4}-\frac{1}{3}$ of its height. $2 n=52$. Arctic and subarctic Europe, southwards to S. Norway and C. Scotland. Br Fa Fe Is No Rs (N) Sb Su .
S. hyperborea R.Br. in Parry,Jour. Voy. N.W.Pass.(Suppl. App.) 274 (1824), recorded from Svalbard (also from Greenland and arctic America), has usually been included under 91, but possibly deserves specific status. It differs in the reddish colour of the whole plant (including petals), the smaller petals and the absence of stolons. It has $2 n=26$.
92. S. cernua L., Sp. Pl. 403 (1753). Basal leaves $15-25 \mathrm{~mm}$ wide, reniform, 5 - to 7 -lobed, subglabrous, with long petiole; cauline leaves numerous, similar, but with progressively shorter petioles and fewer, deeper and more acute lobes; all with reddish bulbils in their axils. Stem up to 30 cm but often much less, usually simple, with a solitary, terminal flower (very rarely several flowers, one on each branch), which is, however, often abortive. Petals in well-developed flowers $8-12 \mathrm{~mm}$, white, glabrous; ovary superior or very slightly immersed in receptacle. Seeds unknown, reproduction being entirely by bulbils. $2 n=50,64$. Arctic and subarctic Europe, southwards to c. $57^{\circ}$ N. in Scotland and Ural; Alps; Carpathians. Au Br Cz Fe He Is It No Po Rm Rs (N, C) Sb Su .
S. $\times$ opdalensis Blytt, Christ. Vidensk.-Sels. Forh. 1892: 52 (1892) (S. cernua $\times$ rivularis) is frequent in one district of Norway, near Opdal, apparently dispersed by bulbils from a single original cross. It is stouter than either of the parent species; it resembles $S$. cernua in having bulbils in the axils of the cauline leaves, but they are greenish, the petals are smaller ( 6 mm ), and the ovary more deeply immersed in the receptacle.
(h) Evergreen perennials, perennating by epigeal stolons or sterile, leafy shoots; leaves opposite, sessile, undivided, with marginal hydathodes, often lime-encrusted; ovary semi-inferior.
93. S. oppositifolia L., Sp. Pl. 402 (1753). Stems procumbent or ascending, forming a loose mat or a more or less compact cushion. Leaves $2-6 \mathrm{~mm}$, opposite (the upper ones rarely alternate), suborbicular to obovate-lanceolate, of a dull, often bluish green, thick, keeled below, plane or somewhat recurved at the tip, ciliate at least towards the base; hydathodes 1-5. Flowering stems very short, leafy, glandular-pubescent, 1 -flowered. Sepals ciliate. Petals $5-15 \times 2-7 \mathrm{~mm}$, pale pink to deep purple; anthers bluish. $2 n=26$. Arctic and subarctic Europe and on most of the mountain-ranges southwards to the Sierra Nevada, C. Italy and Bulgaria. Al Au Br Bu Cz Fa Fe Ga Ge Hb He Hs Is It Ju No Po Rm Rs (N) Sb Su.

Extremely variable in habit, size and colour of flower, form, size and ciliation of leaf, and number of hydathodes. This variation shows little geographical consistency, and in view of the wide range of the species the elevation to subspecific rank of local populations of characteristic facies is scarcely justified. Among the variants that are often treated as subspecies (here cited for convenience by their binomials ) are:
S. rudolphiana Hornsch. ex Koch, Syn. Fl. Germ. 269 (1835). Very compact; small in all its parts; leaves c. 2 mm , densely imbricate. E. (? and C.) Alps.
S. blepharophylla Kerner ex Hayek, Österr. Bot. Zeitschr. 52: 329 (1902). Leaves very obtuse, with long cilia in apical half. Austrian Alps.
S. murithiana Tiss., Bull. Trav. Soc. Murith. 1: 27 (1868). Cilia of calyx gland-tipped; leaves with 1 hydathode. S.W. Europe and Alps.
S. latina (N. Terracc.) Hayek, Denkschr. Akad. Wiss. Math.Nat. Kl. (Wien) 77: 678 (1905). Similar, but with 3 hydathodes. Appennini.
S. speciosa (Dörfler \& Hayek) Dörfler \& Hayek in Hayek, op. cit. 677 (1905). Apical part of leaf with broad cartilaginous margin, without cilia. Flowers large. C. Italy (Appennini Abruzzesi).

Plants from Spitsbergen which are perhaps assignable to the Arctic-American S. pulvinata Small, Bull. New York Bot. Gard. 2: $172 \mathbf{( 1 9 0 1 )}$, are said to be tetraploid $(2 n=52)$.
94. S. retusa Gouan, Obs. Bot. 28 (1773) (S. purpurea All.). Rather like some compact variants of 93, but with small (24 mm ) leaves of a dark, shining green, strongly arcuate-recurved from about the middle, ciliate only towards the base, with 3-5 hydathodes; flowering stems with 1-5 flowers; sepals glabrous or glandular-pubescent but without marginal cilia; petals $4-5 \times$ 2 mm , ovate with long, slender claw, purplish-red; filaments purple, longer than the petals; anthers orange. Usually above 2000 m.; ofter" in exposed, snow-free situations. $2 n=26$. © E. \& C. Pyrenees, Alps, Carpathians, Bulgaria. Au Bu Cz Ga He Hs It Po Rm.
(a) Subsp. retusa: Sepals and hypanthium glabrous. Peduncles 1.5 cm or less, with $1-3$ flowers. Petals $c .4 \mathrm{~mm}$. Mainly calcifuge. Throughout the range of the species, except for parts of S.W. Alps.
(b) Subsp. augustana (Vacc.) D. A. Webb, Feddes Repert. 68: 208 (1963): Sepals and hypanthium densely glandular-pubescent. Peduncles $2-5 \mathrm{~cm}$, with $2-5$ flowers. Petals $c .5 \mathrm{~mm}$. Mainly calcicole. S.W. Alps, eastwards to Monte Rosa.
95. S. biflora All., Mélang. Phil. Math. (Misc. Taur.) Soc. Roy. Turin 5: 86 (1774). Stems procumbent to ascending, forming a mat or loose cushion. Leaves $5-9 \times 3-6 \mathrm{~mm}$, opposite, broadly obovate or suborbicular, obtuse, sessile, with a single hydathode, less coriaceous than in 93 and 94 and not lime-encrusted, often reddish beneath. Flowers $2-5(-8)$ in terminal corymbose cymes. Sepals ciliate, glandular-pubescent; petals reddish-purple or dull white; disc yellow, conspicuous; filaments whitish, shorter than petals; anthers pink to orange, eventually black. Damp screes, moraines and river-gravels. $2 n=26$. Alps. Au Ga Ge He It.

The typical plant has oblanceolate petals, $5-6 \times 2 \mathrm{~mm}$. In var. kochii Kittel (subsp. macropetala (Kerner) Rouy \& Camus) the petals are broadly elliptical, $6-9 \times 4-5 \mathrm{~mm}$.
(i) Similar to ( $h$ ) but leaves coriaceous, alternate, often in rosettes.
96. S. marginata Sternb., Revis. Saxifr. Suppl. 1, 1 (1822). Densely caespitose, with rosette-like or columnar leafy shoots. Leaves $3-12 \times 1-5 \mathrm{~mm}$, very variable, linear-oblong to obovatespathulate, more or less obtuse, glandular-ciliate towards the base, with a distinct hyaline border throughout, plane or recurved distally. Flowering stems $3-9 \mathrm{~cm}$, leafy, pubescent, bearing a compact corymbose cyme of $2-8$ flowers. Petals $7-14 \mathrm{~mm}$, obovate, white or pale pink. Mountain rocks; calcicole.
Balkan peninsula, S. Carpathians, C. \& S. Italy. Al Bu Gr It Ju Rm.

The contrast between the extreme varieties of this species (var. rocheliana (Sternb.) Engler \& Irmscher, with flat rosettes of leaves $c .10 \times 2.5 \mathrm{~mm}$, and var. coriophylla (Griseb.) Engler, with columnar shoots of imbricate, recurved leaves $c .4 \times 1 \mathrm{~mm}$ ) has led many authors to treat them as species or subspecies, but they are connected to each other and to the type by a full range of intermediates and are not clearly separated geographically. Extreme examples of var. coriophylla can scarcely be distinguished from 99.
97. S. scardica Griseb., Spicil. Fl. Rumel. 1: 332 (1843). Like 96, differing chiefly in the acute or apiculate, dorsally keeled, grey-green leaves ( $5-14 \times 2-4 \mathrm{~mm}$ ), sometimes serrulate in the proximal half, and in the more numerous (4-12) flowers on each stem. Petals c. $7 \times 3.5 \mathrm{~mm}$, white or pink. Mountains of Balkan peninsula, from Crna Gora to S. Greece. Al Gr Ju.
98. S. spruneri Boiss., Diagn. Pl. Or. Nov. 1 (3): 18 (1843). Leafy shoots numerous, caespitose, columnar, forming large cushions. Leaves $4-6 \mathrm{~mm}$, obovate-oblong, obtuse, ciliate in basal half, with a narrow, hyaline border in apical half, glandularhairy on lower surface, erect, appressed. Flowering stems 4 8 cm , with 6-12 flowers in an irregular cyme. Petals $c .5 \times 2.5 \mathrm{~mm}$, white. - Mountains of Balkan peninsula, from N. Albania to C. Greece. Al Bu Gr ?Ju.
99. S. diapensioides Bellardi, App. Fl. Pedem. 21 (1792). Leafy shoots numerous, columnar, caespitose, forming a deep, rigid cushion. Leaves $4-6 \times 1-1.5 \mathrm{~mm}$, suberect, densely imbricate, oblong, obtuse, thick, glaucous, glabrous except for a few cilia near the base; margin hyaline. Flowering stems $3-7 \mathrm{~cm}$, glandu-lar-hairy, bearing 2-6 flowers. Petals $c .8 \times 5 \mathrm{~mm}$, white. $2 n=26$. Mountain rocks; calcicole. S.W. Alps, eastwards to Monte Rosa. Ga He It.
100. S. tombeanensis Boiss. ex Engler, Monogr. Gatt. Sax. 268 (1872). Like 99, differing chiefly in the leaves, which are slightly shorter, lanceolate, elliptical or rhombic, cucullate, with a
distinct incurved mucro, thinner, scarcely glaucous, and more conspicuously ciliate. Petals often up to 12 mm . Mountain rocks; calcicole. Italian Alps, from $10^{\circ} 30^{\prime}$ to $11^{\circ} 15^{\prime}$ E. It.
101. S. vandellii Sternb., Revis. Saxifr. 34 (1810). Leafy shoots numerous, columnar, caespitose, forming a dense, hard, deep cushion. Leaves $8-11 \times 1 \cdot 5-2 \mathrm{~mm}$, suberect, lanceolate-subulate, strongly apiculate, pungent, kecled below, not glaucous, ciliatedenticulate towards the base; margin hyaline. Flowering stems $4-8 \mathrm{~cm}$, bearing $3-8$ flowers in a compact corymb. Petals $c$. $9 \times 4 \mathrm{~mm}$, oblanceolate-cuneate, white. $2 n=26$. Limestone cliffs. - Italian Alps, from $9^{\circ} 15^{\prime}$ to $10^{\circ} 45^{\prime}$ E. It.
102. S. burserana L., Sp. Pl. 400 (1753). Shoots shorter than in 99-101, rather densely caespitose, forming a low cushion or thick mat. Leaves $5-12 \times 1 \cdot 2-2 \mathrm{~mm}$, linear-subulate, tapering from the base to an acute, pungent apex, glaucous, with a narrow, hyaline margin. Flowers solitary; peduncles $2-5 \mathrm{~cm}$, reddish; petals $7-15 \times 5-9 \mathrm{~mm}$, white. $2 n=26$. Rocks and screes; calcicole. - E. Alps, from $10^{\circ} 30^{\prime}$ eastwards. Au Ge It Ju.
103. S. juniperifolia Adams in Weber \& Mohr, Beitr. Naturk. 1: 53 (1806). Habit as in 101. Leaves $7-14 \times 1 \cdot 5-2 \cdot 5 \mathrm{~mm}$, erectopatent, linear-lanceolate or linear-oblong, strongly mucronate or apiculate, not glaucous or lime-encrusted, with a narrow hyaline border, denticulate at least in basal half. Flowering stem $2-4 \mathrm{~cm}$, leafy, bearing a compact cyme of $3-11$ subsessile flowers. Petals $5-6 \times 2-3 \mathrm{~mm}$, obovate-cuneate, acute, suberect, bright yellow, shorter than the stamens. Damp or shady mountain rocks. Bulgaria and N. Greece. Bu Gr.

Two rather ill-defined subspecies can be recognized:
(a) Subsp. juniperifolia: Leaves $10-14 \mathrm{~mm}$, entire at least in the apical third; inflorescence ovoid, not corymbose, with 6-11 flowers. Bulgaria. (Caucasus.)
(b) Subsp. sancta (Griseb.) D. A. Webb, Feddes Repert. 68: 208 (1963) (S. sancta Griseb.): Leaves $7-11 \mathrm{~mm}$, denticulate almost to the apex; inflorescence globose or subcorymbose, with 3-7 flowers. Greece (Athos, Olimbos). (Asia Minor.)
S. kotschyi Boiss., Diagn. Pl. Or. Nov. 3 (2): 65 (1856), a species from Asia Minor, which differs in its subacute, somewhat glaucous leaves, ciliate towards the base but not denticulate, and its lax inflorescence with pedicels $4-10 \mathrm{~mm}$, has been claimed for Europe on the strength of a single plant in a mixed sheet from C. Greece (Khiona), but requires confirmation.
104. S. ferdinandi-coburgi J. Kellerer \& Sünd., Allgem. Bot. Zeitschr. 1901: 116 (1901). Shoots numerous, columnar, caespitose, forming a dense, hard cushion. Leaves $5-7 \times 1-1.5 \mathrm{~mm}$, suberect, linear-oblong, with a short, incurved mucro and a narrow hyaline border, glaucous, glabrous except for a few cilia at the base. Flowering stem $3-7 \mathrm{~cm}$, with usually 7-13 flowers, stalked, in a fairly compact cyme. Petals $5-7 \mathrm{~mm}$, longer than the stamens, bright yellow. Mountains of Bulgaria and $N$. Greece. Bu Gr.
105. S. aretioides Lapeyr., Fig. Fl. Pyr. 28 (1801). Very like 104, but with slightly wider leaves, which are less glaucous, less obviously mucronate, and with a wider hyaline border, and with fewer (3-5) flowers with slightly larger petals. $2 n=26$.
Pyrenees, Cordillera Cantábrica. Ga Hs.
106. S. caesia L., Sp. Pl. 399 (1753). Leafy shoots densely caespitose, forming dense cushions, each shoot terminating in a small leaf-rosette. Leaves $3-6 \mathrm{~mm}$, oblong-spathulate to elliptical, obtuse, arcuate-recurved from near the base, very glaucous and lime-encrusted, without hyaline border, ciliate near the base.

Flowering stems $4-10 \mathrm{~cm}$, very slender, with 2-5 flowers. Calyx and pedicels glandular-hairy; lower part of flowering stem often nearly glabrous. Petals $4-6 \mathrm{~mm}$, broadly obovate, white. Rocks, screes and stony ground; calcicole. $2 n=26$. Mountains of C. \& S. Europe, from the Alps and W. Carpathians to the Pyrenees, C. Appennini and Crna Gora. $\mathrm{Au} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Hs} \mathrm{It} \mathrm{Ju} \mathrm{Po}$.
107. S. squarrosa Sieber, Flora (Regensb.) 4: 99 (1821). Like 106, but leafy shoots more densely packed, giving deeper, harder cushions; leaves slightly smaller, linear-oblong, subacute, suberect in lower part and arcuate-recurved only near the apex; flowering stems usually densely glandular-hairy towards the base and nearly glabrous in the inflorescence. Limestone rocks. - S.E. Alps. Au It Ju.
108. S. luteoviridis Schott \& Kotschy, Bot. Zeit. 9: 65 (1851) (S. corymbosa Boiss., non Lucé). Caespitose, with crowded leaf-rosettes. Leaves $13-20 \times 3-5 \mathrm{~mm}$, oblanceolate-lingulate, mucronate to subobtuse, entire, glaucous, often purple beneath. Flowering stem 4-13 cm; flowers rather numerous, in a panicle. Calyx densely covered with long, glandular hairs. Petals c. 3 mm , pale greenish-yellow, equalling or slightly exceeding the sepals. Limestone rocks above 1500 m . - E. \& S. Carpathians; Bulgaria. Bu Rm Rs (W).
(109-111). S. porophylla group. Leafy shoots rather densely caespitose, terminating in leaf-rosettes. Leaves linear to spathulate, entire, glaucous, lime-encrusted. Flowers subsessile in a spike-like raceme. Calyx large, campanulate, densely covered with long, deep red, glandular hairs. Petals purplish-pink, about equalling the sepals.

Constant in the inflorescence (which varies only in size and number of flowers), but very variable in leaf-shape. Both extremes are found in the Balkan peninsula; the Italian populations are intermediate. This has led to very diverse groupings by different authors. The arrangement here is tentative; fuller knowledge is required of the range of variation of plants from Albania and Crna Gora.

1 Leaves scarcely expanded towards the apex, acute or apiculate, seldom more than 2.5 mm wide 109. sempervivum
1 Leaves oblanceolate or spathulate, obtuse or mucronate, usually more than 2.5 mm wide
2 Leaves $10-30 \times 4-7 \mathrm{~mm}$, spathulate; flowering stem $10-18 \mathrm{~cm}$, with $15-25$ flowers
110. grisebachii

2 Leaves 6-15 $\times 2 \cdot 5-3.5 \mathrm{~mm}$, oblanceolate; flowering stem 5 8 cm , with 6-12 flowers
111. porophylla
109. S. sempervivum C. Koch, Linnaea 19: 40 (1846) (S. porophylla Bertol., var. sibthorpiana (Griseb.) Engler \& Irmscher; incl. S. media subsp. porophylla sensu Hayek, pro parte). Rosettes rather squarrose. Leaves $8-15 \times 1-3 \mathrm{~mm}$, linear or linearoblong, acute or apiculate. Flowering stem $8-14 \mathrm{~cm}$, with 7-20 flowers. Limestone rocks, usually above 1800 m . Balkan peninsula, from Crna Gora and C. Bulgaria southwards. Al Bu Gr Ju.
110. S. grisebachii Degen \& Dörfler, Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 64: 721 (1897) (S. media subsp. porophylla sensu Hayek, pro parte; incl. S. porophylla var. montenegrina (Halácsy \& Bald.) Engler \& Irmscher). Rosettes regular, flat. Leaves $10-30 \times 4-7 \mathrm{~mm}$, spathulate or oblanceolate, obtuse or mucronate. Flowering stem $10-18 \mathrm{~cm}$, with $15-25$ flowers. Limestone rocks. Balkan peninsula, from Crna Gora to $N$. Greece. Al Bu Gr Ju.
111. S. porophylla Bertol. in Desv., Jour. Bot. Appl. 4: 76 (1814). Rosettes fairly flat. Leaves $6-15 \times c .3 \mathrm{~mm}$, oblanceolate,
mucronate. Flowering stem 5-8 cm, with 6-12 flowers. Limestone rocks above $1000 \mathrm{~m} . \quad$ C. \& S. Italy. It.
112. S. stribrnyi (Velen.) Podp., Verh. Zool.-Bot. Ges. Wien 52 : 652 (1902). Leafy shoots rather densely caespitose, terminating in flat leaf-rosettes. Leaves $10-20 \times 4-6 \mathrm{~mm}$, oblong-spathulate, obtuse or mucronate, entire, glaucous, lime-encrusted. Inflorescence a panicle with $10-30$ flowers; pedicels $10-15 \mathrm{~mm}$. Calyx large, campanulate, densely covered with long, deep red, glandular hairs. Petals $c .4 \mathrm{~mm}$, about equalling the sepals, purplishpink. Rocks; calcicole. Bulgaria and N. Greece. Bu Gr.
113. S. media Gouan, Obs. Bot. 27 (1773). Like 112 but leaves $7-20 \times 2-4 \mathrm{~mm}$, linear-oblong to oblanceolate, acute or apiculate, in somewhat squarrose rosettes; flowers fewer (6-15), usually in a raceme; petals c. 2.5 mm . Rocks; calcicole. E. Pyrenees, westwards to $0^{\circ} 30^{\prime} E$. Ga Hs.
114. S. valdensis DC. in Lam. \& DC., Fl. Fr. ed. 3, 5: 517 (1815). Leafy shoots erect, densely caespitose, terminating in small leaf-rosettes, forming deep, hard, rather irregular cushions. Leaves 4-12 mm, linear to oblanceolate-spathulate, obtuse, entire, very glaucous and lime-encrusted; upper surface irregularly pitted. Flowering stems $5-12 \mathrm{~cm}$; cauline leaves longer than those of the rosettes. Flowers 5-12, in a corymbose panicle. Petals $5-6 \mathrm{~mm}$, white. $2 n=28$. Rock-crevices; generally calcicole. - S.W. Alps, from $44^{\circ} 30^{\prime}$ to $45^{\circ} 30^{\prime} \mathrm{N}$. Ga It.
115. S. callosa Sm. in Dickson, Coll. Dried Pl. 3: no. 63 (1791). Leaves variable in size and shape, entire or feebly erosecrenate, glaucous and lime-encrusted, often dark red near the base, mostly basal, in monocarpic rosettes; vegetative reproduction by short stolons which produce new rosettes. Flowers numerous, in an elongate, fairly narrow panicle, which usually occupies about half the flowering stem. Inflorescence glabrous, or with subsessile glands, or with a few, short glandular hairs. Pedicels slender, often reddish. Petals 6-9 mm, white, often with crimson spots, especially towards the base. Limestone rocks. - W. Mediterranean. Ga Hs It Sa Si.
(a) Subsp. callosa (S. lingulata Bellardi): Leaves $25-90 \times 2 \cdot 5-$ 6 mm , linear or oblanceolate, usually subacute. Peduncle and inflorescence eglandular, or with a very few scattered glandular hairs. $2 n=28$. Maritime Alps, Appennini, Sardegna, Sicilia.

The type, with long, narrow, linear leaves, is restricted to the eastern part of the Maritime Alps and the N. \& C. Appennini; plants with broader usually shorter, oblanceolate leaves, from the western Maritime Alps and from the C. \& S. Appennini and the islands, have been distinguished as $S$. lantoscana Boiss. and $S$. australis Moric. respectively. There are too many transitional forms to make recognition, even as subspecies, profitable, and it seems impossible, among the broader-leaved plants, to distinguish those from France from those from C. \& S. Italy.
(b) Subsp. catalaunica (Boiss.) D. A. Webb, Feddes Repert. 68: 208 (1963) (S. catalaunica Boiss.): Leaves $15-30 \times 4-6 \mathrm{~mm}$, oblanceolate, often acute. Inflorescence rather densely covered by subsessile glands. Peduncle glabrous or with glandular hairs. N.E. Spain (Monserrat); S.E. France (hills near Marseille).

The French plant is transitional to (a), but seems best placed here.
116. S. cochlearis Reichenb., Fl. Germ. Excurs. 559 (1832). Like 115, but smaller and more delicate; leaves $8-40 \times 2 \cdot 5-6 \mathrm{~mm}$, spathulate, with an expanded, suborbicular apical part; flowering stem $5-45 \mathrm{~cm}$; inflorescence glabrous or with a few glandular hairs; petals usually with numerous small red spots. $2 n=28$. Limestone rocks. - Maritime Alps; Liguria. Ga It.
117. S. crustata Vest, Bot. Zeit. (Regensb.) 3:314(1804). Leaves $15-60 \times 2-4 \mathrm{~mm}$, linear, entire, glaucous and lime-encrusted, in flat, densely caespitose rosettes. Flowering stem $12-30 \mathrm{~cm}$; panicle smaller and with fewer flowers than in 115, occupying about half the stem or less, each branch bearing 1-3 flowers. Pedicels glandular-hairy; hypanthium and calyx usually glabrous. Petals $4-6 \mathrm{~mm}$, white, sometimes with red spots. Limestone rocks. - E. Alps, extending southwards to C. Jugoslavia. Au It Ju.
118. S. cotyledon L., Sp. Pl. 398 (1753). Leaves $20-60 \times 9$ 15 mm , obovate-lingulate, mucronate, finely and regularly serrate, glaucous, forming large rosettes. Flowering stem $15-50 \mathrm{~cm}$, branched from near the base to form a large, pyramidal panicle of very numerous flowers. Pedicels and calyx glandular-hairy. Petals $6-10 \mathrm{~mm}$, white. $2 n=28$. Rocks; calcifuge. S. Alps; C. Pyrenees; W. Fennoscandia and Iceland. Au Ge He ?Hs Is It No Su.

The populations from N. Europe, the Alps and the Pyrenees differ slightly, and should perhaps be treated as subspecies.
119. S. paniculata Miller, Gard. Dict. ed. 8, no. 3 (1768) (S. aizoon Jacq.). Rather densely caespitose; leaves (5-)12-$40(-60) \times 2-8 \mathrm{~mm}$, more or less upwardly curved at the apex, forming hemispherical rosettes, obovate to oblong-lingulate, obtuse or acute, finely serrate, glaucous and usually limeencrusted. Flowering stem (4-)12-30 cm, branched only in its upper third to form a small panicle; branches patent or suberect, 1 - to 3 -flowered, glandular-hairy. Petals $4-6 \mathrm{~mm}$, white or pale cream, sometimes with small red spots. $2 n=28$. Throughout the mountains of C. \& S. Europe, from the Vosges and C. Poland to N. Spain, S. Italy and C. Greece; also very locally in Norway. AI $\mathrm{Au} \mathrm{Bu} \mathrm{Co} \mathrm{Cz} \mathrm{Ga} \mathrm{Ge} \mathrm{Gr} \mathrm{He} \mathrm{Hs} \mathrm{Hu} \mathrm{Is} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs} \mathrm{(W)}$.

Very variable in size and in leaf-shape. A distinct subspecies (subsp. cartilaginea (Willd.), D. A. Webb, Feddes Repert. 68: 208 (1963)), with apiculate or acuminate leaves, occurs in the Caucasus and Asia Minor; certain plants from the Balkan peninsula show some approach to it.
120. S. hostii Tausch, Syll. Pl. Nov. Ratisbon (Königl. Baier, Bot. Ges.) 2: 240 (1828). Like 119 but leaves less glaucous, and tending to curve downwards at the apex; larger in all its parts (leaves $20-100 \times 4-11 \mathrm{~mm}$; stem $25-60 \mathrm{~cm}$ ); paniclebranches mostly with at least 3 flowers; and petals rather larger $(5-8 \mathrm{~mm})$, almost always with numerous small red spots. Calcicole. - E. Alps, mainly on S. side. Au It Ju [No].
(a) Subsp. hostii (subsp. dolomitica $\mathrm{Br} .-\mathrm{Bl}$.): Leaves obtuse. From c. $10^{\circ} 30^{\prime}$ E. in Austria to c. $15^{\circ}$ E. in Slovenija.
(b) Subsp. rhaetica (Kerner) Br.-Bl. in Hegi, Ill. Fl. Mitteleur. 4 (2): 590 (1922). Leaves narrower, tapered gradually to an acute apex. Italian Alps, from $9^{\circ} 15^{\prime}$ to $10^{\circ} 45^{\prime} \mathrm{E}$.
121. S. mutata L., $S p$. Pl. 570 (1753). Leaf-rosettes few, laxly caespitose. Leaves $10-70 \times 7-12 \mathrm{~mm}$, lingulate-oblanceolate, obtuse, coriaceous, shining, dark green, with marginal hydathodes but not lime-encrusted, with a conspicuous hyaline border, entire distally, fimbriate-ciliate towards the base. Flowering stem stout, branched usually from the middle or below; flowers fairly numerous in a lax, densely glandular-hairy panicle. Petals $5-8 \mathrm{~mm}$, linear-lanceolate, acute, orange. Alps and adjacent regions; $S$. Carpathians. Au Ga He It Rm.
(a) Subsp. mutata: Stem $20-50 \mathrm{~cm}$; panicle with a distinct main axis. $2 n=28$. Alps and adjacent regions.

[^148]${ }^{2}$ By S. Pawłowska.
(b) Subsp. demissa (Schott \& Kotschy) D. A. Webb, Feddes Repert. 68: 209 (1963): Main axis of panicle usually atrophied, giving numerous racemes or slightly branched panicles, $6-20 \mathrm{~cm}$, from each rosette. S. Carpathians ( $25^{\circ}$ to $26^{\circ}$ E.).
(j) Monocarpic perennials without vegetative reproduction; leaves forming a long-lived rosette; ovary semi-inferior.
122. S. longifolia Lapeyr., Fig. Fl. Pyr. 1: 26 (1801). Leaves $30-80 \times 3-8 \mathrm{~mm}$, linear, somewhat expanded below the apex and then tapered to a subacute apex, entire or feebly erose-crenate, glabrous, glaucous, lime-encrusted, very numerous, forming a large, flat, regular rosette. Flowering stem $25-50 \mathrm{~cm}$, stout, branched from near the base to form a large, pyramidal panicle with very many flowers. Pedicels and hypanthium glandularhairy. Petals $5-6 \mathrm{~mm}$, white, rarely with fine red spots. $2 n=28$. Mountain cliffs; calcicole. Pyrenees and E. Spain. Ga Hs.
123. S. florulenta Moretti, Tent. Ill. Saxifr. 9 (1823). Like 122 in habit; very slow-growing and long-lived; dead leaves persistent, so that rosette eventually forms a low cylinder. Leaves $30-$ $60 \times 4-7 \mathrm{~mm}$ in mature plants, but considerably shorter in young ones, oblanceolate, apiculate or mucronate, coriaceous, dull, dark green, without hydathodes; margin cartilaginous, ciliate except near the apex. Inflorescence a long, narrow, glandular-hairy, thyrsoid panicle, shortly pedunculate. Petals $5-7 \mathrm{~mm}$, oblanceolate, acute, flesh-coloured. Carpels often 3; sometimes 5 in the terminal flower. $2 n=28$. Shady, vertical rocks above 1900 m.; calcifuge. Central part of Maritime Alps; rare andapparently decreasing. Ga It.

## 2. Bergenia Moench ${ }^{1}$

Like Saxifraga in floral structure, but of different habit, with stout, fleshy rhizome and very broad leaves, which are punctulate with totally immersed glands. Flowers 5 -merous; receptacle basin-shaped; stamens 10 ; ovary superior; carpels united only at base.

1. B. crassifolia (L.) Fritsch, Verh. Zool.-Bot. Ges. Wien 39: 587 (1889). A glabrous perennial, with creeping rhizome c. 2 cm in diameter. Leaves $15-30 \mathrm{~cm}$, all basal, thick, shining, broadly elliptic-obovate, obscurely sinuate-crenate and remotely denticulate with bristle-like teeth, punctulate on both surfaces; petiole sheathing at base. Flowering stems up to 30 cm , leafless, with numerous drooping flowers in a rather dense panicle. Petals $10-$ 12 mm , obovate, tapered to a broad claw, erect, bright purplishpink. Styles exceeding stamens. Cultivated for ornament and locally naturalized. [Au Ga.] (N. \& C. Asia.)

## 3. Chrysosplenium L. ${ }^{2}$

Perennial; leaves petiolate, entire or crenate. Flowers small, 4 -merous, in terminal, leafy, corymbose cymes. Petals absent. Stamens 8 (rarely 4). Ovary partly or almost wholly inferior.

Literature: H. Hara, Jour. Fac. Sci. Tokyo Univ. (Bot.) 7: 1 (1957).

1 Leaves alternate
2 Stamens 8; plant somewhat hairy 1. alternifolium
2 Stamens 4; plant almost glabrous
2. tetrandrum 1 Leaves opposite
3 Capsule asymmetrical, much exceeding the sepals; seeds suborbicular, furnished with conspicuous, bristle-like papillae 5. dubium

3 Capsule symmetrical, scarcely exceeding the sepals; seeds ovoid, very minutely papillose

4 Plant hairy, at least in lower part; leaves crenulate
3. oppositifolium

4 Plant glabrous; leaves $\pm$ entire
4. alpinum

1. C. alternifolium L., Sp. Pl. 398 (1753). Somewhat hairy, at least towards the base. Stems up to $20 \mathrm{~cm}, 3$-angled, arising from a mainly underground rhizome. Leaves mostly basal, orbicularreniform, deeply cordate, with numerous crenations or shallow lobes; petiole long. Cauline leaves alternate; bracts yellowish. Sepals c. 2 mm , patent, ovate, obtuse, yellowish. Stamens 8. Filaments and styles much shorter than sepals. Disc slightly 8 -lobed. Seeds smooth, shining, brown or almost black. $2 n=48$. Damp and shady places. Most of Europe, but absent from the extreme north and west and most of the Mediterranean region. Au $\mathrm{Be} \mathrm{Br} \mathrm{Bu} \mathrm{Cz} \mathrm{Da} \mathrm{Fe} \mathrm{Ga} \mathrm{Ge} \mathrm{He} \mathrm{Ho} \mathrm{?Hs} \mathrm{Hu} \mathrm{It} \mathrm{Ju} \mathrm{No} \mathrm{Po} \mathrm{Rm} \mathrm{Rs}$ ( $\mathrm{N}, \mathrm{B}, \mathrm{C}, \mathrm{W}, \mathrm{E}$ ) Su .
2. C. tetrandrum (N. Lund) Th. Fries, Bot. Not. 1858: 193 (1858). Like 1, but very nearly or quite glabrous; creeping stems epigeal, leafy; leaves with fewer crenations; inflorescence smaller, with green bracts; sepals green, erect, suborbicular- or triangularovate; stamens 4 (opposite the sepals); and disc smaller, 4-lobed. $2 n=24$. Wet places. Arctic Europe, extending southwards to $66^{\circ}$ N. in Finland. Fe No Rs (N) Sb Su.
3. C. oppositifolium L., Sp. Pl. 398 (1753). Laxly caespitose, with decumbent, rooting, leafy stems but without underground rhizome; hairy, at least towards the base. Leaves opposite, orbicular-ovate, crenulate or sinuate, truncate or shortly cuneate at the base, somewhat hairy on upper surface, thin, dark
glaucous-green; petioles rather long. Flowering stems up to $20 \mathrm{~cm}, 4$-angled. Flowers $c .4 \mathrm{~mm}$ in diameter; sepals ovate or triangular-ovate, yellow. Stamens 8; filaments slightly shorter than sepals. Capsule free from hypanthium in its upper third only. Seeds blackish, covered with glandular hairs about twice as long as thick. $2 n=42$. Damp and shady places. - W. Europe and parts of C. Europe, extending eastwards to W. Poland, C. Czechoslovakia and ?Slovenija. Be Br Cz Da Ga Ge Hb He Ho Hs It ?Ju Lu No Po.
4. C. alpinum Schur, Verh. Siebenb. Ver. Naturw. 10: 133 (1859). Like 3, but usually more densely caespitose and quite glabrous; leaves thicker, often wider than long, bright yellowishgreen; petioles shorter; flowering stems up to $10(-15) \mathrm{cm}$; sepals suborbicular, often wider than long, with cucullate apex; and seeds verrucose with very short hairs, which are scarcely longer than their diameter. Mountain springs and flushes. - E. Carpathians. Rm Rs (W).
5. C. dubium Gay ex Ser. in DC., Prodr. 4:48 (1830). Glabrous, stoloniferous. Leaves opposite, ovate or suborbicular, crenate, cuneate or rounded at base; petiole equalling or shorter than lamina. Flowering stems up to 15 cm . Sepals $1 \cdot 5-2 \mathrm{~mm}$, yellowishgreen. Disc distinctly 8 -lobed. Stamens 8. Filaments and styles much shorter than sepals. Capsule deeply bilobed, with unequal lobes, free from hypanthium in its upper two-thirds, considerably longer than sepals. Seeds suborbicular, furnished with conspicuous, bristle-like papillae in longitudinal rows. Mountains of S. Italy. It. (N. Africa and S.W. Asia.)

## LXXIV. PARNASSIACEAE ${ }^{1}$

Perennial herbs with undivided leaves. Flowers solitary, 5merous. Stamens 5, alternating with 5 nectariferous staminodes. Ovary superior; carpels 4; placentae parietal. Fruit a capsule.

## 1. Parnassia L. ${ }^{2}$

Leaves mostly basal. Stigmas 4, sessile. Seeds numerous.

1. P. palustris L., Sp. Pl. 273 (1753). Glabrous and somewhat glaucous. Stem $5-40 \mathrm{~cm}$, erect, usually bearing a single sessile leaf. Remaining leaves basal, petiolate, ovate to deltate-orbicular, cordate, often spotted with red beneath. Flowers $15-30 \mathrm{~mm}$ in diameter; petals white, with darker, semi-transparent veins; staminodes spathulate, terminating in 9-13 linear processes tipped with yellow-green glands. Wet places. Most of Europe, but rare in the south. Al Au Be Br Bu Cz Da Fe Ga Ge Gr Hb He Ho Hs Hu Is It Ju No Po Rm Rs (N, B, C, W, E) Su.

A variable species, in which the relation between phenotypic, ecotypic and geographical variation, and their relation to chromosome number, is not yet clear. Two European subspecies may be recognized, but intermediates are found in the Alps and elsewhere.
(a) Subsp. palustris: Cauline leaf ovate-orbicular, cordateamplexicaul, not far below the middle of the stem. Sepals considerably shorter than the petals or capsule. $2 n=18$. Throughout the range of the species, except the extreme north.
(b) Subsp. obtusiflora (Rupr.) D. A. Webb, Feddes Repert. 64: 25 (1961) (P. obtusiflora Rupr.): Cauline leaf often absent; if present, near the base of the stem and usually somewhat deltate, with truncate base, not amplexicaul. Sepals nearly as long as the petals and capsule. $2 n=36$. Arctic and subarctic Europe.

## LXXV. HYDRANGEACEAE ${ }^{1}$

Deciduous shrubs with opposite, simple, exstipulate leaves. Flowers regular; petals 4-5, free; stamens epigynous; ovary inferior, 3- or 4-locular. Fruit a capsule opening at the top; seeds numerous.
Sepals and petals 4 ; stamens c. 25; styles 4, united except at the apex

1. Philadelphus

Sepals and petals 5 ; stamens 10 ; styles 3 , free
2. Deutzia

## 1. Philadelphus L. ${ }^{2}$

Sepals and petals 4. Stamens numerous. Ovary 4-locular; styles united except at the apex.

Literature: S. Y. Hu, Jour. Arnold Arb. 36: 52 (1955).

1. P. coronarius L., Sp. Pl. 470 (1753) (P. pallidus Hayek ex C. K. Schneider). $1-3 \mathrm{~m}$, with numerous slender, dark brown twigs. Leaves $5-8 \mathrm{~cm}$, ovate to oblong-elliptical, acuminate,
remotely and finely toothed, shortly stalked, glabrous or sparingly hairy beneath. Flowers in short terminal racemes, strongly scented. Sepals triangular, acute. Petals $12-18 \mathrm{~mm}$, oblongelliptical, creamy white. Stamens c. 25 , shorter than the petals. Scrub or woodland on warm slopes. N. \& C. Italy; Austria; C. Romania. Au It *Rm [Cz Rs].

This plant has been a favourite in European gardens for centuries, and its origin is subject to some doubt. Stations where it is undoubtedly native are very few, and the cultivated plant, on which the Linnaean species is based, differs somewhat from wild specimens. P. caucasicus Koehne, Gartenfl. 1896: 508 (1896), which is cultivated and locally naturalized in S. Russia and Ukraine, does not seem to differ from the plant of C. Europe sufficiently to be considered specifically distinct.

## 2. Deutzia Thunb. ${ }^{1}$

Sepals and petals 5. Stamens 10. Ovary 3-locular; styles free.

1. D. scabra Thunb., Nov. Gen. Pl. 1: 20 (1781) (D. crenata Siebold \& Zucc.). 2-3 m; principal branches erect, with peeling bark. Leaves 4-8 cm, ovate, acute, finely serrate, shortly stalked, scabrid on both surfaces with white, stellate hairs. Flowers in small, erect panicles. Calyx and hypanthium tomentose. Petals $6-10 \mathrm{~mm}$, suberect, oblong or narrow-elliptical, white, often tinged with pink outside. Filaments broad, usually with conspicuous shoulders or lobes near the top. Cultivated for ornament; locally naturalized in C. Europe. [Au.] (China and Japan.)

## LXXVI. ESCALLONIACEAE ${ }^{2}$

Shrubs with alternate, simple, exstipulate leaves. Flowers hermaphrodite, 5 -merous, regular. Petals free; stamens 5; ovary inferior, of two carpels; placentae parietal, but large, so that the central cavity of the ovary is occluded. Fruit a capsule.

## 1. Escallonia Mutis ex L. fil. ${ }^{1}$

Evergreen shrubs. Flowers in racemes or panicles. Petals with their claws juxtaposed to form a tube; limb patent or revolute. Stigma capitate or somewhat 2-lobed. Seeds numerous.
Flowers $15-18 \mathrm{~mm}$ in diameter; calyx glandular-pubescent

1. macrantha

Flowers c. 8 mm in diameter; calyx glabrous
2. rubra

1. E. macrantha Hooker \& Arnott in Hooker, Bot. Misc. 3: 341 (1833). Densely branched shrub $2-3 \mathrm{~m}$; branches glandular-
pubescent. Leaves 3-6 cm, broadly obovate, subsessile, biserrate, glabrous, dark shining green, viscid with an aromatic, resinous secretion. Flowers $15-18 \mathrm{~mm}$ wide and about as long, in small, pyramidal panicles. Calyx glandular-pubescent; corolla bright pinkish-red; stamens very slightly exserted. Cultivated in W. Europe, especially in coastal districts for hedges, and locally naturalized in S. England and W. Ireland. [Br Hb.] (Chile.)
Sometimes treated as a variety of 2 , but very distinct as seen in cultivation.
2. E. rubra (Ruiz \& Pavon) Pers., Syn. Pl. 1: 235 (1805). Like 1, but less dense and with longer, flexuous branches; leaves 25 cm , obovate-lanceolate, glandular-ciliate towards the base, scarcely viscid; flowers $c .8 \mathrm{~mm}$ wide, in narrow panicles; calyx glabrous. Cultivated for ornament in W. \& S. Europe, and locally naturalized in S. France. [Ga.] (Chile and Argentina.)

## LXXVII. GROSSULARIACEAE ${ }^{2}$

Deciduous shrubs with alternate, exstipulate leaves. Flowers regular, 5 -merous, in racemes or small axillary clusters. Petals free. Stamens 5. Ovary inferior; styles 2, united below. Fruit a berry.

## 1. Ribes L. ${ }^{1}$

Small or medium-sized shrubs. Leaves palmately 3- or 5-lobed. Receptacle pelviform or nearly flat. Petals small, often greenish.
R. aureum Pursh, Fl. Amer. Sept. 1:164(1814), with bright yellow flowers and glabrous foliage, and R. sanguineum Pursh, loc. cit. (1814), with conspicuous, red or pink flowers in spring, both native to $W$. North America, are often cultivated and are partly naturalized in parts of C. Europe.
Literature: E. de Janczewski, Mém. Soc. Phys. Genève 35: 199 (1907).
1 Flowers in axillary clusters of 1-3
2 Leaves usually more than 20 mm wide; spines usually present; bracteoles present
6. uva-crispa

[^149]2 Leaves rarely 15 mm wide; spines absent; bracteoles absent
7. sardoum

1 Flowers in racemes
3 Functionally dioecious; bracts $4-10 \mathrm{~mm}$; leaves not more than 6 cm wide; axis of inflorescence glandular-hairy
4 Buds ovoid, obtuse; fruit glandular-hairy
9. orientale

4 Buds elongate, acute; fruit glabrous
8. alpinum

3 Flowers hermaphrodite; bracts $1-2 \mathrm{~mm}$; larger leaves 715 cm wide; axis of inflorescence without glandular hairs
5 Leaves covered beneath with sessile, aromatic glands 5. nigrum 5 Leaves without sessile glands
6 Sepals ciliate; leaves up to 15 cm wide
4. petraeum

6 Sepals not (or very sparsely) ciliate; leaves $6-10 \mathrm{~cm}$ wide
7 Sepals ligulate, deflexed 1. multiflorum
7 Sepals obovate or spathulate, erect or patent
8 Receptacle nearly flat, with a raised ring; anther-lobes widely separated 2. rubrum
8 Receptacle basin-shaped, without a raised ring; antherlobes contiguous on inner side
3. spicatum

1. R. multiflorum Kit. ex Roemer \& Schultes, Syst. Veg. 5: 493 (1819). $1 \cdot 5-2 \mathrm{~m}$. Leaves $c .10 \times 10 \mathrm{~cm}$, usually glabrous; petiole pubescent. Racemes drooping, up to 12 cm , with $30-50$ yellowgreen flowers. Bracteoles 1 mm . Receptacle pelviform with,
between stamens and styles, a raised ring bearing 5 large protuberances. Sepals ligulate, deflexed; petals much shorter, also deflexed. Fruit red, acid, glabrous. Balkan peninsula, C. Italy, Sardegna. Bu Gr It Ju Sa.
2. R. rubrum L., Sp. Pl. 200 (1753) (R. vulgare Lam., R. sylvestre (Lam.) Mert. \& Koch). $1-1.5 \mathrm{~m}$. Leaves c. $6 \times 7 \mathrm{~cm}$, cordate, nearly glabrous. Racemes inclined or drooping, rather lax, with $10-20$ pale green flowers, slightly tinged with purple. Receptacle nearly flat, with a raised ring between stamens and styles. Sepals orbicular-spathulate, patent. Petals very small. Anther-lobes separated by a connective as wide as themselves. Fruit red, acid, glabrous. $2 n=16$. Cultivated throughout Europe and naturalized in many countries; native only in the west. $\mathrm{Be} \mathrm{Ga} \mathrm{Ge} \mathrm{Ho} \mathrm{It}$.
3. R. spicatum Robson in With., Arr. Br. Pl. ed. 3, 2: 265 (1796) ( $R$. rubrum sensu Jancz. et auct. recent. nonnull., non L.; incl. R. pubescens (Hartman) T. Hedl., R. hispidulum (Jancz.) Pojark., R. schlechtendalii Lange). Very like 2 and often confused with it, but leaves usually larger and less cordate, varying from glabrous to tomentose on lower surface; receptacle pelviform, without a raised ring; and anthers about as long as wide, with the lobes almost contiguous on their inner face. $2 n=16$. N. \& $E$. Europe; sometimes cultivated in the east, but rarely naturalized outside its native territory. *Au Br Da Fe ?Ge No Po Rm Rs (N, $\mathrm{B}, \mathrm{C}, \mathrm{W}, \mathrm{E}) \mathrm{Su}[\mathrm{Cz}]$.

Variable in pubescence, leaf-shape and inflorescence. Several local populations have been described as species or subspecies, but the diagnoses are usually unsatisfactory in view of the variability of the species elsewhere. It seems probable that the arctic and subarctic populations (R. glabellum (Trautv. \& C. A. Meyer) T. Hedl., Bot. Notis. 1901: 98 (1901)) with nearly glabrous leaves, and those of E. European Russia (R. hispidulum (Jancz.) Pojark., Bull. Appl. Bot. Pl.-Breed. (Leningrad) 22: 339 (1929)) with small, usually glandular-hairy leaves, may be entitled to subspecific rank.
4. R. petraeum Wulfen in Jacq., Misc. Austr. Bot. 2: 36 (1781). $1-3 \mathrm{~m}$. Leaves up to $15 \times 15 \mathrm{~cm}$, glabrous or pubescent, sometimes bullate above and glandular beneath. Racemes $c .10 \mathrm{~cm}$, horizontal or drooping, with 20-35 pinkish, campanulate flowers. Sepals ciliate, orbicular-spathulate, the lower part erect, the upper patent. Petals half as long as sepals. Upper part of ovary protruding above the disc. Fruit dark purple-red, acid. Mountains of C. Europe, extending southwards to the Pyrenees, C. Italy and Bulgaria. Au Bu Cz Ga Ge He Hs Hu It Ju Po Rm Rs (W).
5. R. nigrum L., Sp. Pl. 201 (1753). 1-2 m. Leaves up to 10 cm wide, glabrous above, slightly pubescent and with numerous sessile, aromatic glands beneath. Racemes drooping. Flowers campanulate, reddish- or brownish-green; sepals oblong, recurved, pubescent; petals smaller, erect, whitish. Fruit up to 12 mm in diameter, black, sweetish and aromatic. $2 n=16$. Most of Europe, except the Mediterranean region; native certainly in C. \& E. Europe; cultivated and widely naturalized in the west, where its native limits are hard to ascertain. * $\mathrm{Au} * \mathrm{Be}^{*} \mathrm{Br} \mathrm{Bu} * \mathrm{Cz}$ *Da Fe Ga Ge *Ho *Hu It Ju *No Po Rm Rs (N, B, C, W, E) Su [Co Hb He .
6. R. uva-crispa L., Sp. Pl. 201 (1753) (R. grossularia L., Grossularia reclinata (L.) Miller). $1-1.5 \mathrm{~m}$, freely and intricately branched, and armed at the nodes with stout spines, usually in groups of 3 (very rarely absent). Leaves $2-5 \mathrm{~cm}$ wide, rarely more, rather deeply lobed, glabrous or pubescent. Flowers in axillary clusters of $1-3$; pedicels with 2 bracteoles near the middle. Sepals $5-7 \mathrm{~mm}$, ligulate, pale or pinkish-green; petals white, smaller. Fruit $c .10 \mathrm{~mm}$ in diameter, green, yellow or purple-red, usually hispid. $2 n=16$. Native in S., C. \& W. Europe; extensively cultivated and frequently naturalized by bird-dispersal in other areas. Au Be Br Bu Cr Cz Ga Ge Gr He Ho Hs Hu It Ju Po Rm Rs (W) [Co Da Fe Hb Lu No Rs (N, B, C) Su].
7. R. sardoum U. Martelli, Malpighia 8: 384 (1894). A small shrub, superficially resembling 6 , but without spines; with numerous subsessile glands on the leaves and young branches; with leaves only $10-13 \mathrm{~mm}$ wide and less deeply lobed; without bracteoles; apparently dioecious (only female flowers are known), with sepals 2-3 mm and ovary glabrous. - Sardegna (Oliena). Sa.
8. R. alpinum L., $S p$. Pl. 200 (1753). 1-2 m. Leaves $2-6 \mathrm{~cm}$, usually longer than wide, rather deeply 3-lobed, glabrous or sparsely hairy. Buds up to 10 mm , acute. Dioecious, but with rudimentary organs of the other sex. Flowers in glandularhispid racemes (longer in male plants), each flower subtended by a conspicuous bracteole $4-8 \times 1-2 \mathrm{~mm}$. Flowers small, rotate, greenish; sepals elliptical. Fruit scarlet, glabrous, insipid. $2 n=16 . N . \& C$. Europe, extending southwards in the mountains to N. Spain, C. Italy and Bulgaria. Au Br Bu Cz Da Fe Ga Ge He Hs Hu It Ju No Po Rm Rs (N, B, C) Su.
9. R. orientale Desf., Hist. Arb. 2: 88 (1809). Like 8, but with shorter, ovoid, obtuse buds; leaves usually as wide as long, and more thickly covered with glandular hairs; and fruit paler and glandular-hispid. C. \& S. Greece. Gr. (W. \& C. Asia.)

## LXXVIII. PITTOSPORACEAE ${ }^{1}$

Trees or shrubs. Leaves simple, usually entire, alternate, exstipulate. Flowers actinomorphic, usually hermaphrodite, solitary or cymose. Sepals 5, imbricate. Petals 5, imbricate, often connate by the claws; limb recurved or patent. Stamens 5, hypogynous, free. Ovary superior, with 2 , rarely $3-5$ carpels. Fruit a capsule or berry.

## 1. Pittosporum Gaertner ${ }^{2}$

Trees or shrubs. Leaves often clustered at the end of the shoots, usually evergreen. Flowers solitary or in terminal corymbose or
${ }^{1}$ Edit. T. G. Tutin.
${ }^{2}$ By J. do Amaral Franco.
umbellate cymes. Fruit a capsule, with 2-4 leathery or woody valves. Seeds not winged, immersed in a viscid substance.

Leaves obtuse, white-tomentose beneath; petals blackish-purple; capsule tomentose, with 3-4 woody valves 1. crassifolium Leaves acute, glabrous; petals white; capsule glabrous, with 2 coriaceous valves
2. undulatum

1. P. crassifolium Putterl., Syn. Pittosp. 12 (1839). An erect, evergreen shrub or small tree up to 10 m , with black bark and a subfastigiate crown. Leaves $5-8 \times 2-3 \mathrm{~cm}$, obovate-oblong to oblong, obtuse, dark green above and white-tomentose beneath, very coriaceous. Flowers in few-flowered umbellate cymes.

Petals blackish-purple, oblong. Capsule $20-28 \mathrm{~mm}$, subglobose, white-tomentose, with 3-4 woody valves. Cultivated for ornament and shelter in parts of W. Europe ; naturalized in the Isles of Scilly. [Br.] (New Zealand.)
P. tobira (Thunb.) Aiton fil., Hort. Kew. ed. 2, 2: 27 (1811), from S. Japan and E. China, with leaves of similar shape but glabrous, and with white or yellowish, fragrant flowers, is cultivated for ornament in parts of S. \& W. Europe.
2. P.undulatum Vent., Descr.Pl.Jard. Cels. t. 76(1802). Glabrous tree up to 20 m , with grey bark and a pyramidal crown. Leaves 7$13 \times 2-5 \mathrm{~cm}$ (on vigorous shoots up to $20 \times 6 \mathrm{~cm}$ ), ovate-lanceolate, acute, cuneate at base, shining green, thin, usually undulate, evergreen. Flowers fragrant, in few-flowered umbellate cymes. Petals white, lanceolate. Capsule $10-12 \mathrm{~mm}$, obovoid, glabrous, orange when ripe, with 2 valves. Widely cultivated for ornament in S. \& W. Europe; extensively naturalized in the Açores and locally elsewhere. [Az Lu.] (S.E. Australia.)

## LXXIX. PLATANACEAE ${ }^{1}$

Trees with scaling bark. Monoecious; flowers arranged in globose unisexual capitula. Perianth 4 - or 6 -merous, arranged in two whorls. Stamens 4-6, opposite the outer perianth-segments. Ovary superior; carpels 3-6, free, each with 1(2) pendulous, orthotropous ovules.

## 1. Platanus L. ${ }^{2}$

Leaves alternate; lamina palmately lobed; petiole with dilated base, enclosing the bud. Filaments of stamens very short. Carpels in fruit obpyramidal, indehiscent, surrounded at the base by long hairs.

Leaves lobed to beyond the middle, cuneate at base; female capitula usually 3-6 1. orientalis Leaves lobed at most to the middle, truncate or cordate at base; female capitula usually 2 2. hybrida
${ }^{1}$ Edit. T. G. Tutin.
${ }^{2}$ By T. G. Tutin.

1. P. orientalis L., Sp. Pl. 999 (1753). Up to 30 m . Leaves 5to 7-lobed; central lobe much longer than its width at base; all lobes coarsely dentate, rarely entire. Capitula (2-)3-6(-7) on a long pendulous axis. - Balkan peninsula southwards from c. $42^{\circ} \mathrm{N}$. ; Kriti; often planted elsewhere. Al Bu Cr Gr Ju.
2. P. hybrida Brot., Fl. Lusit. 2: 487 (1804) (P. acerifolia (Aiton) Willd., P. cuneata Willd.). Like 1 but leaves lobed at most to the middle; central lobe little longer than its width at base. Capitula nearly always 2. $2 n=42$. Commonly planted in much of Europe, especially as a roadside tree.

It has been suggested that this tree is a hybrid between P. occidentalis L., from North America and $\mathbf{1}$ or, alternatively, that it is a cultivar of 1. As its origin is unknown there seems at present to be no means of deciding between these possibilities.

## APPENDICES

## NOTE TO APPENDICES I-III

Considerable variation is found in the orthography of the names of many authors, especially of the earlier ones and of those whose names are transliterated from cyrillic script. Variant spellings are given here only if they are likely to give rise to doubts about identity.

The initials used by some authors vary according to whether the vernacular or latinized form of a Christian name is used (e.g. Karl or Carolus); the form most frequently used by the author is adopted in these lists.

The dates given for books and periodicals indicate, as far as can be ascertained, the date of effective publication; this may differ from the date on the title-page.

The data given for periodicals are intended to be sufficient only for the identification of the periodical and volume cited. Fuller bibliographical data on all periodicals cited will be published in a later volume.

Certain publications are of a character intermediate between books and periodicals. These, together with a few short-lived periodicals which are traditionally cited as books, will mostly be found in Appendix II.

## APPENDIX I

## KEY TO THE ABBREVIATIONS OF AUTHORS' NAMES CITED IN VOLUME I

Abromeit J. Abromeit (1857-1946)
Acht. B. Achtarov (1885-1959)
Adamović L. Adamović (1864-1935)
Adams M. F. Adams (J. F. Adam) (1780-1833)
Adanson M. Adanson (1727-1806)
Ade A. Ade (fl. 1900)
Aellen P. Aellen (b. 1896)
Ahlfvengren F. E. Ahlfvengren (1862-1921)
Ahti T. Ahti (b. 1933)
Aichele D. Aichele (b. 1928)
Aiton W. Aiton (1731-1793)
Aiton fil. W. T. Aiton (1766-1849)
Albov N. M. Albov (Alboff) (1866-1897)
Alexeenko M. I. Alexeenko (Alexejenko) (b. 1905)
All. C. Allioni (1728-1804)
Alston A. H. G. Alston (1902-1958)
Ambrosi F. Ambrosi (1821-1897)
Amo Mariano del Amo y Mora (1809-1894)
Anderson, G. G. Anderson (d. 1817)
Andersson, N. J. N. J. Andersson (1821-1880)
Andrasovszky J. Andrasovszky (1889-1933)
Andrews H. C. Andrews (d. 1830)
Andrz. A. L. Andrzejowski (1785-1868)
Ångström J. Ångström (1813-1879)
Antoine F. Antoine (1815-1886)
Arcangeli G. Arcangeli (1840-1921)
Ard. P. Arduino (1728-1805)
Arnold (possibly a pseudonym; fl. 1785)
Arnott G. A. W. Arnott (1799-1868)
Arrh., A. J. I. A. Arrhenius (b. 1858)
Ascherson P. F. A. Ascherson (1834-1913)
Aspegren G. C. Aspegren (1791-1828)
Asso I. J. de Asso y del Rio (1742-1814)
Aublet J. B. C. F. Aublet (1720-1778)
Aucher P. M. R. Aucher-Eloy (1792-1838)
Avé-Lall. J. L. E. Avé-Lallemant (1803-1867)
Aznav. G. V. Aznavour (fl. 1896-1911)
Bab. C. C. Babington (1808-1895)
Badaro G. B. Badaro (1793-1831)
Bailly E. Bailly (fl. 1890)
Baker J. G. Baker (1834-1920)
Balansa B. Balansa (1825-1891)
Balbis G. B. Balbis (1765-1831)
Bald. A. Baldacci (1867-1950)
Balf. J. H. Balfour (1808-1884)
Balk. B. E. Balkovsky (b. 1899)
Ball J. Ball (1818-1889)
Ball, P. W. P. W. Ball (b. 1932)
Banks J. Banks (1743-1820)
Barbarich A. Barbarich (b. 1903)
Barbey, W. W. Barbey-Boissier (1842-1914)
Barc. F. Barceló y Combis (d. 1889)
Barkoudah Y. I. Barkoudah (b. 1933)
Bartl. F. G. Bartling (1798-1875)
Basil. N. A. Basilevskaja (Bazilevskaja) (b. 1902)
Bast. T. Bastard (1784-1846)

Batt. J. A. Battandier (1848-1922)
Baumg. J. C. G. Baumgarten (1765-1843)
Beauv. A. M. F. J. Palisot de Beauvois (1752-1820)
Beauverd G. Beauverd (1867-1942)
Becherer A. Becherer (b. 1897)
Bechst. J. M. Bechstein (1757-1822)
Beck, G. G. Beck von Mannagetta (1856-1931)
Becker, A. Alexander Becker (1818-1901)
Béguinot A. Béguinot (1875-1940)
Bellardi C. A. L. Bellardi (1741-1826)
Benn., Ar. Arthur Bennett (1843-1929)
Benson, L. L. D. Benson (b. 1909)
Bentham G. Bentham (1800-1884)
Berger, A. A. Berger (1871-1931)
Bergeret, J. P. J. P. Bergeret (1751-1813)
Bernard P. F. Bernard (1749-1825)
Bernh. J. J. Bernhardi (1774-1850)
Berth. S. Berthelot (1794-1880)
Bertol. A. Bertoloni (1775-1869)
Besser W. S. J. G. von Besser (1784-1842)
Biasol. B. Biasoletto (1793-1859)
Bieb. F. A. Marschall von Bieberstein (1768-1826)
Bigelow J. Bigelow (1787-1879)
Bihari J. Bihari (fl. 1928)
Billot P. C. Billot (1796-1863)
Binz A. Binz (1870-1963)
Biria J. A. J. Biria (fl. 1810)
Biv. A. de Bivona-Bernardi (1774-1837)
Blanche E. Blanche (1824-1908)
Błocki B. Błocki (1857-1917)
Bluff M. J. Bluff (1805-1837)
Blytt M. N. Blytt (1789-1862)
Bobrov E. G. Bobrov (b. 1902)
Boenn. C. M. F. von Boenninghausen (1785-1864)
Boguslaw I. A. Boguslaw (fl. 1846)
Boiss. P. E. Boissier (1810-1885)
Bolós, A. A. de Bolós (b. 1899)
Bolós, O. O. de Bolós (b. 1924)
Bolton J. Bolton (c. 1758-1799)
Bolus, L. L. H. M. Bolus (Mrs F. Bolus) (b. 1877)
Bong. H. G. von Bongard (1786-1839)
Bonjean J. L. Bonjean (1780-1846)
Bonnet E. Bonnet (1848-1922)
Bonnier G. E. M. Bonnier (1853-1922)
Bonpl. A. J. A. Bonpland (1773-1858)
Borbás V. von Borbás (1844-1905)
Bord. H. Bordère (1825-1889)
Bordzil. E. I. Bordzilowski (1875-1949)
Boreau A. Boreau (1803-1875)
Borhidi A. Borhidi (b. 1932)
Boriss. A. G. Borissova-Bekrjaševa (b. 1903)
Borkh. M. B. Borkhausen (1760-1806)
Börner C. Börner (b. 1880)
Bornm. J. F. N. Bornmüller (1862-1948)
Bory J. B. G. M. Bory de St Vincent (1778-1846)
Borza A. Borza (b. 1887)

Borzi A. Borzi (1852-1911)
Bosc L. A. G. Bosc (1759-1828)
Botsch. V. P. Botschantzev (b. 1910)
Boulay N. J. Boulay (1837-1905)
Bourgeau E. Bourgeau (1813-1877)
Bout. J. F. D. Boutigny (1820-1884)
Boutelou E. Boutelou (1776-1813)
Bouvet G. Bouvet (1874-1929)
Br., N.E. N. E. Brown (1849-1934)
Br., R. R. Brown (1773-1858)
Brackenr. W. D. Brackenridge (fl. 1838-1854)
Brandza D. Brandza (1846-1895)
Braun, A. A. C. H. Braun (1805-1877)
Braun, J. J. Braun (later J. Braun-Blanquet) (b. 1884)
Br.-BI. J. Braun-Blanquet (b. 1884)
Breistr. M. Breistroffer (b. 1906)
Brenan J. P. M. Brenan (b. 1917)
Briq. J. I. Briquet (1870-1931)
Britton N. L. Britton (1859-1934)
Brot. F. de Avellar Brotero (1744-1828)
Brouss. P. M. A. Broussonet (1761-1807)
Brügger C. G. Brügger (1833-1899)
Brummitt R. K. Brummitt (b. 1937)
Bruno - Bruno (fl. 1760)
Bubani P. Bubani (1806-1888)
Buchanan-White F. Buchanan-White (1842-1894)
Buchholz F. Buchholz (1872-1924)
Buffon G. L. L. de Buffon (1707-1788)
Bunge A. A. von Bunge (1803-1890)
Burgsd. F. A. L. von Burgsdorff (1747-1802)
Burm. fil. N. L. Burman (N. L. Burmannus) (1734-1793)
Burnat E. Burnat (1828-1920)
Burtt, B. L. B. L. Burtt (b. 1913)
Busch, N. N. A. Busch (1869-1941)
Buschm. A. Buschmann (b. 1908)
Cadevall J. Cadevall i Diars (1846-1910)
Camb. J. Cambessedes (1799-1863)
Campd. F. Campderá (fl. 1819)
Camus, A. A. A. Camus
Camus E. G. Camus (1852-1915)
Cañigueral J. Cañigueral Cid
Cariot A. Cariot (1820-1883)
Carrière E. A. Carrière (1818-1896)
Caruel T. Caruel (1830-1898)
Cast. J. L. M. Castagne (1785-1858)
Cav. A. J. Cavanilles (1745-1804)
Cavara F. Cavara (1857-1929)
Celak. L. J. Čelakovsky (1834-1902)
Cesati V. de Cesati (1807-1883)
Chaix D. Chaix (1730-1799)
Cham. L. A. von Chamisso (L.C.A. Chamisseau de Boncourt) (1781-1838)
Charrel L. Charrel ('Abd-ur-Rahmān-Nadji) (fl. 1888)
Chater A. O. Chater (b. 1933)
Chaub. L. A. Chaubard (1785-1854)
Chenevard P. Chenevard (1839-1919)
Chevall. F. F. Chevallier (1796-1840)
Chiarugi A. Chiarugi (1901-1960)
Ching, R.-C. Ren-Chang Ching (Jên-ch'ang Ch'in) (b. 1899)
Chiov. E. Chiovenda (1871-1940)
Chowdhuri P. K. Chowdhuri (fl. 1960)
Chr., C. C. F. A. Christensen (1872-1942)
Christ H. Christ (1833-1933)
Christm. G. F. Christmann (b. 1752)
Chrtek J. Chrtek (b. 1931)
Clairv. J. P. de Clairville (1742-1830)

Clapham A. R. Clapham (b. 1904)
Clarke, E. D. E. D. Clarke (1779-1822)
Claus K. Claus (1796-1864)
Clavaud A. Clavaud (d. 1890)
Clemente S. de Rojas Clemente y Rubio (1777-1827)
Clementi, G. C. G. C. Clementi (1812-1873)
Clerc O. E. Clerc (1845-1920)
Coincy A. de Coincy (1837-1903)
Colla L. A. Colla (1766-1848)
Colmeiro M. Colmeiro y Penido (1816-1901)
Comolli G. Comolli (1780-1859)
Conr. P. Conrath (b. 1892)
Conti, P. P. Conti (1874-1898)
Copel. E. B. Copeland (b. 1873)
Corb. L. Corbière (1850-1941)
Corr. C. F. J. E. Correns (1864-1933)
Cosent. F. Cosentini (1769-1840)
Cosson E. S. C. Cosson (1819-1889)
Costa A. C. Costa y Cuxart (1817-1886)
Coste H. J. Coste (1858-1924)
Coulter J. M. Coulter (1851-1928)
Court. R. J. Courtois (1806-1835)
Coutinho A. X. Pereira Coutinho (1851-1939)
Covas G. Covas (b. 1915)
Craib W. G. Craib (1882-1933)
Crantz H. J. N. von Crantz (1722-1799)
Crépin F. Crépin (1830-1903)
Cuatrec. J. Cuatrecasas (b. 1903)
Cullen J. Cullen (b. 1936)
Curtis W. Curtis (1746-1799)
Cutanda V. Cutanda (1804-1865)
Cyr. D. Cyrillo (1739-1799)
Czecz. H. Czeczott (fl. 1925-1939)
Czern. V. M. Czernajew (Czernjaew) (1796-1871)
Czetz A. Czetz (1801-1865)
Dahl, O. C. O. C. Dahl (1862-1940)
Dalla Torre K. W. von Dalla Torre (1850-1928)
Damanti P. Damanti (b. 1858)
Dandy J. E. Dandy (b. 1903)
Danser B. H. Danser (1891-1943)
Davidov B. Davidov (b. 1870)
Davis, P. H. P. H. Davis (b. 1918)
DC. A. P. de Candolle (1778-1841)
DC., A. A. L. P. P. de Candolle (1806-1893)

De Bary H. A. de Bary (1831-1888)
Debeaux J. O. Debeaux (1826-1910)
Decken C. C. von der Decken (1833-1865)
Decker P. Decker (b. 1867)
Decne J. Decaisne (1807-1882)
Degen A. von Degen (1866-1934)
Delarbre A. Delarbre (1724-1841)
De Lens - De Lens (fl. 1828)
Delile A. R. Delile (1778-1850)
Delponte J. B. Delponte
Dennst. A. W. Dennstedt (fl. 1800-1820)
De Not. G. de Notaris (1805-1877)
Desf. R. L. Desfontaines (1750-1833)
Desmoulins C. Desmoulins (1797-1875)
Desr. L. A. J. Desrousseaux (1753-1838)
Desv. A. N. Desvaux (1784-1856)
Deville L. Deville (fl. 1859)
Dickson J. Dickson (1738-1822)
Diels F. L. E. Diels (1874-1945)
Dietr., A. A. Dietrich (1795-1856)
Dietr., D. D. N. F. Dietrich (1800-1888)
Dingler H. Dingler (fl. 1878-1927)

Dippel L. Dippel (1827-1914)
Dode L. A. Dode (1875-1943)
Döll J. C. Döll (1808-1885)
Dolliner G. Dolliner (1794-1872)
Domac R. Domac (b. 1918)
Domin K. Domin (1882-1952)
Domokos J. Domokos (b. 1904)
Don, D. D. Don (1799-1841)
Don, G. G. Don (1764-1814)
Don fil., G. G. Don (1798-1856)
Donn J. Donn (1758-1813)
Dörfler I. Dörfler (1866-1950)
Dostál J. Dostál (b. 1903)
Douglas D. Douglas (1798-1834)
Drejer S. T. N. Drejer (1813-1842)
Dreves J. F. P. Dreves (1772-1816)
Druce G. C. Druce (1850-1932)
Dubois, F. F. N. A. Dubois (1752-1824)
Duby J. E. Duby (1798-1885)
Duchartre P. E. S. Duchartre (1811-1894)
Dudley, T. R. T. R. Dudley (b. 1936)
Dufour J.-M. L. Dufour (1780-1865)
Duh. H. L. Duhamel du Monceau (1700-1781)
Dumort. B. C. J. Dumortier (1797-1878)
Dunal M. F. Dunal (1789-1856)
Durieu M. C. Durieu de Maisonneuve (1796-1878)
Duroi J. P. Duroi (1741-1785)
D'Urv. J. S. C. D. D'Urville (1790-1842)
Duthie J. F. Duthie (1845-1922)
Du Tour - Du Tour de Salvert (fl. 1803-1815)
Duval-Jouve J. Duval-Jouve (1810-1883)
Dyer W. T. Thiselton-Dyer (1843-1928)
Edgew. M. P. Edgeworth (1812-1881)
Edmondston T. Edmondston (1825-1846)
Ehrh. J. F. Ehrhart (1742-1795)
Eig A. Eig (1894-1938)
Ekman, Elis. H. M. E. A. E. Ekman (1862-1936)
Elkan L. Elkan (1815-1851)
Emberger M. L. Emberger (b. 1897)
Enander S. J. Enander (1847-1928)
EndI. S. L. Endlicher (1804-1849)
Engelm. G. Engelmann (1809-1884)
Engler H. G. A. Engler (1844-1930)
Facch. F. Facchini (1788-1852)
Farwell O. A. Farwell (1867-1944)
Fauché - Fauché
Fedde F. K. G. Fedde (1873-1942)
Fedtsch., B. B. A. Fedtschenko (1872-1947)
Fée A. L. A. Fée (1789-1874)
Fenzl E. Fenzl (1808-1879)
Fernald M. L. Fernald (1873-1950)
Fernandes, A. A. Fernandes (b. 1906)
Fernandes, R. R. Fernandes (b. 1916)
Fieschi - Fieschi (fl. 1932)
Fil. N. Filarszky (1858-1941)
Fingerh. K. A. Fingerhuth (1802-1876)
Fiori A. Fiori (1865-1950)
Fischer F. E. L. von Fischer (1782-1854)
Fischer von Wald. A. A. Fischer von Waldheim (1803-1884)
Fitschen J. Fitschen (d. 1947)
Flod., B. B. G. O. Floderus (1867-1941)
Flügge J. Flügge (1775-1816)
Foggitt W. Foggitt (1835-1917)
Fomin A. V. Fomin (1869-1935)
Font Quer P. Font Quer (1888-1964)
Form. E. Formánek (1845-1900)

Forskål P. Forskål (1732-1763)
Forster fil. J. G. A. Forster (1754-1794)
Fouc. J. Foucaud (1847-1904)
Foug. A. D. Fougeroux de Bondaroy (1732-1789)
Fourn., E. E. P. N. Fournier (1834-1884)
Fourn., P. P. Fournier (b. 1877)
Fourr. J. P. Fourreau (1844-1871)
Franco J. do Amaral Franco (b. 1921)
Franklin J. Franklin (1786-1847)
Fraser, Neill P. Neill Fraser (1830-1905)
Freyc. L. C. Desaulses de Freycinet (1779-1842)
Freyn J. F. Freyn (1845-1903)
Friedrich H. Friedrich (b. 1925)
Fries E. M. Fries (1794-1878)
Fries, Th. T. M. Fries (1832-1913)
Fritsch K. Fritsch (1864-1934)
Fritze R. Fritze (fl. 1870)
Friv. E. Frivaldszky von Frivald (I. Frivaldszky) (1799-1870)
Fröhlich J. A. von Fröhlich (1766-1841)
Fuchs, H. P. H. P. Fuchs (b. 1928)
Fuss M. Fuss (1814-1883)
Gaertner J. Gaertner (1732-1791)
Gaertner, P. P. G. Gaertner (1754-1825)
Gand. M. Gandoger (1850-1926)
Garcke F. A. Garcke (1819-1904)
Gariod H. Gariod (fl. 1872)
Gars. F. A. de Garsault (1691-1776)
Gartner, H. H. Gartner (f. 1939)
Gaspar. G. Gasparrini (1804-1866)
Gaud.-Beaup. C. Gaudichaud-Beaupré (1789-1854)
Gaudin J. F. A. T. G. P. Gaudin (1766-1833)
Gaussen H. Gaussen (b. 1891)
Gavioli O. Gavioli (1871-1944)
Gay J. E. Gay (1786-1864)
Gáyer G. Gáyer (1883-1932)
Genn. P. Gennari (1820-1897)
Georgescu C. C. Georgescu (b. 1898)
Georgi J. G. Georgi (1729-1802)
Germ. J. N. E. Germain de Saint-Pierre (1815-1882)
Gibelli G. Gibelli (1831-1898)
Gilib. J. E. Gilibert (1741-1814)
Gillet C. C. Gillet (1806-1896)
Gillies J. Gillies (1747-1836)
Gillot F. X. Gillot (1842-1910)
Ginzberger A. Ginzberger (1873-1940)
Giraud. L. Giraudias (b. 1848)
Gled. J. G. Gleditsch (1714-1786)
Gmelin, C. C. C. C. Gmelin (1762-1837)
Gmelin, J. F. J. F. Gmelin (1748-1804)
Gmelin, J. G. J. G. Gmelin (1709-1755)
Gmelin, S. G. S. G. Gmelin (1744-1774)
Godet C. H. Godet (1797-1879)
Godron D. A. Godron (1807-1880)
Goffart J. Goffart (1864-1954)
Goldie J. Goldie (1793-1886)
González-Albo J. González-Albo (fl. 1935)
Goodding L. N. Goodding (b. 1880)
Gordon G. Gordon (1806-1879)
Gorodkov B. N. Gorodkov (1890-1953)
Gorschk. S. G. Gorschkova (b. 1889)
Görz, R. R. Görz (1879-1935)
Gouan A. Gouan (1733-1821)
Grab. H. E. Grabowski (1792-1842)
Graebner K. O. P. P. Graebner (1871-1933)
Graells M. de la P. Graells (?1818-1898)
Graham, R. C. R. C. Graham (1786-1845)

Gram, K. K. J. A. Gram (1897-1961)
Grande L. Grande (fl. 1904-1914)
Gray, A. A. Gray (1810-1888)
Gray, S. F. S. F. Gray (1766-1828)
Grec. D. Grecescu (1841-1910)
Greene, E. L. E. L. Greene (1843-1915)
Gremli A. Gremli (1833-1899)
Gren. J. C. M. Grenier (1808-1875)
Grev. R. K. Greville (1794-1866)
Grimm J. F. K. Grimm (1737-1821)
Grinţ., G. G. P. Grinţescu (1870-1947)
Griseb. A. H. R. Grisebach (1814-1879)
Gröntved J. Gröntved (1882-1956)
Gross, H. H. Gross (b. 1888)
Grossh. A. A. Grossheim (1888-1948)
Gruner L. F. Gruner (fl. 1868)
Gueldenst. I. A. Gueldenstaedt (1745-1781)
Guérin J. X. B. Guérin (1775-1850)
Guersent L. B. Guersent (1776-1848)
Guicc. G. Guicciardi (fl. 1855)
Guinea E. Guinea (b. 1907)
Guinier P. Guinier (b. 1876)
Gulia G. Gulia (1835-1889)
Gunnarsson J. G. Gunnarsson (1866-1944)
Gunnerus J. E. Gunnerus (1718-1773)
Gürke R. L. A. M. Gürke (1854-1911)
Guss. G. Gussone (1787-1866)
Guşuleac M. Guşuleac (1887-1960)
Guterm. W. Gutermann (b. 1935)
Guthnick H. J. Guthnick (1800-1870)
Habl. C. von Hablitz (1752-1821)
Hacq. B. A. Hacquet (1739-1815)
Hadač E. Hadač (b. 1914)
Haenke T. Haenke (1761-1817)
Haenseler F. Haenseler (1766-1841)
Hahne A. Hahne (1873-1942)
Halácsy E. von Halácsy (1842-1913)
Haller A. von Haller (1708-1777)
Haller fil. A. von Haller (1758-1823)
Halliday G. Halliday (b. 1933)
Hamet R. Hamet (fl. 1910-1960)
Hampe G. E. Hampe (1795-1880)
Hand.-Mazz. H. von Handel-Mazzetti (1882-1940)
Hartig H. J. A. R. Hartig (1839-1901)
Hartinger A. Hartinger (b. 1806)
Hartman K. J. Hartman (1790-1849)
Hartweg K. T. Hartweg (1812-1871)
Hausskn. H. K. Haussknecht (1838-1903)
Haw. A. H. Haworth (1768-1833)
Hayek A. von Hayek (1871-1928)
Haynald S. F. L. Haynald (1816-1891)
Hayne F. G. Hayne (1763-1832)
Häyrén E. F. Häyrén (1878-1957)
Hedberg K. O. Hedberg (b. 1923)
Hedl., T. T. Hedlund (1861-1953)
Hedley G. W. Hedley (1871-1941)
Heer O. Heer (1809-1883)
Hegelm. C. F. Hegelmaier (1834-1906)
Hegetschw. J. J. Hegetschweiler (1789-1839)
Hegi G. Hegi (1876-1932)
Heimans J. Heimans (b. 1889)
Heldr. T. von Heldreich (1822-1902)
Hendrych R. Hendrych (b. 1926)
Henry, A. A. Henry (1857-1930)
Henry, Louis Louis Henry (1853-1913)
Hepper F. N. Hepper (b. 1929)

Herbich F. Herbich (1791-1865)
Hermann, F. F. Hermann (b. 1873)
Herter W. G. Herter (1884-1958)
Hervier J. Hervier-Basson (b. 1846)
Hess, H. H. Hess (b. 1920)
Heuffel J. Heuffel (1800-1857)
Heukels H. Heukels (1854-1936)
Heynh. G. Heynhold (fl. 1850)
Heywood V. H. Heywood (b. 1927)
Hicken C. M. Hicken (1875-1933)
Hiern W. P. Hiern (1839-1925)
Hieron. G. H. E. W. Hieronymus (1846-1921)
Hiitonen H. I. A. Hiitonen (b. 1898)
Hill J. Hill (1716-1775)
Hitchc., E. E. Hitchcock (1793-1864)
Hochst. C. F. Hochstetter (1787-1860)
Hoffm. G. F. Hoffmann (1761-1826)
Hoffm., O. O. Hoffmann (1853-1909)
Hohen. R. F. Hohenacker (1798-1874)
Holl F. Holl (fl. 1820-1842)
Holm T. Holm (1880-1943)
Holmberg O. R. Holmberg (1874-1930)
Holmboe J. Holmboe (1880-1943)
Holub, J. J. Holub (b. 1930)
Holzm. T. Holzmann (b. 1843)
Hooker W. J. Hooker (1785-1865)
Hooker fil. J. D. Hooker (1817-1911)
Hoppe D. H. Hoppe (1760-1846)
Hornem. J. W. Hornemann (1770-1841)
Hornsch. C. F. Hornschuch (1793-1850)
Hornung E. G. Hornung (1795-1862)
Hort. hortulanorum
Horvatić S. Horvatić (fl. 1933)
Horvátovszky S. Horvátovszky (fl. 1770)
Host N. T. Host (1761-1834)
Houtt. M. Houttuyn (1720-1798)
Houtzagers G. Houtzagers (1888-1957)
Howard H. W. Howard (b. 1913)
Howell T. J. Howell (1842-1912)
Huber, J. A. J. A. Huber (1867-1914)
Hudson W. Hudson (1730-1793)
Huet A. Huet du Pavillon (1829-1907)
Hülphers K. A. Hülphers (1882-1948)
Hultén E. O. G. Hultén (b. 1894)
Humb. F. H. A. von Humboldt (1769-1859)
Hussenot L. C. S. L. Hussenot (1809-1845)
Huter R. Huter (1834-1909)
Huth E. Huth (1845-1897)
Hy F. C. Hy (1853-1918)
Hyl. N. Hylander (b. 1904)
Iljin M. M. Iljin (Ilyin) (b. 1889)
Iljinsky, A. A. P. Iljinsky (1885-1945)
Ionescu M. A. Ionescu (b. 1900)
Irsmscher E. Irsmscher (b. 1887)
Jackson, A. B. A. B. Jackson (1876-1947)
Jackson, A. K. A. K. Jackson
Jacq. N. J. von Jacquin (1727-1817)
Jahandiez E. Jahandiez (1876-1938)
Jalas J. Jalas (b. 1920)
Jameson W. Jameson (1796-1873)
Jan G. Jan (1791-1866)
Janchen E. Janchen (b. 1882)
Jancz. E. Janczewski von Glinka (1846-1918)
Janisch. D. E. Janischewsky (1875-1944)
Janka V. Janka von Bulcs (1837-1890)
Jardine, N. N. Jardine (b. 1943)

Jaub. H. F. Jaubert (1798-1874)
Jáv. S. Jávorka (1883-1961)
Jeanb. E. M. J. Jeanbernat (1835-1888)
Jermy A. C. Jermy (b. 1932)
Joh., K. K. Johansson (1856-1928)
Jones, B. M. G. B. M. G. Jones (b. 1933)
Jordan A. Jordan (1814-1897)
Jordanov D. Jordanov (fl. 1935-1963)
Junge P. Junge (1881-1919)
Juratzka J. Juratzka (1821-1878)
Juss. A. L. de Jussieu (1748-1836)
Juz. S. V. Juzepczuk (1893-1959)
Kalela A. Kalela (b. 1908)
Kalenicz. J. Kaleniczenko (1805-1876)
Kanitz Á. Kanitz (1843-1896)
Kar. G. S. Karelin (1801-1872)
Karsten G. K. W. H. Karsten (1817-1908)
Kaulfuss G. F. Kaulfuss (1786-1830)
Keller, R. R. Keller (1854-1939)
Kellerer, J. J. Kellerer (fl. 1905)
Kerner A. J. Kerner von Marilaun (1831-1898)
Kihlman A. O. Kihlman (Kairamo) (1858-1938)
Kindb. N. C. Kindberg (1832-1910)
Kir. I. P. Kirilow (1821 or 1822-1842)
Kirschleger F. R. Kirschleger (1804-1869)
Kit. P. Kitaibel (1757-1817)
Kitanov B. Kitanov (b. 1912)
Kittel M. B. Kittel (1796 or 1797-1885)
Kleopow J. D. Kleopow (1902-1942)
Klika J. Klika (1888-1957)
Klinggr. K. J. von Klinggraeff (1809-1879)
Klokov M. V. Klokov (b. 1896)
Klotzsch J. F. Klotzsch (1805-1860)
Knaben G. Knaben (b. 1911)
Knaf J. Knaf (1801-1865)
Knight J. Knight (1781-1855)
Knoche H. Knoche (1870-1945)
Koch W. D. J. Koch (1771-1849)
Koch, C. C. H. E. Koch (1809-1879)
Koch, Walo Walo Koch (1896-1956)
Koehne B. A. E. Koehne (1848-1918)
Koelle J. L. C. Koelle (1763-1797)
Koerte F. Koerte (1782-1845)
Komarov V. L. Komarov (1869-1945)
Kondrat. E. N. Kondratjuk (b. 1914)
König, D. D. König (b. 1909)
Korsh. S. I. Korshinsky (1861-1900)
Kos.-Pol. B. M. Koso-Poliansky (1890-1957)
Kotov M. I. Kotov (b. 1896)
Kotschy T. Kotschy (1813-1866)
Kotula, A. A. Kotula (fl. 1888)
Krašan F. Krašan (1840-1907)
Krause, E. H. L. E. H. L. Krause (1859-1942)
Krause, K. K. Krause (fl. 1958)
Krecz., V. V. I. Kreczetowicz (1901-1942)
Krocker A. J. Krocker (1744-1823)
Krylov P. N. Krylov (1850-1931)
Kühlew. P. E. Kühlewein (1798-1870)
Kuhn M. F. A. Kuhn (1842-1894)
Kulcz. S. Kulczyński (b. 1895)
Kümmerle J. B. Kümmerle (1876-1931)
Kunth S. Kunth (1788-1850)
Kuntze, O. K. E. O. Kuntze (1843-1907)
Kunz, H. H. Kunz (fl. 1950)
Kunze, G. G. Kunze (1793-1851)
Kusn. N. I. Kusnezow (Kuznetzov) (1864-1932)

Kuzen. O. I. Kuzeneva (b. 1887)
Kuzinský P. A. von Kuzinský (fl. 1889)
L. C. von Linné (C. Linnaeus) (1707-1778)
L. fil. C. von Linné (1741-1783)

Labill. J. J. H. de Labillardière (1755-1834)
Lacaita C. C. Lacaita (1853-1933)
Laest. L. L. Laestadius (1800-1861)
Lag. M. Lagasca y Segura (1776-1839)
Lagerh. N. G. von Lagerheim (1860-1926)
Lagger F. Lagger (1799-1870)
Lagrèze-Fossat A. Lagrèze-Fossat (fl. 1850)
Laínz M. Laínz (b. 1923)
Lam. J. B. A. P. Monnet de la Marck (1744-1829)
Lamb. A. B. Lambert (1761-1842)
Lamotte M. Lamotte (1820-1883)
Landolt E. Landolt (b. 1926)
Láng, A. F. A. F. Láng (1795-1863)
Lange J. M. C. Lange (1818-1898)
Langsd. G. H. von Langsdorff (1774-1852)
Lapeyr. P. Picot de Lapeyrouse (1744-1818)
La Pylaie A. J. M. B. de la Pylaie (1786-1856)
Lauche W. Lauche (1827-1882)
Lavrenko E. M. Lavrenko (b. 1900)
Lawalrée A. Lawalrée (b. 1921)
Lawson, C. C. Lawson (1794-1873)
Lawson, P. P. Lawson (d. 1820)
Laxm. E. Laxmann (1737-1796)
Layens G. de Layens (1834-1897)
Láz.-Ibiza Blas Lázaro é Ibiza (1858-1921)
Lebel E. Lebel (fl. 1868)
Lecoq H. Lecoq (1802-1871)
Lecoyer C. -J. Lecoyer (1835-1899)
Ledeb. C. F. von Ledebour (1785-1851)
Le Gall N. J. M. le Gall (b. 1787)
Le Grand A. le Grand (1839-1905)
Lehm. J. G. C. Lehmann (1792-1860)
Lehm., C. B. C. B. Lehmann (fl. 1860)
Lej. A. L. S. Lejeune (1779-1858)
Le Jolis A. F. le Jolis (1823-1904)
Lemaire C. A. Lemaire (1801-1871)
Léman D. S. Léman (1781-1829)
Leresche L. Leresche (1808-1885)
Lesp. G. Lespinasse (1807-1876)
Less. C. F. Lessing (1810-1862)
Lester-Garland L. V. Lester-Garland (1860-1944)
Léveillé A. A. H. Léveillé (1863-1918)
Levier E. Levier (1838-1911)
Leybold F. Leybold (1827-1879)
L'Hér. C. L. L'Héritier de Brutelle (1746-1800)
Lid J. Lid (b. 1886)
Liebl. F. K. Lieblein (1744-1810)
Liebm. F. M. Liebmann (1813-1856)
Liljeblad S. Liljeblad (1761-1815)
Lindb., H. H. Lindberg (1871-1963)
Lindblad M. A. Lindblad (1821-1899)
Lindblom A. E. Lindblom (1807-1853)
Lindley J. Lindley (1799-1865)
Lindman C. A. M. Lindman (1856-1928)
Lindt. V. Lindtner (b. 1904)
Link J. H. F. Link (1767-1851)
Lipsky V. I. Lipsky (1863-1937)
Litard. R. V. de Litardière (1888-1957)
Litv. D. I. Litvinov (Litwinow) (1854-1929)
Lloyd J. Lloyd (1810-1896)
Loeff. P. Loefling (1729-1756)
Loisel. J. L. A. Loiseleur-Deslongchamps (1774-1849)

Lojac. M. Lojacono-Pojero (b. 1853)
Lonsing A. Lonsing (fl. 1939)
Lorent J. A. Lorent (fl. 1845)
Loret H. Loret (1810-1888)
Losa M. Losa España (b. 1893)
Loscos F. Loscos y Bernál (1823-1886)
Loudon J. C. Loudon (1783-1843)
Lour. J. de Loureiro (1715-1796)
Löve, Ȧ. Á. Löve (b. 1916)
Löve, D. D. Löve (b. 1918)
Lowe R. T. Lowe (1802-1874)
Lucé J. W. L. von Lucé (fl. 1823)
Luerssen C. Luerssen (1843-1916)
Luizet D. Luizet (fl. 1913)
Lund, N. N. Lund (1814-1847)
Lundström, E. E. Lundström (b. 1882)
Lynge B. A. Lynge (1884-1942)
Macbride J. F. Macbride (fl. 1927-1956)
Mach.-Laur. B. Machatschki-Laurich
Magne J. H. Magne (1804-1885)
Maire R.C. J. E. Maire (1878-1949)
Majevski P. F. Majevski (1851-1892)
Major C. J. F. Major (1843-1923)
Malinovski E. Malinovski (fl. 1911-1960)
Maly, F. F. Maly (fl. 1865)
Maly, J. Joseph Karl Maly (1797-1866)
Malý, K. Karl Malý (1874-1951)
Mansfeld R. Mansfeld (1901-1960)
Manton I. Manton (b. 1904)
Marchesetti C. de Marchesetti (1850-1926)
Marès P. Marès (1826-1900)
Margot H. Margot (fl. 1838)
Mariz J. de Mariz (1847-1916)
Markgraf F. Markgraf (b. 1897)
Marsden-Jones E. M. Marsden-Jones (1887-1960)
Marshall H. Marshall (1722-1801)
Marshall, E. S. E. S. Marshall (1858-1919)
Mart., C. F. P. C. F. P. von Martius (1/94-1868)
Mart., H. H. von Martius (1781-1831)
Martelli, U. U. Martelli (fl. 1894)
Masters M. T. Masters (1833-1907)
Mattei G. E. Mattei (1865-1943)
Mattf. J. Mattfeld (1895-1951)
Mattuschka H. G. von Mattuschka (1734-1779)
Mauri E. Mauri (1791-1836)
Maxim. K. J. Maximowicz (1827-1891)
Maxon W. R. Maxon (1877-1948)
Mayer, E. E. Mayer (b. 1920)
Mayer, J. J. C. A. Mayer (1747-1801)
McClell. J. McClelland (1805-1883)
McMillan C. McMillan (1867-1929)
McNeill J. McNeill (b. 1933)
Medicus F. C. Medicus (Medikus) (1736-1808)
Meerb. N. Meerburgh (1734-1814)
Meissner C. F. Meissner (1800-1874)
Mela A. J. Mela (1846-1904)
Melderis A. Melderis (b. 1909)
Melville R. Melville (b. 1903)
Mendes E. J. S. M. Mendes (b. 1924)
Menéndez Amor J. Menéndez Amor
Menyh. L. Menyhárth (1849-1897)
Mérat F. V. Mérat (1780-1851)
Merino B. Merino y Román (1845-1917)
Mert. F. K. Mertens (1764-1831)
Merxm. H. Merxmüller (b. 1920)
Mett. G. H. Mettenius (1823-1866)

Metzger J. Metzger (1789-1852)
Meyer, B. B. Meyer (1767-1836)
Meyer, C. A. C. A. von Meyer (1795-1855)
Meyer, D. E. D. E. Meyer (b. 1926)
Meyer, E. H. F. E. H. F. Meyer (1791-1858)
Meyer, G. F. W. G. F. W. Meyer (1782-1856)
Michx A. Michaux (1746-1802)
Michx fil. F. A. Michaux (1770-1855)
Middendorff A. T. von Middendorff (1815-1894)
Miégeville - Miégeville (fl. 1860-1893)
Milde C. A. J. Milde (1824-1871)
Miller P. Miller (1691-1771)
Mirbel C. F. B. Mirbel (1776-1854)
Mitterp. L. Mitterpacher (1734-1818)
Moench C. Moench (1744-1805)
Moessler J. C. Moessler (fl. 1805-1815)
Mohr D. M. H. Mohr (1779-1808)
Moldenke H. N. Moldenke (b. 1909)
Molina J. I. Molina (1740-1829)
Monnier, P. P. C. J. Monnier (b. 1922)
Montandon F. J. Montandon
Montelucci G. Montelucci (b. 1899)
Monts., P. P. Montserrat Recoder (b. 1920)
Moq. C. H. B. A. Moquin-Tandon (1804-1863)
Moretti G. Moretti (1782-1853)
Mori A. Mori (1847-1902)
Moric. M. E. Moricand (1779-1854)
Moris G. G. Moris (1796-1869)
Moritzi A. Moritzi (1807-1850)
Morot M. L. Morot (fl. 1885)
Morren C. J. E. Morren (1833-1886)
Morton, C. V. C. V. Morton (b. 1905)
Möschl W. Möschl (b. 1906)
Moss C. E. Moss (1872-1930)
Motelay L. Motelay (1831-1917)
Mueller, F. F. J. H. von Mueller (1825-1896)
Muenchh. O. Muenchhausen (1716-1774)
Muhl. G. H. E. Muhlenberg (1753-1815)
Müller Arg. J. Müller of Aargau (Argoviensis) (1828-1896)
Munby G. Munby (1812-1876)
Münch E. Münch (1876-1946)
Murb. S. S. Murbeck (1859-1946)
Murr, J. J. Murr (1864-1932)
Murray J. A. Murray (1740-1791)
Murray, A. A. Murray (1812-1878)
Mutel A. Mutel (1795-1847)
Mutis J. C. Mutis (1732-1808)
Mygind F. Mygind (1710-1789)
Nakai T. Nakai (1882-1952)
Nasarow M. I. Nasarow (1882-1942)
Necker N. J. von Necker (1729-1793)
Nees C. G. D. Nees von Esenbeck (1776-1858)
Nees, T. T. F. L. Nees von Esenbeck (1787-1837)
Neilr. A. Neilreich (1803-1871)
Nelson, A. A. Nelson (1859-1952)
Nestler C. G. Nestler (1778-1832)
Neuman L. M. Neuman (1852-1922)
Neumann, A. A. Neumann
Neumayer, H. H. Neumayer (1887-1945)
Neves, J. J. de Barros Neves
Nevski S. A. Nevski (1908-1938)
Newbould W. W. Newbould (1819-1886)
Newman E. Newman (1801-1876)
Nicotra L. Nicotra (b. 1846)
Nobre A. Nobre (fl. 1906)
Nolte E. F. Nolte (1791-1875)

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Nordh. R. Nordhagen (b. 1894)
Nordm. A. von Nordmann (1803-1866)
Nordstadt C. F. O. Nordstadt (1838-1924)
Norrlin J. P. Norrlin (1842-1917)
Norton J. B. Norton (1877-1938)
Not \(\varnothing\) A. Notø (1865-1948)
Novák F. A. Novák (b. 1892)
Nutt. T. Nuttall (1786-1859)
Nyárády, A. A. Nyárády (b. 1920)
Nyárády, E. I. E. I. Nyárády (b. 1881)
Nyl., F. F. Nylander (1820-1880)
Nyman C. F. Nyman (1820-1893)
Oeder G. C. Oeder (1728-1791)
Ohwi J. Ohwi (b. 1905)
Oken L. Oken (1779-1851)
Olivier G. A. Olivier (1756-1814)
Opiz P. M. Opiz (1787-1858)
Orlova N. I. Orlova (b. 1921)
Orph. T. G. Orphanides (1817-1886)
Örsted A. S. Örsted (1816-1872)
Ortega C. Gómez Ortega (1740-1818)
Ostenf. C. E. H. Ostenfeld (1873-1931)
Otth K. A. Otth (1803-1839)
Otto C. F. Otto (1783-1856)
Ovcz. P. N. Ovczinnikov (b. 1903)
Pacher D. Pacher (b. 1816)
Pacz. I. K. Paczoski (1864-1942)
Padmore P. A. Padmore (b. 1929)
Paegle B. Paegle (fl. 1927)
Palassou Palassou (fl. 1798-1815)
Palhinha R. T. Palhinha (1871-1957)
Pallas P. S. Pallas (1741-1811)
Pamp. R. Pampanini (1875-1949)
Pančić J. Pančić (1814-1888)
Pant. J. Pantocsek (1846-1916)
Paol. G. Paoletti (1865-1941)
Pardo J. Pardo y Sastrón (1822-1909)
Parl. F. Parlatore (1816-1877)
Parodi L. R. Parodi (b. 1895)
Parry W. E. Parry (1790-1855)
Passer. G. Passerini (1816-1893)
Patrin E. L. M. Patrin (1742-1815)
Patze C. Patze (fl. 1850)
Pau C. Pau (1857-1937)
Paulsen O. V. Paulsen (1874-1947)
Pavlov N. V. Pavlov (b. 1893)
Pavón J. Pavón (1750-1844)
Pawt. B. Pawłowski (b. 1898)
Pax F. A. Pax (1858-1942)
Pénzes A. Pénzes (b. 1895)
Pérard M. Pérard (1835-1887)
Perf. I. A. Perfiljew (fl. 1882-1942)
Perr. J. O. E. Perrier (1843-1916)
Pers. C. H. Persoon (c. 1762-1836)
Péterfi M. Péterfi (1875-1922)
Peterm. W. L. Petermann (1806-1855)
Petitmengin M. G. C. Petitmengin (1881-1908)
Petrov V. A. Petrov (1896-1955)
Phillips, E. P. E. P. Phillips
Phipps, C. J. C. J. Phipps (1744-1792)
Pierrat D. Pierrat (1835-1895)
Pilger R. K. F. Pilger (1876-1953)
Piller M. Piller (1733-1788)
Piré L. A. H. J. Piré (1827-1887)
Pires de Lima A. Pires de Lima (b. 1886)
Pirona G. A. Pirona (1822-1895)
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Pissjauk. V. V. Pissjaukowa (b. 1906)
Planchon J. E. Planchon (1823-1888)
Planellas J. Planellas Giralt (fl. 1852)
Pobed. E. G. Pobedimova (b. 1898)
Podl. D. Podlech (b. 1931)
Podp. J. Podpěra (1878-1954)
Poggenb. J. F. Poggenburg (1840-1893)
Poiret J. L. M. Poiret (1755-1834)
Pojark. A. I. Pojarkova (b. 1897)
Pomel A. Pomel (fl. 1860-1875)
Popl. G. I. Poplavskaja (Poplawska) (1885-1956)
Popov, M. M. G. Popov (1893-1955)
Porta P. Porta (1832-1923)
Portenschl. F. E. von Portenschlag-Ledermayer (1772-1822)
Post G. E. Post (?1838-1909)
Pourret P. A. Pourret de Figeac (1754-1818)
Praeger R. L. Praeger (1865-1953)
Prantl K. A. E. Prantl (1849-1893)
Presl, C. C. (K.) B. Presl (1794-1852)
Presl, J. J. S. Presl (1791-1849)
Price W. R. Price (b. 1866)
Pritzel, G. A. G. A. Pritzel (1815-1874)
Prodan J. Prodan (1875-1959)
Pugsley H. W. Pugsley (1868-1947)
Purkyně E. Purkyně (1831-1882)
Pursh F. T. Pursh (1774-1820)
Putterlick A. Putterlick (1810-1845)
Rabenh. G. L. Rabenhorst (1806-1881)
Racib. M. Raciborski (1863-1917)
Rafin. C. S. Rafinesque-Schmaltz (1783-1840)
Rafn C. G. Rafn (1769-1808)
Ramond L. F. E. Ramond de Carbonnières (1753-1827)
Raunk. C. Raunkiær (1860-1938)
Rech. K. Rechinger (1867-1952)
Rech. fil. K. H. Rechinger (b. 1906)
Rees A. Rees (1743-1825)
Regel E. A. von Regel (1815-1892)
Rehder A. Rehder (1863-1949)
Rehman A. Rehman (1840-1917)
Reichard J. J. Reichard (1743-1782)
Reichenb. H. G. L. Reichenbach (1793-1879)
Reichenb. fil. H. G. Reichenbach (1824-1889)
Rendle A. B. Rendle (1865-1938)
Req. E. Requien (1788-1851)
Resvoll-Holmsen H. Resvoll-Holmsen (1873-1943)
Retz. A. J. Retzius (1742-1821)
Reuss, G. G. Reuss (1818-1861)
Reuter G. F. Reuter (1805-1872)
Revel J. Revel (1811-1887)
Reyn. A. Reynier (1845-1932)
Ricci A. M. Ricci (1777-1850)
Richard, A. A. Richard (1794-1852)
Richard, L. C. M. L. C. M. Richard (1754-1821)
Richter H. E. F. Richter (b. 1808)
Richter, K. K. Richter (1855-1891)
Riddelsd. H. J. Riddelsdell (1866-1941)
Rigo G. Rigo (fl. 1890)
Rikli M. A. Rikli (1868-1951)
Rink H. J. Rink (1819-1893)
Risso J. A. Risso (1777-1845)
Rivas Goday S. Rivas Goday (b. 1905)
Robert - Robert (fl. 1838)
Robill. L. M. A. Robillard d'Argentelle (d. 1828)
Robson E. Robson (1763-1813)
Robyns W. Robyns (b. 1901)
Rochel A. Rochel (1770-1847)

Rodr. J. D. Rodriguez (1780-1846)
Roemer J. J. Roemer (1763-1819)
Roemer, R. de R. de Roemer (fl. 1852)
Rogow. A. S. Rogowicz (1812-1878)
Rohlena J. Rohlena (1874-1944)
Röhling J. C. Röhling (1757-1813)
Rohrb. P. Rohrbach (1847-1871)
Ross, J. J. Ross (1777-1856)
Rossi M. L. Rossi (1850-1932)
Rössler W. Rössler (b. 1909)
Rostrup F. G. E. Rostrup (1831-1907)
Roth A. W. Roth (1757-1834)
Rothm. W. Rothmaler (1908-1962)
Rottb. C. F. Rottboel (Rottbøll) (1727-1797)
Rouleau E. Rouleau (b. 1916)
Rouy G. C. C. Rouy (1851-1924)
Roxb. W. Roxburgh (1751-1815)
Royle J. F. Royle (1779-1858)
Rozan. M. A. Rozanova (1885-1957)
Rudolph, J. H. J. H. Rudolph (fl. 1781)
Ruiz H. Ruiz López (1754-1815)
Runemark H. Runemark (b. 1927)
Rupr. F. J. Ruprecht (1814-1870)
Russell, A. A. Russell (fl. 1756)
Russell, P. P. G. Russell (b. 1889)
Rydb. P. A. Rydberg (1860-1931)
Rylands T. G. Rylands (1818-1900)
Sabine - Sabine (fl. 1884)
Sabr. H. Sabransky (1864-1916)
Sadler J. Sadler (1791-1849)
Sagorski E. Sagorski (1847-1929)
Salisb. R. A. Salisbury (1761-1829)
Salzm. P. Salzmann (1781-1851)
Sam. G. Samuelsson (1885-1944)
Sambuk F. V. Sambuk (1900-1942)
Samp. G. A. de Silva Ferreira Sampaio (1865-1937)
Sándor I. Sándor
Sandwith N. Y. Sandwith (b. 1901)
Santi, G. G. Santi (1746-1822)
Sapjegin A. A. Sapjegin (1883-1946)
Sarato C. Sarato (b. 1830)
Sarg. C. S. Sargent (1841-1927)
Sart. G. B. Sartorelli (1780-1853)
Sauer W. Sauer
Sauter A. E. Sauter (1800-1881)
Sauzé C. Sauzé (b. 1815)
Sǎvul. T. Sǎvulescu (1889-1963)
Scaling W. Scaling (fl. 1863-1882)
Schaeffer J. C. Schaeffer (1718-1790)
Schaeftlein H. Schaeftlein (b. 1886)
Scheele G. H. A. Scheele (1808-1864)
Schellm. C. Schellmann
Schenk J. A. Schenk (1815-1891)
Scherb. J. Scherbius (1769-1813)
Schiffner V. F. Schiffner (1862-1944)
Schimper, C. C. F. Schimper (1803-1867)
Schinz H. Schinz (1858-1941)
Schipcz. N. V. Schipczinski (1886-1955)
Schischkin B. K. Schischkin (1886-1963)
Schkuhr C. Schkuhr (1741-1811)
Schlecht. D. F. L. von Schlechtendal (1794-1866)
Schleicher J. C. Schleicher (1768-1834)
Schlosser J. C. Schlosser (1808-1882)
Schmalh. I. F. Schmalhausen (1849-1894)
Schmeil O. Schmeil (b. 1860)
Schmid, E. E. Schmid (b. 1891)

Schmidel C. C. Schmidel (1718-1792)
Schmidt, Franz Franz Schmidt (1751-1834)
Schmidt, F. W. Franz Willibald Schmidt (1764-1796)
Schmidt Petrop., Friedrich Friedrich Schmidt of St Petersburg (1832-1908)
Schneider, C. K. C. K. Schneider (1876-1951)
Schnittspahn G. F. Schnittspahn (1810-1865)
Scholz, J. B. J. B. Scholz
Schönl. S. Schönland (1860-1940)
Schott H. W. Schott (1794-1865)
Schousboe P. K. A. Schousboe (1766-1832)
Schrader H. A. Schrader (1767-1836)
Schrank F. von Paula von Schrank (1747-1835)
Schreber J. C. D. von Schreber (1739-1810)
Schrenk A. G. Schrenk
Schrödinger R. Schrödinger
Schultes J. A. Schultes (1773-1831)
Schultes fil. J. H. Schultes (1804-1840)
Schultz, C. F. C. F. Schultz (1765-1837)
Schultz, F. W. F. W. Schultz (1804-1876)
Schulz, O. E. O. E. Schulz (1874-1936)
Schur P. J. F. Schur (1799-1878)
Schwantes G. Schwantes (fl. 1927)
Schwarz, A. A. Schwarz (1852-1915)
Schwarz, O. O. Schwarz (b. 1900)
Schwegler H. W. Schwegler (fl. 1957)
Schweigger A. F. Schweigger (1783-1821)
Schweinf. G. A. Schweinfurth (1836-1925)
Scop. G. A. Scopoli (1723-1788)
Sebastiani A. Sebastiani (1782-1821)
Sebeók A. Sebeók de Szent-Miklós
Seem. B. C. Seemann (1825-1871)
Selin G. Selin (1813-1862)
Sell, P. D. P. D. Sell (b. 1929)
Semen., N. N. Z. Semenova-Tjan-Schanskaja (1906-1960)
Sennen Frère Sennen (E. M. Grenier-Blanc) (1861-1937)
Ser. N. C. Seringe (1776-1858)
Serres J. J. Serres (d. 1858)
Seub. M. Seubert (1818-1878)
Shivas M. G. Shivas (fl. 1961)
Shuttlew., R. J. R. J. Shuttleworth (1810-1874)
Sibth. J. Sibthorp (1758-1796)
Sieber F. W. Sieber (1789-1844)
Siebold P. F. von Siebold (1796-1866)
Sikura J. J. Sikura (fl. 1960)
Silliman B. Silliman (1779-1864)
Silva, P. A. R. Pinto da Silva (b. 1912)
Sim, R. R. Sim (1791-1878)
Simmler G. Simmler (fl. 1910)
Simmons H. G. Simmons (1866-1943)
Simon primus, E. E. Simon (1848-1924)
Simon secundus, E. E. Simon (fl. 1958)
Simonkai L. von Simonkai (L. Simkovicz) (1851-1910)
Sims J. Sims (1749-1831)
Sint. P. E. E. Sintenis (1847-1907)
Sirj. G. I. Sirjaev (Schirjaev) (1882-1954)
Skvortsov, A. A. K. Skvortsov (fl. 1963)
Slosson M. Slosson (b. 1873)
Sm. J. E. Smith (1759-1828)
Small J. K. Small (1869-1938)
Smirnov P. A. Smirnov (b. 1896)
Smith, K. A. H. K. A. H. Smith (b. 1889)
Soczava V. B. Soczava (b. 1905)
Solander D. C. Solander (1736-1782)
Solemacher Solemacher-Antweiler
Solms-Laub. H. Solms-Laubach (1842-1915)

Sommer. I. Sommerauer (fl. 1819-1940)
Sommier C. P. S. Sommier (1848-1922)
Sommerf. S. C. Sommerfelt (1794-1838)
Sonder O. W. Sonder (1812-1881)
Song. A. Songeon (1826-1905)
Soó R. de Soó (b. 1903)
Sosn., D. D. I. Sosnowsky (1885-1952)
Soulié J. A. Soulié (1868-1930)
Sowerby J. Sowerby (1757-1822)
Soyer-Willemet H. F. Soyer-Willemet (1791-1867)
Spach E. Spach (1801-1879)
Speg. C. Spegazzini (1858-1926)
Spenner F. K. L. Spenner (1798-1841)
Sprengel C. (K.) P. J. Sprengel (1766-1833)
Spring F. A. Spring (1814-1872)
Spruner W. von Spruner (1805-1874)
Standley P. C. Standley (1884-1963)
Stankov S. S. Stankov (1892-1962)
Stapf O. Stapf (1857-1933)
Stefani C. de Stefani (b. 1851)
Stefanov B. Stefanov (b. 1894)
Stefánsson S. Stefánsson (1863-1921)
Steinb. K. M. von Steinberg
Steinh. A. Steinheil (1810-1839)
Stephan C. F. Stephan (1757-1814)
Stern, F. C. F. C. Stern (b. 1884)
Sternb. C. M. von Sternberg (1761-1838)
Sterns, E. E. E. E. Sterns (1846-1926)
Steudel E. G. von Steudel (1783-1856)
Steven C. Steven (1781-1863)
St-Hil. A. C. F. P. de Saint-Hilaire (1779-1853)
St-Lager J. B. Saint-Lager (1825-1912)
Stoj. N. Stojanov (b. 1885)
Störk A. Störk (1741-1803)
Strempel K. F. Strempel (b. 1800)
Strobl P. G. Strobl (1846-1910)
Stur D. Stur (1827-1893)
Sturm J. Sturm (1771-1848)
Suckow, G. G. A. Suckow (d. 1867)
Sudworth G. B. Sudworth (1864-1927)
Suk. V. N. Sukaczev (Sukatschew) (b. 1880)
Sünd. F. Sündermann (1864-1946)
Suter J. R. Suter (1766-1827)
Sutulov - Sutulov (fl. 1914)
Svob. B. Svoboda
Swartz O. P. Swartz (1760-1818)
Sweet R. Sweet (1783-1835)
Syme J. T. I. Boswell Syme (formerly Boswell) (1822-1888)
Szafer W. Szafer (b. 1886)
Szov. A. J. Szovits (fl. 1827)
Szysz. I. Szyszylowicz (1857-1910)
Taliev V.I. Taliev (1872-1932)
Tanfani E. Tanfani (1848-1892)
Tardieu-Blot M. L. Tardieu-Blot (b. 1902)
Tausch I. F. Tausch (1793-1848)
Temesy E. Temesy (fl. 1957)
Ten. M. Tenore (1780-1861)
Tepl. F. A. Teplouchow (1845-1905)
Terechov A. F. Terechov (fl. 1931)
Terracc., N. N. Terracciano (1837-1921)
Texidor J. Texidor y Cos (fl. 1870)
Teyber A. Teyber (1846-1913)
Thell. A. Thellung (1881-1928)
Thév. A. Théveneau
Thomas E. Thomas (1788-1859)
Thommen E. Thommen (1880-1961)

Thomson T. Thomson (1817-1878)
Thore J. Thore (1762-1823)
Thouars L. M. A. Aubert du Petit-Thouars (1758-1831)
Thouin A. Thouin (1747-1824)
Thuill. J. L. Thuillier (1757-1822)
Thunb. C. P. Thunberg (1743-1828)
Timb.-Lagr. P. M. E. Timbal-Lagrave (1819-1888)
Timm J. C. Timm (1734-1805)
Tineo V. Tineo (1791-1856)
Tiss. P. G. Tissière (1828-1868)
Tod. A. Todaro (1818-1892)
Tolm. A. I. Tolmatchev (b. 1903)
Top. S. Topali (fl. 1938)
Țopa E. Tुopa (b. 1900)
Torrey J. Torrey (1796-1873)
Trabut L. Trabut (1853-1929)
Tratt. L. Trattinick (1764-1849)
Trautv. E. R. von Trautvetter (1809-1889)
Trelease W. Trelease (1857-1945)
Trew C. J. Trew (1695-1769)
Trotzky P. Kornuch-Trotzky (1803-1877)
Tryon jun., R. M. R. M. Tryon jun.
Turcz. N. S. Turczaninow (1796-1864)
Turesson G. W. Turesson (b. 1892)
Turra A. Turra (1730-1796)
Turrill W. B. Turrill (1890-1961)
Tutin T. G. Tutin (b. 1908)
Tuzson J. Tuzson (1870-1941)
Ucria B. Ucria (1739-1796)
Uechtr. M. F. S. von Uechtritz (1838-1886)
Ugr. K. A. Ugrinsky (fl. 1920)
Ulbr. E. Ulbrich (1879-1952)
Underw. J. Underwood (fl. 1780-1834)
Unger F. J. A. N. Unger (1800-1870)
Ung.-Sternb. F. Ungern-Sternberg (d. 1885)
Urban I. Urban (1848-1931)
Urum. I. K. Urumoff (1856-1937)
Vacc. A. Vaccari (b. 1873)
Vahl M. H. Vahl (1749-1804)
Vahl, J. J. L. M. Vahl (1796-1854)
Valck.-Suringar - Valckeniev-Suringar (1865-1932)
Valentine D. H. Valentine (b. 1912)
Vandas K. Vandas (1861-1923)
Van den Bosch R. B. van den Bosch (1810-1862)
Van Hall H. C. van Hall (1801-1874)
Van Houtte L. B. van Houtte (1810-1876)
Van Ooststr. S. J. van Ooststroom (b. 1906)
Vasc. J. de Carvalho e Vasconcellos (b. 1897)
Vassilcz. I. T. Vassilczenko (b. 1903)
Velen. J. Velenovský (1858-1949)
Vendr. X. Vendrely
Vent. E. P. Ventenat (1757-1808)
Vest L. C. von Vest (1776-1840)
Vicioso, C. C. Vicioso Martínez (fl. 1948-1963)
Vidal L. M. Vidal
Vierh. F. Vierhapper (1876-1932)
Vig. L. G. A. Viguier (fl. 1814)
Vill. D. Villars (Villar) (1745-1814)
Villar, H. del E. Huguet del Villar (fl. 1935)
Vilmorin P. L. F. L. de Vilmorin (1816-1860)
Vis. R. de Visiani (1800-1878)
Viv. D. Viviani (1772-1840)
Vogler J. A. Vogler (1746-1816)
Volk. A. Volkart (1873-1951)
Vollmann F. Vollmann (1858-1917)
Vorosch. V. N. Voroschilov (b. 1908)

Voss A. Voss (1857-1924)
Vuk. L. F. Vukotinović (1813-1893)
Wahlenb. G. Wahlenberg (1780-1851)
Waisb. A. Waisbecker (1835-1916)
Waldst. F. A. von Waldstein-Wartemberg (1759-1823)
Wale R. S. Wale (d. 1952)
Walker, S. S. Walker (b. 1924)
Wall. N. Wallich (1786-1854)
Wallr. K. F. W. Wallroth (1792-1857)
Walpers W. G. Walpers (1816-1853)
Walters S. M. Walters (b. 1920)
Wangenh. F. A. J. von Wangenheim (1747-1800)
Warburg, E. F. E. F. Warburg (b. 1908)
Watson, H. C. H. C. Watson (1804-1881)
Watson, S. S. Watson (1826-1892)
Watt D. A. P. Watt (1830-1917)
Webb P. B. Webb (1793-1854)
Webb, D. A. D. A. Webb (b. 1912)
Weber F. Weber (1781-1823)
Weevers T. Weevers (1875-1952)
Weigel C. E. von Weigel (1748-1831)
Weihe K. E. A. Weihe (1779-1834)
Weinm. J. A. Weinmann (1782-1858)
Welw. F. Welwitsch (1806-1872)
Wendelberger G. Wendelberger (b. 1915)
Wenderoth G. W. F. Wenderoth (1774-1861)
Wesmael, A. A. Wesmael (1832-1905)
Weston R. Weston (1733-1806)
Wettst. R. von Wettstein (1863-1931)
Whitehead F. H. Whitehead (b. 1913)
Wibel A. W. E. C. Wibel (1775-1814)
Wibiral E. Wibiral (1878-1950)
Wichura M. Wichura (1817-1866)
Widder F. Widder (b. 1892)
Wierzb. P. Wierzbicki (1794-1847)
Wiesb. J. Wiesbaur (1836-1906)

Wilce J. H. Wilce (fl. 1963)
Willd. C. L. Willdenow (1765-1812)
Williams, F. N. F. N. Williams (1862-1923)
Willk. H. M. Willkomm (1821-1895)
Wilmott A. J. Wilmott (1888-1950)
Wimmer C. F. H. Wimmer (1803-1868)
Winge Ö. Winge (b. 1886)
Wissjul. E. D. Wissjulina (b. 1902)
With. W. Withering (1741-1799)
Wolff, H. H. Wolff (1866-1929)
Wolfner W. Wolfner (fl. 1858)
Wollaston G. B. Wollaston (1814-1899)
Wolley-Dod A. H. Wolley-Dod (1861-1948)
Wołoszczak E. Wołoszczak (1835-1918)
Wood, W. W. Wood (1745-1808)
Woods, J. J. Woods (1776-1864)
Woronow J. N. Woronow (Voronov) (1874-1931)
Woynar H. K. Woynar (1865-1917)
Wulf E. V. Wulf (E. W. Wulff, E. V. Vul'f) (1885-1941)
Wulfen F. X. von Wulfen (1728-1805)
Wünsche J. G. Wünsche
Zahlbr. J. Zahlbruckner (1782-1850)
Zamels A. Zamels (1897-1943)
Zapal. H. Zapałowicz (1852-1917)
Zawadzki A. Zawadzki (1798-1868)
Zenari S. Zenari (b. 1896)
Zerov D. K. Zerov (b. 1899)
Zimm. W. Zimmermann (b. 1892)
Zimmeter A. Zimmeter (1848-1897)
Zinger, N. N. Zinger (1866-1923)
Zinn J. G. Zinn (1727-1759)
Ziz J. B. Ziz (1779-1829)
Zodda G. Zodda (b. 1877)
Zoega J. Zoega (1742-1788)
Zucc. J. G. Zuccarini (1797-1848)

## APPENDIX II

# KEY TO THE ABBREVIATIONS OF TITLES OF BOOKS CITED IN VOLUME I, WITH A SUPPLEMENT OF ANONYMOUS WORKS 

Aiton, Hort. Kew.
W. Aiton, Hortus Kewensis, or a Catalogue of the Plants cultivated in the Royal Botanic Garden at Kew. Ed. 1. London. 1789. (1-3 in 1789.) Ed. 2, by W. T. Aiton. London. 18101813. ( $\mathbf{1}$ in $1810 ; 2 \& 3$ in $1811 ; 4$ in $1812 ; 5$ in 1813.) (Cf. C. E. Britton, Jour. Bot. (London) 50, suppl. 3, 1-16 (1912) and F. A. Stafleu, Taxon 12: 53-54 (1963).)

All., Auct. Fl. Pedem.
C. Allioni, Auctuarium ad Floram Pedemontanam cum Notis et Emendationibus. Augustae Taurinorum. 1789.
All., Fl. Pedem.
C. Allioni, Flora Pedemontana sive Enumeratio methodica Stirpium indigenarum Pedemontii. Augustae Taurinorum. 1785. ( $\mathbf{1 - 3}$ in 1785.)

Amo, Fl. Iber.
Mariano del Amo y Mora, Flora fanerogámica de la Peninsula ibérica ó Descripción de las Plantas cotyledóneas que crecen en España y Portugal. Granada. 1871-1873. (1 \& 2 in 1871; $3 \& 4$ in 1872; 5 \& 6 in 1873.)
Andrews, Bot. Reposit.
H. C. Andrews, The Botanist's Repository. Ed. 1. London. 1799-1811. (1-10. For dates cf. M. J. van Steenis-Kruseman \& W. T. Stearn in C. G. G. J. van Steenis, Fl. Males. I. 4: clxvi (1954).) Ed. 2. London. 1816.

Antoine, Kupress.-Gatt.
F. Antoine, Die Kupressineengattungen Arceuthos, Juniperus, und Sabina. Wien. 1857-1860.
Arcangeli, Comp. Fl. Ital.
G. Arcangeli, Compendio della Flora italiana, ossia Manuale per la Determinazione delle Piante che trovansi selvatiche od inselvatichite nell' Italia e nelle Isole adiacenti. Ed. 1. Torino. 1882. Ed. 2. Torino \& Roma. 1894.
Ard., Animadv. Bot. Spec. Alt.
P. Arduino, Animadversionum botanicarum Specimen alterum. Venetiis. 1763.
Arnold, Reise Mariazell
Arnold, Reise nach Mariazell in Steyermark. Wien. 1785.
Ascherson, Fl. Brandenb.
P. F. A. Ascherson, Flora der Provinz Brandenburg, der Altmark und des Herzogthums Magdeburg. Berlin. 1859-1864. (1: pp. i-xxii, 1 - 320 in 1860 ; pp. 321-1034 in 1864; 2 \& 3 in 1859.) For Ed. 2, cf. Ascherson \& Graebner, Fl. Nordostd. Flachl.
Ascherson \& Graebner, Fl. Nordostd. Flachl.
P. F. A. Ascherson \& K. O. P. P. Graebner, Flora des nordostdeutschen Flachlandes (ausser Ostpreussen). Berlin. 1898-1899. (Pp. 1-482 in 1898; pp. 483-875 in 1899.) This is Ed. 2 of Ascherson, Fl. Brandenb.
Ascherson \& Graebner, Syn. Mitteleur. Fl.
P. F. A. Ascherson \& K. O. P. P. Graebner, Synopsis der mitteleuropäischen Flora. Ed. 1. Leipzig. 1896-1938. (1: pp. 1-160 in 1896; pp. 161-416 in 1897; 2 (1): pp. 1-64 in 1898; pp. 65-304 in 1899; pp. 305-544 in 1900; pp. 545-704 in 1901; pp. 705-796 in 1902; 2 (2): pp. 1-144 in 1902; pp. 145-224 in 1903; pp. 225-530 in 1904; 3: pp. 1-320 in 1905; pp. 321-560 in 1906; pp. 561-934 in 1907; 4: pp. 1-80 in 1908; pp. 81-320 in 1909; pp. 321-400 in 1910; pp. 401-640 in 1911; pp. 641-800
in 1912; pp. 801-886 in 1913; 5 (1): pp. 1-224 in 1913; pp. 225400 in 1914; pp. 401-480 in 1915; pp. 481-544 in 1916; pp. 545624 in 1917; pp. 625-784 in 1918; pp. 785-948 in 1919; 5 (2): pp. 1-160 in 1920; pp. 161-400 in 1921; pp. 401-480 in 1922; pp. 481-560 in 1923; pp. 561-640 in 1926; pp. 641-812 in 1929; 5 (3): pp. 1-98 in 1935; 5 (4): pp. 1-160 in 1936; pp. 161-252 in 1938; $6(\mathbf{1})$ : pp. 1-64 in 1900; pp. 65-240 in 1901; pp. 241560 in 1902; pp. 561-640 in 1903; pp. 641-800 in 1904; pp. 801896 in 1905; 6 (2): pp. 1-160 in 1906; pp. 161-496 in 1907; pp. 497-688 in 1908; pp. 689-1008 in 1909; pp. 1009-1094 in 1910; 7: pp. 1-80 in 1913; pp. 81-240 in 1914; pp. 241-320 in 1915; pp. 321-400 in 1916; pp. 401-480 in 1917; 12 (1): pp. 180 in 1922; pp. 81-160 in 1924; pp. 161-400 in 1929; pp. 401492 in 1930; 12 (2): pp. $1-160$ in 1930; pp. 161-480 in 1931; pp. 481-640 in 1934; pp. 641-790 in 1935; 12 (3): pp. 1-320 in 1936; pp. 321-480 in 1937; pp. 481-708 in 1938.) Ed. 2. Leipzig. 1912-1913. (1: pp. 1-480 in 1912; pp. 481-630 in 1913.)

## Asso, Syn. Stirp. Arag.

I. J. de Asso y del Rio, Synopsis Stirpium indigenarum Aragoniae. Massiliae. 1779.
Balbis, Cat. Stirp. Hort. Bot. Taur.
G. B. Balbis, Catalogus Stirpium Horti bot. Taurinensis. Taurini. 1807. App. 1. Taurini. 1810. App. 2. Taurini. 1812. App. 3. Taurini. 1813. App. 4. Taurini. 1814.
Balbis, Syn. Pl. Hort. Bot. Taur.
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## APPENDIX III

## KEY TO THE ABBREVIATIONS OF TITLES OF PERIODICALS CITED IN VOLUME I

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Abh. Böhm. Ges. Wiss. (Math.-Nat.)
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Abh. Senckenb. Naturf. Ges.
Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft. Frankfurt a. M. 1854 $\rightarrow$.
Abh. Zool.-Bot. Ges. Wien
Abhandlungen der kaiserlich-königliche zoologisch-botanischen Gesellschaft in Wien. Wien. 1901 $\rightarrow$.
Acta Bot. Acad. Sci. Hung.
Acta botanica Academiae Scientiarum Hungaricae. Budapest. $1955 \rightarrow$.
Acta Bot. Bohem. Acta botanica Bohemica. Praha. 1922-1947.
Acta Bot. Fenn. Acta botanica Fennica. Helsingforsiae. $1925 \rightarrow$.
Acta Bot. Neerl.
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Acta Fac. Rer. Nat. Carol.
Acta Facultatis Rerum naturalium Universitatis Carolinae/ Spisy Vydávané Přirodovědeckou Facultou Karlovy Universityl Publications de la Faculté des Sciences de l'Université Charles. Praha. 1923-1949.
Acta Geobot. Hung.
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Acta Horti Bergiani/Meddelanden från Kungl. Svenska Veten-skaps-Akademiens Trädgård, Bergielund. Stockholm. $1890 \rightarrow$.
Acta Horti Bot. Univ. Jurjev.
Труды ботаническаго Сада Имп. Юрьевскаго Универсиmema/Trudy botaničeskago Sada Imp. Jur'evskago Universitetal Acta Horti botanici Universitatis Imp. Jurjevensis. Jurjev. 19001914.

Acta Horti Bot. Univ. Latv.
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Петербургъ/Trudy Imp. S.-Peterburgskago botaničeskago Sada. S.-Peterburg. 1871-1918. Continued as Труды главнаго ботаническаго Сада. Петроград/Trudy glavnago botaničeskago Sada. Petrograd 1918-1931.
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Act. Soc. Linn. Bordeaux
Actes de la Société Linnéenne de Bordeaux. Bordeaux. $1830 \rightarrow$.
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Acta Societatis Scientiarum Fennicae. Helsingforsiae. $1842 \rightarrow$. Agron. Lusit.

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Anais Inst. Sup. Agron. (Lisboa)
Anais do Instituto superior de Agronomia. Lisboa. $1920 \rightarrow$.
Anal. Acad. Române
Analele Academiei Române. București. $1867 \rightarrow$.
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Compte(s) rendu(s) hebdomadaire(s) des Séances de l'Académie des Sciences. Paris. $1835 \rightarrow$.
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Доклады Академии Наук СССР. Моснва, Јенинград/Doklady Akademii Nauk SSSR. Moskva, Leningrad/Compte(s) rendu(s) (Doklady) de l'Académie des Sciences de l'URSS. Moscou, Leningrad. 1922-1945.
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International Journal of organic Evolution. Lancaster, Pennsylvania. $1947 \rightarrow$.
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Flora og Fauna. Aarhus.
Flora (Regensb.)
Flora oder allgemeine botanische Zeitung. Jena \& Regensburg. $1818 \rightarrow$
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The flowering Plants of South Africa. A Magazine containing hand-coloured Figures with Descriptions of the flowering Plants indigenous to South Africa. 1-24. 1920-1944. Continued as The flowering Plants of Africa. A Magazine containing coloured Figures with Descriptions of the flowering Plants indigenous in Africa. $25 \rightarrow .1945 \rightarrow$. This work has no page numbers, only plates.
Fl. Serres Jard. Eur.
Flore des Serres et des Jardins de l'Europe. Gand. 1845-1880. ( 1 in $1845 ; 2$ in $1846 ; 3$ in $1847 ; 4$ in $1848 ; 5$ in $1849 ; 6$ in 1851 ; 7 in 1851-1852; 8 in 1853; 9 in 1854; 10 in 1855; 11 in 1856; 12 in 1857; 13 in 1858; 14 in 1859; 15 in 1865; 16 in 1865-1867; 17 in 1868-1869; 18 in 1869-1870; 19 in 1873; 20 in 1874; 21 in 1875; 22 in 1877; 23 in 1880.) The full title of this work is very variable, but the first part (given above) is more or less constant. Earlier volumes have no page numbers, but nearly every

## APPENDIX III

leaf is numbered, and these are treated as page numbers, sometimes with $\mathrm{a} \& \mathrm{~b}$ added.
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Fragmenta floristica et geobotanica. Kraków. 1945 $\rightarrow$.
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Gardeners' and Farmers' Journal. London.
Gard. Mag.
Gardeners' Magazine. London. 1-59. 1860-1916.
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The Gardeners' Magazine and Register of rural and domestic Improvement (conducted by J. C. Loudon). London. 1-19. 1826-1843.
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Gentes Herbarum. Occasional Papers on the Kinds of Plants. Ithaca, N.Y. $1920 \rightarrow$.
Ges. Nat. Freunde Berlin Mag.
Der Gesellschaft naturforschender Freunde zu Berlin, Magazin für die neuesten Entdeckungen in der gesammten Naturkunde. Berlin. 1-8. 1807-1818. Other titles at other periods.
Gior. Arcad. Sci. (Roma)
Giornale arcadico di Scienze, Lettere ed Arti. Roma.
Gior. Bot. Ital.
Giornale botanico italiano. Firenze. 1 \& 2. 1844-1852.
Gior. Fis. Chem. Stor. Nat. Pavia
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## APPENDIX IV

## GLOSSARY OF TECHNICAL TERMS

The number of technical terms used in Flora Europaea has been kept as low as is consistent with a reasonable standard of accuracy and brevity. Most of them are used in well-established traditional senses, and their meanings may be ascertained by reference to glossaries such as H. I. Featherly, Taxonomic Terminology of the Higher Plants (Ames, Iowa, U.S.A., 1954). No term is used in a sense inconsistent with that given by Featherly.

Experience has shown, however, that some useful terms are liable to misinterpretation, and others, which can be used in a wider sense, are used in a restricted sense in Flora Europaea. This glossary is intended simply to indicate without ambiguity the sense in which these potentially ambiguous terms are here employed.

Certain technical terms, which are restricted to descriptions in particular families or genera, are explained under the family or genus concerned.
above Used to indicate both the upper surface of a normally horizontal organ and the upper part of an organ or of the whole plant.
ACROSCOPIC Designates the side of a segment or secondary axis which is directed towards the apex of the axis on which it is borne.
alternate Arising singly at a node; includes regularly spiral, as well as distichous arrangements.
annual Completing its life-cycle from seed to seed in less than 12 months; includes 'overwintering' annuals, which germinate in autumn and flower the following year.
BASISCOPIC Designates the side of a segment or secondary axis which is directed towards the base of the axis on which it is borne.
below Used to indicate the basal part of a plant, stem or inflorescence; cf. beneath.
beneath Used to indicate the lower surface of a normally horizontal organ; cf. below.
bilateral When used of spores or seeds means elongated, with one axis much longer than the others.
CADUCOUS Falling prematurely; cf. deciduous.
Clathrate Used to designate scales composed of cells with thickened vertical and transparent horizontal walls, thus presenting a reticulate appearance in surface view.
cochleariform With a concavo-convex apical part, resembling the bowl of a spoon; cf. spathulate.
costa A secondary rhachis of the leaf of a fern.
deciduous Eventually falling; cf. caducous.
ERECTO-PATENT Diverging at an angle of $15-45^{\circ}$ from the axis on which the structure is borne.
floccose Clothed with woolly hairs, which are disposed in tufts or tend to rub off and adhere in small masses.
Glabrescent Becoming glabrous with increasing age or maturity. For structures very slightly but persistently hairy the term subglabrous is used.
hirsute Covered with long, moderately stiff and not interwoven hairs.
HISPID Covered with stiff hairs or bristles.
lanate Covered with soft, flexuous, intertwined hairs.
MONILIFORM Deeply constricted at fairly regular intervals, so as to resemble a necklace of beads.
peltate Denotes an organ of which the stalk is attached to a more or less flat surface, and not to the margin; the attachment is not, however, necessarily central.
simple hair Indicates an unbranched hair; it may or may not bear a gland.
spathulate Expanded rather suddenly towards the apex, so as to resemble the outline of a spoon; the organ is, however, nearly or quite flat; cf. cochleariform.
stock The persistent, usually somewhat woody base of an otherwise herbaceous perennial.
tetrahedral When used of spores means isodiametric; the spore may approximate to a geometrical tetrahedron or may be nearly globular.
tomentose With hairs compacted into a felty mass.
tuberculate Covered with smooth, knob-like elevations.
verrucose Covered with rough, wart-like elevations.
villous Covered with long, usually appressed, soft, straight hairs.

# APPENDIX V <br> VOCABULARIUM ANGLO-LATINUM <br> <br> IN USUM LECTORUM LINGUAE ANGLICAE MINUS PERITORUM CONFECTUM 

 <br> <br> IN USUM LECTORUM LINGUAE ANGLICAE MINUS PERITORUM CONFECTUM}
N.B. Plurimi termini ad descriptionem botanicam in lingua anglica usurpati aequipollentibus latinis persimiles sunt, e.g. ovate (ovatus), inflorescence (inflorescentia). Talia verba omnia sunt omissa.


## APPENDIX V

head caput, capitulum
heath ericetum, callunetum
hedge saepes
helmet galea
hill collis
hoary incanus
hollow fistulosus, cavus; cavum, excavatio
hood cucullus
hooked uncinatus
inner interior, internus
inside intus, intra; pagina vel pars interior
introduced inquilinus, allatus
jagged argutus
jointed articulatus
juice succus
keel carina
lake lacus
late sero
later postea
leaf folium
leaffess foliis carens
leaflet foliolum
length longitudo
less minus
level altitudo
light clare
limestone calx
lip labium
locally hic inde
low humilis, pusillus
lower inferior
lowland campestris, planitiem incolens
main principalis
male masculus, stamineus
many multi
marbled marmoratus
marsh palus
mat stratum e ramulis procumbentibus
intertextis compositum
meadow pratum
mealy farinosus
medicinal officinalis
middle pars centralis; medius
midrib costa, folii nervus principalis
milky lacteus
mistake error
more plus, magis
most plerique, pars major
mountain mons
mouth os
much multo, multum
naked nudus
narrow angustus
native indigenus
naturalized subspontaneus
near prope
nearly paene, fere
neither...nor nec...nec
net reticulum
never numquam
nodding nutans, cernuus
none nulli
northern borealis
northwards septentrionem versus
notch incisio
nut nux
often saepe
open apertus
orange aurantiacus
ornament decus
other alius, alter
otherwise aliter
outer exterior, externus
outside extra; pagina vel pars exterior
overlapping imbricatus
pale pallidus
papery chartaceus
pasture pascuum
patch macula
peat-bog turbarium
pink roseus
pitted foveolatus
planted cultus
point acumen
pond stagnum
pool stagnum
prickle aculeus
purple purpureus
quarter pars quarta
rank ordo
rarely raro
ray radius
red ruber
related affinis
remains reliquiae
rest ceteri
rib costa
rice-field oryzetum
ridge carina
ring anulus
river flumen
road via
rock saxum, rupes
root radix
rosette rosula
rough asper
rounded rotundatus
rust-coloured ferrugineus
salt-marsh palus salsa
sand arena
scale squama
scanty exiguus
scar cicatrix
scarcely vix
scarlet laete et clare ruber, paullulo aurantiaco affectus; ut flos Salviae splendentis coloratus
scattered sparsus
scented fragrans
scree clivus alpestris, saxis deorsum conjectis copertus
sea mare
seed semen
seldom raro
several nonnulli, complures
shady umbrosus
shallow haud profundus
shape forma
sharply acute
sheath vagina
shelter tegmen contra ventum
shingle glarea maritima vel fluviatilis
shiny nitidus
shoot caudiculus, surculus
shore litus, ora
short brevis
shoulder angulus obtusus
shrub frutex
side latus, pagina
silky sericeus
silvery argenteus
slender tenuis, gracilis
slightly leviter, paullo
slipper calceolus
slit rima, foramen longum sed angustum
slope clivus, declivitas
small parvus
smell odor
smooth laevis
snow-patch locus in montibus ubi nix sero perdurat
soft mollis
soil solum
sometimes interdum
southern australis
southwards meridiem versus
spikelet spicula
spot punctum, macula
spreading patens, divaricatus
spring ver
spur calcar
square quadratus
stalk stipes
standard vexillum
stem caulis
stiff rigidus
stock caudex
stony lapidosus
stout crassus, robustus
straight rectus
streak linea
stripe vitta
strong robustus, validus
suddenly abrupte
summer aestas
sunk immersus
surface superficies, pagina
sweet dulcis
swollen tumidus, inflatus

## APPENDIX V

\(\left.$$
\begin{array}{l|l}\text { tall altus } \\
\text { tawny fulvus } \\
\text { teeth dentes } \\
\text { thick crassus, densus, spissus } & \begin{array}{l}\text { twining volubilis } \\
\text { twisted contortus } \\
\text { uncertain incertus, dubius } \\
\text { undivided indivisus }\end{array} \\
\text { thicket dumetum } & \begin{array}{l}\text { unequal inaequalis } \\
\text { united conjunctus, connatus } \\
\text { upper superior }\end{array}
$$ <br>
third pars tertia <br>
timber materia; lignum ad usum homi- <br>
num aptum <br>
upermost supremus <br>
upwards sursum <br>
usually plerumque <br>
veil velum <br>
vein nervus <br>

velvety velutinus\end{array}\right\}\)| violet violaceus |
| :--- |
| tip apex suffusus |
| tipped ad apicem munitus vel tinctus verruca |
| tooth dens |
| top vertex |
| tough lentus |
| tree arbor |
| tufted in fasciculos dispositus, caespitosus incultus |
| twice bis |
| twig ramulus, virga | | weak debilis, flaccidus |
| :--- |
| well bene |
| western occidentalis |

```
westwards occidentem versus
wet madidus
white albus, candidus
whorled verticillatus
wide latus
widespread late diffusus
width latitudo
wing ala
winter hiems
wiry filo ferreo similis
withered marcidus
without sine
wood silva; lignum
woody lignosus
woolly lanatus
wrinkled rugosus
yellow flavus, luteus
```


## ADDENDA TO APPENDIX III

Annu. Cons. Jard. Bot. Genève<br>Annuaire $d u$ Conservatoire et $d u$ Jardin botanique de Genève. Genève. 1897-1922.<br>\section*{Gartenflora}<br>Gartenflora. Berlin \& Erlangen. 1852-1938.<br>Gior. Ital. (Griselini)<br>Giornale d'Italia, spettante alla Scienza naturale, e principalmente all' Agricoltura, alle Arti ed al Commercio. Edit. F. Griselini. 1764-?.<br>Magas. Encycl.<br>Magasin Encyclopédique, ou Journal des Sciences, des Lettres et des Arts. Paris. 1795-?.<br>Mém. Mus. Hist. Nat. (Paris)<br>Mémoires du Muséum d'Histoire naturelle. Paris. 1-20. 1815-1832.<br>Trudy Kommiss. Kiev. Učebn. Okr.<br>Труды Коммиссии, высочайше учрежденной при Императорском Университете Св. Владимира, для Описания Губерній Кіевскаго Учернаго Округа. Кіевъ./Trudy Kommissii, vysočajše učreždennoj pri Imperatorskom Universitete Sv. Vladimira, dlja Opisanija Gubernij Kievskago Učernago Okruga. Kiev.<br>\section*{Watsonia}<br>Watsonia. Journal of the Botanical Society of the British Isles. Arbroath. $1949 \rightarrow$.<br>Wentia<br>Wentia. Amsterdam. $1959 \rightarrow$.

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## INDEX

This index is intended to serve two purposes: to enable the reader to find the page on which any plant is mentioned, and to cite and explain names relegated to synonymy which occur in 'Standard Floras', but are not in sufficiently wide currency to justify their citation in the text (see p. xxii).

Generic names adopted in Flora Europaea are printed in bold-faced type; specific and subspecific epithets adopted are printed in ordinary type. (This applies not only to numbered species and genera, but also to those mentioned incidentally in observations, or in the introductory descriptions of families or genera.) All synonyms are printed in italic type, and are followed by a page-reference (also in italics); for those not cited in the text the page number is followed by a further number or numbers in parentheses to indicate the species (and, where necessary, subspecies, genus and family) on that page to which the synonym is referable. Among these numbers roman numerals denote the family, arabic numerals in ordinary type the genus, arabic numerals in bold-faced type the species, and a small letter (also in bold-faced type) following the species number the subspecies. Thus,

Saxifraga<br>alpina Degen, 370 (30)

indicates that the name is regarded as a synonym (partial or complete) of the species on p .370 which is numbered 30 , namely S. petraea. Similarly,

## Grammitis

```
leptophylla (L.) Swartz, }11\mathrm{ (xI, 1, 1)
```

indicates that this name is regarded as a synonym of species 1 (leptophylla) in genus 1 (Anogramma) of family xi (GYMNOGRAMMACEAE); because several small families are treated on the same page, citation of genus and family is necessary to avoid ambiguity.

Synonyms of taxa mentioned in notes following a numbered species are indexed as being synonyms of that species. In cases where this procedure would be ambiguous or misleading, the synonym in question has been inserted in the text.

All infraspecific taxa are arranged alphabetically, regardless of rank, under the species with which they are combined.

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rotundifolium Tineo, 319 (3)
salisii Brügger, 319
stenopterum Boiss. \& Reuter, 319
stylosum (Ten.) Mutel, 320
suecicum Jordan, 319 (5)
sylvestre Jordan, 319
sylvium Gaudin, 321
taygeteum Boiss., 320 (10)
tinei Nyman, 319 (3)
tymphaeum Hausskn., 320 (16)
trojagense Zapat., 321 (22)
umbrosum Waisb., 320
villarsianum Jordan, 319 (5)
virens Jordan, 319
virgatum Gren. \& Godron, 319 (5)
vogesiacum Jordan, 319 (5)
vulcanorum Lamotte, 319 (5)
Thuja L., 37
occidentalis L., 37
orientalis L., 37
plicata D. Don ex Lamb., 37
Tillaea L .
aquatica L., 351
muscosa L., 351
vaillantii Willd., 351
Tiniaria Reichenb.
baldschuanica sensu Janchen, 81 (3)
convolvulus (L.) Webb \& Moq., $81(3,1)$
dumetorum (L.) Opiz, $81(3,2)$
japonica (Houtt.) Hedburg, $81(4,1)$
sachalinensis (Friedrich Schmidt Petrop.) Janchen, $81(4,2)$
Tolmiea Torrey \& A. Gray
menziesii (Pursh) Torrey \& A. Gray, 364
Torularia (Cosson) O. E. Schulz, 278
contortuplicata (Stephan ex Willd.) O.E. Schulz, 278
rossica O. E. Schulz, 278
torulosa (Desf.) O. E. Schulz, 278
Toxylon Rafin.
pomiferum Rafin., $66(3,1)$
Trichomanes L., 13
radicans auct., vix Swartz, 13
speciosum Willd., 13
Trollius L., 210
asiaticus L., 210
europaeus L., 210
subsp. transsilvanicus (Schur) Jáv., 210
uralensis Gorodkov, 210
Tsuga (Antoine) Carrière, 30
americana (Miller) Farwell, 30 (2)
canadensis (L.) Carrière, 30
heterophylla (Rafin.) Sarg., 30
mertensiana auct., $30(3,1)$
Tunica auct., 186
alpina (Habl.) Bobrov, 187 (6)
armerioides (Ser.) Halácsy, 187
cretica auct. balcan., non (L.) Fischer \& C. A. Meyer, 187 (4)
cretica (L.) Fischer \& C. A. Meyer, 187 (5)
var. taygetea (Boiss.) Halácsy, $186(35,1$ c)
cretica sensu Fischer \& C. A. Meyer pro parte, 187
cretica sensu Hayek pro parte, non (L.) Fischer \& C. A. Meyer, 186
dianthoides (Sibth. \& Sm.) Boiss., 187
fasciculata (Margot \& Reuter) Bciss., 187
glumacea (Chaub. \& Bory) Boiss., 188 (16)
graminea (Sibth. \& Sm.) Boiss., 187
illyrica (L.) Fischer \& C. A. Meyer, 186
subsp. haynaldiana (Janka) Prodan, 186(35, 1 b)
ochroleuca (Sibth. \& Sm.) Fischer \& C. A. Meyer, 186
var. phthiotica (Boiss. \& Heldr.) Hayek, 187

Tunica (cont.)
olympica Boiss., 187 (6)
pachygona Fischer \& C. A. Meyer, 187
phthiotica Boiss. \& Heldr., 187 (7)
prolifera auct. eur. occid. pro parte, 188
prolifera (L.) Scop., 187
rigida (L.) Boiss., 187
saxifraga (L.) Scop., 187
sibthorpii Boiss., 187 (3)
stricta (Ledeb.) Fischer \& C. A. Meyer, 187
taygetea (Boiss.) P. H. Davis, 186 (35, 1 c)
taygetea sensu P.H. Davis pro parte, non
(Boiss.) P. H. Davis, 187 (4)
thessala Boiss., 187
velutina (Guss.) Fischer \& C. A. Meyer, 188
Turritis L., 290
glabra L., 291
laxa (Sibth. \& Sm.) Hayek, 291
pseudoturritis (Boiss. \& Heldr.) Velen., 291

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Ulmus L., 65
angustifolia (Weston) Weston, 65
campestris auct., non L., 65
canescens Melville, 65
carpinifolia G. Suckow, 65
coritana Melville, 65
diversifolia Melville, 65 (3)
effusa Willd., 65
elliptica C. Koch, 65
foliacea sensu Hayek, 65
glabra Hudson, 65
glabra Miller, non Hudson, 65 (3)
$\times$ hollandica Miller, $65(1 \times 3$ ?)
laevis Pallas, 65
minor Miller, 65
montana With., 65
pedunculata Foug., 65 (5)
plotii Druce, 65
procera Salisb., 65
scabra Miller, 65
stricta (Aiton) Lindley, 65 (3)
Umbilicus DC., 351
chloranthus Heldr. \& Sart. ex Boiss., 351
erectus DC., 352
var. lassithiensis (Gand.) Stoj., 352
erectus sensu Willk., non DC., 351 (?6)
gaditanus Boiss., 352
heylandianus Webb \& Berth., 352
hispidus (Lam.) DC., $352(5,2)$
horizontalis (Guss.) DC., 352
intermedius Boiss., 352
lassithiensis Gand., 352 (3)
neglectus (Coutinho) Rothm. \& P. Silva, 352
parviflorus (Desf.) DC., 351
pendulinus DC., 352
praealtus Mariz, 352 (6)
rupestris (Salisb.) Dandy, 352
sedoides (DC.) DC., 352
serratus (L.) DC., 364 (1)
umbilicus-veneris sensu Stoj. \& Stefanov, 352 (3)
vulgaris Knoche, 352 (4 and 5)
winkleri Willk., 361
Urtica L., 67
atrovirens Req. ex Loisel., 68
cannabina L., 68
caudata Vahl, non Burm. fil., 68
dioica L., 68
dodartii L., 68 (8)
dubia Forskål, 68
galeopsifolia Wierzb. ex Opiz, 68 (2)
gracilis Aiton, 68 (2)
kioviensis Rogow., 68
membranacea Poiret, 68
pilulifera L., 68
pubescens Ledeb., 68
rupestris Guss., 68
urens L., 68

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Vaccaria Medicus, 186
grandiflora Jaub. \& Spach, $186(34,1)$

Vaccaria (cont.)
parviflora Moench, $186(34,1)$
perfoliata Gilib., $186(34,1)$
pyramidata Medicus, 186
segetalis Garcke, 186
vulgaris Host, 186
Vandenboschia Copel., 13
speciosa (Willd.) Copel., $13(2,1)$
Velezia L., 204
quadridentata Sibth. \& Sm., 204
rigida L., 204
Vella L., 342
aпnиa L., 342
badalii Pau ex Pau, $342(96,1)$
monosperma Menéndez Amor, $342(96,1)$
pseudocytisus L., 342
var. badalii (Pau ex Pau) Heywood, 342
spinosa Boiss., 342
tenuissima Pallas, $281(35,1)$
Vesicaria Lam., 296
graeca Reuter, $296(48,1)$
sinuata (L.) Poiret, 296
utriculata (L.) Lam., $296(48,1)$
Vibo Medicus
spinosa (L.) Medicus, $89(9,1)$
Viscaria Bernh., 156
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viscosa Ascherson, 157
vulgaris Bernh., 157
Viscum L., 72
album L., 72
subsp. abietis (Wiesb.) Abromeit. 73 subsp. austriacum (Wiesb.) Vollmann, 73
cruciatum Sieber ex Boiss., 72
laxum Boiss. \& Reuter, 73 (2c)
var. abietis (Wiesb.) Hayek, 73
var. pini (Wiesb.) Hayek, 73
Vogelia Medicus, non J. F. Gmelin, 315
apiculata (Fischer, C. A. Meyer \& Avé-Lall.) Vierh., $315(67,1)$
paniculata (L.) Hornem., 315

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angustiflora Rupr., 166
Wilckia Scop., 277
angulifolia (Boiss. \& Orph.) Halácsy, 278 (11)
africana (L.) F. Mueller, 277 (4)
bicolor (Boiss. \& Heldr.) Halácsy, 278 (15)
chia (L.) Halácsy, 278 (13)
flexuosa (Sibth. \& Sm.) Halácsy, 278 (7)
gracilima Samp., 277 (2)
graeca (Boiss. \& Spruner) Halácsy, 278 (8)
hydraea Halácsy, 277 (4)
lacera (L.) Samp., 277 (2)

Wilckia (cont.)
littorea (L.) Druce, 277 (1)
maritima (L.) Halácsy, 277 (6)
maritima sensu Samp., 278 (7)
orsiniana (Ten.) Degen, 278 (10)
parviflora (DC.) Halácsy, 277 (2)
patula (DC.) Samp., 277 (2)
serbica (Pančić) Halácsy, 277 (1)
Woodsia R.Br., 19
alpina (Bolton) S. F. Gray, 19
glabella auct. eur. centr., non R.Br., 19 glabella R.Br., 19
hyperborea (Liljeblad) R.Br., 19
ilvensis (L.) R.Br., 19
subsp. alpina (Bolton) Ascherson, 19 subsp. alpina S. F. Gray, 19 (2)
var. alpina (Bolton) Ascherson, 19 (2)
subsp. rufidula (Michx) Ascherson, 19
pulchella Bertol., 19
rufidula Ascherson, $19(4,1)$
Woodwardia Sm., 23
radicans (L.) Sm., 23
Zahlbrucknera Reichenb.
paradoxa (Sternb.) Reichenb., 371
Zelkova Spach, 65
abelicea (Lam.) Boiss., 65
cretica (Sm.) Spach, 65

To illustrate the boundaries of Europe for the purposes of Flora Europaea, and its division into 'territories' which are indicated by two-letter abbreviations after the summary of geographical distribution for each species. These abbreviations are derived from the Latin name of the territory concerned.

| Al | Albania |
| :--- | :--- |
| Au | Austria, with Liechtenstein |
| Az | Açores |
| Be | Belgium, with Luxembourg |
| Bl | Islas Baleares |
| Br | Britain, including Orkneys, Zetland and Isle of Man; excluding Channel Islands and Northern Ireland |
| Bu | Bulgaria |
| Co | Corse |
| Cr | Kriti (Creta), with Karpathos, Kasos and Gavdhos |
| Cz | Czechoslovakia |
| Da | Denmark (Dania), including Bornholm |
| Fa | Færöer |
| Fe | Finland (Fennia), including Ahvenanmaa (Aaland Islands) |
| Ga | France (Gallia), with the Channel Islands (Îles Normandes) and Monaco; excluding Corse |
| Ge | Germany (both eastern and western republics) |
| Gr | Greece, excluding those islands included under Kriti (supra) and those which are outside Europe as |
|  | defined for Flora Europaea |
| Hb | Ireland (Hibernia); both the republic and Northern Ireland |
| He | Switzerland (Helvetia) |
| Hs | Spain (Hispania), with Gibraltar and Andorra; excluding Islas Baleares |
| Ho | Netherlands (Hollandia) |
| Hu | Hungary |
| Is | Iceland (Islandia) |
| It | Italy, including the Arcipelago Toscano; excluding Sardegna and Sicilia as defined infra |
| Ju | Jugoslavia |
| Lu | Portugal (Lusitania) |
| No | Norway |
| Po | Poland |
| Rm | Romania |
| Rs | U.S.S.R. (Rossia). This has been subdivided as follows, using the floristic divisions of Komarov's Flora |
|  | U.R.S.S. |
|  | Rs (N) Northern division: Arctic Europe, Karelo-Lapland, Dvina-Pečora |
|  | Rs (B) Baltic division: Estonia, Latvia, Lithuania, Kaliningradskaja Oblast', |
|  | Rs (C) Central division: Ladoga-Ilmen, Upper Volga, Volga-Kama, Upper Dnepr, Volga-Don, Ural |
|  | Rs (W) South-western division: Moldavia, Middle Dnepr, Black Sea, Upper Dnestr |
|  | Rs (K) Krym (Crimea) |
|  | Rs (E) South-eastern division: Lower Don, Lower Volga, Transvolga |
|  | White Russia falls entirely within Rs (C). Ukraine is largely in Rs (W), but partly in Rs (K), Rs (C) and |
| Sa | Rs (E). The European part of Kazakhstan is in Rs (E) |
| Sb | Sardega |
| Si | Svalbard, comprising Spitsbergen, Biörnöya (Bear Island) and Jan Mayen |
| Su | Sweden with Pantelleria, Isole Pelagie, Isole Lipari and Ustica; also the Malta archipelago |
| Tu | Turkey (European part), including Imroz |
|  |  |



## MAP II

To illustrate the boundary between Europe and Asia in the Aegean region.
The boundary is based largely on the proposals of K. H. Rechinger, 'Grundzüge der Pflanzenverbreitung in der Aegäis', Vegetatio 2: 55 (1949). His northern, western and Kikladhes divisions are regarded as entirely in Europe and his eastern division as entirely in Asia; it was, however, necessary to divide his southern and north-eastern divisions.


## MAP III

To illustrate the boundary between Europe and Asia in the southern part of the U.S.S.R.
The southern boundary of Europe between the Caspian and Black Seas is defined for Flora Europaea as running up the Terek River westwards to $45^{\circ}$ E.; thence along the eastern and northern boundaries of the Stavropol'skij Kraj (as marked in The Times Atlas) to meet the Kuban River a short distance east of Kropotkin; thence down the Kuban River to its more southerly mouth.
The eastern boundary of Europe is defined as running in the Arctic Ocean between Novaja Zemlja and Vajgač; up the Kara River to $68^{\circ} \mathrm{N}$.; thence along the crest of the Ural Mountains (following the administrative boundaries) to $58^{\circ} 30^{\prime} \mathrm{N}$.; thence by an arbitrary straight line to a point 50 km E. of Sverdlovsk, and by another arbitrary straight line to the head-waters of the Ural River (S. of Zlatoust); thence along the Ural River to the Caspian Sea.
The following administrative districts of the Russian S.F.S.R. near the eastern or southern boundary of Europe are regarded as entirely in Europe:

| Arkhangel'skaja Obl. | Volgogradskaja Obl. |
| :--- | :--- |
| Komi A.S.S.R. | Astrakhanskaja Obl. |
| Permskaja Obl. | Kalmyckaja A.S.S.R. |
| Kujbyševskaja Obl. | Rostovskaja Obl. |
| Saratovskaja Obl. |  |

The following are regarded as partly in Europe, partly in Asia:

Russian S.F.S.R.
Sverdlovskaja Obl.
Čeljabinskaja Obl.
Baškirskaja A.S.S.R. (only the extreme N.E. corner being in Asia)
Orenburgskaja Obl.

Dagestanskaja A.S.S.R
Čečeno-Inguškaja A.S.S.R. Krasnodarskij Kraj
Kazakhstan
Zapadno-Kazakhstanskaja Obl.
Gur'jevskaja Obl.


To illustrate the meaning to be attached to certain phrases used in summaries of geographical distribution.
W. Europe: Açores, Portugal, Spain, Islas Baleares, France, Ireland, Britain, Færöer, Iceland, S.W. Norway, Netherlands, Belgium, W. Denmark (Jylland), Corse, Sardegna, and small parts of N.W. Italy and W. Switzerland
E. Europe: N.E. Greece and the Aegean islands, Bulgaria, S. \& E. Romania, Finland, U.S.S.R.
N. Europe: Svalbard, Iceland, Færöer, Ireland, Britain (excluding S. England), Denmark, Fennoscandia, U.S.S.R. north of a line running through Minsk-Tula-Penza-Orsk
S. Europe: Europe south of a line running through Bordeaux-Chambéry-Aosta-Locarno-Riva-Udine-Zagreb-Beograd-Ploesti-Odessa-Rostov-Astrakhan'.
For the definition and illustration of the meaning of S.W., N.W., S.E., N.E. and C. Europe, and of certain other geographical phrases, see map $v$.


MAP V
To illustrate the meaning to be attached to certain phrases used in summaries of geographical distribution.
S.W. Europe: Açores, Portugal, Spain, Islas Baleares, Corse, Sardegna, S. France, N.W. Italy
N.W. Europe: Iceland, Færöer, Britain, N. France, Belgium, Netherlands, N.W. Germany, W. Denmark (Jylland), Norway
S.E. Europe: The Balkan peninsula, Aegean islands, S.E. Italy, S. \& E. Romania, U.S.S.R. south of about $48^{\circ} \mathrm{N}$.
C. Europe: Alsace and Lorraine, Germany, Switzerland, Austria, the Italian Alps from Monte Bianco eastwards, Hungary, Czechoslovakia, Poland, the Ukrainian Carpathians, N., W. \& C. Romania, Jugoslavia north of the Danube-Sava-Kupa line.

Maps iv and $v$ are intended merely to give precision to certain geographical phrases which are commonly used, but used in various senses in different parts of Europe. They do not purport to divide Europe into phytogeographical regions, as is apparent from the fact that along parts of their boundaries these regions overlap, and along other parts they are not contiguous.

Certain other phrases used in the summaries of geographical distribution, but not illustrated in the maps, may be briefly defined as follows:
Alps: Separated from the Appennini at $8^{\circ} 15^{\prime}$ E. (above Savona); bounded on the east by the line Semmering-Graz-Maribor-Ljubljana-Trieste. Divided into three major divisions: eastern, central, and south-western, by the lines Arlberg-St Moritz-Chiavenna-Como and Genève-Chamonix-Aosta-Ivrea.
Carpathians: Divided into western, eastern and southern divisions at the pass of Łupków ( $22^{\circ} \mathrm{E}$.) and the Oituz Pass ( $46^{\circ} 05^{\prime} \mathrm{N}$.). The western division is in Czechoslovakia and Poland, the southern entirely in Romania, the eastern extends from Czechoslovakia and Poland through Ukraine to Romania.
Pyrenees: Includes the subsidiary chains within 50 Km of the main watershed, and extends westwards to Bilbao and Vitoria. Divided into eastern, central and western divisions at the Pont du Roi ( $0^{\circ} 45^{\prime} \mathrm{E}$.) and the Col du Somport ( $0^{\circ} 30^{\prime}$ W.).
Balkan peninsula: Jugoslavia south of the Danube-Sava-Kupa line, Bulgaria, Albania, Greece (including islands close to the mainland) and Turkey-in-Europe.
Fennoscandia: Norway, Sweden, Finland and part of N.W. Russia (Murmanskaja Oblast' and Karelskaja A.S.S.R.).

Mediterranean region: All European territories within 100 km of the Mediterranean Sea (including the Adriatic, but not the Black Sea), and including also all Italy except the Alpine region and all Spain except the west and north-west. It is divided into eastern and western divisions by a line following the main watershed of Italy and running east of Sicilia. Central Mediterranean indicates the region between $8^{\circ} \mathrm{E}$. and $20^{\circ} \mathrm{E}$.
Aegean region: All islands in the Aegean Sea which come within the scope of the Flora, and those parts of Greece and Turkey-in-Europe which drain into the Aegean Sea or the Dardanelles.
Macedonia: Comprises the Jugoslav republic of Makedonija, the Greek province of Makedhonia, and the Bulgarian province of Blagoevgrad.



[^0]:    ${ }^{1}$ For Iberian and Mediterranean species, synonyms used in the Prodromus of Willkomm \& Lange, and the Supplementum by Willkomm (p. xxiii) are also included.

[^1]:    1 Feddes Repert. 63: 107-228 (1961).

[^2]:    ${ }^{1}$ By W. Rothmaler. $\quad{ }^{2}$ Edit. D. H. Valentine. $\quad{ }^{3}$ By A. Lawalrée.

[^3]:    ${ }^{1}$ Edit. D. H. Valentine.
    ${ }^{2}$ By A. C. Jermy.

[^4]:    ${ }^{1}$ Edit. D. H. Valentine.

[^5]:    ${ }^{1}$ Measurements given for leaf-length in the Filicopsida refer to the whole leaf, including the petiole.
    ${ }^{2}$ Edit. D. H. Valentine. ${ }^{3}$ By W. Rothmaler.

[^6]:    ${ }^{2}$ By D. A. Webb.

[^7]:    ${ }^{1}$ By A. C. Jermy and H. P. Fuchs.
    ${ }^{3}$ Edit. D. H. Valentine.
    ${ }^{2}$ By D. H. Valentine.

    - By A. Lawalrée.

[^8]:    ${ }^{1}$ Edit. D. H. Valentine.
    ${ }^{3}$ By A. Lawalrée.
    ${ }^{2}$ By T. G. Walker.
    ${ }^{4}$ By T. G. Tutin.

[^9]:    ${ }^{1}$ Edit. D. H. Valentine.
    ${ }^{2}$ By D. H. Valentine.
    ${ }^{3}$ By A. Lawalrée.

[^10]:    ${ }^{1}$ By D. A. Webb. ${ }^{2}$ Edit. D. H. Valentine. ${ }^{3}$ By A. C. Jermy.

[^11]:    ${ }^{1}$ By A. C. Jermy.
    ${ }^{2}$ Edit. D. H. Valentine.
    ${ }^{3}$ By J. A. Crabbe, A. C. Jermy and J. D. Lovis.

[^12]:    ${ }^{1}$ By A. Lawalrée. ${ }^{2}$ By D. H. Valentine. ${ }^{3}$ Edit. D. H. Valentine.

[^13]:    ${ }^{1}$ By A. C. Jermy.

[^14]:    ${ }^{1}$ By A. O. Chater.
    ${ }^{2}$ By A. Lawalrée.

[^15]:    ${ }^{1}$ By D. H. Valentine.
    ${ }^{3}$ By V. H. Heywood.

[^16]:    ${ }^{1}$ By A. Lawalrée.
    ${ }^{2}$ Edit. D. H. Valentine.
    ${ }^{3}$ By D. H. Valentine.

    - By J. A. Crabbe.

[^17]:    ${ }^{1}$ By J. A. Crabbe.
    ${ }^{2}$ Edit. D. H. Valentine.
    ${ }^{8}$ By A. Lawalrée.

[^18]:    ${ }^{1}$ Edit. D. H. Valentine.

[^19]:    ${ }^{2}$ By A. Lawalrée.

[^20]:    1 Short shoots absent; leaves all solitary
    2 Leaves borne on persistent, peg-like projections or cushions
    3 Leaves petiolate; resin canal 1, median 4. Picea
    3 Leaves sessile; resin canals lateral
    3. Tsuga

    2 Leaves not borne on peg-like projections, but leaving disc-like scars
    4 Leaf-scars circular, not at all projecting; cone erect 1. Abies
    4 Leaf-scars elliptical, slightly projecting; cone deflexed or pendent
    2. Pseudotsuga

    1 Short shoots present, bearing fascicles of two or more leaves
    5 Leaves on long shoots scale-like, not green; short shoots much reduced, bearing 2-5 green leaves
    7. Pinus

    5 Leaves on long shoots similar to those on short shoots; short shoots prominent, bearing many densely clustered leaves
    6 Leaves deciduous; bracts exceeding ovuliferous scales in flower; cones not more than 4 cm 5. Larix

    6 Leaves evergreen; bracts minute or absent; cones more than 4 cm
    6. Cedrus

[^21]:    ${ }^{1}$ Edit. V. H. Heywood.

[^22]:    ${ }^{1}$ By J. Amaral Franco.
    ${ }^{2}$ By H. Gaussen, V. H. Heywood and A. O. Chater.

[^23]:    ${ }^{1}$ Edit. V. H. Heywood.
    ${ }^{2}$ By V. H. Heywood.
    ${ }^{3}$ By J. Amaral Franco.

[^24]:    ${ }^{1}$ Edit. V. H. Heywood.

[^25]:    ${ }^{1}$ Edit. V. H. Heywood. $\quad{ }^{2}$ By F. Markgraf.

[^26]:    1 Previous year's twigs thick, dark, hairy; stipules often present; leaves obovate, densely covered on both surfaces with silky hairs
    51. arenaria

[^27]:    1 Pistillate flowers long-pedicellate, with caducous disc; leaves very variable, some, particularly towards end of long shoots, lanceolate or linear-lanceolate
    11. euphratica

    1 Pistillate flowers subsessile, with persistent disc; leaves variable but never lanceolate
    2 Leaves of long shoots densely tomentose beneath, those of short shoots less tomentose or subglabrous
    3 Leaves of long shoots palmately lobed, white-tomentose beneath; bracts dentate 1. alba
    3 Leaves of long shoots with wide irregularly serrate teeth, grey-tomentose beneath; bracts laciniate $\quad$ 2. canescens
    2 Leaves not tomentose beneath (sometimes thinly tomentose when very young)
    4 Leaves without a translucent margin
    5 Petioles strongly compressed
    6 Leaves cuneate or truncate at base, coarsely dentate; buds grey-tomentose
    6 Leaves rounded or subcordate at base, sinuately crenatedentate; buds glabrous, slightly viscid
    4. tremula

    5 Petioles terete

[^28]:    ${ }^{1}$ By J. Amaral Franco.

[^29]:    ${ }^{1}$ Edit. N. A. Burges.
    ${ }^{3}$ Edit. V. H. Heywood.
    ${ }^{2}$ By N. A. Burges.
    ${ }^{4}$ By T. G. Tutin.

[^30]:    ${ }^{1}$ By T. G. Tutin.
    ${ }^{2}$ Edit. S. M. Walters.

[^31]:    ${ }^{1}$ By P. W. Ball.

[^32]:    ${ }^{1}$ Edit. T. G. Tutin.
    ${ }^{3}$ Edit. S. M. Walters.
    ${ }^{2}$ By T. G. Tutin.

[^33]:    1 Leaves very variable in size and toothing; involucre more or less obconical
    (b) subsp. anatolica

[^34]:    ${ }^{1}$ Edit. T. G. Tutin.

[^35]:    ${ }^{1}$ Edit. T. G. Tutin.

[^36]:    ${ }^{1}$ Edit. T. G. Tutin.
    ${ }^{3}$ Edit. V. H. Heywood.
    2 By T. G. Tutin.
    $\stackrel{4}{4}$ By P. W. Ball.

[^37]:    ${ }^{1}$ By P. W. Ball.

[^38]:    ${ }^{1}$ By P. W. Ball.

[^39]:    ${ }^{1}$ Edit. S. M. Walters.

[^40]:    ${ }^{1}$ Edit. V. H. Heywood.
    ${ }^{2}$ By P. W. Ball.

[^41]:    ${ }^{1}$ By P. W. Ball.

[^42]:    1 Erect, much-branched shrubs
    2 Stamens 12 or more

[^43]:    ${ }^{1}$ Edit. D. A. Webb.
    ${ }^{3}$ Edit. T. G. Tutin.

[^44]:    ${ }^{1}$ By D. A. Webb.

[^45]:    ${ }^{1}$ By D. A. Webb.

[^46]:    ${ }^{1}$ By J. P. M. Brenan.

[^47]:    ${ }^{1}$ By P. W. Ball.
    ${ }^{2}$ By P. Aellen; spp. 17-19 based on data provided by B. Hulme.

[^48]:    ${ }^{1}$ By P. W. Ball.

[^49]:    ${ }^{1}$ By P. W. Ball.

[^50]:    ${ }^{1}$ By P. W. Ball.

[^51]:    ${ }^{1}$ By P. W. Ball.

[^52]:    ${ }^{1}$ By P. W. Ball.

[^53]:    ${ }^{1}$ By P. Aellen.
    ${ }^{2}$ By P. W. Ball.

[^54]:    ${ }^{1}$ By P. W. Ball.

[^55]:    ${ }^{1}$ By T. G. Tutin.

[^56]:    ${ }^{1}$ Edit. V. H. Heywood.

[^57]:    ${ }^{1}$ Edit. D. A. Webb.
    ${ }^{2}$ By D. A. Webb.
    ${ }^{3}$ Edit. T. G. Tutin.

    - By T. G. Tutin.

[^58]:    ${ }^{1}$ By T. G. Tutin.
    ${ }^{2}$ By D. A. Webb.
    ${ }^{\mathbf{a}}$ Edit. T. G. Tutin.

[^59]:    ${ }^{1}$ By T. G. Tutin.
    ${ }^{2}$ Edit. T. G. Tutin.
    ${ }^{3}$ Edit. S. M. Walters.
    ${ }^{4}$ By S. M. Walters.

[^60]:    1 Stipules present, though sometimes caducous (Subfam. Paronychioideae)
    2 All leaves alternate
    3 Sepals $3-7 \mathrm{~mm}$; fruit a capsule
    24. Telephium

    3 Sepals less than 3 mm ; fruit an achene
    14. Corrigiola

    2 Leaves opposite or verticillate (or some leaves apparently alternate)
    4 Fruit with persistent inflated peduncle, and crowned by spiny processes (Malta)
    18. Pteranthus

[^61]:    ${ }^{1}$ By A. O. Chater and G. Halliday.

[^62]:    ${ }^{1}$ By G. Halliday.

[^63]:    ${ }^{1}$ By A. O. Chater and V. H. Heywood.

[^64]:    ${ }^{1}$ By A. O. Chater ${ }^{2}$ By S. M. Walters.
    ${ }^{3}$ Perennial spp. by J. Jalas; annual spp. by P.D. Sell and F. H. Whitehead.

[^65]:    ${ }^{1}$ By A. R. Clapham.

[^66]:    ${ }^{1}$ By A. R. Clapham.
    ${ }^{2}$ By A. R. Clapham and N. Jardine.

[^67]:    ${ }^{1}$ By A. O. Chater.
    ${ }^{2}$ By P. D. Sell and S. M. Walters.

[^68]:    ${ }^{1}$ By A. O. Chater.
    ${ }^{2}$ By V. H. Heywood.

[^69]:    ${ }^{1}$ By J. A. Ratter.
    ${ }^{2}$ By P. Monnier and J. A. Ratter.

[^70]:    ${ }^{1}$ By A. O. Chater.

[^71]:    ${ }^{1}$ By A. O. Chater.

[^72]:    74 Carpophore 6-8 mm
    125. ungeri

    73 Calyx scabrid to pubescent, usually at least as long as pedicel

[^73]:    ${ }^{1}$ By S. M. Walters.
    ${ }^{2}$ By R. Domac.
    ${ }^{3}$ By Y. I. Barkoudah and A. O. Chater.

[^74]:    ${ }^{1}$ By T. G. Tutin.

[^75]:    1 Leaves not more than 2.5 mm wide; flower c. 20 mm in diameter
    (a) subsp. campestris 1 Leaves $3-5 \mathrm{~mm}$ wide; flower less than 20 mm in diameter
    2 Epicalyx-scales with a point up to 0.5 mm (b) subsp. laevigatus 2 Epicalyx-scales with a point at least 1 mm (c) subsp. steppaceus

[^76]:    ${ }^{1}$ By A. O. Chater.
    ${ }^{2}$ Edit. T. G. Tutin.
    ${ }^{3}$ By T. G. Tutin.

[^77]:    ${ }^{1}$ Edit. D. A. Webb.
    ${ }^{2}$ By D. A. Webb.
    ${ }^{3}$ Edit. T. G. Tutin.

[^78]:    1 Rhizome absent; stems overwintering, $\pm$ woody; leaves all cauline
    2 Leaf-segments 7-11; flowers campanulate 1. foetidus
    2 Leaf-segments 3; flowers with widely spreading perianthsegments
    2. lividus

    1 Rhizome present; stems of short duration, herbaceous; basal leaves present
    3 Bracts entire
    11. niger

    3 Bracts divided and leaf-like
    4 Follicles free to base, shortly stipitate

[^79]:    ${ }^{1}$ By T. G. Tutin.

[^80]:    ${ }^{1}$ By T. G. Tutin.

[^81]:    ${ }^{1}$ By T. G. Tutin.

[^82]:    ${ }^{1}$ By T. G. Tutin.

[^83]:    ${ }^{1}$ By T. G. Tutin.
    ${ }^{2}$ By T. G. Tutin from data supplied by H. Merxmüller.

[^84]:    1 Inflorescence without glandular hairs
    7. variegatum

    1 Inflorescence with at least some glandular hairs
    2 Helmet usually scarcely higher than wide; bracts linear
    2 Helmet usually higher than wide; bracts ovate

    $$
    \begin{aligned}
    & \text { 9. paniculatum } \\
    & \text { 8. toxicum }
    \end{aligned}
    $$

    7. A. variegatum L., Sp. Pl. 532 (1753). Inflorescence glabrous or with short crispate hairs only; helmet about twice as high as wide. $2 n=16$. Mountains of C. Europe, extending to C. Italy, Bulgaria and W. Ukraine. Au Bu Cz Ga Ge He Hu It Ju Po Rm Rs (W) [Da].
    8. A. toxicum Reichenb., Uebersicht Acon. 43 (1819). Inflorescence glandular; bracts ovate; helmet about twice as high as wide. - Romania; C. and W. Jugoslavia. Ju Rm.
[^85]:    ${ }^{1}$ By B. Pawłowski.

[^86]:    ${ }^{1}$ By T. G. Tutin.

[^87]:    1 Perennial; petals more than 10; anthers yellow
    2 Stems with scales at base; leaves all cauline and sessile
    3 Leaves at least twice as long as wide; petals obovate 3. sibirica
    3 Leaves little longer than wide; petals elliptic or narrowly lanceolate
    4 Leaf-lobes narrowly linear, entire 1. vernalis 4 Leaf-lobes linear-lanceolate, dentate
    2. volgensis

    2 Stems without scales at base; basal leaves long-petiolate
    5 Sepals pubescent; beak of achene c. 1 mm ; stems up to c. 15 cm , curved (S. Italy)
    5. distorta

    5 Sepals glabrous; beak of achene 2 mm or more; stems usually $25-60 \mathrm{~cm}$, straight
    6 Beak c. 2 mm , distinctly shorter than achene, stout and flattened (Pyrenees and Alpes Maritimes) 4. pyrenaica
    6 Beak c. 3 mm , almost as long as achene, slender, terete (Greece)
    6. cyllenea

    1 Annual; petals 8 or fewer; anthers blackish-purple
    7 Inner margin of achene almost straight, without a projection
    7. annua

    7 Inner margin of achene with a rounded or angular projection

[^88]:    1 Stems at flowering-time very short, the leaves crowded at the base; achenes hirsute
    (a) subsp. calthifolius

    1 Stems elongated at flowering time, leaves not crowded in a rosette; achenes puberulent or pubescent

[^89]:    ${ }^{1}$ By T. G. Tutin. ${ }^{2}$ By J. Cullen and V. H. Heywood.

[^90]:    ${ }^{1}$ By T. G. Tutin.

[^91]:    1 Edit. V. H. Heywood.

[^92]:    ${ }^{1}$ Edit. D. A. Webb. ${ }^{2}$ By W. T. Stearn and D. A. Webb.

[^93]:    1 Leaves with 10-25 spines each side; stems light-coloured
    2 Racemes $30-50 \mathrm{~mm}$, with usually more than 15 flowers; stigma completely sessile

    1. vulgaris

    2 Racemes $20-30 \mathrm{~mm}$, with less than 15 flowers; stigma very shortly but distinctly stipitate 2. aetnensis
    1 Leaves with $0-10$ spines each side; stems dark purplish
    3 Racemes $10-30 \mathrm{~mm}$, with 6-16 flowers
    3. hispanica

    Racemes $8-12 \mathrm{~mm}$, with 3-6 flowers
    4. cretica

[^94]:    ${ }^{1}$ By A. B. Mowat.

[^95]:    ${ }^{1}$ By A. B. Mowat.

[^96]:    ${ }^{1}$ By D. A. Webb.
    ${ }^{2}$ By A. B. Mowat; revised by A. O. Chater.

[^97]:    1 Annual or biennial, or perennial with rhizomatous stock; leaves many; racemes axillary
    2 Leaves with tendrils; pedicels less than 3 mm 1. claviculata
    2 Leaves without tendrils; pedicels more than 3 mm
    3 Petals purplish, yellow at apex
    7. sempervirens

    3 Petals yellow, whitish or greenish, not purplish
    4 At least the lower bracts toothed or dissected
    5 Lower bracts similar to the upper leaves
    2. capnoides

    5 Lower bracts distinctly less compound or dissected than the upper leaves
    6. nobilis

    4 All bracts entire
    $\begin{array}{lll}6 & \text { Petiole very narrowly winged; fruit erect } & \text { 5. ochroleuca }\end{array}$
    6 Petiole unwinged; fruit pendent
    7 Annual; leaves glaucous on both surfaces; petals white, yellowish-green at apex 4. acaulis 7 Perennial; leaves green above, glaucous beneath; petals golden yellow, darker at apex
    3. lutea

    1 Perennial with tuberous stock; stems, or each branch of stem, with 1-2(-3) leaves; racemes terminal
    8 Stem without a conspicuous scale below lowest leaf
    9 Racemes 1- to 3-flowered; leaves opposite
    8. rutifolia

    9 Racemes more than 5 -flowered; leaves alternate
    9. bulbosa

    8 Stem with a conspicuous scale below lowest leaf
    10 All bracts entire
    12. intermedia

    10 At least the lower bracts dissected or 3-fid
    11 Lower pedicels less than 5 mm
    13. pumila

    11 Lower pedicels more than 5 mm
    12 Corolla reddish, purplish or white
    13 Ripe fruit about as long as pedicel
    14. solida

    13 Ripe fruit 2-3 times as long as pedicel
    12 Corolla yellow
    14 Ultimate leaf-segments linear-lanceolate
    10. paczoskii
    11. angustifolia

    14 Ultimate leaf-segments broadly obovate
    14. solida

[^98]:    ${ }^{1}$ By V. H. Heywood.

[^99]:    ${ }^{1}$ By P. W. Ball.
    ${ }^{2}$ Edit V. H. Heywood.
    ${ }^{3}$ By V. H. Heywood.

    - By A. O. Chater.

[^100]:    ${ }^{1}$ By P. W. Ball.

[^101]:    ${ }^{1}$ By P. W. Ball.

[^102]:    ${ }^{1}$ By P. W. Ball.

[^103]:    ${ }^{1}$ By P. W. Ball.

[^104]:    ${ }^{1}$ By P. W. Ball.

[^105]:    1 Cauline leaves linear-oblong erect and often appressed to the stem; stems usually $10-30 \mathrm{~cm}$, simple (b) subsp.transsilvanicum

[^106]:    ${ }^{1}$ By P. W. Ball.

[^107]:    ${ }^{1}$ By P. W. Ball.

[^108]:    ${ }^{1}$ By P. W. Ball.

[^109]:    ${ }^{1}$ By P. W. Ball.

[^110]:    ${ }^{1}$ By P. W. Ball.

[^111]:    ${ }^{1}$ By V. H. Heywood.

[^112]:    ${ }^{1}$ By D. H. Valentine.

[^113]:    ${ }^{1}$ By B. M. G. Jones.

[^114]:    ${ }^{1}$ By B. M. G. Jones.

[^115]:    ${ }^{3}$ By P. W. Ball.

[^116]:    ${ }^{1}$ By P. W. Ball.

[^117]:    ${ }^{1}$ By P. W. Ball.
    ${ }^{2}$ By V. H. Heywood and P. W. Ball.
    ${ }^{3}$ By R. Domac.

[^118]:    ${ }^{1}$ By P. W. Ball and T. R. Dudley, with the assistance of E. I. Nyárády.

[^119]:    ${ }^{1}$ By P. W. Ball.

[^120]:    ${ }^{1}$ By V. H. Heywood.

[^121]:    ${ }^{1}$ By P. W. Ball.
    ${ }^{2}$ By A. O. Chater.
    ${ }^{3}$ By S. M. Walters.

[^122]:    ${ }^{1}$ By S. M. Walters.

[^123]:    ${ }^{1}$ By S. M. Walters.
    ${ }^{2}$ By P. W. Ball.
    ${ }^{3}$ By A. O. Chater and V. H. Heywood.

[^124]:    1 Silicula ovoid to globose
    2. officinalis

    1 Silicula ovoid-ellipsoid
    2 Lateral veins of petals anastomosing to form 2 or more meshes on each side of the mid-vein
    4. polonica

    2 Lateral veins of petals anastomosing to form usually only one mesh on each side of the mid-vein
    3. pyrenaica

[^125]:    ${ }^{1}$ By A. O. Chater and V. H. Heywood.

[^126]:    ${ }^{1}$ By V. H. Heywood.
    ${ }^{2}$ By R. D. Meikle.
    ${ }^{3}$ By P. W. Ball.

[^127]:    ${ }^{1}$ By A. O. Chater.
    ${ }_{2}^{2}$ By V. H. Heywood and B. M, G. Jones.

[^128]:    ${ }^{1}$ By V. H. Heywood.

[^129]:    ${ }^{1}$ By P. W. Ball.
    ${ }^{2}$ By J. de Carvalho e Vasconcellos.
    ${ }^{3}$ By A. R. Clapham.

[^130]:    ${ }^{1}$ By A. O. Chater.
    ${ }^{2}$ By V. H. Heywood.
    ${ }^{3}$ By A. R. Pinto da Silva and J. do Amaral Franco.

[^131]:    1 Silicula $5-7 \times 7 \cdot 5-10 \mathrm{~mm}$; sepals $2-2 \cdot 5 \mathrm{~mm}$

[^132]:    ${ }^{1}$ By D. A. Webb.
    ${ }^{2}$ By J. de Carvalho e Vasconcellos.

[^133]:    ${ }^{1}$ By V. H. Heywood.

[^134]:    ${ }^{1}$ By A. O. Chater.

[^135]:    ${ }^{2}$ By V. H. Heywood.

[^136]:    ${ }^{1}$ By T. G. Tutin.
    ${ }^{3}$ By P. W. Ball.

[^137]:    ${ }^{1}$ By V. H. Heywood.
    ${ }^{2}$ By P. W. Ball.
    ${ }^{3}$ By J. de Carvalho e Vasconcellos.

[^138]:    ${ }^{1}$ By P. W. Ball.
    ${ }^{3}$ By V. H. Heywood.

[^139]:    ${ }^{1}$ Edit. V. H. Heywood.

[^140]:    ${ }^{1}$ By V. H. Heywood. $\quad{ }^{2}$ Edit. D. A. Webb. ${ }^{3}$ By D. A. Webb.

[^141]:    ${ }^{1}$ By D. A. Webb.
    ${ }^{2}$ Edit. D. A. Webb.

[^142]:    ${ }^{1}$ By D. A. Webb.

[^143]:    ${ }^{1}$ By D. A. Webb.
    ${ }^{2}$ By C. Favarger and F. Zésiger.

[^144]:    ${ }^{1}$ By C. Favarger and F. Zésiger.

[^145]:    ${ }^{1}$ By D. A. Webb.

[^146]:    ${ }^{1}$ By D. A. Webb.

[^147]:    ${ }^{1}$ By D. A. Webb.

[^148]:    ${ }^{1}$ By D. A. Webb.

[^149]:    ${ }^{1}$ By D. A. Webb.
    ${ }^{2}$ Edit. D. A. Webb.

[^150]:    Abies Miller, 29
    alba Miller, 30
    balsamea Miller, 29
    borisii-regis Mattf., 30
    cephalonica Loudon, 30
    excelsa (Lam.) Poiret, 31 (1)
    grandis (D. Don) Lindley, 29
    homolepis Siebold \& Zucc., 29
    $\times$ insignis Carrière ex Bailly, 30
    lasiocarpa (Hooker) Nutt., 29
    nebrodensis (Lojac.) Mattei, 30
    nobilis Lindley, non A. Dietr., 29
    nordmanniana (Steven) Spach, 30
    pardei Gaussen, 30
    pectinata (Lam.) DC., 30
    pinsapo Boiss., 30
    procera Rehder, 29
    sibirica Ledeb., 29
    Achyranthes L., 110
    argentea Lam., 110 (2)

