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James W. H. Trail

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TRANSACTIONS AND PROCEEDINGS
OF THE
BOTANICAL SOCIETY OF EDINBURGH

SESSION LXVII.

SUGGESTIONS TOWARDS THE PREPARATION OF A RECORD
OF THE FLORA OF SCOTLAND. By JAMES W. H. TRAIL.

(Read 12th February 1903.)

Towards the close of last century it appeared to me desirable to obtain, as far as possible, a record of what was known about the flora of Scotland, to serve in future as a standard of comparison by which to mark changes in the flora, and possibly to show something of the causes on which such changes depend. Much had been done in the previous two decades in exploring districts that had long been unvisited by botanists, and of the results of most of these explorations I had kept notes. It seemed at the outset that little more was required than a careful compilation from the local floras formerly and recently published, and from the numerous lists or fuller articles that had appeared in botanical journals and transactions. But a more careful examination of these showed that we are still far from the accurate information that is necessary before a record can be prepared that could be used as a trustworthy standard for future comparison.

Few of the floras or lists relate to natural areas, and fewer still supply the needful information with desirable completeness. Rarely is there even an attempt to show,

in a systematic way, the distribution of a species within the district included in the flora or list. A few localities are enumerated for many species, and the other parts of the districts are seldom if ever mentioned. Often little more is given than a mere list of names of species, without notes of whether these are natives, or introduced by man, and, if the latter, whether they are casuals or planted or naturalised, weeds of fields or near houses, rare or frequent. Or, if such notes are given, they are so in the most arbitrary way, and often mislead instead of aiding the inquirer. Naturally, the older books and lists are very defective in their treatment of critical groups, whether these relate to polymorphic genera or to forms usually regarded as varieties of polymorphic species.

A good deal of experience in the use of the published records, and also in trying to work out the flora of limited areas in a systematic way, had led me to certain views with regard to the work that is still much required, both in the field and in the preparation of satisfactory records of local floras; and these views may be put forward for criticism.

When the plants of Scotland were first studied, it was scarcely possible to do more than to note the occurrence of species here and there during journeys, and, naturally, more interest was excited by the rarer and more local species than by those common everywhere. It was hardly to be expected that local botanists could be found with knowledge and opportunity to qualify them for an exhaustive study of the districts around their homes. A few localities became known as habitats, either from their vicinity to the larger towns or from exceptional wealth of species. Their reputation led to their being visited by generations of botanists, and all the more local and rarer forms in them were put on record, often many times. But they drew to themselves the attention that would otherwise have been distributed more widely over the country, and, in consequence, many districts remained almost unvisited until a late period, and comparatively few have been really well explored throughout.

Some works on local floras endeavour to give somewhat full information with regard to the plants treated of, *e.g.*

Dr. Buchanan White's "Flora of Perthshire"; but in most of even the larger works, and still more in the briefer ones, we usually find only a few localities enumerated, with the name of the collector or reporter for each, following a brief general statement such as "rare," "frequent," "local," "by streams," "in fields." Man's share in the present state of the flora is very inconsistently treated. Common weeds of cultivated ground are admitted into every list without question, though many of them are dependent on man's labour, not only for their introduction, but also for their continuance in the district. Others are relegated to a special list of species introduced by man, though they may show themselves as widespread as, and better able to retain their hold in the district than, the field-weeds, and along with them are associated many that are clearly mere outcasts and casuals, unlikely to appear in any one locality for more than one or two years unless reinforced. Species are included that have clearly been planted originally where they continue to be found, whether they have spread and become naturalised in aspect, or remain limited to the original spot. Some tree and shrubs are included, *e.g.* the maples and limes, while others are omitted even though they seed freely, *e.g.* the larch, spruce, and silver fir.

The confusion becomes still greater when all species admitted into the local list run on in one series, in which some are noted as "introduced," while to others no such note is added, though not less evidently called for. Man's influence in limiting or extending the numbers and range of distribution of species within a district is even less consistently treated in local lists than his share in their introduction. Remarks on it are usually limited to the few species that have become extinct, or are approaching extinction.

One rarely finds information of a kind at all definite or serviceable with regard to the actual abundance and the relative increase or diminution of the commoner (therefore the usually characteristic) species of a district. Only now and again are terms employed such as imply actual reference to the local conditions. Frequently they might have been copied from some text-book or general flora.

The districts and their local sub-divisions employed in the records of topographical botany in Scotland have varied considerably, and it is not always easy to correlate them so as to make the older ones of use for comparison with the more recent. Yet a good deal is lost if such comparisons cannot be made.

In the earliest works, *e.g.* Sibbald's "*Scotia Illustrata*" (1684), the topographical information amounts to the notification of the species believed by the author to exist in Scotland, with special localities noted for a few. Lightfoot's "*Flora Scotica*" (1778), and Hooker's "*Flora Scotica*" (1821), proceed on almost the same lines. They do not attempt to indicate the local distribution of species in Scotland except by enumeration of localities for the rarer and local forms.

Of the local floras, some of the earlier limit themselves to some distance around a town as a centre, without limitation to, or indication of, special districts, whether natural, such as river basins, or artificial, such as counties and parishes. Of this class are Greville's, Balfour and Sadler's, and Sonntag's floras of the district around Edinburgh, Dickie's "*Flora Aberdonensis*," and P. Macgillivray's "*Flora of Aberdeen*." Others, *e.g.* Edmonston's "*Shetland Flora*," and Henedy's "*Clydesdale Flora*," relate to natural areas, but with no systematic sub-division of the areas; and others limit themselves to political districts, such as Johnston's "*Botany of the Scottish Borders*" and "*Flora of Berwick-on-Tweed*," Dickie's "*Botanist's Guide to the Counties of Aberdeen, Banff, and Kincardine*," and Scott Elliott's "*Flora of Dumfries, Kirkcudbright, and Wigtown*." White's "*Flora of Perthshire*" is limited to the political area Perthshire and Clackmannan; but that area is chiefly the Tay basin, and is, in so far, natural, and it has been sub-divided in the "*Flora*" by river basins and geological formations. Thus the two methods are combined in this case.

Mr. H. C. Watson's works on the topographical botany of Great Britain added so greatly to the information available to local botanists, and to the precision and accuracy of that information by his careful analysis of earlier work, that his divisions of counties and vice-

counties have been the basis for very much of the best topographical work of the past half-century. The consistent use of well-recognised divisions has allowed of the results being tabulated, and, by showing where conspicuous gaps in the records existed, it has directed attention to these, and has led to their being filled.

But there are very evident defects in the employment of divisions that are so often quite artificial and of unequal extent, even with the modifications in their boundaries and areas that Mr. Watson employed, and in which he has been followed. Within recent years the boundaries of many counties have been considerably altered, and in some cases the older records have been a good deal altered thereby, and may become misleading. In the valuable handbook of "The Flora and Fauna of the Clyde District," prepared for the meeting of the British Association in Glasgow in 1901, a strictly artificial method was followed, the basis of the river and firth being sub-divided by parallels of latitude and of longitude at each degree and half-degree; and the areas so bounded are denoted by capital letters.

When we seek to gain from books or lists a trustworthy conception of the flora of the district of which each treats, and, still more, if we wish to compare the past condition as recorded for us with the flora as we know it, we find that, in almost every case, much is left untouched that we should greatly like to have a record of. That a plant has been observed in a district is worth noting as a fact in topographical botany, but much more is frequently desirable. If it be a critical species or variety, we should know by whom it was determined, and if a specimen was seen by an expert, and has been preserved as a voucher. If there is no doubt as to accuracy of the determination, there are questions requiring an answer as regards its occurrence, such as the likelihood of its having been introduced by man, its frequency, whether it seems to be extending its range or losing ground, its habitats, etc. But to most such questions an answer is not often found in published records.

The work so successfully begun by Mr. Robert Smith, and the value of which has been well urged by Dr. W.

Smith and by Mr. Hardy, brings prominently into view the chief characteristic features of local floras; but, though it will thus add very greatly to our knowledge of the topographical botany of Scotland, it yet leaves much untouched, and there is ample room for other methods also in attacking the problem. It appears to me that success can be attained only by the co-operation of numerous workers, having a common end in view, but concentrating their efforts on such parts of the problem as leisure and opportunity give them a reasonable hope of advancing. More will be done of permanent value by knowing a limited area thoroughly than by visits to localities noted for their floral wealth, though one's herbarium may not contain so many rarities.

A new factor to be considered in this connection has been introduced by the requirement now imposed on those that are entering the teaching profession, that they shall be qualified to give instruction in nature-study. It may reasonably be expected that among the new teachers some will seek to acquaint themselves with the natural objects of the districts in which they live. Indeed, to become successful teachers of the methods of nature-study they must know what resources are within their reach. Valuable aid may be looked for in a few years from them. But they also require aid; and it would be well that in the preparation of local floras this should be kept in view.

It may be said that as yet I have been speaking chiefly of defects in such topographical records as we have, and that it is not enough to find fault, unless one is prepared to suggest improvements. I must pass on then to the questions of the information that topographical records should supply, and how they can be rendered most useful. In answering these questions we may also find help in determining the form or forms that they should assume.

How much should the record contain? To this some would answer that it should include all plants of the district that clearly do not owe their presence in it to man, and also those introduced by man that now hold their place without his aid or in his fields against his will; but that no others should be mentioned. Watson's

"Topographical Botany" is drawn up nearly within these limits. But even there the limits are not very consistently adhered to.

To me it seems that more accurate results are arrived at if all plants are included except those known in a district *only* in cultivation, and that, even of these, the species commonly cultivated in fields and in gardens, in plantations and in woodlands, might with advantage be named in a separate list. The terms "native" and "indigenous" denote only that the ancestors of the plants now living in any locality arrived in it, so far as we know, without man's aid, by what we call natural agencies; for we have no evidence that any species in the Linnean sense is really indigenous in Britain, though certain varieties and "critical species" (in such genera as *Rubus* and *Hieracium*) are not yet known from elsewhere. Man has profoundly modified the British flora even as regards these "natives," and has admittedly brought into our islands a number of species that are included without question in our lists; while a good many that appear to be "native" in certain districts have in others evidently been introduced by man. The question really becomes narrowed down to the period when they were introduced, intentionally or otherwise, by man; but the *time* of introduction scarcely appears to warrant so absolutely different a treatment as the inclusion of some and the exclusion of others. Man's agency must be recognised as a cause of great changes in the floras of the world. It is in a sense one of the natural forces that modify the vegetation of the world; and the difference between the action of unconscious forces and the conscious agency of man, though great in degree, should scarcely be reckoned as one of kind. Moreover, man's aid in the migration of plants is often as unconscious as any of the natural forces. Is it not desirable to include all, as above suggested, in the local list, and, as far as possible, to ascertain and to record by what agency, and at what period, each has reached Scotland? Records do not exist of a kind such as to permit of our ascertaining whether species may not have been introduced, even within recent times, apart from man's aid.

The past and present distribution of each species should be ascertained in a very much more systematic way than has yet been done, or, except in a few cases, even attempted, the habitats should be indicated, and the frequency should be recorded on some definite scale. Absolute accuracy cannot be expected; but it should be possible to reach a degree such as to permit of the records being used by later workers as a scale by which to determine the changes that show themselves as the years go by, and perhaps to afford evidence of the causes that bring about these changes, both of increase and of decrease or extinction, of gain and of loss. A method that I have made use of to record the changed condition of the vegetation from year to year on made-up ground, and other places near Aberdeen, I have found very useful on limited areas, where a complete record of the species observed was kept, and the rarity or abundance of each was marked by a scale from 1 to 4, denoting rare, common, frequent, abundant, each also modified by the signs — and +. Thus I used twelve grades, from 1 —, denoting extremely rare, to 4 +, denoting abundance to the exclusion of other species. I found it possible in this way to follow with confidence rapid changes in the relative proportions of the species, and also to record the incoming of species new to a locality, and could follow the struggle among the various forms until a relative equilibrium was reached.

For larger areas other methods have been employed. Buchenau, for example, in his "Flora der nordwestdeutschen Tiefebene" (1894), employs signs to distinguish four grades in the relation of plants to the district, viz. * characteristic species; * confined to certain limited habitats, *e.g.* sea-coast, etc.; ↑ species of middle or east Germany that have overpassed the south or east boundary of the north-west German plains; + adventitious plants, relatively late introductions, or immigrants.

It is evident that the usual indications of frequency (frequent, common, rather local, etc.) are defective, as they do not indicate clearly the relative frequency of localities and of individual plants within these localities.

W. Schemmann, in "Beiträge zur Flora der Kreise

Bochum, Dortmund und Hagen" (Verh. d. naturh. Ver. d. Preuss. Rheinlande u. Westfalens, 1884), employs a comparatively simple scale in the form of fractions, the numerators of which denote the number of localities thus—1 in one place, 2 in a few places, 3 in several places, and 4 in many places; while the denominators denote frequency thus—1 sparingly, 2 commonly, 3 in quantities, *e.g.* $\frac{2}{3}$ denotes in a few places in quantities, 5 denotes in countless places in very great amount.

The method I employ for my own notes, after various experiments and rejection of more than one method, is as follows:—

After a general indication of the habitat (*e.g.* sand-dunes, meadows, swamps, etc.), and of whether "native" or "alien," with grade if "alien," I use the Greek letters α , β , γ , δ , ϵ to denote the frequency both of localities and of plants within the localities. Thus two simple scales are formed for localities— α denotes in one locality; β in two or three in a district, *i.e.* very local; γ in a good many, yet local; δ in many or common; ϵ everywhere within suitable habitats. Within the localities α denotes only once found; β very rare, yet occasionally met with; γ not rare, yet not common, to be found without difficulty if looked for; δ common; ϵ abundant, even to exclusion of other species in some cases. These scales are combined readily, the first letter denoting localities, the second the individuals within these. Thus— $\alpha\alpha$ denotes in one locality once found; $\alpha\delta$ in one locality, but common there; $\delta\beta$ in many localities, but rare within each; $\epsilon\epsilon$ universally present in suitable habitats, and abundant everywhere.

On theoretical grounds the areas marked out by parallels of latitude and of longitude have the undoubted advantage of simplicity, if denoted in such a way as to combine brevity with freedom from error; but to be really useful the areas must not be large. For noting briefly and accurately the localities of plants in field-work, I use the 1-inch Ordnance maps, divided into areas by the minutes of latitude and the even-numbered minutes of longitude. The spaces so marked off are noted by co-ordinates along the margins of the map, these being capital letters from south to north,

and small letters from east to west. Such a symbol as 77 Br denotes very closely the locality of some plant gathered on the bank of the Dee a few miles from Aberdeen. The addition of K after the square would show that it grew on the Kincardineshire side of the river. Thus a good deal of writing is saved. The method is also excellently suited to marking out on squared paper the actual distribution of each species in a district.

But if the areas are large (*e.g.* between half-degrees, extending to 900 square minutes) the advantage of precision of reference is lost. They thus are useless alike for notebook and for subsequent mapping, and they are, of course, absolutely useless as indicating natural or well-known political areas.

In this, as in so many other cases, no one method possesses all the advantages, and it is well to combine them, so as in the end to secure all the help that can be obtained.

The geographical method, for publication, is most useful when the distribution is exhibited on maps, so that the eye can appreciate at one view the results expressed in words only at considerable length and in a form difficult to appreciate. With small areas it is, as already said, exceedingly useful in field work. But it is not desirable to ignore natural regions (such as river basins, etc.), though often difficult to define in some respects, and usually themselves in need of sub-divisions based on varied conditions of environment. It is unwise, too, to set aside well-recognised political divisions, for these often appeal most strongly to the local naturalists, and their co-operation is most desirable in working out the distribution of both flora and fauna. Theoretically there is no reason why the investigation of, say, 20 or 25 square miles should not be as heartily entered on as that of a parish, of 140 as of the Cairngorm mountains, or of 2000 as of Aberdeenshire. Yet there is no question that fewer would undertake the one area than the other, though of nearly equal size. It is likely that some of the teachers now being trained will undertake the investigation of the districts around their homes, and to them the parish, or the district, is the area of greatest interest. To local societies the county or

counties immediately adjoining the central town, or some former territorial division (still retained in popular use, though no longer corresponding with existing geographical divisions), or the river basin, is the region to be investigated. To the teachers it is of especial importance to learn what materials for nature-study are within reach, and the books or lists of most use to them are likely to be those that indicate distribution by parishes. But as parishes are seldom natural areas, and as it is desirable that records, whether of field work or when published, should be in form to permit of these latter areas also being recognised, it is necessary to combine the two sets of divisions. I have found that, by making use of the parish boundaries and watersheds of streams, along with local features, such as coast, lochs, lowland, and hill, it becomes possible to obtain areas of a relatively small size, with somewhat uniform characters throughout each, and that, with these as units, the distribution of species is well shown, whether frequent, local, or rare, by natural divisions, or by parishes and counties. By preparing *maps* of the species-distribution also, the record would be rendered very much more complete than has yet been accomplished in any published work on the flora or fauna of Scotland. From such local records a "Topographical Botany" of all Scotland could be prepared that would be found of very great value by our successors. Their preparation requires only industry, care, and accuracy, the critical species being submitted to experts for their verdicts.

Briefly summarising the views stated above, they express these conclusions:—

Much requires to be done before a complete account can be given of the flora of Scotland. The preparation for this demands the labour of many local botanists, each doing the work for a district around his home, or within so easy access as to permit of frequent visits. The local work done by them, and the general work resulting from their collaboration, should rest on the investigation of areas so planned as to be combined at will into parishes, counties, or natural districts, and such in size and in relation to environments as to show accurately the distribution as a whole, and any peculiarities of a noteworthy kind. For

each species and variety a map should be prepared to show the distribution, except where its rarity makes it desirable not to indicate the localities too minutely. The records should include, in the ordinary series, every species observed under such conditions as might lead to its being regarded as a wild plant (and in an appendix might be enumerated the plants cultivated in the country generally); but against each plant should be noted whether it appeared to be "native," or "alien," owing its presence in the district to man's agency, intentional or unintentional. In the latter case, its condition as observed should be noted, whether only a suspected "alien," or a "denizen," holding its place without man's aid, or a "colonist," continuing to grow as a weed of cultivated ground against man's will, or a "casual" merely, dying out after a time, or planted where found. It should also be noted of the "aliens," where possible, how they seemed to have been introduced, whether as outcasts, or escapes, or relics of cultivation, or with commercial products, etc. As to "native" plants, it might be stated whether their range of distribution or abundance was being altered noticeably by man or from natural causes.

For each district, at least of larger extent, the characteristic and local plants should be indicated, and also the immigrants from other districts, and those that reach a geographical limit in it. The grade of scarcity or of abundance should also be stated. Any plant-associations of a noteworthy kind, deserve mention. Information as to habitats, restriction to certain geological formations or soils, peculiar forms, associations with insects, either beneficial (as in pollination) or hurtful (galls or other injuries) diseases, and other matters of biological interest that might affect the flora might be included, or might form a companion volume to the "Topographical Botany of Scotland" of the future.

By the use of a few simple and easily understood contractions, local lists might easily give much more information on a good many of the above points than one usually finds in them, with very slight addition to their bulk.

Lastly, the progress of investigation of the flora is of much interest, and the earliest record of each plant in a

district should be noted, along with any noteworthy variation of frequency. Such notes are of peculiar interest with reference to immigrants.

TOPOGRAPHICAL BOTANY OF THE RIVER-BASINS FORTH
AND TWEED IN SCOTLAND. By JAMES W. H. TRAIL.

(Read 12th February 1903.)

The following brief outline of the progress of botanical investigation in the basins of the rivers Forth and Tweed (in Scotland), and the abstract of county-distribution of their floras, in so far as I have been able to ascertain it up to 1903 from published records and other sources of information, have been prepared in the hope that they may be found useful to field botanists in the south-east of Scotland, and may help towards the preparation of such a record of the Scottish flora as is much to be desired.

The counties included are Berwick, Roxburgh, Selkirk, Peebles, Haddington, Edinburgh, Linlithgow, Fife and Kinross, Stirling, and Perth and Clackmannan within the basin of the Forth. Parts of Fife and Stirling lie outside the basin of the Forth; but it is not possible, from the information within my reach, to determine from the records of the several plants published for these counties whether they refer only to parts of the counties beyond the Forth valley or to it also. Thus under these counties may be included a (very) few species not found in that valley. It has seemed more likely to be of use to include *all* species known to me to have been recorded for any of these counties, whether truly indigenous or introduced originally by man. In the floras and lists that enumerate the plants of the counties, there are too often no indications of whether the various plants are indigenous or aliens, and such information as is given is at times apparently misleading. I have sought, as far as my knowledge of the flora of Scotland would allow, to indicate which must be regarded as aliens (marked †), introduced intentionally or unintentionally by man. Attention has been drawn to the many defective records, especially for