

VIII.—*Memoir on the Spermogones and Pyenides of Filamentous, Fruticulose, and Foliaceous Lichens.* BY W. LAUDER LINDSAY, M.D., F.L.S. Communicated by Professor BALFOUR.

(Read 7th March 1859.)

Preface.

The following Memoir contains the results of researches made during the last three years. My investigations were originally directed to *British* lichens only, but they have subsequently and gradually embraced lichens from all parts of the world. The majority of *Scotch* species examined were collected by myself while on botanical tours in various parts of Scotland during the last ten years. Lowland species were collected chiefly in the counties of Perth, Edinburgh, and Dumfries; but also in Forfar, Fife, and others of the midland counties. In order to study alpine species I made a special tour among the highest of our Scotch mountains in the summer of 1856. I then visited the Braemar Highlands, Ben Lawers, Ben Nevis, and the Coollin Hills, in Skye. I have likewise studied the lichens of Don, now in the possession of Mr M'NAB, of the Royal Botanic Garden, Edinburgh; the lichens collected by MAUGHAN, M'MILLAN, and others, in the Herbarium of the Botanical Society of Edinburgh; those collected by the late ALEXANDER MENZIES, in the Menziesian Herbarium belonging to the Botanic Garden of Edinburgh; those collected by BORRER, HOOKER, CARMICHAEL, GARDINER, and others, in the magnificent Hookerian Herbarium at Kew; and I have also examined the valuable herbarium of the University of Edinburgh, under the care of Professor BALFOUR, and the herbarium of Dr GREVILLE. The examination of specimens in the herbaria of HOOKER, MENZIES, and DON, has been especially valuable, in so far as they contain species authenticated by the earlier British lichenologists,—lichenologists to whom I am proud to have an opportunity of expressing my deep obligations. I am further indebted for interesting specimens of Scottish lichens—now in my own herbarium—to Mr JAMES HARDY, of Penmanshiel, in Berwickshire,—to Mr ALEXANDER CROALL, of Montrose, and to Professor GEORGE LAWSON, of Kingston, Canada West. The two latter gentlemen supplied me with many alpine species, chiefly from Clova and the Forfarshire hills. For *English* species I am indebted to the kindness of the Rev. W. A. LEIGHTON, of Shrewsbury, who has repeatedly sent me lichens from Shropshire, and Wales, more especially; to Mr WILLIAM MUDD, of Cleveland, Yorkshire; to Dr CARRINGTON, of Yeadon, near Leeds; and to Dr DEIGHTON, of Clapham, near Lancaster, all of whom have frequently sent in-

teresting Yorkshire lichens; and to Dr BARCLAY MONTGOMERY, of Penzance, Cornwall, for specimens from the extreme south of England. I have also carefully examined all the specimens (260 in number) contained in the first eight fasciculi of the Rev. W. A. LEIGHTON'S *Lichenes Britannici exsiccati*. In addition to which, the Hookerian Herbarium—in studying whose valuable contents I spent a month during last summer—contains a large series of English specimens, collected by BORRER, TURNER, LEATHES, HOOKER, and others. In regard to *Irish* species I have had an opportunity of examining the greater part of the lichens described by TAYLOR in MACKAY'S *Flora Hibernica*, as they are contained in the Herbaria of Dr MACKAY of Dublin, Mr DAVID MOORE of Glasnevin, Dublin, and Mr ISAAC CARROLL of Cork. For a loan of the herbarium of lichens first named (TAYLOR'S) I am indebted to the kindness of Professor HARVEY of Dublin, who also procured for me a loan of the collection of lichens made by Mr DAVID MOORE, while attached to the Geological Survey of Ireland. They are chiefly from Antrim and other northern counties of Ireland, and now belong to the Museum of Irish Industry, Dublin. Mr CARROLL of Cork has repeatedly sent me large collections of lichens made by himself in the south of Ireland; and Professor DICKIE of Belfast has sent me specimens from the north of Ireland. All the Irish collections sent to me have been most interesting, as containing both new forms and new species not hitherto described, or erroneously described and classified.

In regard to *foreign* specimens, my obligations are chiefly due to the Hookerian Herbarium at Kew, which in some respects contains the finest collection of lichens in the world; while in other respects it is second only to that of the *Jardin des Plantes*, Paris. In that herbarium I availed myself of the opportunity of examining specimens from all parts of the world—from the arctic regions, collected by ROSS, BEECHER, PARRY, LYALL; from the antarctic regions, collected by Dr HOOKER; from the arctic parts of North America, collected by RICHARDSON, SCOULAR, and MENZIES; from the United States, by TUCKERMAN, LEA, and others; from Mexico, by LINDEN and GALEOTTI; from Peru, by HUMBOLDT; from Brazil, by GARDNER; from India, by Drs HOOKER and THOMAS THOMSON, and Messrs STRACHEY and WINTERBOTTOM; from China, by FORTUNE; from the Philippine Islands, by CUMING; from Java, by MIGUEL; from Australia and Tasmania, by Dr HOOKER, GUNN, and others; from New Zealand, by COLENSO; from every part of the world, indeed, to which botanical travellers have penetrated. In the summer of 1857 I went to Norway, for the purpose of studying *in situ* alpine lichens, spending several weeks amid the wilds of Sucehätten and the other alps of the Døvreffjeld range of mountains. I have carefully studied all the specimens (650 in number) contained in the twenty-six fasciculi of SCHÆRER'S *Lichenes Helveticæ exsiccati*, and also 478 specimens in the first eight fasciculi of HEPPE'S *Die Flechten Europas*, which is a continuation of SCHÆRER'S work just men-

tioned. *French* species I have studied in NYLANDER'S *Herbarium Lichenum Parisiensium* (Fasc. 1-3, 150 specimens. Paris, 1855). I have also to thank Dr HOOKER for a valuable suite of his antarctic gatherings during the surveying voyage of the "Erebus and Terror," embracing specimens from the Falkland Islands, Auckland Islands, Cape Horn, and New Zealand; Dr A. O. BRODIE for specimens from North America, and Mr DEIGHTON for specimens from California. Most of the lichens above enumerated included separate fragments or duplicates; so that in all I must have submitted to careful microscopical examination—as the basis of the following memoir—many thousand specimens, from every variety of clime, country, and habitat, and in every conceivable state or form. The number of species or specimens cannot be estimated by the number enumerated in the body of the Memoir; the latter only shows the specimens in which spermogones were distinctly found by me, and furnishes no indication of the far larger number examined with equal care, and at the expense of similar time and labour, in which negative results were obtained.

Hitherto, so far as I am aware, no researches have been made, or at least published, in this country with a view to expound the minute anatomy and physiology of the spermogones of lichens, if we except a couple of papers published by myself in the *Quarterly Journal of Microscopical Science*.* Nor do I know of any monograph in any language or in any country devoted to this subject. Much has certainly been done by TULASNE,† in his elaborate and valuable "Memoir on the Natural History of the Lichens,"—a memoir to which I owe many and deep obligations. To him I conceive we are indebted for having placed spermogonology on a scientific basis, and by so doing for having raised the lichens, in regard to their anatomy and physiology, at least to equal rank with other cryptogamic families. To a German,‡ moreover (ITZIGSOHN), is due the credit of the discovery of the existence of spermogones in lichens, or at least of an approximation to the first scientific appreciation of their character and functions. Though my own researches were commenced several years ago, I have not hitherto ventured to lay them before the public for a variety of reasons. One of the chief of these was my anxiety to correct or confirm my earlier investigations by more extended observation, especially among foreign specimens of British species; and this I have not had a satisfactory opportunity of doing until last summer at Kew. I lay them now before the Royal Society of Edinburgh, not as claiming to consti-

* 1. Monograph of the Genus *Abrothallus*. (De Not. and Tul., emend.) Read before Section D. of the meeting of the British Association at Cheltenham in August 1856.—*Quarterly Journal of Microscopical Science*. January 1857.

2. On the Structure of *Lecidea lugubris*, Sommf. Ibid. July 1857.

† Mémoire pour servir à l'Histoire Organographique et Physiologique des Lichens. Par M. L. R. Tulasne, aide-Naturaliste au Museum d' Histoire Naturelle, &c.—*Annales des Sciences Naturelles*, 3d serie. Botanique, vol. xvii., 1852.

‡ Dr HERMANN ITZIGSOHN, whose researches may be found in the *Botanische Zeitung* for 1850-51, *et seq.*

tute a perfect monograph, but simply and humbly as a contribution to a subject hitherto unelucidated in this country. I believe, however, this memoir will be found to contain first descriptions of no inconsiderable number of the spermogones and pycnides of lichens, both British and foreign, as well as many additional instances of lichens possessing two or three forms of reproductive bodies; or, in other words, *pycnides* as well as *spermogones* and *apothecia*. Some of the spermogones and pycnides, which I believed I had discovered and described for the first time, have subsequently been alluded to in the recent publications of Dr NYLANDER of Paris,*—publications which are certainly the most valuable contributions made of late years to lichenology,—that most difficult of all departments of cryptogamic botany. But these organs are seldom fully described by NYLANDER, and hence I have every reason to believe that, in these cases also, the first full expositions of their structure will be found in the following Memoir.

Spermogonological investigations are surrounded by many and serious difficulties; and it is perhaps but justice to those botanists who have hitherto avoided the study of the reproductive organs of lichens here to state what some of these difficulties or obstacles are. Prior to the introduction of the microscope bodies so minute as spermogones and spermatia could not possibly have been properly studied. But even at the present day, when microscopes abound, it is to be feared that few of our best lichenologists are well versed in histology and the use of the microscope. It can scarcely be denied, further, that many botanists have been too much mere classificators or name-givers: they have devoted attention too exclusively to the discrimination of species and varieties, to the neglect of minute anatomy and physiology, as studied by the aid of microscopy and chemistry. Continental botanists are infinitely before us in the latter respect: we can show little or nothing in botanical microscopy comparable with the productions of the French school of observers, as published in the "Annales des Sciences Naturelles," or to those of the German school, as given in the "Botanische Zeitung." But the possession of a good microscope, facility in microscopical manipulation, and a familiarity with the general principles or facts of physiological botany, are not the only requisites or qualifications for investigations in spermogonology. The observer must be possessed of unwearied patience and perseverance: he must expect to meet, and he must bring to his task a determination to surmount and conquer, endless difficulties and disappointments. I have now examined carefully, under the microscope, as I have already stated, many

- * 1. Synopsis Methodica Lichenum omnium hucusque cognitorum. Paris, 1858.
2. Enumeration Générale des Lichens, avec l'indication sommaire de leur Distribution Géographique. Cherbourg, 1858.
3. Monographia Calicieorum. 1857.
4. Prodromus Lichenographiæ Galliæ et Algeriæ. Bourdeaux, 1857.
5. Essai d'une Nouvelle Classification des Lichens. Cherbourg, 1854.

thousand specimens of lichens from every part of the known world, and *in a large proportion of cases, with negative or unsatisfactory results.* I have frequently examined most anxiously several hundred specimens of a particular genus or species,—for instance, *Peltigera* and *Siphula*,—without once having the good fortune to meet with its spermogones or pycnides. But, on the other hand, in the midst of disappointments of this nature, I have been rewarded occasionally by the discovery of spermogones or pycnides hitherto unobserved and undescribed. It were desirable, further, that the observer should possess an almost unlimited leisure. The time consumed in manipulations so delicate,—researches so intricate,—is incredibly great. KOERBER candidly speaks of leaving such investigations to those “die bei grösserer Musse solche subtile Studien verfolgen können.”* It frequently happens that even a small portion of tree-bark or rock contains several lichens belonging to the families of the *Graphidæ*, *Verrucariæ*, and *Lecidææ*. Intermixed with the apothecia of these lichens, and with each other, may be a variety of spermogones and pycnides. The spermogones and pycnides may closely resemble each other in external character, or they may differ considerably. In either case it is often most difficult, if not impossible, at the present stage of our knowledge on the subject, to determine to what species of lichen each kind of spermogone or pycnide is to be referred. This is more especially the case when the organs in question are very minute, black, and cone-like, as in the old genus, erroneously so constituted,—*Pyrenotheca*, which is now found to consist almost entirely of the spermogones of other lichens. Such spermogones and pycnides are frequently indistinguishable from certain *Verrucariæ*, parasitic fungi, and even parasitic lichens; and the only means of deciding as to their real nature is by microscopical examination. Again, the spermogones of some lichens, as *Ricasolia herbacea* and *R. glomulifera*, and the pycnides of others, as *Peltigera*, so closely resemble in external appearance the nascent apothecia of the same species as to be indistinguishable therefrom without the aid of the microscope. As a general rule, the parasitic *Sphæriæ*, with which the spermogones and pycnides of lichens are apt to be confounded, are very superficial, removable by the least touch from the surface on which they grow—have a black colour, possess an envelope or capsule formed of hexagonal or roundish cells in a state of close aggregation, and of a dark brown colour, and contain minute, abundant, brownish, simple or 1-septate spores. Sometimes spermogones and pycnides occur alone, unassociated with the apothecia of any species; and it is in such a case, unless in rare instances, equally impossible to say to what lichens they are referable or belong. It is therefore possible, nay perhaps probable, that some of the spermogones and pycnides which I have referred to particular lichens, may be hereafter found, when my researches have been repeated and extended, really to belong not to these, but to other species. And it may also be discovered to what lichens

* *Systema Lichenum Germaniæ*, von Dr G. W. KOERBER. Breslau, 1855, p. 152.

rightly to refer those spermogones and pycnides which I did not find associated with apothecia. This, however, can only be done by examining a larger number of specimens from different habitats and countries than I have been able to collect or had leisure to study. I offer the present results of my studies merely as a preliminary contribution to lichenological literature, and all that I can venture to hope is, that they may be found useful as a basis for the investigations of those who follow me with ampler means and opportunities of research. It sometimes happens that different specimens of the same lichen from different habitats or countries appear to possess several sorts of spermogones and pycnides; or, associated with a particular species, may be found a considerable variety of these organs. Probably, in the majority of cases, such spermogones and pycnides are really referable to different lichens, and not to the single species to which they apparently belong. But I think there is strong ground for believing that some of the lower lichens are possessed of several forms of reproductive bodies and organs, just as certain of the lower fungi are; at least I have repeatedly met with phenomena which are inexplicable on any other supposition. We now know that the genus *Erysiphe*, belonging to the fungi, has no less than five forms of reproductive bodies or organs; and I have met with many lichens which possess either simply, both spermogones and pycnides, in addition to apothecia, that is, three different forms of reproductive organs, or two or more different forms of spermogones or of pycnides as the case may be. Hitherto it has been customary to refer all such secondary forms of reproductive organs in lichens, when they were observed at all, to parasitic fungi. But this arose from ignorance of the fact that lichens possess other reproductive organs than apothecia. In investigations on the border ground between the lichens and the fungi, there are at present almost insurmountable difficulties. Many of the organisms which we at present regard as the pycnides of lichens may, in the course of subsequent researches, prove to be, or to belong to, fungi; while, on the other hand, the corresponding organs of certain fungi, or certain fungi themselves, may prove to be really the accessory reproductive organs of lichens. The boundary line between the lichens and the fungi is for ever shifting; and it is perhaps at present impossible to fix or determine it. Mycologists and lichenologists alike have given it up as a hopeless task. The old distinction as to the habitat,—lichens being supposed to grow always on *living*, and fungi on *dead* tissues—is utterly absurd. Until lately, it was thought that chemistry had furnished a means of distinguishing these two important cryptogamic families in the presence or absence of starchy matter in the hymenial and other tissues, which in lichens, as a general rule, strike a blue colour with iodine, while in fungi they do not. But Mr FREDERICK CURREY has pointed out that this reaction frequently occurs also in undoubted fungi. Between the higher fungi and the higher lichens the distinction is obvious enough; but between the lower groups of each family the difference gradually becomes imperceptible, until it is

lost. How closely, frequently, do *Spharicia* resemble *Verrucaria*, and the spermogones and pycnides of lichens those of the fungi? So intimate is the alliance between the fungi and lichens, that BERKELEY,* in his Cryptogamic Botany, makes his division "*Mycetales*," to include the "*Lichenales*" and "*Fungales*." Many spermogones, it now appears, have been described by the older lichenologists as independent species of lichens: FRIES' genus *Pyrenotheca*, and WALLROTH'S *Thrombium*, are chiefly made up of spermogones which belong to various *Lecideæ*, *Graphidæ*, and *Verrucariæ*. Some of these may hereafter be found really to belong to the fungi. Several genera or species of fungi have shared a similar fate, as a consequence of the progress of microscopical mycology, having been found to constitute mere secondary or tertiary forms of fruit of more familiar species; such fungi are *Sclerotium*, *Cytispora*, *Melasmia*, *Phyllosticta*, *Polystigma*, *Phoma*, partly, and many others, according to TULASNE, who is equally distinguished as a mycologist and lichenologist. It were specially desirable that he who studies the spermogones and pycnides of lichens should be a mycologist, as well as a lichenologist; in no other way can he properly interpret and appreciate what he observes. I believe that he only can be a philosophical lichenologist who is comparatively well acquainted with the anatomy and affinities of the fungi and algæ: while it is equally necessary that the mycologist and algologist should possess a competent knowledge of the structure and physiology of the lichens. Indeed, it has perhaps been from a too exclusive study of particular tribes of plants, and a desire to fill their ranks at the expense of their allies or neighbours, that much confusion has been introduced into classification and nomenclature, and much ignorance has prevailed as to the true position of lichens in the scale of vegetable life. Monographers, it is to be feared, work too much in their own favourite fields to arrive at or deduce broad, philosophical, or scientific conclusions or general laws; specialists are apt to take up one-sided, and hence erroneous views. Nor must the student of spermogonology confine himself to the lichens of one country or clime, and still less to herbaria of dried specimens. I have sometimes succeeded in finding, in *foreign* specimens of a lichen, spermogones which were absent in all the *British*, or even *European*, specimens examined by me: for instance, in *Nephromium tomentosum*. Another advantage of the study of foreign species is, that it will serve to exhibit the constancy with which spermogones or pycnides of a particular character occur in the majority of lichens, as well as the constant relation as to site which they bear to the apothecia.

Frequent disappointments must have been experienced by all who have sought for the spermogones of lichens, in so far as they may *fail* to find them oftener than they *succeed*. This arises, in many cases, undoubtedly from ignorance of the relative periods of development of the spermogones and apothecia.

* Introduction to Cryptogamic Botany. By the Rev. M. J. BERKELEY, M.A., F.L.S. London, 1857.

The spermogones must be looked for and examined at a particular stage of their development; otherwise our results cannot fail to be unsatisfactory. They may be too young, and the spermatia are undeveloped; or too old, and the spermatia have all escaped;—the sterigmata may have become sterile and hypertrophied, filling up the cavity of the spermogone; or the body of the organ may have fallen out, nothing being left save a large irregular cavity. Observers are probably too much in the habit of examining only fruited specimens of lichens—thalli-bearing apothecia—in their search for spermogones. But two circumstances must be borne in mind,—*firstly*, That in development, the spermogones normally precede the apothecia; and that, consequently, the former may have disappeared, or have become old and degenerate, by the time the latter have arrived at maturity; and *secondly*, That spermogones are frequently most abundant, or are only found on thalli, or portions of thalli, bearing no apothecia. The only safe rule for the student, therefore, is to examine specimens *in every state*, however unpromising, whether fertile or sterile, old or young; and he should never feel secure in regarding a particular conceptacle as a spermogone or pycnide, unless he see distinctly abundance of *free* spermatia or stylospores. This procedure implies, of course, an immense amount of fruitless labour. I have myself acted on this principle, and followed out this plan; and I regret that I cannot yet indicate to the student any more “royal road” to a knowledge of the secondary reproductive organs of the lichens. He must advance himself slowly and gradually, by sheer plodding industry, and perseverance unconquerable: he must labour patiently for months, aye years, before he sees even dawnings of the interesting and important results, which it may be his good fortune subsequently to achieve.

Considerable discussion has occurred regarding the spelling and use of the words, “*spermogone*” and “*spermatogone*.” The former word is that originally introduced by TULASNE to designate the conceptacle containing the linear corpuscles, which he calls *spermatia*. The latter is used by the Rev. M. J. BERKELEY in his “Introduction to Cryptogamic Botany,” on the ground that it is etymologically more correct. I confess to a natural repugnance unnecessarily to render even scientific terms pedantic and repulsive; and my desire in this case to retain the simpler of the two words in question is supported by the opinion of the present Professor of Greek in the University of Edinburgh. In a letter to me (of date 15th April 1858), Professor Blackie remarks, “There is not the slightest necessity for your altering *spermogone*, which has the advantage of being shorter. The analogy of the well-known Greek word *σπερματολόγος*, which you will find in the New Testament (Acts xvii. 18), and other compounds in the commonest dictionaries, are quite sufficient to defend the shorter form.” I will therefore, throughout this memoir, make use of the word “*spermogone*” instead of “*spermatogone*.”

For the sake of uniformity of arrangement, but by no means as implying my concurrence in his classification and nomenclature, I have adopted, in the follow-

ing memoir. the names of genera and species used by Dr NYLANDER, in what are both the most recent, and at the same time most accurate and philosophical, continental works in lichenology.* I do this the more readily, inasmuch as I have not yet elaborated the classification and nomenclature I mean to follow in my forthcoming "Synopsis of the British Lichens."—(BRADBURY and EVANS, London.) For usefulness of reference to the reader, I beg to append a vidimus of NYLANDER's arrangement,† so far as it contains genera and species, whose spermogones and pycnides are described in the following Memoir. The genera and families, however, will not be found arranged in the order laid down by NYLANDER. I have begun with the higher lichens; and I have been guided in the arrangement or sequence of the families and genera more by the similarity of their spermogones, than by general anatomical affinities. It is obviously, however, a matter of no moment how the families and genera follow each other, or are arranged. The point of real importance is, that the spermogones in each family, genus, and species, be fully and distinctly described.

	FAMILY I. <i>Collemacci</i> .	<i>Genera.</i>
	Tribe 1. <i>Lichinei</i> ,	{ Ephebe, Fr. Lichina, Ag.
	Tribe 2. <i>Collemei</i> ,	{ Synalissa, DR. Omphalaria, DR. Collema, Ach. Leptogium, Fr. Obryzum, Wallr.
	FAMILY II. <i>Myriangiacei</i> .	
	Tribe 1. <i>Myriangei</i> ,	Myriangium, Mont. and Berk.
	FAMILY III. <i>Lichenacei</i> .	
Series I. Epiconiodei,	Tribe 1. <i>Caliciei</i> ,	{ Sphinctrina, Fr. Calicium, Ach. Coniocybe, Ach. Trachylia, Fr.
	Tribe 2. <i>Sphærophorei</i> ,	{ Sphærophoron, Pers. Acroscyphus, Lév.
Series II. Cladoniodei,	Tribe 3. <i>Bæomycei</i> ,	Bæomyces, Pers.
	Tribe 4. <i>Cladonei</i> ,	Cladonia, Hoffm.
	Tribe 5. <i>Stereocauli</i> ,	Stereocaulon, Schreb.
Series III. Ramalodei,	Tribe 6. <i>Roccellei</i> ,	Roccella, Bauh.
	Tribe 7. <i>Siphulei</i> ,	{ Siphula, Fr. Thamnolia, Ach.

* His "Synopsis Methodica Lichenum," and his "Enumeration Générale des Lichens," both published in 1858.

† As given in his "Synopsis," p. 65.

FAMILY III. <i>Lichenacei</i> —continued.		Genera.
Series III. <i>Ramalodei</i> , . . . <i>continued</i>	Tribe 8. <i>Usneei</i> , . . .	Usnea, Hoffm. Neuropogon, N. and Flot. Chlorea, Nyl.
	Tribe 9. <i>Ramalinei</i> , . . .	Alectoria, Ach. Evernia, Ach. Dufourea, Ach. Dactylina, Nyl. Ramalina, Ach.
	Tribe 10. <i>Cetrariei</i> , . . .	Cetraria, Ach. Platysma, Hoffm.
Series IV. <i>Phyllodei</i> , . . .	Tribe 11. <i>Peltigerei</i> , . . .	Nephroma, Ach. Nephromium, Nyl. Peltigera, Hoffm. Solorina, Ach.
	Tribe 12. <i>Parmeliei</i> , . . .	Sticta, Ach. Ricasolia, DN. Parmelia, Ach. Physcia, Fr.
	Tribe 13. <i>Gyrophorei</i> ,	Umbilicaria, Hoffm.
	Tribe 14. <i>Pyxinei</i> , . . .	Pyxine, Fr.
Series V. <i>Placodei</i> , . . .	Tribe 15. <i>Lecanorei, pro parte</i> ,	Psoroma, Fr. Pannaria, Del. Coccocarpia, Pers. Amphiloma, Fr. Squamaria, DC. Placodium, DC., &c.

The part of NYLANDER'S table given above, refers to the filamentous, fruticulose, and foliaceous lichens,—those whose spermogones are described in this memoir. The other half relates to crustaceous lichens, which include the *Lecanorei*, *Lecidinei*, *Graphidei*, and *Pyrenocarpei* (or *Verrucaria*).

In the researches on which the following memoir is based, I was in the habit of using the magnifying power 380 of a NACHET'S microscope ("petit modèle"), made in 1851, and a micrometer eye-piece made by JAMES BRYSON, Edinburgh.

In giving measurements from the French, as I do in a few cases in describing spermogones or their contents, which have been observed by NYLANDER or TULASNE, but not by myself, I have calculated the French millimetre as equal to $\frac{1}{25}$ th of an English inch. The usual calculation hitherto has been $\frac{1}{26}$ th; but I believe $\frac{1}{25}$ th to be more correct, and to be, therefore, gradually coming into more general use both in France and in this country.

As a sort of key to the following memoir, I beg to subjoin a

Summary of the general characters of Spermogones and Pycnides,† and their respective contained corpuscles, Spermatia‡ and Stylospores.§*

I. SPERMOGONES.

I. *External Form.*—They are generally more or less oval or spherical bodies: sometimes wholly immersed in the substance of the thallus; more frequently partly immersed and partly projecting on the surface of the cortical layer: in some cases, naked and sessile, seated on the surface of the horizontal thallus, or forming the terminations of the ramuscles in the erect fruticulose one. The immersed and semi-immersed spermogones are plunged in the substance of the medullary tissue of the thallus, and they are usually partly covered by the cortical layer, and partly encircled by the gonidic layer.

Spermogones appear on the surface of the thallus, as:—

1. *Punctiform* bodies—In which case they are wholly immersed, the apex alone being visible on the thalline surface; in many *Parmelias*, in *Evernia*, *Roccella*, *Dufourea*, and *Chlorea*.

2. *Conoid* or *Papillæform* bodies—In which case they are semi-immersed; in many *Physcias*, *Umbilicarias*, *Parmelias*, *Placodiums*, *Squamarias*, and *Pannarias*.

3. *Mammillæform* bodies—In which case they are sometimes seated on, or in, special thalline tubercles; in many *Stictas*, *Ricasolias*, and some *Physcias*, *Parmelias*, *Pannarius*, and *Coccocarpus*.

4. *Discoid* bodies—In *Collema* and *Leptogium*.

5. *Wart-like* bodies—In *Ramalina*, *Usnea*, *Thamnolia*, *Ephebe*, and *Stereocaulon*. The papillæform and mammillæform spermogones also frequently become wart-like and very irregular when confluent.

6. *Barrel-shaped* or *tub-shaped* bodies—In *Cladonia*, some *Nephromiums*, *Lichinas*, and *Parmelias*.

7. *Large lecidine* bodies—Whitish in *Placodium circinatum*, var. *ecrustaceum*; brown in a form of *Cladonia papillaria*.

Externally, the spermogones frequently resemble, and are apt to be confounded with,—

a. Nascent apothecia; as in *Ricasolia herbacea*.

b. *Pycnides*.

* From σπέρμα, a seed, and γονή, generation.

† πυκνός, compact, or πυκνότης, a compact series (Latin, *Pycnitis*), in allusion to the closely aggregated sterigmata. The designation, *Pycnidis*, which was originally given by TULASNE, is common to similar organs, which occur in various fungi, particularly the *Hypoxyla*.

‡ σπέρμα, ατος, a seed or germ.

§ στυλος, a pillar (Latin, *Stylus*), and σπορά, a seed, from being borne on the end of pedicles or stalk-like filaments, called *Sterigmata*; στήριγμα, a support.

c. *Parasitic fungi*,—especially of the genus *Sphæria*.

d. Minute *Verrucarias*.

e. Parasitic *Lecideæ*—as *L. vermicularia*, *L. alectorice*, *L. cladoniaria*, and *L. obscuroides*.

From all these bodies they are only to be distinguished by microscopical examination.

II. *Position* of the spermogones on the thallus, and in relation to the apothecia.

They occur generally on specimens bearing also apothecia; sometimes, however, only on sterile specimens of species whose apothecia are common; and still more rarely on species or specimens never yet found bearing apothecia, as in *Thamnomia vermicularis* and *Dufourea madreporiformis*.

1. *Superficial*.—On the foliaceous, horizontal thallus, usually scattered about the margins of the lobes or laciniae, as in many *Parmelias* and *Physcias*. In this case they are situated external to the region occupied by the apothecia.

In exceptional cases they are scattered generally over the whole surface, and are then intermixed with the apothecia, as in *Parmelia conspersa*, *P. encausta*, and *P. stygia*. The same occurs sometimes in species with a fruticulose thallus, as in some *Cladonias* and *Roccellas*.

They are sometimes confined to the plicæ of the thallus, as in some species of *Sticta* and *Ricasolia*.

In some *Placodia*, which approach the true crustaceous type of thallus, spermogones are scattered,—isolated, or in groups of two or three,—on the thalline areolæ, central or peripheral, generally the latter, sometimes both.

2. *Marginal*.—In some species with a foliaceous thallus, they are seated directly on the margins of the lobes, to which they give a denticulate character, as in many *Platysmas*, in *Collema* and *Leptogium*, in *Parmelia perforata* var. *denticulata*, *Nephromium tomentosum*, and some forms of *Ricasolia herbacea*. They are also marginal in some species, with a subfoliaceous or fruticulose thallus,—as *Parmelia Fahlunensis*, *P. tristis*, and *Evernia Richardsoni*. In other lichens, they are seated at the ends of cilia or processes given off from the margin of the thallus, as in *Cetraria islandica*, and some forms of *Nephromium tomentosum*.

3. *Terminal*.—In several species or genera, having a fruticulose or filamentous thallus, the spermogones are scattered toward the ends of the thalline segments or ramules, as in *Usnea*, *Ramalina*, *Ephebe*, and *Roccella*. In *Cladonia*, they generally either form the tips of the tapering, simple, or branching podetia, as in *C. rangiferina*, *C. furcata*, and *C. uncialis*; or they fringe, as tooth-like processes, the margins of the scyphi, as in *C. pyxidata*. In some cases they are seated on the same podetia with the apothecia, as in most species with scyphi: in others, they are on different podetia, as in those with a ramose thallus, such as *C. rangiferina*. In both cases, however, they are in close proximity to the apothecia. Some *Cladonias* have spermogones on the surface, as well as the margins of the scyphi.

Others, in addition to terminal spermogones, have barrel-shaped ones, of similar size and form, seated either on the horizontal primary thallus, or on the folioles or squamules which cover the podetia, as in *C. alvicornis*, *C. squamosa*, var. *cæspititia*, and *C. bellidiflora*; or, in the same cases, they occur on the horizontal thallus or the folioles alone.

In some species of *Alectoria* and *Neuropogon*, the spermogones are the terminal bulgings of the ultimate ramules, as in *A. Taylora* and *N. melananthus*.

In *Stereocaulon*, they are warts usually crowded in groups at or about the ends of the ramules. In some species, they form a sort of collar round the terminal apothecia.

In *Sphaerophoron*, *Acroscyphus* and *Lichina*, they are seated on or near the tips of the ultimate divisions of the thallus.

In addition to the above normal or usual positions of spermogones, they sometimes occur in the following exceptional situations:—

- a. On the exciple of the apothecia, as in *P. conspersa*.
- b. On the apothecia themselves, as in *Lichina pygmaea* and *confinis*, and some forms of *Cladonia rangiferina*.
- c. In the hypothecial tissue of the apothecium, as in *Celidium fusco-purpureum*. (Tul. Mém. Pl. 14, f. 12.)

III. *External colour* of the spermogones.—In immersed or semi-immersed spermogones, it is generally only the superior portion, or that portion which projects above the surface of the cortical layer of the thallus, that is coloured. In many cases the ostiole alone, or its margin, is the seat of visible colour. The naked or sessile spermogones, however, are usually coloured uniformly all round, the ostiole here, as in all cases, being darker than the surrounding tissues.

The spermogones are generally differently coloured from the thallus, the one being dark and the other light; and this contrast of colour is one reason why the spermogones are frequently so readily visible under the lens. In cases where both thallus and spermogones have a dark or a light colour, the latter are generally with difficulty recognised, as in *Umbilicaria*, *Usnea*, and *Ramalina*. The colour of the spermogone generally passes more or less gradually into that of the surrounding thalline surface. But sometimes the spermogone is distinctly circumscribed, both as to colour and form, as in *Collema* and *Leptogium*, where its brownish-yellow colour contrasts well with the green of the thallus.

The spermogones are:—

- a. *Black* in many *Parmelias*, *Physcias*, and *Roccellas*. Some of them, though black to the naked eye, or under the lens, or when dry, are found to be really *brown* when submitted to the microscope, or when moistened.
- b. *Brown* in *Cladonia*, *Nephromium*, and some *Physcias* and *Parmelias*.
- c. *Orange-red* or *yellow* in several *Physcias* and *Placodiams*.

d. Concolorous with the thallus in *Usnea*, *Ramalina*, *Thamnolia*, *Stereocaulon*, *Ephebe*, and *Lichina*.

IV. *Size of the Spermogones*.—Their diameter varies from $\frac{1}{25}$ th to $\frac{1}{500}$ th of an inch, many having an average diameter of $\frac{1}{100}$ th to $\frac{1}{200}$ th.

They appear as extremely minute, microscopic points in many *Parmelias*, in *Evernia*, and *Roccella*. They are visible to the naked eye, or are readily recognized under a simple lens of low power, in many *Ricasolias* and *Cladonias*, and in some *Usneas*, *Ramalinas*, *Physcias*, *Coccocarpias*, and *Placodiums*. They are of an intermediate size in *Sticta* and certain *Physcias*.

V. *Number of the Spermogones*.—They are seldom single and isolated, but this sometimes occurs in the terminal spermogones of *Cladonia*. In some species with a fruticulose thallus, such as *Cladonia rangiferina*, or *C. furcata*, and *Cetraria aculeata*, they are generally in groups of two or three. The papillæform, mammillæform, and wart-like spermogones, are generally grouped in larger number; but they never occur in such numbers as the punctiform ones. The latter sometimes cover the whole surface of the thallus, so as to give it a black-punctate character, as in *Parmelia encausta*, *P. conspersa*, and *P. stygia*.

VI. *Structure of the Spermogone*.—Every spermogone consists of the following parts:—

1. A capsule or envelope.
2. A nucleus, which again is made up of—
 - a.* Sterigmata, which generate;
 - b.* Spermatia; and of a
 - c.* Basal cellular tissue.
3. A central cavity, which opens to the external surface by a more or less minute
4. Ostiole or Pore.

1. The *capsule* or *envelope* is usually more or less thick and tough in its texture. It is made up of cells, sometimes round, but more generally, from their close aggregation and mutual pressure, hexagonal or irregularly angular, oblong or elongated. They are usually more or less thick-walled. Sometimes so close is their apposition, that the outline of the individual cells becomes lost, or is very indistinct. The structure of the capsule may be described, in general terms, as closely resembling that of the exciple of the apothecium and the cortical layer of the thallus. Its colour is as described under that of the spermogone generally. It is very frequently blackish or brownish; indigo in *Pannaria triptophylla*; orange in several *Physcias* and *Placodiums*.

2. The *nucleus* is mainly made up of the closely aggregated sterigmata, which are united by a mucilage, that also occupies the spermogonal cavity. Its texture is dense and more or less horny, frequently to such an extent that it admits of being sectioned in very thin slices. The texture becomes denser and harder

with age. From its density, the nucleus can be frequently readily separated from its capsule and from the thallus by the point of a needle, as in many *Ricci-solias* and *Stictas*, where it is comparatively large. Its colour is usually whitish or grayish; sometimes it is rose-coloured; seldom is it so different from that of the surrounding medullary tissue as to be readily distinguished therefrom. At other times, however, this difference or contrast in colour between the nucleus and the surrounding medullary tissues is the only means of distinguishing the former on section of the thallus. In old age, the nucleus frequently falls out spontaneously, leaving a cavity, which is at first not very conspicuous, but which gradually becomes so by being deepened, acquiring a dark colour, and having swollen lips or margins. These cavities, which are sometimes very irregular in form, frequently give the thallus the appearance of being covered over with perforations, more or less closely aggregated, as in *Parmelia saxatilis*, var. *omphalodes*, *P. encausta*, and *P. stygia*.

*a. Sterigmata.**—These are delicate filaments, arranged vertically to the wall of the spermogone, and convergently to its central cavity. They consist either of a single elongated cell, or its ramifications; or of a number of shorter, and usually broader cells in superposition. Hence they are divided into *simple*, and *compound* or *articulated* [*Arthro-sterigmata*, Nyl.] They are so closely aggregated, that, under a low power, they look like mere striæ; and sometimes, under the microscope, they appear united at their bases. Their walls differ much in thickness; they are usually thickest in some arthrosterigmata. They appear to contain a colourless, homogeneous fluid; and their walls are also colourless, generally speaking, though occasionally in age their bases acquire a certain degree of colour. The tissue which they form is very hygrometric, imbibing water with great rapidity and ease.

(1.) *Form a. Simple*, filiform, and 1-cellular, or consisting of the ramifications of a single cell.

Longish in *Ramalina*, *Lichina*, *Roccella*, *Sphaerophoron*, *Stereocaulon*, *Alectoria*, and *Dufourea*.

Shortish, sometimes almost absent, in *Squamaria*. Simple sterigmata sometimes taper gradually into spermatia, which then appear as terminal joints. They generate spermatia only from their apices. They divide or branch at or near the base only, and their ramifications sometimes resemble digitate processes from basal tubes or filaments. In the old state, the simple sterigma becomes sometimes sterile, elongated, and ramose; and its ramifications form a filamentous network more or less occupying the spermogonal cavity, and resembling that which is found in the spermogone of many *Parmelias* having articulated sterigmata. This is particularly noticeable in some *Cladonius*.

* στήριγμα, a support, in allusion to their function of generating the Spermatia.

b. Compound or articulated [arthrosterigmata]. Component cells are,—

1. *Short*, broadish, often thick-walled, and numerous in *Sticta*, *Ricasolia*, *Nephromium*, *Pannaria*, *Coccocarpia*, *Placodium*, *Umbilicaria*, *Collema*, *Leptogium*, and some *Physcias*.

2. *Longish*, narrow, mostly thin-walled, and few in *Parmelia*, many *Physcias*, *Evernia*, *Usnea*, *Platysma*, and *Cetraria*.

Like the simple sterigmata, the articulated sterigmata are sometimes ramose, but the ramifications may come off at any point between their base and apex. It is noteworthy, that arthrosterigmata uniformly bear *straight* spermatia, which are given off from both apex and sides, while the simple sterigmata bear spermatia, which are sometimes curved or twisted, sometimes straight. In the case of simple sterigmata, the spermatia are more frequently short, oblong, oblong-oval, or crescentic; in that of arthrosterigmata, they are almost always rod-shaped or acicular. In the arthrosterigmata, the spermatia, though given off from the *sides* of the sterigmatic filament, as a whole, are generated from the *apices* of the individual or component cellules, at more or less irregular angles. Hence they project from the sides of the sterigmata like a series of needles or bristles, numerous in proportion to the number of the constituent cellules of each sterigma. This bristled appearance is, therefore, most marked where the individual articulations or cells are short and numerous, as in *Collema*, *Umbilicaria*, and *Placodium*.

(2.) *Size*.—In *length*, sterigmata vary from $\frac{1}{100}$ th to $\frac{1}{2500}$ th of an inch, a medium being $\frac{1}{500}$ th to $\frac{1}{1000}$ th. They are shortest when simple; in some cases so short as to appear absent. In *breadth*, they vary from $\frac{1}{5000}$ th to $\frac{1}{20,000}$ th; an average being $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th. Simple sterigmata are usually narrower, as well as shorter, than arthrosterigmata; in them the breadth is sometimes so small as $\frac{1}{10,000}$ th to $\frac{1}{20,000}$ th. Arthrosterigmata are frequently $\frac{1}{5000}$ th to $\frac{1}{6000}$ th broad, though sometimes they do not exceed $\frac{1}{12,000}$ th. The following micrometrical scale, applied to the *length* of the sterigmata, may assist the reader:—

1. Very short,	.	.	.	.	From	$\frac{1}{2500}$	to	$\frac{1}{2500}$	inch.
2. Short,	.	.	.	.	.	$\frac{1}{500}$		$\frac{1}{1000}$	...
3. Shortish,	.	.	.	.	.	$\frac{1}{1000}$		$\frac{1}{1000}$	...
4. Medium size,	.	.	.	.	.	$\frac{1}{1000}$		$\frac{1}{500}$	...
5. Longish,	.	.	.	.	.	$\frac{1}{500}$		$\frac{1}{500}$	...
6. Very long,	.	.	.	.	.	$\frac{1}{250}$		$\frac{1}{250}$	...

The cavity of the spermogone, in many lichens,—as in *Parmelia physodes*, *P. saxatilis*, *P. tiliacea*, *P. acetabulum*, *P. perlata*, *P. perforata*, *P. sinuosa*, *P. mutabilis*, *P. conspersa*, *P. kamtschadalis*, and in *Ramalina*, *Usnea*, and *Evernia*, almost all having compound or articulated sterigmata,—is occupied more or less by a lax network of very delicate anastomosing filaments. These would appear to be hypertrophied, sterile sterigmata; at least, the elongated ramose sterigmata of *Cladonia* seem to me to furnish a key to their true nature. They spring from

among the spermatiferous sterigmata, which they greatly exceed, both in length and tenuity. Their extremities are usually more or less knobbed or bulging.

b. Spermata are solid bodies, colourless and transparent; homogeneous, having no contents and showing no septa; generally more or less linear in form, and of equal thickness throughout; never quite spherical; of extreme tenuity; exhibiting great uniformity in size and shape; devoid of cilia or other appendages; possessing Brownian or molecular movements in water; having no power of germination; never intermixed with oil globules, but imbedded in a mucilage.

These essential characters it is of importance to bear in mind, especially in contrasting, as to function, *spermata* with *stylospores*.

Form a. Straight.—1. Rods with obtuse ends, or needles with pointed ends, in all species with arthrosterigmata. This, therefore, is the commonest form of spermatium.

2. Oblong, oval-oblong or ellipsoid in *Ramalina*, *Lichina*, and *Ephebe*.

b. Curved.—1. Shortish; sickle-shaped or crescentic; of equal thickness throughout, and with blunt ends, or thickest in the centre; with pointed ends in *Cladonia*, *Roccella*, *Stereocaulon*.

2. Long; twisted or vermiform in *Squamaria*.

Size.—The length of the spermata varies from $\frac{1}{500}$ th to $\frac{1}{15,000}$ th of an inch, a medium or average being $\frac{1}{3000}$ th to $\frac{1}{5000}$ th. Sometimes, though rarely, as in *Parmelia tiliacea* occasionally, they are twice as long when attached as when free. But, in such cases, it would appear that, when thrown off from the sterigmata, they divide into two equal segments. Their breadth is most frequently about $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th, or it is so small as scarcely to admit of measurement. The following micrometrical scale, applied to the length of the spermata, may assist the reader:—

1. Very minute,	.	.	.	.	.	$\frac{1}{15,000}$	inch to	$\frac{1}{10,000}$
2. Minute,	.	.	.	.	.	$\frac{1}{10,000}$	...	$\frac{1}{8000}$
3. Smallish,	.	.	.	.	.	$\frac{1}{8000}$	...	$\frac{1}{5000}$
4. Medium size,	.	.	.	.	.	$\frac{1}{5000}$	...	$\frac{1}{3000}$
5. Longish,	.	.	.	.	.	$\frac{1}{3000}$	...	$\frac{1}{1000}$
6. Very long,	.	.	.	.	.	$\frac{1}{1000}$	...	$\frac{1}{500}$

Position on the Sterigmata.—They are given off from—

a. Apices only, in simple sterigmata.

b. Apices and sides, in compound or articulated ones.

Development.—The spermatium first appears as a minute, papillar bulging of the apex of the sterigmatic filament or cell. This papilla gradually becomes elongated, and when maturity has been arrived at, a line of separation becomes marked, and the spermatium falls from its parent cell and base of support. Each

sterigmatic cell would appear to give off in succession many spermatia ; hence the infinite numbers in which the latter are found in the spermogonal cavity.

Emission or expulsion from the Spermogone.—When thrown off from the sterigmata, the spermatia accumulate in the central cavity of the spermogone, and gradually escape by the ostiole or pore. The emission or expulsion takes place under the influence of moisture, and its mechanism is the same in principle as that which regulates the expulsion of the spore from the thecæ and apothecia. The nucleus or sterigmatic portion of the spermogone imbibes water with great rapidity and avidity, swelling much ; while the capsule or envelope does so much less readily and more slowly. The result is, that under the influence of moisture, a considerable pressure is exerted by the latter upon the former, the spermogonal cavity is contracted in size, and its contents,—the spermatia and the mucilage in which they are imbedded,—are squeezed out of the ostiole with considerable force, frequently, indeed, as if in a cloud or stream.

3. *Cavity*.—The spermogonal cavity is simple in the majority of lichens ; but it is divided into a series of compartments or loculi, with more or less sinuous walls, in some *Physcias*, *Coccocarpias*, *Usneas*, *Ramalinas*, *Thamnolias*, *Stereocaulons*, and *Neuropogons*.

It contains a mucilage, which is usually colourless ; but which is rose-red in some *Cladonias*. In this are imbedded the spermatia. The cavity is sometimes occupied by a net-work of anastomosing filaments, which arise from among the spermatiferous sterigmata, and which appear themselves to be hypertrophied, sterile, modified sterigmata. In age, the sterigmata frequently encroach upon the spermogonal cavity so much, by becoming elongated and hypertrophied, that it is frequently at length obliterated.

4. *Ostiole or Pore—Form*.—It is normally regular and round ; but in the old state it is very frequently stellate-fissured, or otherwise irregular in its outline. In wart-shaped spermogones it is also frequently elongated and irregular. In position, it is central, one being seated on the apex of each spermogone. But when the spermogones are confluent, the ostioles are frequently so also, or a mass of confluent spermogones may be dotted over with an irregular series of foramina or ostioles, as in the case of *Alectoria Taylori*, and *Neuropogon melananthus*. The ostiole may be either flat,—that is, even with the surface of the thallus,—papillæform, or depressed ; or it may possess all three forms in the same species, or even specimen. But the papillæform ostiole is more common than either of the other two. It is frequently surrounded by, or seated in the centre of, a round areola, as in many *Stereocaulons*, *Sphaerophorons*, and *Parmelias*.

The lips or margins of the ostiole in the young and mature state are seldom very prominent ; but in the old state they are frequently swollen, coloured, and prominent.

Size.—The ostiole is generally very minute ; invisible without the aid of the

lens, and even with its aid, difficult of detection, as in many *Parmelias*, *Physcias*, *Evernias*, &c. In some cases it is so large and patent as at once to be recognised under the lens, as in *Cladonia*, some *Parmelias*, &c.

Colour—is generally blackish or brownish; in some *Physcias* and *Plucodiums* it is orange-red; and in *Usnea* and *Ramalina* it is concolorous with the spermogone and thallus, and hence is extremely inconspicuous. In exceptional cases it is pruinose, as in *Physcia pulverulenta*, in which species, also, it is sometimes of a rose-red colour.

VII. *Chemical Characters*.—No portion of the spermogonal tissues ever gives a blue reaction with iodine, as the thecæ and other elements of the hymenial tissues of the apothecia do. But the spermatia are rendered sometimes more distinct by being coloured a deep reddish-brown.

VIII. *Function of the Spermogone*.—It is generally *supposed*, by continental observers, that the spermogones are the analogues of male organs; but no impregnatory or fecundating influence on the spore has yet been distinctly observed or proved. In connexion with speculations as to their function, it is important to note:—

1. The universality of the occurrence of spermogones in lichens.
2. Their intimate relation, as regards position, to the apothecia.
3. Their priority in development over the apothecia.
4. The general resemblance of the spermatia to the spermatozoids of other cryptogams, though they are destitute of all appendages.
5. The differences in form and structure between spermatia and spores. The former are solid, homogeneous, of extreme tenuity, elongated, colourless, of almost uniform shape and size. The latter are hollow, with heterogeneous contents, frequently septate, usually spherical or oval, shortish, frequently coloured, varying greatly in size and form.
6. The absence of germinative power in spermatia.
7. The relative size of the spermatia and spores,—the former being infinitely more minute.
8. The relative number of spermatia and spores,—the former being infinitely more numerous.

IX. *Effects on Classification, &c.*, of the discovery of Spermogones.—What are now ascertained to be spermogoniferous states of many lichens were regarded by the older lichenologists as separate varieties, species, and even genera; hence the discovery of spermogones has been the means, *inter alia*, of greatly reducing the number of lichens, and of simplifying their classification and nomenclature.

II. PYCNIDES.

The Pycnides of lichens may be described generally as externally resembling in form, colour, site, &c., the spermogones, from which they can be distinguished

only by microscopical examination. The essential difference lies in the character of the contained corpuscles—the *stylospores*, though the sterigmata also differ from those of the spermogones to this extent, that they are almost always simple, shortish, and stoutish, generating the stylospores only at their apices. The pycnides consist, like the spermogones, of a—1. Capsule; 2. Nucleus, made up of sterigmata, with *stylospores* instead of *spermatia* however; 3. Cavity; and 4. Ostiole. They resemble outwardly, and are frequently mistaken for—*a*. Spermogones; *b*. Minute *Verrucarias*; *c*. Parasitic Fungi; and *d*. Parasitic *Lecideae*, such as those mentioned under the head of spermogones. From all of these bodies they can only be distinguished by careful microscopical examination.

They resemble the organs known as *Phoma*, *Septoria*, *Diplodia*, &c., which, according to TULASNE, belong, as secondary reproductive organs, to various theca-sporous fungi. Their occurrence, alike in fungi and lichens, is a strong link binding together in close alliance these two great cryptogamic families. They are more plentiful in the lower than in the higher,—in crustaceous than foliaceous, lichens,—or, in other words, in those species most nearly approaching, in other particulars of their organization, the fungi. In crustaceous species they usually occur as very minute black perithecia, resembling the apothecia of *Verrucaria*. But in the higher lichens, they are frequently much larger, more closely resemble the spermogones, and are variously coloured, as in *Peltigera* and *Alectoria*. In the first-named genus they are marginal, like the apothecia; in the other, they are seated sometimes as warts on the thalline filaments, or in the axils of their ramifications.

Pycnides are sometimes associated both with spermogones and apothecia; sometimes with apothecia alone, no spermogones being present. Occasionally, pycnides and spermogones occur without apothecia, as in some species of *Strigula*; and sometimes pycnidiferous states of lichens are found just as spermogoniferous states are,—without either of the other forms of reproductive organs.

The distinction between pycnides and spermogones is, to a certain extent, one of convenience,—one depending on the difference in character of the contained corpuscles,—not one as yet founded on essential differences in function, inasmuch as the function of neither can yet be said to be thoroughly established or understood. Hence it may hereafter appear that some organs now denominated pycnides should be really regarded as spermogones, as those of *Peltigera* and *Alectoria*, and perhaps, though less likely, the converse,—that some organs now regarded as spermogones should be looked upon as pycnides, as those of *Lichina*!

Stylospores have the following distinctive characters:—

Form is very variable; but they are usually pyriform or oval. Generally they resemble spores in appearance. They are hollow bodies, with contents which are, at least, partly oily. They are usually found intermixed also with oil globules of various sizes. Occasionally they are septate, like many spores. Some-

times they retain their sterigmata as caudate appendages, shrivelled, but still distinct. Their colour is sometimes a pale yellow.

Size, like form, is variable. The length varies from $\frac{1}{1000}$ th to $\frac{1}{4000}$ th of an inch, and the breadth from $\frac{1}{4000}$ th to $\frac{1}{6000}$ th. Their size is therefore much greater in every dimension than that of the spermatia. At the same time, they are much fewer in number than the spermatia.

They are given off from the apices only of the sterigmata, and they are said by NYLANDER to possess the power of germinating.

Function of the Pycnides and Stylospores.—Founding solely or chiefly on their alleged power of germination, the stylospores are described in the latest continental work on lichens (NYLANDER'S "Synopsis") as *sporoid* bodies, that is, resembling spores, both in form and function. According to this view, we should regard the pycnides as secondary or supplementary apothecia. I have not, however, seen this germination of the stylospores for myself; neither have I observed impregnation of the spores by the spermatia; and though I am inclined, so far as my own observations have gone, to the views regarding the functions of the spermogones and spermatia, pycnides and stylospores,—which I have above enunciated as those taken by continental observers,—all that I feel warranted at present in advancing is, that I believe both spermogones and pycnides, in some way not yet fully established, to subserve the purposes of reproduction in lichens.

FAMILY I. USNEÆ.

GENUS I. USNEA, *Hoffm.*

The spermogones of this genus are extremely difficult of discovery, from their being of the same colour as the thallus, and from the ostiole being pale and inconspicuous; moreover, they are seldom met with. I have examined hundreds of specimens in every state, and from all manner of habitats, without success, and I had despaired of ever finding its spermogones, when, about two years ago, I succeeded in discovering them in abundance in a specimen of *U. barbata*, var. *hirta*, Fr., in LEIGHTON'S "Lichenes Britannici exsiccati." I have subsequently found them more plentifully in foreign specimens of the same species. I am now in a position to announce that the variety *hirta* of the older authors is, in great part at least, simply a spermogoniferous state or condition. It is partly also a state in which sorediiferous, instead of spermogonal, warts are abundant. These two separate kinds of warts can seldom be safely distinguished otherwise than by microscopical examination. I am not aware that, at the period of my discovering the spermogones of *Usnea*, I had been anticipated in my observations by any previous author. KOERBER says distinctly, "Spermogonien sind bis jetzt weder an dieser noch den andern arten aufgefunden worden."*

* "Systema Lichenum Germaniæ," "Die Flechten Deutschlands," von Dr G. W. KOERBER. Breslau, 1855. P. 3. (Sub *U. florula*, L.)

the spermogones of *Usnea* would appear to have been noticed by Dr NYLANDER of Paris, who, however, has as yet given no full or precise account thereof.

These spermogones are tubercles or warts, varying greatly in size and form, which are scattered abundantly (when they occur at all) along the ultimate ramuscles of the thallus, near their tips especially. To these they give the very rugose or warted appearance, which they not unfrequently bear, especially in var. *hirta*. They occur sometimes also on the cilia, which diverge from the margins of the large flat apothecia. They are, as I have already stated, concolorous with the thallus, and the ostiole can rarely be detected, unless when it is, as is seldom the case, black-punctate. Their nature, however, can be readily determined by placing one or two of them in a drop of water between glass slides under the microscope, while subjecting them to moderate pressure. The emission of myriads of small needle-like spermatia will at once remove all doubt as to their nature. Sometimes the spermogonal warts are isolated; more frequently they are confluent and irregular. Their cavity, too, though sometimes simple, is generally sinuous or compound, branching into numerous narrow compartments. Externally, the spermogones of *Usnea* resemble those of *Ramalina*, which are somewhat better known and more abundantly met with. The sterigmata, which converge towards the centre of the spermogonal cavity from its internal walls, are either simple and linear, or composed of a few linear, delicate cells or articulations, as in many *Parmelia*. These cells bear, on their apices, rod-shaped spermatia, varying from $\frac{1}{4000}$ th to $\frac{1}{6000}$ th long, and having a breadth of about $\frac{1}{25,000}$ th. Associated with the ordinary sterigmata are numerous elongated, ramose, delicate, sterile filaments, such as occur in *Ramalina*, and in several *Parmelia*. NYLANDER describes the spermatia as rather thicker at one end, which thicker end is the one attached to the sterigma, and therefore lowest. This I have not specially noticed. The spermogones of *Usnea* are sufficiently and well illustrated by those of its species, *U. barbata*, which is to be found all over the world.

SPECIES 1. *U. barbata*, Fr.

Specimen 1.—Var. *hirta* (or *spermogonifera*, pro parte). LEIGHTON'S "Lich. Brit. exsicc." No. 1. (Engl. Bot., Plate 1354). Haughmond Hill, Shropshire. On the two right-hand specimens in my copy, both of which are dwarfed, deformed, much warted, and of a very dark greenish-gray colour: in fruit. In one specimen the spermogonal warts are chiefly scattered over the cilia, proceeding from the margins of the apothecia; in the other they cover the sterile ramuscles, especially about their extremities. In site and external appearance the spermogones are extremely like those of *Ramalina scopulorum*, Ach., and *R. polymorpha*, Ach. They are generally confluent, large, and irregular, and are among the most distinct spermogones I have ever observed in this genus. Their envelope is composed of hexagonal or roundish cells, constituting a tissue resembling that of the

epidermis or cortical layer of the thallus, and having either a greenish or brownish colour. The internal tissue is dense, white, and hygrometric, as it is in the majority of lichens; and the cavity is full of viscid mucilage, in which are imbedded the free spermatia thrown off from their sterigmata on reaching maturity. The latter corpuscles are straight and linear; sometimes very short, not exceeding $\frac{1}{6000}$ th to $\frac{1}{3000}$ th long, sometimes long and acicular, attaining a length of $\frac{1}{4000}$ th. The breadth in both cases is generally the same, being about $\frac{1}{25,000}$ th. The sterigmata are sometimes simple and linear, ramose at base, or coming off in a digitate manner from basal filaments or tubes. At other times, and more generally, they are composed of a few—occasionally of numerous—articulations, which are delicate, linear, longish cells. These articulations or component cells, however, differ greatly in size and shape. They may be short and oval-oblong, or spherical, or elongated, and with very irregular outline. Moreover, they are articulated to each other at very irregular angles, and the whole sterigmata have frequently, therefore, a very zigzag and irregular outline. In the older spermogones are to be found masses of projecting elongated hypertrophied sterile ramose filaments, having quite the characters of those which occur in *Ramalina*, in *Parmelia physodes*, *P. tiliacea*, and many other lichens.

Specimen 2.—Van Dieman's Land; collected by Dr J. D. HOOKER, 1856. In the Hookerian Herbarium, Kew (sub nom. *U. florida*, Ach.). This is also var. *hirta*, a name, I think, which should, to avoid errors and misconceptions, be retained solely for spermogoniferous warted states of *U. barbata*. It is not of itself a good variety, for rough warted spermogoniferous states may occur equally in the varieties *florida*, *ceratina*, *plicata*, and *hirta* of authors, though they are most abundant in the latter variety. The spermogones are here abundant on the small ramuscles which diverge as cilia from the margins of the apothecia; and also on the small transverse ramuscles, which are given off by the erect (or pendent) main ramules in the neighbourhood of the apothecia. The warts are small and indistinct, and seldom, though occasionally, is the ostiole distinguishable. The spermatia are delicate needles, about $\frac{1}{6500}$ th to $\frac{1}{4000}$ th long. The sterigmata are very delicate, and either subsimple or slightly ramose; composed of two or three longish, delicate, linear articulations, as in *Parmelia saxatilis*, *P. physodes*, &c. Accompanying the spermogonal warts, but generally on separate ramuscles, are sorediiferous warts, which are at once distinguishable on microscopical examination.

Specimen 3.—Also var. *hirta*; dwarf form. Tasmania. Antarctic Expedition, 1839–43. Collected by Dr HOOKER (sub nom. *U. florida*, Ach.): in abundant fruit. The main ramules give off very numerous transverse ramuscles. The latter, about their tips, are frequently roughened by indistinct, small spermogonal tubercles. They are so small as to be apt to be overlooked. The spermatia and sterigmata are as described in No. 2. But the latter sometimes also consist of simple linear, but irregular cells, which come off from basal tubes, lodged in the

capsule or walls of the spermogone, as digitate prolongations. This capsule or envelope is of a tissue, which is either pale yellow or colourless.

Specimen 4.—Var. *hirta*. On the white oak of California. Collected by Mr DEIGHTON, 1857. The ramuscles are roughened over with warts, which, however, are chiefly sorediiferous. The spermogones are sparingly scattered about the tips of the ramuscles as elongated, flattish, pale warts, with ostioles of the same colour as the thallus. The sterigmata are very delicate and indistinct, of single, linear, elongated cells, subdigitately ramose at base. No free spermatia were found, the spermogones being chiefly old.

Specimen 5.—Rio Janeiro, 1846–51. Sent to HENRY PAUL, Esq. A few spermogones occur on the long and abundant cilia proceeding from the margins of the apothecia, as well as on the ramuscles diverging at right angles from the main branches of the thallus. They are either distinctly tuberculated, or they merely form fusiform swellings of the filiform ramuscles. The ostioles are pale and large; the tissue surrounding them still paler.

Specimen 6.—Ceylon. WALKER. In Hookerian Herb., Kew. Scattered about the tips of the ramuscles are tubercles, with pale brown disk-like ostioles, resembling young apothecia; these appear to be spermogones; but they are old, and contain no free spermatia. The tubercles are generally surrounded by a pale collar or ring of thallus. The last two specimens both belong to the var. *florida*, Fr.

GENUS II. NEUROPOGON, *Nees and Flot.*

The only species of this genus, *N. melaaanthus*, resembles the *Usnea florida*, Ach., than which, however, it is much stronger, coarser, and more deeply coloured. This is only what we should expect from its habitat and geographical distribution, the genus being peculiar to the arctic and antarctic regions. The fruit, which is abundant, and the spores, are those of *Usnea barbata*, while the spermatia and sterigmata are similar, though somewhat longer. Instead of being tubercles, the spermogones constitute irregular fusiform swellings of the tips of the ultimate ramuscles, which are very black. These swellings are dotted over with minute perforations, which are the ostioles of the confluent compound spermogones. I can see no valid reason for dissociating *U. melaaanthus* as a genus from *Usnea*, nor from another closely allied lichen, which NYLANDER places in *Alectoria*, *A. Taylori*, and which has precisely similar spermogones, though the thallus is somewhat more simple.

SPECIES 1. *U. melaaanthus*, Ach.

Specimen 1.—Hermite Island, Cape Horn. Antarctic Expedition, 1839–43. Dr HOOKER. The plant has a deep brownish-red colour, and very black apices, which contain the peculiar spermogones above described. The envelope of the spermogones is of a pale brown cellular tissue. The spermatia are delicate needles,

about $\frac{1}{2000}$ th to $\frac{1}{3000}$ th long, with a breadth of about $\frac{1}{25,000}$ th. NYLANDER describes them as thicker at one end. The sterigmata are very delicate, and composed of longish, linear, somewhat irregular cells, from the apices of which are given off the spermatia. The sterigmata resemble those of *Parmelia tiliacea*, and other *Parmeliæ*. NYLANDER describes them as simple and linear!

GENUS III. CHLOREA, *Nyl.*

The spermogones of this genus,—at least if *C. vulpina*, the only species I have had an opportunity of examining, may be taken as a type,—are more allied to those of *Evernia*, than of *Usnea* and *Neuropogon*, with which NYLANDER associates it. The species named has altogether more of an everniiform than an usneiiform aspect. The spermogones are black or brown points or papillæ according as they are immersed or superficial, scattered on the angles of the laciniaë about their extremities, and conspicuous from contrast with the beautiful lemon-yellow colour of the thallus. The spermatia are straight, rod-shaped, or acicular. NYLANDER describes them as slightly thicker or “fusiform-incrassate” at one end. They vary in size from $\frac{1}{2000}$ th to $\frac{1}{4000}$ th, with a breadth of about $\frac{1}{25,000}$ th. The sterigmata are simple, linear, somewhat irregular cells, ramose at the base; or they are composed of a few delicate linear cells or articulations, as in *Usnea* and *Neuropogon*. Their length varies from $\frac{1}{1000}$ th to $\frac{1}{1500}$ th.

SPECIES 1. *C. vulpina*, *Nyl.*

(*Synonyms*.—*Cornicularia*, SCH. Enum. 6; *Evernia*, KÖRB, 41; FRIES. L. E. 24, exs. 142; MASS. Lich. Ital. exs. 1 Pp. *Parmelia*, Ach.) Occurs in North America as well as in Europe.

Specimen 1.—On the bark of the *Wellingtonia gigantea*, California; the specimen exhibited in the Crystal Palace, Sydenham, February 1857; J. HARDY. In fruit. The spermogones are brown tubercles, which give the laciniaë a very rugose, warted character; they are sometimes very large and distinct. The sterigmata are elongated, linear cells, subdigitately ramose at base. The spermatia are about $\frac{1}{2500}$ th long. On the same thallus occurs, as it frequently does, the parasitic *Phacopsis vulpina*, Tul. (HEPP. exs. 474). The apothecia of this Parasite are generally confluent, and form very large and irregular black warts or tuberculated masses, placed usually near the base of the thallus, or on the larger laciniaë only. Besides, its spermogones have not yet been discovered, and its apothecia can scarcely, therefore, be confounded with the isolated brown or black spermogones of *C. vulpina*.

Specimen 2.—HEPP. exs. 474 (sub *Phacopsis vulpina*, Tul., which is parasitic on its thallus). Bark of old larches, and on old palings, about St Moritz, Switzerland. Here the spermogones are minute, black tubercles, scattered along the angular edges of the laciniaë, and indistinguishable from nascent apothecia, unless by microscopical

examination. The spermatia and sterigmata are among the largest and most distinct I have seen. Both are somewhat hazy or granular, and the basal portions of the sterigmata are brown. The bases of the latter are very closely agglomerated, and merge into the brown, dense, cellular tissue of the envelope. The sterigmata are simple cells, elongated, having a very irregular outline, coming off subdigitately from basal tubes.

Specimen 3.—Rocky Mountains, DRUMMOND; north-west coast of America, DOUGLAS; in Hookerian Herb., Kew. The spermogones extend a considerable distance down the laciniae. They are wholly immersed, and exhibit on the surface only their small, black, papillæform ostioles. The spermatia are about $\frac{1}{4000}$ th long, with a breadth of $\frac{1}{25,000}$ th. The sterigmata are about $\frac{1}{1500}$ th long, and consist of a few delicate, linear, irregular cells or articulations.

Specimen 4.—SCHÆRER exs., No. 390 (sub *Parmelia*); on firs in the Alps; on right-hand specimen in my copy (ed. alt. immut., 1840). The spermatia are about $\frac{1}{3000}$ th long; the sterigmata either linear, single cells, or of a few articulations; about $\frac{1}{1000}$ th to $\frac{1}{1200}$ th long.

Specimen 5.—Germany; in Herbarium Bot. Soc. Edin. The spermogones are abundant as greenish or greenish-brown tubercles, with a black tip. The spermatia are about $\frac{1}{3000}$ th to $\frac{1}{4000}$ th long. The sterigmata are as described in No. 4.

FAMILY II. RAMALINEÆ.

GENUS I. RAMALINA, Ach., Fr.

As a general rule, the spermogones of this genus resemble those of *Usnea*. They are irregular tubercles of the same colour as the thallus, sometimes isolated, but more frequently confluent, scattered over the laciniae, especially about their extremities. Spermogonal warts are the cause of the very rugose, deformed character of the laciniae in several species; for instance, in *R. scopulorum* and *R. polymorpha*, in dwarf specimens of which they are especially abundant. The ostiole is generally pale and inconspicuous; under moisture it is usually semi-translucent, and more easily recognisable. It is sometimes, more generally in foreign than British species and specimens, black-punctate, and then it is comparatively distinct and easily seen on the pale green thallus. Where the laciniae are round or filiform, the spermogones are scattered over the whole surface; where they are flattened, as in the *ampliata* form of var. *fraxinea*, they are sometimes confined to the rugæ, with which the thallus is frequently marked. The size of the spermogones varies greatly; their diameter generally ranges from $\frac{1}{60}$ th to $\frac{1}{150}$ th. In *R. calicaris*, var. *fraxinea*, it is $\frac{1}{50}$ th to $\frac{1}{60}$ th; in *R. scopulorum* $\frac{1}{80}$ th to $\frac{1}{130}$ th. The envelope is either of a pale brown or green, or it is colourless; its component tissue is cellular, and similar to that of the cortical layer of the thallus. The cavity is simple or compound, and divided into sinuosities or compartments; the latter

apparently in the case of confluent spermogones. The internal tissue is white, horny, and dense, as contrasted with the loose, white, medullary tissue in which they are imbedded. The sterigmata are very delicate, short, linear cells, sometimes ramose at the base, of equal width with the spermatia, which are given off as terminal cells. Sometimes, though rarely, they appear to be subarticulate, several long, linear, delicate cells coming off from a central, principal, or trunk cell near its base. Their length varies from $\frac{1}{750}$ th to $\frac{1}{1500}$ th, frequently averaging $\frac{1}{1000}$ th. Associated or intermixed with the ordinary sterigmata are numerous elongated, ramose, very delicate filaments, which fill up the cavity of the spermogone, and occur so constantly as to constitute a characteristic feature of the spermogones of this genus. NYLANDER regards these anastomosing filaments as a point of distinction between this genus and *Dufourea*. The spermatia are short and oblong; sometimes, though rarely, ellipsoid. Their breadth is about $\frac{1}{20,000}$ th; their length varies from $\frac{1}{5000}$ th to $\frac{1}{10,000}$ th, averaging about $\frac{1}{7000}$ th.

In *R. ceruchis*, a species from central America, the spermogones differ somewhat from those of the British *Ramalinae*. They are here black, cone-like bodies, either directly seated on the thallus, or placed on thalline warts or tubercles. The difference, however, is more apparent than real; and, altogether, this is an exceptional or anomalous species. It is only the ostioles which are black and papillæform, and the envelope of a deep indigo blue colour; the whole internal structure is that of the spermogones of British species of *Ramalina*. There is a remarkable uniformity in regard to the structure or contents of the spermogones of this genus,—a circumstance which, taken along with the uniformity in character of the spores, leads me to suggest that all our British species, at least, of *Ramalina*, should be associated in a single species,—call it by what name we may.

SPECIES 1. *R. calicaris*, Fr.

A cosmopolite, which has been found in some of its numerous varieties or forms equally in Europe, Africa, America, Asia, and Australia.

Specimen 1.—Var. *fraxinea*, Fr. Broad form of laciniae (form *ampliata* of authors). On trees, Glen Cluny, Braemar, August 1856, W. L. L.; no apothecia. Laciniae marked by prominent, decussating rugæ or plicæ. On these the spermogones occur generally in closely aggregated, irregular groups, and most abundant about the extremities of the laciniae. The ostioles are generally of the same colour as the thallus; sometimes of a darker green, but never very conspicuous. The spermatia are about $\frac{1}{6500}$ th long; the hypertrophied ramose filaments are abundantly intermixed with the ordinary sterigmata. The apices of the latter generally bulge somewhat, resembling, in this character, the paraphyses of most lichens.

Specimen 2.—Sub *Alectoria tuberculata*, Tayl., in Hookerian Herb., Kew; Peru, on trees in arid situations; Monte Christo, Columbia. This lichen has broadish,

flattened laciniae, and is apparently referrible to the same variety as No. 1. The surface is abundantly warted over with both spermogonal and soresdic tubercles; hence, probably, the source of the name given it by TAYLOR.

Specimen 3.—HEPP. exs. 167, var. *ampliata*; in fruit; on old fruit-trees. The smallest and lowest specimen in my copy has spermogones, scattered over the edges and towards the ends of the laciniae, as yellowish tubercles. The envelope is of a pale brown, or colourless.

Specimen 4.—Teneriffe; in Hookerian Herb., Kew. The segments of the thallus are linear or narrow, but flat. The margins are roughened or warted over with spermogonal warts, whose ostioles are either pale or black-punctate. In the latter case they are easily discoverable. The spermatia are about $\frac{1}{7000}$ th long; the sterigmata $\frac{1}{1000}$ th. The greater frequency of the black-punctate condition of the ostiole in foreign, than in British specimens, is one great reason why the spermogones of the former are generally more easily recognised.

Specimen 5.—Philippine Islands, CUMING; in Hookerian Herb., Kew; sterile segments of thallus linear and flat. The spermogones are marked by a central brown pore or ostiole; they are scattered over the surface of the laciniae about their tips; they are here easily discoverable under the lens. The spermatia are about $\frac{1}{7000}$ th long; the sterigmata $\frac{1}{750}$ th to $\frac{1}{1000}$ th.

Specimen 6.—Sub *Lichen calicaris*, Linn., in Herbarium Linnæi, preserved in the Library of the Linnæan Society of London. The thallus is dotted abundantly over with spermogones, the ostioles of which are minute black dots or points.

Specimen 7.—Forfarshire; T. DRUMMOND, in Hookerian Herb., Kew; a form passing into *R. scopulorum*. The thallus is very dark, and is covered with spermogones. In *R. calicaris*, the cellular capsule or envelope of the spermogone is generally about $\frac{1}{1500}$ th thick.

SPECIES 2. *R. scopulorum*, Ach.,

Which is nearly as widely distributed over the world as *R. calicaris*, being found in Europe, Africa, Asia, and Australia.

Specimen 1.—Isle of Bute; in Hookerian Herb., Kew; a small, delicate form, with round filiform segments. These are abundantly warted over, especially near their tips, with spermogones, having black-punctate ostioles. Hence these organs are here easily recognisable on the pale lemon-yellow thallus. The size and form of the spermogones vary greatly. The sterigmata are about $\frac{1}{1000}$ th long, and sub-ramose at base; the spermatia sub-ellipsoid, about $\frac{1}{3000}$ th long, with a breadth of $\frac{1}{20,000}$ th.

Specimen 2.—Rocks on the sea-coast, between Burntisland and Aberdour, Fife; collected May 1856, by Dr MURRAY LINDSAY. Spermogones are abundantly scattered over the exceedingly deformed, rigid, dark-coloured segments of the thallus, as

very irregular warts, paler than the thallus, generally flattened on their surface; having an ostiole concolorous with the thallus, or paler, never black.

Specimen 3.—Kinnoull Hill, Perth; rocks on summit, overlooking the Tay, W. L. L. A small, rigid, dwarf, dark-coloured form, as in No. 2. Some specimens are quite free from spermogones, others have them in abundance, as in No. 2.

Specimen 4.—LEIGHTON'S exs., No. 2. Engl. Bot. 688; on rocks, South Stacks, Holyhead, Anglesea; sterile. Spermogones are abundant in both specimens in my copy; large and small forms of thallus. They are generally confluent, and very irregular in form; occasionally having a blackish ostiole. The spermatia are about $\frac{1}{7000}$ th long, and sterigmata about $\frac{1}{1000}$ th. Many of the latter are really ramose, giving off linear elongated branches or cells near their base. The hypertrophied anastomosing filaments are very abundant and distinct in the right-hand specimen in my copy.

Specimen 5.—Forfarshire, T. DRUMMOND; in Hookerian Herb., Kew (sub nom. *R. fraxinea* var. *fastigiata*). Segments very much warted over with spermogones, having black ostioles.

Specimen 6.—Miss HUTCHINS; apparently from Ireland; in Hookerian Herb., Kew. Spermogones abundant, but pale and inconspicuous. The thallus here is terebrate, or pierced by foramina, and marked by lacunæ. I have noticed this condition in many other British specimens of this species, so that it can scarcely be regarded as a good specific character,—as in TAYLOR'S *R. terebrata*. In another specimen, also from Miss HUTCHINS, in the same Herbarium, the ostioles of the spermogones are black-punctate.

Specimen 7.—Rocks, Scilly Islands, DICKSON; in Hookerian Herb., Kew. Flat linear segments, showing a transition to *R. calicaris*. These are dotted over with spermogones, which, from having black-punctate ostioles, are easily seen.

Specimen 8.—Probably from the coast of Appin, Argyleshire, CARMICHAEL; in Hookerian Herb., Kew. Spermogones abundant, and with black ostioles. They are pale and inconspicuous in other specimens marked from the Hebrides.

Specimen 9.—Lundie Crags, about ten miles from the sea (near Dundee), GARDINER, 1844; in Hookerian Herb., Kew. The thallus is of a very dark green, almost black; the spermogones pale.

Specimen 10.—GREVE DE LECQ., Jersey, 1851; in Hookerian Herb., Kew. The thallus is of a pale lemon-yellow, probably the result of age and desiccation. The tips and bases of the segments of the thallus are black, while the thallus is studded over with patches of black. The spermogones are abundant, with largish black ostioles, occasionally resembling somewhat the spermogones of *Neuropogon melananthus*.

Specimen 11.—Teneriffe, rocks near the Mesa de Mota, 1849; BOURGEOU Pl. Caner., No. 351. Spermogones abundant, and with black ostioles.

Specimen 12.—St. Vincent, point of Mount Veredi, 2500 feet high; and Cape de Verde; VOGEL. Segments flat, and of a very dark brownish-red colour. The margins of the laciniae are fringed with spermogonal warts. Nos. 11 and 12 are in the Hookerian Herb., Kew.

Specimen 13.—Rocks on the Island of Potoo, China, 1856, FORTUNE. In fruit, spermogones abundant, pale.

Specimen 14.—WELWITZSCH exs., 36, on granite rocks; 37, *β. b.* Cabo da Rocca, Estremadura; 38, *γ.* Cabo da Rocca,—all in Portugal. Both sterile and fertile segments are warted over with spermogones, having black ostioles. This and No. 13 are in the Hookerian Herb., Kew.

Specimen 15.—SCHERER exs., 554; maritime rocks, shores of the Atlantic; PELVET. The spermogones are abundant, flattish, very variable as to size, and marked by a pale ostiole, which is only visible on close examination. The spermatia are $\frac{1}{8000}$ th long; the sterigmata $\frac{1}{2000}$ th to $\frac{1}{1500}$ th.

Specimen 16.—SCHERER exs., 603 (sub var. *humilis*); rocks on coast of Corsica; Requier; in fruit. This seems merely a maritime form of *fastigiata* var. of *R. calicaris*. The spermogones are abundant about the ends of the thalline segments; they are elongated, irregular in form, and marked by a pale gray or greenish ostiole.

In *R. scopulorum*, it will be observed that the spermogonal ostiole is more frequently black than in *R. calicaris*. It may sometimes be confounded with a small, black, punctiform *Sphaeria*, whose perithecia are occasionally scattered over the surface of the thallus. The subarticulate sterigmata, which occur occasionally, resemble those of *Cladonia*, except that they are distinctly composed of several cells, instead of being a single ramose one. This is perhaps the best species in which to study the spermogones of *Ramalina*. So abundant are these bodies on it, and so constantly do they occur, that I regard this species mainly as a spermogoniferous maritime form of *R. calicaris*.

SPECIES 3. *R. polymorpha*, Ach.,

Which occurs in Africa, as well as in Europe. I do not know on what principle this is separated as a species from *R. scopulorum*. I regard it simply as a dwarf, deformed, spermogoniferous state, and referrible to *R. calicaris*. Its spermogones are precisely those of *R. calicaris* and *R. scopulorum*.

Specimen 1.—LEIGHTON exs., No. 73; on Whitestone Cliff, near Thirsk, Yorkshire. The thallus is dwarfed, deformed, and of a very dark colour; the segments are thick, and are abundantly warted over with the spermogones of *R. scopulorum*. The hypertrophied, ramose, sterile filaments are here abundant and distinct,—more so generally in this species and in *R. scopulorum* than in *R. calicaris*.

Specimen 2.—WELWITZSCH exs., No. 39; Cabo da Rocca, Estremadura, Portugal; in Hookerian Herb., Kew. Fruit (that of *fastigiata* var. of *R. calicaris*), abundant. This I refer to the *fastigiata* section of *R. calicaris*; it is simply, as in No. 1, a dwarf deformed state, abundantly warted over with spermogones.

SPECIES 4. *R. terebrata*, Taylor.

This I do not regard as a separate species, but would refer it, as a variety, to *R. calicaris*.

Specimen 1.—Falkland Islands; Antarctic Expedition, 1839-43; Dr HOOKER. Its spermogones externally, as well as their spermatia and sterigmata, are those of *R. calicaris*. The spermogones are scattered about the ends of the narrow flat laciniae: they are sparingly distributed, and are small, flattened, distinct tubercles, having no visible ostiole. The spermatia are almost atomic as to size, about $\frac{1}{10,000}$ th long, and oblong. The elongated anastomosing filaments are so abundant as almost to hide the ordinary short spermatiferous ones. The spermogonal envelope is of a pale greenish-brown colour.

SPECIES 5. *R. homalea*, Ach.,

Which grows in Australia and California.

Specimen 1.—California; in Hookerian Herb., Kew. The segments of the thallus are flattish, resembling those of *Rocella fuciformis* somewhat. The spermogones are scattered, chiefly on the edges of these laciniae, and towards their tips, as black, punctiform, immersed bodies. They frequently become confluent, and, in old age, are sometimes very large, irregular, and maculiform.

SPECIES 6. *R. ceruchis*, Ach.

(Syn. *Desmazieria*, Mont.; *Usnea*, Mont.; *Borrera*, Ach.).

Specimen 1.—Chili, CUMING; in Hookerian Herb., Kew. The segments of the thallus are dotted over with large, black, roundish bodies, seated either directly on the thallus, or placed on thalline warts or tubercles; they are frequently confluent, and are then very irregular in form. The body of the spermogone is wholly immersed. The envelope is of a deep indigo-blue. The spermatia are about $\frac{1}{5000}$ th long, with a breadth of $\frac{1}{20,000}$ th; the sterigmata about $\frac{1}{1500}$ th long. The cortical layer of the thallus is frequently eroded at irregular intervals, the white medullary tissue being thereby exposed. This gives rise to an appearance somewhat similar to that possessed by var. *articulata* of *Usnea barbata*, in which the central, white, medullary thread is exposed by decortication, at intervals, of the thalline filaments or ramules. When this erosion occurs, the spermogone remains intact, and it then appears as a prominent, large, black papilla, contrasting well with the white medullary tissue which surrounds it. This plant also bears

some resemblance, in its general aspect, to *Neuropogon melaxanthus*. "Lying without adhesion," says TWEEDIE, apparently, of this curious lichen (in Herb. Hook.), "on laxe sands at Iquique, Peru, 2-3000 feet, where clouds often hang. Tint to sand green from a distance. One other minute yellow lichen on old bones, and a cactus on lofty rocks on the coast. No other plant on coast for 14 leagues inward, and then three only on the west mountains!"

Specimen 2.—Var. *gracilior*, Nyl. (Syn. *Usnea tumidula*, Nyl.); Coquimbo, CUMING; in Herb. Hooker, Kew. Its segments are round, narrow, and filiform, and the whole plant has the aspect of *R. calicularis*, var. *canaliculata*, Fr., or of *R. linearis*. The spermogones are large, black, round superficial bodies, sparingly scattered about the ends of the ramules. This specimen also bear apothecia.

GENUS II. DUFOUREA, Ach., Nyl.

In this genus the spermogones are minute, black, punctiform, immersed, scattered about the angles of the erect thallus. The black points indicate the ostioles, which lead to the immersed body of the organ; they vary greatly in size, and are generally flattish, though sometimes papillæform. The spermogones, externally, closely resemble those of *Roccella*. As in *Ramalina*, the sterigmata are short, simple, linear cells; but they are much more irregular in outline, and are generally of greater diameter; they are generally similarly sub-ramose at base. Their length varies from $\frac{1}{2000}$ th to $\frac{1}{8000}$ th long. But, unlike *Ramalina*, there are no elongated, anastomosing, sterile filaments intermixed. The spermatia also differ remarkably from those of *Ramalina*. They are linear, long, and slender, about $\frac{1}{2000}$ th long, and slightly curved.

SPECIES 1. *D. madreporiformis*, Ach.

Specimen 1.—Switzerland; in Herb. Hooker, Kew. The angles about the ends of the ramules are dotted over with the minute black points which mark the ostioles, and which become brown when moistened. The spermatia are about $\frac{1}{2000}$ th long, with a breadth of $\frac{1}{25,000}$ th; they are very slender and beautiful, straight, or more generally slightly curved. The sterigmata are irregular dilatations of simple cells, or digitate prolongations of basal tubes. Sometimes, though rarely, they are composed of two or more simple irregular cells or articulations. In general they resemble those of *Lecanora subfusca*.

Specimen 2.—SCHLEICHER exs., No. 67, 1814 (sub *Lichen madreporiformis*, WULF. HALL., No. 1962); on top of Mount Letscherberg; in Herb. Hooker, Kew. The spermogones occupy the position they do in *Sphaerophorum compressum*, than whose spermogones, however, they are larger and not so crowded. They are generally scattered in groups of two or three together, near, but not on, the apices of the segments of the thallus. There are no spermogones in the specimen in SCHÆRER'S exs. in Herb. Hooker. I have not met with apothecia on any speci-

mens I have examined. The sterigmata vary greatly in length, being sometimes not above $\frac{1}{6000}$ th to $\frac{1}{8000}$ th long, and at other times $\frac{1}{2000}$ th to $\frac{1}{3000}$ th.

Specimen 3.—SCHERER exs., 85 (sub *Cladonia*); on the ground on calcareous alpine heights. Intermixed with the spermogones, as above described, are numerous black, superficial, easily removable, conical minute bodies, which appear to be the pycnides of a fungus. They contain small, ellipsoid, or oval stylospores, on longish, linear, irregular delicate sterigmata.

GENUS III. DACTYLINA, *Nyl.*

The spermogones resemble those of *Dufourea* in being black, punctiform, and immersed, scattered about the tips and along the sides of the erect podetia-like expansions of the thallus. The spermatia, however, are chiefly straight, linear, and smaller—about $\frac{1}{6000}$ th long; and the sterigmata, though generally simple, are sometimes composed of a few articulations.

SPECIES 1. *D. arctica*, Hook.

(Syn. *Dufourea* of older authors.)

Specimen 1.—FRANKLIN'S first voyage; in Herb. Hooker, Kew: sterile. The plant consists of very large podetia, coming off like fingers from a horizontal branch or stem. The spermogones are scattered about the apices of these erect, digitate offshoots of the horizontal thallus, as well as along their sides, generally in groups of a dozen, or more. They are wholly immersed, and their presence is indicated by very minute black points. They occur equally on sterile and fertile podetia. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long, with a breadth of $\frac{1}{25,000}$ th. The sterigmata are frequently about $\frac{1}{3000}$ th long, and are either simple linear cells, variously bulging in their walls, or composed of two or three linear elongated cells or articulations.

Specimen 2.—Rocky Mountains, America; Cape Ross; Melville Island, Captain PARRY; Koby Sound, BEECHY; in Herb. Hooker, Kew. Spermogones occur on all these specimens, especially on those with a smooth thallus, for in some the thallus is much wrinkled and lacunose, apparently from desiccation in an arid habitat.

GENUS IV.—ALECTORIA, *Ach.*, pro parte, *Nyl.*

The most common and familiar species of this genus, *A. jubata*, is interesting, inasmuch as, like *Peltigera*, it possesses pycnides instead of,—perhaps in addition to,—spermogones. I have never met with the latter, whereas I have several times found the former occupying the position, and having the outward semblance, of the latter. These bodies are spherical or fusiform warts or dilatations, generally seated at the junction of several thalline filaments or branches. They are large and conspicuous when they occur at all, which is rare, and are apt to be mistaken for

apothecia. The sterigmata are linear, simple, ramose at the base, as in *Ramalina*, and about $\frac{1}{1000}$ th to $\frac{1}{1200}$ th long. Each gives off from its apex an oval or pyriform stylospore, irregular in shape, and closely resembling similar corpuscles in the pycnides of *Peltigera*. They vary in length from $\frac{1}{6000}$ th to $\frac{1}{9000}$ th, their breadth being frequently so small as $\frac{1}{10,000}$ th.

In other species, spermogones of the ordinary characters occur. In *A. lata* they are minute, black, flattish tubercles or warts, scattered along the edges and about the ends of the delicate filiform ramuscles of the thallus. The spermatia are straight, linear, and very small, their length being about $\frac{1}{10,000}$ th, their breadth $\frac{1}{20,000}$ th. The sterigmata are also linear, short, and simple, of equal width with the spermatia, which appear as terminal cells, having a length of about $\frac{1}{2000}$ th to $\frac{1}{3000}$ th. In *A. Taylori* the spermogones are quite of a different character, and assimilate those of *Neuropogon*. They constitute fusiform irregular swellings of the black apices of the ultimate ramuscles of the thallus, which swellings are studded over with numerous minute perforations or ostioles. Their cavity is generally compound or sinuous, a result of the confluence of many spermogones. The spermatia and sterigmata are similar to those of *Usnea* and *Neuropogon*, though considerably larger and more distinct than those of the former genus. NYLANDER describes the spermatia of *Alectoria* as slightly thickened at both ends, or slightly constricted or thinner in the middle. This I have not specially observed.

SPECIES I. *A. jubata*, Ach.,

Which is widely distributed over the world, occurring in Europe, America, and Asia.

Specimen 1.—SCHÆRER exs., No. 496 (sub *Parmelia jubata* δ *cana*); on trunks of firs, Mount Gurnigel. Spermogonal warts are abundant at the angles and junctions of the thalline filaments. The form and size of the contained corpuscles, which I venture to call stylospores, are so irregular and variable, that they have the aspect rather of the bodies just named as they occur in *Lecidea Smithii*, *L. Welrothii*, *Peltigera*, and in other lichens, than of true spermatia, while the conceptacles in which they occur have rather the external aspect of spermogones than of pycnides. In many of the stylospores there is a dark spot like a nucleus, which is probably a rudimentary septum, a phenomenon which is never observed to occur in true spermatia. The spermogonal warts here are abundant, black on the surface, irregular in outline, and generally flattened.

Specimen 2.—SCHÆRER exs. 392, associated with *Evernia divaricata*, Ach.; on the trunks of trees in alpine woods, Switzerland. The spermogonal warts are precisely as above described. The stylospores are oval or pyriform, about $\frac{1}{6000}$ th to $\frac{1}{9000}$ th long, with a breadth of about $\frac{1}{10,000}$ th, of minute size, therefore, compared with those of *Peltigera*. The sterigmata are linear, simple, ramose at base, as in *Ramalina*, with a length of about $\frac{1}{1000}$ th to $\frac{1}{1200}$ th.

SPECIES 2. *A. lata*, Tayl. Nyl.

Syn. *Cornicularia*, Tayl.

Specimen 1.—Mexico; in Herb. Hooker, Kew. The plant has the aspect of *A. ochroleuca*. The spermogones are plentiful, and easily seen. They are small, brown, flattish tubercles or warts, varying in size, scattered about the edges and towards the tips of the delicate, filiform, thalline ramuscles. Their bodies are immersed in the thallus, and from the fact of the latter being semi-translucent, the depth of their immersion can be readily seen. The spermatia and sterigmata are as I have already described, and resemble those of *Ramalina*.

SPECIES 3. *A. Taylori*, Hook.

Specimen 1.—Kerguelen's Land; Antarctic Expedition, 1839–43; Dr HOOKER. In its spermogones, as in its thallus or general aspect, this plant resembles *Neuropogon*, as already described. The spermatia are delicate needles, about $\frac{1}{2000}$ th long, resembling those of *Parmelia tiliacea*, *P. physodes*, and other *Parmeliae*. The sterigmata also resemble those of *P. tiliacea* in being composed of a few delicate linear cells or articulations; others are, however, simple cells, sub-ramose at base. The spermatia and sterigmata are among the most beautiful with which I am acquainted. A parasitic punctiform *Lecidea*, which is apt to be mistaken for spermogones, occurs on the smooth and thicker part of the thalline ramules. I am not aware that it has hitherto been noticed or described, and I therefore propose for it the, at least provisional, name of *Lecidea alectoria*, in reference to its habitat. It occurs also, however, on *Nephromium cellulosum*, Ach. It consists of minute round black points, sparingly scattered, flat or depressed, never papillate; they are wholly immersed in the thallus of the *Alectoria*, and having no thallus of their own, the apothecia may be said to constitute the plant. They resemble, in external aspect, the *Lecidea vermicularia*, which is parasitic under similar circumstances on *Thamnolia vermicularis*, but from which it differs in the characters of the spore, which is three-septate, and oval or ellipsoid. The thecae are like those of *L. vermicularia*, being obovate and sac-like, irregularly and suddenly bulging, and not tapering gradually into a pedicel below as in the majority of thecae. There are no distinct paraphyses. This parasite occurs also on the back or lower surface of the apothecia of *A. Taylori*. The spores of *A. Taylori* are those of our British *Usnea barbata*, and to the genus *Usnea*, in which it was formerly placed, I am inclined to refer it along with the allied *Neuropogon melaxanthus*.

GENUS V. EVERNIA, Ach. Nyl.

The spermogones of this genus are usually punctiform and immersed, of a black or brown colour, scattered about the ends of the laciniae on their flat sur-

face, or on their angular edges. They resemble those of many of the *Parmeliæ*, but are generally smaller. Sometimes they are more superficial or prominent, constituting wartlets or tubercles. Occasionally they are seated on wart-like or papillar elevations of the thallus, or they are surrounded by an inconspicuous thalline ring, giving them a pseudo-papillate character. They are marginal in *E. Richardsoni*, to the lobes or laciniaë of which they give a denticulate or nigro-ciliate character, as in *Platysma nitale*. Occasionally also they occur on tooth-like prolongations from the margin of the laciniaë, in which event they resemble the spermogones of *Cetraria islandica*. The spermatia are straight, linear, rod-shaped, and small, varying from $\frac{1}{4000}$ th to $\frac{1}{8000}$ th, averaging $\frac{1}{4000}$ th to $\frac{1}{5000}$ th. The sterigmata are ramose, and consist of a few delicate linear cells or articulations; they vary in length from $\frac{1}{750}$ th to $\frac{1}{1200}$ th. Associated with them occasionally are ramose, elongated, sterile filaments, like those of *Ramalina*.

SPECIES 1. *E. furfuracea*, Mann.,

Which is very widely distributed over the world, occurring in Europe, Africa, Asia, and America.

(Syn. *Borrera*, Ach.; *Physcia*, Schaer. En. 10; *Parmelia*, Schaer.)

Specimen 1.—Ingleborough, Yorkshire, 1855; coll. by Dr DEIGHTON. The spermogones are the minute black points or spots scattered over the smooth, light-gray ends of the laciniaë; the spermatia are very small, only about $\frac{1}{8000}$ long.

Specimen 2.—SCHLERER exs., 387 (sub *Parmelia*); on trunks of trees in alpine woods. The spermogones are to be found, as in No. 1, only on the smooth tips of the laciniaë; on the furfuraceous ones none can generally be discovered. The extreme points of the laciniaë are generally of a deep brown colour, and are apt to be mistaken for spermogones, like those of the genus *Cladonia*. The spermatia are about $\frac{1}{4000}$ th long; the sterigmata are very irregular, articulated, about $\frac{1}{1000}$ th to $\frac{1}{2000}$ th long. The elongated, anastomosing, sterile filaments resemble those of *Parmelia physodes*, or *Ramalina*.

Specimen 3.—Near Vera Cruz, Mexico; Peak of Orizaba, 11,000 feet high, 1838; coll. by J. LINDEN, No. 98; in Herb. Hooker, Kew. The spermogones are black or deep brown points, closely resembling those of *Parmelia physodes*. The spermatia are about $\frac{1}{4000}$ th long, with a breadth of $\frac{1}{25,000}$ th, and are delicate needles. The sterigmata are about $\frac{1}{750}$ th to $\frac{1}{1000}$ th long, and consist of a few linear articulations, as in *P. physodes*.

Specimen 4.—Peak of Orizaba, Mexico; on oaks and pines, at 9000 to 10,000 feet; coll. H. GALEOTTI, 1840; in Herb. Hooker, Kew. The spermogones are brown points, sometimes on wart-like elevations of the thallus, or surrounded by a small thalline ring, which gives the appearance of a papilla.

SPECIES 2. *E. prunastris*, Ach.,

Which is less widely distributed than *E. furfuracea*; but which, nevertheless, occurs in Europe, Africa, and America.

Specimen 1.—On North Berwick Law, near Edinburgh, August 1855; W. L. L. Its spermogones precisely resemble those of the preceding species, being black or brown points, abundantly scattered over the laciniaë towards their tips. Their bodies are wholly immersed, with a simple cavity. Here the spermogones are apparently old, as they contain no free spermatia. KORBER describes a minute parasitic *Sphaeria* as occasionally occurring on the thallus, and which is apt to be confounded with or mistaken for the spermogones.

SPECIES 3. *E. Richardsoni*, Hook.

(Sub *Cetraria*.)

Specimen 1.—Polar Seas; DEASE and SIMPSON, Fort Enterprise; in Herb. Hooker, Kew. Spermogones abound along the margins of the laciniaë as minute brown tubercles, giving them a denticulate or nigro-ciliate character, as in *Platysma nivale*. When seated on small tubercles, spines, or cilia, which project from the margins of the laciniaë, as is sometimes the case, they closely resemble the spermogones of *Cetraria islandica*. They are very variable as to size. No free spermatia are found in any of them; they are apparently either old or degenerate. The character of the spermogones is, I think, at least one strong reason for associating this plant with *Cetraria* rather than *Evernia*; and I therefore am of opinion that NYLANDER has erred in altering HOOKER'S arrangement.

SPECIES 4. *E. Ashneh* (?).

(Syn. *Borreria*.)

Specimen 1.—Saharunpore, 1850; Dr JAMESON, in Herb. Royal Botanic Garden, Edinburgh. The name and place in classification of this plant do not appear to have been yet determined. From its general aspect,—its apothecia and its spermogones,—I am inclined to place it under this genus, beside *E. prunastris* and *E. furfuracea*. The apothecia resemble those of *E. prunastris*, and are scattered about the ends and over the surface of the laciniaë. Its spermogones are punctiform, immersed, deep brown, scattered especially about the tips of the laciniaë.

FAMILY III. ROCCELLEÆ.

GENUS I. ROCCELLA, *Bauh.*

The spermogones are generally in the form of minute black points, scattered more or less abundantly over the flattened or round segments of the thallus. The black points in question are the ostioles, the bodies of the organs being wholly

immersed in the thallus. These punctiform ostioles are usually flat on the surface, sometimes depressed, seldom papillæform. Sometimes they are surrounded with a pale ring or collar of the thallus, and then they assume a pseudo-papillæform aspect. In this case they may resemble the nascent apothecia. The spermogones are frequently confluent, sometimes becoming very irregular, even maculiform. When spermogones do occur, they are usually very distinct, and easily recognised, from the contrast of their black colour with the pale reddish-yellow or buff colour of the thallus. In some cases they are most abundant towards the tips of the ramules; at other times they are scattered over the whole surface, or nearly from base to apex,—usually, however, of sterile ramules. Their cavity is simple. Their size varies considerably, their diameter being, in *R. tinctoria*, $\frac{1}{170}$ th to $\frac{1}{130}$ th, and in *R. Montagnei* $\frac{1}{430}$ th to $\frac{1}{320}$ th. The spermatia are linear, delicate, generally curved more or less, but sometimes also straight and rod-shaped: in both cases they are obtuse at the ends, and of equal thickness throughout. Their length varies from $\frac{1}{1500}$ th to $\frac{1}{4000}$ th, averaging about $\frac{1}{3000}$ th, with a breadth of from $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th. The sterigmata are linear, simple, delicate cells, ramose at the base, as in *Ramalina*, and sometimes of equal width with the spermatia. They vary in length from $\frac{1}{1500}$ th to $\frac{1}{3000}$ th, with a breadth of from $\frac{1}{10,000}$ th to $\frac{1}{20,000}$ th.

SPECIES I. *R. tinctoria*, Ach.,

Which has the widest geographical range of any species of this genus, occurring alike in Europe, Africa, America, and Asia.

Specimen 1.—St Ouen's Bay, Jersey, 1851; in Herb. Hooker, Kew. The plant appears to me rather referrible to *R. phycopsis*. The tips of the laciniae are frequently dotted over with brown punctiform spermogones.

Specimen 2.—Mauritius; Cape of Good Hope, 1822, Dr THOM; both in Herb. Hooker, Kew. In both cases the spermogones are abundant as brown points.

Specimen 3.—"Lima thickest Orchella weed," imported from the west coast of South America into London and Liverpool for the British Orchill manufacture; given me by Messrs BENJAMIN SMITH and SON, Orchill manufacturers, London, 1851. The spermogones are sparingly scattered in groups over the laciniae, and among the warts bearing the apothecia, in the form of minute, round, black, chiefly depressed points, resembling in external aspect the spermogones of *Parmelia tiliacea* or *P. physodes*. In some specimens, instead of being depressed or flat, the ostioles are papillæform or wart-like. They are then larger, rough on the surface, perched on thalline papillæ, isolated, or grouped two or three together on a large, distinct, thalline wart. The segments of the thallus are sometimes roughened over with these spermogonal warts. Sometimes the ostioles become confluent, and assume various irregular forms, especially stellate or lirellæform appearances. In this case they are apt to be confounded with warts bearing

apothecia, which frequently assume similar appearances. The microscopic structure at once distinguishes them. These warts, both spermogonal and apothecial, are frequently pruinose, or covered by a fine dust, derived from the surface of the thallus, which pruina obscures their naturally black surface. Sometimes the black ostiole is sunk in the thalline wart, which forms a pale, sub-prominent margin around it. But more generally, as I have already mentioned, it is flattened or convex. The spermatia in all the different forms of spermogone just described are very beautiful and delicate, about $\frac{1}{1500}$ th to $\frac{1}{2000}$ th long, and curved or twisted like those of the *subfusca* group of *Lecanoras*. They are borne on the apices of linear delicate sterigmata, which are sub-ramose at the base, and are closely aggregated. The form of the immersed body of the spermogone is spherical, its cavity simple, and the internal tissue, though originally white, becomes brown with age.

SPECIES 2. *R. fuciformis*, Ach.,

Which, though not quite so extensively distributed as the preceding species, yet occurs in Europe, Africa, and America.

Specimen 1.—SCHLÆRER, exs., 553; maritime rocks, shores of the Atlantic: PELVET. One large segment of the thallus is studded over with prominent, irregular, black tubercles, which are old spermogones, containing no free spermatia.

Specimen 2.—Imported from Lisbon into Liverpool under the name of “Chicken-weed,” for the British Orchill manufacture; sent by Rev. W. A. LEIGHTON, April 1856. The spermogones are sparingly scattered towards the extremities of the laciniae, as largish, black, distinct points. The spermatia and sterigmata differ considerably from those which occur in the spermogones of African specimens. The former are oblong or rod-shaped, very minute, resembling those of *Ramalina*, being about $\frac{1}{6500}$ th to $\frac{1}{8100}$ th long; the sterigmata also being like those of *Ramalina*.

Specimen 3.—Imported for the British Orchill manufacture, probably from the west coast of Africa; used in the manufacture of Orchill, under the name of “mixed Orchella weeds,” by Messrs ROBINSON, Huddersfield. Many of the specimens, at least, are corticolous, for they are found with small portions of the twigs of trees or bushes attached. The spermogones are abundantly scattered over the laciniae as minute, round, brown points. These points or ostioles sometimes are surrounded by a pale thalline ring or margin, and they then somewhat resemble young apothecia. The spermatia are generally sickle-like or curved, not twisted or vermiform, about $\frac{1}{3000}$ th long. The sterigmata are longish, linear, simple, delicate. In some specimens, in abundant fructification, the spermogones are unusually large and distinct, scattered among the apothecia. The spermatia are rod-shaped or straight, about $\frac{1}{6500}$ th long. The sterigmata are short and sub-ramose at base. Occasionally the apothecia are dotted over with black, punctiform, depressed spermogones; they are rendered distinct, when they occur, from con-

trast with the white-pruinose disk of the apothecia. These spermogones have the usual characters of such as ordinarily occur on the thallus. The spermatia are small and curved, about $\frac{1}{6500}$ th long, generated on the apex of simple or sub-simple short sterigmata. Hence it would appear, that in different specimens of the same species, apparently from the same locality or habitat, the spermatia and sterigmata differ considerably in character. This, however, is a phenomenon we constantly meet with in lichens. On some of the twigs on which the *Roccella* grows, I also find associated with the degenerate lirellæ of a *Graphis*, resembling *Graphis scripta*, a number of small, round, black spermogones, apparently belonging thereto. The spermatia are curved, like those of the *Roccella*, about $\frac{1}{4000}$ th long, and borne on the apex of short, linear, simple sterigmata.

SPECIES 3. *R. Montagnei*, Bél.

Occurs in equinoctial Africa, India, and Java. This and the following species are intermediate, in regard to the characters of the thallus, between *R. tinctoria* and *R. fuciformis*.

The spermogones are quite those of the species just named. Indeed there is considerable uniformity in the species of *Roccella*, in regard, at least, to the external character of the spermogones. Here they are scattered either on the general surface, and especially towards the tips of the laciniaë, or on the angles of the laciniaë, when these exist.

Specimen 1.—Aden, on twigs and rocks; top of Dhemsan Mountain, 1700 feet high, 1847; Dr HOOKER, in Herb. Hooker, Kew. Some specimens closely resemble, in the characters of the thallus, the genus *Ramalina*, in which it has been inadvertently placed in the Hookerian Herbarium.

Specimen 2.—Madras, plentiful on the trunks of the *Mangifera indica*; ex. Herb. Montagne; in Herb. Hooker, Kew. Old spermogones, with lacerate-fissured black ostioles, are scattered about the ends of the laciniaë.

Specimen 3.—Java, Lobb; in Herb. Hooker, Kew. The sorediiferous tips of the segments of the thallus are dotted over with punctiform spermogones, having quite the characters of those of *R. tinctoria*.

Specimen 4.—Imported, under the name of “Angola Orchella weed,” from the Portuguese settlements of Angola, on the west coast of Africa, into London and Liverpool, for the British Orchill manufacture; sent by Messrs BENJAMIN SMITH and SON, Orchill manufacturers, London. The plant grows on the twigs of trees and shrubs about the sea-coast. The laciniaë are frequently angulose or terete-compressed. I find two forms of spermogones. The one occurs as minute dark brown points, dotted over the surface of the laciniaë, generally in large groups or masses. The other is in the form of large, round, or irregular, prominent, superficial, black tubercles, sparingly scattered, and resembling young apothecia. In the former the spermatia are curved, delicate, or of great tenuity,

about $\frac{1}{4000}$ th to $\frac{1}{3000}$ th long; the sterigmata short and unassociated with elongated, ramose, sterile filaments. In the larger form of spermogones, on the other hand, the spermatia are generally short, thickish, and rod-shaped, or straight; the sterigmata longer, and accompanied by delicate, anastomosing, elongated filaments, as occurs in *Ramalina*. It is interesting to note that there is a similar diversity in the characters of the apothecia in this species, and, indeed, in most or all the species of *Rocella*. In none, perhaps, is this diversity so easily studied as in *R. tinctoria*. A similar difference in the form of the spermatia occurs in *Opegrapha vulgata*, in which they are found of all intermediate degrees of size and shape between short, straight, rod-shaped, and longish, graceful, crescent-like spermatia. On some of the twigs on which *R. Montagnei* grows, occur minute, black, punctiform spermogones, containing rod-shaped spermatia about $\frac{1}{8000}$ th long, borne on short, linear, delicate sterigmata, which appear referrible to some of the *Graphidew*.

SPECIES 4. *R. phycopsis*, Ach.,

Which occurs equally in Europe and Africa. As I refer *R. Montagnei* to the *fuciformis* or flat-lobed type, I am inclined to refer this species to the *tinctoria* or round-lobed form.

Specimen 1.—Among the mixed *Orchella* weeds sent by Messrs ROBINSON of Huddersfield, and probably collected on the west coast of Africa. The laciniae are angulose or terete-compressed, and are dotted over with spermogones having all the aspect of those of *R. tinctoria*. In some spermogones the spermatia are straight, rod-shaped, and about $\frac{1}{3000}$ th long; while in others on the same specimen they are slightly curved. In both cases they are of great tenuity, and are borne on closely aggregated, delicate, linear, simple sterigmata.

SPECIES 5. *R. intricata*, Mont.

Specimen 1.—Coquimbo; in Herb. Hooker, Kew. Spermogones are abundant, as largish, distinct, superficial, black points, frequently surrounded by a ring or collar of the thallus. In the latter case they may resemble nascent apothecia. The spermatia are straight or slightly curved, about $\frac{1}{3000}$ th long, with a breadth of $\frac{1}{25,000}$ th; the sterigmata are short, simple, ramose at base, and about $\frac{1}{1500}$ th long.

SPECIES 6. *R. mollusca*, Ach.

(Sub *Dufourea*. Syn. *Dufourea pruinosa*, Nees.)

This species, which is a native of the Cape of Good Hope, differs from other species of the genus, both in its general aspect somewhat, and in its possessing *terminal* instead of *lateral* apothecia. Its spermogones are, however, quite those of the other species I have just described.

Specimen 1.—In Herb. Hooker, Kew. The spermogones are minute, round,

black, flattened spots, which are the ostioles of immersed nuclei. They are scattered over both sterile and fertile segments of the thallus, especially about the tips, but are most abundant on the former. The spermatia are straight or slightly curved, about $\frac{1}{4000}$ th long, with a breadth of $\frac{1}{25,000}$ th; while the sterigmata are simple, somewhat irregular, short, linear cells, sub-ramose at base, with a length of $\frac{1}{3000}$ th to $\frac{1}{4000}$ th, and a breadth of $\frac{1}{9000}$ th to $\frac{1}{10,000}$ th. Both spermatia and sterigmata closely resemble those of the preceding species.

FAMILY IV. SIPHULÆ.

This is altogether an anomalous and puzzling family, whose place in classification is, as yet, only provisional, from none of its species having been found bearing apothecia. In the typical genus *Siphula*, I have never found even spermogones; but I have had the opportunity of examining only *S. ceratites*, Fr., which grows in northern Europe (Lapland), Asia (the Himalayas), and in arctic America. In *Thamnolia*, however, I succeeded in finding spermogones several years ago, and, at the time of their discovery, I was not aware that my observations had been anticipated by any previous author. NYLANDER has, since that date, referred to its spermogones in some of his publications; but he has not as yet fully described them. His observations, however, so far as they go, do not quite correspond with my own. The only species I have examined is *T. vermicularis*, which grows in arctic or alpine parts of Europe, Asia, and America.

GENUS I. THAMNOLIA, Ach., Schærer.

This curious genus has been hitherto included in the genus *Cladonia*; but the character of its spermogones at once separates it. In *Cladonia* the spermogones are generally terminal, and of a different colour from the thallus, the spermatia curved, and the sterigmata short and simple. In *Thamnolia* the spermogones are lateral and concolorous with the thallus, the spermatia rod-shaped and straight, and the sterigmata longish and articulated. The spermogones are the large, irregular, prominent warts, frequently scattered over the thallus,—of the same colour therewith, and having no conspicuous ostiole. They must be comparatively familiar to lichenologists; but it is seldom that the spermatia and sterigmata can be found; at least I have examined several dozens of specimens from every variety of habitat, and, though I long suspected these warts of being spermogones, I have only been able to satisfy myself as to their true character—by discovering the spermatia and sterigmata—in a single instance. NYLANDER'S description of the spermogones does not at all agree with my observations. He says they resemble the perithecia of an *Endocarpon*. Now, I have never found them punctiform and immersed, as this description would imply; but his words might apply perfectly to a minute, punctiform, parasitic *Lecidea*, *L. vermicularia*, *miki*, which I have frequently found growing on the thallus. Again, the sper-

matia appear to me to be simply linear and rod-shaped, of equal width throughout; while NYLANDER describes them as slightly thickened at both ends. This difference in our observations might arise from his using higher magnifying powers than I am in the habit of employing. Probably this character, if it exists, is not a very prominent one. In respect of size and thickness of walls, the arthrosterigmata of this genus, like those of *Bæomyces*, are intermediate between those of *Sticta* and those of *Parmelia*,—the sterigmata in the latter having longer and fewer articulations or cells; those in the former genus being altogether broader and stronger, the component cells being more cubical, and having much thicker walls.

SPECIES 1. *T. vermicularis*, Schærer.

(Syn. *Cenomyce*, Ach.; *Cladonia*, D.C.; *Cladonia a nuurocrea* β *vermicularis*, KÖRB. 26.)

Specimen 1.—SCHÆRER exs. 86 (sub *Cladonia vermicularis a subuliformis*.) On the ground in alpine situations; Switzerland. The specimen includes two forms of the plant, viz., a larger, coarse, and turgid form, corresponding to the var. *turgida* of *Cladonia uncialis*, and a smaller, ordinary, vermicular form. It is on the former, more particularly, that the spermogones occur. This is the only case in which I have as yet satisfactorily seen the spermatia and sterigmata of the spermogones. The latter occur abundantly as largish, prominent, roundish, flattened, or irregular warts, of the same colour as the thallus, with an obscure, central, stellate-fissured ostiole. The internal walls are formed of arthrosterigmata, resembling those of *Sticta* and *Collema*. They consist of short, thick-walled cells, irregularly articulated, so as to give the whole sterigma a very zigzag outline. The spermatia are small, rod-shaped, about $\frac{1}{6000}$ th long, with a breadth of $\frac{1}{20,000}$ th, bristling over the sterigmata, as in the genera above named, and attached to the apices of the individual articulations or cells. In external aspect the spermogones are somewhat analogous to those of *Usnea* and *Ramalina*; but they are generally isolated and sparingly scattered in *Thamnolia*.

Specimen 2.—Falkland Islands; Antarctic Expedition, 1839-43; Dr HOOKER. The hollow, vermicular, creeping stems are dotted over with minute, black, round, immersed bodies, frequently depressed or flattened, which bear a close resemblance to the spermogones of *Roccella*. These, however, are the parasitic apothecia of a *Lecidea*. The thecæ are irregularly obovate, bulging here and there from pressure by the contained spores, not tapering below into a pedicel, but sac-like, and resembling the thecæ of *Arthonia*. They do not give a blue reaction with iodine. The spores are eight in each theca, brown, 1-septate, oblong-oval, with a constriction opposite the septum, which gives them a figure-of-eight appearance. I am not aware that this parasite has been hitherto described; and I therefore venture to propose for it, in allusion to its habitat,

the name of *Lecidea vermicularia*. It closely resembles, in external aspect, the parasitic *Lecidea alectoriæ*, which inhabits the thallus of *Alectoria Taylori*, whose spores, however, are 3-septate.

Specimen 3.—Falkland Islands; Dr HOOKER; in Herb. Hooker, Kew. A few thalli bear the parasite above described. Its spores are soleæform, resembling those of *L. Smithii*, about $\frac{1}{2000}$ th to $\frac{1}{1500}$ th long by $\frac{1}{4000}$ th broad.

Specimen 4.—Var. *taurica*, which is merely a short, turgid, spermogoniferous form, as described in No. 1; Cairngorm, Aberdeenshire Highlands; in Herb. Hooker, Kew; in very large handsome patches. There are here associated both soredic and spermogonal warts: the former can at once be distinguished, on microscopic examination, from young spermogonal warts, where spermatia occur; but when the spermogones are old, as in this case, the distinction becomes very difficult. Here the spermogonal warts are comparatively large, and resemble the young apothecia of *Lecanora parella* somewhat. They have a distinct, ring-like margin, and a pale brown, disk-like ostiole, which becomes semi-pellucid on being moistened. In the young state they are mere thalline papillæ, with a brown apex, which is the round ostiole. An annotator in Herb. Hooker remarks, in regard to these warts, of date 1810, [probably Dr TURNER],—"Can this be the fruit of *Baeomyces vermicularis*? HUTTON had two or three morsels besides; but I could not get more from him, as he had promised them to Mr GISBORNE. I thought the best of them looked much like the tubercles of *B. roseus*." It is most interesting to note here the association of this species under, or in, the genus *Baeomyces*; for the spermogones of *Thamnolia* and *Baeomyces*, as I have already pointed out, bear a marked resemblance. In my researches I have constantly been struck with the extreme accuracy of the older lichenologists, an accuracy remarkable in the absence of that now all-important aid to the observer, the microscope. It has been customary to decry the classifications of the older authors on lichenology, and to abolish their nomenclature; but I do not hesitate to avow my preference both for their classification and nomenclature, as contrasted, at least, with the modern systems of the German school, if, at all events, we may take the monographs of BAYRHOFER and KÖRBER as types or specimens thereof! In addition to the soredic and spermogonal warts above described, there occasionally, though more seldom, occur warts which appear to be bullosities of the thallus,—large, very rugose, and irregular; they are dotted over with black, punctiform bodies, which, though I have not detected in them the characteristic spores, I have no hesitation in referring to my *L. vermicularia*.

I have found spermogonal warts in specimens collected by myself on Lochnagar, Cairngorm, and Ben M'Dhui, Braemar; on Ben Lawers, Perthshire; and on the Dovrefjeld range of mountains in Norway. I have also met with them occasionally in the following valuable suite of specimens contained in the Hookerian Herbarium at Kew:—

1. Small or ordinary form: Huamantonge, and on the Pampas of the Cordillera, South America; Port Louis, Dr HOOKER; FRANKLIN'S first voyage; Port Bower; the mountains of Canlochan, Clova, GARDINER, 1844; hill above the Corrie of Clova, GARDINER, 1843; Ben Aven, Braemar, spreading over *Cetraria aculeata* and *Trichostomum lanuginosum*, GARDINER of Dundee.

2. Short, turgid form, var. *taurica* of authors: Bommasas, Garkmäl, on the Himalaya, 16,000 feet high, ex. Herb. STRACHEY and WINTERBOTTOM; LEHON; SPRUCE'S "Lichenes Pyrenæi;" British North America; Melville Island, Sir E. PARRY; Hartz Mountains, Dr NÖHDEN; Ben Lawers; Mael Graedha, 1810, coll. by BORRER.

FAMILY V. BÆOMYCEÆ.

GENUS I. BÆOMYCES, Pers.

In this genus the spermogones are with great difficulty visible, and are seldom to be met with. I have seen what I regard as the spermogones—for I have not been able perfectly to satisfy myself—only in a single instance, in *B. placophyllus*. There they occur on the horizontal or flat foliose thallus, as punctiform, immersed, black or brown bodies, somewhat irregular in form. The spermatia are very minute, rod-shaped, or oval; the sterigmata very narrow, delicate, and consisting of numerous short cells or articulations. In respect to the size of these individual articulations, and their general thickness, the arthrosterigmata of *Bæomyces* are intermediate between those of *Collema* or *Sticta*, and those of *Parmelia*, as, indeed, I have already pointed out under the head of *Thamnolia vermicularis*.

SPECIES 1. *B. placophyllus*, Ach.,

Which grows in northern Europe, and northern America.

Specimen 1.—Near Blair Atholl, 1810; BORRER, in Herb. Hooker, Kew. The horizontal thallus is studded over with minute, black, punctiform, or irregular bodies,—immersed in the thalline tissue,—which appear to be its spermogones, but in which I could find no free spermatia nor distinct sterigmata, so that I am in doubt as to their nature. Here there is no fructification (apothecia). The thallus is parmelioid, thick, foliaceous, buff-coloured.

SPECIES 2. *B. roseus*, Pers.

The most familiar species of the genus, perhaps, which occurs in Europe, America, and New Zealand. Its arthrosterigmata are the most delicate known in lichens as to thickness, being only about $\frac{1}{8000}$ th to $\frac{1}{12,000}$ th broad.

SPECIES 3. *B. rufus*, Ach.

(Syn. *B. rupestris*, Pers.; *Biatora byssoides*, Fries.; *Sphyridium fungiforme*, Schrad., KÖRB., 273.)

Like *B. roseus*, this species occurs alike in Europe, America, and New Zealand. KÖRBER describes its spermogones as small, brown warts, sometimes comparatively distinct, with oval spermatia.

SPECIES 4. *B. icmadophilus*, Ach.

(Syn. *Lecidea*, Ach.; *Biatora*, Fries.; *Lichen ericetorum*, SMITH Engl. Bot., 372; *Lecidea ceruginosa*, SCHÆR. exs., 216; *Icmadophila ceruginosa*, Scop., Korb., 151).

This species has a comparatively wide geographical distribution, occurring in Europe, North America, and India. KÖRBER says, he never found separate or isolated spermogones in this species. But once, on making a section of an apothecium, in a part of the hypothecial tissue he came unexpectedly upon a number of atomic, linear bodies, endowed with a molecular movement, having all the appearance of spermatia. He evidently means to imply, that the spermogones here are sunk in the hypothecium below the hymenium of the apothecium; for he throws out the suggestion, that they may stand in the same relation that those of *Celidium fusco-purpureum* do according to TULASNE.* I have found this position of the spermogones in one or two instances only; but I suspect that it is not so uncommon as we are at present led to believe. In such a position, spermogones are extremely apt to be overlooked, and it were well, I think, that the attention of future observers in spermogonology should be directed to this circumstance.

FAMILY VI. SPHEROPHOREÆ.

GENUS I. SPHEROPHORON, Pers.

The spermogones may be described, in general terms, as small but distinct black or brown cones or tubercles, either perched singly on the tips of the ultimate ramuscles, as in *S. coralloides*, or scattered in groups along the zigzag or angular edges of compressed, flattened segments, as in *S. compressum*. They are sometimes dotted over the angles of the ramuscles in *S. coralloides*; but this is very rare, while it is a general phenomenon in *S. compressum*. In *S. coralloides*, the cone form predominates, with a brown colour; in *compressum*, the flattened tuberculated form with a black colour. In the former, the shape is intermediate between the barrel-like spermogone of *Cladonia* or *Cetraria*, and the papilla of *Sticta*

* "Mémoire pour servir à l'Histoire Organographique et Physiologique des Lichens." By M. L. R. TULASNE, Aide-naturaliste au Muséum d'Histoire Naturelle, Paris. Annales des Sciences Naturelles, 3d Series, vol. xvii., Botanical Part, 1852, p. 121; Plate 14, f. 12.

or *Parmelia*. In the latter species (*compressum*), the spermogone is frequently a mere flattened wart. In both, the spermogones are usually very distinct, from the contrast of their colour with the pale gray, or buff-yellow, waxy tint of the thallus. Sometimes they are scattered over the under surface, which is paler or whiter than the upper, as in some forms of *compressum*, in which case they are still more distinct. The ostiole is generally very minute and imperceptible; but frequently also it is large and patent. In the latter case, the spermogone may present the appearance of a flattened cone with a depressed apex, or of a brown or black ring, as is frequent in *compressum*. Moreover, in the old state of the spermogone, the nucleus sometimes falls out, leaving irregular, saucer-shaped cavities. The ramuscles bearing spermogones are generally much more narrow and delicate than those bearing apothecia, which latter indeed are not unfrequently fastigiate or thickened in *tenerum* and *coralloides*. Gentle pressure in a drop of water, between glass slides, of one of the spermogones, causes the emission of myriads of spermatia, which are minute corpuscles, oblong, rod-shaped, or sub-ellipsoid,—generally straight, but sometimes slightly curved;—they are obtuse at the ends, and vary in length from $\frac{1}{6500}$ th to $\frac{1}{10,000}$ th, with a breadth of about $\frac{1}{20,000}$ th. The sterigmata are short, linear, simple cells, subramose at the base, and of equal breadth with the spermatia. They resemble those of *Cladonia*, and are about $\frac{1}{1500}$ th to $\frac{1}{1500}$ th long, with a breadth of $\frac{1}{20,000}$ th. Sometimes they are composed of a few delicate linear cells or articulations. Sometimes intermixed with the ordinary spermatiferous sterigmata are numerous elongated, sterile, anastomosing filaments, resembling those of *Ramalina*. The spermogonal envelope is usually of a brown cellular tissue. LINK makes a very careless and improper use of the term "*Sporangium*," as applied to the reproductive organs of *Sphaerophoron*, a term which is usually applied only to the spore cases of Ferns and Mosses. He evidently refers to the apothecia rather than to the spermogones, when he says,— "Constat sporangium e thecis appositis, parallelis, ut in Opegrapha, aliisque quæ tamen fatiscunt et indumentum pulveraceum quo distinguitur constituunt."* The figure he gives is, moreover, very bad and unlike nature.

SPECIES 1. *S. coralloides*, Pers.,

Which has a wide geographical range, being found in Europe, Northern America, the Antarctic Regions, and the Canary Islands. TULASNE seems to have been singularly unsuccessful in discovering the spermogones of this species, which he describes as similar, in site and structure, to those of *S. compressum*. They are, in almost all the specimens examined by myself, solitary and apical, large and cone-like, while those of *compressum*, according to my observations, are lateral, grouped, flattened, and irregular.

* "De Sphaerophori Sporangio Observatio." By H. F. LINK, p. 465, Plate xi., fig. 2. 'Linnæa,' vol. vii. Berlin, 1832.

Specimen 1.—Glen Dee, Braemar, on quartz boulders; in abundant fruit; August 1856, W. L. L. The spermogones are abundant on the tips of the smaller ramuscles, which surround those bearing apothecia. They are deep brown, cone-shaped bodies, with an imperceptible pore or ostiole; they are generally single, one on each ramuscle; occasionally they are grouped in twos or threes. In general appearance they somewhat resemble the spermogones of *Cetraria islandica*. The spermatia are straight and rod-shaped, about $\frac{1}{6500}$ th to $\frac{1}{8000}$ th long. On first emerging from the spermogone, they frequently appear sub-ovoid or ellipsoid, probably from their being coated with some of the spermogonal mucilage in which they are imbedded. In other specimens, on granite, the spermogones are somewhat older; they appear as deep brown rings, occupying the same site as above mentioned. Here the ostiole is large, round, and patent, as in *Cladonia*. The envelope, as in the former case, consists of a deep brown cellular tissue. The sterigmata are sometimes composed of a few delicate linear cells or articulations. The spermatia are even smaller than those above described, being only about $\frac{1}{10,000}$ th, and they are more frequently sub-ellipsoid in form.

Specimen 2.—On boulders of granite and other rocks; roadside opposite Invercauld, Braemar, August 1856, W. L. L.; sterile. Here the spermogones are old; the cones are flattened on the apex; the ostiole large and patent, with a prominent, brown, thick margin, and depressed occasionally so as to give the spermogone a saucer-like appearance.

Specimen 3.—On rocks of mica slate and gneiss, Craig-y-Barns, Dunkeld, April 1856, W. L. L. Young spermogones are abundant on the brown tips of the ultimate ramuscles.

Specimen 4.—Walls, Ingleby Park, Cleveland, Yorkshire, 1856, collected by W. MUDD. The spermogones are here sparingly scattered on the brown tips of the most delicate ramuscles; they are papillar, with an imperceptible ostiole, and are easily recognised from the contrast of their deep brown colour with the pale waxy-gray of the thallus.

Specimen 5.—Straits of Magellan, WHINNIE; in Herb. Hooker, Kew. The plant is sterile, and the whole thallus is much warted and deformed. The tips of all the innumerable terminal ramuscles of the much-branching thallus are studded with black, papillar spermogones.

Specimen 6.—Russian America, 1837, and North-west America, DOUGLAS; in Herb. Hooker, Kew. The spermogones are here arranged as in *compressum*; they are few, and scattered on the angles about the ends of the ramuscles, as well as seated on their apices. This may be regarded as a transition form between *coralloides* and *compressum*. A specimen from Jamaica, WILSON, also in the Hookerian Herbarium, is labelled *compressum* by NYLANDER himself; it certainly has the spermogones of the latter: but the thallus has all the aspect of that of *coralloides*. In American specimens, the thallus generally branches much, and is

long and lax. In *S. coralloides*, the ramuscle, at its tip, generally suddenly bulges out or becomes thickened below the insertion of the barrel,—or cone-like, spermogone.

SPECIES 2. *S. fragile*, Pers.,

Which has nearly as wide a geographical range as the preceding species, of which indeed I regard it but as a variety. The plant is cæspitose and dwarf; its ramuscles single, or branching little, and closely aggregated.

Specimen 1.—MOUGEOT and NESTLER's exs., No. 263; in Herb. Royal Botanic Garden, Edinburgh. The spermogonal papillæ are isolated and terminal, precisely as in *S. coralloides*.

Specimen 2.—Craig-y-Barns, Dunkeld, 1856, W. L. L.; sterile. The spermogones are young, and constitute the brown tips of the simple closely aggregated ramules.

SPECIES 3. *S. tenerum*, Laur.

If it is not to be considered but a variety of *S. coralloides*, it is very closely allied, both in the general aspect of its thallus, and in the site and structure of its spermogones. The latter are terminal and isolated, each being seated on the tip of one of the extremely narrow, linear, delicate ramuscles.

Specimen 1.—Hermite Island, Cape Horn, Antarctic Expedition, 1839–43, Dr HOOKER. The spermogones are minute, black, round tubercles, with an inappreciable ostiole; they are smaller and darker than, but otherwise of the same character as, those of *S. coralloides*. The spermatia are rod-shaped or sub-ellipsoid, about $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th long, and are given off from the apices, as well as sides, of the delicate indistinct sterigmata, which are composed of a few delicate linear cells or articulations, and are sub-ramose at base. Some specimens have branches somewhat short and thick; in them the spermogones occur in the form of clustered warts, resembling those of *Stereocaulon*.

Specimen 2.—Lord Auckland Islands, Antarctic Expedition, 1839–43, Dr HOOKER. Abounds both in apothecia and spermogones. The ramules bearing the former are strong and fastigate, scarcely ramose; those bearing the latter are filiform, extremely delicate, and very ramose. The spermogones are black papillæ or warts precisely as described in No. 1. The spores are quite those of *S. coralloides*, an additional argument for merging in this species *S. tenerum*.

SPECIES 4. *S. compressum*, Ach.,

Whose geographical range is, at least, as extensive as that of *S. coralloides*, occurring in Europe, America, the African Islands, and Australia.

Specimen 1.—Tasmania, Antarctic Expedition, 1839–43, Dr HOOKER. The thallus is of a pale-yellow on one surface, the upper, which is convex; whitish on the under surface, which is somewhat concave; the edges of the segments

are much notched. Scattered along the notched edges, especially towards the extremities of the branches, and on their under or pale surface, are the spermogones, which are round, black, flattened warts. In some, the ostioles are small or imperceptible, more generally they are distinct, and frequently they are so large and patent that the spermogones have the aspect of mere rings. Sometimes the body of the spermogone falls out, leaving an irregular saucer-shaped cavity. In foreign specimens, this species is very distinct from *S. coralloides* in the aspect of its thallus, and in the character of its spermogones, at least as to their external appearance and site. But in British specimens this is less evident; most British specimens of *S. compressum*, so-called, are, however, really referrible to *S. coralloides*. The spermatia of *S. compressum* are sub-oblong or rod-shaped, sometimes sub-ellipsoid, generally obtuse at the ends, about $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th long. They are borne on the apices of extremely delicate, linear, simple sterigmata, ramose at the base, and resembling those of *Cladonia*. The spermogonal walls, internally, give rise, in addition, to a number of ramose, elongated, anastomosing filaments, like those of *Ramalina*.

Specimen 2.—Lord Auckland Islands, Antarctic Expedition, 1839–43, Dr HOOKER; in fruit. The spermogones are the same as those which occur in Tasmanian specimens, and described in No. 1. They are chiefly scattered on ramules destitute of apothecia; but they also occur, to a minor extent, on the small ramules, which frequently come off below the apothecia. The envelope is of a bluish cellular tissue. The sterigmata are extremely delicate and indistinct, and branch only from the base. Ramose elongated filaments are very abundant, filling the cavity of the spermogone. The spores are those of *S. coralloides*.

Specimen 3.—New Zealand; Auckland Islands, Dr HOOKER; Van Dieman's Land; Tasmania, GUNN; in Herb. Hooker. The spermogones are always scattered over the under pale or channeled surface, where there is a distinction between the two surfaces. There would seem to be a gradual transition between *S. coralloides* and *S. compressum*, in regard to the character of the ramules and spermogones.

Specimen 4.—Port Famine, in Herb. Royal Botanic Garden, Edinburgh, is beautifully studded over with very distinct spermogones.

Specimen 5.—Connemara, 1805, Dr MACKAY; Miss HUTCHINS, 1810, probably also from Ireland; in Herb. Hooker, Kew. The thallus is pale and waxy, and the spermogones are undoubtedly those of *S. compressum*. As a general rule, they are more abundant in this species than in *S. coralloides*. KÖRBER, indeed, seems to believe that they never occur in the latter; at least he remarks, "Spermogonien sind bis jetzt nur bei *S. compressum* aufgefunden worden."

Specimen 6.—North-west America. Spermogones scattered, few, isolated about the angles and end of the sterile ramules; Cotopaxi, JAMESON; Jamaica, PURDIE; New Granada, PURDIE; Cape Horn, Dr HOOKER, sterile specimens

abundantly spermogoniferous; Falkland Islands, Dr HOOKER, thallus much deformed; Van Dieman's Land, FRASER; New Holland, FRASER; Tasmania, Asbestos Hills, GUNN; Van Dieman's Land, GUNN,—all these specimens are in the Hookerian Herbarium, Kew. However variable the thallus, the disposition of the spermogones is always the same. In Van Dieman's Land specimens, the apothecia are sometimes seated in the axils of divergent spermogoniferous ramules.

Specimen 7.—Var. *australe*, Laur.; New Holland, SIEBER; an authentic specimen of LAURER'S plant, from the Rev. CHURCHILL BABINGTON, in Herb. Hooker, Kew; also, New Zealand, COLENZO, in Herb. Hooker. This is a large handsome plant, but certainly only an exaggerated form of *S. compressum*. The spermogones occupy the same position that they do in *S. compressum*, being scattered about the ends of the ramules, on the angles and prominences, which abound thereon. But the ends of these ramules vary considerably in character. Sometimes they are broad and fastigate, at other times simple and narrow. In the latter case, the spermogones are generally terminal and isolated, as in *S. coralloides*. Whether isolated or grouped, they are largish, black, round, semi-immersed bodies, generally very distinct, especially if, as is frequently the case, the thallus is pale gray, or cream-coloured, and waxy. The spermatia are oblong or rod-shaped and straight, or they may be very slightly curved; their length averages $\frac{1}{8,500}$ th, and their breadth $\frac{1}{20,000}$ th. The sterigmata are simple, linear, very delicate, ramose below, as in *Ramalina*; their length averages about $\frac{1}{1200}$ th to $\frac{1}{1500}$ th, and their breadth $\frac{1}{20,000}$ th, or, in other words, they are of equal width with the spermatia.

GENUS II. ACROSCYPHUS, Lév., Tul.,*

In external characters, the spermogones are closely allied to those of *Sphærophoron*, especially of *S. coralloides*, being seated on the tips of sterile ultimate ramuscles. Their character is sufficiently represented by that of the spermogones of the single species of the genus, *A. sphærophoroides*.

SPECIES 1. *A. sphærophoroides*, Lév.,

Which appears peculiar to the mountains of Mexico and India.

Specimen 1.—Wallanchoon, Sikkim, Himalayas; alpine region, at an elevation of 13,000 feet; Dr HOOKER, in Herb. Hooker, Kew; both apothecia and spermogones abundant. The spermogones occur at the ends of sterile ramuscles, which are frequently fastigate, and very much warted; the irregular warts resembling those of some *Stereocaula*. The spermogones are punctiform, brown, most irregular in form and size; these are ostioles leading to immersed, compound spermogones. The spermatia are oblong or sub-ellipsoid, about $\frac{1}{7000}$ th long, with a breadth of $\frac{1}{20,000}$ th, and very abundant, on articulated sterigmata.

* Mém. Lich. t. 15, f. 10–12.

FAMILY VII. STEREOCAULÆ.

GENUS I. STEREOCAULON, *Schreb.*

The spermogones are very irregular warts, which sometimes cover the sterile ramules about their ends; sometimes are seated immediately below the apothecia, to which, when aggregated circularly, they form a kind of collar. Soredic warts also occur abundantly on the different species of this genus; but the spermogonal ones are generally distinguishable, without having recourse to microscopic examination, by their black or brown ostioles, which are generally round, stellate, or triangular, according to their age. These ostioles lead into the body of the spermogone, which is wholly immersed in the warts in question. The internal tissue is sometimes blue, and this colour shines through the thin walls of the spermogone. Hence, the ostiole has occasionally the appearance of being seated in the centre of a bluish-black spot or areola, as in *S. argus*. The envelope or capsule is of a pale brown cellular tissue usually; the cavity simple or sinuous, frequently the latter. So abundant occasionally are spermogonal warts as to constitute what have been described by the older authors as distinct varieties, *e.g.*, var. *stigmatea* of *S. tomentosum* of FLOTOW. But, on the other hand, they are frequently recognisable with great difficulty, and are seldom to be met with. I have examined many hundred specimens of species of *Stereocaulon*, without having met with the spermogones more frequently than a few times. Sometimes the spermogones are terminal, and resemble nascent apothecia. The sterigmata are simple and short, frequently sub-spherical; the spermatia are either straight and rod-shaped or slightly curved. They vary in length from $\frac{1}{2000}$ th to $\frac{1}{8000}$ th, averaging about $\frac{1}{4000}$ th to $\frac{1}{5000}$ th, with a breadth of $\frac{1}{20,000}$ th to $\frac{1}{25,000}$ th.

SPECIES 1. *S. paschale*, Fr.,

Which occurs in Europe, America, and Asia.

Specimen 1.—Hill heaths above Bonhard, Perth, July 1855. W. L. L. The spermogones occur on specimens bearing no apothecia, as small brown warts, scattered about the ends and along the sides of the ultimate ramules. They somewhat resemble small apothecia, are flattened, round, or irregular, with a round ostiole, generally of the same colour as the wart, and indistinct in its outline. The envelope is of a brown cellular tissue. The spermatia are rod-shaped or oblong, about $\frac{1}{8000}$ th long. The sterigmata are short, simple, bulging; sometimes resembling a series of papillæform or nipple-shaped cells, at other times longer and sub-digitate.

SPECIES 2. *S. alpinum*, Laur.,

Which is found in Europe and Asia, but which I regard only as a variety of the preceding species.

Specimen 1.—Ben Nevis, August 1856, W. L. L. This is a tall slender form of the thallus, laxly ramose, and sparingly covered with granules. The spermogonal warts occur both on sterile ramules and on those bearing apothecia. The spermatia are about $\frac{1}{6500}$ th, some of them being curved.

SPECIES 3. *S. denudatum*, Flk.,

Which grows in Europe, America, and Asia; but which, like *S. alpinum*, I consider a mere variety or state of *S. paschale*. The stem is very naked inferiorly, being destitute of the granules or scales which usually clothe it.

Specimen 1.—County Antrim; D. MOORE of Glasnevin, in Herb. ISAAC CAROLL of Cork. The spermogones are abundant on large warted sub-spherical or irregular dilatations of the ends of the ramules, none of which bear apothecia. These spermogonal warts occupy the site, and appear morphologically to take the place, of apothecia. The ostioles are brown, immersed, and punctiform. The spermatia are either straight and rod-shaped, or curved; many of them are the latter. Their length is about $\frac{1}{5000}$ th, their breadth $\frac{1}{20,000}$ th; their sterigmata short and simple, as in *S. paschale*.

SPECIES 4. *S. ramulosum*, Sw.,

Which grows in America, equatorial Africa, Polynesia, and Australia; a large and handsome species.

Specimen 1.—Tasmania, Antarctic Expedition, 1839–43, Dr HOOKER. Both apothecia and spermogones abound. The latter are large, round, flattened warts, scattered about the ends of the sterile ramules, or seated immediately below the apothecia, round which they form a sort of neck or collar, as in *S. argus*. They have a bluish-black colour on the surface, and are marked by stellate-fissured black ostioles. In this state they have greatly the appearance of the young apothecia of *Sphaerophoron coralloides*, in process of fissuring of their capsule or exciple. Internally, the spermogones consist of a congeries of sinuous cavities. The spermatia are very delicate and curved, about $\frac{1}{2000}$ th long, borne on the apices of simple vesicular sterigmata. The short lateral branches proceeding from the main stems frequently terminate in capitular or bullose dilatations; these are full of medullary tissue—white and lax—and they cannot therefore, on microscopic examination at least, be mistaken for, or confounded with, spermogonal warts.

SPECIES 5. *S. argus*, Taylor.

Specimen 1.—Campbell's Island, Antarctic Expedition, 1839–43, Dr HOOKER. The apices of the sterile ramules are irregularly tuberculated; this tuberculated dilatation consisting of a series of small flattened warts of the same colour as the thallus, each separate wart being pierced centrally by a black minute ostiole, which is round, triangular, or stellate. This ostiole is usually surrounded with a halo, which is bluish-black, from the colour of the internal tissue in old spermog-

gones shining through that part of the envelope which is thinnest. These warts are also occasionally scattered in groups of two or three round the branches bearing the apothecia, and immediately below the latter, to which they then appear as collar-like appendages. The spermatia are abundant, thickish, curved, about $\frac{1}{4000}$ th long, on simple vesicular sterigmata.

FAMILY VIII. CLADONIEÆ.

GENUS I. CLADONIA, *Hoffm.*

The spermogones of *Cladonia* are mostly barrel-shaped, long or short, narrow or bulging; generally of the same colour as the apothecia, and with a distinct large round ostiole. The barrels are largest and best marked when terminal, as in *C. furcata*; shortest and most tuberculiform when on the margin of scyphi, as in *C. pyxidata*. In the latter case, they are frequently flattened on the top, and irregular in form. They sometimes form a denticulate fringe of the margin of the scyphi, which may either be comparatively regular, or more or less irregular. In species with branching podetia, terminating in tapering points, the spermogones are generally seated on the ends of the ultimate ramuscles, of which they constitute the brown points, which are erect in *C. furcata*; nodding, or erect also, in *C. rangiferina*. In species with simple podetia, which terminate in scyphi, the spermogones are seated generally on the margins of these scyphi. In some species with a large horizontal and foliose thallus, and which seldom bear podetia, they are seated directly on the folioles of the thallus. But they also occur in species with scyphiferous podetia, seated directly on the squamules or folioles, with which these are frequently more or less plentifully covered; especially in deformed and sterile states, as in *C. bellidiflora*. Sometimes they are seated directly on the sides of the podetia themselves, as in the *cervicornis* variety of *C. gracilis*, and in *C. amaurocraea*. Occasionally they occur on digitate prolongations of the margins of the scyphi, as in *C. bellidiflora* and *C. pyxidata*; and, lastly, they are sometimes, though rarely, studded over the apothecia themselves, as in one instance in *C. rangiferina*. In scyphiferous species, in which they are usually grouped on the margins of the scyphi, they may occur isolated and terminal on their *cornuta* form or variety—a sterile spermogoniferous one with long, simple, tapering podetia. When terminal, the spermogones are generally single or isolated; when occurring on the margins of scyphi, they are grouped in numbers of from two to five in *C. gracilis*,—five to twelve in *C. pyxidata*. The size of the spermogones varies greatly: in *C. rangiferina* they have a diameter of $\frac{1}{200}$ th, with a length of $\frac{1}{150}$ th; but in *C. furcata* they are generally much larger in all their dimensions. As a general rule, they are greatly smaller and more delicate in arctic and antarctic specimens, than in specimens of the same species from temperate countries. Their envelope is generally thin, and of a brown cellular tissue. The deep brown colour of the

spermogones—or brownish-red in species with scarlet apothecia—contrasts well with the pale straw-yellow or gray of the thallus, and renders them particularly conspicuous in this genus. The line of junction between the spermogone and the thallus is readily seen, and the sudden bulging of the barrel-shaped organ adds to this effect. The cavity of the spermogones is generally simple; but I have seen it sometimes sub-compound or divided into several obscure compartments or sinuses, as in *C. macilenta*. This cavity contains abundance of mucilage, in which are imbedded the spermata. In species with scarlet apothecia, and occasionally also in those with brown fruit, as sometimes in *C. pyxidata*, this mucilage has a rose tint. The emission of the spermata can readily be studied, by placing the spermogoniferous tips of the ramuscles of *C. rangiferina* or *C. furcata* in a drop of water between glass slides, and subjecting them to moderate pressure under the microscope. The genus *Cladonia* is, therefore, a good one in which to examine the spermogones and their contents. There is a remarkable uniformity throughout the whole of the species of *Cladonia*, in regard to the form and size of the spermata and sterigmata. The former are, in all cases, curved when free, though they sometimes appear straight, or nearly so, while yet attached. They are somewhat crescent-shaped, that is, they are pointed or acute at the ends, and thicker in the centre. Their length varies from $\frac{1}{3000}$ th to $\frac{1}{5000}$ th, their breadth from $\frac{1}{20,000}$ th to $\frac{1}{50,000}$ th. They are sometimes so short as $\frac{1}{8000}$ th to $\frac{1}{8000}$ th. They must not be looked for in old spermogones, with large gaping ostioles, from which they have long since escaped. While attached to their sterigmata, they are sometimes double the size they are when free, a phenomenon that is of frequent occurrence in lichens. The sterigmata are, in all cases, very delicate, linear, simple cells, very ramose at the base, varying in length from $\frac{1}{1000}$ th to $\frac{1}{3000}$ th, with a breadth of $\frac{1}{20,000}$ th. With age they become elongated and sterile, filling the whole cavity of the spermogone, while, at the same time, they frequently acquire a brown tint. Occasionally, though rarely, elongated, hypertrophied, sterile filaments project from among the ordinary spermatiferous ones, as in *C. rangiferina* in one or two instances. Spermogoniferous forms include many, at least, of the puzzling and anomalous varieties of species of *Cladonia* described by the older authors.

SPECIES 1. *C. pyxidata*, Fr.,

A cosmopolite; occurring almost in every quarter of the globe hitherto explored.

Specimen 1.—Old wall, Caerlaverock Road, Dumfries, August 1856, W. L. L. A deformed and degenerate form, with very large podetia, and scyphi covered with furfuraceous scales. The spermogones are roundish, brown, distinct tubercles, borne on small digitate prolongations from the margins of the scyphi, and having a perceptible ostiole. The interior contains a very beautiful and abundant lake-coloured mucilage. The spermata are chiefly straight.

Specimen 2.—Moors on hills east of Sligachan, Isle of Skye, August 1856, W. L. L. Spermogones are abundant on the margins of the scyphi, as largish, distinct, tub-shaped or globose warts, of a deep brown colour, with distinct ostioles, some of them very large and gaping, round, triangular, or stellate. The spermatia are all curved, apparently of equal thickness throughout, and about $\frac{1}{3000}$ th long.

Specimen 3.—Kinnoull Hill, Perth, March 1856, W. L. L. The spermogones fringe plentifully the sterile scyphi as small, spherical, brown cones or warts.

Specimen 4.—Siberia, Soongarica; collected by KARELIN and KIRILOFF, 1840; in Herb. Hooker, Kew. No apothecia, but with spermogoniferous scyphi.

Specimen 5.—Road to Wellington Falls, Van Dieman's Land; MOSSMAN, 1850; in Herb. Royal Botanic Garden, Edinburgh. No apothecia, but with spermogoniferous scyphi.

Specimen 6.—SCHÆRER exs. 52 (sub *C. pyxidata*, *a. polyscypha*, *B. exigua*); on the trunks of trees; no apothecia. This is simply a spermogoniferous state. There are no spermogones on the short scyphiferous podetia; but barrel-shaped ones are seated on the tips of simple, cylindrical, elongated podetia, which resemble those of *gracilis* or *macilenta*.

Specimen 7.—SCHÆRER exs. 53 (sub *a. polyscypha*, *C. simplex*); on the ground and the trunks of trees; in abundant fructification. The spermogones are abundant on the margins of the scyphi, as small barrel-shaped or conoid bodies.

Specimen 8.—SCHÆRER exs. 58 (sub γ . *longipes*, *E. tubæformis*); on the ground in woods. This is simply a spermogoniferous state; it bears no apothecia. The spermogones are small pale brown cones or tubercles, sparingly fringing the very irregular denticulate scyphi.

Specimen 9.—SCHÆRER exs. 268 (sub ξ . *communis*); in damp and shady places. The spermogones are large barrels on the margins of broad scyphi.

SPECIES 2. *C. fimbriata*, Fr.,

Likewise a cosmopolite; it seems to me to be but a form of the preceding species, marked by toothed scyphi, the margins of which sometimes bear small secondary podetia.

Specimen 1.—Bogin, County Derry, D. MOORE, in Herb. Carroll; with deformed apothecia. This is merely a spermogoniferous form of *C. pyxidata*, in my opinion, though it is the form which NYLANDER refers to his *fimbriata*. The spermogones occur on the diaphragm, as well as the margins of the scyphi, as short, distinct, brown tubercles. The spermatia are all slightly curved, crescent-shaped, about $\frac{1}{4000}$ th long, with a breadth of $\frac{1}{25,000}$ th. The sterigmata are very ramose and delicate, about $\frac{1}{1500}$ th long, with a breadth of $\frac{1}{20,000}$ th.

Specimen 2.—Craigie Hill, Perth, April 1856, W. L. L. The spermogones are seated on small prolongations from the margins of the scyphi.

Specimen 3.—Falkland Islands, Dr HOOKER, in Herb. Hooker, Kew. Besides marginal spermogones, apothecia are abundant, and are quite those of *C. pyxidata*.

Specimen 4.—Road to Wellington Falls, Van Dieman's Land, MOSSMAN, 1850; in Herb. Royal Botanic Garden, Edinburgh. No apothecia, but spermogoniferous scyphi.

Specimen 5.—SCHLÆRER exs. 589 (sub *β. longipes*, *η. denticulata*); in woods. The name *denticulata* would appear to have been given in allusion to, or in consequence of, the spermogoniferous fringe of the scyphi, which is precisely like that so common in *C. pyxidata*. The spermatia are $\frac{1}{4000}$ th long.

Specimen 6.—SCHLÆRER exs. 640 (sub *β. ochrochlora*); on the ground in the valley of the Mittenwald, Upper Bavaria. The spermogones are large barrels, which are seated in groups of two or three on the edge of the narrow scyphi which terminate the podetia. The sterigmata, with the spermatia attached, measure about $\frac{1}{1500}$ th to $\frac{1}{2500}$ th long; they become brown when old and sterile.

Specimen 7.—Long Island, United States, May 1856, Dr A. O. BRODIE. The spermogones are small irregular barrels or cones, fringing the scyphi, precisely as in *C. pyxidata*.

SPECIES 3. *C. cornuta*, Fr.,

Which is said to occur in Europe, Asia, and America; it appears to me to belong partly to *C. pyxidata*, and partly to *C. gracilis*.

Specimen 1.—Craig-y-Barns, Dunkeld, April 1856, W. L. L. This seems referrible to *C. pyxidata*. The spermogones are few, but large and distinct, brown barrels, occurring on the margins of the scyphi.

SPECIES 4. *C. degenerans*, Flk.,

Which occurs in Europe, Asia, and America; it does not appear to me to deserve to rank as a distinct species, but to belong to *C. pyxidata*, *C. gracilis*, and *C. squamosa*, if not to other species.

Specimen 1.—SCHLÆRER exs. 275 (sub *E. euphorea*, Flk.); on stones, Gastern. This is referrible to *C. gracilis*. The spermogones are large barrels, three or four of which are seated on the margins of each of the small narrow scyphi, which terminate the short slender podetia. No. 274 (sub *E. aplolea*, Flk.), from the same locality in my copy, is not distinguishable from No. 275, either as to its thallus or spermogones.

Specimen 2.—Kollong, Khasia, Himalayas; temperate region, at an elevation of 5000 feet; collected by Dr HOOKER and Dr THOMAS THOMSON. The spermogones are abundant and large. Another specimen, also in the Hookerian Herbarium, NYLANDER seems to refer to *squamosa*, but it is really intermediate between *squamosa* and *furcata*. It has abundance of large spermogones, on dark-brown dingy degenerate podetia.

SPECIES 5. *C. cenotea*, Schær.,

Which grows in Europe and North America; it seems to me to belong to *C. pyxidata*.

Specimen 1.—SCHÆRER exs. 71; on the ground and the putrid trunks of trees, in hilly and alpine regions, Switzerland. There are no apothecia; the scyphi are not much dilated, and the spermogones are marginal, and precisely of the characters of those of *C. pyxidata*.

Specimen 2.—(sub *C. trachiata*, Fr.) Mahourat; SPRUCE'S "Lich. Pyrenæi;" in Herb. Hooker, Kew. The podetia are sub-digitately divided above, and are covered throughout with an abundant gray pruinosity. The spermogones here, too, are those of *C. pyxidata*.

SPECIES 6. *C. gracilis*, Fr.,

Like *C. pyxidata* and *C. fimbriata*, a cosmopolite. It has two principal varieties, *verticillata*, Fr., which occurs in Europe, America, and Australia, and *cervicornis*, Ach., which is confined in its range to Europe.

Specimen 1.—Blaeberry Hill, Perth, April 1856, W. L. L. The spermogones occur on the margin of the small scyphi, which terminate the long slender podetia; they exactly resemble those of *C. pyxidata*.

Specimen 2.—Lion's Face, 1844, and Sidlaw Hills, 1846, Forfarshire; GARDINER of Dundee; in Herb. Hooker, Kew. Plant bears both apothecia and spermogones; the latter as in No. 1.

Specimen 3.—Tasmania, Antarctic Expedition, 1839-43, Dr HOOKER (sub *Cenomyce ccmocyna*, Ach., var. *a.*; the var. *gracilis* of NYLANDER). This is a long, delicate, graceful form, the podetia being simple and cylindrical, and abundantly clothed with scales or folioles. The spermogones are few, terminal, isolated, short, deep-brown, barrel-shaped organs, closely resembling those of *C. furcata* or *C. rangiferina*. The ostiole is large and distinct.

Specimen 4.—Falkland Islands, Antarctic Expedition, 1839-43, Dr HOOKER. The thallus is much broken up; the spermogones are few and old, scattered on the margins of the scyphi. There are no free spermatia. The sterigmata are elongated and hypertrophied, filling the cavity of the spermogone; they are very delicate, linear, and ramose at the base.

Specimen 5.—Var. *elongata*, Fr. and Nyl., Disco Island; LYALL, 1854. A very long and graceful form, with abundant spermogones.

Specimen 6.—SCHÆRER exs. 67 (sub β . *hybrida*, *C. elongata*); on the ground in alpine districts. The spermogones occur on the ends of elongated, sterile podetia; they are largish and barrel-shaped, but are old. The sterigmata are elongated, hypertrophied, and very ramose, filling the cavity of the spermogone, as in No. 4; a phenomenon which is common in the old spermogones of all the *Cladonias*.

Specimen 7.—SCHLÆRER exs. 641 (sub β . *turbinata squamulosa*); in woods in the valley of the Lauen. The spermogones are small pale-brown barrels or flattened cones, fringing the terminal scyphi like so many teeth. The ostioles are very distinct; the spermogones are old, and contain no free spermatia.

Specimen 8.—Var. *verticillata*, Fr., which occurs in Europe, America, and Australia; New Zealand, Antarctic Expedition, 1839–43, Dr HOOKER. Specimen associated with *C. aggregata*. The spermogones are small, barrel-shaped, brown tubercles, with distinct ostioles, occurring on the margins of the scyphi. The spermatia are curved and very delicate; about $\frac{1}{6000}$ th to $\frac{1}{4000}$ th long.

Specimen 9.—Var. *verticillata*, SCHLÆRER exs. 62 (sub *C. verticillata*, *A. dilatata*); on ground in alpine districts, Switzerland. The spermogones are precisely as in No. 8.

Specimen 10.—Var. *cervicornis*, Ach. (*syn. Cladonia* or *Cenomyce cervicornis* of authors); Morven, Braemar, Professor DICKIE of Belfast; in Herb. meo. The spermogones fringe the small, cup-like, dilated ends of the short narrow podetia, which spring at right angles from the horizontal foliose thallus.

Specimen 11.—Var. *cervicornis*; top of Muckish Mountain, County Donegal, Ireland, Professor DICKIE; in Herb. meo. The podetia are very deformed, short, thick, and covered with warts or processes. The spermogones are dotted over the podetia themselves, as well as seated on the warts or processes just mentioned.

Specimen 12.—Var. *cervicornis*; Blaeberry Hill, Perth, April 1856, W. L. L.; very abundant; seldom bearing podetia or apothecia; in cæspitose thick tufts. On the margins of the scyphi, which terminate some of podetia, are a few broad, bulging, sub-spherical spermogones, with gaping ostioles.

Specimen 13.—Var. *cervicornis*; Ben Nevis, 1856, W. L. L. Large barrel-shaped spermogones occur, growing upright from the horizontal folioles, as well as fringing the scyphi on the longish delicate podetia. They are apt to be confounded with the numerous abortive apothecia; but their more regular form, and the presence of the ostiole, generally suffice to distinguish the spermogones.

Specimen 14.—Var. *cornuta*; Craig-y-Barns, Dunkeld, 1856, W. L. L. No apothecia; but largish, barrel-shaped, distinct spermogones fringe the scyphi.

Specimen 15.—SCHLÆRER exs. 66 (sub β . *hybrida*, *B. simplex*); on the ground in alpine districts. Large, barrel-shaped spermogones fringe the scyphi, and are sometimes intermingled with apothecia on the same scyphus.

SPECIES 7. *C. squamosa*, Hoffm.,

Like *C. pyxidata*, *C. fimbriata*, and *C. gracilis*, a cosmopolite. Indeed the genus *Cladonia* contains at least as many cosmopolite species as any other lichen-genus. There is great variety in *C. squamosa* in the form of the thallus, and equal variety in the site of the spermogones. They may be isolated and terminal; seated on the ends of long graceful cylindrical podetia, as in KÖRBER's var. β *asperella*; or

grouped on the margins of very irregular dilacerate scyphi, or seated on longish prolongations from the margins of the same scyphi. In all these cases, however, they are barrel-shaped, and as in the species already described.

Specimen 1.—Blaeberry Hill, Perth, April 1856, W. L. L. The spermogones are terminal, as in KÖRBER'S var. *β. asperella*. Ben Nevis, August 1856, W. L. L. Here also they are terminal on podetia resembling those of *C. gracilis*.

Specimen 2.—Hills east of Glen Callater, Braemar, August 1856, W. L. L. Apothecia and spermogones occur on the same podetia, but on different branches thereof; the spermogones being placed on the higher ones. The ostioles are very large and patent; the envelope is of a dense brown cellular tissue. The spermatia are curved, about $\frac{1}{4000}$ th long, nearly straight while attached to their sterigmata.

Specimen 3.—Australian Alps, MÜLLER, 1855; in Herb. Hooker, Kew. The plant seems rather referrible to *C. gracilis*; it is simple, and scarcely squamose. The spermogones are as above.

Specimen 4.—SCHÆRER exs. 74 (sub *C. ventricosa*, *a. microphylla*, *C. cymosa*); on the ground and on decayed tree-trunks, in woods, Switzerland. Small but very distinct barrel-shaped spermogones are studded over the ends of very irregular ramose ramules.

Specimen 5.—SCHÆRER exs. 73 (sub *C. ventricosa*, *a. microphylla*, *B. prolifera*); on the ground and decayed trunks of trees, in woods, Switzerland. The spermogones are terminal, as in *C. furcata*.

Specimen 6.—Var. *anomæa* (syn. *Scyphophorus anomæus*, Hook., E. B. 2d ed., p. 91, Tab. 2283; 1st ed. *Lichen anomæus*, T. 1867; Hook. Br. Flora, 238, vol. ii.); Kelly's Glen, D. MOORE; in Herb. Carroll. No apothecia. Spermogones terminal, young, contain no free spermatia.

Specimen 7.—Var. *cæspititia*, Ach.; occurs in Europe and America. SCHÆRER exs. 280 (sub *C. ventricosa*, *γ. fungiformis*); in woods, Switzerland. The spermogones are seated directly on the folioles or scales of the horizontal thallus; they are barrel-shaped; blackish or deep brown; large and distinct, and have certainly a fungoid aspect. The spermatia and sterigmata have the usual character; many of the latter in old spermogones are elongated and hypertrophied.

SPECIES 8. *C. alpicornis*, Flk.,

Which grows in Europe, Africa, and America. This species is of great interest, as being one of the lichens in which IRZIGSOHN first discovered the existence of spermatia.* He, however, described these corpuscles as *Spermatozoids*, endowed with animal motion. This motion is now proved beyond a doubt to be merely the Brownian movement of minute particles of matter, organic or inorganic alike, in a fluid. The barrel-shaped spermogones are here generally seated directly on the

* Botanische Zeitung, p. 913. 1850.

folioles of the horizontal thallus. The diameter of the spermogone is about $\frac{1}{8}$ th. The spermatia are generally curved when free, but frequently straight while attached. I can draw no good distinction between *C. endiviæfolia*, the *cervicornis* variety of *C. gracilis*, and this species. They appear to me to differ essentially only as to the size of the folioles of the horizontal thallus, while podetia are rare in all. Certainly the spermogones are the same in all three. I should feel inclined to bring them all under *C. pyxidata*. Podetia, bearing both apothecia and spermogones, in a specimen in LEIGHTON'S exs. 15, are quite those of *C. pyxidata*.

Specimen 1.—LEIGHTON exs. 15; Haughmond Hill, Shropshire; Engl. Bot. 1392. The spermogones are on the margins of the podetial scyphi; they are largish, deep brown, barrel-shaped, and quite those of *C. pyxidata*. On the lower or paler surface of the folioles of the horizontal thallus are scattered sparingly, in the right-hand specimen in my copy, distinct black cones or papillæ, semi-immersed. These are pycnides, but unassociated with either apothecia or spermogones of any kind. I have great hesitation in regarding them as belonging to this *Cladonia*, inasmuch as I have not elsewhere found them in this genus. I am therefore rather inclined to look upon them as accidental parasites. They contain stylospores, oval or oblong-oval, generally more or less curved, but very irregular in form.

Specimen 2.—(Sub nom. *C. damæcornis*, Ach.); Suffolk; in Herb. British Museum, London. It has abundance of large barrel-shaped spermogones, scattered on the folioles of the horizontal thallus.

Specimen 3.—In Herb. Menziesian, Royal Botanic Garden, Edinburgh; habitat not given. It possesses only spermogoniferous podetia; which is generally, if not always, the case in Scotch specimens also.

Specimen 4.—Aldborough, Sir T. GAGE; in Herb. British Museum. Spermogones as in No. 2.

Specimen 5.—SCHÆRER exs. 455 (sub *C. foliacea*, *a. alcicornis*); near Vire; PELVET. The spermogones here also are seated directly on the folioles. The spermatia are about $\frac{1}{4000}$ th long, the sterigmata, with spermatia attached, $\frac{1}{1500}$ th.

SPECIES 9. *C. endiviæfolia*, Fr.

Specimen 1.—LAVINGE, 1814; Observation Inlet, SCOULER; in Herb. Hooker. Kew. The spermogones are sometimes distributed on the surface, sometimes on the margins of the thalline folioles; occasionally on the edges of the cup-shaped terminations of very irregular and deformed podetia, which rise directly from the surface of the larger folioles. They are precisely those of the preceding species, from which the present appears to me to differ in no essential respect.

SPECIES 10. *C. Papillaria*, Hoffm.,

Which occurs in Europe and North America. This is altogether an anomalous

and exceptional species, which is arranged in a sub-section by itself, *Pycnothelia*, Duf. Its spermogones, however, resemble those of *C. pyxidata*.

Specimen 1.—Appin and Ben Nevis; in Herb. Hooker, Kew. The podetia are largish and irregular, with abundant spermogones and apothecia.

Specimen 2.—SCHÆRER exs. 511 (sub *A. clavata*); heaths or moors, Switzerland. The spermogones are mostly old; they are small, distinct, brown cones or papillæ, scattered in groups on the sides of the large irregular podetia. The spermatia are about $\frac{1}{5000}$ th long, chiefly straight or very slightly curved; many of the sterigmata are hypertrophied and elongated.

Specimen 3.—SCHÆRER exs. 512 (sub *B. molariformis*, Hoffm.). Here the spermogones are somewhat differently disposed. They are largish, brown, distinct, irregular, flattened tubercles, seated directly on the thallus, like the apothecia of a *Lecidea*. The spermatia and sterigmata are as in all *Cladonias*. The former are crescent-shaped, and about $\frac{1}{4000}$ th long; the latter, with spermatia attached, measure about $\frac{1}{1500}$ th.

SPECIES 11. *C. bellidiflora*, Schær.,

Which inhabits cold, alpine, or sub-alpine regions in Europe and America. The spermogones of this and other species with red apothecia do not differ, except in colour, from those of species such as *C. pyxidata*, having brown fruit. Nor do the spores differ. Indeed, it admits of doubt whether the mere colour of the apothecia should be regarded as at all a good distinctive mark of sections or species of *Cladonia*; for the apothecia are occasionally indiscriminately red or brown in the same species. I am of those who would abolish the distinction, and would merge the phæocarpous and erythrocarpous sections of NYLANDER into one.

Specimen 1.—Ben Nevis, Aug. 1856, W. L. L.; form *polyccephala* of KÖRB., p. 29. A few tub-shaped spermogones occur on the apices of narrow long cylindrical podetia,—the stronger podetia bearing on their summits apothecia. Spermogones also occur on the margins of indistinct scyphi. In some deformed sterile states they are abundantly scattered over the podetia towards their apices, as large, distinct, brown, broad-based cones, with a very patent ostiole. In other podetia, which are very foliose or squamulose, the large tub-shaped spermogones—among the largest indeed I have ever seen—are seated directly on these squamules or folioles, especially near the ends of the podetia. The cavity contains abundance of rose-coloured mucilage, in which are imbedded curved spermatia, about $\frac{1}{4000}$ th long. The sterigmata are of the usual characters, as described in *C. pyxidata*. It is note-worthy that the colour of these spermogones externally is *brown*, and that their envelope consists of a *brownish* cellular tissue. Their cavity is simple.

Specimen 2.—SCHÆRER exs. 39 (sub *C. bellidiflora*, *B. ampullifera*); on ground and stones in alpine districts, Switzerland. The scyphi bear no apothecia; but

are spermogoniferous, their margins being fringed with dark brownish-red spermogones, like small barrels or cones flattened on the top, or somewhat irregular. Red mucilage abounds in their cavity.

Specimen 3.—Kelly's Green, Ireland, D. MOORE; in Herb. Carroll, Aug. 1853. The folioles of the horizontal thallus are studded over with the apothecia and spermogones of *Lecidea cladoniaria*, Nyl., which occur also on the scales of the podetia from the base to their apex. The apothecia are black, discoid, semi-immersed, resembling those of *L. oxyspora*, as it occurs on *Parmelia saxatilis*, *P. conspersa*, and *Platysma glaucum*. The spermogones are minute, brown or black, punctiform, scattered among the apothecia. The spermatia are largish and ellipsoid, resembling those of *Lecidea abietina*, and are borne on very short, simple, linear sterigmata. I refer to *L. cladoniaria* here only with a view to show that there is no danger of confounding either its apothecia or spermogones with the spermogones of *Cladonia bellidiflora*.

SPECIES 12. *C. cornucopioides*, Fr.,

A cosmopolite species. I must confess my inability to perceive any good distinctive marks between this and the preceding or following species. Indeed, I regard *C. bellidiflora* as a type or species, including *C. cornucopioides*, *C. macilenta*, *C. digitata*, and *C. deformis*, just as I hold *C. pyxidata* to embrace *C. fimbriata*, *C. degenerans*, *pro parte*, and *C. cornuta*. *C. cornucopioides* is the familiar *C. coccifera* of older authors.

Specimen 1.—Falkland Islands; Antarctic Expedition, 1839–43, Dr HOOKER. Spermogones occur on the margins of the scyphi, as small, but distinct, round, flattened, brown tubercles, pierced with distinct ostioles. They are all old, and contain no free spermatia.

Specimen 2.—Var. *pleurota*, Flk. A cosmopolite variety; appears to me to be merely a spermogoniferous form, bearing the same relation to *C. cornucopioides* that *fimbriata* does to *C. pyxidata*. The spermogones are red; the apothecia few. Scotland; collected by ALEXANDER MENZIES himself; in Menziesian Herb., Royal Botanic Garden, Edinburgh.

SPECIES 13. *C. macilenta*, Hoffm.,

Likewise a cosmopolite. This is the familiar *filiformis* of the older authors. KÖRBER's var. *clavata*, p. 31, is probably a spermogoniferous state:—"thallo clavato-ventricoso subulato substerile."

Specimen 1.—Ben Nevis, Aug. 1856, W. L. L. From the ramules bearing apothecia there sometimes branch off, a little below the apothecia, spermogoniferous ramuscles, bearing at their ends, in groups of three or four, brown barrel-shaped spermogones.

Specimen 2.—SCHLÆRER exs. 33 (sub *C. filiformis*, *A. cornuta*); on peaty

earth. The margins of the cup-like, dilated ends of the podetia are fringed with large barrel or cone-shaped, deep-brown spermogones, generally in groups of four or five. The cavity is apparently compound and sinuous—a phenomenon that is unusual in the *Cladonias*.

Specimen 3.—SCHÆRER exs. 36 (sub *C. filiformis*, *D. ramulosa*). The spermogones are as in No. 2, but smaller.

Specimen 4.—Var. *polydactyla*, Flk., which occurs in Europe and America. SCHÆRER exs. 454 (sub *C. incana*, γ . *polydactyla*); near Vire, PELVET. The spermogones are brownish-red barrels, grouped in three or four, on the margins of the narrow closed cups in which the podetia terminate. The spermatia are about $\frac{1}{4000}$ th long; and the sterigmata $\frac{1}{1500}$ th.

SPECIES 14. *C. digitata*, Hoffm.,

Which occurs in Europe, Asia, and America, and which, I think, stands in the same relation to *C. bellidiflora* or *C. cornucopioides* that *C. fimbriata* does to *C. pyxidata*.

Specimen 1.—Ben Nevis, Aug. 1856, W. L. L. The plant is more or less deformed; it is scyphiferous, but the scyphi have seldom an equal or even edge. More generally they are ragged and lacerated; sometimes give off a series of irregular digitate prolongations from their margins. The spermogones are beautiful scarlet flattened cones, seated on the margins of the scyphi, or of the prolongations therefrom just described. Their envelope consists of a dense reddish cellular tissue. *C. digitata* graduates sometimes into the following species.

SPECIES 15. *C. deformis*, Hoffm.,

Almost a cosmopolite, occurring in Europe, Asia, America, and Australia. As a general rule, it is not found bearing apothecia, but occasionally spermogones are met with.

Specimen 1.—Howth, August 1853, MOORE; in Herb. Carroll; no apothecia. This seems to me merely the *cornuta* form of *C. bellidiflora*, such as occurs abundantly on Kinnoull Hill, Perth, and Craig Vinean, Dunkeld. The spermogones are small scarlet cones, fringing the occasional obscure terminal scyphi.

Specimen 2.—SCHÆRER exs. 49 (sub *a. vulgaris*, *c. gonecha*, Ach.); in alpine regions, Switzerland. The left-hand podetium in my copy (ed. alt. immut., 1842) is dotted over, especially inferiorly, with small, black, round cones, which are pycnides. The stylospores are largish, distinct, very numerous, and very variable as to form; the sterigmata are short and simple. Their position would lead me to look upon them as parasitic rather than as belonging to the plant on which they occur,—because, 1. I have found them only in another instance—*C. Papillaria*; 2. Their situation is not that of the spermogones of *C. deformis*; and 3. Their colour and general character differ *in toto* from those of the said spermogones.

SPECIES 16. *C. uncialis*, Hoffm.,

Which occurs in Europe, America, and Asia. This and the species to follow are characterized by the absence of scyphi; in them the spermogones are terminal and more prominent than in those which have preceded.

Specimen 1.—Moors about the Stro Rock, Isle of Skye, Aug. 1856, W. L. L. The spermogones are generally in groups of two or three, constituting or crowning the terminal horns of the podetia; their brown colour, in contrast with the straw-yellow of the podetia, renders them very distinct. They vary in length, being elongated and subfusiform or subspherical. The ostioles are large and patent in the older ones. The spermatia are chiefly straight—all the attached ones are; some are slightly curved; their length is about $\frac{1}{6000}$ th.

Specimen 2.—Hills east of Glen Callater, Braemar, Aug. 1856, W. L. L. The spermogones are distinctly-bulging barrel-shaped organs, with a perceptible ostiole. Their spermatia, as in No. 1, are straight or curved—the former while attached; their length is about $\frac{1}{6000}$ th.

Specimen 3.—Ben Lawers, Aug. 1855, Dr GILCHRIST of Dumfries. The barrel-shaped spermogones bulge most superiorly; their base or pedicel is narrow. But there is always a distinct line of separation between the spermogone and podetium, both in respect to colour and thickness.

Specimen 4.—Rorrie Moor, near Forfar, A. CROALL of Montrose; in Herb. Hooker, Kew. Has the same spermogones as in No. 3.

Specimen 5.—SCHLÆRER exs. 82 (sub *C. stellata* α . *uncialis*); on ground in the Alps and valleys of the Jura. Exs. 513 (sub *C. stellata* β . *ceranoides*); on the ground on moors; has its spermogones on the horns or tips of large handsome podetia. Lake-coloured mucilage abounds in their interior, and this is noteworthy, seeing that the spermogones themselves are brown. The spermatia are crescent-shaped, and about $\frac{1}{4000}$ th long; the length of the sterigmata is about $\frac{1}{3000}$ th. Exs. 514 (*b. adusta*) has the spermogones just described.

SPECIES 17. *C. turgida*, Hoffm.,

A native, according to NYLANDER, of Europe, Asia, and America. I look upon it simply as a form, and a very ill-marked form frequently, of the preceding species, the podetia being usually shorter, thicker, darker, and considerably deformed. NYLANDER places *C. turgida*, in his classification,* between *furcata* and *rangiferina*.

Specimen 1.—Summit of the Bassies, Clova, 1843, GARDINER; in Herb. Hooker, Kew (sub nom. *C. uncialis* β . *turgida*). Possesses spermogones only, which are precisely those of *C. uncialis*.

* Énumération générale des Lichens, p. 95. Cherbourg, 1858.

Specimen 2.—SCHÆRER exs. 83 (sub *C. stellata* γ . *obtusata*), and 84 (δ . *turgida*), both on the ground in alpine regions, Switzerland. Have old spermogones, containing no free spermatia, which are also quite those of *C. uncialis*.

Specimen 3.—Kamkola, Sikkim, Himalaya, alpine region, about 15,000 feet high, Dr HOOKER; in Herb. Hooker, Kew. Appears also simply a turgid form of *C. uncialis*. It possesses spermogones, but no apothecia.

SPECIES 18. *C. amaurocræa*, Flk.,

Which occurs in Europe, Asia, America, and Australia; it is closely allied also to *C. uncialis*, from which it differs chiefly in its more compound or ramose thallus.

Specimen 1.—Var. *capitellata*, Bab. in "Flora of New Zealand," (HOOKER fms.), (syn. *C. capitellata*, Bab.); New Zealand, COLENSO; in Herb. Hooker, Kew. The apothecia and spermogones are quite those of *uncialis*. The latter are generally terminal and erect, but they also occur occasionally scattered on the sides of the ultimate ramuscles of the thallus, from which they project peg-like at right angles. The spermatia are always curved when free; their length is about $\frac{1}{4000}$ th, with a breadth of $\frac{1}{20,000}$ th. When attached, however, they are frequently straight and very long—at least double the length of the free spermatia, a circumstance I have already more than once pointed out as occurring in lichens. The sterigmata are long and filiform—ramose below; their length is about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th.

SPECIES 19. *C. furcata*, Schær.,

A cosmopolite species, having two main varieties—*racemosa*, Schær., and *pungens*, Ach., both of which occur alike in Europe, Asia, and America. The spermogones of this species are generally among the largest and most distinct of those of *Cladonia*. The ostiole also is usually large and easily perceptible. The spermatia are generally curved, and about $\frac{1}{4000}$ th, sometimes only $\frac{1}{6000}$ th, long.

Specimen 1.—Craigie Hill, Perth, April 1856, W. L. L.; with apothecia. The thallus is of a dark-brown, and the brown terminal spermogones are not, therefore, so easily recognised as in species with a straw-coloured thallus. They are here short, broad, and bulging.

Specimen 2.—Suffolk, Ben Cruachan, 1810, BORRER; in Herb. Hooker, Kew; are spermogoniferous only, as is the case in a specimen from Wales in Herb. British Museum, London.

Specimen 3.—Ingleby Park, Cleveland, Yorkshire, 1856; coll. W. MUDD. The podetia are slender, ramose, and closely aggregated; the spermogones small, and sometimes on apices, slightly nodding, as in *C. rangiferina*.

Specimen 4.—(Sub *Cenomyce bacillaris*, Ach.) Falkland Islands, Antarctic Expedition, 1839–43, Dr HOOKER; in Herb. meo. The spermogones are abundant as the short, bulging, barrel-shaped apices of the bifurcate extremities of the ultimate ramuscles. Specimens (sub nom. *C. gracilis*) from the Falkland Islands

and Cape Horn, coll. by Dr HOOKER, and in Herb. Hooker, Kew, seem to be the same plant, which is here spermogoniferous only. The ramules are frequently black, straggling, and very delicate.

Specimen 5.—Pic d'Orizaba, Cordillera (Vera Cruz), Mexico, at an elevation of 11,000 to 12,000 feet; coll. by H. GALEOTTI, 1840, No. 6906; also from the same locality, 1838, coll. by J. LINDEN, No. 102; both in Herb. Hooker, Kew; spermogoniferous.

Specimen 6.—SCHLÆRER exs. 22, Switzerland; associated with *Cetraria islandica*. The spermogones are large distinct barrels.

Specimen 7.—Var. *racemosa*, Sch.; on old walls, Caerlaverock Road, Dumfries, August 1856, W. L. L. The podetia are dark-coloured, and are covered with furfuraceous granules, scales, or folioles, from base to apex. The spermogones are short, and sometimes so broad and subspherical as to resemble young apothecia. They crown the delicate ultimate ramuscles, which are lax and patent. The spermatia are chiefly straight, and about $\frac{1}{600}$ th long. Some of the sterigmata are subarticulate, consisting of a few linear cells, placed in superposition, or branching off laterally in groups, in which case the sterigmata are very ramose, and somewhat longer than usual.

Specimen 8.—Var. *racemosa*; LEIGHTON exs. 16, Haughmond Hill, Shropshire; a few apothecia. The spermogones are chiefly old, containing no free spermatia. The sterigmata are very irregular in form, and thickened.

Specimen 9.—Var. *racemosa*; Sandhills, Newcastle, County Down, Ireland; Professor DICKIE. The plant is dwarf, deformed, and bears no apothecia. The spermogones are few, young, and contain no mature or free spermatia.

Specimen 10.—Var. *racemosa*; rocks, Mount Wellington, Van Dieman's Land, MOSSMAN, 1850; in Herb. Royal Botanic Garden, Edinburgh. Plant spermogoniferous only.

Specimen 11.—Var. *racemosa*; SCHLÆRER exs. 80 (sub *C. fruticosa* a. *racemosa*); on the ground in woods, Switzerland; also exs. 81 (δ . *furcata*). In both, the spermogones have the usual characters.

Specimen 12.—Schooley's Mountains, North America, July 1856, Dr A. O. BRODIE. Spermogones have the characters of those of British plants or specimens.

Specimen 13.—Singalelah, Sikkim, Himalaya, alpine region, at an elevation of 11,000 feet; Chongtan, Sikkim, temperate region, at 8000 feet; Lachoong, Sikkim, temperate region, at 9000 feet—all collected by Dr HOOKER. Churra and Khasia, subtropical region, at 4000 feet; Kollong, Khasia, temperate region, at 5000 feet; coll. by Drs HOOKER and THOS. THOMSON; all spermogoniferous, but bearing no apothecia. New Zealand, Dr JOLLIFFE; thallus very white and delicate, and minutely scaly. St Domingo, SCHOMBURGK; very pale, thin, delicate podetia. Jamaica; 4–6 inches tall. Ohio, Lea; Cedar Swamp, near Urbana; spermogones abundant and distinct. Boston. Switzerland, near Chateau d'Oex. FRANKLIN'S first journey;

British North America (sub nom. *C. furcata*, var. *subcrispata*, Nyl., and *C. crispata*, Ach., Nyl., both of which seem referrible to *racemosa*); apothecia and spermogones both well formed. All the specimens comprised in No. 13 are in the Herb. Hooker, Kew.

Specimen 14.—Var. *pungens*, Ach. (syn. *C. pungens*, Delise, Hook. British Flora, 235; KÖRB., 35; *C. furcata* ε. *rangiformis*, SCH. Enum. 202; *C. furcata* γ. *fruticosa*, SCH. exs. 459). This variety graduates into *racemosa*, and both into *C. rangiferina*. They are chiefly distinguished usually by their squamulose surface, gray colour, and ramose character. Blaeberry Hill, Perth, April 1856, W. L. L. The podetia vary much; some are turgid, thick, short, and covered profusely with scales or folioles; others are long, lax, and have more of the usual character of *furcata*. The turgid pale form closely resembles *C. rangiferina*, from which it is sometimes scarcely distinguishable. In all forms the spermogones are brown barrels, seated on erect apices of the ramuscles; they differ much in size, being short and broad, or elongated and narrow.

Specimen 15.—Var. *pungens*; old road to Caerlaverock, Dumfries, on a wall, April 1856, W. L. L. The podetia are of a light gray colour, and covered inferiorly with squamules, superiorly with granules. The spermatia are straight, and of unusual length; the sterigmata are also longer than usual—some of them being articulated, as in No. 7, which is nearly identical with this variety also as to the thallus.

Specimen 16.—Var. *pungens* (sub *Baeomyces pungens*), Thetford; also Esher Common, Surrey; in Herb. Hooker, Kew. Spermogones abundant.

SPECIES 20. *C. rangiferina*, Hoffm.,

A cosmopolite species, and one of the most familiar of the *Cladonias*. Its chief varieties, according to NYLANDER, are *sylvatica* L. and *alpestris*, L.; like their type, both are cosmopolites. The spermogones are quite the same in the varieties as in the type. These varieties have not, I think, any good distinctive characters, unless in regard to the height, strength, and ramoseness of the thallus: in *alpestris*, the thallus is very ramose, and the ramuscles densely aggregated and thyriform. In general terms, the spermogones of this species are those of *C. furcata*, both in regard to site, appearance, and structure; they are uniformly, however, smaller in all their dimensions. The apices of the ramuscles on which they are seated, or which they constitute, are frequently nodding, but frequently also erect, as in *furcata*. In arctic and antarctic specimens especially, the ramuscles of the thallus are extremely attenuated, and the spermogones are correspondingly so; in this case the latter are linear or ellipsoid bodies, giving a nigro-corniculate character to the tips of the ramuscles. The spermogones are generally grouped two or three together, in consequence of the bifurcation or further division of the ends of the ramuscles. Their cavity is simple. Their diameter is about $\frac{1}{200}$ th; their length $\frac{1}{150}$ th or $\frac{1}{160}$ th.

The spermatia are about $\frac{1}{3000}$ th to $\frac{1}{4000}$ th long; their breadth about $\frac{1}{80,000}$ th. The spermatiferous, or ordinary sterigmata, are sometimes associated with sterile, hypertrophied, ramose filaments, as in *Ramalina*; but the latter are seldom or never so long or so ramose as in that genus.

Specimen 1.—Blaeberry Hill, Perth, April 1856, W. L. L. Abounding in apothecia, as well as spermogones. The ramuscles, or their divisions, which bear the spermogones, are as erect as those which bear apothecia. The nodding apices bear only sterile or abortive spermogones; the latter are of the same thickness as their pedicels, whereas the fertile spermogones always bulge out distinctly, and generally show a perceptible terminal ostiole. The ramuscles bearing spermogones and those bearing apothecia are intermixed; when the former ramuscles are longer than the latter, the spermogones are frequently found drooping over the apothecia.

Specimen 2.—Hills east of Glen Callater, Braemar, August 1856, W. L. L. Both apothecia and spermogones occur. The plant is large and coarse; the podetia vary in tint from straw-yellow to leaden-gray; they are also very granular and rough; sometimes covered with mealy warts. The spermogoniferous ramuscles are erect. The spermatia are either straight or curved, about $\frac{1}{4000}$ th to $\frac{1}{5000}$ th long; the sterigmata are sometimes sub-articulate and very ramose; long, linear, extremely delicate cells being given off in place of branches.

Specimen 3.—Ben Lawers, August 1855, Dr GILCHRIST. No apothecia. Here the nodding apices are all spermogoniferous; the spermogones being linear and elongated rather than barrel-shaped. The thallus is dark-gray.

Specimen 4.—Long Island, North America, May 1856, Dr A. O. BRODIE. The spermogones are abundant, short, and inconspicuous. The spermatia are very small but curved, about $\frac{1}{8000}$ th long; the sterigmata are also very short, about $\frac{1}{3000}$ th long, becoming, with age, sterile and brown. The podetia are sometimes covered from base to apex with irregular bullose warts; the latter are perforated here and there as if with ostioles, and they then closely resemble the spermogones of some crustaceous lichens; but their internal structure is only that of the thallus. The apothecia on the same deformed podetia are frequently single, and are sometimes studded over with spermogones, which project at right angles like pegs, or radii from the spoke of a wheel.

Specimen 5.—Tasmania, Antarctic Expedition, 1839-43, Dr HOOKER. Both apothecia and spermogones occur, the latter only sparingly, however. The spermogoniferous ramuscles are stellate-patent or erect; they are sometimes short, thick and rigid, and fastigiately ramose, and then the spermogones constitute little horns or teeth, crowning their apices. This form of thallus agrees with the vars. ϵ . *alpestris* and β . *incrassata* of SCHLÆRER, Enum. p. 203. In the more common form of the plant, the ultimate ramuscles and spermogones are much more narrow and delicate than those in British specimens. The spermatia are

generally straight, about $\frac{1}{6000}$ th to $\frac{1}{8000}$ th long; some of them are slightly curved, thickish, and short. The sterigmata are frequently of the same thickness as the spermatia, which, indeed, appear given off as ultimate joints or articulations, as in *Ramalina*; they are frequently of a brown colour in old age. Elongated, sub-simple, or sub-ramose filaments also frequently, especially in the older spermogones, project from among the ordinary spermatiferous ones into the cavity of the spermogone, which they fill, as in *Ramalina*.

Specimen 6.—Falkland Islands, Antarctic Expedition, 1839–43, Dr HOOKER. The plant more resembles our British plant than Dr HOOKER's Tasmanian specimens; the thallus is of a pale straw-yellow colour, granular or mealy on the surface, resembling herein Swiss or Norwegian specimens of var. *alpestris*. Many of the sterile ramuscles are not at all coloured at the apex; in others the spermogones are short and degenerate, or abortive. The spermogones are frequently black; their ostiole is generally patent and large; the ramuscles, on which they are seated, are always erect, never nodding. They are in some specimens associated with apothecia, which are quite those of our British plant.

Specimen 7.—Wallanchoon, Sikkim, Himalaya, alpine region, at an elevation of 13,000 feet; Jongri, Sikkim, alpine region, at 12,000 feet; Lachoong, Sikkim, temperate region, at 4000 to 7000 feet, with apothecia; Lachen, Sikkim, alpine region, at 14,000 feet; Kambachen, Sikkim; Yongma Valley, East Nepal; all collected by Dr HOOKER, and all in Herb. Hooker, Kew. All the specimens are spermogoniferous.

Specimen 8.—Var. *portentosa*, Duf., Nyl.; summit of Lion's Face, 1844, GARDINER; Pentland Hills, 1828, sender's name not given; also a specimen from GARDINER, habitat not given; all in Herb. Hooker, Kew. This variety appears merely a form with a coarse thick thallus, the spermogoniferous ramuscles being short and closely aggregated.

SPECIES 21. *C. retipora*, Flk.

This is one of the most beautiful of Australian and Tasmanian lichens, in consequence of the reticulated or fenestrated character of the thallus.

Specimen 1.—Tasmania, Antarctic Expedition, 1839–43, Dr HOOKER. Its spermogones are precisely similar, in site and structure, to those of the preceding species, but they are smaller, and always erect. They are frequently so minute, as to be with difficulty recognised even under the lens; and are sometimes so rare, that a great many specimens may be examined without finding them. They are grouped as little, dark-brown horns, on the apices of the broad cancellated podetia.

SPECIES 22. *C. aggregata*, Sw., Eschw.

(*Syn. Dufourea ocllodes*, TAYLOR); occurs in equatorial Africa, America, Asia, and Australia.

In the character of its thallus, it closely resembles the preceding species. TAYLOR has associated this species with *Dufourea*, but very erroneously, I think; for the spermogones and spermatia, as well as the apothecia and spores, are those of *Cladonia*. Its spermogones and their contents are as described under *C. rangiferina* and *C. retipora*.

Specimen 1.—Falkland Islands, Antarctic Expedition, 1839–43, Dr HOOKER. Both apothecia and spermogones are abundant. The podetia or divisions of the thallus bearing these different forms of reproductive organs differ remarkably in size and form. Those bearing apothecia are broad, short, thick, fastigate superiorly; the apothecia are much more crowded than in *C. rangiferina*, whose apothecia they otherwise resemble. The podetia or ramules bearing spermogones, on the other hand, are narrow and delicate, ramose, much attenuated and elongated towards the apices, which generally bifurcate or divide into two or three patent erect ramuscles or horns, each of which bears a single oblong or barrel-shaped spermogone, generally longer than, but otherwise resembling, the same organ in *C. rangiferina*. It is the podetia bearing apothecia chiefly that are retiporous and spongiform, as in *C. retipora*.

Specimen 2.—Tasmania, Antarctic Expedition, 1839–43, Dr HOOKER. In some specimens, I have seen delicate narrow podetia dividing at the apex into two terminal ramules, one thick and bearing apothecia, the other attenuated and bearing only spermogones. Other specimens were spermogoniferous only; the podetia were as strong, dark-coloured, and thick, as those usually bearing apothecia, sometimes even fastigate superiorly. The spermogones are shorter than in Falkland Island specimens, and grouped in tufts.

Specimen 3.—New Zealand, Antarctic Expedition, 1839–43, Dr HOOKER. Both apothecia and spermogones are abundant; sometimes they occur on different divisions of the same ramules, sometimes on different ramules. The ostioles of the spermogones are generally visible. The podetia are usually smooth, seldom retiporous. The spermatia are curved and very delicate, of the same size and form as in *C. rangiferina*. The sterigmata are also those of the species just named; and besides the ordinary spermatiferous ones, sterile ramose filaments also occur, which, however, are seldom much longer than the fertile sterigmata. The chestnut or brown colour of the thallus at once distinguishes *C. aggregata* from *C. retipora* or *C. rangiferina*; but it may sometimes be confounded with states of *C. furcata*.

FAMILY IX. PELTIGERÆ.

GENUS I. NEPHROMIUM, *Nyl.*

The spermogones of this genus resemble the *Pycnides* of *Peltigera*, in their site and external characters. They are marginal, brown, obtuse tubercles or cones; sometimes seated directly, like so many teeth, on the margin of the lobes of the

thallus; sometimes seated at the ends of tooth or fringe-like prolongations from the margin of the thallus. In the latter case, they are generally more barrel-shaped than cone-like, and they resemble, though they greatly exceed in size, the spermogones of *Cetraria islandica*. The ostiole is frequently very distinct, especially if the spermogone is moistened; the cavity is simple. There is this difference, however, between the spermogones of *Nephromium* and the *Pycnides* of *Peltigera*, that the former have true spermatia and arthrosterigmata, while the latter have stylospores on simple sterigmata. The spermatia are straight and rod-shaped, about $\frac{1}{5000}$ th long, with a breadth of $\frac{1}{20,000}$ th to $\frac{1}{25,000}$ th. They are sometimes also slightly curved, in which case they resemble those of *Cladonia*.

SPECIES 1. *N. tomentosum*, Hoffm..

Which occurs in Europe and Northern America. I have not been successful in finding spermogones in British or European specimens; and in foreign specimens I have found them in very few instances. They are comparatively rare. They are generally small brown knobs, cones, or tubercles, smooth on the surface, rounded and obtuse, pierced by a central pore.

Specimen 1.—SCHLÆRER exs. 259 (sub *Peltigera resupinata*, *a. tomentosa*); in alpine woods, on trees and stones. The spermogones are distinct nodules or tubercles, seated either directly on the margins of the thallus, or on irregular and lacerate-edged prolongations from the margins of the lobes. They are of a paler reddish-brown than the rest of the thallus. The spermatia are rod-shaped or sub-ellipsoid, $\frac{1}{5000}$ th long and $\frac{1}{20,000}$ th broad, seated on arthrosterigmata, which are among the thickest I have seen, consisting of short, broad, thick-walled cells or articulations.

Specimen 2.—Lachen, Sikkim, Himalaya, temperate region at an elevation of 10,000 feet, Dr HOOKER; with apothecia. The thallus, at its edges, is divided into, or marked by, a number of long tooth-like segments or prolongations, each of which bears at its extremity a large, barrel-shaped, very distinct or prominent spermogone. The latter organs resemble those of *Cetraria islandica*, or the *Cladonias*, but are greatly larger. They are deep-brown externally, the ostiole very distinct, or becoming so under moisture. The cavity is simple; the spermatia are abundant, straight, and rod-shaped, about $\frac{1}{5000}$ th long and $\frac{1}{25,000}$ th broad, seated on the apices and sides of longish articulated sterigmata, which resemble those of *Sticta* and *Collema*. This specimen is sub nom. *Nephroma resupinatum*, in Herb. Hooker, Kew, and appears to be var. *helveticum*, Ach., which occurs in Europe, America, Asia, Mexico, and the Isle of Bourbon.

GENUS II. NEPHROMA, Ach., pro parte, Nyl.

It resembles, in the character of its spermogones, the foregoing genus, from which NYLANDER separates it, apparently in consequence solely of the different character

of their gonidia. In *Nephromium*, according to NYLANDER, the gonidia, or rather bodies representing gonidia, upon which he bestows the name *gonima*, consist of granules without a cell-wall, and which are chiefly bluish; in *Nephroma*, on the other hand, true gonidia occur, which have a distinct cell-wall and contents. In a word, the one genus differs anatomically from the other, as *Pannaria* does from *Psoroma*. The separation seems to me a most unnatural and unnecessary one.

SPECIES 1. *N. arcticum*, Fr.,

A large handsome species, which inhabits the arctic and antarctic regions. NYLANDER describes it as possessing small rod-shaped spermatia, seated on arthrosterigmata, as in *Nephromium tomentosum*.

GENUS III. PELTIGERA, Hoffm.

Spermogones containing true spermatia,—that is, spermatia having the usual characters,—do not occur in *Peltigera*; but there are sometimes found marginal tubercles, resembling the spermogones of *Nephromium*, containing sporoid corpuscles. The latter are regarded as spermatia by TULASNE; and as stylospores by NYLANDER, with whom I concur. It appears to me very desirable to draw a distinction between spermogones and pycnides in regard to the character of their corpuscles, and to call *spermatia* corpuscles of uniform size, and generally more or less linear form; and *stylospores* those which are variable in size, and generally more or less oval or pyriform. I have acted throughout the present monograph on this principle, in describing spermogones and pycnides respectively. This is a classification or nomenclature of convenience, and as yet provisional. It is quite unconnected with any view or theory as to the physiological functions of these corpuscles, and the organs which contain them. Viewing them by this light, then, the marginal tubercles of *Saltigera* are, in my opinion, *Pycnides*. There are not wanting, however, circumstances or analogies favourable to TULASNE'S idea. He draws attention to the fact, that in *Nephromium*, bodies having the same site and same external aspect contain true spermatia seated on arthrosterigmata; he argues that the contained corpuscles in *Peltigera* merely differ in form; and he infers that in this genus, therefore, we must regard the conceptacles which contain these bodies as spermogones. The pycnides, then, of *Peltigera* are largish brown marginal tubercles, closely resembling the young apothecia, which are likewise marginal. They are so rare, however, that I have not once been fortunate enough to meet with them, and I therefore owe my descriptions to TULASNE.* The diameter of the organ in *P. polydactyla* is from $\frac{1}{170}$ th to $\frac{1}{140}$ th. The stylospores are generally oval or pyriform, varying in length from $\frac{1}{1000}$ th to $\frac{1}{4000}$ th, with a breadth usually of $\frac{1}{5000}$ th to $\frac{1}{8000}$ th; they frequently contain distinct oil globules in their in-

* Mém. Lich., p. 200, Plate IX.

terior,—a phenomena unknown in ordinary or true spermatia. The sterigmata, each of which bears at its apex a stylospore, are simple, linear, ramose at the base, resembling those of *Lichina*; their length being sometimes so great as $\frac{1}{300}$ th to $\frac{1}{500}$ th, their breadth $\frac{1}{2500}$ th.

SPECIES 1. *P. canina*, Hoffm.

The tubercles which constitute the pycnides are generally very obtuse, and so closely resemble young apothecia as to be readily mistaken therefor. They are usually, however, of a deeper brown colour. The cavity is simple and very narrow. The sterigmata are somewhat irregular in outline, and ramose at the base; they are almost solid, from thickening deposit in the interior of the cells which constitute them. Each sterigma gives off in succession a series of stylospores. The contents of these stylospores are semifluid, and almost homogeneous; they become dark brown in iodine water, while the cell-wall, which appears thick, is only coloured yellow. The greatest dimension of the stylospores is from $\frac{1}{2000}$ th to $\frac{1}{1000}$ th; the least from $\frac{1}{2500}$ th to $\frac{1}{4000}$ th. The length of the sterigmata is about $\frac{1}{500}$ th to $\frac{1}{300}$ th, with a diameter of $\frac{1}{2500}$ th. BERKELEY takes the same view, apparently, as NYLANDER and myself in regard to the character of the corpuscles, which we all agree in calling *stylospores*,—at least equally with similar corpuscles which occur in *Lecidea Smithii* and other lichens.

SPECIES 2. *P. polydactyla*, Hoffm.

The diameter of the pycnides is from $\frac{1}{170}$ th to $\frac{1}{130}$ th. The stylospores are smaller than those of the preceding species, but otherwise the same; their length is about $\frac{1}{4000}$ th; their breadth about half as much; they are oval, slightly curved, with very obtuse ends. From the characters of the thallus, apothecia, and spores, I am led to refer this species to *canina*, and the character of the pycnides confirms me in this opinion.

SPECIES 3. *P. rufescens*, Hoffm.

This and the two preceding species are all cosmopolites. The pycnides are as described in *P. canina* and *P. polydactyla*. The stylospores are oval, about $\frac{1}{3500}$ th to $\frac{1}{2000}$ th long, and $\frac{1}{6000}$ th to $\frac{1}{5000}$ th broad. This species I refer partly to *P. canina* and partly to *P. horizontalis*, unless we look upon all the British *Peltigeras* as mere varieties of one species, which I am greatly inclined to do. This genus wants simplification in regard to its species, which certainly pass into each other, and in this respect it is in the same category with *Umbilicaria* (*Gyrophora*), *Ramalina*, and *Usnea*.

GENUS IV. SOLORINA, Ach.

In this genus I have not yet succeeded in finding spermogones or pycnides

belonging thereto, though I have occasionally met with sundry parasites closely resembling them, and for which they might be mistaken.

SPECIES 1. *S. saccata*, Ach.,

Which grows both in America and Europe. The sterile thallus is sometimes covered over with black cones or tubercles, partly immersed, and with a distinct ostiole. These may readily be mistaken for spermogones; but their contents at once reveal their true nature. They are found to be perithecia, containing brown 3-4-septate oblong-oval spores. This is the *Sphæria urceolata*, SCHÆRER (in HEPP. exs. 475, f. 2), on limestone rocks on the Pilatus, Switzerland; and *Endocarpon psoromoides*, HOOK. and LEIGHTON, at least *pro parte*. This parasite, again, is apt to be confounded with *Verrucaria psoromia*, NYL., which has simple, ellipsoid, colourless spores (*Phacopsis psoromoides*, HEPP. exs. 475, f. 1, *Verrucaria*, BORRER, E. B. 2612, f. 1.)

SPECIES 2. *S. crocea*, Ach.,

Which occurs in Europe, America, and frigid or northern Asia.

Specimen 1.—Brandon Mountain, Kerry, Ireland, CARROLL; Wicklow, D. MOORE, in Herb. Carroll. On one specimen there is a number of large black cones, resembling the pycnides of *Dichonia rugosa*, evidently parasitic, and having no relation to the *Solorina*, further than that they grow on it. They are closely aggregated or grouped on the surface of the thallus, to which they give a very irregular warted character. The stylospores are very large—about $\frac{1}{750}$ th to $\frac{1}{600}$ th long and $\frac{1}{3000}$ th broad—apparently normally 1-septate, colourless, full of granular or grumous matter.

FAMILY X. CETRARIÆ.

GENUS I. CETRARIA, Ach., Nyl.

NYLANDER has retained three species in the old genus *Cetraria*, viz., the fruticulose species,—placing those having a flat, broad, Parmelioid thallus in a separate genus,—*Platysma*. Undoubtedly, both groups are comparatively natural; still it admits of doubt how far it is advisable to constitute two genera, rather than merely two sections of a single genus. The spermogones differ somewhat in the two groups or genera. In *Cetraria* they are more of the character of those of *Cladonia* than in *Platysma*. They are barrel-shaped organs, seated on the apices of the ultimate ramuscles of the thallus, as in *aculeata*, or on cilia, fringing the margins of the lacinia, as in *Islandica*. In neither case are they very conspicuous, unless on careful examination. They are of the same colour as the thallus; hence the line of separation or junction of the thallus and spermogone is not so distinct as in *Cladonia*. Neither are they so large nor so distinctly barrel-shaped as in that genus. They vary greatly in length, being

sometimes short and broad, at other times long and narrow. Where the marginal cilia are very short or wanting—in *C. Islandica*—the spermogones appear seated directly on the margins of the laciniae, like so many teeth, resembling the spermogones of the *Platysma* group. The thallus of *C. aculeata* terminates in delicate ramuscles or spinules, the tips or horns of which are formed by its spermogones. These organs are generally very delicate and minute, with difficulty recognised even under the lens, or until subjected to pressure in water between glass slides under the microscope, when the emission of myriads of spermata betrays their true character. The length of the spermogone in *C. aculeata* scarcely exceeds $\frac{1}{400}$ th to $\frac{1}{500}$ th. The cavity is usually simple. The spermata are straight and linear, about $\frac{1}{3000}$ th to $\frac{1}{7000}$ th long, with a breadth of $\frac{1}{25,000}$ th to $\frac{1}{30,000}$ th. The sterigmata are generally composed of a few linear delicate cells or articulations; occasionally they are simple, or consist of single cells, as in *Platysma*.

SPECIES 1. *C. Islandica*, Ach.,

Which is almost a cosmopolite, occurring in Europe, America, and Asia (northern Himalayas).

Specimen 1.—Large form of thallus, with broad laciniae; var. *b. platyna*, KÖRB. 44; Ben Macdhui, Braemar (Cairntoul side), August 1856, W. L. L. The margins of the laciniae are chiefly naked; the marginal cilia are so short that the spermogones appear directly seated on the margins of the laciniae as denticulate warts or tubercles, not distinctly barrel-shaped.

Specimen 2.—Summit of a hill near Kinsale, Ireland; coll. by J. SULLIVAN; in Herb. Carroll, who says—“This is rare in Ireland; I have never observed it.” The plant bears no apothecia, as is generally the case also in British specimens; but it is abundantly furnished with marginal cilia, many of which are spermogoniferous. The latter are tipped with small, short, deep-brown barrel-shaped warts. The sterile cilia are generally longer, more wavy, and have pale apices. The spermata are rod-shaped, about $\frac{1}{7000}$ th long, and $\frac{1}{30,000}$ th broad. The sterigmata are shortish, and consist of a few oblong or linear articulations, as in many of the *Parmelia*.

Specimen 3.—HEPP. exs. 169; among moss on the Hütli, Switzerland; abundant in fructification on St Moritz. The spermogoniferous marginal cilia are short, but numerous. The sterigmata are of a few articulations, or sub-simple.

Specimen 4.—SCHLÆRER exs. 22 (sub var. *vulgaris*), Switzerland. The marginal cilia are short, and not terminating in a distinct barrel; many of them are bifid, trifid, or proliferous. The spermata are delicate needles of medium size, that is, about $\frac{1}{4000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata are short, indistinct, broadish, and of a few articulations.

Specimen 5.—Ben Lawers, June 1856, W. L. L. The spermogones are seated on longish marginal cilia; they are broader, or bulge more, towards their apex

than base, and they vary much in length. Some of the cilia are bifid, or irregularly knobbed at the ends; these are always abortive or sterile. The function of these cilia is generally considered to be merely to act as pedicels to the spermogones. TULASNE speaks of two or three spermogones sometimes being united; this I have never seen.

Specimen 6.—Mount Forster, near the top, Cape Horn; Dr HOOKER; in Herb. Hooker, Kew. The spermogoniferous marginal cilia are long and prominent. This and the preceding belong to var. *crispa*, Ach.

SPECIES 2. *C. aculeata*, Fr.,

Which occurs in America and Europe. The very ramose branches of the thallus divide at their summit into very delicate ramuscles, short and divaricate, some of which resemble cilia or spinules. Some of the latter, again, have black or very deep-brown bulging tips; and these, under the lens, are found to be oval or oval-truncate spermogones, resembling the barrel-shaped ones of *Cladonia rangiferina*. The length of the spermogone scarcely exceeds $\frac{1}{400}$ th to $\frac{1}{600}$ th, and that of its support or pedicel is about $\frac{1}{130}$ th. The spermatia are usually from $\frac{1}{3000}$ th to $\frac{1}{4000}$ th long, and $\frac{1}{20,000}$ th broad. The terminal spinules here are analogous in function to the marginal ones in the preceding species. The thallus of the plant varies greatly in regard to the number and ramoseness of its branches, and the quantity of the spermogoniferous or sterile spinules.

Specimen 1.—LEIGHT. exs. 3, Haughmond Hill, Shropshire. The spermatia and sterigmata are so minute as to be with great difficulty seen. The ciliate-spinulose varieties, described by various authors, are probably chiefly spermogoniferous states of the plant similar to this.

GENUS II. PLATYSMA, Hoffm., Nyl.

In this genus the spermogones generally occur as black or brown tubercles or cones, scattered on the crisped margins of the thalline lobes, to which they give more or less of a denticulate or nigro-ciliate character, as in *P. nivale*, *cucullatum*, *ciliare*, and *juniperinum*. This has not escaped the older lichenologists, who have described such spermogoniferous states as varieties. Sometimes the spermogones occur on prolongations of, and from, the margins of the thallus, and occasionally, though very rarely, they are scattered on the flat surface of the thallus, as brown, grain-like bodies, seated on pale, inconspicuous, thalline papillæ, as in a form of *sepincola*. They are frequently very distinct and easily seen, from the contrast of their dark colour with the beautiful lemon-yellow of the thallus, as in *nivale* and *cucullatum*. The cavity of the spermogone is simple; the envelope deep-brown, of regular, distinct, roundish cells. The sterigmata are generally formed of a few irregular articulated cells. The spermatia are straight and linear, about $\frac{1}{4000}$ th long, with a breadth of $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th. NYLANDER describes

them as either thickened at one or both ends, and he divides the species of *Platysma* into sections, according as their spermatia have the one or other character. This I have not specially noticed. But either NYLANDER or his printer makes a strange mistake, in his "Prodomus" or "Synopsis," in regard to the names of the species having spermatia thickened at one or both ends. In the former volume (p. 49), he arranges under,—

A. "Spermatia versus apicem modo alterum fusiformi-incrassatula,"

P. cucullatum and *P. nivale*; and under,—

B. "Spermatia apice utroque leviter fusiformi-clavata,"

P. juniperinum, *glaucum*, and *sepinolum*.

In his Synopsis, again (p. 37), he gives, as instances of,—

I. "Spermaties aciculaires un peu épaissies en fuseau à l'une de leurs extrémités (spermatia acicularia versus alterum apicem leviter fusiformi-incrassatula),"

P. glaucum and *P. juniperinum*; and, of—

II. "Spermaties aciculaires très légèrement épaissies en voisinage de leurs extrémités (spermatia versus utrumque apicem levissime fusiformi-incrassata),"

P. nivale and *P. cucullatum*!

There is surely some typographical error to account for such a manifest contradiction!

SPECIES 1. *P. nivale*, L.,

Which occurs in northern America, as well as in Europe. Its spermogoniferous states constitute the var. *b. denticulata* of SCHÆRER. (Enum., p. 14, "Thali ora nigro-denticulata.")

Specimen 1.—LEIGHT. exs. 43; Clova, Scotland. The spermogones are deep-brown or black, minute, round, prominent warts, fringing the crisped edges of the laciniae, or seated on tooth-like prolongations from their margins. The ostiole is inconspicuous. The spermatia are rod-shaped, about $\frac{1}{4000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata consist of a few irregular articulations.

Specimen 2.—SCHÆRER exs. 19; Switzerland. Spermogones as in No. 1.

Specimen 3.—Disco Island, Arctic America, Dr LYALL, 1852; no apothecia; spermogones abundant. FRANKLIN'S first journey; broad-lobed form of thallus. Both apothecia and spermogones abound. In Herb. Hooker, Kew.

Specimen 4.—Lochnagar, Braemar. Professor DICKIE; specimen closely resembles *P. cucullatum*, and is apparently a transition form.

Specimen 5.—Sugar-loaf Mountain, County Wicklow, Ireland, in which country it is very rare; D. MOORE, in Herb. Carroll; no apothecia, but spermogoniferous.

Specimen 6.—Plants of Braemar, No. 394, coll. by A. CROALL of Montrose; source of Dee, August 1855; spermogones as in No. 1.

SPECIES 2. *P. cucullatum*, Hoffm.

The close ally and frequent companion of the preceding species. On the Norwegian mountains. I almost always found these two species growing in the same tuft. Indeed they would appear to graduate into each other. Their apothecia and spermogones are quite alike, as are also their spores and spermatia. The spermogones are deep-brown minute tubercles, fringing the crisped margins of the laciniae, precisely as in *nivale*; they are generally flatter and more irregular as to size than in the species just named.

Specimen 1.—SCHÆRER exs. 18; Switzerland. The spermogones are chiefly seated about the apices of the laciniae. The spermatia are rod-shaped; the sterigmata articulated, thickish, short; their bases pale-brown, as is also the cellular tissue of the envelope.

Specimen 2.—Arctic Coast, Garray Island, 1850, Captain PULLEN; Kotzebue Sound, BEECHY; apothecia abundant. In all these specimens, which are in Herb. Hooker, Kew, the spermogones are as above described, or as described in *P. nivale*. In a specimen from Norton Sound, the Rev. CHURCHILL BABINGTON remarks, that the “upper part of the thallus is sparingly fringed with black teeth.”* This he does not at all seem to be aware is the ordinary spermogoniferous state of the plant.

SPECIES 3. *P. juniperinum*, L.,

And its var. *pinastri*, Scop.; both of which occur in America and Europe. Its spermogones are similar in site, appearance, and contents, to those of the two preceding species, being small black warts or points, fringing the crisped borders of the lobes; seldom so numerous or so closely aggregated as to give a nigro-denticulate character to the thallus, as in *P. nivale*. They are generally easily distinguishable, from the contrast of their dark colour with the beautiful yellow of the thallus. KÖRBER describes the spermatia “as almost club-shaped.” They have always appeared to me to be simply needle-shaped, and if there is any deviation from the linear form, it is probably very slight and unimportant.

Specimen 1.—SCHÆRER exs. 20 (sub var. *α. terrestris*). The spermogones are brown; they are most abundant in the right-hand specimen in my copy. The envelope is deep-brown, of regular, distinct, roundish cells. The spermatia are delicate needles of medium size, longer than in the two preceding species. The sterigmata are short, thick, and composed of a few indistinct articulations.

Specimen 2.—West coast of North America; on twigs; FRANKLIN'S first voyage; Arctic Islets, Sir E. PARRY; all in Herb. Hooker, Kew.

SCHLEICHER'S exs. No. 52, 1810; Alps; P. de Caunteret, Pyrenees, SPRUCE'S

* SEEMANN'S Botany of the Voyage of H.M.S. Herald, during 1848-52, p. 47. Enumeration of the Lichens of Norton and Kotzebue Sounds. By Rev. CHURCHILL BABINGTON.

“Lich. Pyrenæi;” approaches *β. virescens*, TUCKERM. One specimen has spermogones in little black tufts dotting over here and there the margin of the lobes. Alps of Dovrefjeldt, 1828; Sommerfeldt Itin. Some specimens are nigro-denticulate with spermogones, as in *P. nivale*. The above species are all contained in Herb. Hooker, Kew.

SPECIES 4. *P. citrinum*, Tayl.,

A native of Java; a beautiful species, with a broad-lobed lemon-yellow thallus. The spermogones are marginal, minute brown tubercles, resembling, but scarcely so prominent as, those of *P. nivale*.

SPECIES 5. *P. glaucum*, Hoffm.,

Which occurs in Europe, America, and Asia. KÖRBER says, “Spermogonien sah ich noch nicht,” and certainly they are not very common.

Specimen 1.—Sierra de Estrella, Portugal; WELWITZSCH, “Crypt. Lusitan.” No. 116. The thallus approaches var. *fallax*, Sch., in the division of its lobes into laciniae, which again have their margins frequently studded over with isidioid growths. The spermogones are marginal, crowded, indistinct, minute, brown tubercles, which add to, though they seldom of themselves give, a denticulate character to the margins of the lobes.

Specimen 2.—Var. *fallax* of authors; Scotland; in the Menziesian Herbarium, Royal Botanic Garden, Edinburgh. The plant bears no apothecia; the lobes are laciniate, and their margins isidiiferous. Some of the specimens belong, undoubtedly, to *Parmelia perlata*, with which this *Platysma* is frequently confounded, especially the var. *fallax* of the latter with var. *ciliata* of the former. The spermogones of the *Parmelia* are, however, quite different from those of the *Platysma*. They are punctiform, black, immersed, and scattered on the flat surface of the lobes of the thallus near their margin. In this Scotch specimen of var. *fallax* there are no spermogones; but a few occur in a specimen of the same var. from the west coast of North America, 1787; collected by ALEX. MENZIES himself. Apothecia occur at the ends of the laciniae; the margins of which laciniae and lobes are very isidioid. The tooth-like isidia are sometimes tipped with spermogones; but the majority of them are sterile. American specimens of some other *Platysmae* are occasionally spermogoniferous, while British specimens are not,—such is *P. sepincolum*.

SPECIES 6. *P. lacunosum*, Ach.,

Its spermogones are marginal, as in the preceding species, between which and *P. ciliare* it is intermediate in regard to their size and appearance.

Specimen 1.—West coast of North America; Oregon, SCOULER; in Herb.

Hooker, Kew. The spermogones are longish, brown, irregular tubercles or warts, frequently becoming enlarged and deformed.

Specimen 2.—On trees and pales, New England, U. S. America; TUCKERMANN, No. 6, exs. (sub *Cetraria lacunosa*, β . *Atlantica*). The margins of the lobes are studded over with chiefly degenerate spermogones, which do not give so characteristic a fringe or denticulate appearance as in *P. ciliare*. Besides being marginal, the spermogones are frequently studded over the flat surface of the lobes near their margin. Cambridge, Massachusetts; on pales; TUCKERMANN; in Herb. Menzies, Royal Botanic Garden, Edinburgh. The spermogonal fringe of the lobes is similar to that in *P. ciliare*, but the spermogones are smaller. Sometimes they are studded over projections from the margins of the thallus.

SPECIES 7. *P. ciliare*, Ach.

It is frequently confounded with *P. sepinolum*, but is distinguishable by its marginal spermogones, which are very distinct, constant, and crowded, and which give the thalline lobes a peculiar warted appearance. Its name has been conferred, it would appear, not in allusion to its spermogones, which might earn for it the name rather of *denticulata*, but on account of occasional marginal fibres,—strong, darkish, and branching,—with which it is also furnished.

Specimen 1.—Schooley's Mountains, North America, June 1856; Dr A. O. BRODIE. The spermogones are largish brown cones or warts; more abundant, more distinct, and more constant, than in any of the other species of *Platysma*. The thallus is greenish-gray, smooth and shining above, whitish and lacunose below; the laciniae are sometimes narrowish. The spermogones somewhat resemble those of *P. sepinolum*, which, however, I have met with only on the surface, not on the edges, of the thallus. The spermatia are acicular, and about $\frac{1}{4000}$ th long; the sterigmata are simple, or of a few articulations.

Specimen 2.—Cambridge, Massachusetts, TUCKERMANN; in Herb. Menzies, Royal Botanic Garden, Edinburgh; with apothecia. The spermogones are very distinct, barrel-shaped organs, seated on the ends of cilia, or tooth-like projections from the margin of the thallus. They thus somewhat resemble the spermogones of *Cetraria Islandica*, but are much shorter. The ordinary form of spermogones occurs in TUCKERMANN'S exs. No. 5; on trees and pales, New England, U. S. America.

SPECIES 8. *P. sepinolum*, Hoffm.,

Which occurs in Europe, America, and Asia.

Specimen 1.—On trees, Ingleby Park, Cleveland, Yorkshire, 1854; collected by W. MUDD. The spermogones are abundant as small olive-brown prominent round tubercles or papillae; superficial or sub-pedicellate; seated on slight pale

papillar elevations of the thallus, scattered on the flat surface of the lobes near their margin. Occasionally, but rarely, they would appear to occur on the crisped and curled margins themselves; in which case, it is impossible to distinguish them from those of the preceding species. The cavity of the spermogones is simple, regular, round; the envelope consists of a brownish or olive-coloured cellular tissue. The spermatia are rod-shaped or acicular, and about $\frac{1}{8000}$ th long, on the apices chiefly of short, simple, inconspicuous sterigmata.

Specimen 2.—Owhyhee, Sandwich Islands, 1794; collected by ALEX. MENZIES; in Herb. Menzies; and also California, 1793; both in Herh. Royal Botanic Garden, Edinburgh. The margins of the lobes are fringed with small brown or black tooth-like spermogones, as in *P. ciliare*, to which MENZIES'S plant may perhaps really belong.

FAMILY XI. UMBILICARIÆ.

GENUS I. UMBILICARIA, *Hoffm.*

There is great uniformity in this genus in regard to the internal structure, or the contents, of the spermogones. In all the species the sterigmata are articulated, and the spermatia very numerous, short, and rod-shaped. Externally the spermogones vary somewhat. They are always more or less immersed in the substance of the thallus; but their ostioles exhibit every gradation of form between the papilla and the mere point. Their colour externally is usually black, and, as a general rule, they are easily seen in proportion as the thallus is light-gray or copper-coloured. Sometimes the spermogones are largish flattened cones, or even tubercles, with a depressed apex. These cones may be perched on papillar elevations of the thallus, which render them still more prominent. Sometimes they are apparent on the surface of the thallus as mere immersed black points, flat or depressed. Round these points, which are the ostioles, the cortical layer of the thallus may be ruptured or fissured in a radiating manner, or the thallus may form a sort of ring round the black punctiform ostiole. This ostiole is usually simple, round, very minute, and inconspicuous. But in old spermogones it frequently becomes gaping and very prominent, irregular in form, triangular or stellate-fissured. The thallus sometimes appears dotted over with largish irregular black perforations, which are the ostioles of old spermogones. Moreover, the nucleus or body of old spermogones frequently falls out, and irregular saucer-like cavities are left. The size of the spermogones varies greatly. They may be so minute that they are scarcely visible even under the lens, as in *U. polyphylla*; or they may be very large and distinct, as in some forms of *U. redlet*, *U. hirsuta*, and *U. cylindrica*. In *U. proboscidea* their diameter is $\frac{1}{30}$ th to $\frac{1}{130}$ th; in *U. erosa* $\frac{1}{170}$ th to $\frac{1}{260}$ th; and in *U. hirsuta* their depth is $\frac{1}{100}$ th to $\frac{1}{250}$ th. They are generally scattered in large numbers about the margins of the lobes on their flat

surface; sometimes they are scattered among the apothecia; at other times they are met with only on specimens or thalli bearing no apothecia. The envelope is brown or black, and very thin, being formed of hexagonal or roundish cells. The internal tissue is grayish and horny; and the body of the spermogones is easily enucleated with a needle. The cavity is simple, and more or less spherical. The arthrosterigmata are longish, as in *Sticta* and *Collema*, ramose, and densely aggregated into a more or less compact tissue; they are made up of short, roundish, or cubical cellules, which become thickened by deposits on their internal walls. Their length in *U. pustulata* is $\frac{1}{350}$ th to $\frac{1}{500}$ th; their breadth varies from $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th. The spermatia are rod-shaped bodies, seated on the apices and sides of the sterigmata; their length is about $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th; their breadth $\frac{1}{25,000}$ th to $\frac{1}{30,000}$ th.

SPECIES 1. *U. pustulata*, Hoffm.,

Which occurs in Europe, Africa, and northern America. It is the type of a section distinguished by 1-spored thecæ, constituting the genus *Lasalia*, Mær., and including the two following species—*U. papulosa* and *U. Pennsylvanica*. Its spermogones are usually isolated, obtuse, very prominent, black cones, round which the cortical or epidermic layer of the thallus is sometimes ruptured or raised: their diameter is about $\frac{1}{50}$ th to $\frac{1}{60}$ th.

Specimen 1.—Dartmoor; in Herb. Hooker, Kew. The specimens from this station are very large,—the thallus being as handsome as in specimens collected by me on the Norwegian mountains, and more so than those got in the Isle of Skye (base of the Coolin Hills). The spermogones are abundant, but there are usually no apothecia. On one specimen, however, from the “Two Tors on Dartmoor, near Chagford, Aug. 1836,” the apothecia, as well as the spermogones, abound.

Specimen 2.—Labrador; in Herb. Hooker, Kew. Both apothecia and spermogones are plentiful and distinct. The spermatia are about $\frac{1}{10,000}$ th long, with a breadth of $\frac{1}{25,000}$ th. The sterigmata are about $\frac{1}{500}$ th to $\frac{1}{550}$ th long, with a breadth of $\frac{1}{10,000}$ th, articulated as in *Sticta* or *Collema*.

Specimen 3.—Sierra de Gerez, Portugal; WELWITZSCH, Crypt. Lusit., No. 107: with apothecia; in Herb. Hooker, Kew. The spermogones are superficial, large, distinct papillæ, scattered over the pale-gray pustules of the thallus. Sometimes these papillæ seem immersed, from being surrounded by a collar of the cortical layer of the thallus, which they fissure in a stellate-radiate manner. Occasionally the spermogones are mere immersed black points.

Specimen 4.—Puerto de Leiteriegos, Durieu, “Plant. select. Hisp.-Lusit.,” No. 58; in Herb. Hooker, Kew. Apothecia are plentiful; the spermogones are scattered about the margins of the pale-gray thallus as large, distinct, black papillæ, with a distinct round or regular ostiole.

SPECIES 2. *U. papulosa*, Ach.,

Which occurs in North America and in the Himalayas. It closely resembles, in its thallus, apothecia, and spermogones, the preceding species, and I know of no good distinctive marks, such as to justify their separation as species.

Specimen 1.—British North America; United States; North Carolina; Lemel Mountain, Pennsylvania; in Herb. Hooker, Kew. The spermogones are plentiful as minute black papillæ, scattered in groups towards the periphery of the thallus. The spermatia are rod-shaped, $\frac{1}{10,000}$ th long, and $\frac{1}{20,000}$ th broad, on arthrosterigmata, as in *U. pustulata*.

Specimen 2.—Schooley's Mountains, North America; July 1856; Dr A. O. BRODIE. Apothecia and spermogones abundant, but the former are chiefly degenerate. The thallus is of a light-gray or brownish-gray tint, on which the minute, black, papillar spermogones are easily recognised. They appear to the naked eye as very small black grains, scattered all over the thallus, including its pustular elevations, but most abundant about the margins of the thallus. They more resemble the spermogones of *U. polyphylla* than of any other species of *Umbilicaria*. The ostioles are invisible even under the lens. The sterigmata are irregular in outline, and are composed of short, broad, thick-walled irregular cells. The spermatia are as described in No. 1.

SPECIES 3. *U. Pennsylvanica*, Ach.

Specimen 1.—White Mountains, North America; TUCKERMANN; in Herb. Menzies, Royal Botanic Garden, Edinburgh. The thallus is of a pale-brown, darkest about its margins. The spermogones are paler than the thallus; hence they appear scattered abundantly about the margins of the thallus as white sago-like grains. They are large papillæ,—among the largest spermogones I have met with in *Umbilicaria*,—and they have a distinct brown, round, or irregular ostiole.

Specimen 2.—FRANKLIN'S First Journey; in Herb. Hooker, Kew. The spermogones are plentiful about the periphery of the thallus, as distinct black papillæ, with stellate-fissured ostioles.

SPECIES 4. *U. Mühlenbergii*, Ach.,

Like the two preceding species, a native of North America. This and the following species have 8-spored thecæ and simple spores.

Specimen 1.—White Mountains, North America; TUCKERMANN; in Herb. Menzies, Royal Botanic Garden, Edinburgh; and its var. β *alpina*; with apothecia. Spermogones are plentiful about the margins of the thallus as small, distinct, flattish papillæ, of the same colour as the thallus, or not greatly darker, with ostioles more or less distinct.

Specimen 2.—Rocky Mountains, North America; in Herb. Hooker, Kew. Spermogones are abundant as black papillæ, with central roundish pores or ostioles. The spermatia and sterigmata are as described in the preceding species.

SPECIES 5. *U. polyrrhiza*, L.,

Which occurs in Europe and Asia. This is the familiar *Gyrophora pellita*, Ach., of the earlier lichenologists.

Specimen 1.—Hills above Loch Freuchie, Amulree, Perthshire, May 1856, W. L. L.; no apothecia. The spermogones are plentiful, especially about the periphery of the thallus, as small papillæ, of the same colour as the thallus. Hence they are not easily seen, and this, therefore, is one of the worst species in which to study the spermogones of *Umbilicaria*. These papillæ are pierced by a very minute, round, or stellate-fissured ostiole. In many cases there are no papillæ, and the ostioles then appear directly to perforate the thallus, which may appear studded over with patent, black, irregular perforations, as in *P. saxatilis*, var. *omphalodes*.

Specimen 2.—Lochnagar, Braemar, August 1854; Plants of Braemar, A. CROALL, No. 197; with abundant apothecia. The spermogones are chiefly sub-marginal, punctiform, depressed, and inconspicuous. In other specimens from the same locality, collected by Mr CROALL (in Herb. meo), but not bearing apothecia, the margins of the thallus are studded over with minute depressions, which appear to be old spermogones. Papillar spermogones occasionally occur, pierced by a black, minute, round, or irregular ostiole. The body of the spermogones has in some cases fallen out, leaving saucer-shaped cavities, with turgid black irregular borders.

Specimen 3.—Highlands of Scotland, 1778, collected by ALEX. MENZIES; in Herb. Menzies, Royal Botanic Garden, Edinburgh. The thallus is very pale; hence the black apothecia are well seen by contrast of their colour. The spermogones are also distinct, but they are chiefly old and deformed.

Specimen 4.—North-west America (sub nom. *G. pellita* and *G. vellea*); in Herb. Hooker, Kew. Spermogones are plentiful about the periphery of the thallus, as small black papillæ, scarcely distinguishable, however, on the dark-olive, or brown thallus.

SPECIES 6. *U. polyphylla*, Hoffm.,

Which occurs in Europe, America, and Asia, with its var. *deusta*, Ach., Fr., which inhabits Europe and Asia at least.

Specimen 1.—Ben Macdhui, Braemar, August 1856, W. L. L. This appears to be a transition form into *U. hyperborea*, but the thallus is not yet pustular or warted. I may here mention, that most of the British species, at least, of *Umbilicaria*, pass into each other, as regards the thallus and apothecia; while the spores and spermatia are essentially the same in all. I therefore prefer, with

LEIGHTON,* to regard them as varieties of one species, rather than to look upon them as separate species. This specimen is associated with forms of *U. hyperborea*, which are generally referred by authors to *U. erosa*. The spermogones are abundant on some of the lobes, as very minute indistinct papillæ.

Specimen 2.—Roadside walls, opposite Invercauld, Braemar, August 1856, W. L. L.; no apothecia. The spermogones are minute black cones, with a deep-brown cellular envelope, and rod-shaped spermatia, about $\frac{1}{8000}$ th long.

Specimen 3.—Lochnagar, Braemar, July 1855, ALEX. CROALL; Plants of Braemar, No. 392; no apothecia. Spermogones are scattered indiscriminately over the thallus as small, indistinct black papillæ, with no perceptible ostiole. From the dark colour of the thallus, and the fact that the spermogones are generally more or less of the same tint as the thallus, and hence not easily distinguished, this is a bad species, like *U. polyrrhiza*, in which to study the spermogones of *Umbilicaria*.

Specimen 4.—Howden Gill, Cleveland, Yorkshire, 1854; coll. W. MUDD; no apothecia. Spermogones are plentifully scattered all over the thallus, but they are most minute black papillæ, scarcely visible even under the lens. Their walls are deep-brown; their spermatia and sterigmata distinct, and of the characters described in the foregoing species.

SPECIES 7. *U. hyperborea*, Hoffm.,

And its var. *arctica*, SOMMERF., which occur in Europe and America.

Specimen 1.—HEPP. exs. 116, sub *Gyrophora*; syn. MOÛG. and NESTLER'S exs. 1047; on granite rocks, St Moritz; with apothecia. Spermogones are scattered over the copper-coloured thallus, as black cones or papillæ, largish and distinct, some flattened, a few depressed, others slightly raised. The envelope is of a deep-brown hexagonal cellular tissue; the spermatia and sterigmata are as in *U. pustulata*, and the other species already described.

Specimen 2.—Brandon Mountain, County Kerry, Ireland, D. MOORE; in Herb. Carroll. The surface of the thallus consists of, or is marked by, a series of convolutions, so arranged as to appear like an agglomeration of warts. On the tops of these are perched the spermogones, as small black papillæ, with sub-prominent ostioles. The cortical layer of the thallus is often eroded, exposing the subjacent white medullary tissue. The spermogones on such portions of thallus are very distinct, as round brown points, seated on the tops of whitish pulvinuli. The spermatia are about $\frac{1}{5000}$ th to $\frac{1}{6000}$ th long; the sterigmata are longish and distinct.

Specimen 3.—North-west Passage, PARRY; Walden Island, PARRY; in Herb. Hooker, Kew. In one of PARRY'S specimens spermogones are abundant.

* "Monograph of the British Umbilicariæ." By the Rev. W. A. LEIGHTON.—*Annals of Nat. History*, Oct. 1856; and reprinted as a separate pamphlet.

SPECIES 8. *U. erosa*, Hoffm.,

Which occurs in Europe and America. This appears to me a particularly bad species, inasmuch as all the *Umbilicarias* are liable to erosion of the margins of the thallus, though this is greatest in the preceding species, to which *U. erosa* ought chiefly to pertain as a variety. Next to *U. hyperborea*, erosion of the thallus is common in *U. proboscidea* and *U. cylindrica*. Though spermogones are usually abundant in *U. erosa*, they are not easily seen, from being of the same colour as the thallus, or from their minute size. They are papillæform or punctiform; immersed; with a diameter of $\frac{1}{170}$ th to $\frac{1}{200}$ th. The cavity is simple; the envelope black, and moderately thick; and the internal tissue ash-gray.

Specimen 1.—Ben Macdhui, Braemar, August 1856, W. L. L. Spermogones are abundant and distinct as black cones or papillæ, scattered about the margins of the pitchy or bronze-coloured thallus. They are intermediate in size, between those of *U. cylindrica* and *U. polyphylla*; the spermogones of the latter species being the smallest I have met with in *Umbilicaria*. The ostiole is generally distinct, round, chink-like, triangular or stellate-fissured, according to age; in the older spermogones it is large and patent. The spermatia are rod-shaped, and about $\frac{1}{8000}$ th long. Another specimen from the same locality has more the character of *U. cylindrica*; but the margin of the thallus is decidedly and distinctly erose. The spermogones are mostly old; the ostiole is large and saucer-like, surrounded by a turgid black border. The thallus seems roughened over with a multitude of little saucers, which are most profusely scattered about the edge of the lobes.

Specimen 2.—Ben Nevis, August 1856, W. L. L. Old spermogones are here also abundant, especially about the periphery of the thallus. They have large saucer-like ostioles.

Specimen 3.—Hills east of Sligachan, Isle of Skye, August 1856, W. L. L.; apothecia abundant. This appears to be a mere form or state of *U. hyperborea*. The spermogones are large black warts or papillæ, scattered over the bronze-coloured thallus. The spermatia are about $\frac{1}{8000}$ th long; the sterigmata irregular, thickish, composed of short roundish cells or articulations.

Specimen 4.—Highlands of Scotland, 1778; collected by ALEX. MENZIES; in Herb. Menzies, Royal Botanic Garden, Edinburgh. This plant, too, has quite the aspect of *U. hyperborea*, except as to the erose or cribriform thallus. It is beautifully studded over with spermogones.

Specimen 5.—Mangerton, County Kerry, Ireland; coll. ISAAC CARROLL. Thallus much deformed. The spermogones are minute black papillæ; of the old ones nothing remains but the irregular gaping ostiole. The cavity seems frequently multiple, apparently from coalescence of several spermogones. Associated with the ordinary spermatiferous sterigmata are numerous long, hypertrophied, sterile filaments, somewhat as in *Ramalina*, but neither so long nor so

ramose. The ordinary sterigmata are about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long; the spermatia $\frac{1}{10,000}$ th long, and $\frac{1}{30,000}$ th broad.

Specimen 6.—Shores of Loch Muick, Braemar, August 1854; A. CROALL. The margins of the thallus are covered with a mass of papillar elevations, apparently of the thallus itself, and not differing in colour therefrom, each pierced by a distinct round or irregularly fissured ostiole. These are the spermogones which are not easily seen, from being concolorous with the thallus.

Specimen 7.—From DON'S Herbarium, now in the possession of Mr MACNAB, Royal Botanic Garden, Edinburgh; habitat not given. Spermogones are abundant as large, distinct, cone-like warts, scattered among the apothecia, with generally an indistinct stellate-fissured ostiole.

Specimen 8.—Achtermannshöhe, Hartz Mountains, Germany; coll. HAMPE, 1846; exs. No. 7. The thallus is referrible to *U. hyperborea*; the apothecia resemble those of *U. polyrrhiza*. Spermogones are abundant as very minute black points.

Specimen 9.—SCHÆRER exs. 153; on granitic rocks; Alps, Switzerland. The spermogones are scattered generally over the thallus as black elevated papillæ, pierced by an indistinct ostiole.

SPECIES 9. *U. proboscidea*, DC.,

Which occurs in Europe, America, and Asia. This appears to me a particularly ill-marked species, which is partly referrible to *U. polyphylla*, *U. hyperborea*, and *U. cylindrica*.

Specimen 1.—Iceland; in Herb. Hooker, Kew. The thallus is of a very pale-grayish colour, and has submarginal largish black spermogones, whose diameter is from $\frac{1}{30}$ th to $\frac{1}{130}$ th.

SPECIES 10. *U. cylindrica*, L. Fr.,

Which occurs in Europe, America, and New Holland. This is a species or variety—according to the view taken of the classification of the *Umbilicarias*—comparatively well-marked, when it bears its characteristic marginal fibres or cilia; but these are frequently absent, in which case it passes into the preceding species, and others.

Specimen 1.—Top of Ben Lawers, Perthshire, June 1856, W. L. L. The thallus is gray, thick, and much curled or gnarled. Spermogones are especially abundant on specimens bearing no apothecia; in them they are scattered generally over the whole surface, while in specimens with apothecia they are chiefly confined to the margins. They are distinct black papillæ or cones, varying greatly in size, some of them very large. In the older spermogones the ostioles are large, gaping, and sometimes saucer-shaped; in the younger ones they are some-

times triangular, chink-like, or stellate-fissured. In other specimens from the same locality, the spermogones are very minute papillæ, scarcely conspicuous; or there is merely a round black spot, perforated by an ostiole. This is an excellent species in which to study the spermogones of *Umbilicaria*. The spermatia are rod-shaped and short. The sterigmata are composed of short, thick-walled, roundish cellules.

Specimen 2.—Top of Ben Lomond, August 1855, W. L. L. Spermogones are here also abundant, as largish sub-prominent cones or papillæ.

Specimen 3.—Morchone (or Morven), Braemar, August 1856, W. L. L. The spermogones are very abundant, and occur in a great variety of forms. In one specimen, which is polyphyllous, much curled and convex, the ostioles are very patent, and surrounded by a prominent black edge. They give the thallus the appearance of being studded over with a series of black perforations. In another specimen, where the thallus is of an ashey-gray colour, the spermogones are prominent as minute black papillæ, with an indistinct ostiole. In others, the spermogones are old, hypertrophied, and degenerate; they have no ostiole, and appear as black, flat, large irregular disks or tubercles, scattered irregularly over the surface of the thallus, to which they give a curiously warted character. They are generally most abundant and best marked in specimens destitute of apothecia. Sometimes, again, the spermogones are black cones, seated on the flattened apex of a second and larger cone formed of the thallus; and these double cones are frequently very distinct when the thallus is of a pale colour.

Specimen 4.—Hills above Loch Freuchie, Amulree, Perthshire, May 1856, W. L. L. Apothecia abundant; marginal cilia long and strong. The thallus is light-coloured; the spermogonal papillæ black and distinct; the ostiole distinct, stellate-fissured, but not very large.

Specimen 5.—Ben Lawers, August 1855, Dr GILCHRIST; no apothecia. Thallus being pale-gray, the spermogones are easily seen; they are distinct large black papillæ, scattered chiefly about the margins of the thallus; many of them are irregular, flattened, large, and hypertrophied. The spermatia are about $\frac{1}{8000}$ th long, and very abundant.

Specimen 6.—Lochnagar, Braemar, July 1855, A. CROALL. The margins of the thallus are almost naked; and the plant approaches *U. proboscidea*. The spermogones are large cones or tubercles, darker than the thallus, with a round, elongated or stellate-fissured ostiole.

Specimen 7.—Top of Muckish Mountain, County Donegal, Ireland, Professor DICKIE. The thallus is chiefly monophyllous; its margin fringed with short, coarse, rudimentary fibres; the colour gray, the surface cracked, the consistence leathery. There are no apothecia. Spermogones are abundant and distinct, from contrast with the pale colour of the thallus; they are small, black papillæ. The spermatia are $\frac{1}{10,000}$ th long, and $\frac{1}{20,000}$ th broad.

Specimen 8.—Disco Island, Dr LYALL, 1854; in Herb. Hooker, Kew; has both apothecia and spermogones.

Specimen 9.—LEIGHTON exs. 95 (sub *U. varia* var. *proboscidea*, a. LEIGHT.), Clova; with apothecia. The spermogones are black cones, pretty well seen on the grayish thallus.

Specimen 10.—SCHÆRER exs. 143 (sub *U. polymorpha*, a. *cylindrica*, A: *Syn. Lichen crinitus*, LIGHTFOOT); on the Grimsel, Switzerland. The spermogones are submarginal, distinct, black cones or papillæ.

SPECIES 11. *U. vellea*, L., Fr.,

Which occurs in Europe, Abyssinia, the Canary Islands, and America. The thallus is usually pale in colour; hence the spermogones are easily seen. It properly, I think, ought to include the following species, *U. hirsuta*.

Specimen 1.—Sierra de Estrella, Portugal, WELWITZSCH, "Crypt. Lusit.," Nos. 108 and 120. The spermogones are abundant, as small, black points, which are the ostioles of wholly immersed spermogones. The spermata are about $\frac{1}{8000}$ th long, and $\frac{1}{25,000}$ th broad; the arthrosterigmata have the same character as in all the preceding species.

Specimen 2.—Luz, Pyrenees, SPRUCE'S "Lich. Pyrenæi." The spermogones are largish black papillæ, scattered about the margins of the thallus, surrounded by a pale thalline ring. This and the preceding specimen are in Herb. Hooker, Kew.

SPECIES 12. *U. hirsuta*, DC.,

Which is found equally in Europe, America, and Asia. If it is not a form of the preceding, it is very closely allied. (*vide* SCHÆRER exs. 137–40. MOUGEOT and NESTLER, 344 and 1144.)

Specimen 1.—HEPP. exs. 117 (sub *Gyrophora*); on granitic rocks, St Moritz; on upper and right-hand specimen in my copy; with apothecia. Spermogones are abundant about the periphery of the thallus, which is copper-coloured; they are large, distinct, elevated cones of the same colour as the thallus, except the ostiole, which is black, and round, or irregularly stellate-fissured. The body of the spermogone is easily enucleated, leaving an irregular saucer-like cavity.

Specimen 2.—SCHÆRER exs. 137, sub *U. depressa* a. *hirsuta*, SCH.; on granitic rocks, Alps of Switzerland. Spermogones abound about the margins of the thallus as small, obscure blackish cones, closely grouped. They occur also in SCHÆRER'S exs. 138 (sub *C. vulgaris*), very indistinct; in 139 (sub *D. abortiva*), deformed and old; in 140 (sub *F. rupta*), large, distinct, and grouped.

FAMILY XII. PARMELLIÆ.

GENUS I. STICTA, Ach.

The spermogones in this genus are more or less immersed in the tissue of the thallus, their presence being indicated on the surface of the thallus generally by a minute, punctiform brown ostiole. This ostiole may be flattened, slightly elevated, or depressed. It is also frequently seated on the apex of thalline papillæ, varying in size, and which, when confluent, as occasionally happens, may even assume the character of large irregular tubercles. Moreover, frequently in the same species, and even in the same specimen, the ostiole may be flat, depressed or papillæform. Now, it is of importance to bear this in mind, inasmuch as NYLANDER describes the spermogones of *Sticta* as always and altogether immersed, and this he regards as a distinguishing character of *Sticta*, as contrasted with his genus *Ricasolia*, whose spermogones are mammillar tubercles. This I do not regard as a good, because by no means a constant, character. In regard to their spermogones, as to their thallus and apothecia, *Sticta* and *Ricasolia* pass into each other, and are inseparably united and intermingled. The division is purely arbitrary, and hence unnatural. In both genera the spermatia and sterigmata are precisely the same. In few species of either genus do the spermogones always maintain the same unvarying character. Though normally or generally punctiform, they may be occasionally papillæform; and though usually papillæform, they may be sometimes punctiform. Hence, I will speak of a form of spermogone *predominating* in certain species. With this explanation or reservation, I would say that the punctiform spermogone predominates in *S. pulmonacea*, *sylvatica*, *linearis*, *carpoloma*, *aurata*, *orygmæa*, *favcolata*, *filicina*; the papillæform in *S. endochrysa*, *obvoluta*, *argyracea*, *damæcornis*, *xanthosticta*, *cinereo-glaucæ*, *glabra*, *Freyinetii*, and *laciniata*: while the spermogones may be either flat, depressed or papillæform in *S. flavicans*, *D'Urvillei*, and *flabellata*. In *S. obvoluta*, and *damæcornis*, the papillæ are sometimes large, with a conspicuous brown ostiole: and they then resemble nascent or young apothecia. The spermogones of *Sticta* are sometimes easily seen on the beautiful yellow or glaucous thallus, from the contrast with the deep-brown colour of the largish ostiole. This ostiole, however, in the young and mature state, is generally more or less minute; and, added to its minute size, it is sometimes of so pale a colour that it is apt to be overlooked. Sometimes it is large and disk-like, flat or depressed, especially when crowning large papillæ. With age, it expands, and when the nucleus or body of the spermogone falls out, as frequently happens, it may become saucer-shaped, with ragged, generally thickened and dark-coloured, margins. In this state, the ostioles of old spermogones sometimes have the aspect of black rings or disks, as occasionally in *S. aurata*. However large or small the ostiole or external protuberance of the

spermogone, its body is almost in all cases a large white kernel of a dense horny tissue, which becomes gelatinous and semipellucid in water. From its density, it can easily be enucleated with the point of a needle, and I have already stated, that it sometimes falls out of itself. The diameter of this body is sometimes $\frac{1}{30}$ th to $\frac{1}{35}$ th. The envelope, which consists generally of a brown cellular tissue, is about $\frac{1}{600}$ th to $\frac{1}{500}$ th thick. The depth of the spermogone is generally as great, at least, as that of the thallus: and it may form, as in *Endocarpion*, a slight prominence on the lower as well as on the upper surface of the thallus, where its depth exceeds that of the latter. The spermogones may either be scattered over the whole surface of the thallus, or only about its margins; or they may be confined to the plicæ or rugæ, with which the thallus is sometimes conspicuously marked. They are usually scattered over the general surface in *S. damæcornis*, *obvoluta*, *carpoloma*, and *gilva*; they are chiefly confined to the margins of the lobes in *S. endochrysa*, *orgymæa*, *glabra*, and *Freycinetii*; and they are scattered on the rugæ or plicæ only, or principally, in *S. pallida*, and *linearis*. But this distribution is by no means invariable; for, in the same species, the spermogones may be distributed sometimes in the one way, sometimes in the other. The spermata, in all cases, are straight and linear or rod-shaped, with obtuse ends; their length varies from $\frac{1}{6000}$ th to $\frac{1}{8000}$ th; their breadth, from $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th. The sterigmata are, in all cases, articulated and longish, bearing spermata in great abundance on their sides and apices. They are composed of small, round or cubical cellules, at first having thin walls, which latterly become greatly thickened by deposits on their interior. They vary in length from $\frac{1}{200}$ th to $\frac{1}{600}$ th, with a breadth of from $\frac{1}{4000}$ th to $\frac{1}{8000}$ th.

SPECIES I. *S. pulmonacea*, Ach.,

Which has a very wide geographical range, occurring in Europe, Africa, America, and Australia. *S. linita*, Ach., which occurs in Europe and Asia, is included, and very properly, I think by NYLANDER, as a variety. The spermogones are normally or generally here punctiform and depressed; but not always, as NYLANDER and KÖRBER describe them, for I have met with them occasionally, though rarely, papillæform. The body of the spermogone is spherical; the cavity simple; the envelope resembles in structure the cortical layer of the thallus, being composed of very thick-walled cells. The internal tissue is whitish or pale rose-coloured; and, when dry, has a consistence as dense as horn; hence it is divisible by the knife into very thin sections. The body of the organ causes a slight protuberance or papilla on the under surface of the thallus. The horizontal diameter of the spermogone is about $\frac{1}{30}$ th to $\frac{1}{35}$ th; the thickness of its envelope $\frac{1}{600}$ th to $\frac{1}{500}$ th. The sterigmata are very irregularly ramose and long, reaching almost to the centre of the spermogonal cavity. The constituent, short, roundish, or cubical cellules have a very narrow cavity from thickening of their walls in process of growth. The

breadth of the sterigmata is about $\frac{1}{4000}$ th to $\frac{1}{6000}$ th. The spermatia are so abundant as to roughen the sterigmata, as it were, with small bristles; their length is usually about $\frac{1}{5000}$ th to $\frac{1}{6000}$ th. The spermogones of this species probably constitute WALLROTH'S variety *stigmatea*, and are also what he describes as a parasitic *Sphaeria*, *S. epiblastematica*.

Specimen 1.—Glen Muick, Braemar, Professor DICKIE; no apothecia. The spermogones are old, and contain no free spermatia. They are scattered indiscriminately over the surface of the thallus, and are not confined to the rugæ, as is usually the case. They are frequently maculiform and degenerate.

Specimen 2.—Guttanen Valley, Switzerland; in Herb. Hooker, Kew. The rugæ are dotted over with abundant, minute, brown, papillæform or punctiform spermogones. One specimen from MENZIES (habitat apparently not given), also in Herb. Hooker, has the rugæ studded over with punctiform, brown, immersed spermogones. The thallus has entire, or nearly entire, large rounded lobes; its surface is marked by elevated rugæ and deep sulci; and its colour is deep-olive. It appears to me to be the *S. limba*, Ach.

Specimen 3.—Bootan, India, NUTTALL. The spermogones are few, largish, and very distinct, scattered on the rugæ. Also from Madras, Dr WIGHT; East Indies, Mr SHEPHERD; all in Herb. Hooker, Kew. The rugæ are sharp and well defined, and the spermogones scattered over them are largish, distinct, and brown.

Specimen 4.—North-west America. Spermogones are sometimes here maculiform, that is they are largish, brown spots, rather than mere points. Fort Vancouver, Columbia, SCOUler; both in Herb. Hooker, Kew. Spermogones largish and distinct, brown, round, impressed.

SPECIES 2. *S. sylvatica*, Ach.,

Which occurs in Europe, Africa, and Northern America. I have great doubts as to whether this is really separable, on any good grounds, from *S. fuliginosa*. Though this species is rarely found with apothecia, spermogones sometimes occur of the same character as those of the preceding species. They are usually, however, so minute that they are very apt to be overlooked. The body of the spermogone is of a yellowish colour, which contrasts readily with the white medullary tissue of the thallus, so that one of the best modes of examining or seeing the spermogones is to make a section through the brown punctiform ostioles, and through the thallus. The spermatia are about $\frac{1}{8000}$ th long.

SPECIES 3. *S. cinereo-glauca*, Tayl.,

A New Zealand species; in Herb. Hooker, Kew. The spermogones are small, inconspicuous, brown papillæ, scattered here and there over the lobes of the thallus. They resemble young apothecia, with which they are apt to be con-

founded. But the lacerate-stellate border, gradually enlarging so as to show the disk, and their greater size will distinguish the latter.

SPECIES 4. *S. filicina*, Ach.,

A native of equatorial America, New Zealand, and Java. Its var. *Menziesii*, Hook. f., occurs in New Zealand, the Antarctic Regions, and Nepal (syn. *Sticta Menziesii*, Tayl., in Dr HOOKER'S "Flora of New Zealand"). In specimens, in Herb. Hooker, Kew, the spermogones are with difficulty discernable. The ostiole is generally depressed in the centre of crater, or cup-shaped cavities of the thallus, or of papillæform elevations thereof. Sometimes the ostiole is black and punctiform, more frequently it is so pale that it is very apt to be overlooked.

SPECIES 5. *S. damæcornis*, Ach.,

Which occurs in Ireland, America, the African Islands, and Australia. This species is most variable, and it includes a number of well-marked or important varieties, of which may be mentioned:—

Var. *linearis*, Nyl., Polynesia.

„ *macrophylla*, Hook., Ireland; African Islands; Java.

„ *rufa*, Ach., Mexico.

„ *dichotoma*, Del., African Islands; Java.

„ *sinuosa*, Pers., Equatorial America; Philippine Islands.

„ *quercizans*, Ach., America and Central Asia.

„ *Canariensis*, Nyl., Madeira.

Specimen 1.—Feejee Islands; high grounds; on trees, abundant; MILNE, H. M. S. Herald, 1855; in Herb. Hooker, Kew. Both apothecia and spermogones are marginal. The latter are usually brown warts, not very prominent, flattened, often grouped two or three near each other, varying in size. Sometimes, there is merely a brown spot, marked centrally by a depressed ostiole of irregular shape and size.

Specimen 2.—Var. *linearis*, Nyl., Tasmania; Antarctic Expedition, 1839–43, Dr HOOKER. This plant is extremely like *S. pulmonacea*, except that its laciniae are much more narrow and delicate. The apothecia are marginal, and, as well as the spermogones, are quite those of the species just named. The thallus is furnished below with short brown fibres in rigid tufts, as is frequently the case also in *S. pulmonacea*. The spermogones are abundant, minute, brown depressed points, distinctly visible under the lens, scattered along the margins of the laciniae, as well as on the rugæ of the thallus. The body of the organ is large, white, hard, and easily enucleated.

Specimen 3.—Var. *macrophylla*. This a bad name for a very variable form. Though in many cases the lobes are broad and round, and the plant bears the same relation to *S. damæcornis* that *S. linita* does to *S. pulmonacea*; yet in many

other cases, and frequently in Irish specimens, the laciniae are much more narrow than those of *S. pulmonacea*, and it ought to be referred to the var. *linearis*. The spermogones resemble those of *S. pulmonacea*, says TULASNE. So far as regards their external characters, this statement does not at all agree with my own observations. For, while those of *S. pulmonacea*, are generally minute and punctiform, those of *S. dumecornis* are generally largish and papillæform. The spermatia and sterigmata are certainly the same in both; for they are the same, or at least similar, throughout the whole genus *Sticta*. The ostiole is frequently large and round; in the old state of the spermogone it may become an irregular, large stellate fissure, and the thallus may appear studded over with the pseudo-perforations thus produced, precisely as in *Parmelia saxatilis* var. *omphalodes*.

Rocks, Turk Waterfall, Killarney, WILSON; in Herb. Hooker, Kew. (Sub nom. *S. macrocarpa?* var. syn. *S. macrophylla*, Tayl., in MACKAY'S 'Flora Hibernica,' p. 150.) This is certainly not a distinct species; and the specific name of the plant, *S. dumecornis*, to which it belongs as a variety, ought to be restored to our Irish plant. The spermogones are papillæform. In some specimens the lobes are broad and rounded; but in others the segments of the thallus are much narrower, and resemble in their size and form those of *S. pulmonacea*.

Specimen 4.—Var. *macrophylla*; woods of Killarney; TAYLOR, in Herb. Hooker, Kew. TAYLOR remarks on the label, "I have seen specimens with segments still narrower." The colour of the thallus is deep-olive or brown. The papillæform spermogones are with difficulty distinguishable; sometimes they are flattened, and have very pale-brown tips. In age they become large, with stellate-fissured ostioles.

Specimen 5.—Var. *macrophylla*, Killarney Woods; TAYLOR, in Herb. Dr MACKAY, Dublin (author of the "Flora Hibernica"); with apothecia. In describing the apothecia in the "Flora Hibernica," Taylor, apparently inadvertently, includes the spermogones, which he mistakes for young apothecia. The spermogones are large, brown-tipped papillæ, resembling in form and size those of *Ricasolia herbacea* and *R. glomulifera*. Its spermogones should associate this plant with NYLANDER'S genus *Ricasolia*; but, in regard to cyphellæ, it is a true *Sticta*. The spermogones are usually smooth and cone-like, with a round deep-brown ostiole; but frequently also they are flattened, and their apex corrugated round a stellate-fissured ostiole. Their body is a kernel of dense white tissue, and which can be readily enucleated. The tissue becomes gelatinous under moisture. The spermogones are abundant, and are scattered over the whole surface of the thallus. The spermatia are about $\frac{1}{8000}$ th long, with a breadth of $\frac{1}{20,000}$ th. The sterigmata are long and delicate, from $\frac{1}{200}$ th to $\frac{1}{600}$ th long, with a breadth of about $\frac{1}{8000}$ th, their articulations or component cells being distinct.

Specimen 6.—Var. *macrophylla*, Java, LOBB; in Herb. Hooker, Kew. This seems exactly the Irish plant. The spermogones are scattered chiefly about the

margins of the lobes or laciniaë; they are punctiform and flat or depressed, or papillæform—rarely the latter. When papillæform, they resemble the spermogones of *Ricasolia herbacea*, but are smaller. Sometimes they occur in the old state as mere dark maculæ.

Specimen 7.—Var. *dichotoma*, LA POUË, Mauritius; GARDNER, in Herb. Hooker, Kew. The spermogones are either scattered generally over the surface of the thallus, or only on the margins of its laciniaë. They are depressed, very pale points, and are very apt to be overlooked.

Specimen 8.—Var. *sinuosa*, Philippine Islands, CUMING; in Herb. Hooker, Kew. The spermogones occur chiefly about the margins of the laciniaë; they are more frequently punctiform than papillæform, brown, and in all cases inconspicuous. The ostioles of the punctiform spermogones are generally depressed in crater or cup-like cavities of the thallus.

Specimen 9.—Var. *quercizans*, Jamaica, PURDIE; in Herb. Hooker, Kew. The thallus is brownish; hence the spermogones, which are also brownish, are not easily seen. They are very small papillæ, crowned with brown ostioles of a deeper tint than the papillæ themselves.

Specimen 10.—Var. *Canariensis*, Madeira, LOWE; on the trunks of *Persea Canariensis*, Canary Islands; Herb. Williamson, Dr LEMAN, both in Herb. Hooker, Kew. The spermogones are scattered chiefly about the ends of the lobes or laciniaë. They resemble those of *Ricasolia herbacea*, being papillæform; the apices of the papillæ are sometimes flattened, seldom depressed.

Specimen 11.—Var. *rufa*, Ecuador, SEEMANN; in Herb. Hooker, Kew. The spermogones are here scattered chiefly about the periphery of the thallus; they are papillæform, and resemble those of *Ricasolia herbacea*, but are small, and not so prominent.

SPECIES 6. *S. argyracea*, Del.,

Which occurs in America, Java, Cochin-China, Polynesia, and Australia.

Specimen 1.—Pacific Islands, SINCLAIR; Philippine Islands, CUMING; Martinique, Juan Fernandez, 1830; Madras, Dr WIGHT; all in Herb. Hooker, Kew. The spermogones are few, scattered, papillæform, resembling those of *Ricasolia herbacea*, but are smaller and less prominent.

SPECIES 7. *S. nitida* Tayl.,

(Syn. *S. flabellata* Mont.)

Specimen 1.—Chili, LOBB; in Herb. Hooker, Kew. This is a narrow-lobed species, somewhat resembling *S. damacornis*. The spermogones are papillæform or punctiform, scattered chiefly about the ends of the lobes. The papillæform spermogones are frequently flattened on the apex; the punctiform ones are black or brown, sometimes depressed, or surrounded by a thalline ring. In age they

may become maculiform. The spermogones may be papillæform about the ends of the lobes, and punctiform, flat, or depressed more centrally. Sometimes they are so abundant as to give the thallus a black or brown-punctate character.

SPECIES 8. *S. Freycinetii*, Del.,

Which occurs in equatorial America, Australia, and the Antarctic Regions.

Specimen 1.—Auckland Islands, Dr HOOKER, in Herb. Hooker, Kew. The spermogones resemble those of *S. orygmæa*; they are mostly punctiform and depressed, though sometimes papillæform. HOOKER apparently describes them as abortive apothecia in his “Flora Antarctica,” (Part 25, p. 528, Plate 196. fig. 4.)

Specimen 2.—Var. *fulvocinerea*, MONT. (Syn. *Sticta fulvocinerea*, MONT.) Straits of Magellan, Captain COLLINSON. The spermogones are scattered immediately on or near the margins of the thallus; they are generally papillæform and crowded, with a deep-brown or black ostiole or apex. Sometimes they are punctiform and flat, seldom depressed. The thallus is of a beautiful lemon-yellow colour; hence the spermogones are easily seen.

Specimen 3.—Var. *Gaudichaudii*, DEL. (Syn. *Sticta Gaudichaudii*, DEL.) Australia, BIDWILL; in Herb. Hooker, Kew, as is also No. 2. The spermogones occur on the margins of the lobes, and are papillæform and small, with a pale-brown apex.

SPECIES 9. *S. laciniata*, Ach.

Specimen 1.—Xalapa, Mexico, HARRIS; in Herb. Hooker, Kew. This is a large, handsome species. The spermogones are subpapillæform, sometimes flattened, scattered abundantly about the ends of the lobes.

SPECIES 10. *S. faveolata*, Del.,

A native of equatorial America and Australia.

Specimen 1.—Chili, LOBB; in Herb. Hooker, Kew. The spermogones are minute, depressed brown points, scattered on the rugæ, precisely as in *S. pulmonacea*.

Specimen 2.—Var. *Richardi*, MONT. (sub *Sticta*); which occurs in Chili, Australia, the Auckland Islands, and New Zealand. A specimen from New Zealand, 1853, in Herb. Hooker, Kew, greatly resembles *S. pulmonacea* in its linear laciniaæ, and its punctiform spermogones distributed on the thalline rugæ.

SPECIES 11. *S. obvolvata*, Ach.

Specimen 1.—On the trunks and branches of trees in hill woods, Juan Fernandez, 1830; in Herb. Hooker, Kew; a very beautiful species, with marginal large handsome apothecia. The spermogones are the largest I have found in either the

genus *Sticta* or *Ricasolia*. They are large papillæ, or cones of the thallus, paler than the surrounding surface; sometimes confluent, and then becoming irregular tubercles. The cones are usually crowned by a brown apex, varying greatly in size, but resembling the disk of an apothecium. The ostiole is sometimes visible in the centre of this brown apical spot. The spermogones are scattered over the whole surface of the thallus, and bear a close resemblance to nascent apothecia. Interspersed among the spermogones are numerous small, round, soresdic warts. The spermatia are about $\frac{1}{7000}$ th long, rod-shaped, with a breadth of $\frac{1}{20,000}$ th; on the usual arthrosterigmata of *Sticta*. In connection with NYLANDER'S division into *Sticta* and *Ricasolia*, according as the spermogones are punctiform or papillæform, it is note-worthy here, that the papillæform or mammillar spermogones are larger than in any species of *Ricasolia* I have yet met with!

SPECIES 12. *S. xanthosticta*, Pers.

(Syn. *lutescens*, TAYL.); a species allied to *S. filicina*, which is found in America, the Canary Islands, and Java.

Specimen 1.—Jamaica, PURDIE; in Herb. Hooker, Kew. The spermogones are very minute, brown papillæ, scarcely discernible even under the lens.

SPECIES 13. *S. carpoloma*, Del.

(Syn. *S. impressa*, TAYL.); a species which inhabits equatorial America, Polynesia, and Java. This is a very large and handsome species, having a pale-coloured thallus; hence the spermogones are usually more or less distinct and easily seen.

Specimen 1.—New Zealand, Antarctic Expedition, 1839–43, Dr HOOKER, Kew. The surface of the thallus is smoothish; its under surface fibrillose and pale-coloured; the apothecia marginal. The margins of the thalline lobes or laciniaë are studded over with irregular cushion-like warts, which are soresdic, and have no connection either with apothecia or spermogones. The spermogones are either papillæform or punctiform; when the former, they are chiefly scattered about the margins of the lobes; when the latter, they are either distributed over the whole surface of the thallus, or confined to the rugæ, with which it is marked, as in *S. pulmonacea*. When seated on the rugæ, they are frequently disposed in a linear series; they are then usually brown and depressed, resembling the pricks of a needle-point. The thallus is sometimes somewhat raised round the ostiole, to which it gives the appearance of being girt by a ring or border. TAYLOR'S name, *impressa*, was probably given in allusion to the punctiform, depressed spermogones so abundantly scattered over the rugæ. The spermatia are rod-shaped, and about $\frac{1}{8000}$ th long. The sterigmata consist of short, thick-walled, cubical cellules, precisely as in *S. pulmonacea*.

Specimen 2.—Another specimen from New Zealand (sub nom. *S. impressa*,

TAYL.), in the Herbarium, Royal Botanic Garden, Edinburgh, is of enormous size,—at least 1 foot in diameter. The spermogones are punctiform and immersed wholly; they are either seated on the rugæ, or scattered over the general surface of the lacinia towards their ends.

Specimen 3.—Brazil, in Herb. Hooker, Kew (also sub nom. *S. impressa*, TAYL.). The spermogones are very distinct, punctiform, and depressed, dotting over the here very prominent rugæ. Another specimen in Herb. Hooker (habitat not given), has spermogones irregularly scattered over the whole surface of the thallus, sometimes papillæform, sometimes punctiform; in the latter case usually flat, seldom depressed.

SPECIES 14. *S. orygmæa*, Ach.,

Which occurs in equatorial America, Australia, and the Antarctic Regions.

Specimen 1.—Lord Auckland Islands, Antarctic Expedition 1839–43, Dr HOOKER. The spermogones are either papillæform or punctiform; more frequently the latter. In the punctiform state, they resemble those of *S. pulmonacea*, but are larger and more distinct. They are scattered chiefly on the rugæ of the thallus, and are very abundant. The spermatia are rod-shaped and about $\frac{1}{8000}$ th long; the arthrosterigmata have the usual characters of the genus *Sticta*. The body of the spermogone is a whitish, dense, hard kernel, easily enucleated, as is generally the case in the spermogones of *Sticta*.

Specimen 2.—Chiloe, CUMING; in Herb. Hooker, Kew. The spermogones are abundant about the edges of the lobes; they are minute black points, generally slightly depressed. Sometimes they are papillæform, or the ostioles have a slight ring of thallus surrounding them.

SPECIES 15. *S. flavicans*, Hook. fils., and Tayl.

I have great doubt as to this being properly a separate species; but I am not prepared to say to what species it is best referrible.

Specimen 1.—Falkland Islands, Antarctic Expedition, 1839–43, Dr HOOKER. This is a large and handsome species, with abundant and very distinct spermogones. These organs are usually punctiform and depressed, minute, black or brown round spots. Sometimes they are surrounded by a sub-prominent thalline margin; sometimes they are seated on distinct, thalline papillæ, and the spermogones have then the aspect of those of *Ricasolia herbacea*. From the beautiful yellow colour of the thallus, the spermogones of this species are among the most distinct of those in the genus *Sticta*. The ostiole is generally not perceptible; sometimes it is distinct in the centre of each of the brown or black round spots above referred to, as a round or stellate-fissured perforation.

Specimen 2.—Hermite Island, Cape Horn, Antarctic Expedition, 1839–43, Dr HOOKER; no apothecia. The spermogones are usually sub-papillæform, scattered

sometimes over the whole surface of the thallus, sometimes over the margins of the lobes only. They are flattened and not prominent, the ostiole is almost always depressed. The body of the spermogone is a hard white kernel, easily enucleated. The spermatia are about $\frac{1}{8000}$ th long; the sterigmata are those of *S. pulmonacea*.

SPECIES 16. *S. D'Urvillei*, Del.,

Which occurs in equatorial America, and in New Zealand.

Specimen 1.—Chili, LOBB; in Herb. Hooker, Kew. This plant seems identical with *S. flavicans*, Hook. ; and its spermogones are precisely similar.

SPECIES 17. *S. endochrysa*, Del.

Specimen 1.—Andes, LOBB; in Herb. Hooker, Kew. The spermogones are scattered near the periphery of the thallus; they are largish, brown, round spots, flat, or on the apex of slightly elevated thalline papillæ.

SPECIES 18. *S. gilva*, Ach.

Specimen 1.—Juan Fernandez; in Herb. Hooker, Kew. The spermogones are flat, punctiform, brown, scattered over the surface of the lobes of the thallus.

Specimen 2.—Rocks, sea-side, Uitenhage, Cape of Good Hope (sub nom. *S. crocata*, Ach., var. β . *gilva*, Ach.) The spermogones are scattered about the ends of the lobes; they are black or brown minute points, generally flat, sometimes papillæform.

SPECIES 19. *S. aurata*, Ach.,

Which has a wide geographical distribution, being found in India, America, Africa, Asia, Polynesia, and Australia.

Specimen 1.—Coll. Salwey; in Herb. Hooker, Kew. Supposed to be an *English* specimen; but no habitat is given! The thallus bears no apothecia; but old and degenerate spermogones occur as minute, irregular, brown dots scattered abundantly about the periphery of the lobes.

Specimen 2.—On trees, Minas-Gerães, Brazil, 1840; on trees, at an elevation of 7500 feet on the Cordillera, Oaxaca, Mexico; coll. H. GALEOTTI, 1840; both in Herb. Hooker, Kew. The spermogones are old and degenerate chiefly; they occur as largish black disks or rings; flat, seldom sub-papillæform or depressed; sometimes maculiform.

Specimen 3.—Norfolk Island, FR. THOMPSON; in Herb. Hooker, Kew. The thallus is very handsome; about 1 foot in diameter, of a beautiful lake-colour. The spermogones are abundant, large, papillæform, frequently with a deeper coloured ring or macula surrounding them. In another specimen, also in Herb. Hooker, from New Holland, both apothecia and spermogones are abundant.

SPECIES 20. *S. glabra*, Tayl.

I do not regard this as a good species, but I am not prepared to allocate it.

Specimen 1.—Falkland Islands, Antarctic Expedition, 1839–43, Dr HOOKER. In the character of its thallus, as well as of its spermogones, it closely resembles *Ricasolia herbacea*. The latter organs are abundant about the margins of the lobes, as large distinct papillæ, marked on the apex by a round, brown spot which surrounds the ostiole. Sometimes they are grouped in twos or threes, though they are usually scattered singly; but they are seldom or never confluent. The spermatia are rod-shaped, and from $\frac{1}{6000}$ th to $\frac{1}{8000}$ th long; the sterigmata are composed of short, cubical, thick-walled cellules.

SPECIES 21. *S. pallida*, Hook. f. fil.

Specimen 1.—On the branches of decayed and live trees; forests, Kaipara, New Zealand, coll. by S. MOSSMAN, 1850, No. 788; in Herb. Royal Botanical Garden, Edinburgh. This species appears to belong to the *S. pulmonacea* group of *Stictis*; its laciniæ are narrow and sub-linear; the lacunæ deep; the rugæ correspondingly prominent; the spermogones studded over these rugæ, immersed and punctiform.

GENUS II. RICASOLIA, DN., Nyl.

The separation of this genus from *Sticta*, I have already pointed out, appears to me to be an exceedingly arbitrary and mischievous one. So far as the spermogones are concerned, most assuredly no distinction can be drawn between the two genera, for I have shown, under *Sticta*, that several species of that genus have papillæform spermogones as large as, nay even sometimes larger than, those of any of the *Ricasolias*, while others have papillæform spermogones of the same character as those of *Ricasolia*, though somewhat smaller. I have also shown that it is very common for the same species of *Sticta* to have indiscriminately, papillæform or punctiform spermogones, which latter may further possess flat or depressed ostioles. Precisely the same thing occurs in *Ricasolia*. In *R. corrossa* and *R. Kunthii*, I have found the spermogones either papillæform or punctiform, the latter with depressed or flat ostioles. In *R. dissecta*, the spermogones are usually punctiform and depressed, exactly as in the *S. pulmonacea* group of *Stictis*. Sometimes, in *R. dissecta*, as is frequently the case in the *Stictis*, the ostiole is surrounded by a sort of thalline ring. Here also the spermogones are rarely papillæform. In *R. crenulata*, again, they are usually papillæform, but small; punctiform ones, however, also occasionally occur. Sometimes a ring of thallus round a depressed or flat punctiform ostiole gives the semblance of a papillæ, when this does not really exist. The spermogones of *Ricasolia* may be described in general terms as

precisely those of *Sticta*, with the single exception, that they are more generally large and papillæform, resembling nascent apothecia. They are generally so large as to be visible to the naked eye, as in *R. herbacea*. Their diameter in this species is about $\frac{1}{20}$ th to $\frac{1}{25}$ th; in *R. glomulifera*, $\frac{1}{25}$ th to $\frac{1}{30}$ th. They are frequently confluent, in which case they become still larger irregular tubercles, with a somewhat depressed apex. Occasionally the spermogones are flat, lurid, or deep-brown maculæ, as in certain forms or varieties of *R. glomulifera*. The ostiole is usually small and round; with age, it becomes frequently stellate-fissured, or it expands into a saucer-shaped cavity, with dark, turgid, irregular edges, when the nucleus or body of the old spermogone falls out. The thallus is sometimes studded over with black, very irregular perforations, where there existed old spermogones, whose nuclei have fallen out. The patent irregular ostiole frequently gives the spermogonal papilla the aspect of a young apothecium, as in *R. herbacea* and *R. glomulifera*. In regard to *site*, the spermogones may be either scattered over the general surface of the thallus, or chiefly on or about the margins of the lobes. They are peripheral in *R. dissecta*, *crenulata*, *Kunthii*, and *coriacea*. Sometimes they occur on large, deformed, wart-like growths of, and from, the thallus, resembling those of *Parmelia saxatilis*, on which *Lecidea Smithii* grows. Occasionally they are met with, seated directly on the margins of the lobes, to which they give a coarsely denticulate character, as in the analogous form of *Parmelia perforata*. Here they are rather barrel-shaped than mammillar or papillæform. The internal tissue, spermatia and sterigmata, are quite those of *Sticta*. The typical species of the genus, *R. herbacea* and *R. glomulifera*, were formerly included among the *Parmelias* by SCHÆRER and other authors, but I long ago pointed out that they really belong to *Sticta*.*

SPECIES 1. *R. herbacea*, DN.,

Which occurs in Europe and America. The spermogones are usually abundant and very distinct; hence this is one of the best species in which to study the spermogones of *Ricasolia*. *Parmelia perlata* is not unfrequently confounded with it; but the character of the spermogones suffices at once to distinguish these two lichens,—those of the *Parmelia* being punctiform, very minute, black, and immersed. The large papillar or mammillar spermogones of *R. herbacea* have the same tint as the thallus, of which they appear to be elevations, with the exception of the ostiole, which is in the centre of a brown areola or spot seated on the apex of the cone. The spermogones are flattened or depressed at the apex; they closely resemble young apothecia; and the only safe way of distinguishing them is by microscopic examination. The internal tissue is white, dense, horny, semi-transparent when moistened, of a grayish or pale rose tint.

* Popular History of British Lichens. London, 1856, pp. 189 and 191.

Specimen 1.—On old trees, Inverary; in Herb. Botanical Society, Edinburgh; coll. by MAUGHAN; apothecia abundant. The spermogones are plentiful, scattered about the periphery of the thallus as regularly formed, very prominent cones or papillæ, readily visible to the naked eye. The ostiole is brown, circular, apical, distinct. The sterigmata are ramose, thick, irregular in outline, formed of short, cubical, or irregularly shaped articulations or cellules, which have very thick walls. With age, they acquire a greenish tint. From among these project a number of long, sterile, ramose, articulated filaments, of the character of those of *Ramalina*; but neither so delicate nor so ramose. The spermatia are longer than is usual in *Sticta*, being about $\frac{1}{5000}$ th to $\frac{1}{6000}$ th long; they are found in abundance only in the youngest spermogones.

Specimen 2.—On young oak, Cawdor Wood, Nairn; coll. A. CROALL; in Herb. Hooker, Kew. Spermogones are plentiful, but there are no apothecia. Appin; coll. CARMICHAEL; in very large patches, with both apothecia and spermogones; also in Herb. Hooker.

Specimen 3.—Kerry, Ireland; in woods; TAYLOR in Herb. Mackay, Dublin. The spermogones are abundant; the older ones become flattened, and have a stellate-fissured, large, brown ostiole. The spermatia are $\frac{1}{6000}$ th to $\frac{1}{7000}$ th long, and $\frac{1}{20,000}$ th broad; the sterigmata are about $\frac{1}{6000}$ th broad.

Specimen 4.—Killarney; in Herb. Royal Botanical Garden, Edinburgh; with apothecia. Spermogones large and abundant.

Specimen 5.—Lachen, Sikkim, Himalaya, alpine region, at 11,000 feet, Dr HOOKER; in Herb. Hooker, Kew; with apothecia. Some of the spermogones are seated directly on the margin of the thallus, forming a kind of teeth, as in the denticulate form of *Parmelia perforata*. Their form is more that of a barrel than of a cone.

Specimen 6.—South Africa, DREGE (sub nom. *Sticta quercizans*, Ach.); Dax, Pyrenees, SPRUCE'S "Lich. Pyrenæi;" in Herb. Hooker, Kew. In both the spermogones are plentiful.

Specimen 7.—LEIGHT. exs. 75 (sub *Sticta*, Delise, "Eng. Bot." 294); Ayrshire. The spermogones are subperipheral, large, and frequently confluent.

Specimen 8.—SCHLÆRER exs. 560 (sub *Parmelia latevirens a. simplex*). On trunks of trees about Vire, PELVET. Spermogones are plentiful. The spermatia are about $\frac{1}{5000}$ th long; the sterigmata $\frac{1}{500}$ th to $\frac{1}{600}$ th long,

SPECIES 2. *R. glomulifera*, DN.,

Which occurs in Europe, America, and Asia.

(Syn. *Sticta amplissima*, KÖRB, 68; *Parmelia*, Ach.) The spermogones are exactly those of the preceding species, but they are scarcely so prominent.

Specimen 1.—On old beech trees, Inverary Woods; in Herb. Botanical Society,

Edinburgh ; with apothecia and glomeruli. The spermogones are plentiful, but old, containing no free spermatia. They are scattered about the margins of the lobes of the thallus, and closely resemble nascent apothecia, of which the brown, round, saucer-like ostioles somewhat resemble the disks.

Specimen 2.—Minto Craigs, Roxburghshire ; Glen Lyon, Breadalbane, coll. by Rev. HUGH M'MILLAN ; both in Herb. Royal Botanical Garden, Edinburgh. Both specimens are spermogoniferous ; neither have apothecia ; and the Glen Lyon specimens have enormous glomeruli. In them the spermogones occur abundantly as lurid or brownish-red round macules, resembling the apothecia of *Arthonia lurida*.

Specimen 3.—SCHÆRER exs. 559 (sub *Parmelia amplissima*, Scop.). Trunks of trees about Vire, PELVET. The specimen has only two or three old spermogones, containing no free spermatia.

Specimen 4.—Col de Lourvie, Pyrenees ; “ without glomeruli always in this locality,” remarks the Rev. CHURCHILL BABINGTON on the label in SPRUCE’S “ Lich. Pyrenæi,” in Herb. Hooker, Kew. Besides the ordinary form of spermogones, some are distributed on irregular, large, wart-like growths of and from the thallus, resembling those of *Parmelia saxatilis*, on which *Lecidea Smithii* and *L. oxyspora* grow. These growths are subfoliaceous, of a deeper brown than the thallus, and manifestly distinct therefrom, or at least not a normal or usual part thereof. Over these wart-like growths are dotted the ostioles of immersed spermogones, which are brown, round, and rather larger than in the usual form of the spermogones. Under moisture, they swell so as to become small subgelatinous cones. The spermatia are about $\frac{1}{6000}$ th long, and $\frac{1}{20,000}$ th broad.

SPECIES 3. *R. coriacea*, Tayl.

Specimen 1.—New Zealand ; in Herb. Hooker, Kew. The spermogones resemble those of *R. herbacea* ; but they are smaller and more abundant. They are crowded about the margins of the lobes, are papillæform, sometimes confluent and tuberculiform, with a brown apex.

SPECIES 4. *R. discolor*, Ach.,

Which inhabits the Isle of Bourbon, Madagascar, and Java.

Specimen 1.—Muckross, Ireland ; on trees, 1828 ; in Herb. Hooker, Kew ; named by NYLANDER himself. This appears to me simply our British *R. herbacea*, with a more delicate thallus than usual, but having apothecia and spermogones quite of the usual type. The spermatia are about $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad.

SPECIES 5. *R. crenulata*, Hook.

Specimen 1.—On twigs, Juan Fernandez ; in Herb. Hooker, Kew. In regard both to its apothecia and spermogones, this species stands near *R. herbacea* and

R. glomulifera. The spermogones are smaller than in these species; they are small papillæ, marked on the apex by a depressed, black, punctiform ostiole. They are scattered about the margins of the lobes. The spermatia are about $\frac{1}{6000}$ th long and $\frac{1}{25,000}$ th broad; the sterigmata are $\frac{1}{300}$ th to $\frac{1}{600}$ th long, and $\frac{1}{6000}$ th broad.

SPECIES 6. *R. dissecta*, Ach.

Specimen 1.—Casapi, Peru, MATTHEWS; in Herb. Hooker, Kew; in large handsome patches. The spermogones are scattered sparingly about the periphery of the lobes, usually as depressed, round, black points. Though generally flat or depressed, they sometimes become papillæform. Occasionally they are surrounded by a sort of ring of the thallus, well marked. When old, they appear frequently as largish black rings or disks, with a stellate-radiate fissure. The thallus is sometimes studded over with very irregular black perforations, where old spermogones existed, and the bodies or nuclei have fallen out.

SPECIES 7. *R. corrosa*, Ach.,

A native of equatorial America.

Specimen 1.—(Sub nom. *Sticta dissecta*, Ach.); from Mr DICKSON; in Herb. Hooker, Kew. No habitat is given; but it would appear to be from Scotland, as all Mr DICKSON's other collectanea are Scotch! The spermogones are sometimes punctiform, sometimes papillæform: in the former case they are usually depressed, in the latter they possess a distinct, brown, round ostiole. The body of the organ is a large, white, hard kernel, as in all *Stictas* and *Ricasolias*.

SPECIES 8. *R. Kunthii*, Del.

Specimen 1.—Organ Mountains, Brazil; probably coll. by GARDNER; in Herb. Hooker, Kew. The spermogones are very abundantly scattered about the periphery of the thallus. They are usually round brown spots or points, flat, or sometimes depressed; occasionally surrounded by a paler ring of the thallus, which gives them a pseudo-papillate appearance. They are seldom distinctly papillæform.

Specimen 2.—Chinos, Cordillera (Oaxaca), Mexico, at 7000 to 9000 feet of elevation; coll. by H. GALEOTTI, 1840, No. 6895 (sub nom. *Sticta fuliginosa*); in Herb. Hooker, Kew. This specimen is closely allied to, if it is not a mere form or variety of, *R. herbacea*. Its apothecia and spermogones, spores and spermatia, are the same as in that species.

GENUS III. PARMELIA, Ach., Nyl.

In this large and comprehensive genus the spermogones are chiefly black, punctiform, wholly immersed in the thallus, and scattered about the periphery of the thallus and on the convexities of the laciniaë, where the thallus is divided into

narrow, linear, or sub-linear segments. These black points are the ostioles, which are usually round and very minute, but which are sometimes elongated, even lirellæform, as in some forms of *P. sinuosa*. Sometimes the punctiform ostiole is perched on a pale thalline papilla or wart, as in some forms of *P. tiliacea*. As in most lichens, the ostiole, in the old state, is generally large and gaping, and it then frequently has a prominent ring-like border. The thallus is sometimes studded over with black, large, irregular perforations—frequently lacerate or stellate-fissured—as in *P. stygia*, *P. tristis*, and *P. saxatilis*, var. *omphalodes*. The black punctiform spermogones frequently resemble parasitic *Sphaeriæ*, for which they were generally or often mistaken by earlier lichenologists. Seldom are they distinctly papillæform, tuberculiform, or barrel-shaped, as in *P. perforata* var. *denticulata*. In the latter lichen, which is altogether an exceptional and anomalous one, the spermogones are very large barrels, studded on, and forming part of, the margins of the lobes, precisely as in the genus *Platysma*. What is still more curious, they either occur alone, or they are associated on the same specimen with the ordinary black, punctate spermogones of *P. perforata*. Generally, the punctiform ostioles are extremely minute, as in *P. saxatilis*; they are of the same character, but rather larger and more distinct in *P. perlata*, *P. physodes*, *P. tiliacea*, *P. perforata*, and *P. conspersa*. From the fact that the ostiole, or that part of the apex of the spermogone which generally projects or is most visible on the surface of the thallus, is black usually, while the colour of the thallus itself is glaucous or gray, the spermogones of *Parmelia* are generally readily recognised. They are usually scattered, in considerable numbers, outside the region of the apothecia, on the surface of the thallus. In exceptional cases, they are confined to the margins of the laciniaë or lobes, to which they give a more or less denticulate character. On the flattened linear laciniaë of *P. tristis* they are small, and not very prominent; but in var. *denticulata* of *P. perforata* they are very large and conspicuous. Sometimes they are distributed on the flat surface of digitate expansions from the margins of the thallus, as in a form of *P. perforata* from the Organ Mountains, Brazil. Occasionally they are dotted over the exciple of the apothecia, and even on the saucer-like cavities left by the falling out of the disk in degenerate apothecia, as in *P. conspersa*. In number the spermogones are generally considerable, even when merely dotted over the margins of the lobes. But sometimes they are dotted in great profusion over the whole surface of the thallus, as in *P. encausta*, *P. olivacea*, *P. stygia*, and *P. conspersa*. In the last-named species the name might be supposed to have been given in allusion to the great abundance of the spermogones. The walls or envelope of the spermogones are generally thick, and of a brown cellular tissue; they are frequently of the same structure as the epidermic or cortical layer of the thallus. The cavity is usually simple; the internal tissue dense, horny, hygrometric, and pale grayish. In the old state of the spermogone,

from the density of the internal tissue and the thickness of the walls, this organ is easily enucleated by a needle. In age, also, the cavity becomes obliterated, and is occupied by a mass or kernel-like nucleus, usually more or less spherical, of a horny consistence, and sometimes slightly coloured. The spermatia are straight, linear, and very delicate, more frequently acicular, with pointed ends, than rod-shaped, with obtuse extremities. NYLANDER describes them as very slightly attenuated in the middle. This I have not specially noticed. Their length varies from $\frac{1}{3000}$ th to $\frac{1}{6000}$ th, the average being about $\frac{1}{4000}$ th; seldom are they so small as $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th long, as in some forms of *P. Fahlunensis*. Sometimes, as in some forms of *P. tiliacea*, they are double the length when attached that they are when free. In this instance, while still attached to the sterigmata, they measure $\frac{1}{1200}$ th to $\frac{1}{2000}$ th long, and when thrown off and free, $\frac{1}{2500}$ th to $\frac{1}{3000}$ th. In such cases it would appear probable that, after becoming free, the spermatia divide into two equal segments. The breadth of the spermatia generally varies from $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th, or it is inappreciable. The sterigmata are generally longish, very narrow and delicate, consisting of 2-3, or 5-6 linear elongated cells, which are sometimes articulated, united, or superimposed at very irregular angles. Their length generally varies from $\frac{1}{750}$ th to $\frac{1}{1500}$ th, their breadth from $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th. They are sometimes $\frac{1}{500}$ th to $\frac{1}{400}$ th long in *P. tiliacea*, in which species the sterigmata are among the longest and most handsome I have seen. In many species, associated with the ordinary spermatiferous sterigmata, occur numerous elongated, very ramose, sterile, delicate filaments, resembling those of *Ramalina*,—as in *P. physodes*, *P. stygia*, and *P. sinuosa*. In the latter species they are about $\frac{1}{500}$ th long. These anastomosing filaments serve to fill up the cavity of the spermogone. *Pycnides* occasionally occur in *Parmelia*. It may be doubted by some whether they really belong to the species on which they occur. But their occurrence among the undoubted spermogones of the species, all of whose external characters they possess, and the acknowledged existence of pycnides in other lichens, similar to those of many fungi, seem to me strong reasons for regarding them as really pertaining to the lichens, on whose thallus they are found. They are in all respects similar to spermogones, except in regard to their stylospores and sterigmata. I found them chiefly in two Irish specimens, *P. saxatilis* from Connemara, and *P. sinuosa* from Dunkerron. From their abundance and prominence, the genus *Parmelia* is a good one in which to study spermogones.

SPECIES 1. *P. caperata*, Ach.,

Which occurs in Europe, Africa, America, Asia, and Australia.

Specimen 1.—Great stones, near Penzance, Cornwall; in Herb. Hooker, Kew. The thallus is very large and handsome—nearly a foot in diameter. Where the cortical layer is intact, the surface of the thallus is very rugose and warted. But the thallus is nearly altogether devoid of a cortical

layer, which has been eroded, exposing the subjacent white, medullary tissue. So much so is this the case, that the plant is scarcely recognisable as *P. caperata*. Apothecia, which are usually rare, are here abundant. The spermogones are punctiform and immersed—black when dry, brown when moistened; they are most irregular as to size and form, often chink-like, sometimes confluent. They are dotted over the rugose or warted portions of the thallus; but they are most conspicuous on the white eroded portions, their brown colour forming a good contrast to the white of the medullary tissue. The body of the organ is spherical, and its cavity simple.

Specimen 2.—Fermanagh, Ireland; Dr SCOTT, 1803; wood, near Camelford, England, 1799; in Herb. Hooker, Kew. The thallus is coarsely warted, the warts or rugosities being studded over with punctiform spermogones, as in No. 1.

Specimen 3.—Tasmania, very common; OLDFIELD; in Herb. Hooker, Kew. The spermogones are more distinct and abundant in this specimen than in any others of this species I have examined. They are distributed chiefly centrally on the thallus, but to a minor extent peripherally, and on specimens not bearing apothecia. The thallus is very rugose, and often consists centrally of a series of large cushion-like warts, which are abundantly studded over with spermogones, resembling parasitic *Sphaeriæ*. These spermogones are comparatively large, black, round rings or spots, superficial, flattened, varying in size, sometimes confluent and irregular, never distinctly papillate. In the centre of these rings or spots are the simple, round ostioles. The envelope is of a sooty black colour; the body of the spermogone is easily enucleated. The spermatia are acicular, about $\frac{1}{4000}$ th to $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad. KÖRBER very erroneously describes them, as in this species *atomic and globular*, which they certainly never are, according to my observations. The sterigmata usually consist of two, or not more than three, elongated linear cells, articulated at irregular angles; their length is about $\frac{1}{1500}$ th. The spermogones, which occur about the more flattened and simple margins of the thallus, are more usually simply punctiform, and wholly immersed; nor are they so crowded as centrally.

SPECIES 2. *P. perlata*, Ach.

Almost a cosmopolite, as well as its well-marked but puzzling variety, *ciliata*, DC., which occurs in Europe, Africa, America, Asia, and Australia. This is a very variable lichen. Many forms of it, especially var. *ciliata*, so strongly resemble *Platysma glaucum* as to be constantly mistaken therefor; others closely resemble forms of *P. sinuosa*, *tiliacea*, and other species. It passes into the next species, *P. perforata*, which I regard, indeed, as a mere variety of *P. perlata*. Its spermogones are generally black, punctiform, immersed, and scattered about the margins of the lobes of the thallus. Its spermatia are acicular and of medium size; its sterigmata are composed of a few linear articulations.

Specimen 1.—Old wall, Caerlaverock Road, Dumfries, August 1856, W. L. L. The edges of the thallus are marked by the presence of a few rudimentary cilia; the surface is fibrillose beneath; there are marginal soredia on some lobes. The spermogones are few, depressed, punctiform; the spermatia about $\frac{1}{4000}$ th long; the sterigmata of several cylindrical cells, irregularly articulated.

Specimen 2.—Banks of Crinan Canal, Argyllshire, August 1856, W. L. L. The margins of some of the lobes are sorediiferous, of others black-ciliate. The spermogones are abundantly scattered about the edges of the lobes. The spermatia vary in length from $\frac{1}{6000}$ th to $\frac{1}{4000}$ th; the sterigmata consist of cylindrical cells, differing in length and breadth. Projecting from among the ordinary spermatiferous sterigmata occur many elongated, articulated, sterile ones, analogous to those of *Ramalina*.

Specimen 3.—Dunkerron, Ireland; coll. by TAYLOR; in Herb. Mackay, Dublin; with apothecia. The margins of the thallus are ciliate. The spermogones are few, and chiefly old, containing no free spermatia.

Specimen 4.—SCHLÆRER exs. 360; trunks of trees, Switzerland. Here the spermogones are somewhat exceptional in their characters; they appear to be old and hypertrophied, and contain no free spermatia. They are small, brown, semi-translucent, grain-like bodies, dotted thickly about the edge of one or two lobes.

Specimen 5.—Karin Pass, Kumaon, Himalaya, at an elevation of 7500 feet, Dr HOOKER; in Herb. Hooker, Kew; with apothecia. The plant closely resembles *Platysma glaucum*. The spermogones are as above described. Jamaica, PURDIE (sub nom. *P. perforata*); a very handsome specimen. Spermogones are large and abundant. Teneriffe; rocky parts of Lagura, 1845; BOURGEAU "Pl. Canar." No. 1088 (erroneously labelled *P. conspersa*). The margins of the thallus are ciliate. Teneriffe; common in the woods, 1845. BOURGEAU, "Pl. Canar." No. 1098. The spermogones abound about the margins of the lobes.

Specimen 6.—Canary Islands, ex. Herb. Webbianum; in Herb. Hooker, Kew. This is exactly the plant that is imported, under the name of "Canary Rock Moss," from the Canary Islands into London for the Orchill manufacture. It bears no apothecia; centrally it is frequently sorediiferous or isidiiferous; it sometimes possesses terminal soredia also. In consistence or texture the thallus is leathery and thick; its surface is variously cracked and reticulated. The spermogones are abundant and large.

Specimen 7.—Caribbean Islands, H. SMEATHMAN; Jamaica; both in Herb. British Museum. Neither bear apothecia; the latter has a ciliate margin. Both have abundant spermogones. These, and most of the specimens above enumerated, are referrible to the var. *ciliata* of *P. perlata*; but in none of them is the ciliation of the margin so prominent or so constant as in those which follow.

Specimen 8.—Var. *ciliata*; on trees, Castle Bernard, Cork; coll. CARROLL (sub nom. *P. perforata*). The *P. perforata* of Hook, "Engl. Flora," p. 200; of

Acharius, of Leight. exs. 112, and of E. B. t. 2423, seem to me referrible to *P. perlata*. The confusion between *P. perforata* and *P. perlata* is constant, and the only way to avoid this for the future is, as I certainly do, to regard the former as a mere variety of the latter. Specimens with perforate apothecia are not at all common in the so-called *P. perforata*, and even when they do occur, they are not peculiar to this species, but are found as an accidental condition in various *Parmelias*. The majority of specimens of *P. perforata* I have seen are referrible to var. *ciliata* of *P. perlata*. To the same variety of the same species I am inclined to refer *P. proboscidea*, Tayl., "Fl. Hib.," 143. This Castle Bernard specimen has spermogones of the usual type of those of *P. perlata*.

Specimen 9.—Var. *ciliata*, SCHÆRER exs. 253 (sub *Cetraria glauca* β. *fallax*, Ach.); in woods on Mount Gurnigel, Switzerland. The spermogones are old, containing no free spermatia; they are dotted over the margin of the thallus. SCHÆRER has here made the very common mistake of confounding *P. perlata* with *Platysma glaucum*, whose marginal spermogones, as well as spermatia and sterigmata, however, at once distinguish it.

Specimen 10.—Var. *reticulata*, Tayl. (syn. *P. reticulata*, Tayl. "Fl. Hib." 148.) TAYLOR'S plant seems to me partly referrible also to *P. sinuosa*. Dunkerron, Ireland; coll. TAYLOR, in Herb. Mackay, and named by TAYLOR himself. The plant is most variable; some of its lobes are broad and rounded, as in *perlata*; others narrow and sub-linear, as in *sinuosa*. The larger lobes are ciliate, precisely as in var. *ciliata* of *P. perlata*; the smaller ones are frequently tipped with soredia as in *sinuosa* and its var. *laevigata*. The reticulations, which give the plant its name, are merely cracks or fissures of a thick, coriaceous, old thallus. The plant bears no apothecia; but its spermogones are sub-marginal, and as described in other forms of *P. perlata*. The same plant occurs also (collected by TAYLOR) in Herb. D. Moore, Glasnevin, Dublin. New Zealand specimens of TAYLOR'S *P. reticulata* in Herb. Hooker I refer rather to *P. sinuosa*.

Specimen 11.—Var. *lutiformis*, Fée (sub *Parmelia*), Cuba, ex. Herb. Montagne; in Herb. Hooker, Kew. This is a very curious variety, in which the thallus is very rugose and warted, as in *P. caperata*, chiefly centrally, but the warted condition extending also almost to the margins of the thallus. The apothecia are very abundant and crowded, but all are degenerate; the disk has fallen out, and the saucer-shaped cavity which contained it is of the same colour and substance as the exciple. The exciple is thick and warted; and the apothecia, which vary much in size, resemble so many warts of the most irregular forms. The thallus and apothecia are indiscriminately studded over with black, immersed, punctiform spermogones, as frequently also happens in *P. conspersa*. The spermatia are rod-shaped, $\frac{1}{5000}$ th long and $\frac{1}{27,000}$ th broad. The sterigmata consist of cylindrical, somewhat irregular cells, articulated at very acute angles; they vary in length from $\frac{1}{750}$ th to $\frac{1}{1500}$ th, with a breadth of $\frac{1}{10,000}$ th.

SPECIES 3. *P. perforata*, Ach.,

Which occurs at the Cape of Good Hope, in America, Polynesia, and Australia. Like the preceding, to which I believe it chiefly belongs, it is a most variable and puzzling plant. It is non-British, but frequent in warm climates; *supposed* British specimens are all referrible to *P. perlata*. The examination of a considerable suite of foreign specimens in the Hookerian Herbarium, named by NYLANDER himself, convinces me that the majority of foreign, equally with British specimens, is referrible to *P. perlata*, and that the perforate state of the apothecia is a most variable and unsatisfactory feature in either *P. perforata* or *P. perlata*. The normal spermogones of *P. perforata* would appear to be essentially those of *P. perlata*, being black, punctiform, immersed, and scattered on the flat surface of the thallus near its periphery. When degenerate, or aged, they sometimes become mere black maculæ. In exceptional cases, the apothecia, as in var. *luteiformis* of *P. perlata*, are studded over with spermogones. But the most interesting feature in regard to the spermogones is the occurrence, in var. *denticulata*, on the margins of the lobes, of enormous barrel-shaped ones which appear like a fringe or series of coarse black teeth. Sometimes these occur alone, or as the only form of spermogone; at other times, they are associated in the same specimen with the ordinary black punctiform spermogones. It is of much interest here to notice the double form of spermogone; the fact tends to prove that the lichens, as well as the fungi, may have several forms of reproductive organs, and that there is nothing more unnatural in supposing the lichens possessed of spermogones and pycnides—sometimes of more than one form of each—than in allowing that these latter organs are possessed by many fungi, which, fortunately for themselves, have been more fully studied than the lichens!

Specimen 1.—Long Island, North America, May 1856; Dr A. O. BRODIE. The apothecia are very large and abundant; they are flat, cracked, or fissured at their margins, and have a central lacerate-elongate perforation or fissure. This is undoubtedly the *P. perforata* of authors; but the apothecia and spermogones, spores and spermatia, are all those essentially of *P. perlata*. The spermogones are abundant, and, under the lens, distinct; they are scattered about the periphery of the thallus. They are minute, round, black spots, or indistinct papillæ, having their centre pierced by an ostiole, which is generally depressed. The latter is round and patent in the older spermogones; it has sometimes a sub-prominent black margin, or it may be surrounded by a pale thalline margin, not circumscribed, but passing gradually into the ordinary colour of the thallus. Rarely it is seated on a distinct papillar elevation of the thallus. The body of the spermogone is wholly immersed, and consists of a grayish tissue. The spermatia are long delicate needles, about $\frac{1}{2000}$ th long, among the largest and most handsome I

have seen. The same remark applies to the sterigmata, which are made up of delicate, elongated, cylindrical cells. Intermixed with them are numerous very long branching delicate filaments, as in *Ramalina*, which obscure by their abundance the ordinary sterigmata, and fill up the cavity of the spermogone. In specimens also collected by Dr BRODIE, and labelled Waterville, Long Island, April 1856, there are no apothecia, and the spermogones are old. They contain only sterile, elongated, branching filaments as above described, and which, with age, accumulate in the mature spermogone so as to obliterate the spermatiferous sterigmata.

Specimen 2.—Rio Janeiro, 1846–51; from HENRY PAUL, Edinburgh. A very elegant and beautiful form, in which both the margins of the thallus and of the apothecia are ciliated. The spermogones are as described in No. 1.

Specimen 3.—Mahasa, Simla, North-West Himalaya; temperate region at 8000 feet; coll. by Dr THOMAS THOMSON; in Herb. Hooker, Kew. The thallus has a ciliate margin, and the spermogones are those of *P. perlata*. Lachen, Sikkim, Himalaya; temperate region at 9000 feet; coll. Dr HOOKER; has no apothecia and no ciliate margin of thallus. Monkrum, Khasia; temperate region at 5000 feet; coll. by Drs HOOKER and T. THOMSON; all in Herb. Hooker, Kew. The spermogones are those of *P. perlata*. Madras, coll. Dr HUNTER; also in Herb. Hooker. The margin of the thallus is slightly ciliate; the spermogones are those of *P. perlata*.

Specimen 4.—(Sub nom. *Lichen perforatus*, Jacq.), ex herb. Dickson; in Herb. Menzies, Royal Botanical Garden, Edinburgh. The apothecia are large and perforate; the margin of the thallus is furnished with long marginal cilia; and the spermogones are abundant, and of the character of those of *P. perlata*.

Specimen 5.—Var. *digitata* mihi. Ascent to the Pedra Bonita, Leguca (Brazil), 1836; coll. GEORGE GARDNER; in Herb. Hooker, Kew. The margins of the thallus are prolonged into curious finger-like lobes or laciniae, dotted over with black punctiform spermogones, which also cover a large portion of the thallus. The spermogones are largish and distinct. They occur also on a specimen from the branch of a tree in Jurajuba Bay, Rio Garda, 1837 (GARDNER), in which the thallus has a rusty-red tint. In a specimen also in Herb. Hooker (with no habitat given), which is referred to *P. perlata* by NYLANDER, the lobes are frequently divided and prolonged into linear laciniae, branching and dissected a good deal. These prolongations are evidently the analogues of the digitate ones in Organ Mountain specimens sent home by GARDNER. They are almost invariably covered over with black, punctiform, immersed spermogones; they are fringed with long beautiful black fibrils, as are also the margins of the ordinary lobes. The apothecia here are of enormous size.

Specimen 6.—Var. *denticulata*, mihi. Singalelah, Sikkim, Himalaya; alpine region at 11,000 feet; coll. Dr HOOKER; in Herb. Hooker, Kew. No spermogones

of the ordinary kind occur here ; but on the margins of the lobes is seated a series of very large black cones, which resemble a fringe of coarse teeth. Some are rather barrel-shaped than papillæform ; most of them are broad and short, and all have distinct ostioles. The spermatia are rod-shaped, about $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata are about $\frac{1}{1500}$ th long, and $\frac{1}{7500}$ th broad ; they are very delicate, are composed of 5 or 6 delicate cylindrical articulations, and are with difficulty seen amid the dense, intertangled mass of sterile, elongated, anastomosing filaments, which project from among and far beyond them and fill up the cavity of the spermogone. The latter filaments resemble those of *P. saxatilis*, *P. physodes*, and many other *Parmelias* ; but they are usually much more abundant, and they branch and anastomose in all directions. The thallus bears apothecia ; the under surface and sometimes the margin are sparingly fringed with long black fibres. The spermogones here resemble those of *Platysma*, though the sterigmata, spermatiferous and sterile, differ somewhat. Were it not that in the two following specimens these spermogones are found associated with the ordinary spermogones of *P. perforata* or *P. perlata*, there might be some difficulty in deciding whether this plant belongs to *Platysma* or *Parmelia*. As it is, I have no hesitation in placing it here. The spermogones vary greatly in regard to size and closeness of apposition ; hence they form a most irregular fringe or margin.

Specimen 7.—Var. *denticulata*, Munklow, Khasia, India ; sub-tropical region, at 4000 feet ; coll. Drs HOOKER and THOMAS THOMSON. This appears to be a transition form of great interest, inasmuch as, in addition to the large barrel-shaped marginal spermogones described in No. 6, it possesses black punctiform spermogones of the ordinary kind, dotted about the margins of the lobes. The plant bears apothecia ; the margin of the thallus is slightly ciliate, and, but for the barrel-shaped spermogones, the plant has all the appearance of *P. perlata*.

Specimen 8.—Var. *denticulata*, Nepal ; in Herb. Hooker, Kew ; a very large and handsome plant. Like No. 7, this possesses both forms of spermogones, the barrel-shaped ones being among the largest and most distinct I have ever met with in lichens. Besides occurring on the margins, however, they are occasionally studded on the flat surface of the lobes, near their margins. The spermatia and sterigmata are precisely as in *P. perlata*.

SPECIES 4. *P. crinita*, Ach.

Specimen 1.—Sicily Island, Ohio, U. S., America, PECK ; in Herb. Hooker, Kew. This plant also seems to me referrible to var. *ciliata* of *P. perlata* ; its lobes are fringed with beautiful long, delicate, black fibres. The spermogones are abundant, as they are in all extra-European forms of *P. perlata* and its congeners.

SPECIES 5. *P. tiliacea*, Ach.,

Which occurs in Europe, Africa, America, Asia, and Australia. BAYRHOFER regards this as the type of a hermaphrodite lichen. From observations on this and other lichens, he maintains the doctrine, that spermogones are transformed, in the progress of development, into apothecia. There is certainly nothing in this species to warrant such a conclusion. The site and structure alike of the apothecia and spermogones are different. But BAYRHOFER'S views on this and other departments of physiological lichenology are now generally regarded as speculative in the extreme,—as more ingenious than sound. They will be found freely criticised in the “Flora” for 1851–2, as well as in TULASNE'S *Mémoire*, p. 165, *et seq.* From the pale-gray colour of the thallus, the black punctiform spermogones of this species are generally easily recognised. They are usually grouped, sometimes confluent, studded about the margins of the lobes. The internal tissue is dense, horny, and of a grayish colour, the cavity simple, but obliterated with age, the whole body of the spermogone becoming a nucleus or kernel of a horny tissue. The spermogone, in its mature and old state, particularly the latter, is easily enucleated by the point of a needle. The sterigmata are about $\frac{1}{500}$ th to $\frac{1}{400}$ th long, and $\frac{1}{8000}$ th broad; they consist of five or six delicate linear articulations. The spermatia frequently differ in length, according as they are fixed or free; in the former case they are sometimes $\frac{1}{2000}$ th to $\frac{1}{1500}$ th. in the latter, $\frac{1}{3000}$ th to $\frac{1}{2500}$ th long.

According to NYLANDER, *P. carporrhizans*, Tayl., is referrible to *P. tiliacea*. It may be so *pro parte*; but the majority of specimens I have seen are certainly referrible rather to *P. sinuosa*.

Specimen 1.—SCHÆRER exs. 358 (sub nom. *P. quercifolia a. munda*,) on the trunks and branches of trees, Mount Laügenberg, Switzerland. The spermatia and sterigmata of the black punctiform spermogones are among the most beautiful I have seen in the genus *Parmelia*. Some of the attached spermatia are $\frac{1}{1500}$ th to $\frac{1}{2000}$ th long, with a breadth of $\frac{1}{25,000}$ th. Intermixed with the ordinary spermatiferous sterigmata are numerous elongated, sterile, ramose filaments, as in *P. saxatilis*, *P. physodes*, *P. perforata*, and other *Parmelias*. The free spermatia measure $\frac{1}{3000}$ th long; some of the spermatiferous sterigmata, with the spermatia attached, about $\frac{1}{500}$ th.

Specimen 2.—B. de Bigorre, Pyrenees, SPRUCE'S “Lich. Pyrenæi;” in Herb. Hooker, Kew; with plentiful apothecia. The spermogones are generally crowded on the convexities, and about the ends of the lobes, of the thallus, each being perched upon, or rather contained in, a pale cone-like elevation of the thallus. The ostioles are marked by largish black points. The spermatia are needle-shaped, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata consist of five or six linear delicate cells or articulations.

Specimen 3.—Medhari Pass, Kumaon, Himalayas, at an elevation of 8200 feet; ex. Herb. Strachey and Winterbottom; in Herb. Hooker, Kew (sub nom. *P. scortea*, Ach.) The thallus is smoothish; the apothecia abundant. The spermogones are also plentiful, sometimes marked by black points, round or irregular, largish, seated on the summit of pale cone-like elevations of the thallus. Sometimes they are confluent; occasionally the black ostiole is depressed, and seated in the centre of a ring or macula of the thallus.

Specimen 4.—Tasmania, Antarctic Expedition 1839–43, Dr HOOKER; in Herb. meo; a small fragment on a twig, associated with *Usnea barbata*. It has no apothecia; but spermogones are abundant about the margins of the thallus, as distinct, black, round, papillar points, sometimes flattened, but never depressed. The spermatia are delicate needles, about $\frac{1}{4000}$ th long, seated on the apices and sides of articulated sterigmata, of the character described in No. 2. The cells or articulations, which compose the latter, differ much in length and breadth, though they are generally largish and cylindrical.

Specimen 5.—On trees, Blankenburg, Hartz district, Germany; coll. HAMPE, 1846; exs. No. 43. Chinar, Kumaon, Himalayas, at 8700 feet; ex. Herb. Strachey and Winterbottom; apothecia and spermogones abundant. Both organs also occur plentifully in specimens from New Zealand, coll. COLENZO; British North America, coll. DRUMMOND; Ohio, U. S., America, coll. LEA (sub nom. *P. galbina*, Ach.) All these specimens are in Herb. Hooker, Kew.

Specimen 6.—(Sub nom. *P. submarginalis*, Ach.) Canada, Carolina, and other parts of North America; in Herb. Hooker, Kew. This is a small form of the thallus, but the apothecia and spermogones alike are essentially those of *P. tiliacea*. The spermogones are black, punctiform, wholly immersed, and scattered about the ends of the lobes on their flat surface.

SPECIES 6. *P. sinuosa*, Ach.

Almost a cosmopolite species. It is a most variable and puzzling species, and so closely resembles *P. perlata*, *P. perforata*, *P. saxatilis*, *P. tiliacea*, and other *Parmelias*, as to be frequently confounded therewith. The apothecia are seldom met with, and the spermogones are generally neither abundant nor very distinct. There are several important varieties more or less well marked, viz. :—

1. Var. *hypothrix*, Nyl., which includes, for the most part, *P. carporrhizans*, Tayl. It occurs both in Europe and in the Canary Islands.

2. Var. *relicina*, Fr., which would appear to be marked chiefly by its yellow colour. This is not, however, a good, because not a constant, distinction. Specimens with a yellow thallus chiefly occur in foreign countries, such as America, Australia, and Java; but I have found them also occasionally in British specimens. Such specimens have generally a tougher thallus than in those of a white or gray

colour, and its surface is generally more or less reticulate or fissured. Hence this var. passes into, and is closely associated with, var. *reticulata*.

3. Var. *reticulata* is *pro parte* *P. reticulata*, Tayl., which also belongs partly to *P. perlata*. It is chiefly a New Zealand species.

4. Var. *rugosa*, the *P. rugosa*, Tayl., "Fl. Hib.," 145, which may sometimes also belong, *pro parte*, to *P. saxatilis*.

5. Var. *laxigata*, Ach. The *P. laxigata*, Tayl., "Fl. Hib.," 148, Eng. Bot., 1852; chiefly an Irish species, but which occurs also in America.

6. Var. *erratica* mihi, a curious erratic form, so far as I am aware as yet peculiar to Melbury Hill, near Shaftesbury, Dorsetshire,

Specimen 1.—On Dunkerron, Ireland; coll. TAYLOR; in Herb. Mackay; with apothecia. The thallus is thick and coriaceous; the ends of the laciniae frequently bear large soredia, as is commonly the case in foreign specimens; and the colour of the thallus is that of *P. conspersa*. Its colour would refer it to NYLANDER'S var. *relicina* (*Parmelia relicina*, Fr.) Intermixed with the spermogones occur Pycnides, having all the outward aspect, as well as the site, of the spermogones. It admits of a doubt whether these bodies really belong to *P. sinuosa*, as I have not found them in other specimens. But, on the contrary, there are no grounds for supposing that, while the spermogones of *P. sinuosa* really belong to that species, the pycnides which occur in this individual specimen do not! The pycnides are minute, black, punctiform bodies, wholly immersed, and scattered near the margins of the lobes, on their flat surface. Their envelope is brown. Their stylospores vary much as to size and form; they are mostly spherical or oval, about $\frac{1}{800}$ th in diameter, on very short, simple, linear sterigmata. The spermogones, with which these pycnides are associated, are frequently largish, brown, round bodies, seated on warts of the thallus.

Specimen 2.—Apparently also from Ireland; coll. Miss HUTCHINS, 1810; in Herb. Hooker, Kew; said to be "common on rocks." The spermogones are chiefly old, and sometimes occur as largish, round, flat maculae.

Specimen 3.—Ballachulish, Argyllshire, 1807; in Herb. Hooker, Kew. The thallus has the greenish-yellow colour of *P. conspersa*, and is therefore referrible to FRIES' *P. relicina*. The spermogones are few and scattered, and resemble outwardly those of *P. conspersa*. Glen Nevis; coll. BORRER, 1810; also in Herb. Hooker; a few young spermogones, containing no free spermatia.

Specimen 4.—Jamaica, Dr WRIGHT. The spermogones are very abundant, dotting over the entire convex surface of the laciniae, but grouped especially about their extremities. They are generally brown, punctiform, wholly immersed, sometimes with a depressed ostiole, at other times seated on small, ill-marked thalline papillae, frequently irregular as to form. Mauritius, BOYER; Casapi, Peru, MATTHEWS; Columbia, JAMESON; Quito; old spermogones become large, round, black depressions on the surface of the thallus; Chinar, Kumaon, Hima-

laya, at 8700 feet, ex Herb. Strachey and Winterbottom. All these specimens are in Herb. Hooker, Kew.

Specimen 5.—Var. *hypotherix*, Nyl. “Lich. Paris.” (exs.) The spermogones are very abundant and distinct on the smooth glaucous thallus, about its periphery, as minute, brown, elevated papillæ. The spermatia are delicate needles, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata measure about $\frac{1}{1500}$ th long, and are very irregular in outline from the acute angles at which the component cells are articulated.

Specimen 6.—Var. *reticulata*, New Zealand, Antarctic Expedition, 1839-43, Dr HOOKER. The thallus is gray, or of a very pale brownish-yellow colour, apparently the result of desiccation; some of the laciniaë have sorediiferous tips, others have black-ciliate margins. The spermogones are old, few, and scattered about the ends of the laciniaë or lobes; they contain no free spermatia. There are no apothecia.

Specimen 7.—Var. *rugosa*, Blackwater River, County Kerry; coll. TAYLOR in Herb. Mackay, and named by TAYLOR himself. The spermogones occur mostly as brown points scattered about the ends of the laciniaë; sometimes they are sub-papillæform; when old and degenerate, or when confluent, they occasionally become maculiform. The ostiole is generally so minute as to be inconspicuous; but occasionally it has a thick, brown, prominent, ring-like margin. The spermatia are needle-shaped, about $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata consist of few articulations. Specimens from the same locality in Herb. D. Moore, also collected and named by TAYLOR himself, are identical with specimens in the Herbaria of MACKAY and HOOKER. The young spermogones are generally punctiform, brown, wholly immersed, studded singly, or in small groups, on papillar elevations of the thallus. The older ones are chiefly single, each being the centre of a thalline papilla. The apex of this papilla forms a pale ring round the deep chestnut-coloured ostiole, which is flattened or depressed. Sometimes these old spermogones are so prominent as to appear like *Verrucariae*, or young apothecia. In the old state of the spermogone, the ostiole is frequently gaping and fissured, and surrounded by a deep-brown ring, as is often the case also in *P. saxatilis*. In a specimen in Herb. Carroll, coll. in County Kerry, in 1842, by D. MOORE, the spermogones are also old, prominent, brown papillæ or rings, with gaping ostioles. The plant has apothecia; the thallus is very white or cream-coloured, smoothish, with frequently proliferous margins. The laciniaë are neither lacunose nor rugose; hence, in this case at least, and perhaps in the majority of cases, the name *rugosa* is a bad and non-characteristic one. Many of the Irish specimens have a greater resemblance, so far as regards their thallus, to *P. saxatilis* than to *P. sinuosa*. A specimen from Dunkerron, Ireland, coll. by TAYLOR, in Herb. Hooker, Kew, has spermogones which, with age, become brown superficial warts, perched on pale thalline papillæ. The apothecia resemble those of *P. saxatilis*.

Specimen 8.—Var. *lævigata*. On Maam, Connemara, Ireland; coll. D. MOORE;

in Herb. Carroll. There are no apothecia; but old degenerate spermogones abound about the ends of the laciniae. They are brown, immersed, round, ellipsoid or lirellæform, or still more irregular in form; on free spermatia are seen. The colour of the thallus is white. Nova Scotia, 1784, in Herb. Menzies, Royal Botanic Garden, Edinburgh; has both apothecia and spermogones; as has also a specimen from Kollong, Khasia, India, temperate region, at an elevation of 5000 feet; coll. Drs HOOKER and THOS. THOMSON; in Herb. Hooker, Kew.

Specimen 9.—Var. *erratica* mihi, Melbury Hill, near Shaftesbury, Dorsetshire, May 1857; coll. Sir WALTER C. TREVELYAN of Wallington. This is a very curious, erratic, globular form, the thallus having become repeatedly curled inwards on itself, so as to assume the form of a small ball; it was found lying free or unattached on the ground, rolling before the wind on the downs of Melbury Hill. Specimens were submitted by Sir WALTER TREVELYAN to the most distinguished British lichenologists, all of whom were puzzled in regard to its name and place in classification, and each of whom ascribed it to a different species. Sir W. HOOKER referred it to *P. saxatilis*;* the Rev. M. J. BERKELEY and the Rev. CHURCHILL BABINGTON to *P. stellaris*;* the Rev. W. A. LEIGHTON to *P. saxatilis*, of which he constituted it var. *concentrica*;[†] while I placed it provisionally under *P. coarsia*.[‡] This difficulty or dubiety arose from the absence of apothecia. Nor, when I first examined the plant, did I find any spermogones; but in specimens subsequently sent me by Sir WALTER TREVELYAN, I have been successful in finding them in small quantity; and hence am now able to refer the plant to *P. sinuosa*. Many specimens are very like *P. perlata*, and others like *P. saxatilis*. But the examination of a suite of specimens, in very different states, leads me to place it here; constituting it, as it deserves, into a distinct variety, to which I give, in allusion to its peculiar habit, the appellation *erratica*. The thallus is smooth and glaucous; marginal soredia and marginal cilia are occasionally found on some specimens, and on some lobes. The spermogones are few, old, and scattered about the ends of the laciniae; they contain no free spermatia. Outwardly, they have all the characters of those of *P. sinuosa*. In some specimens the plant is associated with spermogoniferous states of *P. physodes*, and has evidently been detached from the twigs of trees, which would appear to be its normal or usual habitat.

Specimen 10.—Var. *Caracensis* (*Parmelia Caracensis*, Taylor), Caracas, South America; coll. J. LINDEN, 1842, exs. No. 576; also Columbia, JAMESON; both in Herb. Hooker, Kew. The spermogones are scattered about the ends of the laciniae, the young ones as punctiform, immersed, black bodies, the old ones as small black

* Gardener's Chronicle, Feb. 9, 1856, p. 84, and March 15, 1856, p. 172. Scottish Gardener, No. 3, p. 100, March 1856 (Proceedings of Botanical Society of Edinburgh).

† LEIGHTON'S Lich. Britannici exsicc. Fasc. 8, No. 232 (1856).

‡ Popular History of British Lichens, London, 1856, p. 211, *et seq.* Monograph of the Genus *Abrothallus*, in Quarterly Journal of Microscopical Science, January 1857, p. 41.

sub-prominent papillæ. The cavity is simple ; the spermatia are about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad, needle-shaped ; the sterigmata are $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long, and consist of a few articulations only. Projecting from among the latter, are numerous elongated, very ramose, and delicate filaments, generally about $\frac{1}{600}$ th long, as in *P. saxatilis*, *P. physodes*, *P. perforata*, and other *Parmelias*.

SPECIES 7. *P. mutabilis*, Tayl.

Specimen 1.—On rocks, Uitenhage, Cape of Good Hope ; in Herb. Hooker, Kew. This plant is at least partly referrible to *P. conspersa*. The spermogones are brown, punctiform, wholly immersed ; grouped in considerable numbers on the convexities and about the ends of the laciniaë. The spermatia are acicular, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad ; the sterigmata about $\frac{1}{1500}$ th to $\frac{1}{2000}$ th long, associated with a few elongated, sterile, ramose filaments, as in *P. physodes*, &c.

SPECIES 8. *P. Kamtschadalis*, Ach.

An Asiatic species, some of whose varieties, however, occur also in America. This species is so protean and puzzling that it is necessary to study very carefully all its varied forms. It appears, on the one hand, to pass into *Evernia furfuracea*, and, on the other, into *P. physodes* and *P. perlata*. In the Hookerian Herbarium it is partly included under the genera *Borreria* and *Evernia*, being supposed, apparently, allied to *Evernia furfuracea*, from which, indeed, it is frequently indistinguishable on cursory examination. The peculiarity of the plant is that the thallus is prolonged into linear, digitate processes, more or less irregular in form, which are sometimes convex above, and channelled below, as in *Evernia*, sometimes fistulose (var. *fistulata*, Taylor). These thalline processes appear analogous to those that occur in Organ Mountain specimens of *P. perforata*.

Specimen 1.—Kumaon, India ; in Herb. Hooker, Kew. The thalline lobes are frequently margined by long, irregular, narrow processes, which are at first merely channelled below and convex above, but which, from curling in, or involution of the margins, become sub-fistulose and nearly round. The flat processes, especially, sometimes give off from their ends secondary or smaller processes of a similar kind, in groups or tufts. All these processes are studded over with black, punctiform, immersed spermogones, with acicular spermatia, about $\frac{1}{6000}$ th long, and sterigmata, consisting of a few articulations, about $\frac{1}{1500}$ th long. Specimens also in Herb. Hooker, from Nepaul and the Neilgherry Hills, India (ex. Herb. Montagne), have laciniaë abundantly dotted over with spermogones, resembling those of *P. physodes*, var. *vittata*, Schærer. Some forms of this species are also very like *P. perlata*.

Specimen 2.—On the white oak, California ; coll. DEIGHTON, 1857. The apothecia resemble those of *P. physodes* ; but they are scattered about the ends

of the long linear laciniae or processes. Some specimens so closely resemble *P. physodes*, in some of its aspects, that they might be referred to that species as a variety. The spermogones are abundant about the ends of the laciniae or processes; they resemble those of *P. physodes* in internal structure and contents, as well as in outward aspect. The spermatia are acicular, about $\frac{1}{4000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata consist of a few delicate cylindrical articulations, and are associated with long ramifying and anastomosing filaments, as in *P. physodes*. The spermogonal envelope is of a pale-brown cellular tissue.

SPECIES 9. *P. moniliformis*, Bab.

Specimen 1.—New Zealand, Colenso, Nos. 863 and 2685; in Herb. Hooker, Kew. This plant is very closely allied to *P. conspersa*, if it does not belong thereto merely as a variety. Two forms of it here occur. One has linear, simple laciniae, of a beautiful lemon-yellow, dotted over with punctiform, black, immersed spermogones. The other has lobes much corrugated and warted, convex and deformed; these too are dotted over with spermogones, which have all the external characters of those of *P. conspersa*. These spermogones are frequently confluent, joining each other by black radiating fissures; sometimes they are large and almost papillæform. The spermogones are also studded over the warts, with which the thallus is more or less plentifully covered, and they occasionally occur also on the apothecia, especially the young ones. The spermatia are acicular, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad.

SPECIES 10. *P. colpodes*, Ach.

(Syn. *P. Michauxii*, Auct.)

Specimen 1.—North America; in Herb. Hooker, Kew. This species, like the last, is closely allied to *conspersa*, if it does not belong to it. The spermogones are scattered over the convexities and about the ends of the lobes; they are brown, punctiform, immersed. The ostiole is sometimes easily seen under the lens; it often appears surrounded by a brown ring. The spermatia are acicular, and about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata are about $\frac{1}{1000}$ th in length, and are composed of a very few long delicate cylindrical cells, articulated at very irregular and acute angles.

SPECIES 11. *P. physodes*, Ach.

Almost a cosmopolite. This is a most changeable plant, containing a number of marked varieties, to two only of which NYLANDER gives separate names—viz., var. *lugubris*, Pers., and var. *enteromorpha*, Ach., both American species. I also refer to this species, ACHARIUS' *P. encausta*. In all forms of *P. physodes*, spermogones are more or less plentiful; in some to such an extent as to have been chiefly or wholly the source of the names given to its varieties by earlier lichenologists.

Thus SCHLÆRER'S varieties η . *multipuncta* and δ . *vittata* of his *P. ceratophylla*, as well as the var. *stigmatea* of Wallroth, are mainly or merely spermogoniferous states. The spermogones are usually largish and distinct, scattered about the ends of the laciniae; they are black, punctiform, and immersed. In the old state the ostioles frequently become large and distinct, generally round, though often stellate-fissured, sometimes surrounded by a turgid brown ring; at other times they are confluent and maculiform. The spermatia are acicular, and about $\frac{1}{4000}$ th to $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th to $\frac{1}{30,000}$ th broad. The sterigmata are usually composed of a few delicate cylindrical articulations, and measure in length, with the spermatia attached, about $\frac{1}{750}$ th to $\frac{1}{1000}$ th, their breadth being about $\frac{1}{15,000}$ th to $\frac{1}{10,000}$ th. Associated with the ordinary spermatiferous sterigmata are elongated, very delicate, branching and anastomosing filaments, which project into and fill the cavity of the spermogone. Their length is frequently about $\frac{1}{400}$ th to $\frac{1}{500}$ th.

Specimen 1.—Craigie Hill, Perth; on old walls; April 1856, W. L. L. Spermogones are very abundant, in all their stages of development. The older ones have a distinct round black ostiole, surrounded by a prominent ring or border, brown or black. Sometimes, on the darker laciniae, contiguous ostioles are united by black fissures passing between them; sometimes they become confluent and maculiform. This specimen has abundant apothecia; the young ones sometimes resemble the brown rings which occasionally surround the spermogonal ostiole. There is great variety in regard to the form and size of the laciniae: sometimes they are short and broad; at other times long and narrow, terminating or not in soredia.

Specimen 2.—Blaeberry Hill, Perth, April 1856, W. L. L.; on the bark of firs and other trees. The thallus has short broad laciniae. Many of the spermogonal ostioles are depressed; sometimes a chain or group of ostioles is united by a series of black cracks or fissures. The ostiole has also frequently a prominent black border. Corticolous specimens are destitute of apothecia, which, however, occur sparingly on saxicolous ones in this locality.

Specimen 3.—Kinnoull Hill, Perth, March 1856, W. L. L.; on the stumps of dead firs and pines; with apothecia. The spermogones are few; the laciniae are elongated and sorediiferous, and inflated at the ends.

Specimen 4.—Knock Hill, Crieff, June 1856, W. L. L.; on the bark of firs and pines, especially the Scotch fir (*Pinus sylvestris*). The apothecia are very abundant, more so than in any specimens of this species I have ever collected or seen. The spermogones are also plentiful.

Specimen 5.—Moncreiffe Hill, Perth, on rocks, August 1856; coll. Dr MURRAY LINDSAY; broad-lobed form; no apothecia.

Specimen 6.—In woods, between Dalmahoy and Currie, near Edinburgh, June 1856; coll. Dr MURRAY LINDSAY; on trees; with apothecia. The thallus is of a dark-gray; the laciniae are narrow, elongated, and sorediiferous. The spermo-

gones are associated with large, flattened, black maculæ, which seem fungoid in their nature.

Specimen 7.—On rocks, Morchone, Braemar, August 1856, W. L. L.; with apothecia. The central as well as peripheral parts of the thallus are studded over with very minute black punctiform spermogones.

Specimen 8.—On blasted Scotch firs (*Pinus sylvestris*), Glen Lui Beg, Braemar, August 1856, W. L. L.; no apothecia. Spermogones are of the usual character.

Specimen 9.—Bridge of Cally, Blairgowrie, August 1856, W. L. L.; on walls; no apothecia. The thallus is eroded in patches, exposing the white medullary layer. Roadside walls, Spittal of Glenshee, Braemar, August 1856, W. L. L.; no apothecia. The spermogones are large; the ostioles patent, with thickish, distinct, black borders, which are ring-like. Frequently the spermogones are confluent and maculiform.

Specimen 10.—Melbury Hill, near Shaftesbury, Dorsetshire, May 1857; coll. Sir WALTER C. TREVELYAN; associated with *P. sinuosa*, var. *erratica*. The spermogones are few and scattered.

Specimen 11.—On a stone fence, near Montrose, Forfarshire, July 1843; coll. A. CROALL; with apothecia. The spermogones are extremely minute, brown, and punctiform, scattered about the ends of laciniaë with large terminal soredia, and inflated or bullose tips. In specimens from Guthrie, Forfarshire, also coll. by CROALL, in Herb. Hooker, Kew, the lobes are broad and simple, but the spermogones are the same.

Specimen 12.—Kildale, Cleveland, Yorkshire, 1855-6; coll. W. MUDD. The thallus is of a darkish hue; the spermogones are very minute and punctiform, giving the laciniaë the appearance of being covered with a series of very minute black perforations.

Specimen 13.—On the white oak of California; coll. DEIGHTON, 1857; with abundant apothecia. The plant resembles SCHLÆRER's var. *η. multipuncta*, which, however, he describes as chiefly saxicolous. The laciniaë, or segments of the thallus, differ much in form and size; some are narrow and linear, not terminating, however, in inflated bullæ or soredia; others are flattish, sub-fastigiate at the ends, and somewhat retuse, also like the laciniaë of *P. saxatilis*. The spermogones are minute, punctiform, black. The spermatia are acicular, about $\frac{1}{4000}$ th long, borne on the apices and sides of sterigmata, which are composed of two or three delicate, cylindrical articulations only. From among the latter project numbers of the elongated, sterile, very ramose filaments already described as so generally occurring in *P. physodes*.

Specimen 14.—On rocks, Blackpool, near Cork; coll. CARROLL. This is near SCHLÆRER's vars. *η. multipuncta* and *δ. vittata*. Though in these spermogoniferous states of *P. physodes*, spermogones are abundant, they are generally old and degenerate, and he who expects always to find in them abundance of spermatia will

most assuredly be frequently doomed to disappointment. In specimens on bark from Ardrum, near Cork, also collected by CARROLL, the spermatia are delicate needles about $\frac{1}{6000}$ th long, and $\frac{1}{30,000}$ th broad; the sterigmata, with spermatia attached, measure $\frac{1}{750}$ th to $\frac{1}{1000}$ th long, and $\frac{1}{10,000}$ th to $\frac{1}{15,000}$ th broad. The elongated, ramose, sterile filaments reach a length of $\frac{1}{400}$ th to $\frac{1}{500}$ th, with a breadth of $\frac{1}{10,000}$ th to $\frac{1}{20,000}$ th. The envelope is of a pale-brown cellular tissue.

Specimen 15.—SCHÆRER EXS. 367 (sub *δ. vittata*); on firs. There are a few old spermogones on the lower specimen in my copy (ed. alt. immut. 1840), scattered on the convexities of the laciniae near their ends. The ostioles are large, round or oval, with a turgid, black, ring-like border.

Specimen 16.—Van Dieman's Land; coll. CHAS. STUART. The thallus is broad-lobed, very white; the apothecia are seated on bullose erect pedicles, or podetia-like dilatations of the lobes, which resemble those of *Leptogium bullatum*. The spermogones are very abundant, large, and easily seen. Mauritius; both specimens being in Herb. Hooker, Kew.

Specimen 17.—On trees and rocks, forests round Mount Wellington, Van Dieman's Land; coll. MOSSMAN, 1840; in Herb. Royal Botanic Garden, Edinburgh. The laciniae are large, white, and glossy; the apothecia and spermogones plentiful, and of the ordinary characters.

Specimen 18.—Var. *vittata*, Schær.; West Coast of North America; coll. A. MENZIES, 1787; in Herb. Menzies, Royal Botanic Garden, Edinburgh. The laciniae are very long, flaccid, narrow, and eveniform. There are no apothecia; and the spermogones are few but large. In a specimen from the same locality, also collected by MENZIES, in Herb. Hooker, Kew, the laciniae are pendent, and sometimes bullose at their extremities; the spermatia and sterigmata of the spermogones are quite those of our British *P. physodes*.

Specimen 19.—Norway; in Herb. Hooker, Kew; very near SCHÆRER's *vittata*. Some of the laciniae are wholly dotted over with old spermogones, in few or none of which are spermatia discoverable.

Specimen 20.—Var. *lugubris*, Pers., Avon Ranges, Australia; coll. MÜLLER, 1854; in Herb. Hooker, Kew; with apothecia. The plant greatly resembles *P. encausta*, the whole surface of the laciniae being black-punctate with immersed spermogones, as in that species.

Specimen 21.—Var. *enteromorpha*, Ach. (sub *Parmelia enteromorpha*, Ach.); Tasmania, Antarctic Expedition 1839–43, Dr HOOKER. This is a form trailing over shrubs of various kinds, just as it does on heather, &c., in this country. In some specimens apothecia abound, and the same specimens are generally more or less plentifully dotted over with spermogones. They are in all respects those of the type to which this plant manifestly belongs as a variety. They are usually grouped in large numbers; the ostiole is flat or depressed, never papillate. The spermatia are acicular, about $\frac{1}{6000}$ th long. Associated with the sperma-

tiferous sterigmata, occur the elongated, branching ones, already so frequently described.

Specimen 22.—Var. *enteromorpha*, Falkland Islands, Antarctic Expedition, 1839–43, Dr HOOKER. The laciniae are longish and narrow, convex above; concave under surface of a pitchy black colour. The spermogones are as in No. 21.

Specimen 23.—Var. *enteromorpha*, West Coast of North America; coll. A. MENZIES, 1787; in Herb. Menzies, Royal Botanic Garden, Edinburgh. The ends of the laciniae, which otherwise resemble those described in No. 22, are bullose or inflated; on these bullose extremities the apothecia are seated. The spermogones are abundant, and as in No. 21. In American specimens they sometimes become papillæform, but more usually they are punctiform. Spermogones are also plentiful in specimens from the North-West Coast of America, DOUGLAS; Russian America; the Oregon River, SCOULER; and Monterrey, California, BEECHEY,—all in Herb. Hooker, Kew.

SPECIES 12. *P. encausta*, Ach.,

Which is more or less abundant in various alpine parts of Europe. As I have already stated, I regard it simply as a variety—an alpine spermogoniferous one—of the preceding species. The spermogones are generally much more profusely scattered and easily seen than in *P. physodes*; they are larger, and cover over the whole surface of the laciniae and thallus. They are wholly immersed, their form subspherical, their cavity simple, their thickish envelope at first grayish, but becoming black. The spermatia, sterigmata, and ramose filaments of the spermogones are precisely as in *P. physodes*. The thallus, however, is much thicker, generally coriaceous; the laciniae very narrow, and convex on their upper surface.

Specimen 1.—Var. *stygioides*; summit of Cairngorm, Braemar, August 1856, W. L. L. The thallus is centrally of a brown tinge, and pale or whitish only at the periphery. From its great general resemblance to *P. stygia*, with which it is very apt to be confounded, I propose designating this plant, provisionally at least, var. *stygioides*. The spermogones are very distinct on the laciniae, as small black cones or papillæ. I have gathered similar specimens, but in very small quantity, on Morchone, Braemar; in considerable abundance, however, on the summit of Ben Nevis. The laciniae are frequently sub-articulated; the spermogones are sometimes large and irregular, with ostioles which are patent and easily seen. Sometimes the segments of the thallus are lobes instead of laciniae, broadening at their periphery or ends, and dotted over with punctiform spermogones, as in the ordinary form of *P. physodes*. These are evidently transition forms into *P. physodes*, and furnish strong reasons for associating *P. encausta* with *P. physodes*. In Cairngorm specimens, the spermogones are very easily recognised, when the thallus is greenish or pale. In the young state they are papillar; in the old, the ostiole is prominent, large, and roundish, sometimes surrounded by a turgid, black, ring-like border;

at other times they are depressed or flattened. The laciniae are sometimes profusely covered with black holes or perforations, which are the ostioles in question; this is the source or cause of their frequently pitted character. The spermogonal envelope is of a deep-brown colour, and consists of a tissue made up of small but well-defined roundish cellules. The spermatia are rod-shaped, about $\frac{1}{5000}$ th long, borne on the apices and sides of very ramose, delicate, articulated sterigmata. Associated with the latter are numerous elongated branching filaments, with bulging extremities, which project into and fill up the cavity of the spermogone. In the Morchone specimens, which occur on quartz rock and gneiss, the spermogones are mostly old, with large ostioles, which give the thallus the appearance of being jagged all over with large black foramina.

Specimen 2.—SCHÆRER exs. 368 (sub *Parmelia ceratophylla*, η . *multipuncta*); on granitic rocks in the Alps; on the lower specimen in my copy (ed. alt. immut. 1840) the upper one being certainly referrible to *P. savatilis*, the furfuraceous form of thallus. The spermogones are abundantly scattered over all the laciniae as minute black papillæ. The spermatia are acicular, about $\frac{1}{4000}$ th to $\frac{1}{3000}$ th long. The sterigmata consist of articulations, joined at very irregular angles; with the spermatia attached, they measure in length $\frac{1}{1000}$ th to $\frac{1}{1200}$ th. KÖRBER very erroneously describes the spermatia of *P. encausta* as *ellipsoid*. I have never seen them otherwise than acicular, and as in *P. physodes*.

Specimen 3.—HEPP. exs. 52 (sub *Imbricaria ceratophylla*, var. *candefacta*, Ach.); on granitic rocks, St Moritz, Switzerland. The thallus is very beautifully studded over with the spermogones, which are chiefly old, containing no free spermatia. They occur partly as largish, distinct cones, partly as black perforations, which are the old ostioles. In a specimen in HEPP.'s exs. 40, occurring on moss at St Moritz, associated with *Lecidea disciformis*, var. *muscorum*, the thallus is as plentifully covered with spermogones, which, however, are mostly young; the spermatia and sterigmata are as in No. 2.

Specimen 4.—On rocks, Bructeri, Hartz district, Germany, HAMPE exs. No. 2 (sub *P. physodes*, β . *encausta*, Fr.), 1846; tops of the mountains near Kongsvold, Dovrefjeld, Norway, SOMMERFELDT, Un. Itin., 1828; Alps of Dalecarlia, Sweden, Dr SWARTZ, 1809; Riesengebirge, Dr C. LUDWIG, 1814; Hartz Mountains, MOHR, 1802; Grimsel, Switzerland, SCHÆRER, 1815;—all in Herb. Hooker, Kew. Also from the Glaciers of Savoy, SMITH; in Herb. Menzies, Royal Botanic Garden, Edinburgh. In all these specimens spermogones, having the characters described in No. 2, are abundant.

SPECIES 13. *P. pertusa*, Schærer,

Which occurs in Europe, America, Asia, and Australia, and which is ACHARIUS' *P. diatrypa*. I also refer this plant as a variety to *P. physodes*. It differs in nowise from that species, except in regard to the ends of the laciniae being occa-

sionally perforated by an irregular hole or fissure. This erosion or perforation is analogous to what occurs in *Umbilicaria erosa*, and other lichens. Either apothecia or thallus may be erose or perforated; but such erosion is accidental—not peculiar to any one species or variety—and does not therefore furnish a good distinctive character. The thecæ and spores of *P. pertusa* are generally larger than those of *P. physodes*; but there are few species in which the thecæ and spores are uniformly of the same size. They usually vary more or less in different specimens of the same species from different localities. The spermogones of *P. pertusa* are identical with those of *P. physodes*, but they are less common and less plentiful.

SPECIES 14. *P. cincinnata*, Ach.

Specimen 1.—Staten Land, Cape Horn; in Herb. Hooker, Kew; also collected by A. MENZIES, 1787, in Herb. Menzies, Royal Botanic Garden, Edinburgh. If this plant is not a form of *P. physodes*, which I am inclined to regard it, it is at least very closely allied. The laciniaë are bullose at their extremities in both sets of specimens; in MENZIES'S, occasionally pertuse. In both cases the spermogones are abundantly scattered over the ends of the laciniaë, as black or brown, punctiform, immersed bodies. The spermatia are acicular, about $\frac{1}{4000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata consist of a few delicate cylindrical articulations or cells, as in *P. physodes*.

SPECIES 15. *P. placorodia*, Ach.

Specimen 1.—On the trunks of trees, Troy, U. S., America; in Herb. Hooker, Kew. The plant greatly resembles *P. tiliacea*. The spermogones are scattered generally in round, closely aggregated groups, about the ends of the laciniaë, as black, immersed, punctiform bodies. The spermatia are acicular, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad, on sterigmata about $\frac{1}{1000}$ th long, which consist of several articulations, as in *P. tiliacea*.

SPECIES 16. *P. saxatilis*, Ach.,

Which occurs in Europe, Africa, America, and Asia. There is one very well-marked variety, *omphalodes*, Ach., Fr., which occurs in Europe and Asia—the *Parmelia omphalodes* of the earlier lichenologists. It has no claim, however, to rank as a separate species; the gradations between it and the type are easily studied. Its apothecia and spermogones alike are those of *P. saxatilis*. The spermogones are generally very minute, black, punctiform, wholly immersed bodies, scattered over the ends of the laciniaë, always on smooth ones, seldom or never on furfuraceous ones; or, if they occur on the latter, they are so minute and inconspicuous that they are overlooked. The ostiole is flat or depressed, seldom papillæ-form. Normally it is round, and exceedingly minute; but with age it becomes triangular or stellate-fissured, with turgid, prominent borders or not. The ends of the laciniaë, especially in var. *omphalodes*, are frequently studded over with

irregular, stellate-fissured perforations, which are the ostioles of old spermogones. The spermatia are rod-shaped or acicular, about $\frac{1}{4000}$ th to $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata are about $\frac{1}{750}$ th to $\frac{1}{1000}$ th long, and consist of three to six delicate, cylindrical articulations, which are sometimes very irregular in form; their breadth is frequently $\frac{1}{10,000}$ th to $\frac{1}{15,000}$ th. As in *P. physodes* in all its forms and varieties, along with the spermatiferous sterigmata occur numerous elongated, ramose, delicate filaments, that project into and fill up the cavity of the spermogone, which is simple. Occasionally the spermatiferous sterigmata would appear to become elongated and hypertrophied, and to anastomose. In one specimen from Connemara, *pynides* occur interspersed among the spermogones, of which they have all the external aspect, and from which, outwardly, they cannot be distinguished. The stylospores are very irregular in form,—spherical, oval, or pyriform chiefly,—sometimes curved, about $\frac{1}{6000}$ th long, and $\frac{1}{8000}$ th broad, on short, simple, linear sterigmata. Pycnides, associated with the ordinary spermogones of the plant, and having almost the same characters as those now described, occur in a specimen of *P. sinuosa*, from Dunkerron (*vide* page 216). It is curious that both the *Parmelias* in which these pycnides occur are *Irish* specimens! KÖRBER appears to me to err greatly where he describes the spermatia of *P. saxatilis* as almost spherical “kugligen spermatien.” I have never seen them otherwise than straight and linear, of great tenuity throughout.

Specimen 1.—Form *furfuracea*. It is almost uniformly on this state or form of *P. saxatilis* that spermogones occur; but generally only where the ends of the laciniae are smooth and free of furfuraceous or isidioid growths. Blaeberry Hill, Perth, April 1856, W. L. L. Most of the laciniae are broad or lobate, with rounded margins; these laciniae are found especially at the periphery of the plant. More centrally the laciniae are narrower, with retuse or truncate ends. It is on the latter, and not the former, that spermogones occur.

Specimen 2.—Birnam Hill, Dunkeld, 1856; with apothecia; W. L. L. Some of the laciniae are studded over with black stellate-fissured perforations, which are the ostioles of old spermogones. Craig-y-Barns, Dunkeld, April 1856, W. L. L.; with apothecia. The general surface of the plant is furfuraceous; but some of the laciniae have smooth, glaucous ends, on which occur a few large, degenerate, maculiform spermogones. Craig Vinean, Dunkeld, May 1856, W. L. L. Some of the laciniae are very narrow, and all are of a bluish-gray colour, and smooth towards the ends. Old wall, Amulree Road, Dunkeld, June 1856, W. L. L.; with apothecia. The laciniae are narrow, and the punctiform black spermogones are sparingly scattered in groups at their extremities.

Specimen 3.—Hills above Abernethy and Newburgh, May 1856, W. L. L.; with apothecia. Here the spermogones, which have mostly depressed ostioles, are scattered among the isidioid growths which cover the thallus.

Specimen 4.—On roadside walls, Linn of Dee Road, Braemar, August 1856,

W. L. L. ; furfuraceous form, with narrow laciniae. The sterile, elongated, ramose filaments are here abundant in the spermogones ; they usually have a distinctly bulging apex, and are frequently distinctly septate, like the paraphyses.

Specimen 5.—Storr Rock, Skye, August 1856, W. L. L. ; with apothecia. The spermogones are here very distinct and characteristic ; they are of a deep-brown colour, rather than black, however.

Specimen 6.—On roadside walls, between Percy and the Spittal of Glenshee, Perthshire, August 1856, W. L. L. The spermogones are mostly old ; in their interior, nothing is to be seen but the ramose, elongated filaments already described, which frequently assume a pale-brown colour at their tips ; they are also distinctly septate.

Specimen 7.—On rocks, near Ayton, Cleveland, Yorkshire, 1856, Mudd ; furfuraceous form. The spermogones are abundantly scattered among the isidioid growths, which cover the ends of the laciniae.

Specimen 8.—CROALL'S Plants of Braemar, No. 389 ; on stones, common ; July 1855. Furfuraceous form ; apothecia plentiful. Dotted over the smooth, shining, light-gray ends of the laciniae, are numerous punctiform spermogones,—so minute that they can with difficulty be seen even under the lens,—whose ostioles are sometimes slightly depressed, though generally flat.

Specimen 9.—Connemara, Ireland, D. MOORE ; in Herb. Carroll ; apparently growing on the ground ; no apothecia. Spermogones occur only on one specimen ; they are mostly degenerate. The ostiole is seldom quite round, generally less or more irregular in outline, and frequently surrounded by a sort of raised, thalline, ring-like border. Intermixed, and scarcely distinguishable from these spermogones except by their slightly greater size, are black punctiform pycnides. The stylospores are very irregular in shape, though mostly spherical, oval, or pyriform, and frequently curved ; the sterigmata are short, simple, linear bodies. Pycnides having a similar site and external characters occur associated with the ordinary spermogones in a specimen of *P. sinuosa* from Dunkerron, Ireland. I find no spermogones on specimens from Tasmania, Dr HOOKER ; Quebec, SHEPHERD ; and B. de Bigorre, Pyrenees, SPRUCE ;—all in Herb. Hooker.

Specimen 10.—Var. *sulcata*. The *Parmelia sulcata*, Taylor, "Fl. Hib." 145, seems to me undoubtedly referrible to *P. saxatilis*, and I therefore place it here as a variety, though I do not regard it even as a well-marked variety. It is merely a form of what is called var. *leucochroa* by WALLROTH, SCHLZERER, and others of the earlier lichenologists, a variety distinguished by large lobes, smooth and white, and marked on the upper surface by distinct sulci or lacunae. It is common in Britain on trees ; seldom or never on rocks or stones. Van Dieman's Land, GUNN ; in Herb. Hooker, Kew. The spermogones are precisely those of *P. saxatilis*. Here they are few and large, scattered about the ends of the laciniae—the ostiole being sometimes depressed, sometimes surrounded by a black ring or seated in the centre

of a macula, or perhaps papillate. The spermatia are acicular, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata are about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long, and consist of a few linear articulations.

Specimen 11.—Var. *panniformis*, Schær.; on alpine rocks, Switzerland; in Herb. Hooker, Kew. There are a few scattered spermogones, of the character of those of the type; but they are old, and contain only sterile, branching, delicate filaments.

Specimen 12.—Var. *omphalodes*; hills above Abernethy, 1856, W. L. L.; with apothecia. Some of the spermogones are distinctly papillæform, and large; but they occur chiefly in the old state as ostioles,—triangular or stellate-fissured, large and black, with a turgid black edge,—studded over the ends of the laciniaë. As a general rule, the spermogones are larger in this variety than in the type, and the large gaping ostioles of the old spermogones are particularly conspicuous.

Specimen 13.—Var. *omphalodes*; hills above Loch Freuchie, Amulree, May 1856, W. L. L.; with apothecia. The ends of the dark laciniaë appear as if perforated with a series of black holes, which are sometimes round, more frequently stellate-fissured, even saucer-shaped. These are the ostioles of old spermogones, which are sometimes, moreover, confluent, or are united to each other by black, radiating fissures.

Specimen 14.—Var. *omphalodes*; Birnam Hill, Dunkeld; on mica slate and gneiss; July 1855, W. L. L.; with apothecia. The old ostioles are so abundant here as to give the laciniaë the appearance of having been profusely pricked by needle-points. They are as irregular as those described in No. 13. They sometimes have a black prominent border; are sometimes flat, and at other times depressed. There are also a few young and mature spermogones, containing spermatia and sterigmata of the characters of the type. Craig Vinean, Dunkeld, May 1856, W. L. L. Here also the spermogones are chiefly old, the ostiole being sometimes seated in a papillar elevation of the thallus.

Specimen 15.—CROALL'S Plants of Braemar, No. 390, common, July 1855. The dark, bronze-coloured laciniaë are covered by a peculiar bluish-gray pruina or bloom, through which the spermogones appear as minute points or papillæ. Clova, Forfarshire, CROALL, July 1853; with apothecia. The ends of the smaller laciniaë are jagged over with the depressed, irregular, patent black ostioles of old spermogones.

Specimen 16.—Bunbeg, County Donegal, Professor DICKIE, August 1851. The laciniaë are narrow, and many of them are covered with a pruina or bloom of a peculiar bluish-gray tint, as in No. 15; this gives the plant much the aspect of *Physcia pulverulenta*. In respect to colour, this plant is intermediate between the type and var. *omphalodes*. There are no apothecia; but spermogones are plentiful. They are chiefly old, with gaping ostioles, and are distinct under the lens. The spermatia are acicular, about $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata measure about $\frac{1}{750}$ th to $\frac{1}{1000}$ th in length, and $\frac{1}{10,000}$ th to $\frac{1}{15,000}$ th in breadth; they con-

sist generally of five or six articulations, normally cylindrical, but frequently very irregular in outline. They are, moreover, joined or superimposed at very irregular angles. Sometimes apparently they become elongated, by the superposition of additional articulations or cells, and they anastomose with each other, forming a network, projecting beyond the mass of the sterigmata into the cavity of the spermogone. They continue, however, in this state to bear spermatia, which are developed from the apices of the component articulations. The cavity of the spermogone is further occupied by a network of very delicate, anastomosing filaments, of nearly equal width throughout, very ramose, generally septate, and never bearing spermatia. These are the filaments which so commonly occur in the spermogones of *P. saxatilis*, *P. physodes*, *P. perforata*, and other *Parmelias*, and which are particularly constant in the two species first mentioned.

Specimen 17.—LEIGHTON'S exs. 7; Barmouth, Merionethshire; with apothecia. The laciniae are broad, and exhibit the large gaping ostioles of the old spermogones to great advantage; these ostioles have usually a black, hard border.

Specimen 18.—HEPP. exs. 116; associated with *Umbilicaria hyperborea*; on granitic rocks, St Moritz, Switzerland; no apothecia. Here also the spermogones are chiefly old, the ostioles having a black, raised, ring-like border. The ramose, elongated, sterile filaments abound in the interior of the spermogones.

Specimen 19.—Lachen, Sikkim, Himalaya, alpine region, at an elevation of 13,000 feet; coll. Dr HOOKER; in Herb. Hooker, Kew. The thallus is dark-brown, and of the *omphalodes* type; the spermogones are very abundant and large.

SPECIES 17. *P. Borreri*, Ach.,

Which occurs in Europe, Africa, America, and Asia. I am in doubt as to whether this should be separated as a species from *P. tiliacea*. The apothecia and spermogones are essentially those of the species just named. I cannot help regarding it as a merely sorediiferous form of *P. tiliacea*. This is the result of the examination of a large suite of specimens from every part of the world, contained in the Hookerian Herbarium at Kew, including specimens from Sussex, Ireland, the Pyrenees, Switzerland, Portugal, Teneriffe, South Africa, Chili, Ohio, India, Spitzbergen, and the Arctic Regions. The spermogones are minute, black, punctiform, immersed bodies, generally scattered about the margins of the lobes, but frequently also arranged or distributed more centrally. The ostiole is sometimes depressed, generally flat, but occasionally perched on papillar elevations of the thallus, or surrounded by a ring of the thallus, which gives the spermogones a pseudo-papillar aspect. Sometimes the thallus is very rugose, and much warted over; in such cases, the spermogones are dotted over these thalline warts or rugosities, as in a specimen from Barmouth, coll. SALWEY, in Herb. Hooker, Kew.

Specimen 1.—On trees, Paul, Penzance, Cornwall; coll. Dr BARCLAY MONTGOMERY, Sept. 1856; with apothecia. The thallus is abundantly sorediiferous;

its whole surface more or less mealy. The spermogones are scattered chiefly peripherally; in some the ostiole is depressed, in others it is girt by a slight ring of the thallus, giving it a pseudo-papillate aspect.

Specimen 2.—On the bark of trees, Riverstown, Cork; coll. CARROLL. On one specimen there are a few old spermogones, dotted about the margin of the lobes of the thallus; some of them appear seated on a flattened thalline papilla, others are girt by a thalline ring, as in No. 1.

Specimen 3.—LEIGHTON exs. 231 (Eng. Bot. t. 1780); Twycross, Leicestershire; no apothecia. The thallus is abundantly sorediiferous. The spermogones are peripheral in regard to distribution; the spermatia are short and acicular, on articulated, ramose, delicate sterigmata, as in *P. tiliacea*.

Specimen 4.—SCHÆRER exs. 361 (sub *Parmelia dubia*); on trunks of trees and palings, Switzerland. A few spermogones are dotted over the margins of the lobes, but they are old, and contain no free spermatia.

SPECIES 18. *P. conspersa*, Ach.

A cosmopolite. There are two chief forms of the plant: one with narrow, linear convex laciniae, the var. *stenophylla*, or *minor*, of some authors; and the other, with broad, round lobes, flattened, and resembling occasionally *P. caperata*, usually described as var. *major*. In a very large suite of specimens I have examined, from every part of the world, in the Hookerian Herbarium, Kew, I have rarely found spermogones absent. Moreover, they generally occur in great plenty scattered over the whole surface of the laciniae, or thallus. So much so is this the case, that the name of the plant may be supposed to have been bestowed in allusion to the great profusion of the spermogones. They are usually minute, black, punctiform, immersed bodies, with an imperceptible ostiole. But, with age, the latter expands and becomes patent, having either a round, triangular, or stellate-fissured shape, as is the case in *P. saxatilis* and *P. physodes*. Hence, the plant is frequently studded over with a profusion of black, lacerate perforations, which are the ostioles of old spermogones. It frequently happens that the apothecia of this species are degenerate or abortive; the disk falls out, and a cup-shaped cavity remains, of the same colour as the exciple and the thallus. The exciple, at the same time, generally becomes corrugated, and the whole organ assumes a coarse, warted appearance. On these apothecia, disk and exciple alike, the spermogones are frequently studded as plentifully as on the thallus, giving them a peculiar black-punctate character. KÖRBER apparently implies that the apothecium becomes barren and degenerate as a consequence of the spermogones taking possession of it as a site. But I see no evidence for regarding the phenomenon either as a *propter hoc*, or a *post hoc*. It rather appears to me that, the apothecia being degenerate from other causes, the spermogones are developed upon them. Were we theorizing, on physiological and analogical grounds we might suppose that the spermogones should be

first developed, and subsequently the apothecia. But this would not appear to be the case here at least. The cavity of the spermogone is simple; its internal tissue gray. The spermatia are acicular, varying in size usually from $\frac{1}{4000}$ th to $\frac{1}{6000}$ th, with a breadth of $\frac{1}{25,000}$ th. The sterigmata consist of three to six delicate, cylindrical articulations or cells, and measure in length about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th. Both spermatia and sterigmata resemble those already described as occurring in *P. saxatilis* and *P. physodes*.

Specimen 1.—On old walls about Moffat, Dumfriesshire, August 1851; W. L. L. The apothecia are more abundant and beautiful in Moffat specimens than in any others I ever collected. The spermogones are plentiful on the convexities, and towards the ends, of the laciniae. The spermatia are about $\frac{1}{6000}$ th to $\frac{1}{7000}$ th long. The sterigmata are ramose, and composed of a few long, delicate, cylindrical articulations.

Specimen 2.—Var. *minor*; Glen Clova, Forfarshire; coll. CROALL, July 1853; on stones. Here, also, the spermogones are most plentiful about the ends of the laciniae, as very minute brown or black flat points. Apothecia are less abundant and large than in No. 1.

Specimen 3.—LEIGHT. exs. 79, var. *stenophylla*, Schærer; on stones, Bardon Hill, Leicestershire; a form with narrow, linear, convex laciniae. On the right-hand specimen in my copy the spermogones are very large and abundant on the convexities of the thalline laciniae, as prominent, black cones—frequently flattened. The spermatia and sterigmata are as above described.

Specimen 4.—Glenesk, Forfarshire; on old walls, at the foot of the glen; small-lobed form. Quebec, SHEPHERD; both in Herb. Hooker, Kew. The latter has large distinct spermogones. A specimen in the Herbarium of the Botanical Society of Edinburgh, with apothecia—no habitat given—has a thallus black-punctate over its whole surface from the profusion of spermogones. Back River Gully, Tasmania, on rotten wood; coll. by OLDFIELD; in Herb. Hooker; is a large-lobed form, resembling *P. caperata*, with a few large, scattered spermogones.

Specimen 5.—SCHÆRER exs. 379 (sub *P. centrifuga* a. *conspersa*); on micaceous stones, Switzerland. Spermogones abound, in every stage of their development; sometimes punctiform, sometimes maculiform, always thickly aggregated, frequently with black, stellate-fissured ostioles. The spermatia are acicular, and about $\frac{1}{4000}$ th long. The sterigmata, with the spermatia attached, measure about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long.

Specimen 6.—HEPP. exs. 37; on the same piece of stone with *Lecidea atro-alba* β, *vera*. Næg. There are only a few fragments of *P. conspersa*, which are studded over with the apothecia of *Lecidea oxyspora*, Tul. These are round, discoid, largish, black, and immersed; the thecae are 8-spored, easily found, and strike a blue colour with solutions of iodine. These apothecia cannot be confounded with the spermogones of *P. conspersa*; but the spermogones of *L. oxyspora*

might with those of *P. conspersa*. The spermogones of *L. oxyspora*, however, will always be found intermixed with its apothecia, and these generally occur on deformed bullose or wart-like portions of the thallus of *P. conspersa*, somewhat resembling those of *P. saxatilis*, *P. olivacea*, *Platysma glaucum*, and other lichens on which the same *Lecidea* is sometimes parasitic. In this individual specimen I do not find the spermogones of *L. oxyspora*; but they will be found described in my "Monograph of the Genus *Abrothallus*." The spermatia are like those of *P. conspersa*; but the sterigmata differ, in being simple and non-articulated.

Specimen 7.—Var. *leonora* (sub *Parmelia leonora*, Spr.; *P. conspersa*, var. *multifida*, Flot.): near Constantia, Northern Africa, Dr KRAUP; in Herb. Hooker, Kew. The thallus has narrow linear laciniae, sub-convex above, and distinctly dotted over with the black ostioles of immersed spermogones, which are frequently depressed, frequently surrounded by a black ring, or seated in the centre of a black macula. The spermatia and sterigmata are precisely as in our British *P. conspersa*.

Specimen 8.—*P. Tasmanica*, Tayl., if it is not referrible here as a variety, is a closely allied species. Van Dieman's Land, GUNN; in Herb. Hooker, Kew. In regard to the size of its lobes, it is intermediate between the ordinary forms of *P. conspersa* and *P. caperata*. Its spores are oval and simple, like those of *P. conspersa*. The spermogones are confined to the margins of the lobes; they are black, punctiform, and grouped. The older ones have very irregular, often stellate-fissured ostioles; the spermatia are acicular, about $\frac{1}{4000}$ th long; the sterigmata quite as in *P. conspersa*. Some specimens of this supposed species seem to me, also, probably referrible to *P. sinuosa*. The character of the thallus and the site of the spermogones approximate it, in some cases, more to *P. sinuosa* than to *P. conspersa*.

Specimen 9.—*P. cribellata*, Tayl., is also a closely allied species to, if it is not a variety of, *P. conspersa*. West Coast of America; in Herb. Hooker, Kew. The spermogones are punctiform and abundant about the ends of the lobes; they are usually larger and more distinct than those of *P. conspersa*. Frequently they are minute black papillae, rough on their outer surface. The spermatia and sterigmata are the same, in regard to size and other characters, as those of *P. conspersa*.

SPECIES 19. *P. centrifuga*, Ach.,

Which occurs in the northern parts of both Europe and America. On the Norwegian Alps, I have gathered it in great abundance and great beauty. I do not regard it as a separate species, but refer it, scarcely even as a well-marked variety, to *P. conspersa*.

Specimen 1.—FRANKLIN'S First Journey; in Herb. Hooker, Kew. The thallus is of a lighter yellow than *P. conspersa* usually possesses; the laciniae are narrow

and convex, and dotted over abundantly with spermogones, like those of *P. conspersa*. A morsel collected in FRANKLIN'S First Voyage, also in Herb. Hooker, is marked by NYLANDER as the true *P. centrifuga*; it has neither apothecia nor spermogones, but the thallus is that of *P. conspersa*.

Specimen 2.—Specimens from ACHARIUS, 1805, and from Mr MOHR, Upsal, 1803, in Herb. Hooker, Kew, NYLANDER also labels as the true *centrifuga*. They are quite the Norwegian plant collected by myself; and the apothecia and spermogones alike are those of *P. conspersa*. A specimen from near Edinburgh, in Herb. Menzies, Royal Botanic Garden, Edinburgh, is a large-lobed form of *P. conspersa*, with spermogones sparingly distributed.

SPECIES 20. *P. incurva*, Fr.,

Which occurs in Europe and North America, appears to me to bear the same relation to *P. conspersa* that *P. stygia* does to *P. Fahlunensis*. The laciniae are narrow, convex—sometimes sub-articulate and dotted over with spermogones, which are essentially those of *P. conspersa*. This plant is the *Lichen incurvus*, Ach.; *Lichen multifidus*, Dicks.; and *P. recurva*, Ach.

Specimen 1.—Mr. ROBSON—from England, probably; BORRER, 1809—from Scotland, probably; and Dr. C. LUDWIG, 1814, Riesengebirge; all in Herb. Hooker, Kew. In all cases the spermogones, as well as the thallus and apothecia, where the latter occur, seem to refer the plant to *P. conspersa*.

SPECIES 21. *P. acetabulum*, Dub.,

A native of Europe, Africa, and North America. It includes, I think, *P. corrugata*, Ach., scarcely as a variety (*Lichen corrugatus*, Smith). In regard to the site and character of its spermogones, it closely resembles *P. tiliacea*. They are scattered about the margins of the lobes as small black papillae, more or less obtuse or flattened on the summit. They are wholly immersed; in depth they extend through the whole thickness of the thallus; their form is oval, spherical, or irregular. The envelope is horny in consistence, and its structure resembles that of the cortical layer of the thallus; the ostiole is usually so minute as to be imperceptible. The spermatia are acicular—from $\frac{1}{5000}$ th to $\frac{1}{8000}$ th long, with a breadth of about $\frac{1}{25,000}$ th. The sterigmata consist of 3 or 4 cylindrical or irregular articulations, and vary in length from $\frac{1}{600}$ th to $\frac{1}{1000}$ th. This species is comparatively abundant in certain continental countries—*e.g.* in France; and from the abundance and conspicuous character of its spermogones, it is a good species in which to examine these organs. WALLROTH appears to have been familiar with its spermogones, which he described as his *Sphaeria epiblastematica*. MASSALONGHO, according to KÖRBER, has described—very erroneously, as it appears to me—the spermatia of this species as globular or roundish. I have never seen them otherwise than straight and linear.

Specimen 1.—SCHÆRER exs. 547; on the trunks of trees; Switzerland. Spermogones are abundantly studded over the margins of the lobes; they are black or deep-brown punctiform or papillæform bodies—in the latter case, flattened or depressed on the apex. The envelope is of a pale-brown cellular tissue. The spermatia are about $\frac{1}{6000}$ th long; the sterigmata, $\frac{1}{600}$ th to $\frac{1}{750}$ th long. Associated with the ordinary or spermatiferous sterigmata, occur numerous long, branching, delicate filaments, projecting into and occupying the cavity of the spermogone, as in *P. physodes*, *P. saxatilis*, &c.; they have a breadth of about $\frac{1}{15,000}$ th to $\frac{1}{18,000}$ th.

Specimen 2.—(Sub *P. corrugata*, Ach.); no habitat given; in Herb. Hooker, Kew. Apothecia are large and plentiful. The spermogones are also plentiful about the margin of the lobes, as brown punctiform bodies, closely aggregated, sometimes sub-confluent—frequently surrounded by a brown ring, or seated in the centre of a roundish macula. The spermatia are about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata are about $\frac{1}{1000}$ th long.

SPECIES 22. *P. Hottentotta*, Ach.,

As its name would imply, an African species (syn. *P. reticulata*, Nees; *Sticta Hottentotta*, Ach.; *Omphalodes Hottentotta*, Flot.) The spermogones are frequently very large and distinct, crowded about the periphery of the thallus. NYLANDER refers this plant to the *P. acetabulum* group; but the general aspect of the plant, as well as its apothecia and spermogones, would lead me to place it under *P. saxatilis*.

Specimen 1.—Cape of Good Hope; in Herb. Hooker, Kew. The spermogones, in site, external characters and internal structure, are those of *P. saxatilis*. The spermatia are acicular, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata are about $\frac{1}{1000}$ th long, and consist of a few delicate linear articulations.

SPECIES 23. *P. olivacea*, Ach.,

Which is found in Europe, Africa, America, Asia, and Australia.

Specimen 1.—Var. *exasperata*, Ach. (syn. *Imbricaria aspera*, Mass. Körb. 78.); on birch and other trees, foot of Morchone, Braemar, August 1856, W. L. L. Almost the whole surface of the thallus is isidiiferous, or covered over with very minute cone-shaped or columnar warts—as occurs in *P. saxatilis* or *Evernia furfuracea*. This form of *P. olivacea* bears the same relation to the type that the var. *furfuracea* of *P. saxatilis* does to its type. It is an unnecessary refinement to constitute this into a distinct variety, and still more into a distinct species. The spermogones must be looked for on the smooth ends of the peripheral laciniae. So difficultly recognizable are they, that it will be necessary to moisten the thallus before they can be seen even under the lens. They will then become apparent, as extremely minute black immersed points. They cannot be confounded with the isidioid warts of the thallus, which contain only gonidia and white medullary

tissue. The interior of the spermogone contains much mucilage. The spermatia are rod-shaped, thickish throughout, with obtuse ends—about $\frac{1}{2000}$ th to $\frac{1}{3000}$ th long. They are thrown off from the ends and sides of very irregular, ramose sterigmata, which consist of several linear, longish articulations—very beautiful and distinct. The cellular tissue, of which the spermogonal envelope is composed, is of a very pale brown. Apothecia are abundant.

Specimen 2.—SCHÆRER exs. 370 (sub *a. corticola a. glabra*); on trees in open places; Switzerland. The spermogones occur, on the right-hand specimen in my copy, as deep olive-coloured or brown punctiform bodies,—wholly immersed,—scattered about the edges of the lobes. The thallus, as in the former case, and indeed in all cases, requires to be moistened before the extremely indistinct spermogones can be seen.

Specimen 3.—SCHÆRER exs. 372 (sub *β. saxicola, a. glabra*); on stones in alpine localities; Switzerland. The spermogones are here scattered over the surface of the thallus as minute black or brown bodies, sometimes punctiform, sometimes papillæform. The spermatia are about $\frac{1}{6000}$ th to $\frac{1}{8000}$ th long, rod-shaped, studded on the apices and sides of articulated sterigmata.

Specimen 4.—Var. *aquiloides* mihi. From Miss HUTCHINS, 1810; no habitat given, but probably from Ireland; in Herb. Hooker, Kew; and also, from the same lady, in Herb. Carroll. The whole plant so closely resembles in general aspect *Physcia aquila*, that I propose designating it as var. *aquiloides*. It is generally only distinguishable by its apothecia and spores, which are those of *P. olivacea*, simple, oval, and colourless; those of *P. aquila* being brown and 1-septate. The laciniae are pale, narrow, and convex, studded over with minute papillæform spermogones, resembling those of *P. aquila*, chiefly old, and containing no free spermatia.

SPECIES 24. *P. stygia*, Ach.,

A native of Europe and Northern America.

Specimen 1.—Summit of Ben Nevis, August 1856, W. L. L. The plant is abundant in this locality, bearing fine apothecia. The laciniae are narrow, convex, and pitchy-black; they are covered over with black minute papillæ or perforations, the latter having generally a sub-prominent black edge. These papillæ mark young spermogones with imperceptible ostioles; the perforations are the patent ostioles of old spermogones, generally very indistinct on the dark-coloured thallus. The peripheral laciniae are sometimes pale; in which event the plant has a close resemblance to var. *stygioides* of *P. encausta*, as it occurs on the summit of Cairngorm.

Specimen 2.—Summit of Morchone, Braemar, August 1856, W. L. L.; with apothecia. The spermogones are scattered abundantly over the convexities, and towards the tips of the laciniae, as minute black papillæ. The older spermogones

are marked by large, gaping ostioles, usually more or less round in outline, having black, turgid, ring-like borders. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long, seated on the apices and sides of very irregular, delicate sterigmata, the articulations of which are short, roundish cells. Associated with the sterigmata are numerous elongated branching filaments, also articulated or septate, which project into and occupy the cavity of the spermogone, as in *P. physodes*, *P. saxatilis*, &c.

Specimen 3.—SCHLÆRER exs. 255 (sub *Cetraria stygia*, *a. latior*); with apothecia; on stones in the higher Alps, Switzerland. The laciniae are studded over with minute perforations, which are the ostioles of old spermogones, containing no free spermatia.

SPECIES 25. *P. Fahlunensis*, Ach.,

A native of the alpine or frigid portions of Europe, America, and Asia. In this and the following species the spermogones are marginal,—forming a sort of denticulate fringe, as in *Platysma*.

Specimen 1.—Summit of Cairngorm, August 1856, W. L. L. The spermogones abundantly fringe the crisped, curled margins of the flat, linear, pitchy-black laciniae, as deep-brown, minute, round warts. They resemble the spermogones of *Platysma ciliare*, but are generally not so closely aggregated. The spermatia are very minute, ellipsoid, about $\frac{1}{10,000}$ th long, immersed in an abundant mucilage. The sterigmata are articulated, but very delicate and indistinct.

Specimen 2.—On rocks, Carlowrie, 1843; coll. GARDINER, of Dundee; in Herb. Royal Botanic Garden, Edinburgh. There are no apothecia; but the spermogones are very abundant and distinct. They are barrel-shaped and black, fringing the margins of the laciniae like teeth, and precisely resembling the spermogones of *P. ciliare*. They are seated also frequently on the flat surface of the laciniae, near their ends, growing upwards at right angles to the thalline surface.

Specimen 3.—SCHLÆRER exs. 373 (sub *a. vulgaris*, *a. major*), and 374 (sub *a. vulgaris*, *b. minor*); on micaceous rocks in the Alps. The spermogones are precisely as in Nos. 1 and 2; the spermatia are rod-shaped and minute, and the sterigmata shortish and of a few articulations.

SPECIES 26. *P. tristis*, Web.,

A native of Europe and North America. As in the preceding species, the spermogones occur only on the margins of the flat, linear, erect laciniae. In the young state, they are inconspicuous small black cones or warts; in the old state, they are much more easily recognised by the large, gaping ostioles with turgid, black borders. The oldest spermogones are usually found lowest down on the thalline laciniae; hence the spermogones about the tips are generally papillæform, young, and full of free spermatia, while those about the base are perforate, empty,

and contain no spermatia at all. The spermatia are rod-shaped, and about $\frac{1}{5000}$ th to $\frac{1}{6000}$ th long.

Specimen 1.—Hills above Loch Freuchie, Amulree, Perthshire, May 1856, W. L. L. The spermogones are abundant as small irregular warts, fringing the margins of the sub-compressed laciniaë. They are generally of a deeper black colour than the laciniaë, and have a more or less distinct and patent ostiole. They vary much in size; sometimes they are confluent, and then become very irregular. They are generally arranged in a linear series along the edge of the laciniaë, but sometimes they are clustered thickly about their ends. In some cases the apex of a lacinia consists of an irregular fusiform bulging or swelling, pierced by a number of minute perforations, irregularly distributed, and of a deeper black than the swellings in question, or than the general surface of the thallus. These perforations are the ostioles of confluent and compound spermogones, and closely resemble what occurs normally and regularly in *Neuropogon melaxanthus* and *Alectoria Taylori*.

Specimen 2.—Summit of Morchone, Braemar, August 1856, W. L. L. The spermogones are as described in No. 1. The spermatia are rod-shaped, about $\frac{1}{6500}$ th long, borne on the apices of sub-simple linear sterigmata, which are ramose at the base. They are frequently sub-digitate, apparently given off as finger-like processes or elongations from basal tubes or cells. They are almost always very delicate and indistinct.

Specimen 3.—Hills east of Sligachan, Skye, August 1856, W. L. L. The spermogones are sparingly distributed; they are chiefly old, and are marked by large, gaping ostioles.

Specimen 4.—High Mountains, County Kerry; coll. TAYLOR; in Herb. Hooker, Kew. There are spermogones, resembling those above described, but no apothecia.

Specimen 5.—SCHÆRER exs. 256 (sub *Cetraria*); on stones in the higher Alps; with apothecia. The spermogones are mostly old, containing no free spermatia; they are black tubercles, scattered along the edges of the flattened linear laciniaë, to which they give a minutely denticulate character. Most of them are perforated by a large, gaping ostiole.

GENUS IV. *PHYSCIA*, Fr., Nyl.

I do not think that *Physcia* should be separated from *Parmelia*, save as a section or sub-division. Its spermogones are essentially the same, though there are several points of difference as well as resemblance. Their site is usually the same—they are more or less immersed—the spermatia are straight and linear, borne on articulated sterigmata. In *Physcia*, however, the spermogones are usually larger and more conspicuous than in *Parmelia*; their colour is sometimes orange-red or yellow, as well as brown or black; the spermatia are mostly smaller, and the sterigmata longer and composed of more numerous and shorter

articulations. In *Physcia*, the spermogones are more frequently papillæform, or tuberculiform, than in *Parmelia*. Sometimes they are very large and prominent, particularly when they become confluent, and assume the form of irregular tubercles, as in *P. ciliaris*. The diameter of the spermogone in this species is $\frac{1}{25}$ th; while in *P. parietina* it is about ten times less. The spermogones are largish, distinct, black cones in *P. stellaris* and other species with a grayish or whitish thallus. In other cases, they are brown. Sometimes they are covered with a white pruina, as in *P. pulverulenta*. In *P. parietina*, *flavicans*, *chrysophthalma*, *flammea*, *villosa*, and other species, they are orange-coloured cones or warts, which become very conspicuous and beautiful where the plant has a grayish or whitish thallus, as in *P. villosa*. In this species, also, they may be so large as to be visible to the naked eye. The ostiole is usually very minute and round. Sometimes it becomes stellate-fissured with age, as in *P. pulverulenta*. Frequently, also, in the old state of the spermogone, it assumes the form of a large roundish perforation, with more or less distinct, turgid margins, as in *P. aquila*. If the body of the spermogone fall out in age, as is occasionally the case, the ostiole may expand still more, and become saucer-shaped, or like cyphellæ, as in the same species. The diameter of the simple, round, imperceptible ostiole is frequently about $\frac{1}{600}$ th to $\frac{1}{800}$ th, as in *P. parietina*. The spermogonal envelope is formed of roundish or cubical cellules, more frequently brown than any other colour. The cavity of the spermogone is generally simple; but in several species, and particularly in the case of compound or confluent spermogones, it is divided into sinuosities or compartments, as in *P. ciliaris* and *P. villosa*. The spermatia are generally shorter than those of *Parmelia*; they are usually rod-shaped or acicular, sometimes sub-ellipsoid. They vary in length from $\frac{1}{3000}$ th to $\frac{1}{10,000}$ th, a large number being from $\frac{1}{4000}$ th to $\frac{1}{8000}$ th long. Their average breadth is $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th. The sterigmata seldom consist of only two or three articulations, as in *Parmelia*, nor are these articulations often long linear cells. They are more usually longish, ramose or simple, composed of more than five or six short, roundish or cubical cellules. These cellules have originally thin walls, which, however, become thickened by deposits in their interior. The arthro-sterigmata of *Physcia*, therefore, somewhat resemble those of *Sticta* and *Collema*. Their length varies from $\frac{1}{300}$ th to $\frac{1}{1000}$ th generally.

SPECIES 1. *P. ciliaris*, DC.,

A native of Europe, Africa, and North America. This species is of much historical importance and interest to the lichenologist, inasmuch as in it spermogones were first discovered and described by ITZIGSOHN, in Germany. It is, moreover, a common lichen, and a species abounding in large, well-marked spermogones, visible usually to the naked eye. They are obtuse, very prominent warts or tubercles, scattered on the convexities of the lacinia; they are isolated or con-

fluent—in the latter case becoming very irregular in form. Their colour is usually brown; that of the thallus varies between olive and gray. The spermogones are generally most conspicuous on the gray thallus, from the contrast of their deep olive-brown colour. The apex of the spermogone is usually brown, sometimes blackish, the ostiole being minute and very indistinctly marked. Sometimes it is elongated or chink-like. The apices of confluent spermogones are generally studded over with minute black or brown roundish ostioles. The interior tissue is grayish, and of a horny denseness; it is hence easily sectioned in thin laminæ. The sterigmata are longish, and composed of short, roundish cellules; they are the “Männliche Prospysen” of the speculative BAYRHOFER. So abundant and so constant are the spermogones sometimes, as to give a character to the plant; hence spermogoniferous states have been described as varieties by the earlier authors. Such is the var. *melanostigma* of Acharius.

Although it is only a few years ago since ITZIGSOHN pointed out the existence of what are now called “spermatia,” yet the spermogones above described have long been familiar to lichenologists. So long ago as 1741, DILLENIUS* drew attention to the brown tubercles occurring on the thallus of *P. ciliaris*; and HEDWIG,† in 1784, saw in the same bodies one of the forms of his supposed masculine organs of reproduction in lichens. ACHARIUS regarded the same organs as secondary or accessory apothecia,—of inferior importance to the normal or usual ones,—which he called *Cephalodia*, and which he described as filled with *gongyli*. Nor did ITZIGSOHN, so lately as 1850, correctly appreciate the character of the spermogones of *P. ciliaris*, or of their contents. He described the spermogones as *antheridia*, and the spermatia as *spermatozoids*, similar to those of *Marchantia* and *Polytrichum*, possessing true animalcular movements. From these spermatozoids, however, the spermatia of *P. ciliaris* differ entirely in regard to their genesis. The important bearing of ITZIGSOHN’S observations, whether his theories were correct or not, was at once seen by other Continental botanists, who forthwith proceeded to repeat his experiments. Some observers corroborated ITZIGSOHN’S theories as well as his facts; while others, more cautious, less biassed, and less impulsive or sanguine in their temperament perhaps, saw the spermatia, but took a different view as to their nature and analogies. It is unnecessary to detail the results of the observations of different German botanists, who contributed voluminously on the subject to the “Botanische Zeitung,” in 1850 and 1851. ‡ Suffice it to notice the most important result of ITZIGSOHN’S observation on *P. ciliaris*,—apparently a most simple one,—which was, that the subject was followed up in France by TULASNE to a previously unknown extent. He made an

* *Historia Muscorum*, p. 150, Tab. 20, f. 45, BC.

† *Theoria Generationis et Fructificationis Plant. Crypt.*, p. 120. Pl. 30 and 31.

‡ *Vide* vol. viii., pp. 393–94, May 17, 1850; pp. 917–19, December 27, 1850. Vol. ix., pp. 153–4, February 21, 1851, and p. 913.

elaborate series of investigations, to ascertain whether all lichens did not possess similar organs; and the result was one of the most valuable contributions ever made to the natural history of the lichens,—one which is the basis of all our recent and improved information on their minute structure.* The years 1850 and 1852, the dates of the publications respectively of ITZIGSOHN and TULASNE, may be thus said to constitute an important era or epoch in the history of lichenology. The labours of the German and French lichenologists, during the years 1848–52, have certainly given a powerful and much-wanted impetus to lichenology.

Specimen 1.—On old ash trees, roadside, Balthayock, near Perth, June 1856, W. L. L. The spermogones are old, containing no free spermatia; they are mostly confluent, very irregular and quite distinct to the naked eye. So abundant are they, that they give a coarsely warted character to the whole thallus. In none of the spermogones, whether isolated or confluent, is there a distinct ostiole.

Specimen 2.—On trees, old Castle of Melgund, Forfarshire; coll. A. CROALL, 1853. Here also the spermogones are old; they are of a deeper brown colour than the thallus, and are irregular large warts, frequently confluent, scattered about the ends of the laciniae. The ostiole is seldom recognisable when young; when old, it sometimes becomes a narrow elongated fissure.

Specimen 3.—A specimen in Herb. Botanical Society, Edinburgh (no habitat given), has young and mature spermogones, containing spermatia. The spermogones are very abundant as brown papillae rather than warts. The ostiole is seldom round, generally elongated or stellate-fissured. The spermogones are generally grouped, frequently confluent; they are distinct on account of the pale grayish-brown colour of the thallus. This is one of the best specimens I have ever met with of the spermogones of *P. ciliaris*. The spermatia are rod-shaped, about $\frac{1}{6500}$ th long.

SPECIES 2. *P. leucomela*, Mich.,

A beautiful species, growing in Europe, Africa, Asia, America, and Australia. The spermogones are essentially those of the last species in site and structure; but they are usually smaller and more regular, and, from the whitish colour of the thallus, and their own brown or blackish colour, they are usually much more easily recognised than in *P. ciliaris*.

Specimen 1.—On rocks by the sea, near Ballycotton, County Cork; coll. CARROLL. There are a few old spermogones, closely resembling those of *P. ciliaris*; they are largish brown tubercles or papillae, scattered about the ends of the laciniae, and very distinct from the contrast of their deep-brown colour with the almost pure white of the thallus. The cavity is sinuous, as in *P. ciliaris*.

* Mémoire pour servir, &c., *ol. citat.*

The spermatia are rod-shaped, and about $\frac{1}{7000}$ th long, with a breadth of $\frac{1}{25,000}$ th seated on articulated indistinct sterigmata.

Specimen 2.—Torquay, 1812; in Herb. Hooker, Kew. In this, as in all English specimens I have seen, the laciniae are short, stout, and broadish; the spermogones are rare, and the apothecia never found.

Specimen 3.—Var. *contracta*, Nyl. (Syn. *P. echinata*, Tayl.); in Herb. Hooker, Kew. Here also the lobes are short and broad. The spermogones are abundant as brown warts or papillae, about the ends, and on the convexities, of the grayish or whitish lobes. Most of the foreign specimens of *P. leucomela*, in Herb. Hooker, are referrible to NYLANDER'S var. *angustifolia*, M. and Flot., which he describes as occurring only in equatorial America, St Helena, and the East Indies.

SPECIES 3. *P. speciosa*, Fr.,

Which occurs in Europe, Africa, America, Asia, Polynesia, and Australia. This plant may be considered, in regard to its general aspect, as intermediate between *P. leucomela* and *P. stellaris*, though it more closely resembles the latter than the former. Its spermogones are for the most part those of the latter,—of which, indeed, I am inclined to consider *P. speciosa* a variety.

Specimen 1.—SCHLEICHER'S exs. No. 47, 1815; on the trunk of *Prunus avium*, Nepal. The spermogones are those of *P. stellaris*. They are black, prominent papillae, seated on the convexities, and about the ends, of the laciniae, sometimes isolated, sometimes in closely aggregated groups. A specimen from Caracas, BIRSCHELL, is precisely the Irish form of the plant as sent me by Mr CARROLL. There are no apothecia; but spermogones are abundant. Mauritius specimens have the spermogones brown, very small and inconspicuous, wholly immersed. In those from Jamaica, Dr WRIGHT, the laciniae are large and cream-coloured, and the spermogones bluish-black, and distinct from the contrast of their colour with that of the thallus. In those from Madras, the laciniae or lobes are large, waxy, and pale, and the spermogones few, large, and black. All the above specimens are in Herb. Hooker, Kew.

Specimen 2.—(Sub *P. diadenata*, Tayl.); Madras, Calcutta, Singapore, Nepal, Jamaica; all in Herb. Hooker, Kew. This is a very handsome form of the plant, peculiar to hot climates. The spermogones occupy precisely the position they do in *P. stellaris*. A few are grouped together about the ends of the laciniae, as small, brown papillae.

SPECIES 4. *P. Domingensis*, Mont. non. Ach.,

Which occurs in America, Asia, and Polynesia. It seems to me also a mere form of *P. stellaris*; their spermogones are quite the same.

Specimen 1.—Cuba, ex. Herb. Mont.; in Herb. Hooker, Kew. The spermogones are grouped on the convexities of the laciniae; they are usually brown, punctiform, and immersed. Sometimes they are confluent, and then they become

irregular in form. The spermatia are rod-shaped, about $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata consist of a few delicate, cylindrical articulations, and measure about $\frac{1}{3000}$ th long only.

SPECIES 5. *P. stellaris*, Fr.,

A native of Europe, America, Africa, Asia, and Australia. There are several varieties, of which the most common and important is var. *tenella*, Schæerer, which is *pro parte* at least the *Borrera tenella* of the earlier authors. From the frequency with which the spermogones occur, and from their distinctness,—their colour being black or deep brown, while that of the thallus is gray or whitish—*P. stellaris* is one of the best species in which to study the spermogones of *Physcia*. Usually only the black, papillar ostioles are visible on the surface of the thallus, in the medullary tissue of which the body of the spermogone is immersed. Hence those black ostioles frequently resemble parasitic *Sphæriæ*. The walls or envelope of the spermogone are at first gray, but subsequently become black. The diameter of the spermogone in the large-lobed form of the plant,—*P. aipolia* of authors,—is about $\frac{1}{130}$ th. The cavity is pluricellular and sinuous, as in *P. ciliaris*.

Specimen 1.—On ash trees, Muirhall, Perth, W. L. L.; associated with *P. pulverulenta*, which it often very closely resembles. The spermogones and spores, however, especially the former, to a certain extent distinguish *P. stellaris*; for the spores differ from those of *P. pulverulenta* chiefly in size. The spermogones of *P. stellaris* are always small, black or brown cones or papillæ, with imperceptible ostioles; while those of *P. pulverulenta* are largish cæcio-pruinose, thalline papillæ or tubercles, opening by stellate-fissured ostioles.

Specimen 2.—Kyles of Bute, on trees, 1852, W. L. L. This is a broad-lobed form. The spermogones are grouped in considerable numbers as small, punctiform, immersed bodies.

Specimen 3.—On ash trees, roadside, near Pitrodie, Carse of Gowrie, June 1856, W. L. L. The spermogones are smooth, prominent, black cones or warts, with imperceptible ostioles, scattered sparingly about the ends of the laciniaë. On ash trees, roadside, near Glencarse, Carse of Gowrie, May 1856, W. L. L. They vary greatly in size; but all are black, papillar, and distinct, the thallus being of a very pale grayish tint. In other narrow-lobed forms from the same locality, the spermogones are very prominent as brown, minute, round warts grouped on the convexities of the thallus. The spermatia are about $\frac{1}{3000}$ th long; the sterigmata are very delicate, composed of short roundish cellules or articulations.

Specimen 4.—On trees, Glen Nevis, August 1856. Here the spermogones are mostly degenerate. They are, moreover, sparingly scattered, inconspicuous and small, being more mere black points than well-developed warts. Spermogones also abound in specimens collected on ash and other trees, at Annat Cottage, Carse of Gowrie, 1855, W. L. L.

Specimen 5.—On trees, Morchone, Braemar, August 1856, W. L. L. This is the broad-lobed form—the *P. aipolia* of older authors. The spermogones are minute, black papillæ; their envelope light brown; the spermatia from $\frac{1}{6500}$ th to $\frac{1}{8000}$ th long, and the sterigmata short and distinct. On roadside walls, between the Spittal of Glenshee and Braemar, August 1856, W. L. L. The spermogones are few; the spermatia about $\frac{1}{4000}$ th long; the sterigmata very distinct, irregular, composed of elongated, cylindrical, thick-walled cells, varying, however, considerably in size.

Specimen 6.—On trees, Kinmundy, Aberdeen, Professor DICKIE. The disk of the apothecium is brown, instead of black, and the apothecia have consequently the appearance of those of *Lecanora subfusca*. The spermogones are abundant as black papillæ or cones. The spermatia are rod-shaped, about $\frac{1}{8000}$ th long, and $\frac{1}{25,000}$ th broad, on sterigmata which measure $\frac{1}{1500}$ th to $\frac{1}{1000}$ th long, and which are composed of short, roundish or oblong irregular cells.

Specimen 7.—On basalt, near the Giant's Causeway, County Antrim; Dr MOORE, in Herb. Carroll; no apothecia. The spermogones are plentiful; the spermatia about $\frac{1}{10,000}$ th long, and $\frac{1}{25,000}$ th broad.

Specimen 8.—SCHÆRER exs. 350 (sub *a. aipolia*); on the bark of trees about Belp. The spermogones are of the papillar type, as is usual in the broad-lobed form of the plant.

Specimen 9.—HEPP. exs. 473; associated with *Lecidea exilis*; a form passing into var. *tenella*. The spermogones are distinct black cones, scattered in groups over the broadish lacinix.

Specimen 10.—Var. *tenella*, Sch.; a variety characterised chiefly by the presence of marginal and terminal cilia, varying in length. The lacinix are generally narrow; convex above, occasionally almost sub-fistulose, with frequently bullose or sorediiferous extremities. With var. *tenella*, it appears to me that SCHÆRER'S var. *hispida* should also be associated; at least, I know of no valid reason for dissociating them. In this variety, which has usually a very pale thallus, the spermogones are more abundant and distinct than in the ordinary type of the plant. Walls on the hills above Innerleithen, August 1855, W. L. L.; with apothecia. The centre of the thallus is abundantly sorediiferous. The spermogones are plentiful, and very distinct as prominent, elevated, roundish deep blackish-brown or black warts, in many of which the ostiole may be seen as a minute, round, or slightly irregular pore or foramen. The spermatia are rod-shaped, about $\frac{1}{8000}$ th long; the sterigmata very slender. Similar spermogones occur in specimens growing on walls at the Grange, Edinburgh, 1851, W. L. L.

Specimen 11.—Var. *tenella*; Blaeberry Hill, Perth; on trees and stones, plentiful; April 1856, W. L. L. The spermogones are plentiful on specimens destitute of apothecia; the ostiole is frequently distinct, usually triangular or stellate. On an old wall, Rossie Moor, Forfarshire; coll. CROALL. Specimens bear both apothecia and spermogones.

Specimen 12.—Var. *tenella*; on walls, Penmanshiel, Berwickshire, 1856; coll. JAMES HARDY; no apothecia. The spermogones are sometimes isolated, sometimes grouped. The latter chiefly occur about the centre of the thallus. Some of them are very large, prominent, black warts, flattened above, and with a distinct ostiole.

Specimen 13.—Var. *tenella*; Morchone, Braemar; on trees, August 1856, W. L. L. This is a dark olive-green form, closely resembling *P. obscura*. The margins of the laciniae bear few cilia. On the same trees occurs the broad-lobed form of *P. stellaris*. The spermogones are few and scattered.

Specimen 14.—Var. *tenella*; on the trunks of trees, under Dunscombe's Wood, Cork; coll. CARROLL; associated with *P. obscura*. The spermogones are distinct, as black or brown papillae. The spermatia are about $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata measure $\frac{1}{1500}$ th to $\frac{1}{1000}$ th in length. The var. *tenella* is common in Ireland, according to TAYLOR in Herb. Mackay. Spermogones are plentiful in specimens from Carrigaloe, Cork; coll. CARROLL; on the bark of trees.

Specimen 15.—Var. *tenella*; Bielside, Aberdeen, Professor DICKIE; one of the very common transition forms between the *aiolia* and the *tenella* varieties, the marginal fibres or cilia being neither many nor prominent. The spermogones are plentiful and prominent as brownish papillae or tubercles, varying much in size. The envelope is, as in all cases in *P. stellaris*, brown; the spermatia $\frac{1}{9000}$ th long, and $\frac{1}{25,000}$ th broad; and the sterigmata about $\frac{1}{1500}$ th to $\frac{1}{1000}$ th long.

Specimen 16.—Var. *tenella*, SCHLERER exs. 349 (sub *Parmelia pulchella* γ . *semipinnata*); on palings about Belp, Switzerland. The spermogones are prominent black cones or tubercles sparingly scattered. Exs. 351 (sub β . *ambigua*); on young ash trees about Belp.; on the right-hand specimen in my copy (ed. alt. immut. 1840). The spermogones are here smaller, but are still distinct. The spermatia are $\frac{1}{9000}$ th long, and the sterigmata $\frac{1}{1500}$ th to $\frac{1}{1200}$ th. Exs. 352 (sub δ . *tenella*), on the trunks of trees about Belp. The spermatia are very minute, about $\frac{1}{12,000}$ th long, and $\frac{1}{25,000}$ th broad, sub-ellipsoid, and in myriads. The sterigmata are longish, the articulations being numerous and short. HEPP. exs. 15, associated with *Lecidea chalybeia*; on old willows and poplars. The spermatia and sterigmata are those of the type.

Specimen 17.—Var. *adglutinata* mihi; on trees, roadside, Caerlaverock Road, Dumfries, August 1856, W. L. L. This is a peculiar form from the thallus being rather crustaceous than of the usual foliaceous type. It is very closely adherent to the bark on which the plant grows; unless at the periphery here and there, there is little or no trace of laciniae, the thallus consisting of a series of white crustaceous warts. The whole plant has a close resemblance to some forms of *Lecanora sophodes* or *L. atra*. The spermogones also resemble externally those of the *Lecanoras* just named. They are minute black points, scattered on the warts aforesaid, and among the apothecia. The spermatia are about $\frac{1}{5000}$ th long; the sterigmata very irregular, sub-ramose, thickish, composed of short broadish

articulations. The sterigmata are very closely aggregated, and hence indistinct *en masse*.

Specimen 18.—Var. *albinea*, Ach. (Syn. *Parmelia erosa*, Borr.); Falmouth and Cornwall, Miss WARREN. The spermogones are distinct, black, sub-prominent papillæ, generally isolated; the spermatia are $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad, and the sterigmata about $\frac{1}{2000}$ th long, consisting of a very few longish, cylindrical, and generally irregular articulations. British North America, RICHARDSON; Rocky Mountains, DRUMMOND: on the trunks of trees, Troy, U. S.; on *Gleditschia*, Ohio, U. S., LEA; Swan River, Australia, JAS. DRUMMOND; on stone walls, Boston, U. S., F. BOOTT. All these specimens are in Herb. Hooker, Kew, and all possess both apothecia and spermogones.

SPECIES 6. *P. astroidea*, Fr.,

Which occurs in Europe and America. This, as well as the following species, seem to me mere varieties of *P. stellaris*; this is characterized by the very soderiiferous surface of the thallus. The spermogones are externally similar to those of *P. stellaris*; but the spermatia are usually larger, and the sterigmata composed of much longer, delicate, linear cells or articulations. The spermatia, in one specimen, in Herb. Botanical Society of Edinburgh,—the habitat not being given,—are $\frac{1}{4000}$ th long. The plant is associated with var. *tenella* of *P. stellaris*.

SPECIES 7. *P. casia*, Fr.,

A native alike of Northern America and of Europe. It is chiefly saxicolous, characterized by plentiful, roundish, gray soredia on the very narrow convex lacinia. Its spermogones are essentially those of *P. stellaris*; they would appear to have been described by SPRENGEL as *Endocarpon athallum*.

Specimen 1.—On boulders and walls, roadside between Sligachan and Portree, Skye, August 1856, W. L. L. The plant is associated with var. *tenella* of *P. stellaris*; and, indeed, *P. casia*, *P. stellaris*, and *P. astroidea*, graduate into each other, and are certainly, in my opinion, referrible to a common type. The spermatia are very small, about $\frac{1}{5000}$ th to $\frac{1}{10,000}$ th long; the sterigmata very delicate, irregular, and composed of short, roundish articulations.

Specimen 2.—SCHÆRER exs. 348, (sub. *Parmelia pulchella*, β *dubia*); on palings about Belp. There are no apothecia; the spermogones are, in all respects, those of *P. stellaris*.

SPECIES 8. *P. confluens*, Fr.,?

A foreign species, growing in equatorial America, Africa, and Asia.

Specimen 1.—New Orleans; on bark, DRUMMOND; in Herb. Hooker, Kew (sub nom. *Lecanora atra*). The apothecia closely resemble those of *L. atra*; but

the thallus is that of *P. stellaris*. The spermogones are also those of the latter species; they are here brown and punctiform, rather than papillæform however.

SPECIES 9. *P. obscura*, Fr.,

Occurring in Europe, Asia, Africa, and Australia. This species, in regard to both its thallus and spermogones, is intermediate between *P. stellaris* and *P. pulverulenta*; and it is frequently mistaken for one or other of these species. The spermogones, however, are rather those of *P. pulverulenta* than of *P. stellaris*. They are small warts or tubercles, generally of the colour of the thallus, scattered sometimes about the centre, sometimes about the periphery, of the thallus. The internal tissue is whitish; the cavity is divided into sinuous compartments, as in *P. ciliaris*. The sterigmata are longish, and composed of numerous short thick-walled cellules or articulations. The spermatia have always appeared to me rod-shaped or ellipsoid; TULASNE describes them as almost ovoid, and KÖRBER as "eirundlich." They are in all cases very minute,—their average length being $\frac{1}{5000}$ th to $\frac{1}{10,000}$ th.

Specimen 1.—On the trunks of trees under Dunscombe's Wood, Cork; coll. CARROLL. The ends of the laciniae are frequently converted into irregular wart-like bullosities, over which are studded black or brown punctiform immersed bodies, somewhat irregular in shape, which have quite the aspect of spermogones. They are really, however, lecidine apothecia, containing 8-spored thecae, about $\frac{1}{500}$ th long and $\frac{1}{1500}$ th broad. The spores are simple, ellipsoid, $\frac{1}{1500}$ th long, and $\frac{1}{6000}$ th broad, pale-brown or yellow, full of oil globules of every size, which oil globules also abound in the thecal protoplasm. For this parasite, I propose, provisionally only, the name *Lecidea obscuroides*. The apothecia, which are at first round and immersed, ultimately become more superficial and saucer-shaped.

On specimens of var. *leprosa* (HEPP. exs. 65), [a form in which the thallus is almost absent, or is leprose, from Morchone, Braemar (on trees),] there is a parasitic *Sphaeria*, which also closely resembles spermogones. It occurs as small black points on the leprose thallus, external to the apothecia.

Specimen 2.—LEIGHTON exs. 49; on old bark, near Shrewsbury, associated with *P. pulverulenta*; bears apothecia. There are only two spermogones in the specimens in my copy. The spermatia are $\frac{1}{10,000}$ th long, and $\frac{1}{20,000}$ th broad, sub-ellipsoid or rod-shaped.

Specimen 3.—Near Melgund Castle, Forfarshire; coll. A. CROALL, 1854; with apothecia and spermogones: old wall near Rescobie, Forfarshire, July 1853; coll. CROALL (sub nom. *Parmelia cycloselis*, Ach.), with apothecia. The spermogones are scattered about the ends of the laciniae as small, prominent, obtuse, deep-brown warts, in some of which there is a distinct ostiole.

Specimen 4.—HEPP. exs. 183, associated with *Lecanora subfusca*; on the bark of old poplars and other trees. The spermogones are distinct, brown tubercles.

scattered about the ends of the narrow white-pruinose laciniaë. Some of the sterigmata have a brownish colour; they are composed of short broad articulations.

Specimen 5.—SCHLÆRER, exs. 353 (sub *a. chloantha*); on the trunks of trees about Berne. The spermogones are small, distinct, deep olive-coloured papillæ, sparingly scattered—generally isolated—near the ends of the narrow laciniaë. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long; the sterigmata are composed of a few short articulations. Exs. 354 (sub γ *orbicularis*); on tiles and rafters about Belp. The spermogones are as just described; the spermatia are sub-ellipsoid, about $\frac{1}{10,000}$ th long. Exs. 609 (sub var. *nigricans*); on poplars about Bienne. The spermogones are abundant as deep olive-brown, prominent, roundish tubercles, sparingly scattered about the margins of the lobes. The spermatia are about $\frac{1}{10,000}$ th long; the sterigmata are very delicate, narrow, about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long, and composed of three or four, seldom more, articulations.

Specimen 6.—Var. *firmula*, Nyl. (Syn. *Physcia firmula*, Nyl.) NYLANDER places *P. firmula* under *P. obscura*; but I am inclined to refer it rather to *P. speciosa*. A specimen of *P. speciosa* from Lachen, Sikkim, Himalaya (alpine region, at 13,000 feet, with apothecia, in Herb. Hooker, Kew), NYLANDER labels “Transiens in *Ph. firmulam*, Nyl.,” which would imply that he regards the latter as, at least, very near *P. speciosa*. But in his “Enumeration générale des Lichens,” p. 106, he places *P. speciosa* beside *P. leucomela*, and *P. obscura* beside *P. pulverulenta*. Chongtam, Sikkim, Himalaya; temperate region, at 6000 feet. The thallus is whitish and waxy, with marginal black fibres; the lobes are short, thick, sub-erect. The sterile lobes are studded over with large spermogones, usually one or two, not more than two or three, occurring about the end of each lacinia. They are large brown cones, generally flattened; their body is a large hard white kernel, immersed in the medullary tissue of the thallus. The spermatia are $\frac{1}{8000}$ th long, and $\frac{1}{23,000}$ th broad; the spermatia are very indistinct. Dr HOOKER, in his Herbarium, refers the plant to *P. speciosa*.

SPECIES 10. *P. pulverulenta*, Fr.,

Is a familiar and widely spread species, occurring in Europe, Africa, and Northern America. Its spermogones closely resemble those of the preceding species; but they are usually larger and more prominent. They are cones or tubercles, the former generally when single, the latter when compound and formed of several confluent spermogones. They are frequently, like the thallus, dusted over with a fine white pruina or powder. Sometimes they are so abundant, according to KÖRBER, as to give the whole thallus an isidioid character. The ostiole is often stellate-fissured, and comparatively conspicuous, especially in the old state of the spermogone. The internal tissue is white, solid or dense, being hence easily divided into thin sec-

tions. The cavity is divided into numerous sinuous compartments, as in *P. ciliaris* and *P. obscura*. The length of the spermatia is usually about $\frac{1}{4000}$ th to $\frac{1}{6000}$ th.

Specimen 1.—On ash, Muirhall, Perth, W. L. L.; associated with *P. stellaris*, with which it is frequently very apt to be confounded. In regard to the differential diagnosis of these two species, I may refer to what I have already said under *P. stellaris*. Old Scone Road, Perth, April 1855, W. L. L.; associated with *P. obscura*, with which, also, this species is apt to be confounded. The spermogones are very abundant as obscure, irregular cones or warts, of the same colour as the thallus; the apex deeper brown; the ostiole seldom distinct when round, but more conspicuous when stellate-fissured. They are generally grouped, sometimes confluent—two or three spermogones uniting to constitute one spermogonal wart. They are thus very different from the spermogones of *P. stellaris*; which spermogones serve to distinguish—where other marks fail—*P. pulverulenta* from *P. stellaris*.

Specimen 2.—On trees, Glen Nevis, August 1856, W. L. L.; associated here, also, with *P. stellaris*, and sometimes scarcely distinguishable therefrom. The spermogones are brown, sub-confluent, or closely grouped prominent tubercles, seated on the convexities, and about the extremities, of the laciniae. The spermatia are about $\frac{1}{6000}$ th long; the sterigmata are very delicate and irregular, consisting of shortish articulations.

Specimen 3.—Carrigaloe, Cork Harbour; coll. CARROLL. The spermogones are pale-brown, largish, white-pruinose papillae, opening by stellate-fissured ostioles. The spermatia are $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad. On a wall, Sidlaw Hills, 1844, GARDINER; in Herb. Hooker, Kew; a good typical specimen. The spermogones and spermatia are as just described.

Specimen 4.—SCHLÆRER exs. 356 (sub *a. allochroa*, *a. corticola*); on the trunks and branches of trees about Belp. The spermogones are pale-brown, indistinct papillae, slightly prominent, semi-immersed. The spermatia are about $\frac{1}{6000}$ th long, and very abundant; the sterigmata are very irregularly articulated.

SPECIES 11. *P. musciyena*, Ach.,

Which occurs in Europe and North America, seems to me only a muscicolous form of the preceding. The spores are of the same form and size as in *P. pulverulenta*; the spermogones have the same structure, though they are usually smaller papillae, of a darker brown colour—naked, or not so frequently pruinose.

Specimen 1.—Guldbrandsdal, Norway, SOMMERFELDT, Un. Itin. 1828; also Switzerland; in Herb. Hooker, Kew. Both apothecia and spermogones occur. I have gathered this plant abundantly at various points on the Dovrefjeldt range of mountains in Norway.

SPECIES 12. *P. aquila*, Fr.

Specimen 1.—LEIGHTON exs. 144 (E. B. 982; MOUG. and NEST. 1049); Torquay, Devonshire. The spermogones closely resemble those of *Parmelia stygia*; they are plentiful as small brown tubercles, occurring about the ends of the laciniae.

When mature, they are generally seen each to be pierced by a minute ostiole, which, with age, becomes very patent and large. When moistened, the spermogones become semi-translucent. The envelope is deep-brown. The spermatia are minute, rod-shaped, seated on the apices and sides of articulated sterigmata, whose component cellules have very thick walls.

Specimen 2.—On granite, coast of Cork; coll. CARROLL; with apothecia. The spermogones are here also plentiful as small brown papillæ, grouped generally in twos or threes, sometimes confluent, and then very irregular in form. The older ones are marked by their large irregular gaping ostioles, which give the lacinix the appearance of being studded over with a series of perforations. The spermatia are rod-shaped, about $\frac{1}{5000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata consist of a few shortish linear articulations.

Specimen 3.—SCHÆRER EXS. 565; on maritime rocks, coasts of the Atlantic; PELVET. There are a few young or mature papillæform spermogones; but the majority are old, with large irregular ostioles. The latter, in many cases, from falling out of the body of the spermogone, have become saucer-shaped or cyphelloid—the base of the cavity being deep-brown, and the edge very irregular. These cyphelloid ostioles are generally visible to the naked eye. The spermatia are about $\frac{1}{8000}$ th long; the sterigmata $\frac{1}{800}$ th to $\frac{1}{1000}$ th long.

SPECIES 13. *P. parietina*, L.,

A beautiful and familiar plant, having a very wide geographical range, as it occurs in Europe, Africa, Asia, Northern America, Chili, Polynesia, and Australia. In this, and the species which follow, the spermogones are cones or warts of a yellow or reddish colour; but internally, their structure is that of the spermogones of the *Physcia* already described. *P. parietina* is the type of a section of *Physcia* with a Parmeliiform thallus of a yellowish colour—a section which includes *P. candelaria*, *P. flamma*, and *P. chrysophthalma*. The spermogones of *P. parietina* are minute cones or tubercles, scattered about the periphery of the thallus, outside the region occupied by the apothecia. They are of an orange-red colour, deeper than that of the apothecia, and are generally more or less easily seen under the lens. They are usually in groups of two or three, seldom aggregated in large numbers. Their diameter is about $\frac{1}{250}$ th; that of their ostiole, which is usually minute, round, and imperceptible, from about $\frac{1}{850}$ th. The body of the spermogone is a spherical mass of a hard, dense, whitish tissue, immersed in the medullary substance of the thallus. The envelope is composed of delicate, cubical cellules, resembling those which make up the cortical layer of the thallus. The sterigmata are ramose and very irregular; they consist of numerous short, roundish, or cubical cellules, originally having thin walls, which, however, in progress of growth, become almost solid, from thickening deposits on their interior. The spermatia are rod-shaped or sub-ellipsoid, and about $\frac{1}{8000}$ th to $\frac{1}{10,000}$ th long.

Specimen 1.—Kinnoull Hill, Perth, March 1856, W. L. L.; with abundant

apothecia. The thallus has a grayish or very pale greenish colour, apparently due to a deficiency of chlorophylle, from growing in damp, dark situations. Hence the orange-coloured cone-like spermogones are very apparent; they are also very abundant; and not being pierced by distinct ostioles, they cannot be confounded with the nascent apothecia, which, besides their different form (always showing the rudimentary disk and exciple), have uniformly a much paler colour. The spermogonal envelope is composed of beautiful hexagonal cellular tissue, the cells being full of yellow colouring matter; this tissue is similar to that of the cortical layer of the thallus. The spermatia are sub-ellipsoid, and about $\frac{1}{10,000}$ th long; the sterigmata are delicate, indistinct, and very closely aggregated into a compact tissue.

Specimen 2.—On walls, Grange, Edinburgh, 1852, W. L. L. The spermogones are small, sometimes indistinct, cones or papillæ, of a deeper orange than the thallus, having no perceptible ostioles. They are distinguishable from the young apothecia by their rounded apex and their darker colour.

Specimen 3.—LEIGHTON exs. 10 (E. B. 194); Berwick, near Shrewsbury, Shropshire. The spermatia are innumerable, and indistinct from their minute size. Exs. 11, sub. var. *sub-stellata*, Fr. (E. B., 1794); also from Berwick, near Shrewsbury. The thallus bears no apothecia, and only a few spermogones. HEPP. exs. 54 (sub. var. *polycarpa*, Sch.) This is a dwarf form, with abundant, crowded apothecia, common on fruit-trees; its spermogones are those of the type.

Specimen 4.—SCHÆRER exs. 380 (sub *a. vulgaris*); on wood and stones in open places, Switzerland. The spermogones are small, distinct, orange-red papillæ, without distinct ostioles; the whitish hard kernel, which constitutes the body of the spermogone, can be readily enucleated. The spermatia are sub-ellipsoid, and about $\frac{1}{10,000}$ th long; the arthrosterigmata are about $\frac{1}{750}$ th to $\frac{1}{1000}$ th long.

Specimen 5.—Var. *laciniosa*, Sch., a form marked by small laciniae, much dissected or subdivided. SCHÆRER'S exs. 381 (sub δ . *laciniosa*, Duf.); on old trees in hilly and alpine districts, Switzerland. The spermogones have the usual site; but they are of a very bright red, almost vermilion, colour; they are few, and sparingly scattered. Exs. 383 (sub ξ . *fulva*); on palings, about Samaden. This plant seems referrible to var. *laciniosa*. Along with the ordinary spermatia and sterigmata of the type, there occurs in the same specimen, and apparently in the same spermogone, occasionally, abundance of curved, linear, or filiform spermatia, about $\frac{1}{2000}$ th long. I have not met with them elsewhere in this species, and am therefore disposed to regard them as accidental, and not properly belonging thereto. Exs. 549 (sub. var. *lychnea*, Fr.); on trunks of trees in open places. The spermogones are few, scattered; the sterigmata are very delicate and indistinct; the spermatia are about $\frac{1}{10,000}$ th to $\frac{1}{12,000}$ th long, and $\frac{1}{20,000}$ th broad—almost atomic in regard to size.

SPECIES 14. *P. canulelaria*, Ach.,

Which occurs in Europe and North America. It closely resembles var. *laciniosa* of *P. parietina*, but is distinguished from that species by its thecæ having 20 to 30

spores, instead of eight. It seldom occurs bearing apothecia, and its spermogones are not very common or abundant. Externally, they are those of *P. parietina*; but, in regard to their contents, they differ considerably in the specimens I have examined. KÖRBER says, "Spermogonien unbekannt." This species is the var. *candelaria* of *P. parietina* of older lichenologists; and some modern writers have constituted it not only into a separate species, but into a separate genus under the name of *Candelaria vulgaris* (Massalongho, *vide* Körb. 120).

Specimen 1.—SCHÆRER exs. 382 (sub *Parmelia parietina*, ϵ . *candelaris*); on trees and stones, Switzerland. The external appearance and site of the spermogones are the same as in *P. parietina*; but the spermatia and sterigmata differ remarkably. The spermatia are atomic in size, ellipsoid or oval, in myriads, resembling *en masse* a quantity of fish-roe. The sterigmata are simple linear cells, branching below as in *Lichina*, *Ramalina*, and other lichens, having single sterigmata measuring with the spermatia attached about $\frac{1}{2400}$ th long. The spermogonal envelope is pale or colourless, never brown. Some of the spermogones are comparatively large and wart-like, closely resembling nascent apothecia; the ostiole, as in *P. parietina*, is usually indistinct.

SPECIES 15. *P. flammea*, Ach.

There has been some difficulty as to the position of this plant. It is the *Dufourea flammea* of older authors. NYLANDER places it as a distinct species beside *P. parietina*; while LAURENT makes it a mere var. of *P. parietina*. In the latter view I concur. It is a very beautiful plant, with podetia-like ramules or segments, broadish, rounded, hollow, and with extremely thin papyraceous walls. Its colour and general aspect are those of *P. parietina*, and its spermogones are quite those of that species.

Specimen 1.—Cape of Good Hope; also Uitenhage, on trees; Cape Diege, Africa;—all in Herb. Hooker, Kew. The spermogones are scattered on the outside of the fistulose segments of the thallus, especially about the tips. They are small orange tubercles, deeper in colour than the thallus. The spermatia are sub-ellipsoid, about $\frac{1}{10,000}$ th to $\frac{1}{12,000}$ th long, and $\frac{1}{20,000}$ th broad; the arthrosterigmata are about $\frac{1}{500}$ th to $\frac{1}{370}$ th long, and $\frac{1}{5000}$ th broad.

SPECIES 16. *P. chrysophthalma*, DC.,

A beautiful, small species, which grows in Europe, Africa, America, Polynesia, and Australia. The spermogones are essentially those of *P. parietina*, but they are frequently larger and more distinct.

Specimen 1.—SCHÆRER exs. 389 (sub *Parmelia*); on fruit-trees, Switzerland; SCHIMPER. The spermogones are small orange-red tubercles, scattered about the ends of the laciniae; the spermatia and sterigmata are those of *P. parietina*.

Specimen 2.—Long Island, North America, May 1856; coll. Dr A. O. BRODIE; with plentiful apothecia. A few spermogones are distributed in groups about the

ends of the laciniae, as inconspicuous, small, rounded, orange-coloured tubercles. They are chiefly old, containing no free spermata; there are numerous sterile, elongated, hypertrophied sterigmata, which fill up the spermogonal cavity.

Specimen 3.—St Catharine's (Brazil), TWEEDIE; also var. *farnensis*, Ach., Nyl., from North America; in Herb. Hooker, Kew. In the latter variety, the spermogones are generally very distinct, large, deep orange-red tubercles, occurring in the axils of the branches or segments of the thallus, which are linear or filiform as in *P. flavicans*, and of a very light colour.

SPECIES 17. *P. flavicans*, DC.,

A beautiful Everniiform species, growing in Western Europe, Africa, Asia, America, and Australia.

Specimen 1.—Var. *crocea*, Ach., which occurs in the West Indies and Chili (sub. *Cornicularia crocea*, Ach.); from Dr ACHARIUS himself, 1809; in Herb. Hooker, Kew; no habitat given. In addition to the value belonging to the specimen from its being an authentic one from Dr ACHARIUS himself, it is interesting as bearing spermogones, which are not very common in this species. They are small papillae or warts, of the same colour as the thallus, scattered along the sides of the thicker segments of the thallus, nearer the base than the apex. The ostiole is of a deep orange-red, much darker than the colour of the thallus, frequently depressed; in which event the papillæform spermogone assumes an urceolate character. The spermata are rod-shaped, about $\frac{1}{10,000}$ th long, and $\frac{1}{25,000}$ th broad; on longish arthrosterigmata like those of *P. parietina*. But another kind of sterigmata also occurs; they are simple, linear, branching at the base as in *Ramalina* and *Lichina*, about $\frac{1}{1500}$ th to $\frac{1}{1000}$ th long; the spermata, given off from the apices only, of these sterigmata are acicular, $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad. These two kinds of sterigmata occur in different spermogones; but on the same plant or specimen. There is no reason to believe that the one is a rudimentary form of the other; for their structure and appearance differ *ab initio*.

Specimen 2.—Var. *exilis*, Mich., which occurs in equatorial America and Chili. New Orleans, DRUMMOND; in Herb. Hooker, Kew. The thallus is frequently of a very pale gray colour; it is studded over with small orange tubercles, which are spermogones.

SPECIES 18. *P. villosa*, Dub.,

A beautiful species, occurring in Spain and Portugal, Africa and Peru, and a variety of which I have also found occurs sparingly in Ireland. From the pale-gray colour of the thallus, and the large size of the orange spermogones, the latter organs are particularly conspicuous in this species.

Specimen 1.—Portugal, Trans-Tagus Districts, on sea-coasts; coll. WELWITZSCH, No. 110; in Herb. Hooker, Kew; very fine specimens. The spermogones are abundant as very prominent and large orange-coloured tubercles, somewhat

irregular in form, scattered sparingly on the pale segments of the thallus. The spermata are rod-shaped or sub-ellipsoid, $\frac{1}{5000}$ th long, and $\frac{1}{20,000}$ th broad, on arthrosterigmata, resembling those of *P. parietina*.

Specimen 2.—Var. *Dickiana*, mihi*—a plant sent me last summer by Professor DICKIE of Belfast—appears referrible to *P. villosa* as a variety. It was gathered “either on calcareous rocks in the Deer Park, or on the wall which surrounds it. The locality is on the north side of Belfast Bay, and about three quarters of a mile from the Bay” (in litt., 5th May 1858). It has not hitherto been known as a British plant. It is a dwarf, entangled form; the upper surface of the thallus is scarcely villose; the laciniae are grayish above, paler below and scarcely channelled or lacunose; their margins are copiously fringed with short, irregular, white fibres. The apothecia are conspicuous, having a large saffron-coloured disk. The spermogones are very large and distinct as orange tubercles, seated near the ends of the laciniae, rounded, isolated, of similar colour to the apothecia. The spermogonal cavity is divided into sinuous compartments, as in *P. ciliaris*. The spermata are rod-shaped, about $\frac{1}{10,000}$ th to $\frac{1}{12,000}$ th long, and $\frac{1}{20,000}$ th broad, seated on the apices and sides of long articulated sterigmata, resembling those of *P. parietina*.

SPECIES 19. *P. intricata*, Schær.,

Which, like the preceding, is essentially a Spanish and Portuguese species, occurring also in England and in Africa. Its thallus somewhat resembles that of the preceding species; but the disk of the apothecium is black, instead of orange. This is the old *Ecernia intricata*, Fries., the *Borrera Atlantica*, Ach., and *Lichen Atlanticus*, E. B. 1715, which grows sparingly on the south coast of England.

Specimen 1.—Lancerotta, on old trunks of *Opuntia fico-indica*; Teguire, 1846; coll. BOURGÉAU, No. 610;—both in Herb. Hooker, Kew. The spermogones are abundant, but they require to be carefully looked for with the lens, when the thallus is moistened. They are small brown points, scattered over the convexities of the laciniae, or crowning a series of very inconspicuous small warts. The spermata are rod-shaped, about $\frac{1}{5000}$ th long, and $\frac{1}{20,000}$ th broad, on arthrosterigmata such as are found in *P. villosa* and *P. parietina*.

* Since this Memoir was originally presented to the Royal Society, I have had two communications from Professor Dickie on the subject of the *name* of this plant. In his first (dated 25th March 1859), he says, “Twelve months ago I sent a *Borrera*, supposed by me to be a variety of *Atlantica*. I have now good reason to believe that it is *new*. Should you, therefore, publish anything on British species including it, I should wish it to stand as *B. Hibernica*, Dickie MSS.” In his second letter (dated 3d June 1859), he remarks, “The supposed *P. villosa*, Dub., has been submitted to Nylander, who pronounces it a monstrosity of *P. chrysophthalma*. I have compared the fruit in both, and find them identical, so we must bow to the high authority of Nylander.” In giving these criticisms, however, which I do in justice to Professors Dickie and Nylander, I see no reason for in any way modifying or altering my opinion regarding the place in classification or name of the plant in question—as above given.

FAMILY XIII. PYXINEÆ.

GENUS I. PYXINE, Fr.

This genus, which NYLANDER places between the families *Umbilicariæ* and *Lecanoreæ*, has a Parmeliiform thallus, but lecidine apothecia. The whole plant frequently resembles, on the one hand, *Parmelia stellaris*, and on the other, *Lecidea canescens*. For the latter plant, especially, it is often mistaken: several specimens from Madras, Dr WIGHT, in Herb. Hooker, Kew, are labelled *L. canescens*. Its spermogones externally resemble those of many *Parmeliæ* and *Physciæ*, as well as some *Lecideæ*—such as *L. canescens*. The plant occurs in all equatorial countries, and in Chili.

SPECIES 1. *P. cocöes*, Ach.

Specimen 1.—Demerara, W. H. CAMPBELL (sub nom. *Lecidea cocöes*, Ach.); Madras, Dr WIGHT;—both in Herb. Hooker, Kew. The plant has sometimes greatly the aspect of *Parmelia stellaris*; but the apothecia are always lecidine, the exciple and disk being of the same colour, which is black. The spermogones are generally scattered about the ends of the laciniae, as brown points, seated on the apices of pale, thalline papillæ. Sometimes they are not confined to the periphery of the thallus, but are plentifully distributed over the whole thalline surface, and among the apothecia. The body of the spermogone is always immersed in the medullary tissue of the thallus. The spermatia are usually linear, straight, or very slightly curved, with rounded or obtuse ends, about $\frac{1}{6000}$ th long, and $\frac{1}{20,000}$ th broad. The sterigmata closely resemble those of *Ramalina*; they are narrowly linear, very delicate, branching at the base, about $\frac{1}{2000}$ th to $\frac{1}{1500}$ th long, and of equal thickness with the spermatia, which are given off from the apices only, as terminal cells or articulations.

FAMILY XIV. LECANOREÆ.

The genera *Psoroma*, *Pannaria*, *Coccocarpia*, *Squamaria*, and *Placodium* are intermediate between *Parmelia* and *Lecanora*, as regards, particularly, their thallus. In some, the Parmelioid character predominates, in others the Lecanorine. They cannot be properly excluded from the foliaceous class of lichens.

GENUS I. PSOROMA, Fr., p.p. Nyl.

This genus is closely allied to *Pannaria* and *Coccocarpia*, and its spermogones also resemble those of these genera. The most familiar species of the genus, and the only British one, is *P. hypnorum*, Fr., which grows equally in America and Europe. It has short, rod-shaped spermatia, on arthrosterigmata like those of *Pannaria* and *Coccocarpia*.

GENUS II. PANNARIA, Del., Nyl.

The spermogones of this genus are essentially those described under *Cocco-*

carpia, which should not, I think, be separated as a genus from *Pannaria*. They are largish warts or papillæ, scattered about the periphery of the thallus, flattened on the apex, generally brown or black, reddish in *P muscorum*. The spermogones sometimes, in old age, become black internally. The sterigmata are articulated as in *Physcia*; the component cellules being numerous, short, roundish or cubical, and with walls thickened by internal deposits. They occasionally, in old age, and especially about their base, acquire a blackish tint, as in *P. triptophylla*. The spermatia are rod-shaped, varying in length from $\frac{1}{4000}$ th to $\frac{1}{3000}$ th.

SPECIES 1. *P. pannosa*, Del.,

Is common in *all* tropical countries, and also occurs in the Sandwich Islands.

Specimen 1.—Low Island, BEECHEY. The spermogones are abundant as small papillæ, scattered here and there in the direction of the radiations of the lacinia, between the centre region occupied by the apothecia and the margin of the thallus. The apex is marked by a brown, roundish or elongated ostiole. Philippine Islands, CUMING; both in Herb. Hooker, Kew. The spermogones are scattered about the periphery of the thallus, as brown papillæ, sometimes seated on slight elevations of the thallus.

SPECIES 2. *P. rubiginosa*, Del.,

Which occurs in America as well as in Europe.

Specimen 1.—LEIGHTON exs. 234 (sub. *Parmelia*, E. B. 983); Keswick, Cumberland. The spermogones are similar to those of *Coccocarpia plumbea*, both externally as to appearance and site, and internally as to structure or contents. The whole plant is closely allied to *C. plumbea*. Indeed, I am inclined to refer both to a common type; and I look upon NYLANDER'S arrangement, which separates them, as a most artificial and unnatural one.

SPECIES 3. *P. triptophylla*, Ach., Fr.,

Like the preceding, occurs both in America and Europe.

Specimen 1.—SCHÆRER exs. 159 (sub. *Lecidea microphylla a. Schraderi*); on the trunks of trees in alpine woods, Switzerland. The spermogones are small, round, black, roe-like bodies, grouped closely together. The envelope is composed of cellules having an indigo-blue colour; the spermogonal cavity is simple. The spermatia are rod-shaped, about $\frac{1}{8000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata appeared to me simple, linear, short filaments, sometimes branching very slightly below. This is exceptional—the sterigmata of *Pannaria* being, as I have already mentioned, normally articulated.

SPECIES 4. *P. muscorum*, Ach., Del.

Specimen 1.—SCHÆRER exs. 482 (sub. *Parmelia carnosa*); on granite rocks in the Alps. The spermogones are largish, distinct, flattened, reddish-brown

warts, scattered on the thalline laciniae. The spermatia are rod-shaped, about $\frac{1}{4000}$ th long, and $\frac{1}{20,000}$ th broad. The arthrosterigmata resemble those of *Sticta* or *Collema*—the cellules or articulations being short, broadish, and thick-walled.

GENUS III. COCCOCARPIA, Pers., Nyl.

The spermogones of this genus resemble those of *Ricasolia* somewhat, being largish superficial papillae or tubercles, having rod-shaped spermatia on arthrosterigmata. They are generally seated about the periphery of the thallus, outside the region occupied by the apothecia. Sometimes they are arranged longitudinally, or in the line of radii passing from the centre to the circumference of the thallus; sometimes in arcs parallel to the zones which mark distinctly the development of the thallus. They are generally of the colour of the thallus, the ostiole being usually brown or black. In *C. molybdæa*, they are pale yellow, with a brown ostiole. They are frequently confluent, becoming then very irregular in form. The ostiole is seldom round, and this only in the young or mature state. Subsequently it becomes generally elongated or chink-like, and more or less irregular in outline. The body of the spermogone forms a dense, hard, whitish or yellowish kernel, immersed in the medullary tissue of the thallus. The envelope is generally of a pale-brown or brownish-yellow cellular tissue. The sterigmata are ramose, longish,— $\frac{1}{600}$ th to $\frac{1}{750}$ th in length in *C. plumbea*,—with a breadth of $\frac{1}{6000}$ th, composed of short roundish or cubical thick-walled cellules. In the old spermogones, the sterigmata frequently acquire a brown colour, especially below, and they sometimes become aggregated into a compact tissue, which fills the cavity of the spermogone. This tissue, in some cases in *C. plumbea*, may even become black. The diameter of the cavity of the spermogone in *C. plumbea* is $\frac{1}{75}$ th to $\frac{1}{80}$ th; the spermatia are rod-shaped, and about $\frac{1}{6000}$ th to $\frac{1}{7000}$ th long, with a breadth of $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th. NYLANDER'S distinction between *Coccocarpia* and *Pannaria* seems to me a very insufficient and unsatisfactory one:—"Nimis arcta est affinitas inter Coccocarpias et Panarias," he himself admits. "In *Coccocarpiis* thallus ad formam radiato-sub-monophyllinam tendens (sæpe concentrice versus ambitum rugulosam) et apotheciis constanter biatorinis levem offert differentiam a *Pannariis*."*

SPECIES 1. *C. plumbea*, Lightf.,

Which occurs in North Africa, as well as in Europe; a familiar British species. The spermogones are sometimes inconspicuous from being of the same colour with the thallus; the ostiole, however, is generally of a deep brown, sometimes black, colour. They are large, flattened tubercles—frequently elongated in the direction of the radiations of the thallus—often confluent and very irregular in form. The cavity is simple. In old spermogones, the sterigmata frequently assume a brown colour, and become agglutinated into a compact tissue.

* Enumération Générale des Lichens, p. 109. 1858.

Specimen 1.—On trees between Tarbert and Arrochar, Loch Lomond, Aug. 1855, W. L. L. There are no apothecia; but spermogones abound in every stage of their development. They are large papillæ, with ostioles of a deep leaden-gray or blackish colour. The papilla generally becomes elongated, and the ostiole enlarges until a black disk-like or saucer-shaped cavity is exposed. The spermogones are scattered most plentifully about the centre of the thallus, few occurring about its periphery. Some are seated on the plicæ of the thallus, which run from the centre to the circumference; others are distributed parallel to the periphery of the thallus. There are also spermogoniferous specimens in Don's Herbarium (now possessed by Mr M'NAB, Royal Botanic Garden, Edinburgh); no habitat given. The spermogones are chiefly young, with elongated chink-like ostioles. They closely resemble the spermogones of *Ricasolia herbacea* and *R. glomulifera*.

Specimen 2.—LEIGHTON exs. 233 (sub. *Parmelia*, E. B. 353); Keswick, Cumberland; with abundance of apothecia. The spermogones are small tubercles, of the colour of the thallus, with very irregular ostioles.

Specimen 3.—Var. *myriocarpa*; on trees, Killarney, Ireland, common; coll. CARROLL. This is merely a form in which the apothecia are small, and confluent in irregular masses. With it may probably properly be associated SCHÆRER'S γ . *cyanoloma* (Enum. p. 36), which has "apotheciis in maculas fusco-atras congestis." The spermogones are imbedded in large tubercles or papillæ of the thallus, each marked by a brown apex or ostiole; they are scattered abundantly external to the region of the apothecia. The envelope is of a very pale brownish-yellow. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad; the sterigmata are from $\frac{1}{600}$ th to $\frac{1}{750}$ th long, and $\frac{1}{6000}$ th broad.

SPECIES 2. *C. molybdæa*, Pers.,

A species which occurs in all tropical countries, closely allied to the preceding.

Specimen 1.—St Vincent, on barks; Canaries, ex Herb. Welwitzsch; Surinam, ex Herb. Miguel;—all in Herb. Hooker, Kew (Syn. *Solorina maculata*, Tayl.; *Lecidea parmelioides*, Hook.) The spermogones are abundantly scattered all over the thallus; they are pale yellow warts, with brown tips, superficial, prominent, becoming darker in colour and less conspicuous. In one specimen, with the thallus of a leaden hue, closely resembling that of *C. plumbea*, the spermogones are small, distinct, prominent black or brown papillæ, grouped in considerable numbers. The body of the spermogone is a hard yellow kernel, sunk in the medullary tissue of the thallus. The spermatia are rod-shaped, about $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad, on arthrosterigmata like those of *C. plumbea*.

Specimen 2.—Assam; Philippine Islands, CUMING; in Herb. Hooker, Kew. Some specimens have large, handsome, pale lobes. The spermogones are few, scattered, very distinct and large, resembling, except as to size, those of *Ricasolia herbacea*.

GENUS IV. SQUAMARIA, DC.

This genus is closely allied to the following one—*Placodium*; but there are some prominent differences in regard to the character of the spermogones,—particularly in regard to the spermatia and sterigmata. In reference to its spermogones, *Placodium* stands much nearer *Physcia* than *Squamaria* does. The spermogones of *Squamaria* are mostly immersed, and are marked by an inconspicuous punctiform ostiole, which is frequently of the same colour as the thallus. The ostiole is sometimes black, bluish, or brownish—generally minute and round—occasionally stellate-fissured. Seldom are the spermogones tubercles or papillæ; seldom are they conspicuous or large. In *S. aleurites*, they are punctiform; in *S. gelida*, they are perched on pale thalline papillæ. They are usually scattered about the periphery of the thallus—sometimes distributed chiefly about its centre. Sometimes, in *S. chrysoleuca*, they are studded on the apices of isidioid growths of the thallus; and in *S. concolor*, they are scattered over the apothecia. The greatest diameter of the body of the spermogone varies from $\frac{1}{70}$ th to $\frac{1}{150}$ th; in *S. saxicola* it is $\frac{1}{130}$ th. The cavity is usually simple; in *S. crassa* it is divided into sinuous compartments, as in *Physcia ciliaris*. The spermatia are, as a general rule, long, filiform, and curved or twisted, among the most beautiful and largest that occur in lichens. Their length varies from $\frac{1}{600}$ th to $\frac{1}{1000}$ th, many being about $\frac{1}{700}$ th long; their breadth varies from $\frac{1}{25,000}$ th to $\frac{1}{50,000}$ th, and is frequently inappreciable. In *S. aleurites*, I have found short rod-shaped spermatia, about $\frac{1}{7000}$ th long; this, however, is the only instance in which I have ever met with them other than filiform and curved. In this species, too, the sterigmata are of an exceptional character, being articulated, consisting of a few linear, delicate cells, and resembling those of many *Parmeliæ*. They are usually simple, linear, elongated, branching or not at the base, and resembling those of *Lecanora subfusca*. The spermatia, sterigmata, and spermogones of *Squamaria* are much more closely allied to those of *Lecanora* than to those of *Physcia*—quite the reverse being the case in regard to *Placodium*. The length of the sterigmata varies from $\frac{1}{1500}$ th to $\frac{1}{3000}$ th; their breadth from $\frac{1}{10,000}$ th to $\frac{1}{15,000}$ th.

SPECIES I. *S. crassa*, DC.,

Which occurs equally in Africa and Europe. Its spermogones in French specimens, according to TULASNE—for I have not myself met with them—are minute tubercles scattered over the thallus, generally of a pale-brown colour, sometimes flesh-coloured, occasionally violet. The apex is more frequently marked by a fissured ostiole than by a round imperceptible pore. In the old state, the ostiole expands so as to assume a discoid character, its borders being very irregular and lacerate. The greatest or transverse diameter of the spermogone varies from $\frac{1}{75}$ th to $\frac{1}{110}$ th. Its body is wholly or nearly immersed in the thallus; it is sometimes girt by the gonidic layer of the thallus; at other times it is plunged immediately

in, and surrounded by, the white medullary tissue. The cortical envelope is not of a deeper tint than the rest of the tissue of the spermogone. The cavity is irregular, and is divided into numerous sinuses or anfractuositities which are marked externally by bulgings of the walls of the spermogone. The sterigmata are simple, resembling those of *Lecanora subfusca*. The spermatia are very delicate, filiform, and much curved; their length is about $\frac{1}{650}$ th to $\frac{1}{800}$ th, with a breadth of $\frac{1}{25,000}$ th.

SPECIES 2. *S. chrysoleuca*, Sm.,

A beautiful species, which grows in Europe, North America, and the Himalayas.

Specimen 1.—SCHÆRER exs. 345 (sub *Parmelia rubina a. chrysoleuca*); on micaceous rocks, in the Southern Alps. On the right-hand specimen in my copy (original ed. 1840), there are a few old spermogones, containing no free spermatia; they are punctiform, seated on the tips of small, isidioid warts, and are marked by inconspicuous ostioles. On the left-hand specimen, mature and young spermogones are scattered over the surface of lobes bearing no apothecia. They are wholly immersed, and are marked by round black, or bluish-black, ostioles. They closely resemble the spermogones of the preceding species. The spermatia are long, filiform, and curved or twisted, about $\frac{1}{1500}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata are simple, linear, elongated, measuring, with the spermatia attached, $\frac{1}{750}$ th.

SPECIES 3. *S. saxicola*, Ach.,

A cosmopolite. The thallus frequently consists of an aggregation of small, irregular, dark-gray scales. On these the spermogones are scattered as small black points, without appreciable prominence. The body of the spermogone is spherical, with a diameter of about $\frac{1}{130}$ th, of a brownish-violet colour externally, as well as internally. The cavity is simple; the sterigmata are also simple, narrowly linear, almost solid from thickening deposits on their interior; their length is about $\frac{1}{1700}$ th to $\frac{1}{3000}$ th; their breadth scarcely $\frac{1}{13,000}$ th. The spermatia are filiform and curved, about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long.

Specimen 1.—SCHÆRER exs. 332 (sub *Parmelia muralis a. ochroleuca*); on limestone, Switzerland. The spermogones are small black papillæ, seated on separate, sterile scales of the thallus, chiefly at the corners thereof, as in *Lecanora cinerea* and many *Lecideæ*. The spermatia are sub-ellipsoid, $\frac{1}{10,000}$ th long, and $\frac{1}{20,000}$ th broad, seated on the apices and sides of arthrosterigmata. The spermatia and sterigmata show that this plant certainly does not belong to our *S. saxicola*, however much it may outwardly resemble it.

SPECIES 4. *S. concolor*, Ram.

The black warts on the apothecia, of which SCHÆRER speaks, are spermogones. The spermatia are among the most slender, longest, and most beautiful known among lichens. Their length is $\frac{1}{620}$ th; their breadth from $\frac{1}{25,000}$ th to $\frac{1}{50,000}$ th.

SPECIES 5. *S. gelida*, L.,

Which occurs in Europe, America, and New Zealand. In Scotland, it is common in Skye, and also along the banks of the Caledonian Canal.

Specimen 1.—New Zealand, COLENSO; in Herb. Hooker, Kew; on water-worn pebbles, precisely as on the banks of our Caledonian Canal. The spermogones are very beautiful and distinct. The convexities of the laciniae, about their centre, are elevated into a series of aggregated, pale papillae, each having a broadish base, surmounted by a second or separate cone, of a brownish-yellow colour, pierced or not by a very minute ostiole. The interior of the upper cone is found to consist of a large brownish-yellow hygrometric kernel, very like the body of the spermogone of *Pertusaria communis*, and becoming similarly gelatinous under moisture. The spermatia are so extremely delicate as to be almost invisible; they are among the most beautiful I have seen. They are vermiform threads, about $\frac{1}{1500}$ th long, and $\frac{1}{30,000}$ th broad. The sterigmata are linear, simple, branching slightly at the base, about $\frac{1}{3000}$ th to $\frac{1}{1500}$ th long.

SPECIES 6. *S. ambigua*, Wulf.,

Which occurs in Europe, Asia, and North America.

Specimen 1.—Madras; on the bark of trees; in Herb. Hooker, Kew. The plant seldom or never bears apothecia in this country. In this specimen, both apothecia and spermogones occur. The latter are minute, brown, immersed, punctiform bodies, resembling in external aspect the spermogones of *Parmelia saxatilis*.

SPECIES 7. *S. aleurites*, Ach.,

Which also grows in North America, as well as in Europe.

Specimen 1.—Franklin's First Voyage, in Herb. Hooker, Kew (sub nom. *Parmelia ambigua*). This species closely resembles the preceding, with which it is constantly associated, and for which it is constantly mistaken. The spermogones are punctiform, minute, brown or black immersed bodies, outwardly resembling those of *Parmelia saxatilis*.

Specimen 2.—Valley of Guttanen, Switzerland; in Herb. Hooker, Kew. The spermogones are numerous and very distinct. The spermatia are rod-shaped and straight, about $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad; apparently seated on the apices and sides of short articulated sterigmata, about $\frac{1}{2000}$ th long, and which resemble those of *Parmelia conspersa*.

Specimen 3.—On old fir-trees, at Aviemore, 1807; in Herb. Hooker, Kew. The thallus is very like that of *Physcia stellaris*; but the spermogones and the spores equally distinguish the two plants.

GENUS V. PLACODIUM, DC.

This genus is intermediate in character between *Parmelia* or *Physcia*, and *Lecanora*; but its spermogones are those of the two former genera. The spermogones are usually papillæ or tubercles, of various size and variously coloured, scattered about the periphery of the sub-foliaceous thallus, and on the convexities of the laciniaë, just as in *Physcia*. They are isolated or grouped, more or less irregular in form frequently, especially when confluent, often flattened on the apex. Sometimes they are scattered on separate sterile areolæ, as is the case with the spermogones of many *Lecanoræ* and *Lecideæ*. They are then punctiform and immersed, with a raised, light, thalline border, as in *P. chalybæum* and *P. al-phoplacum*. The spermogones are, in a form of *P. circinatum*, pseudo-lecidine in appearance, and as large as apothecia. They are the largest spermogones, without exception, with which I am acquainted. They are large whitish or buff-coloured disks, destitute of an exciple, having frequently a ragged or notched edge. They are generally semi-immersed in the limestone on which the plant grows. The internal structure and contents are those of the ordinary form of spermogone in this species. The colour of the spermogone is also whitish in *P. chalybæum*, in which the ostiole is of a pale-gray. In species with a reddish or yellowish thallus, just as in *Physcia*, the colour of the spermogone is orange-red or orange-yellow. This is the case in *P. muscorum*, *P. callopismum*, *P. elegans*, and other species. The colour is sometimes brownish or blackish; in *P. candicans* it is bluish. The ostiole is usually very minute and indistinct; sometimes it is fissured irregularly. The greatest diameter of the body of the spermogone, in *P. murorum*, is $\frac{1}{50}$ th. The tissue of its body is hard, dense, whitish and hygrometric; its cavity is generally simple. The spermatia are short, linear, straight or rod-shaped, with truncate ends, sometimes oblong or ellipsoid. Their length varies from $\frac{1}{5000}$ th to $\frac{1}{13,000}$ th, a large number measuring about $\frac{1}{6000}$ th to $\frac{1}{8000}$ th long. In many species they are almost atomic in size. Their breadth varies from $\frac{1}{20,000}$ th to $\frac{1}{30,000}$ th. The sterigmata are normally, and as a general rule, articulated,—the component cellules or articulations being short, roundish or cubical, as in many *Physciæ*. They are longish, varying from $\frac{1}{750}$ th to $\frac{1}{1500}$ th, many of them being about $\frac{1}{1000}$ th long, with a breadth of about $\frac{1}{10,000}$ th. In some species, as *P. circinatum* and *P. fulgens*, elongated, ramose, sterile, hypertrophied filaments, not unfrequently occur, growing from among the spermatiferous sterigmata, and filling the cavity of the spermogone. In exceptional cases, as in forms of *P. circinatum* and *P. al-phoplacum*, I have met with sub-simple sterigmata, which, however, is altogether an exceptional phenomenon in this genus. The sterigmata become, in progress of growth, almost solid, from thickening deposits in the interior of their individual component cells.

SPECIES 1. *P. candidans*, Dub.

This may be considered the type of a section of the genus, characterised by a whitish or grayish thallus.

Specimen 1.—LEIGHTON exs. 218 (sub *Lecidea rimosa*). (Syn. It is certainly not E. B. 1736, as LEIGHTON quotes, but E. B. 1778.) On quartzose rock, Great Orme's Head, Caernarvonshire. The spermogones are distinct, as minute bluish or black points, sparingly scattered towards the periphery of the thallus. They are flattened or cone-like, wholly immersed, or nearly so. The spermatia are very short, rod-shaped bodies, bristling over the apices and sides of arthrosterigmata.

SPECIES 2. *P. circinatum*, Pers.,

A comparatively widely-spread species, occurring in Europe, Africa, and Asia.

Specimen 1.—Dereham Church, England, 1810; in Herb. Hooker, Kew (sub nom. *Lichen candidans*, Dicks.; *Parmelia epigæa*, Ach.) The spermogones are plentifully scattered among the apothecia. They are seated on the warts of which the thallus is in a great measure composed. They are brown papillæ, which burst through the thallus, and become irregular, flattish bodies, resembling deformed apothecia. The ostiole is seldom round and inconspicuous; it is, especially in the old state, more or less patent and stellate-fissured. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad, seated on sterigmata about $\frac{1}{1500}$ th long, which are composed of only two or three linear irregular cellules or articulations.

Specimen 2.—Clare Hall Bridge, Cambridge, Rev. H. DAVIES; also from same locality, coll. JAMES DALTON, 1803,—both in Herb. Hooker, Kew. That portion of the thallus external to the region occupied by the apothecia is copiously covered with spermogones; they are seated on thalline warts, and are brown, irregular, papillæform, sub-immersed bodies.

Specimen 3.—Var. *variabile*, Pers.; HEPP. exs. 74 (sub. *Placodium variabile*); on old walls. The spermogones are pale, flat, brown, roundish spots, studded over the periphery of the whitish thallus. They closely resemble the spermogones of *Lecanora subfusca*, whose apothecia those of this variety of *P. circinatum* also resemble in outward aspect. The spermatia are oblong or sub-ellipsoid, almost atomic as to size. *P. circinatum* has frequently, intermixed with the ordinary or spermatiferous sterigmata, elongated, sterile, ramose filaments, like those which occur in many of the *Parmeliæ*. NYLANDER has likewise noticed this fact; but he alludes to it as an abnormal and occasional condition only. I see no reason for regarding the occurrence of these hypertrophied sterile sterigmata in this species as exceptional, while they are regarded as normal in *Ramalina* and *Parmelia*. Indeed, I would lay down as a proposition, that there is a tendency in all spermogones whatever to the development of an elongated, hypertrophied, and sterile condition of the sterigmata. This is mostly seen in old spermogones, the sterig-

mata in which often become so hypertrophied and so aggregated as to fill the whole spermogonal cavity with a dense coloured tissue. But the phenomenon also is of frequent occurrence in mature spermogones; and the abnormal or exceptional condition, I should say, is the absence, not presence, of these peculiar filaments.

Specimen 4.—Var. *ecrustaceum* (sub *Placodium Agardhianum*; syn. *Lecanora Agardhiana*, Ach. SCHÆRER exs. 617; on limestone, in the Jura and Alps); HEPP. exs. 407. The apothecia are black, flattish, or sub-convex bodies, with an indistinct, thin, evanescent border. Accompanying or intermixed with these, are bodies of the same size, flat or sub-convex, without any distinct exciple, having frequently a ragged or notched edge. They are of a whitish or buff colour, have quite the aspect of apothecia, are white-pruinose, like the apothecia and spermogones of *Lecidea abietina*, and are generally semi-immersed in the limestone on which the plant grows. They are really spermogones, though outwardly very unlike these organs in their ordinary forms; and they are the largest bodies of the kind with which I am acquainted. The spermatia are ellipsoid or linear-oblong, about $\frac{1}{10,000}$ th long, and $\frac{1}{20,000}$ th broad. The sterigmata are longish, delicate, articulated, about $\frac{1}{750}$ th to $\frac{1}{1000}$ th long, and $\frac{1}{10,000}$ th broad. The spermogones are not only white-pruinose on their surface, but are whitish and mealy throughout. The apothecia are occasionally also white-pruinose externally, and they are then distinguishable from the spermogones only by microscopical examination. The spermogones, however, are always lecidine, the apothecia lecanorine; but this distinction may not at once strike the eye.

SPECIES 3. *P. chalybæum*, Duf., Næg.

In his “*Prodromus Lichenographiæ Galliæ et Algeriæ*,” 1857, p. 81, NYLANDER arranges this species with the *Lecanoras* having simple sterigmata. This does not at all accord with my observations; the sterigmata in all specimens examined by me, as is also the case in all the species of *Placodium*, were articulated. His removal of this species to the genus *Placodium*, in his “*Enum. Générale des Lichens*,” 1858, p. 111, may, however, be regarded as a confession of error.

Specimen 1.—HEPP. exs. 204; on calcareous rocks. The spermogones are plentifully scattered over the whitish or grayish areolæ; they are punctiform, immersed, grayish or blackish; with a raised, lighter, broken thalline margin. The spermatia are rod-shaped, atomic in size, on arthrosterigmata.

Specimen 2.—SCHÆRER exs. 566 (sub *Lecanora chalybæa*); on calcareous stones about Montpellier, and in the Eastern Pyrenees. The spermogones are whitish small tubercles, with a pale-gray ostiole of the same colour as the thallus, not easily recognised even under the lens. They somewhat resemble the spermogones of *Lecidea fusco-atra*, both in site and in external appearance. The spermatia are very abundant, rod-shaped or ellipsoid, $\frac{1}{12,000}$ th long.

SPECIES 4. *P. alphoplacum*, Wahl.,

Which occurs in North America, as well as in Europe.

Specimen 1.—SCHLÆRER exs. 330 (sub *Parmelia radiosia* β . *inflata*); on granitic alpine rocks; with apothecia. The spermogones are marked by their small, brown ostioles, which crown the separate, sterile warts of the thallus. The spermatia are short, rod-shaped, about $\frac{1}{5000}$ th to $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad. The sterigmata are apparently sub-simple, linear, branching below, measuring with the attached spermatia $\frac{1}{1000}$ th to $\frac{1}{1200}$ th long. The existence of simple sterigmata in *Placodium* is quite exceptional,—arthrosterigmata almost universally occurring.

SPECIES 5. *P. teicholytum*, DC.

This is the type of a section of *Placodium* characterised by the possession of a yellowish thallus (Syn. *Parmelia erythrocarpia*, Fr.; *Lecidea*, Schær.; *Blastenia erythrocarpia*, Pers., Korb. 183; *Lichen cæσιο-rufus*, Sin., E. B. 1040). This species, I think, should certainly be merged in *Lecanora ferruginea*, or, as I should arrange it, *Lecidea ferruginea*. The spermogones are scattered among the apothecia as blackish, punctiform, depressed bodies, sometimes slightly papillæform. The form of the spermogonal cavity is oblong; it is narrow and simple. The spermogonal envelope is black, and this distinguishes the spermogone—on section—from the surrounding white medullary tissue. The spermatia are ellipsoid or ovoid, about $\frac{1}{8000}$ th long, on arthrosterigmata resembling those of *P. murorum*.

SPECIES 6. *P. fulgens*, DC.,

A handsome species, which occurs both in Africa and Europe. The spermogones are large, distinct, orange-red tubercles, which are apt to be mistaken for, or confounded with, the nascent apothecia. The internal tissue is whitish-yellow; the cavity is simple, but it is ultimately obliterated by convergent hypertrophied sterigmata. The sterigmata are ramose, and consist of small cubical cellules, which become almost solid from thickening deposits in their interior. The spermatia are not above $\frac{1}{10,000}$ th to $\frac{1}{13,000}$ th long, and are in immense numbers.

Specimen 1.—HEPP. exs. 194; on sandy ground, on the banks of the Rhine, in the neighbourhood of Tardisbrücke, near Chur. The spermogones are abundant as large, prominent, deep orange-red tubercles or cones, scattered towards the periphery of the thallus. They are most easily seen when moistened. The spermatia are sub-ellipsoid, atomic in size, seated on the apices and sides of arthrosterigmata which resemble those of *Physcia parietina*.

SPECIES 7. *P. aureum*, Schær.,

A beautiful native of the Alps and Pyrenees.

Specimen 1.—SCHLÆRER exs. 165 (sub *Lecidea*); in the fissures of calcareous

rocks among the Alps. The spermogones are largish tubercles, seated at the corners of the squamules, and about the periphery of the thallus, sometimes also scattered among the apothecia. They are usually flattened on the top, are of a paler or lighter colour than the thallus, and have orange-red ostioles. The spermatia and sterigmata are those of the preceding species.

SPECIES 8. *P. scorigenum*, Mont. (sub *Evernia*).

Specimen 1.—Canary Islands, Dr LEMAN; in Herb. Hooker, Kew. The spermogones are seated on the convexities of the laciniaë as orange papillæ or tubercles, which are much lighter in colour than the disks of the apothecia. The spermatia are rod-shaped, and about $\frac{1}{6000}$ th long; the arthrosterigmata are those of the two preceding species. This plant comes very close to *Physcia villosa*, both in regard to its spermogones and apothecia; so close, indeed, that, were a trivial difference in the character of the thallus overlooked, it might almost be included.

SPECIES 9. *P. elegans*, DC.,

One of the most widely-spread species of *Placodium*, occurring in Europe, America, Asia, and Abyssinia. It is also one of the most beautiful species.

Specimen 1.—Var. *miniatum*, SCHÆRER exs. 338 (sub *Parmelia elegans a. miniata*); on sunny stones among the Alps. The spermogones resemble in site and external appearance, as well as internal structure, those of the following species. They are small orange-red tubercles, scattered about the ends of the laciniaë. The spermatia are sub-ellipsoid or rod-shaped, atomic as to size, seated on very indistinct arthrosterigmata.

SPECIES 10. *P. murorum*, DC.,

A cosmopolite, familiar and beautiful species. Its spermogones, in regard to site, outward appearance, and internal structure, closely resemble those of *Physcia parietina*. They are small papillæ or warts, scattered about the periphery of the thallus, isolated or grouped two or three together. Their colour is somewhat deeper than that of the thallus. They sometimes resemble nascent apothecia. The ostiole is usually minute, round, and imperceptible; occasionally it has a thick margin, and sometimes it is fissured. The greatest diameter of the spermogone is $\frac{1}{50}$ th. The internal tissue is hard, dense, whitish, opaline. The form of the body of the spermogone is oblong and irregular; the cavity is divided into many sinuosities. The gonidic layer of the thallus sometimes girds the immersed body of the spermogone, which is more usually directly plunged in the white medullary thalline tissue. The sterigmata are ramose, and are composed of almost solid, cubical cellules. The spermatia are rod-shaped, and vary in length from $\frac{1}{6000}$ th to $\frac{1}{12,000}$ th.

Specimen 1.—LEIGHTON exs. 113 (sub *Parmelia*); on mortar, ruins of Tong

Priory, Shropshire. The spermogones are small orange tubercles, scattered about the periphery of the thallus.

Specimen 2.—Var. *lobulatum*, Flk. ; on limestone, Blackrock, near Cork ; coll. CARROLL ; associated with var. *fuscella*, Ach. of *Verrucaria nigrescens*, Pers. The spermogones are somewhat abundant and distinct as minute, sub-irregular, deep orange-red papillæ, scattered over the convexities of the lacinia, and about the periphery of the thallus. They are usually more or less isolated. Both the thallus and apothecia have an orange-yellow colour ; and hence the spermogones, from their brilliant red tinge, are sufficiently conspicuous, especially under moisture. The spermatia are rod-shaped, very abundant, about $\frac{1}{12,000}$ th long, and $\frac{1}{25,000}$ th broad, on arthrosterigmata which measure $\frac{1}{750}$ th long, and $\frac{1}{9000}$ th broad. *P. callopismum* has similar spermogones. There is no sufficient distinction between *P. murorum* and *P. callopismum*, unless that the apothecia in the latter are generally more of a red colour than those of the former. I refer the latter to the former as a mere variety.*

FAMILY XV. COLLEMACEÆ.

SECTION I. LICHINA Tribe.

GENUS I. EPHEBE, Fr. Born.

The structure of the spermogones of this genus will be sufficiently illustrated by that of the spermogones of *E. pubescens*, its best-known species.

SPECIES 1. *E. pubescens*, Fr., †

Which occurs both in Northern America and in Europe (Syn. *Cornicularia*, Ach. ; *Stigonema atro-virens*, Agardh.) The filiform segments of the thallus, near their tips, exhibit two forms of swellings of their substance. The one is spherical or ovoid, and largish ; the other is fusiform, elongated, and much smaller. The first-mentioned swelling contains the endocarpous apothecium, the last-mentioned the spermogone. But these two forms of swelling, or in other words, apothecia and spermogones, never occur on the same segment of the thallus, nor even on the same tuft of the plant. Apothecia are found on one tuft or specimen ; spermogones on another. But both organs have the same relative position on the segments of the thallus. The spermogonal ostioles or pores are extremely minute and inconspicuous. The envelope is formed of the same kind of cells as those which enter into the structure of the exciple or perithecium of the apothecia ; they are of a bluish-green colour. The sterigmata are very delicate linear cells, branching slightly below, resembling those of *Ramalina*. The spermatia are oblong, with

* The other genera of the *Lecanorei* will be found included in my Memoir on the Spermogones and Pycnides of *Crustaceous* Lichens. *Vide* foot-note, p. 280.

† A good account of the minute structure of its spermogones will be found in BORNET'S " Recherches sur la Structure de *Ephebe pubescens*, Fr." *Annales des Sciences Naturelles*, 3d Ser. Botanique, vol. xviii., 1852, p. 161.

truncate ends, given off as terminal cells or articulations from the apices of the sterigmata.

Specimen 1.—Mr HARRIMAN,—probably from some of the northern counties of England, though no habitat is given; in Herb. Hooker, Kew. The spermogones are abundant as small, but, under the lens, distinct, spherical swellings of, or tubercles attached to, the filaments or segments of the thallus; they are of a brown colour, while the thalline filaments are of a deep bottle-green. The spermatia are sub-ellipsoid, about $\frac{1}{6000}$ th to $\frac{1}{7000}$ th long, and $\frac{1}{20,000}$ th broad, given off from the tips of delicate, linear, simple sterigmata, about $\frac{1}{1500}$ th to $\frac{1}{1000}$ th long, and of equal breadth with the spermatia. Some of the sterigmata, especially in old spermogones, become elongated and hypertrophied, projecting into the free cavity of the spermogone as in *Ramalina*, and in many *Parmeliæ*. NYLANDER has seen the same phenomenon, but he describes it as an abnormal condition. On this subject, I would only refer to what I have already said under the head of *Placodium circinatum* (p. 263). *Ephebe pubescens* is sometimes confounded with *Parmelia lanata*, to which it certainly bears a considerable resemblance. This mistake has occurred in Herb. Menzies, Royal Botanic Garden, Edinburgh (*pro parte*). The character of the apothecia, the stronger segments of the thallus, and the different spermogones, will at once, however, serve to distinguish the two plants.

GENUS II. LICHINA, Ag.

The spermogones of *Lichina*, to a certain extent, resemble those of *Ephebe*; but they are greatly larger. They are seated in spherical or ovoid dilatations of the ramuscles or segments of the thallus. Where they are placed below the apothecia, as in *L. pygmaea*, they appear mere dilatations of the thalline ramuscle as in *Ephebe*; where they are terminal, as in *L. confinis*, they appear large barrel or tub shaped bodies, resembling the spermogones of *Cladonia*, except in that they are much larger. In the latter species, also, they are sometimes seated directly on the apothecia, as also happens occasionally in *Cladonia rangiferina*; in such circumstances they are barrel-shaped, more so than when they form horn-like terminations to the thalline ramuscles. The ostiole is usually very minute and inconspicuous. The cavity is generally divided into sinuous compartments. The spermatia are ovoid or ellipsoid, about $\frac{1}{7000}$ th to $\frac{1}{12,000}$ th long, and $\frac{1}{20,000}$ th broad, seated on the ends of linear, simple sterigmata, about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long, subramose at the base as in *Ramalina*. The presence of these spermogones is a strong reason, among many others, for dissociating this genus from the *Algae*, and placing it permanently among the *Lichens*.

SPECIES I. *L. pygmaea*, Ag.

The spermogones, in specimens which I have examined, are terminal, occupying the same relative position as the apothecia. They are spherical, large,

prominent bodies, seated like horns on the ends of the thalline ramuscles. NYLANDER likewise describes the spermogones as terminal; but TULASNE describes and figures them as seated immediately below the apothecia, and on the same ramuscles therewith. The cavity of the spermogone is divided into compartments, which are very tortuous and narrow. The spermatia are oblong, and imbedded in abundant mucilage.

Specimen 1.—LEIGHTON exs. 260; Torquay, Devonshire. The plant appears to be spermogoniferous only: no apothecia are found; but the very plentiful spermogones closely resemble apothecia. They are seated at the angles of the fastigiate extremities of the thalline segments as very large and prominent spherical bodies of the same colour as the thallus. The ostiole is very minute and imperceptible. The spermogonal wall or envelope consists of large, oblong cells, of an olive-brown colour, closely aggregated into a compact cellular tissue. By placing the ends of any of the thalline segments, bearing spermogones, between glass slides in water, and applying pressure, under the microscope, the spermatia may be seen issuing from the spermogonal ostioles in myriads. They are ellipsoid or oval corpuscles, about $\frac{1}{12,000}$ th long, and $\frac{1}{20,000}$ th broad, or almost atomic as to size, and are given off from the ends of simple, linear sterigmata, about $\frac{1}{1500}$ th long, and branching below.

SPECIES 2. *L. confinis*, Ag.

According to TULASNE, the spermogones of this species are either terminal, occupying the position I have described those of the preceding species to occupy, or they are seated immediately on the apothecia. They are smaller than those of *L. pygmæa*. The position on the apothecia may be supposed in this and other cases to favour the supposition that the contents of the spermogones exercise a direct, and probably a fertilizing, influence on the contents of the apothecia. But it must be remembered that this site is not a very usual one among the lichens. The spermatia are about $\frac{1}{7000}$ th long, and $\frac{1}{10,000}$ th broad, on sterigmata which measure about $\frac{1}{1000}$ th to $\frac{1}{1500}$ th long, and are linear and simple as in *L. pygmæa*.

SECTION II. COLLEMA Tribe.

GENUS I. SYNALISSA, DR.

This genus has the external aspect of *Collema*, both in regard to its thallus and spermogones. But the spermatia are developed from the apices only of very delicate, linear, simple sterigmata, which resemble those of *Ramalina*. The spermatia are among the smallest known, being about $\frac{1}{25,000}$ th long in *S. micrococca*; they are usually rod-shaped or ellipsoid.

SPECIES 1. *S. symphorea*, DC.,

(Syn. *S. lichenophila*, DR.,) which occurs equally in Africa and Europe. This

plant appears to include *Collema synalissum*, Ach. L. U. 640; *Synalissa Acharii*, Trevis, Hepp. exs. 89; *Collema stygium*, var. *incisum*, Schaer. Enum. 260. According to NYLANDER, this species is diceious,—the spermogones and apothecia occurring on separate plants. The spermatia are oblong, or oblong-ellipsoid, about $\frac{1}{8000}$ th long, and $\frac{1}{25,000}$ th broad, given off as terminal cells or articulations from the tips of very delicate, linear, simple sterigmata, precisely like those of *Ramalina*.

Specimen 1.—Sand-hills, Dunfanaghy, County Donegal, Ireland; Prof. DICKIE, 1858. About the name and nature of this plant, I am extremely diffident and doubtful. It occurs in very small patches, and only a few fragments were sent to me for examination. The apothecia are endocarpous, and constitute spherical bulgings at the ends of the laciniae; they somewhat resemble those of *Lichina pygmaea*. The spores are ellipsoid,—1–3 septate,—normally the latter. The spermogones appear also to be terminal, small, spherical bodies,—resembling outwardly, except as to size, the apothecia,—round which they are clustered. The spermatia are sub-ellipsoid, and very small. The sterigmata are not distinctly seen. In *S. micrococca*, a French species, the spermatia are atomic as to size, being about $\frac{1}{25,000}$ th long, and a little less in breadth, according to NYLANDER.

GENUS II. OMPHALARIA, DR. and Mont.

This genus closely resembles *Collema* in its thallus and in its spermogones,—in the latter, both as regards their site, appearance, and contents.

SPECIES 1. *O. pulvinata*, Schaer.,

Which appears to include *Collema stygium*, var. *pulvinatum*, Schaer. exs. 435.

Specimen 1.—Associated with *Pannaria triptophylla*, var. *nigra*; on limestone rocks about Yeadon, Yorkshire; coll. Dr CARRINGTON. Of this plant I am not at all sure. I have examined only a small fragment, and that not bearing apothecia. The spermogones are abundant on the tops of the turgid warts, which form, or occur on, the margins of the lobes. They are pale, brownish-yellow, immersed disks, distinct when moistened from the contrast of their colour with the dark bottle-green of the thallus. The spermatia are rod-shaped and small, and the sterigmata articulated, just as in *Collema*.

GENUS III. COLLEMA, Ach.

The spermogones of this genus are always immersed in the tissue of the thallus, and more or less inconspicuous, unless the thallus is moistened. In this case, they become frequently very distinct, from the contrast of their pale, brownish, or brownish-yellow colour, with the dark-green of the thallus. They are distinctly circumscribed, round, hard disks, when distributed on the flat surface of the thallus; when marginal,—seated on the crisped and sub-erect

margins of the lobes,—they are usually tubercles or warts, resembling frequently knobs or buttons. In the latter case, they give the margins of the thallus a denticulate or warted character. Sometimes, though rarely, they are found both on the sub-erect margins and on the flat surface of the thallus near the margin, as in some forms of *C. melcenum*. From their pale-yellowish or buff colour, and discoid form, they frequently resemble seeds imbedded in the thallus. Sometimes they are of a greenish tint, having acquired some of the colouring matter of the thallus. The size of the spermogones is pretty uniform; in *C. plicatile*, the breadth is $\frac{1}{150}$ th to $\frac{1}{160}$ th. The envelope is of a brownish or yellowish cellular tissue. The ostiole is generally brown, minute, and round,—central,—of a deeper colour than the rest of the organ. Sometimes it becomes, in the old state, patent and conspicuous. The spermogone is not easily enucleated, from its adhesion to the surrounding tissue of the thallus, especially when the latter is moistened and gelatinous. It is generally necessary, for the examination of the spermogones of *Collema* under the microscope, with a pair of very fine-pointed scissors to cut away a portion of the margin of the lobe, with one or more spermogones included, making the incision, if possible, through a spermogone. On subjecting such a section to pressure between glass slides, in a drop of water under the microscope, the emission of myriads of spermatia may be easily seen. These spermatia are in all cases short, rod-shaped, and with obtuse ends; they vary in length from $\frac{1}{4000}$ th to $\frac{1}{12,000}$ th,—the majority being about $\frac{1}{6000}$ th to $\frac{1}{8000}$ th long, with a breadth of $\frac{1}{20,000}$ th to $\frac{1}{25,000}$ th. The sterigmata, in all specimens examined by me, are articulated,—sometimes ramose,—about $\frac{1}{500}$ th to $\frac{1}{600}$ th long, composed of short, roundish, or cubical cells, with thinnish walls compared with the component articulations of the arthrosterigmata of *Sticta*.

SPECIES 1. *C. auriculatum*, Hoffm.

Specimen 1.—SCHLÆRER exs. 432 (sub *Parmelia granosa a. vulgaris*; on stones among moss, Switzerland. There are two specimens, neither of them bearing apothecia; on the right-hand specimen in my copy (original ed., 1842), spermogones occur. In external form, situation, and structure, they closely resemble those of *Leptogium saturninum*.

SPECIES 2. *C. flaccidum*, Ach.,

A widely-spread and familiar species, occurring in Europe, Asia, Northern America, and New Zealand. The fact of a variety *pyrenodes* being mentioned by FLOTOW shows that the spermogones of this species have not escaped the attention of the older lichenologists. He evidently alludes to the spermogones as his “Pseudo-peritheciis minutissimis, fusco-atris, vertice poro vertusis.”

Specimen 1.—On Aghalie Bridge, Lagan Canal, Ireland; D. MOORE; in Herb. Carroll; with apothecia. The spermogones are small, brownish-yellow disks, immersed in the substance of the thallus, and scattered about the margins of its

lobes, on their flat surface. They are conspicuous when moistened, amid the dark-green thallus.

Specimen 2.—Malham, Yorkshire; Dr CARRINGTON, 1857. The spermogones are brown disks or warts,—distinctly perforate or ostiolate on the apex,—scattered over the surface of the lobes among the apothecia, and resembling nascent apothecia.

Specimen 3.—Var. *furvum*, Stroove Head, County Donegal; Prof. DICKIE, 1852. This is a form with a furvous or granulate thallus; it includes *Collema rupestre*, Schærer exs. 412, and is probably also what NYLANDER describes as *C. furvum*. The spermogones are dotted about the margins of the lobes, on their flat surface. They are very minute, pale, brownish-yellow disks,—distinct when the thallus is moistened,—imbedded amid the dark-green tissue of the thallus. The spermatia are about $\frac{1}{12,000}$ th long, and $\frac{1}{20,000}$ th broad, rod-shaped, seated on the apices and sides of long arthrosterigmata.

SPECIES 3. *C. furvum*, Ach.,

Which occurs alike in Northern America and in Europe. This I regard simply as a variety of the preceding, characterised by the possession of a granulate and rough thallus.

Specimen 1.—SCHÆRER exs. 414 (sub *Parmelia rupestris* β . *furca*, c. *fuliginosa*); on stones and the trunks of trees, Switzerland. The spermogones closely resemble those of *Leptogium tremelloides*. They are round disks, of a yellowish or light-brown colour, with a deeper brown, central, punctiform ostiole. They are usually indistinct amid the deep-green thallus, unless when the thallus is moistened, and held up between the eye and the light. They are studded about the edges of the lobes, on their flat surface.

Specimen 2.—SCHÆRER exs. 499 (sub *Parmelia nigrescens* β . *conglomeratum*); on the trunks of various trees in the milder parts of Switzerland,—in my copy (original ed. 1843). The spermogones are as described in No. 1; they are much less distinct than in *Leptogium tremelloides*, on account of the very dark-green colour of the thallus, and its furfuraceous surface. The spermatia are rod-shaped, about $\frac{1}{10,000}$ th long, on arthrosterigmata about $\frac{1}{2,000}$ th to $\frac{1}{600}$ th long.

SPECIES 4. *C. melænum*, Ach.,

Also occurring, like the last, in Northern America and Europe, and including, as a variety, *C. cristatum*, Schær. Among its synonyms are *Collema marginalis*, Hook.; *Parmelia multifida* β . *marginalis*, Schær. En. 255, exs. 420; *Collema*, Körb. 409; *Lichen jacobaeifolius*, Bernhardi; and *Lichen marginalis*, E. B. The spermogones are immersed and discoid, as in the species already described. They may sometimes be mistaken for, or confounded with, a small parasitic *Sphaeria*, whose perithecia are similarly immersed. It is possible that WALL-

ROTH's *Thrombium bacillare*, and SCOPOLI's Pseudo-perithecia of *Collema multifidum* referred either to the *Spharia* in question, or to the ordinary spermogones of the species.

Specimen 1.—Clapham, Yorkshire; coll. Dr DEIGHTON, 1855; a beautiful large specimen, with abundant apothecia. The spermogones are abundant on the edges of the plicate sub-erect lobes as distinct brownish-red warts, easily distinguished when moistened, on account of the contrast of their colour with that of the dark blackish-green of the thallus.

Specimen 2.—Malham, Yorkshire; coll. Dr CARRINGTON; with apothecia. The spermogones are marginal, small, brownish-yellow tubercles, very distinct when moistened. The spermatia are rod-shaped and very small; the arthrosterigmata are short, broadish, and very irregular.

Specimen 3.—Deer Park, Belfast; Prof. DICKIE, 1851. The spermogones are very abundant roundish warts, of a pale brownish-yellow colour, distinct when moistened. They are chiefly marginal, but are also scattered over the flat surface of the lobes, towards their periphery.

Specimen 4.—Ben Bulbin, County Sligo; Prof. DICKIE, 1851. The spermogones are marginal, pale, brownish-yellow knobs or tubercles, but not very distinct even when moistened, as they partake somewhat of the deep dull-green colour of the thallus. The spermatia are rod-shaped, about $\frac{1}{10,000}$ th long, and $\frac{1}{20,000}$ th broad, seated on longish arthrosterigmata.

Specimen 5.—Appin, CARMICHAEL; in Herb. Hooker, Kew. The spermogones are marginal, pale, brownish-yellow or buff-coloured round disks, quite resembling small seeds, their colour contrasting well with the dark-green of the thallus. They are still more abundant and beautiful in specimens from Ireland, Sir THOMAS GAGE (sub nom. *C. crispum*), and from Choos, Pyrenees (sub nom. *C. marginale*, var. Ach.), without apothecia.

Specimen 6.—SCHÆRER exs. 420 (sub *Parmelia multifida* δ . *marginalis*); on sunny calcareous rocks, Switzerland. Spermogones occur on the left-hand specimen in my copy (original ed., 1842). They are plentiful on the edges of the lobes, to which they give a buttoned or toothed character. They are small brown tubercles, roundish or flattened, many of them having a distinct, deepish-brown ostiole. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long; the arthrosterigmata are pale-yellowish, thick, and irregular in outline.

Specimen 7.—Var. *cristatum*, Schærer exs. 417 (sub *Parmelia multifida* β . *cristata*); on calcareous rocks, Switzerland. The spermogones are marginal, grouped, small, distinct, roundish brown tubercles; there is no very perceptible ostiole. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long; the arthrosterigmata are very irregular in outline, and about $\frac{1}{42}$ th to $\frac{1}{500}$ th long.

Specimen 8.—Var. *jacobæfolium* (Syn. *Lichen jacobæfolius*, Bernhardt); with laciniae narrow and much cut or dissected. A specimen from Dr ACHARIUS, 1809,

in Herb. Hooker, Kew, has the curled edges of the laciniae studded over with very distinct, pale, brownish-yellow tubercle-like spermogones.

SPECIES 5. *C. plicatile*, Ach.,

Which occurs in Northern America and Europe. I am inclined to refer this species to *C. pulposum*.

Specimen 1.—HEPP. exs. 86; on the banks of the Lake of Zurich, Switzerland; with apothecia. The spermogones are reddish tubercles, seated on the margins of the lobes. Exs. 215 (sub *C. turgidum*, Ach.); on calcareous rocks, Switzerland. In the upper specimen, the spermogones are marginal, distinct tubercles, brownish-red, and with a perceptible ostiole. In the lower specimen, they are whitish or paleish-brown externally, yellow within. The spermatia of this species are rod-shaped, $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad.

SPECIES 6. *C. pulposum*, Ach.,

A widely-spread species, growing in Europe, Africa, Asia, and Northern America. Its spermogones are immersed disks or tubercles, brownish-yellow externally, whitish within. The ostiole, which is, in the young state of the spermogone, very minute, round, and inconspicuous, enlarges sometimes with age, until it forms a large irregular perforation or cavity. The edge of the thallus as well as the exciple of the apothecia are sometimes studded over with very conspicuous, ragged, deep perforations, which are the ostioles of old spermogones.

Specimen 1.—(Sub *C. chalazanum*, Ach.); in Herb. Hooker, Kew; no habitat given,—but apparently from Dr ACHARIUS. The turgid margins of the thalline lobes as well as the exciple of the apothecium are studded over with abundant spermogones, which are brownish-yellow or tawny-coloured round wartlets, conspicuous amid the deep leek-green tissue of the thallus. They bear on their apex a deep-brown papilla, which marks the ostiole; the former is frequently irregular in form. The papillæform ostiole expands with age into a large irregular perforation. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long, and $\frac{1}{25,000}$ th broad; another specimen, also in Herb. Hooker (sub nom. *C. crispum*, Nyl.), has the edge of the lobes profusely dotted over with spermogones.

Specimen 2.—Lisclash, Fermoy, Ireland; coll. T. CHANDLER; in Herb. Carroll. The spermogones are seated on the top of tumid marginal warts; they are, as usual, of a pale, brownish-yellow colour. The spermatia are rod-shaped, $\frac{1}{10,000}$ th long, and $\frac{1}{25,000}$ th broad. In specimens from Malham, Yorkshire, coll. Dr CARRINGTON, the spermogones are also seated on the tops of turgid marginal warts.

Specimen 3.—Var. *tenax*, LEIGHTON exs. 105 (sub *Collema limosum*, Ach.); Twycross, Leicestershire (E. B. Suppl. 2704, f. 1.) The spermogones are marginal, brownish-yellow, distinct, circumscribed from the surrounding green of the thallus.

Specimen 4.—Var. *tenax*. Hepp. exs. 87 (sub *Collema multiflorum*); on moss,

at the foot of old trunks of willows, Switzerland. The spermogones are tubercles of the same colour as the thallus, scattered upon the edges of the lobes. The envelope is of a deepish-brown cellular tissue. The spermatia are in myriads, rod-shaped, almost atomic as to size.

Specimen 5.—Var. *turgidum*, Schaerer exs. 433 (sub *Parmelia turgida*); on siliceous and calcareous stones, in sunny places, Switzerland. The spermogones are marginal, resembling young apothecia. I am also inclined to place here SCHÆRER'S exs. 434 (sub *Parmelia stygia* β . *orbicularis*), on calcareous rocks, at the Lake of Bienné. In this plant, also, the spermogones are marginal, and intermixed with the apothecia; they are dull-brown, small tubercles. The spermatia are rather longer than those in most of the species of *Collema* I have already described.

Specimen 6.—County Wicklow, Ireland, 1845; among moss; coll. MOORE, in Herb. Carroll. The spermogones are abundant on the margins of the lobes as small, pale-brown disks, distinct when moistened amid the dark leek-green of the thallus. The spermatia are $\frac{1}{8000}$ th long, and $\frac{1}{25,000}$ th broad, rod-shaped; the arthrosterigmata are longish, and about $\frac{1}{8000}$ th broad.

SPECIES 7. *C. crispum*, Ach.

This appears to me to belong to the preceding species; its spermogones and spermatia are the same. The spermogones, though usually of a brownish-yellow tint, are sometimes concolorous with the thallus.

Specimen 1.—LEIGHTON exs. 106 (sub *C. cristatum*, Ach., E. B. 834); near Shrewsbury, Shropshire. The spermogones are as described in *C. pulposum*. In a specimen in Herb. Hooker, Kew, the thallus is a mass of isidioid pulvinuli, many of them tipped with pale, brownish-yellow, discoid spermogones.

SPECIES 8. *C. cheileum*, Ach.,

Which occurs in Africa and Europe. This appears to include *C. crispum*, Schaerer exs. 425, and *C. plicatile*, Moug. and Nestler, 456. The thallus frequently bears a close resemblance to that of *C. melænum*.

Specimen 1.—On sand-hills, Dunfanaghy, County Donegal; Professor DICKIE, 1858. The spermogones are pale, brownish-yellow, round tubercles, fringing the margins of the dark-green, sub-erect lobes. In another specimen from the same locality, they are scattered on the flat surface of the lobes, near their margin; they are distinct amid the dark-olive tissue of the thallus. The spermatia are rod-shaped, about $\frac{1}{8000}$ th long, and $\frac{1}{20,000}$ th broad.

Specimen 2.—On limestone, near Fermoy, Ireland; coll. T. CHANDLER; in Herb. Carroll. The lobes are erect—their margins thin, wavy, and crisped or denticulate from the presence of spermogones, which are small brownish-yellow buttons or disks. The spermatia are about $\frac{1}{9000}$ th long, and $\frac{1}{20,000}$ th broad, rod-shaped, on

longish arthrosterigmata. Similar spermogones occur, giving a denticulate character to the margins of the curled lobes, in specimens from Glencairn Deer Park, coll. D. MOORE, in Herb. Carroll. In specimens from near Galway, on limestone rocks, coll. D. MOORE, in Herb. Carroll, and Black Rock, Cork, on limestone, coll. CARROLL, the spermogones are more or less closely aggregated.

SPECIES 9. *C. microphyllum*, Ach.

Specimen 1.—SCHÆRER exs. 411 (sub *Parmelia nigrescens* *ε. microphylla*, Sch.); on the trunks of trees, Switzerland; with apothecia. The spermogones are small light-brown or yellowish tubercles, scattered near the edges of the lobes, on their flat surface. They somewhat resemble those of *Leptogium tremelloides*. The spermatia are rod-shaped, $\frac{1}{4000}$ th to $\frac{1}{6000}$ th long.

SPECIES 10. *C. nigrescens*, Ach.,

A widely-spread species, which occurs in Europe, Asia, America, Polynesia, and New Zealand.

Specimen 1.—HEPP. exs. 216 (sub *Synechoblastus vespertilio*, Lightf. Syn. *Collema nigrescens a. vespertilio*, Schær. exs. 410; Moug. and Nestler, 164, p.p. and 453; Leight. exs. 104); on the bark of old fruit-trees. In the right-hand specimen in my copy, spermogones occur. They are wholly immersed, and are externally of the same colour as the thallus, except the ostiole, which is of a pale-brown colour and round. The ostioles pierce the apices of the thalline papillæ, which are seated external to the region occupied by the apothecia. The spermatia are rod-shaped, about $\frac{1}{6000}$ th to $\frac{1}{5000}$ th long, seated on ramose, irregular arthrosterigmata.

SPECIES 11. *C. multipartitum*, Sm.

This European species seems closely allied to NYLANDER'S *C. laciniatum*, from Alabama.

Specimen 1.—Dunkerron; coll. TAYLOR; in Herb. Hooker, Kew. The specimen is bad, and in small detached fragments; the apothecia are young. The spermogones are abundant, scattered over the margins of the laciniae; seated on large, pale warts; sometimes confluent, and always more or less irregular.

SPECIES 12. *Collema? epiphyllum*, Leight.

Specimen 1.—LEIGHTON exs. 103; on laurel and other leaves, Gopsall, Leicestershire. There are here two distinct plants. The one occurs in small round scales, gelatinous when moistened, becoming, in progress of growth, palmate and divided irregularly. This plant has quite the aspect of *Collema* externally, but has not its structure internally. Neither has it distinct apothecia, thecæ, spores, nor spermatia. The other plant is a granular, blackish mass, occurring in round patches of varying size. It possesses *Pycnides*, but neither apothecia

nor spermogones. These Pycnides are quite superficial, removeable by the slightest touch; they are minute black perithecia, resembling, on the one hand, the perithecia of many *Sphaeria*, and, on the other, the spermogones of many *Verrucariae* and *Graphideae*. They are probably referrible to some Fungus, whose primary fruit does not occur in the specimens examined by me. The stylospores are plentiful, ellipsoid, pale-yellow, simple, about $\frac{1}{6000}$ th long, and $\frac{1}{5000}$ th broad. The sterigmata are very short, linear and simple. The envelope is of a deep brown. Both plants are altogether anomalous in their characters; and until I have further opportunities of examining them, I do not know where most appropriately to place them.

GENUS IV. LEPTOGIUM, Fr.

As a general rule, in regard to site, external appearance, and internal structure or contents, the spermogones of this genus are precisely those of *Collema*. Nor am I aware of any very valid reason for dissociating *Leptogium* from *Collema*, as is done by NYLANDER and other modern authors. From the thallus in *Leptogium* being frequently more delicate and diaphanous than in *Collema*, and often of a beautiful pale-blue, or bluish-green colour, it is generally easier to see and examine the spermogones in the former than in the latter genus. This is especially the case in *Leptogium tremelloides* and its congeners, which possess the most beautiful and easily studied spermogones in the whole family of the Collemata. The spermogones of *Leptogium* are always immersed, flattened disks, resembling double convex lenses, of a pale brownish-yellow colour, with a central, round, very minute, brownish ostiole. The ostiole, though usually in the mature and young state of the spermogone punctiform, becomes comparatively large and patent in *L. saturninum*, in which it sometimes gives to the spermogone the aspect of a young apothecium. The spermogones of *Leptogium* are more frequently seated on the flat surface of the lobes, near their margin, less often seated on the margins themselves, than in *Collema*. In *L. subtile*, they are marginal, giving a denticulate character to the edges of the lobes, as in many *Collemas*. In *L. fragile* and *L. phyllocarpum*, they occur both on the margins and on the flat surfaces of the lobes, near their margins. Some forms of the beautiful *L. tremelloides* have distinctly denticulate lobes, from the presence of marginal spermogones, though generally, in this species, these organs are scattered over the flat surface of the lobes, near their periphery or margins. In *L. tremelloides*, the marginal spermogones are sometimes distinct largish cones, with a brown apical ostiole. The plant then resembles somewhat variety *denticulata* of *Parmelia perforata*. In this form of *L. tremelloides*, the body of the spermogone sometimes falls out in age, leaving small cup-like cavities, which give to the margin of the thallus a notched and very irregular character. The spermatia and sterigmata in *Leptogium* are precisely those described as belonging to *Collema*.

SPECIES 1. *L. fragile*, Tayl.

Specimen 1.—On limestone, probably from Dunkerron, Ireland; coll. TAYLOR himself; in Herb. Carroll (Syn. *Collema fragile*, Tayl., “Fl. Hib.” 109; Schær. Enum. 259). The plant is allied to *L. cretaceum*, but its thallus is much larger. TAYLOR remarks, “Marginal lobes rough with wrinkles and granules;” and again, “their upper surface rough with granules, concolorous with the thallus, clustered, of different sizes, globular, yet flattened at the top.” The granules described so minutely by TAYLOR are the spermogones of the plant. These organs are scattered abundantly over the flat surface of the lobes of the thallus, towards its periphery, sometimes extending nearly to the centre of the thallus. They never fringe the margins of the lobes. They are pale, brownish-yellow, discoid, immersed bodies, precisely resembling those of the majority of the *Collemas*. They are very conspicuous when moistened, under the lens. The spermatia are rod-shaped, about $\frac{1}{10,000}$ th long, and $\frac{1}{20,000}$ th broad, on arthrosterigmata having the characters of those of *Collema*.

SPECIES 2. *L. subtile*, Nyl.,

Which includes, as a variety, *L. diaphanum*, Ach.

Specimen 1.—Var. *diaphanum*, Philippine Islands, CUMING; in Herb. Hooker, Kew (sub. nom. *Collema erythrophthalma*, Tayl.) The margins of the extremely delicate thalline lobes are fringed with very minute, pale, brownish-yellow spermogonal warts, which constitute a series of teeth or denticulations, resembling those met with in South American forms of *L. tremelloides*.

SPECIES 3. *L. tremelloides*, Fr.,

A cosmopolite and very beautiful species, which includes, as varieties, the *L. azureum*, *L. marianum*, and *L. marginellum* of authors.

Specimen 1.—On trees, Muckcross Woods, Killarney, Ireland; coll. CARROLL; with apothecia. This is one of the best species of *Leptogium* in which to study its spermogones. In this specimen, however, they are well seen only when moistened. They are abundant, resembling grains of mustard-seed, studded along the edges of the lobes; their colour is of a pale brownish-yellow, which contrasts strongly with the dark leaden-gray of the thallus. Each spermogone is pierced centrally by a very minute pore or ostiole. The spermatia are rod-shaped, about $\frac{1}{12,000}$ th long, and $\frac{1}{25,000}$ th broad.

Specimen 2.—Graham’s Town, Cape of Good Hope; in Herb. Hooker, Kew. The spermogones are scattered outside the region of the apothecia, on the flat surface of the thallus, not on its margins. They are aggregated or grouped in considerable numbers as small, regular, roundish or flattened warts or papillæ, concolorous with the thallus. The body of the organ is semi-immersed only, and consists of a hard, whitish kernel; the ostiole is minute, punctiform, and

brown. The spermatia are rod-shaped, about $\frac{1}{7000}$ th long, and $\frac{1}{25,000}$ th broad; the arthrosterigmata are about $\frac{1}{370}$ th long.

Specimen 3.—Schooley's Mountains, North America, June 1856; coll. Dr A. O. BRODIE. The spermogones are easily mistaken for young apothecia; they form small, slightly elevated, flattened tubercles on the surface of the thallus, about its periphery. They somewhat resemble grains of sago; are very distinct, from the contrast of their pale colour with the dark-green of the thallus; and are roundish and hard, having an obscure, minute ostiole. The spermatia are rod-shaped, about $\frac{1}{7000}$ th long, on arthrosterigmata resembling those of *Collema*.

Specimen 4.—SCHÆRER exs. 260, associated with *Nephromium tomentosum*, var. *helveticum*, Black Forest, Switzerland; coll. HOCHSTETTER. The spermogones are plentiful about the margins of the lobes of the thallus. They are distinctly circumscribed, palish-yellow or whitish disks, round, flattened, with a distinct brown punctiform ostiole.

Specimen 5.—South America, HUMBOLDT; in Herb. Hooker, Kew (sub nom. *Collema olivaceum*, Hook.) The thallus is very delicate, diaphanous, and of an olive-green colour; the lobes are large and rounded. The margins are beautifully denticulate, being fringed with spermogones, which look like so many minute teeth. These organs are small but well-formed cones, each marked with a brown, punctiform, apical ostiole. The cones are distinctly circumscribed; the base of the buff-coloured spermogone not passing into, but being clearly distinguishable from, the deep leek-green colour of the thallus. The body of the spermogone sometimes falls out, and then small cups or cavities are left, which give to the margins of the thallus an irregularly notched character. The spermatia are rod-shaped, about $\frac{1}{8000}$ th long, and $\frac{1}{20,000}$ th broad; the arthrosterigmata are about $\frac{1}{300}$ th long.

SPECIES 4. *L. phyllocarpum*, Pers.,

Which is common in tropical countries.

Specimen 1.—On bark, St Vincent, West Indies; in Herb. Hooker, Kew. The margins of the lobes are studded over with distinct, small, brownish-yellow spermogones, of the character of the marginal spermogones of *Collema*. Similar spermogones occur plentifully in specimens from Surinam, ex. Herb. Miguel; also in Herb. Hooker (sub nom. *L. marginellum*, Mont.)

SPECIES 5. *L. saturninum*, Ach.

Specimen 1.—SCHÆRER exs. 423 (sub *Parmelia myochroa a. saturnina*); on the trunks of trees in the warmer parts of Switzerland. The spermogones are quite those of *L. tremelloides*, except that they are less distinct on account of the deeper colour of the thallus. They occur on the right-hand specimen in my copy (original ed., 1842). They abound on the margins of the lobes as pale disks, immersed, with a more or less distinct brown punctiform ostiole. The latter some-

times expands, with age, to such an extent as to give the spermogone the appearance of a young apothecium. The spermatia are rod-shaped, about $\frac{1}{6000}$ th long, on arthrosterigmata about $\frac{1}{600}$ th to $\frac{1}{500}$ th long. The spermogones and spermatia of *L. Hildenbrandii*, Garov., are similar to those just described.

GENUS V. OBRYZUM, *Wallr., Tul.*

This genus is represented by its single species, *O. corniculatum*, Wallr. It possesses angiocarpous apothecia, which are so small that they are very apt to be overlooked, unless very carefully sought for. The spermogones are also very small and inconspicuous; they are scattered about the ends of the lobes, and generally resemble those described under *Collema*. Their diameter is about $\frac{1}{200}$ th. The plant closely resembles *Leptogium palmatum*; but its angiocarpous apothecia distinguish it.

[The Author has embodied his Researches on the Spermogones and Pycnides of *Crustaceous* Lichens in a separate Memoir, similar in length to the foregoing Memoir, and illustrated by an equal number of drawings. This Memoir on *Crustaceous* Lichens will include one or two genera, such as *Endocarpon* and *Normandina*, which have not strictly a *crustaceous* thallus, but which, nevertheless, it would be inconvenient and unscientific to consider apart from their ally,—the extensive and important genus *Verrucaria*. It will also include the *Calicei* (genera *Sphinctrina*, *Calicium*, and *Coniocybe*), which are usually associated in classification with the *Spærophorei*, but which have a horizontal crustaceous thallus, on which the spermogones are seated, or in which they are contained or immersed.]

EXPLANATION OF PLATES*

ILLUSTRATIVE OF DR LAUDER LINDSAY'S MEMOIR ON THE SPERMOGONES AND
PYCNIDES OF LICHENS.

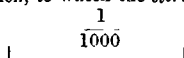
PLATE IV.

Illustrative of the genera USNEA, Hoffm. ; NEUROPOGON, Nees and Flot. ; ALECTORIA, Ach., Nyl. ;
and CHLOREA, Nyl.

- Fig. 1. *Usnea barbata*, Fr., var. *plicata*, Fr., from California ; showing the long pendulous ramules covered over with spermogonal warts.
- Fig. 2. Spermogones from the same specimen, more highly magnified.
- Fig. 3. *U. barbata*, Fr., from Tasmania ; showing spermogonal warts covering the cilia, which radiate from the margins of the apothecium.
- Fig. 4. *U. barbata*, Fr., var. *hirta*, Fr., from Rio Janeiro. Portion of thallus profusely covered with small spermogonal warts, most of which have black-punctate ostioles.
- Fig. 5. Spermogonal warts from the same specimen, more highly magnified.
- Fig. 6. *U. barbata*, Fr. Section of a spermogone, showing the ostiole *a* ; the multiple or compound cavity *b*, dividing into numerous anfractuosités, or compartments with sinuous walls ; *c*, the gonidic layer of the thallus ; *d*, the white medullary tissue, composed of delicate branching tubes ; *e*, the cortical layer of the thallus, consisting of closely aggregated irregular cells.
- Fig. 7. *U. barbata*, Fr. Sterigmata *a*, and spermatia *b*. Elongated, branching, delicate filaments, which project from among the spermatiferous sterigmata, *c* (in right-hand figure).
- Fig. 8. Sterigmata and spermatia of the same species, from a Tasmanian specimen. The letters *a*, *b*, have the same reference as in fig. 7.
- Fig. 9. *Neuropogon melaxanthus*, Ach. *a*, The black fusiform tips of the ramuscles, the seat of the compound or confluent spermogones.
- Fig. 10. Portion of one of the spermogoniferous ramuscles more highly magnified.
- Fig. 11. Sterigmata and spermatia of *N. melaxanthus* ; specimen from Hermite Island, Cape Horn : *a*, sterigmata ; *b*, spermatia.
- Fig. 12. *Alectoria Taylori*, Hook., from Kerguelen's Land : *a*, apothecium ; *b*, *Lecidea alectoriae* mihi, dotted over the under surface of the apothecium, and over the surface of the thallus.
- Fig. 13. *A. Taylori*, showing the tips of the ramuscles, black and warted from the presence of the spermogones *b* ; *a*, an apothecium, young ; *c*, apothecia immersed, punctiform, and black, of *Lecidea alectoriae* mihi.

* The microscopical analyses were chiefly made with the combination of powers of Nacet's microscope (Petit modèle of 1851), which magnify 380 diameters.

The following is the scale of $\frac{1}{1000}$ th of an inch, to which the *sterigmata*, *spermatia*, and *stylospores* are drawn :—



The fragments of thallus bearing spermogones or pycnides are mostly magnified more or less, in order that these organs may be the more easily recognised. The sections of spermogones, which are mostly diagrammatic, are also variously magnified.

- Fig. 14. Portion of tip of one of the ramuscles—spermogoniferous—more highly magnified.
- Fig. 15. Section of the compound spermogones of *A. Taylora*: *a*, ostioles; *b*, cavity of spermogone.
- Fig. 16. Sterigmata *a* and spermata *b* of same species.
- Fig. 17. *Alectoria jubata*, Ach.; Schærer's "Lich. Helvet. exsic.," Nos. 392 and 496, showing the *pycnides* at the angles of the ramules.
- Fig. 18. Sterigmata and stylospores of same species: *a*, sterigmata or basidia; *b*, stylospores, still fixed or adherent to the sterigmata; *c*, free stylospores, apparently devoid of contents; *d*, free stylospores, with nucleiform contents.
- Fig. 19. *A. lata*, Tayl., Nyl., from Mexico. Sterigmata *a* and spermata *b*.
- Fig. 20. *Chlorea vulpina*, Nyl., from Germany, showing the black punctiform spermogones at *a*.
- Fig. 21. Portion of the same thallus more highly magnified, showing the spermogones more distinctly.
- Fig. 22. *Chlorea vulpina* growing on the *Wellingtonia gigantea* of California: *a*, punctiform spermogones; *b*, *Phacopsis vulpina*, Tul., parasitic on its thallus.
- Fig. 23. Portion of the thallus of *C. vulpina*, highly magnified, showing the small barrel-like or wart-shaped spermogones *a*.
- Fig. 24. Section of a spermogone of *C. vulpina*: *a*, ostiole; *b*, cavity; *c*, walls, consisting of sterigmata; *d*, gonidic layer of thallus; *e*, medullary tissue of thallus; *f*, cortical layer of thallus.
- Fig. 25. *C. vulpina*; Schærer exs., 390. }
 Fig. 26. *C. vulpina*; Rocky Mountains. } Sterigmata *a*; spermata *b*; basal cellular tissue *c*.
 Fig. 27. *C. vulpina*; Germany. }

PLATE V.

Illustrative of the genera EVERNIA, Ach., Nyl.; RAMALINA, Ach., Fr.; and THAMNOLIA, Ach., Schær.

- Fig. 1. *Evernia furfuracea*, Mann.; Schærer exs., 387. Portion of extremity of thalline segments: *a*, minute punctiform spermogones; *b*, brown tips of ramuscles, resembling spermogones of *Cladonia*; *c*, furfuraceous or isidioid warts of thallus.
- Fig. 2. *E. furfuracea*; Ingleborough, Yorkshire: *a*, punctiform immersed spermogones; *b*, brown tips of ramuscles, resembling the spermogones of *Cladonia*.
- Fig. 3. *E. furfuracea*; Schærer exs., 387. Sterigmata *a*; spermata *b*; sterile elongated filaments of spermogone *c*; basal cellular tissue *d*.
- Fig. 4. *E. furfuracea*; Orizaba, Mexico. Sterigmata *a* and spermata *b*.
- Fig. 5. *E. Richardsoni*, Hook. Portion of thallus magnified, showing the marginal spermogones, resembling those of *Cetraria Islandica*: *a*, seated on marginal processes; *b*, immediately marginal.
- Fig. 6. *Ramalina calicaris*, Fr., var. *fraxinea*, Fr. (= *ampliata* of authors), Hepp. exs., 167: *a*, apothecia; *b*, wart-like spermogones.
- Fig. 7. Portion of the thallus more highly magnified, showing the very irregular spermogones, and their pale ostioles *a*.
- Fig. 8. Section of the thallus of same species, showing spermogones *a* in different stages of development; *b*, ostioles.
- Fig. 9. *R. calicaris*, var. *fraxinea*. Sterigmata *a*, spermata *b*, and network of elongated branching filaments *c*, which fill the spermogonal cavity; basal cellular tissue *d*.
- Fig. 10. *R. calicaris*, var. *fraxinea*. Section of a spermogone: *a*, ostiole; *b*, cavity divided into several compartments, with sinuous walls; *c*, inner wall of spermogone, consisting of sterigmata; *d*, gonidic layer of thallus; *e*, medullary tissue; *f*, cortical layer of thallus.
- Fig. 11. *R. calicaris*, var. *fraxinea*, Schærer exs., 554. Sterigmata *a* and spermata *b*.
- Fig. 12. *R. ceruchis*, Ach.; Chili. Sterigmata *a* and spermata *b*.

- Fig. 13. *Ramalina scopulorum*, Ach.; Leighton exs., 2. Portion of thallus, showing *a*, apothecium; *b*, irregular wart-like spermogones, mostly with black-punctate ostioles.
- Fig. 14. *R. scopulorum*, Schærer exs., 554. Sterigmata *a* and spermatia *b*.
- Fig. 15. *R. polymorpha*, Ach.; Leighton exs., 73. Thallus very much warted with confluent spermogones *a*.
- Fig. 16. *R. terebrata*, Tayl. Flat thalline segments covered with irregular spermogonal warts.
- Fig. 17. Portion of thallus more highly magnified to show the irregular spermogonal warts, and their pale ostioles *b*.
- Fig. 18. Sterigmata *a*, spermatia *b*, sterile branching filaments *c*, which occupy the cavity of the spermogone in the same species; basal cellular tissue *d*.
- Fig. 19. *Thamnolia vermicularis*, Schær., Falkland Islands, dotted over with the parasitic *Lecidea vermicularia mihi a*.
- Fig. 20. *T. vermicularis*, Schærer exs., 86; bearing large, distinct, wart-like spermogones *aa*.
- Fig. 21. Some of the same spermogones more highly magnified, showing the very pale, inconspicuous, stellate-fissured ostiole *a*.
- Fig. 22. Section of one of the same spermogones: *a*, ostiole; *b*, cavity; *c*, inner wall formed of articulated sterigmata; *d*, gonidia; *e*, medullary tissue of thallus; *f*, cortical tissue of thallus.
- Fig. 23. Sterigmata *a* and spermatia *b* from same specimen (Schær. exs., 86).
- Fig. 24. Section through the thallus of *T. vermicularis*, showing the immersed apothecia of *Lecidea vermicularia*: *a*, with a convex surface; *b*, with a flat or sub-depressed surface; *c*, young, not yet bursting through the cortical layer of thallus.
- Fig. 25. Spores of *Lecidea vermicularia*; Falkland Islands.

PLATE VI.

Illustrative of the genera ROCCELLA, Bauh.; DACTYLINA, Nyl.; DUFOUREA, Ach., Nyl.; ACROSCYPHUS, Lév., Tul.; STEREOCAULON, Schreb.; and SPILÆOPHORON, Pers.

- Fig. 1. *Roccella fuciformis*, Ach., dotted over with black, punctiform, immersed spermogones.
- Fig. 2. Portion of the thallus more highly magnified, showing some of the spermogones to be papillæform; the black ostiole seated on the apex of a thalline papilla.
- Fig. 3. *R. fuciformis*, Ach.; Schærer exs., 553. Portion of the thallus magnified, showing the confluent ostioles, seated on the apices of large, irregular, thalline papillæ.
- Fig. 4. *R. fuciformis*, Ach.; west coast of Africa; used in the manufacture of Orchil by Messrs Robinson, Huddersfield. Portion of thallus magnified, showing the punctiform spermogones scattered alike over the apothecia *a* and thallus.
- Fig. 5. Section through the spermogones of *R. fuciformis*, showing their papillæform character, and the frequently depressed ostiole *a*.
- Fig. 6. Sterigmata and spermatia of *R. fuciformis*, Ach.; Africa.
- Fig. 7. *R. tinctoria*, Ach. Thickest Lima "Orchella Weed." Portion of thallus, showing difform apothecia *a*, and punctiform or sub-papillæform spermogones *b*.
- Fig. 8. Section through same spermogones, showing the depressed form of ostiole *a*.
- Fig. 9. Portion of thallus of same species magnified, showing the papillæform spermogones *a*.
- Fig. 10. Portion of thallus of same species magnified, showing a difform apothecium *a*, and confluent ostioles seated on large irregular thalline papillæ *b*.
- Fig. 11. Two spermogones of same species more highly magnified, showing the confluent ostioles *a*.
- Fig. 12. Sterigmata and spermatia of the same species. Figs. 8-12 are taken from Lima specimens of commercial Orchella Weed.
- Fig. 13. Sterigmata and spermatia from other specimens of *R. tinctoria*, Ach.
- Fig. 14. Free, curved, or twisted spermatia of the same species.

- Fig. 15. *Roccella Montagnei*, Bél.; Angola, Africa. Portion of thallus magnified, showing *a*, the ordinary punctiform immersed spermogones; *b*, large lecidine superficial spermogones; and *c*, cavities left by the falling out of the old lecidine spermogones.
- Fig. 16. Portion of the same thallus more highly magnified, showing the same punctiform or sub-papillæform spermogones *a*, and lecidine ones *b*.
- Fig. 17. Sterigmata and spermatia of same lichen. Some of the sterigmata *a* become degenerate and elongated with age. The cavity of the spermogone is occupied by a network of delicate ramose filaments *b*, resembling those of *Ramalina*.
- Fig. 18. *R. intricata*, Mont., from Coquimbo. Sterigmata and spermatia.
- Fig. 19. *R. mollusca*, Ach. (olim *Dufourea*), from Cape of Good Hope. Portion of thallus magnified, showing an apothecium *a*, and punctiform or papillæform spermogones *b*.
- Fig. 20. Sterigmata and spermatia of same species.
- Fig. 21. *Dufourea madreporiformis*, Ach., from Switzerland. Portion of thallus magnified, showing the punctiform spermogones *b*.
- Fig. 22. Sterigmata and spermatia of same species.
- Fig. 23. *Dactylina arctica*, Hook., collected during Franklin's first voyage to the Polar regions. Sterigmata and spermatia.
- Fig. 24. *Acrosyphus spherophoroides*, Lév., from Sikkim, Himalayas. Portion of end of one of the thalline ramuscles, showing the spermogone (and its ostiole) *a*, resembling that of *Spherophoron coralloides*, Pers.
- Fig. 25. Section of one of the spermogones of same plant. The letters have the same references as in fig. 30.
- Fig. 26. Sterigmata and spermatia of same plant.
- Fig. 27. *Stereocaulon ramulosum*, Sw., from Tasmania. Portion of the ultimate segments of the thallus, showing the roundish or wart-like spermogones *a*.
- Fig. 28. Some of the same spermogones, more highly magnified to show the stellate-fissured, indigo-blue-coloured ostiole *a*.
- Fig. 29. Section through one of the same spermogones: *a*, ostiole; *b*, body of the spermogone.
- Fig. 30. Section, much more highly magnified, through one of the same spermogones: *a*, ostiole; *b*, cavity, divided into numerous sinuous compartments; *d*, gonidia; *e*, medullary tissue of thallus; *f*, cortical layer of thallus.
- Fig. 31. Sterigmata and spermatia of same lichen.
- Fig. 32. Two fragments of the same lichen, showing the spermogones *b*, forming a sort of collar round the apothecia *a*.
- Fig. 33. *S. denudatum*, Flk., from Antrim, Ireland. End of a thalline ramuscle magnified, showing the crowded wart-shaped spermogones *a*.
- Fig. 34. Spermatia of the same plant, partly straight, partly curved.
- Fig. 35. *S. alpinum*, Laur.; Ben Nevis. End of a thalline ramuscle, showing the crowded wart-like spermogones *a*.
- Fig. 36. *S. paschale*, Fr., from near Bonhard, Perth. End of a thalline ramuscle, magnified to show the terminal wart-like spermogones *a*.
- Fig. 37. Some of the same spermogones more highly magnified, showing the stellate-fissured ostiole *a*.
- Figs. 38 and 39. Sterigmata and spermatia from specimens of *S. paschale*, from Bonhard.
- Fig. 40. *S. Argus*, Tayl., from Campbell's Island. Portion of end of one of the thalline ramuscles, showing an apothecium *a*, and a collar of wart-like spermogones *b*.
- Fig. 41. Portion of ends of thalline ramuscles of same plant magnified, showing terminal spermogones *a*, the segments bearing no apothecium.
- Fig. 42. Sterigmata and spermatia of same plant.
- Fig. 43. *Spherophoron compressum*, Ach., var. *australe*, Laur., from New Zealand. Portion of under-surface of thallus magnified, showing the round ring-like ostioles of the spermogones *a*.

- Fig. 44. *Sphaerophoron compressum*, Ach., var. *australe*, Laur., from New Zealand. Specimen resembling *S. coralloides*, Pers., in its terminal spermogones *a*.
- Fig. 45. *S. compressum*, Ach., from the Auckland Islands. Portion of end of one of thalline segments, magnified to show the apothecia *a*, and the grouped spermogones *b*.
- Fig. 46. Portion of a ramuscle, bearing spermogones *a*, still more highly magnified.
- Fig. 47. *S. compressum*, Ach., from Tasmania. Sterigmata and spermatia, with the network of elongated ramose filaments, which occupy the cavity of the spermogone *a*.
- Fig. 48. *S. coralloides*, Pers., from Cleveland, Yorkshire, showing abundance of terminal papillæ-form brown spermogones *a*.
- Fig. 49. Tip of one of the spermogoniferous ramuscles more highly magnified, showing the ostiole *a*.
- Fig. 50. Section of one of the spermogones. The letters have the same references as in fig. 30.
- Fig. 51. Sterigmata and spermatia of same species.
- Fig. 52. *S. fragile*, Pers., from Craig-y-Barns, Dunkeld. Portion of the thallus, showing the same terminal spermogones *a* as in *S. coralloides*, Pers.
- Fig. 53. *S. tenerum*, Laur., from Hermite Island, Cape Horn. Portion of thallus magnified, showing the grouped spermogones *a*.

PLATE VII.

Illustrative of the genus CLADONIA, Hoffm.

- Fig. 1. *Cladonia deformis*, Hoffm., from Ben Nevis. Portion of a podetium, showing the barrel-shaped spermogones *a*.
- Fig. 2. The same spermogones isolated and much more highly magnified: *a*, ostiole.
- Fig. 3. Section of one of the same spermogones: *a*, ostiole; *b*, cavity; *c*, inner wall of spermogone consisting of sterigmata; *d*, gonidia; *e*, medullary tissue; *f*, cortical layer of thallus.
- Fig. 4. *C. deformis*, Schærer exs., 49. Podetium, showing *pycnides* *b*, black, punctiform, immersed.
- Fig. 5. *C. bellidiflora*, Schær.; Ben Nevis. Portion of a podetium, showing brown barrel-shaped spermogones *a*.
- Fig. 6. One of the thalline folioles, with its spermogone more highly magnified: *a*, ostiole; *b*, body of spermogone.
- Fig. 7. *C. bellidiflora*, Ben Nevis: *a*, apothecium; *b*, terminal spermogones resembling those of *C. rangiferina*.
- Fig. 8. *C. bellidiflora*, Schærer exs., 39. Spermogones *a*, on a scyphus *b*.
- Fig. 9. Three of the same spermogones highly magnified: *a*, ostiole; *b*, body of spermogone; *c*, thalline papilla.
- Fig. 10. A barrel-shaped spermogone, also highly magnified: *a*, ostiole; *b*, body.
- Fig. 11. *C. uncialis*, Hoffm.; Schærer exs., 82. End of a podetium, showing the terminal horn-like spermogones *a*.
- Fig. 12. Various-shaped spermogones of the same species magnified: *a*, ostiole; *b*, body.
- Fig. 13. Terminal spermogones *a*, on podetia resembling those of *C. rangiferina*.
- Fig. 14. *C. uncialis*, deformed from being the seat of *Lecidea cladoniararia* mihi, whose *pycnides*, *b*—black, punctiform, immersed—resemble spermogones: *a*, spermogones of *C. uncialis*.
- Fig. 15. Section of deformed bullose portions of thallus of *C. uncialis*, from Birnam Hill, Dunkeld, showing the immersed *pycnides* of *Lecidea cladoniararia* mihi: *a*, old; *b*, young.
- Fig. 16. Sterigmata *a*, and stylospores *b*, of above *pycnides*: *c*, free stylospores, some of them with oily contents.
- Fig. 17. *C. aggregata*, Sw., Eschw. Portion of thallus, showing the terminal barrel-like spermogones at *a*.
- Fig. 18. Portion of thallus, containing on same podetium apothecia *a*, and spermogones *b*.

- Fig. 19. Two of the barrel-shaped spermogones greatly magnified; *a*, ostiole; *b*, body.
- Fig. 20. *Cladonia aggregata*; New Zealand. Sterigmata *a*, spermatia *b*, elongated sterile filaments *c*.
- Fig. 21. Section of a spermogone: the letters have the same reference as in fig. 3.
- Fig. 22. *C. retipora*, Ach., Flk.; Tasmania. Portion of the cancellated thallus, showing the terminal horn-like spermogones at *a*.
- Fig. 23. Spermogones of the same, highly magnified: *a*, ostiole; *b*, body.
- Fig. 24. *C. rangiferina*, Hoffm.; Blaeberry Hill, Perth. Portion of the thallus, showing the terminal spermogones at *a*. Here they are *erect*.
- Fig. 25. Portion of thallus, showing spermogones *a*, on the *nodding* apices of the ultimate ramuscles.
- Fig. 26. Spermogones highly magnified: *a*, ostioles; *b*, body.
- Fig. 27. *C. rangiferina*, from Tasmania. Terminal spermogones *a*, very minute, and whole thallus very delicate and attenuated.
- Fig. 28. *C. rangiferina*; Long Island, U.S., America. Sterigmata *a*, spermatia *b*; sterile, elongated, branching filaments *c*, which occupy the cavity of the spermogone.
- Fig. 29. *C. rangiferina*; Tasmania. Sterigmata *a*, spermatia *b*, and elongated branching filaments *c*.
- Fig. 30. *C. rangiferina*; Long Island, U.S., America. Spermogones *a*, seated on the apothecium *b*.
- Fig. 31. Portion of thallus bulging and warted at *c*, the warts resembling spermogones; *a* and *b* refer as in fig. 30.
- Fig. 32. *C. amaurocraea*, Flk., var. *capitellata*, Bab.; New Zealand. Portion of thallus, showing *a*, terminal spermogones, and *b*, lateral spermogones; in both cases barrel-shaped and large.
- Fig. 33. Spermogones isolated and highly magnified: *a*, ostiole; *b*, body of spermogone.
- Fig. 34. Sterigmata *a*, and spermatia *b c*, of same species—*c* fixed, and *b* free spermatia.
- Fig. 35. *C. macilenta*, Hoffm.; Schærer exs., 337. Showing the barrel-shaped spermogones *a*, fringing the margin of a scyphus.
- Fig. 36. Sterigmata *a*, and spermatia *b*, of same species.
- Fig. 37. One of the spermogones highly magnified: *a*, ostiole; *b*, body.
- Fig. 38. *C. macilenta*; var. *cornuta*; Schærer exs., 337. Spermogones *a*, on margins of narrow scyphi, borne on the ends of long slender podetia.
- Fig. 39. *C. macilenta*, var. *polydactyla*, Flk.; Schærer exs., 454. Spermogones *a*, wart-like or barrel-shaped, fringing a scyphus.
- Fig. 40. *C. macilenta*; Schærer exs., 36. Spermogone terminal and isolated, on end of a long, delicate, linear podetium: *a*, ostiole; *b*, body.
- Fig. 41. *C. macilenta*; Schærer exs., 337. Sterigmata *a*, and spermatia *b c* [*b* fixed, *c* free].

PLATE VIII.

Illustrative of the genus CLADONIA, Hoffm.

- Fig. 1. *Cladonia alpicornis*, Flk., from Craigie Hill, Perth; magnified: *a*, horizontal foliaceous thallus, bearing on its surface sessile, barrel-shaped spermogones *b*; *c*, a podetium, having the margin of its scyphi fringed with abortive spermogones.
- Fig. 2. One of the same spermogones isolated, showing the largish regular ostiole *a*.
- Fig. 3. *C. alpicornis*, Flk.; Leighton exs., 15. Under surface of horizontal thallus, dotted over with papilliform and punctiform pyrenides *a*.
- Fig. 4. Sterigmata *a*, and spermatia *b c*, of *C. alpicornis*; Schær. exs., 455; *b* fixed, *c* free spermatia.
- Fig. 5. Spermogones, *a*, fringing margin of scyphi of same plant; Leighton exs., 15.
- Fig. 6. *C. gracilis*, Fr., var. *cernicornis*, Ach., from Morchone, Braemar; *a*, horizontal foliaceous thallus; *b*, a podetium, terminating in a scyphus fringed with barrel-shaped spermogones *c*.

- Fig. 7. One of the same spermogones isolated and more highly magnified, showing ostiole *a*.
- Fig. 8. *Cladonia gracilis*, Fr., var. *cervicornis*, Ach., from Muckish Mountain, Ireland. A deformed podetium, studded over with abortive or degenerate spermogones *a*.
- Fig. 9. *C. gracilis*, Fr.; Schærer exs., 66: scyphus bearing *a*, apothecia, and *b*, barrel-shaped marginal spermogones.
- Fig. 10. One of latter more highly magnified: *a*, ostiole; *b*, body.
- Fig. 11. *C. gracilis*, Fr., from Tasmania. A barrel-shaped spermogone *a*, forming the apex of a long, slender, tapering podetium *b*.
- Fig. 12. *C. gracilis*, Fr.; Schærer exs., 641. Scyphi, showing marginal tooth-like spermogones *a*; *b* [in lower figure] an apothecium; *c* [in upper figure] a secondary sterile podetium.
- Fig. 13. One of the same spermogones more highly magnified: *a*, ostiole; *b*, body.
- Fig. 14. *C. gracilis*, Fr.; Falkland Islands. Degenerate and old sterigmata, becoming elongated and sub-ramose.
- Fig. 15. *C. gracilis*, Fr.; Schærer exs., 67. Sterigmata also old and degenerate, becoming elongated and ramose; their ramifications forming a network of filaments, which occupy cavity of old spermogone.
- Fig. 16. *C. pyxidata*, Fr.; Schærer exs., 53. A scyphus fringed with marginal barrel-shaped spermogones *a*.
- Fig. 17. Two of the same more highly magnified: *a*, ostiole; *b*, body.
- Fig. 18. *C. pyxidata*, Fr.; Schær. exs., 268. A scyphus bearing *a*, apothecia; and *b*, marginal spermogones.
- Fig. 19. Same plant. A barrel-shaped spermogone terminal on a slender tapering podetium: *a*, ostiole.
- Fig. 20. *C. pyxidata*, Fr.; Schærer exs., 58. A scyphus fringed with large marginal spermogones *a*.
- Fig. 21. The same species; Long Island, North America. A scyphus, bearing marginal spermogones *a*, and secondary tapering sterile podetia *b*.
- Fig. 22. *C. pyxidata*, Fr.; Sligachan, Skye. Surface, as well as margins, of scyphus, studded over with spermogones *a*.
- Fig. 23. Two of the same spermogones more highly magnified: *a*, ostiole; *b*, body.
- Fig. 24. *C. pyxidata*, Fr.; Dumfries. A scyphus bearing large marginal spermogones *a*.
- Fig. 25. Sterigmata *a*, and spermatia *b*, of the same plant.
- Fig. 26. *C. fimbriata*, Fr.; Schærer exs., 589. A scyphus bearing large marginal spermogones *a*.
- Fig. 27. *C. fimbriata*, Fr.; Schærer exs., 640. Sterigmata *a*, and spermatia *b c* [*b* fixed, *c* free].
- Fig. 28. *C. fimbriata*, Fr.; Derry, Ireland. Scyphus bearing an apothecium *a*, and spermogones *b*, both on its surface and margins.
- Fig. 29. Sterigmata *a*, and spermatia *b*, of the same plant.
- Fig. 30. *C. degenerans*, Flk.; Schærer exs., 274. Scyphus bearing marginal large spermogones *a*.
- Fig. 31. *C. cenotea*, Schær. Scyphus bearing marginal spermogones *a*.
- Fig. 32. *C. Papillaria*, Hoffm.; Schærer exs., 511. Irregular deformed podetia, studded over with horn-like or barrel-shaped spermogones *a*.
- Fig. 33. *C. Papillaria*, Hoffm.; Schærer exs., 512. Mature podetium, bearing confluent apothecia *b*; young podetia *c*; brown lecidine spermogones seated on the horizontal granulose thallus *a*.
- Fig. 34. *C. Papillaria*, Hoffm.; Schær. exs., 511 and 512. Sterigmata *a*, and spermatia *b c* [*b* fixed, *c* free]. In the right-hand figure the sterigmata are old and degenerate, becoming elongated and ramose.
- Fig. 35. *C. furcata*, Schær., var. *racemosa*, Schær. Portion of thallus, showing the terminal barrel-shaped spermogones *a*.
- Fig. 36. One of the same spermogones more highly magnified: *a*, the largish regular ostiole; *b*, body.

- Fig. 37. *Cladonia furcata*, Schær., var. *racemosa*, Schær. ; Dumfries. Sterigmata *a*, and spermatia *b c* [*b* fixed, *c* free].
- Fig. 38. Sterigmata *a*, and spermatia *b c* [*b* fixed, *c* free], from other specimens of the same plant. In the left-hand figure the sterigmata are old and degenerate *d*, bearing no spermatia.
- Fig. 39. *C. squamosa*, Hoffm. ; Glen Callater, Braemar. Portion of thallus, showing terminal spermogones at *a*, and sessile ones scattered indiscriminately over the podetium at *b*.
- Fig. 40. *C. squamosa*, Hoffm. ; Schær. exs., 74. A scyphus, bearing marginal large barrel-shaped spermogones *a*, and secondary scyphi, which are fringed with small, tooth-like, abortive spermogones *b*.
- Fig. 41. The same plant ; Schær. exs., 73. Portion of the end of a podetium, showing an apothecium *a*, and terminal barrel-shaped spermogones *b*.
- Fig. 42. *C. squamosa*, Hoffm., var. *cœspititia*, Ach. Portion of thallus, bearing an apothecium *a*, and several sessile barrel-shaped spermogones *b*.
- Fig. 43. One of the same spermogones more highly magnified : *a*, ostiole ; *b*, body.

PLATE IX.

Illustrative of the genera UMBILICARIA, Hoffm. ; PELTIGERA, Hoffm. ; NEPHROMIUM, Nyl. ; SOLORINA, Ach. ; CETRARIA, Ach., Nyl. ; and PLATYSMA, Hoffm., Nyl.

- Fig. 1. *Umbilicaria hyperborea*, Hoffm., var. *convoluta* mihi ; Brandon Mountain, Ireland. Portion of thallus, showing *a*, apothecia ; *b*, spermogones, perched on the summit of the thalline convolutions or papillæ.
- Fig. 2. Section through thallus showing the said convolutions *a*, and spermogones *b*.
- Fig. 3. Two of the thalline papillæ *b*, with spermogones *a* on their apices ; *c*, ostiole.
- Fig. 4. Section of a spermogone : *a*, ostiole ; *b*, cavity ; *c*, inner wall of spermogone, consisting of sterigmata ; *d*, gonidia ; *e*, medullary tissue of thallus ; *f*, cortical tissue of thallus.
- Fig. 5. *U. hyperborea*, var. *convoluta* mihi. Sterigmata *a*, and spermatia *b*.
- Fig. 6. *U. polyphylla*, Hoffm. ; Braemar. Polyphyllous thallus, showing the minute papillæform black spermogones *a*.
- Fig. 7. Section of the thallus, showing the immersed spermogones *a*.
- Fig. 8. *U. cylindrica*, L., Fr. ; Muckish Mountain, Ireland. Showing the minute black punctiform spermogones *a*.
- Fig. 9. *U. cylindrica* ; Ben Lawers. Showing largish papillæform spermogones *a*.
- Fig. 10. The same ; showing *a*, an apothecium, and *b*, wart-like spermogones, with large black ostioles.
- Fig. 11. *U. cylindrica* ; Braemar. Portion of thallus, showing largish punctiform ostioles *a* of spermogones, each ostiole forming the centre of a black spot or areola.
- Fig. 12. *U. cylindrica* ; Braemar. Ostioles *a*, with their surrounding areolæ *b*, isolated and greatly magnified.
- Fig. 13. Section of thallus, showing immersed spermogones *a*. At *b* the spermogones have fallen out, and have left saucer-like cavities.
- Fig. 14. *U. cylindrica* ; Ben Lawers. Section of thallus, showing spermogones *b*, with stellate-fissured large ostioles *a* ; *c*, fibrillæ or fixuræ of under surface of thallus.
- Fig. 15. Section through thallus, in another specimen of same species, showing the papillæform spermogones *a*.
- Fig. 16. Section through thallus, in another specimen, also showing sub-papillæform spermogones *a*.
- Fig. 17. Section through thallus, in another specimen, showing spermogones with depressed ostioles *a*.
- Fig. 18. *U. proboscidea*, DC. ; Lochnagar. Monophyllous thallus, showing sub-papillæform spermogones *b* ; *a*, umbilicus or point of adhesion.
- Fig. 19. Section through thallus, showing papillæform spermogones *a*.
- Fig. 20. *U. polyrrhiza*, L. ; Lochnagar. Monophyllous thallus, showing papillæform spermogones *a*.

- Fig. 21. Section through thallus, showing the immersed spermogones *a*.
- Fig. 22. *Umbilicaria erosa*, Hoffm. Monophyllous thallus, showing the minute, black, papillæform spermogones *a*.
- Fig. 23. Section through thallus, showing the immersed spermogones *a*.
- Fig. 24. *U. hirsuta*, DC.; Hepp. exs., 117. Portion of thallus, showing *a*, apothecia; *b*, papillæform spermogones; *c*, marginal cilia of thallus; *d*, cavities with irregular edges, left by the falling out of the apothecia.
- Fig. 25. Section through thallus, showing *a*, an apothecium; *b*, immersed spermogones.
- Fig. 26. *U. papulosa*, Ach.; Schooley's Mountains, North America. Specimen showing *a*, apothecia; *b*, spermogones,—very minute, black, punctiform, frequently seated on the pustules of the thallus.
- Fig. 27. Section through thallus, showing *a*, an apothecium; *b*, immersed spermogones.
- Fig. 28. *Nephromium tomentosum*, Hoffm.; Schær. exs., 259. Portion of margin of thallus, showing marginal spermogones: *a*, papillæform; *b*, wart-like; *c*, young.
- Fig. 29. Section of one of the same spermogones: *a*, ostiole; *b*, body of spermogone.
- Fig. 30. Portion of margin of thallus of another specimen of the same plant (Schær. exs., 259), showing the spermogones *a*, seated on the ends of digitate processes.
- Fig. 31. *N. tomentosum*, Hoffm.; Sikkim, Himalaya. Large barrel-shaped spermogones *b*, perched on the apices of digitate processes *c*, of margin of thallus: *a*, ostiole.
- Fig. 32. Two of the same spermogones more highly magnified: *a*, ostiole.
- Fig. 33. Section of one of the same spermogones: *a*, ostiole; *b*, cavity; *c*, sterigmata; *d*, gonidia; *e*, medullary tissue of thallus; *f*, cortical layer of thallus.
- Fig. 34. Sterigmata and spermatia of same plant.
- Fig. 35. *Solorina saccata*, Ach., bearing on its surface *Sphaeria urceolata*, *a*; Hepp. exs., 475.
- Fig. 36. *Cetraria Islandica*, Ach. Portion of thallus, showing the marginal cilia *a*, which bear the spermogones.
- Fig. 37. Portion of same thallus magnified, showing the same cilia and the barrel-shaped spermogones *a* at their tips.
- Fig. 38. The same spermogones still more highly magnified: *a*, ostiole.
- Fig. 39. Portion of thallus of another specimen of the same plant, showing abortive marginal cilia *a*.
- Fig. 40. Sterigmata and spermatia from different specimens of *C. Islandica*.
- Fig. 41. *C. aculeata*, Fr.; spermogones highly magnified: *a*, ostiole.
- Fig. 42. *Platysma nivale*, L.; Leight. exs., 43. Portion of thallus, showing the black, wart-like, marginal spermogones *a*.
- Fig. 43. Portion of same thallus magnified, to show the same spermogones *a*, ostiole.
- Fig. 44. Section of one of the same spermogones. The letters have the same references as in fig. 33.
- Fig. 45. Sterigmata and spermatia from different specimens of *P. nivale*, L.
- Fig. 46. *P. sepinolum*, Hoffm.; Cleveland, Yorkshire. Thallus showing brown papillæform spermogones *a*.
- Fig. 47. Some of the same spermogones magnified: *a*, ostiole.
- Fig. 48. Sterigmata and spermatia of same lichen.
- Fig. 49. *P. cucullatum*, Hoffm.; Schær. exs., 18. Portion of thallus, showing the black, wart-like, marginal spermogones *a*.
- Fig. 50. Sterigmata and spermatia of same plant.
- Fig. 51. *P. juniperinum*, L.; Schær. exs., 20. Thallus showing the black, wart-like, marginal spermogones *a*.
- Fig. 52. Sterigmata and spermatia of same species.

PLATE X.

Illustrative of the genera PLATYSMA, Hoffm., Nyl.; RICASOLIA, DN., Nyl.; and STICTA, Ach.

- Fig. 1. *Platysma ciliare*, Ach.; Schooley's Mountains, North America. Showing the marginal denticulate spermogones *a*.
- Fig. 2. Portion of edge of thallus magnified, showing the barrel-shaped spermogones: *a*, ostiole.
- Fig. 3. Sterigmata *a* and spermata *b* of same species.
- Fig. 4. *P. lacunosum*, Ach., var. *β atlanticum*; Tuckerman exs., 6. Portion of thallus, showing the marginal button-shaped spermogones *a*.
- Fig. 5. Portion of edge of thallus, magnified to show the marginal spermogones *a*.
- Fig. 6. *Ricasolia herbacea*, DN., Inverary. Portion of thallus, showing *a*, apothecia; and *b*, papillæform or mammillæform spermogones.
- Fig. 7. Two of the spermogones more highly magnified, showing *a*, a simple ostiole; and *b*, a stellate-fissured ostiole.
- Fig. 8. Section of thallus, showing *a*, an apothecium; *b*, mammillar spermogones.
- Fig. 9. *R. herbacea*, from Sikkim, Himalayas. Portion of thallus, showing marginal tooth-like spermogones *a*, as well as the ordinary mammillæform ones *b*.
- Fig. 10. Two of the same marginal spermogones more highly magnified: *a*, ostiole.
- Fig. 11. *R. herbacea*. Sterigmata *a* and spermata *b*.
- Fig. 12. *R. glomulifera*, DN.; Inverary. Portion of thallus, showing *a*, apothecia; *b*, mammillæform spermogones; and *c*, a "glomerulus."
- Fig. 13. *Sticta glabra*, Tayl.; Falkland Islands. Portion of thallus, showing *a*, apothecia; and *b*, papillæform spermogones.
- Fig. 14. Sections through thallus, showing the spermogones in different phases of development: *a*, body of spermogone; *b*, papillæform ostiole.
- Fig. 15. *S. linearis*, Tayl.; Tasmania. Portion of thallus, showing *a*, apothecia; and *b*, brown punctiform immersed spermogones, scattered chiefly on the rugæ.
- Fig. 16. *S. damæcornis*, Ach., var. *macrophylla*, Hook.; Killarney. Portion of thallus, showing *a*, apothecia; and *b*, mammillæform spermogones.
- Fig. 17. Two of the same spermogones, isolated and magnified to show *a*, a simple ostiole—young; and *b*, a stellate-fissured ostiole—old.
- Fig. 18. Section of one of the same spermogones.
- Fig. 19. Sterigmata *a* and spermata *b* of the same lichen.
- Fig. 20. *S. flavicans*, Tayl.; Falkland Islands. Portion of thallus, showing the sub-marginal papillæform spermogones *a*, and the bright-yellow medullary tissue appearing in a fissure of the cortical layer of the thallus at *b*.
- Fig. 21. Portion of another specimen of same plant, showing both papillæform *a* and punctiform *b* spermogones; the latter occurring chiefly on the rugæ of the thallus.
- Fig. 22. Section of thallus, showing both papillæform *a* and punctiform *b* spermogones.
- Fig. 23. *S. sorymæa*, Ach.; Auckland Islands. Portion of thallus, showing *a*, apothecia; and *b*, sub-papillæform spermogones, seated both on the rugæ and about the margins of the thallus.
- Figs. 24 and 25. Sections of thallus, showing *a*, an apothecium; and *b*, spermogones.
- Fig. 26. *S. carpoloma*, Del. (= *S. impressa*, Tayl.); New Zealand. Portion of thallus, showing *a*, apothecia; and *b*, minute brown punctiform immersed spermogones, mostly seated on the rugæ.
- Fig. 27. Section of thallus, showing the same spermogones *a*.
- Fig. 28. *S. flicina*, Ach., var. *Menziesii*, Hook. fils.; New Zealand. Section through thallus, showing the spermogones *a* seated in cavities *b* of thalline papillæ.
- Fig. 29. *S. pulmonacea*, Ach.; Glen Muick, Braemar. Portion of thallus, showing the brown, minute, punctiform, immersed spermogones *a*.

PLATE XI.

Illustrative of the genus PARMELIA, Ach., Nyl.

- Fig. 1. *Parmelia tiliacea*, Ach.; Tasmania. Portion of thallus, showing *a*, apothecia; *b*, papillæform spermogones; and *c*, punctiform spermogones.
- Fig. 2. Section of thallus, showing both papillæform and punctiform spermogones with depressed ostioles: *a*, mature; *b*, young.
- Fig. 3. *P. tiliacea*; Schærer exs., 358. Sterigmata and spermatia: *a*, sterigmata, composed of a few irregular articulations; *b*, spermatia—*attached*, acicular—double the length of those at *c*, which are *free*; *d*, network of ramose, delicate filaments, which grow from among the sterigmata into the cavity of the spermogone; *e*, basal tissue from which the sterigmata spring.
- Fig. 4. *P. perforata*, Ach.; Rio Janeiro. Portion of thallus, showing *a*, apothecia, perforate in the centre, and with a ciliated border; *b*, punctiform, black, immersed spermogones.
- Fig. 5. *P. perforata*; North America. Sterigmata and spermatia: *a*, sterigmata, composed of a few delicate articulations; *b*, spermatia—*free*—acicular; *c*, network of ramose filaments, which occupy the cavity of the spermogone; *d*, basal tissue, which forms the outer wall of the spermogone.
- Fig. 6. *P. perforata*, Ach., var. *denticulata* mihi; Nepal. Portion of edge of thallus, showing the large barrel-shaped marginal spermogones: *a*, ostiole; *b*, body of the spermogone.
- Fig. 7. One of the same spermogones more highly magnified: *a*, ostiole; *b*, body of spermogone; *c*, margin of thallus.
- Fig. 8. *P. perlata*, Ach., var. *ciliata*, DC.; Crinan Canal, Argyleshire. Portion of thallus, showing papillæform spermogones at *a*, and punctiform ones at *b*.
- Fig. 9. Section of thallus, showing both these forms of spermogones: *a*, papillæform; *b*, punctiform, with sub-depressed ostiole.
- Fig. 10. Sterigmata and spermatia from same specimen: *a*, sterigmata, composed of several irregular articulations or cellules; *b*, free acicular spermatia; *c*, network of anastomosing filaments, which occupy cavity of spermogone; *d*, basal tissue, which forms outer wall of spermogone.
- Fig. 11. *P. perlata*; Schærer exs., 360. Portion of thallus, showing spermogones *a*, which are brownish, semi-pellucid, resembling sago grains.
- Fig. 12. *P. perlata* (= *P. lateformis*, Fée); Cuba. Sterigmata *a*, spermatia *b*, and basal cellular tissue *c*.
- Fig. 13. *P. caperata*, Ach.; Tasmania. Portion of thallus, showing papillæform or wart-like spermogones at *a*, and punctiform ones at *b*.
- Fig. 14. Sterigmata and spermatia from same specimen. Letters have same references as in fig. 12.
- Fig. 15. *P. Borreri*, Ach.; Penzance, Cornwall. Portion of thallus, showing *a*, apothecia; and *b*, punctiform, black, immersed spermogones.
- Fig. 16. *P. acetabulum*, Dub.; Schærer exs., 547. Portion of thallus, showing *a*, apothecia; *b*, papillæform spermogones; *c*, punctiform ones.
- Fig. 17. Section of thallus, showing the same spermogones, both papillæform *a*, and punctiform *b c*.
- Fig. 18. *P. acetabulum*; Schærer exs., 547. Sterigmata and spermatia: *a*, sterigmata, composed of several irregular cells or articulations; *b*, spermatia attached to apices of individual articulations of the sterigmata; *c*, network of anastomosing filaments, which occupy the cavity of the spermogone; *d*, basal tissue.
- Fig. 19. *P. acetabulum* (= *P. corrugata*, Ach.); France. Sterigmata and spermatia. Letters have same references as in fig. 12.

PLATE XII.

Illustrative of the genus PARMELIA, Ach., Nyl.

- Fig. 1. *Parmelia physodes*, Ach.; Knock Hill, Crieff. Portion of thallus bearing apothecia *a*, and punctiform, black, immersed spermogones *b*.

- Fig. 2. *Parmelia physodes*, Ach.; Cleveland, Yorkshire. Portion of a thalline lacinia, showing parasitic fungi *a*, associated with the punctiform spermogones of *P. physodes*; and *b*, marginal soredia.
- Fig. 3. *P. physodes*, Ach.; Schær. exs., 367. Portion of thallus, showing brown, semi-pellucid, lecidine spermogones *a*, and marginal or terminal soredia *b*.
- Fig. 4. *P. physodes*, Ach.; Moncreiffe Hill, Perth; bearing on its thallus the parasitic *Lecidea Smithii*, Tul. *a*; *b*, terminal soredia; *c*, cavities left by the falling out of the apothecia of *L. Smithii*; *d*, punctiform or papillæform pycnides of *L. Smithii*.
- Fig. 5. Section through the above thallus, showing the relative position and size of the apothecia *a*, and pycnides *b*, of *L. Smithii*.
- Fig. 6. Spores of *Lecidea Smithii*, Tul.
- Fig. 7. *P. physodes*, Ach.; Ardrum, Cork. Sterigmata and spermatia, as well as the network (*a*) of ramose filaments, which occupy the spermogonal cavity.
- Fig. 8 *a*. *P. physodes*, Ach., var. *enteromorpha*, Ach.; Tasmania. Portion of thallus bearing an apothecium *a*, and punctiform spermogones *b*, on broad bullose lacinia. 8 *b* shows another specimen of the same plant, with narrow segments, bearing at their ends the same punctiform spermogones *c*.
- Fig. 9. *P. physodes*, Ach., var. *enteromorpha*, Ach.; Falkland Islands. Sterigmata, spermatia, and ramose spermogonal filaments.
- Fig. 10. *P. Kamtschadalis*, Ach.; California. Portion of thallus, bearing apothecia *a*, and punctiform spermogones *b*.
- Fig. 11. Sterigmata, spermatia, and ramose spermogonal filaments of the same plant.
- Fig. 12. *P. encausta*, Ach.; Hepp. exs., 40. Portion of thallus, showing the very abundant punctiform spermogones *a*.
- Fig. 13. *P. encausta*, from Morchone, Braemar. Thallus showing *a*, papillæform spermogones; *b*, an apothecium.
- Fig. 14. Section through the same spermogones, showing the depressed urceolate ostiole *a*.
- Fig. 15. Magnified section of one of the same spermogones: *a*, ostiole; *b*, cavity occupied by a network of ramose filaments; *c*, sterigmata; *d*, gonidia; *e*, medullary tissue of thallus; *f*, cortical layer of thallus.
- Fig. 16. Sterigmata, spermatia, and ramose spermogonal filaments of *P. encausta*, from Morchone.
- Fig. 17. *P. saxatilis*, Ach. Portion of thallus, showing the punctiform, black, immersed spermogones *a*.
- Fig. 18. *P. saxatilis*, Ach.; Storr Rock, Skye. Portion of thallus, showing the abundant brown punctiform spermogones *a*.
- Fig. 19. Sterigmata and spermatia of *P. saxatilis*, Ach., from Bunbeg, Ireland: *a*, network of anastomosing filaments, which occupy spermogonal cavity.
- Fig. 20. *P. saxatilis*, Ach., var. *sulcata*, Tayl.; Derry, Ireland. Portion of thallus, showing spermogones and pycnides, intermixed and outwardly indistinguishable from each other, *a*.
- Fig. 21. *P. saxatilis*, Ach., var. *sulcata*, Tayl.; Connemara: *a*, stylospores; *b*, spermatia.
- Fig. 22. *P. saxatilis*, Ach., var. *omphalodes*, Ach.; Donegal, Ireland. Portions of thallus magnified, showing the stellate-fissured ostioles (*a*) of the immersed spermogones.
- Fig. 23. *P. saxatilis*, var. *omphalodes*; Birnam Hill, Dunkeld. Portion of thallus, showing largish papillæform spermogones *a*.
- Fig. 24. *P. saxatilis*, var. *omphalodes*; Loch Freuchie, Amulree. Portion of thallus magnified, showing the papillæform spermogones, with stellate-fissured ostioles *a*.
- Fig. 25. Sections of the same spermogones: *a*, papillæform; *b*, the urceolate cavities left after the falling out of the bodies of old spermogones.
- Fig. 26. *P. sinuosa*, Ach., var. *hypothria*, Nyl. (= *P. carporrhizans*, Tayl.); Nyl., "Lich. Paris." Portion of thallus, showing *a*, apothecia; *b*, papillæform spermogones; *c*, punctiform spermogones.

- Fig. 27. *Parmelia sinuosa*, var. *hypothric*, Nyl. L. P. Sterigmata and spermatia.
- Fig. 28. *P. sinuosa*, Ach., var. *erratica* mihi; Melbury Hill, Dorsetshire: *a*, oldish spermogones with stellate-fissured ostioles; *b*, youngish spermogones.
- Fig. 29. *P. sinuosa*, Ach., var. *levigata*, Tayl.; Connemara, Ireland. Portion of thallus, showing *a*, punctiform spermogones; *b*, terminal soredia.
- Fig. 30. *P. sinuosa*, Ach., var. *Caracensis*, Tayl.; Caracas. Sterigmata and spermatia: *a*, network of anastomosing delicate filaments, which occupy cavity of spermogone.
- Fig. 31. *P. conspersa*, Ach. Portion of thallus, showing *a*, apothecia, the exciple being studded over with punctiform spermogones; *b*, the punctiform spermogones, frequently with a stellate-fissured ostiole in old state.
- Fig. 32. *P. conspersa*, Ach., minor form; Leight. exs., 79. Narrow laciniae quite covered with punctiform spermogones *a*.
- Fig. 33. *P. conspersa*, Ach., major form; Schær. exs., 379. Portion of thallus, showing *a*, papillæform, and *b*, punctiform spermogones.
- Fig. 34. *P. conspersa*, Ach., major form; Schær. exs., 379. Sterigmata and spermatia.
- Fig. 35. *P. conspersa*, Ach., bearing on its thallus the parasitic *Lecidea oxyspora*, Tul.; Hepp. exs., 37: *a*, apothecia; and *b*, spermogones and pycnides, intermixed, of *L. oxyspora*, Tul.
- Fig. 36. Section showing the relative position and size of the same apothecia, spermogones, and pycnides: *a*, apothecia; *bc*, spermogones; *d*, a pycnide.
- Fig. 37. *P. conspersa*, Ach. Sterigmata and spermatia.
- Fig. 38. The same, from Schær. exs., 379.
- Fig. 39. *P. Tasmanica*, Tayl.; Tasmania. Portion of thallus, showing *a*, apothecia; and *b*, spermogones, punctiform or papillæform.
- Fig. 40. Sterigmata and spermatia of the same lichen.
- Fig. 41. *P. colpodes*, Ach. (= *P. Michauxii*, Ach.); North America. Sterigmata and spermatia.
- Fig. 42. *P. mutabilis*, Tayl.; Uitenhage, South Africa. Sterigmata, spermatia, and ramose filaments of spermogone.

PLATE XIII.

Illustrative of the genera PARMELIA, Ach., Nyl.; and PHYSCIA, Fr., Nyl.

- Fig. 1. *Parmelia tristis*, Web.; Morchone, Braemar. Portion of thallus, showing an apothecium *a*, and marginal wart-like spermogones *b*.
- Fig. 2. Section of the same spermogones: *a*, papillæform, with a depressed ostiole; *b*, simply papillæform, young; *c*, urceolate cavity left by falling out of an old spermogone; *d*, flattened, with depressed ostiole.
- Fig. 3. Sterigmata and spermatia of same plant.
- Fig. 4. *P. Fuhlencensis*, Ach.; Cairngorm, Braemar. Portion of thallus, showing the marginal wart-like spermogones *a*.
- Fig. 5. Some of the same spermogones magnified: *a*, simple or regular ostiole; *b*, stellate-fissured ostiole.
- Fig. 6. Section of one of the same spermogones: *a*, ostiole; *b*, cavity; *c*, sterigmata; *d*, gonidia; *e*, medullary tissue of thallus; *f*, cortical layer of thallus.
- Fig. 7. Sterigmata and spermatia of same plant.
- Fig. 8. *P. stygia*, Ach.; Ben Nevis. Portion of thallus, bearing *b*, an apothecium; *a*, papillæform spermogones. At *c* the spermogones are old, and exhibit largish irregular gaping ostioles.
- Fig. 9. Section of the same spermogones: *a*, papillæform; *c*, with depressed ostiole; *b*, cavities left by falling out of old spermogones.
- Fig. 10. *P. olivacea*, Ach., var. *exasperata*, Ach.; on trees, Morchone, Braemar. Portion of thallus, showing *a*, apothecia; *b*, very minute punctiform spermogones, seen only when the thallus is moistened.

- Fig. 11. Section of the same spermogones, showing the depressed form of ostiole *a*.
- Fig. 12. Sterigmata and spermatia of same plant.
- Fig. 13. *Physcia villosa*, Dub., var. *Dickiana* mihi, Belfast. Portion of thallus, showing apothecia *a*, and beautiful large orange-coloured spermogones *b*.
- Fig. 14. Section of same plant, showing the relation of the apothecium *a* to the spermogones *b*. The apothecium is dotted over with the small black perithecia of a parasitic fungus.
- Fig. 15. Section of one of the same spermogones: *a*, ostiole; *b*, cavity; *c*, sterigmata; *d*, gonidia; *e*, medullary tissue of thallus; *f*, cortical layer of thallus.
- Fig. 16. Sterigmata and spermatia of same plant.
- Fig. 17. *P. leucomela*, Mich.; Cork. Portion of thallus, bearing black papillæform spermogones *a*.
- Fig. 18. Sterigmata and spermatia of same plant.
- Fig. 19. *P. ciliaris*, DC.; Balthayock, by Perth. Portion of thallus, showing *a*, large, irregular, wart-like spermogones, frequently confluent, and with stellate-fissured ostioles; *b*, brown papillæform spermogones; and *c*, punctiform spermogones, as in Schær. exs., 388.
- Fig. 20. One of the large papillæform spermogones magnified: *a*, ostiole.
- Fig. 21. Sections of the same spermogones.
- Fig. 22. *P. stellaris*, Fr., var. *tenella*, Schær.; Penmanshiel, Berwickshire. Portion of thallus, bearing *a*, apothecia; and *b*, papillæform spermogones.
- Fig. 23. *P. stellaris*, Fr., var. *tenella*, Sch. Sterigmata and spermatia from different specimens—Schær. exs., 348; exs., 349; and exs., 352.
- Fig. 24. *P. stellaris*, Fr. (= *Parmelia aipolia*, Auctt.) Portion of thallus, showing numerous papillæform spermogones *a*.
- Fig. 25. Another specimen of the same plant, having brown, instead of black, papillæform spermogones *a*.
- Fig. 26. Some of the same spermogones magnified: *a*, ostiole.
- Fig. 27. *P. stellaris*, Fr.; Schær. exs., 350. Portion of thallus, showing spermogones grouped on wart-like prominences of thallus *a*.
- Fig. 28. *Parmelia stellaris*, Fr. (= *Parmelia aipolia*, Auctt.) Sterigmata and spermatia.
- Fig. 29. *P. stellaris*, Fr., var. *albinea*, Ach. (= *Parmelia crosa*, Borr.); Falmouth. Sterigmata and spermatia.
- Fig. 30. *P. casia*, Fr.; Skye. Portion of thallus, showing papillæform spermogones *a*, and terminal soredia *b*.
- Fig. 31. Sterigmata and spermatia of same plant.
- Fig. 32. *P. obscura*, Fr.; Rescobie, Forfarshire. Portion of thallus, showing the minute, brown, papillæform spermogones *a*.
- Fig. 33. Some of the same spermogones magnified: *a*, ostiole.
- Fig. 34. Sections of the same spermogones.
- Fig. 35. *P. obscura*, Fr. Sterigmata and spermatia.
- Fig. 36. *P. obscura*, Fr.; Cork; bearing on its thallus the parasitic *Lecidea obscuroides* mihi *a*.
- Fig. 37. Sections of the apothecia of *L. obscuroides*, showing them in different stages of development: *a*, mature; *b*, *c*, young.
- Fig. 38. Theca and spores of the same *Lecidea*.

PLATE XIV.

Illustrative of the genera PHYSCIA, Fr., Nyl.; PANNARIA, Del., Nyl.; and COCCOCARPIA, Pers., Nyl.

- Fig. 1. *Physcia parietina*, L., var. *polycarpa*, Ehrh.; Hepp. exs., 54. Portion of thallus, showing the numerous crowded apothecia *a*, and the papillæform spermogones *b*.
- Fig. 2. *P. parietina*, L., var. *laciniosa*, Schær.; Schær. exs., 383: *a*, orange-coloured papillæform spermogones.

- Fig. 3. Section of one of the same spermogones : *a*, ostiole ; *b*, cavity ; *c*, sterigmata ; *d*, gonidia ; *e*, medullary tissue ; *f*, cortical layer of thallus, the component cells full of beautiful yellow colouring matter.
- Fig. 4. Sterigmata and spermatia of same lichen.
- Fig. 5. *Physcia candelaria*, Ach. ; Schær. exs., 382. Portion of thallus, showing orange-coloured papillæform spermogones *a*.
- Fig. 6. Sterigmata and spermatia of same plant.
- Fig. 7. *P. flamma*, Ach. ; Cape of Good Hope. Portion of thallus, showing its orange-coloured papillæform spermogones *a*.
- Fig. 8. *P. chrysophthalma*, DC. ; Long Island, North America. Portion of thallus, showing an apothecium *a*, and orange-coloured wart-like spermogones *b*.
- Fig. 9. Some of the same spermogones magnified : *a*, ostiole.
- Fig. 10. Sections of the same spermogones.
- Fig. 11. *P. pulverulenta*, Fr. ; Scone, Perth. Portion of thallus, showing *a*, simple papillæform spermogones ; *b*, largish, wart-like, frequently confluent ones ; *c*, apothecia.
- Fig. 12. Some of the same spermogones magnified : *a*, simple, papillæform ; *b*, wart-like.
- Fig. 13. Apices of some of the wart-shaped spermogones, magnified to show the stellate-fissured ostioles *a*.
- Fig. 14. Sections of the same spermogones : *a*, simple, papillæform ; *b*, wart-shaped and confluent.
- Fig. 15. *P. pulverulenta*, Fr. Sterigmata and spermatia from different specimens.
- Fig. 16. *P. aquila*, Fr. ; Cork. Portion of thallus, showing *a*, papillæform young spermogones ; *b*, the largish gaping ostioles of old spermogones ; *c*, apothecia.
- Fig. 17. Sterigmata and spermatia of different specimens of same plant.
- Fig. 18. *P. stellaris*, Fr., var. *adglutinata* mihi ; Dumfries. Portion of thallus, showing *a*, apothecia ; *b*, papillæform spermogones perched on thalline warts.
- Fig. 19. Sterigmata and spermatia of same plant.
- Fig. 20. *P. flavicans*, DC. (= *Cornicularia crocea*, Ach.) Sterigmata and spermatia.
- Fig. 21. *Pyxine cocöes*, Ach. ; Demerara. Sterigmata and spermatia.
- Fig. 22. *Coccocarpia plumbea*, Lightf. ; Tarbert, Loch Lomond. Portion of thallus, showing *a*, apothecia ; *b*, confluent spermogones ; *c*, isolated, papillæform spermogones.
- Fig. 23. Some of the same spermogones magnified : *a*, isolated ; *b*, confluent, showing the irregular ostioles *c*.
- Fig. 24. Sections of the same spermogones : *a*, isolated ; *b*, confluent.
- Fig. 25. Sterigmata and spermatia of same species.
- Fig. 26. *Pannaria muscorum*, Ach. ; Schær. exs., 482. Thallus, bearing apothecia *a*, and papillæform spermogones *b*.
- Fig. 27. Portion of a lacinia of same plant, magnified to show the reddish papillæform spermogones *a*.
- Fig. 28. Sections of the same spermogones.
- Figs. 29 and 30. Sterigmata and spermatia of the same plant.
- Fig. 31. *P. rubiginosa*, Del. ; Leighton exs., 234. Thallus, bearing apothecia *a*, and papillæform spermogones *b*.
- Fig. 32. *P. triptophylla*, Ach. ; Schær. exs., 159. Two confluent thalli, bearing apothecia *a*, and black, roe-like spermogones *b*.
- Fig. 33. Sections of the same spermogones.
- Fig. 34. Spermatia of the same plant.
- Fig. 35. Section of one of the spermogones of same plant : *a*, ostiole ; *b*, cavity ; *c*, sterigmata ; *d*, gonidia ; *e*, medullary tissue of thallus ; *f*, cortical layer of thallus.

PLATE XV.

Illustrative of the genera PLACODIUM, DC., Nyl.; SQUAMARIA, DC.; EPHEBE, Fr., Born.; LICHINA, Ag.; COLLEMA, Ach.; *and* LEPTOGIUM, Fr.

- Fig. 1. *Placodium murorum*, DC.; Cork. Portion of thallus, showing apothecia *a*, and orange-coloured papillæform spermogones *b*.
- Fig. 2. Sterigmata and spermatia of same species.
- Fig. 3. *P. circinatum*, Pers., var. *variabile*, Pers.; Hepp. exs., 74. Thallus, bearing apothecia *a*, and brown, pellucid, punctiform spermogones *b*.
- Fig. 4. Section of the same spermogones.
- Fig. 5. *P. circinatum*, Pers.; Dereham Church. Sterigmata and spermatia.
- Fig. 6. Spermogones of same specimen: *a*, simple; *b*, confluent,—in both cases irregularly stellate-fissured and pseudo-lecidine in aspect.
- Fig. 7. *P. alphoplacum*, Wahlb.; Schær. exs., 330. Portion of plant, bearing apothecia *a*, and punctiform or papillæform spermogones *b*, perched on thalline warts.
- Fig. 8. *P. fulgens*, DC.; Hepp. exs., 194. Thallus, bearing apothecia *a*, and papillæform orange-red spermogones *b*.
- Fig. 9. *P. chalybæum*, Duf.; Hepp. exs., 204. Portion of thallus, showing apothecia *a*, and punctiform spermogones *b*.
- Fig. 10. Section of the same spermogones.
- Fig. 11. One of the thalline areolæ, magnified to show the punctiform, immersed spermogones *a*.
- Fig. 12. Sterigmata and spermatia of same plant.
- Fig. 13. *P. candicans*, Dub.; Leighton exs., 218. Portion of thallus, showing *a*, punctiform spermogones; and *b*, apothecia.
- Fig. 14. Section of the same spermogones.
- Fig. 15. *Squamaria chrysoleuca*, Sm.; Schær. exs., 345. Thallus, bearing *a*, apothecia; and *b*, punctiform or papillæform spermogones, seated at *b*, on thalline warts; at *c*, about the subfoliaceous margins of the thallus.
- Fig. 16. Section of the same spermogones: *a*, papillæform; *b*, flattened, with depressed ostiole.
- Fig. 17. Sterigmata and spermatia of same species.
- Fig. 18. *S. gelida*, L.; New Zealand. Section of a spermogone: *a*, ostiole; *b*, body of spermogone; *c*, thalline wart on which spermogone is seated.
- Fig. 19. Sterigmata and spermatia of same species.
- Fig. 20. *Placodium circinatum*, Pers., var. *ecrustaceum*, Nyl.; Hepp. exs., 407. Portion of plant, showing *a*, apothecia; *b*, pseudo-lecidine large spermogones.
- Fig. 21. Section of the same apothecia *a*, and spermogones *b*.
- Fig. 22. Sterigmata and spermatia of the same plant.
- Fig. 23. *Squamaria ambigua*, Wulf. Portion of thallus, showing minute, punctiform, immersed spermogones *a*, and terminal soredia *b*.
- Fig. 24. *Placodium aureum*; Schær. exs., 165. Thallus, bearing apothecia *a*, and papillæform spermogones *b*.
- Fig. 25. Some of same spermogones magnified: *a*, orange-red ostioles.
- Fig. 26. Section of same spermogones.
- Fig. 27. *P. elegans*, DC.; Schær. exs., 338. Thallus, bearing apothecia *a*, and papillæform spermogones *b*.
- Fig. 28. One of the lacinia of same plant, magnified to show the same spermogones *a*.
- Fig. 29. Section of same spermogones.
- Fig. 30. *Ephebe pubescens*, Fr.; ex herb. Harriman. Sterigmata and spermatia.

- Fig. 31. *Lichina pygmaea*, Ag. ; Leighton exs., 260. Portion of thallus, showing different forms of spermogones *a* and *b*.
- Fig. 32. Portion of thallus of same plant, more highly magnified to show the spermogones *a* (closely resembling apothecia).
- Fig. 33. Section of portion of a spermogone : *a*, cellular envelope ; *b*, sterigmata ; *c*, cavity of spermogone full of free spermatia.
- Fig. 34. Sterigmata and spermatia of same species.
- Fig. 35. *L. confinis*, Ag. Apothecia (*a*) highly magnified, showing the spermogones *b*, seated on their surface ; *c*, ostiole of apothecia ; *d*, ostiole of spermogones.
- Fig. 36. *Collema pulposum*, Ach. Portion of thallus, showing an apothecium *a*, and marginal spermogones *b*.
- Fig. 37. *C. melænum*, Ach. (= *C. jacobæfolium*, Auctt.) Thallus, showing an apothecium *a*, and spermogones which are marginal at *b*, and sub-marginal at *c*.
- Fig. 38. *C. melænum*, Ach. Portion of margin of thallus slightly magnified, showing the marginal (*a*) and sub-marginal (*b*) spermogones.
- Fig. 39. One of the discoid marginal spermogones of the same species : *a*, margin of thallus ; *b*, body of spermogone ; *c*, ostiole.
- Fig. 40. *C. nigrescens*, Ach. Portion of thallus, showing *a*, apothecia ; *b*, papillæform spermogones.
- Fig. 41. Section through an apothecium (*a*) and spermogones (*b*) of *C. nigrescens*, Ach.
- Fig. 42. *C. flaccidum*, Ach. ; Aghalie Bridge, Ireland. Portion of thallus, showing apothecia *a*, and sub-marginal spermogones *b*.
- Fig. 43. *Leptogium tremelloides*, Fr. ; Killarney, Ireland. Portion of thallus, showing *a*, apothecia ; *b*, marginal and sub-marginal spermogones.
- Fig. 44. *L. tremelloides*, Fr. ; South America. Portion of margin of thallus, magnified to show the denticulate spermogones *a* ; *b*, ostiole.
- Fig. 45. Sterigmata and spermatia of same species.

INDEX OF FAMILIES AND GENERA.

(Synonyms and the Names of Fungi are in Italics.)

-
- Acroscyphus*, Lév., 109, 113, 151.
Alectoria, Ach., 110, 113, 115, 120, 124, 127, 133, 134.

Bæomyceæ, Nyl., 109, 145.
Bæomyces, Pers., 109, 143, 144, 145.
Borreria, Ach., 131, 136, 137, 219, 254.

Candelaria, Massal., *vide Physcia*, 252.
Celidium, Tul., 113.
Cenomyce, Ach., *vide Cladonia*, 143.
Cetrarieæ, Nyl., 110, 175.
Cetraria, Ach., 110, 116, 137, 146, 175.
Chlorea, Nyl., 110, 111, 125.
Cladonia, Hoffm., 109, 111, 112, 113, 114, 115, 116, 117, 118, 119, 130, 136, 142, 143, 146, 147, 148, 150, 154, 155, 158, 159, 162, 164, 171, 172, 175, 268.
Cladoniæ, Nyl., 109, 154.
Coccocarpia, Pers., Nyl., 110, 111, 114, 116, 118, 255, 256, 257.
Collema, Ach., 109, 111, 112, 113, 116, 143, 145, 172, 183, 239, 257, 269, 270, 271, 275, 276, 277, 278, 279, 280.
Collemaceæ (Family), Nyl., 109, 267.
Collemæ (Section), Nyl., 109.
Cornicularia, Schreb., 125, 135, 253.
Cytispora, Ehrenb. (Fungi), 107.

Dactylina, Nyl., 110, 133.
Desmazieria, Mont., 131.
Diplodia (Fungi), 120.
Dufourea, Ach., Nyl., 110, 111, 115, 132, 133, 141, 170, 171.

Ephebe, Fr., Born., 109, 111, 112, 114, 117, 267, 268.
Erysiphe (Fungi), 106.
Evernia, Ach., 110, 111, 114, 116, 119, 125, 135, 137, 219.

Gyrophora, Ach., *vide Umbilicaria*, 110, 171.

Icmadophila, Ehrh., Kõrb., *vide Bæomyces*.
Imbricaria, Schreb., Kõrb., *vide Parmelia*.

Lasallia, Mér., 183.

Lecanoreæ, Nyl., 110, 254, 255.
Leptogium, Fr., 109, 111, 112, 113, 116, 277, 278.
Lichenacei, 109.
Lichineæ, Nyl., 109.
Lichina, Ag., 109, 111, 113, 114, 115, 117, 120, 174, 252, 253, 267, 268.

Melasmia (Fungi), 107.

Nephromium, Nyl., 110, 111, 113, 116, 171, 172, 173.
Nephroma, Ach. pr. p. Nyl., 110, 172, 173.
Neuropogon, Nees and Flot., 110, 113, 118, 124, 125, 134, 135.

Obryzum, Wallr., Tul., 109, 280.
Omphalaria, DR. and Mont., 109, 270.

Pannaria, Del., 110, 111, 116, 173, 255, 256, 257.
Parmeliæ, Nyl., 110, 111, 122, 136, 191.
Parmelia, Ach., 110, 111, 112, 113, 114, 115, 116, 118, 119, 125, 135, 136, 143, 145, 146, 180, 205, 206, 207, 210, 213, 214, 219, 227, 230, 238, 239, 255, 259, 262, 263, 268.
Peltigereæ, Nyl., 110, 171.
Peltigera, Hoffm., 105, 110, 120, 133, 134, 171, 172, 173.
Phacopsis, Tul., 125.
Phoma, Fr. (Fungi), 107, 120.
Phyllosticta, Pers. (Fungi), 107.
Physcia, Fr., 110, 111, 112, 113, 114, 116, 118, 119, 136, 238, 239, 250, 255, 256, 259, 262.
Placodium, DC., 110, 111, 112, 113, 114, 116, 119, 255, 259, 262, 261, 265, 266.
Platysma, Hoffm., 110, 112, 116, 175, 176, 177, 180, 181, 206, 213, 237.
Polystigma, Pers. (Fungi), 107.
Psoroma, Fr. pr. p. Nyl., 110, 173, 255.
Pycnothelia, Ach., *vide Cladonia*, 161.
Pycnotheca, Fr., 105, 107.
Pyxineæ, Nyl., 110, 254.
Pyxine, Fr., 110, 254.

Ramalinæ, Nyl., 110, 126.

- Ramalina, Ach., Fr., 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 122, 126, 130, 132, 134, 135, 136, 138, 139, 140, 141, 143, 147, 150, 151, 169, 170, 174, 187, 203, 207, 212, 252, 253, 255, 263, 267, 268, 269.
- Ricasolia, DN., Nyl., 110, 111, 112, 114, 115, 116, 191, 195, 198, 201, 205, 257.
- Roccellæ, Nyl., 109, 137.
- Roccella, Bauh., 109, 111, 112, 113, 114, 115, 117, 132, 137, 140, 141, 143.
- Sclerotium*, Tode (Fungi), 107.
- Scyphophorus*, Fée, *vide* Cladonia.
- Septoria* (Fungi), 120.
- Siphula, Fr., 105, 109, 142.
- Siphuleæ, Nyl., 109, 142.
- Solorina, Ach., 110, 171.
- Sphæria*, Haller (Fungi), 105, 107, 112, 130, 137, 175, 193, 206, 208, 234, 243, 217, 272, 273, 276.
- Sphærophoreæ, Nyl., 109, 146.
- Sphærophoron, Pers., 109, 113, 115, 118, 146, 147, 151.
- Squamaria, DC., 110, 111, 115, 117, 255, 259.
- Stereocaulæ, Nyl., 109, 152.
- Stereocaulon, Schreb., 109, 111, 113, 114, 115, 117, 118, 149, 151, 152.
- Sticta, Ach., 110, 111, 112, 114, 115, 116, 143, 145, 146, 172, 183, 191, 195, 198, 199, 201, 202, 205, 239, 257.
- Strigula, Fr., 120.
- Synalissa, DR., 109, 269.
- Synechoblastus*, Trevis., *vide* Collema.
- Thamnolia, Ach., 109, 111, 114, 118, 142, 143, 144.
- Thrombium*, Wallr. (Fungi, pr. p.), 107, 272.
- Umbilicariæ, Nyl., 110, 182, 254.
- Umbilicaria, Hoffm., 110, 111, 113, 116, 174, 182, 184, 185, 186, 187, 188, 189.
- Usneæ, Nyl., 110, 121.
- Usnea, Hoffm., 110, 111, 112, 113, 114, 116, 118, 119, 121, 125, 126, 131, 134, 135, 143, 174.

INDEX OF SPECIES.

(*Synonyms and the Names of Fungi are in Italics.*)

- Acetabulum, Dub. (Parmelia), 116, 234, 235.
- Acharii*, Trevis. (*Synalissa*), 269.
- Aculeata, Fr. (Cetraria), 114, 145, 175, 176, 177.
- Æruginosa*, Scop. (*Lecidea* or *Icmadophila*), 146.
- Agardhiana*, Ach. (*Lecanora*), 264.
- Agardhianum*, Ach. (*Placodium*), 264.
- Aggregata, Sw. (Cladonia), 170, 171.
- Aipolia*, Ach. (Parmelia), 243, 244, 245.
- Alcicornis, Flk. (Cladonia), 113, 160.
- Alectorix, Lindsay (Lecidea), 112, 135, 144.
- Aleurites, Ach. (Squamaria), 259, 261.
- Alphoplacum, Whlb. (Placodium), 262, 265.
- Alpinum, Laur. (Stereocaulon), 152.
- Amaurocæra, Flk. (Cladonia), 143, 154, 166.
- Ambigua, Wulf. (Squamaria), 261.
- Amplissima*, Sch. (*Sticta* or *Parmelia*), 203, 204.
- Anomæa*, Hook. (Cladonia), 160.
- Anomæus*, Sm. and Hook. (*Scyphophorus* or *Lichen*), 160.
- Aquila, Fr. (Physcia), 236, 239, 249.
- Arctica, Hook. (Dactylina), 133.
- Arctica, Hook. (*Dufourea*), 133.
- Arctica, Ach. (Umbilicaria), 180.
- Arcticum, Fr. (Nephroma), 173.
- Argus, Tayl. (Stereocaulon), 152, 153.
- Argyrea, Del. (Sticta), 191, 196.
- Articulata*, Fr. (*Usnea*), 131.
- Ashneh (?), (Evernia or *Borreria*), 137.
- Aspera*, Massal. (*Imbricaria*), 235.
- Astroidea, Fr. (Physcia), 246.
- Athallum*, Spreng. (*Endocarpon*), 246.
- Atlantica*, Ach. (*Borreria*), 254.
- Atlanticus*, Ach. (*Lichen*), 254.
- Atrovirens*, Lyngb. (*Stigonema*), 267.
- Aurata, Ach. (Sticta), 191, 200.
- Aurea*, Schær. (*Lecidea*), 265.
- Aureum, Schær. (Placodium), 265.
- Auriculatum, Hoffm. (Collema), 271.
- Australe, Laur. (Sphærophoron), 151.
- Azureum*, Ach. (*Leptogium*), 278.
- Bacillare*, Wallr. (*Thrombium*), 273.
- Bacillaris*, Ach., (*Cenomyce*), 166.
- Barbata, Fr. (Usnea), 121, 122, 124, 131, 135.
- Bellidiflora, Schær. (Cladonia), 113, 154, 162, 163, 164.
- Borreri, Ach. (Parmelia), 230.
- Byssoides*, Fr. (*Biatora*), 146.

- Cæsia*, Fr. (Physcia), 218, 246.
Cæsiio-rufus, Sm. (*Lichen*), 265.
Cæspititia, Ach. (*Cladonia*), 113, 160.
Calicaris, Fr. (Ramalina), 126, 127, 128, 129, 130, 131, 132.
Calicaris, Fr. (*Lichen*), 128.
Calloplismum, Mér. (Placodium), 262.
Canariensis, Nyl. (*Sticta*), 194, 196.
Candelaria, Ach. (Physcia), 250, 252.
Candicans, Dub. (Placodium), 262, 263.
Candicans, Dicks. (*Lichen*), 262, 263.
Canescens, Ach. (Lecidea), 255.
Canina, Hoffm. (*Peltigera*), 174.
Caperata, Ach. (*Parmelia*), 207, 210, 231, 232, 233.
Capitellata, Bab. (*Cladonia*), 166.
Caracensis, Tayl. (*Parmelia*), 218.
Carnosa, Schær. (*Parmelia*), 256.
Carpoloma, Del. (*Sticta*), 191, 192, 198.
Carporrhizans, Tayl. (*Parmelia*), 214, 215.
Cellulosum, Ach. (*Nephromium*), 135.
Cenotea, Schær. (*Cladonia*), 158.
Centrifuga, Ach. (*Parmelia*), 232, 233, 234.
Ceratina, Fr. (*Usnea*), 123.
Ceratites, Fr. (*Siphula*), 142.
Ceratophylla, Wallr. (*Parmelia* or *Imbricaria*), 221, 225.
Ceruchis, Ach. (Ramalina), 127, 131.
Cervicornis, Schær. (*Cladonia*), 154, 158, 159, 160.
Chalazanum, Ach. (*Collema*), 274.
Chalybæa, Schær. (*Lecanora*), 262, 264.
Chalybæum, Duf. (Placodium), 262, 264.
Cheileum, Ach. (*Collema*), 275.
Chrysoleuca, Sm. (Squamaria), 259, 260.
Chrysophthalma, DC. (Physcia), 239, 250, 252.
Chrysophthalma, DC. (*Parmelia*), 252.
Ciliare, Ach. (Platysma), 177, 180, 181, 182, 237.
Ciliaris, DC. (Physcia), 239, 240, 241, 243, 247, 249, 254, 259.
Cinereo-glaucæ, Tayl. (*Sticta*), 191, 193.
Cinninata, Ach. (*Parmelia*), 226.
Circinatum, Pers. (Placodium), 111, 262, 263, 268.
Citrinum, Tayl. (Platysma), 180.
Cladoniaria, Nyl. (Lecidea), 112, 163.
Coccifera, Hook. (*Cladonia* or *Cenomyce*), 163.
Cocciferus, Hook. (*Lichen*), 163.
Cocões, Ach. (*Lecidea*), 255.
Cocões, Ach. (*Pyxine*), 255.
Collodes, Tayl. (*Dufourea*), 170.
Colpodes, Ach. (*Parmelia*), 220.
Compressum, Ach. (*Sphærophoron*), 132, 146, 147, 148, 149, 150, 151.
Concolor, Ram. (Squamaria), 259, 260.
Confinis, Ag. (*Lichina*), 113, 268, 269.
Confluens, Fr. (Physcia), 246.
Conspersa, Ach. (*Parmelia*), 112, 113, 116, 163, 206, 209, 210, 216, 219, 220, 231, 232, 233, 234, 261.
Coralloides, Pers. (*Sphærophoron*), 146, 147, 448, 149, 150, 151.
Coriacea, Tayl. (Ricasolia), 202, 204.
Corniculatum, Wallr. (*Obyzum*), 280.
Cornucopioides, Fr. (*Cladonia*), 163, 164.
Cornuta, Fr. (*Cladonia*), 157, 159, 163, 164.
Corrosa, Ach. (Ricasolia), 201, 205.
Corrugata, Ach. (*Parmelia*), 234, 235.
Corrugatus, Sm. (*Lichen*), 234.
Crassa, DC. (Squamaria), 259.
Crenulata, Hook. (Ricasolia), 201, 202, 204.
Cretaceum, Sm. (*Leptogium*), 278.
Cribellata, Tayl. (*Parmelia*), 233.
Crinita, Ach. (*Parmelia*), 213.
Crispata, Ach. (*Cladonia*), 168.
Crispum, Ach. (*Collema*), 273, 274, 275.
Cristatum, Schær. (*Collema*), 272, 273, 275.
Crocata, Ach. (*Sticta*), 200.
Crocea, Ach. (*Cornicularia*), 253.
Crocea, Ach. (Solorina), 175.
Cucullatum, Hoffm. (Platysma), 177, 178, 179.
Cyclosetis, Ach. (*Parmelia*), 247.
Cylindrica, L., Fr. (*Umbilicaria*), 182, 187, 188, 190.

Damæcornis, Ach. (*Sticta*), 161, 191, 192, 194, 195, 196.
Damæcornis, Ach. (*Cladonia*), 161.
Deformis, Hoffm. (*Cladonia*), 163, 164.
Degenerans, Flk. (*Cladonia*), 157, 163.
Denticulata, Linds. (*Parmelia*), 112, 203, 206, 211, 212, 213, 277.
Denudatum, Flk. (*Stereocaulon*), 153.
Depressa, Schrad. (*Umbilicaria*), 190.
Deusta, Ach., Flk. (*Umbilicaria*), 185.
D'Urvillei, Del. (*Sticta*), 191, 200.
Diadenata, Tayl. (*Parmelia*), 242.
Diaphanum, Ach. (*Leptogium*), 278.
Diatrypa, Ach. (*Parmelia*), 225.
Dichotoma, Del. (*Sticta*), 194, 196.
Digitata, Hoffm. (*Cladonia*), 163, 164.
Digitata, Linds. (*Parmelia*), 212.
Discolor, Ach. (Ricasolia), 204.
Dissecta, Ach. (Ricasolia), 201, 202, 205.
Domingensis, Mont. (Physcia), 242.
Dubia, Sch. (*Parmelia*), 231.

Echinata, Tayl. (*Parmelia*), 242.
Ecmocyna, Ach. (*Cenomyce*), 158.
Elegans, DC. (Placodium), 262, 266.
Elegans, Ach. (*Parmelia*), 266.
Encausta, Ach. (*Parmelia*), 112, 115, 206, 220, 224, 225, 236.
Endiviæfolia, Fr. (*Cladonia*), 161.
Endochrysa, Del. (*Sticta*), 191, 192, 200.
Enteromorpha, Ach. (*Parmelia*), 220, 223, 224.
Epiblastematica, Wallr. (*Sphæria*), 193, 234.
Epigona, Ach. (*Parmelia*), 263.
Epiphyllum, Leight. (*Collema* ?), 276.
Ericctorian, Sm. (*Lichen*), 146.
Erosa, Hoffm. (*Umbilicaria*), 182, 186, 187, 226.
Erosa, Borr. (*Parmelia*), 246.
Erratica, Linds. (*Parmelia*), 216, 218.
Erythrocarpia, Fr. (*Parmelia*, *Lecidea*, or *Blasenia*), 265.

- Erythrothalma*, Tayl. (*Collema*), 278.
- Fahlunensis, Ach. (*Parmelia*), 112, 207, 231, 237.
- Fallax, Ach. (*Cetraria*), 180, 210.
- Fastigiata, Fr. (*Ramalina*), 129, 130, 131.
- Faveolata, Del. (*Sticta*), 191, 197.
- Ferruginea, Huds. (*Lecidea*), 265.
- Filicina, Ach. (*Sticta*), 191, 191, 198.
- Filiformis, Hook. (*Cladonia*, *Scyphophorus*, or *Cnomyces*), 163, 164.
- Fimbriata, Fr. (*Cladonia*), 156, 163, 164.
- Firmula, Nyl. (*Physcia*), 248.
- Flabellata, Mont. (*Sticta*), 191, 196.
- Flaccidum, Ach. (*Collema*), 271.
- Flammea, Ach. (*Dufourea*), 252.
- Flammea, Ach. (*Physcia*), 239, 250, 252.
- Flavicans, Tayl. (*Sticta*), 191, 199, 200.
- Flavicans, DC. (*Physcia*), 239, 253.
- Florida, Fr. (*Usnea*), 123, 124.
- Foliacea, Schaer. (*Cladonia*), 161.
- Fragile, Pers. (*Sphaerophoron*), 149.
- Fragile, Tayl. (*Leptogium*), 277, 278.
- Fragile, Tayl. (*Collema*), 278.
- Frazinea, Fr. (*Ramalina*), 126, 127, 129.
- Freyinetii, Del. (*Sticta*), 191, 192, 197.
- Fruticosa, Schaer. (*Cladonia*), 167, 168.
- Fuciformis, Ach. (*Rocella*), 131, 139, 140, 141.
- Fulgens, DC. (*Placodium*), 262, 265.
- Fuliginosa, Ach. (*Sticta*), 193, 205.
- Fulvo-cinerea, Mont. (*Sticta*), 197.
- Fungiforme, Schrad. (*Sphyridium*), 146.
- Fungiformis, Sch. (*Cladonia*), 160.
- Furcata, Schaer. (*Cladonia*), 112, 114, 154, 155, 157, 158, 165, 166, 167, 168, 171.
- Furfuracea, Mann. (*Evernia*), 136, 137, 219, 235.
- Furfuracea, DC. (*Borreria* or *Parmelia*), 136.
- Furvum, Ach. (*Collema*), 272.
- Galbina*, Ach. (*Parmelia*), 215.
- Gaudichaudii*, Del. (*Sticta*), 197.
- Gelida, L. (*Squamaria*), 259, 261.
- Gilva, Ach. (*Sticta*), 192, 200.
- Glabra, Tayl. (*Sticta*), 191, 192, 201.
- Glaucua, Ach. (*Cetraria*), 180, 210.
- Glaucum, Hoffm. (*Platysma*), 163, 178, 180, 208, 209, 210, 233.
- Glomulifera, DN. (*Ricasolia*), 105, 195, 202, 203, 205, 258.
- Glomulifera*, Del. (*Sticta* or *Parmelia*), 203.
- Gracilis, Fr. (*Cladonia*), 154, 156, 157, 158, 160, 166.
- Granosa, Schaer. (*Parmelia*), 271.
- Herbacea, DN. (*Ricasolia*), 105, 111, 112, 195, 196, 199, 201, 202, 204, 205, 258.
- Herbacea, Hoffm. (*Sticta*), 203.
- Hildenbrandii, Garov. (*Leptogium*), 279.
- Hirsuta, DC. (*Umbilicaria*), 182, 190.
- Hirsuta, Ach. (*Gyrophora*), 182, 190.
- Hirta, Fr. (*Usnea*), 121, 122, 123, 124.
- Homalea, Ach. (*Ramalina*), 131.
- Horizontalis, Hoffm. (*Peltigera*), 174.
- Hottentotta, Ach. (*Parmelia*), 235.
- Hottentotta, Ach. (*Sticta* or *Omphalodes*), 235.
- Hyperborea, Hoffm. (*Umbilicaria*), 185, 186, 187, 188, 230.
- Hyperborca, Ach. (*Gyrophora*), 185, 186.
- Hypnorum, Fr. (*Psoroma*), 255.
- Hypothrix, Nyl. (*Parmelia*), 215, 217.
- Icmadophila*, Ach. (*Lecidea* or *Biatora*), 146.
- Icmadophilus, Ach. (*Bæomyces*), 146.
- Impressa, Tayl. (*Sticta*), 198, 199.
- Incana, Schaer. (*Cladonia*), 164.
- Incurva, Fr. (*Parmelia*), 234.
- Incurvus, Ach. (*Lichen*), 234.
- Intricata, Schaer. (*Physcia*), 254.
- Intricata, Mont. (*Rocella*), 141.
- Intricata, Fr. (*Evernia*), 254.
- Islandica, Ach. (*Cetraria*), 112, 136, 137, 148, 172, 175, 176, 181.
- Jacobæfolius*, Bernh. (*Lichen*), 272, 273.
- Jubata, Ach. (*Alectoria*), 133, 134.
- Jubata, Schaer. (*Parmelia*), 134.
- Juniperinum, L. (*Platysma*), 177, 178, 179.
- Kamtschadalis, Ach. (*Parmelia*), 116, 219.
- Kunthii, Del. (*Ricasolia*), 201, 202, 205.
- Laciniata, Ach. (*Sticta*), 191, 197.
- Laciniatum, Nyl. (*Collema*), 276.
- Lacunosum, Ach. (*Platysma*), 180.
- Lacunosa, Ach. (*Cetraria*), 181.
- Læteformis, Fée. (*Parmelia*), 210, 211.
- Lætevirans, Schaer. (*Parmelia*), 203.
- Lævigata, Tayl. (*Parmelia*), 210, 216, 217.
- Lanata, L. (*Parmelia*), 268.
- Lata, Tayl. (*Alectoria*), 134, 135.
- Lata, Tayl. (*Cornicularia*), 135.
- Leonora, Spr. (*Parmelia*), 233.
- Leucomela, Mich. (*Physcia*), 241, 242, 248.
- Lichenophila, DR. (*Synalissa*), 269.
- Limosum, Ach. (*Collema*), 274.
- Linearis, Nyl. (*Sticta*), 191, 192, 194, 195.
- Linita, Ach. (*Sticta*), 192, 193, 194.
- Lutescens, Tayl. (*Sticta*), 198.
- Macilenta, Hoffm. (*Cladonia*), 155, 156, 163.
- Macrocarpa, Wilson (*Sticta*), 195.
- Macrophylla, Fée (*Sticta*), 194, 195.
- Maculata, Tayl. (*Solorina*), 258.
- Madreporeiformis, Ach. (*Dufourea*), 112, 132.
- Madreporeiformis, Wulf. (*Lichen*), 132.
- Madreporeiformis, Sch. (*Cladonia*), 133.
- Marginalis, Hook. (*Collema*), 272, 273.
- Marginalis, Huds. (*Lichen*), 272.
- Marginellum, Mont. (*Leptogium*), 278, 279.
- Marianum, (*Leptogium*), 278.
- Melaxanthus, Ach. (*Neuropogon*), 113, 118, 124, 129, 132, 135, 238.
- Melænum, Ach. (*Collema*), 271, 272, 275.

- Menziesii*, Tayl. (*Sticta*), 194.
Michauxii, Ach. (*Parmelia*), 220.
 Micrococca, Born. (*Synalissa*), 269, 270.
Microphylla, Ach. (*Lecidea*), 256.
Microphyllum, Ach. (*Collema*), 276.
Mollusca, Ach. (*Dufourea*), 141.
Mollusca, Ach. (*Roccella*), 141.
Molybdæa, Pers. (*Coccocarpia*), 257, 258.
Moniliformis, Bab. (*Parmelia*), 220.
Montagnei, Bél. (*Roccella*), 138, 140, 141.
Mühlenbergii, Ach. (*Umbilicaria*), 184.
Multifida, Sch. (*Parmelia*), 233, 272, 273.
Multifidum, Sch. (*Collema*), 272, 273.
Multifidus, Dicks. (*Lichen*), 234.
Multiflorum, Schær. (*Collema*), 274.
Multipartitum, Sm. (*Collema*), 276.
Muralis, Schær. (*Parmelia*), 250.
Murorum, DC. (*Placidium*), 262, 265, 266.
Museigena, Ach. (*Physcia*), 249.
Muscorum, Ach. (*Pannaria*), 256.
Mutabilis, Tayl. (*Parmelia*), 116, 219.
Myochroa, Schær. (*Parmelia*), 279.

Nigrescens, Ach. (*Collema*), 276.
Nigrescens, Ach. (*Parmelia*), 276.
Nitida, Tayl. (*Sticta*), 196.
Nivale, L. (*Platysma*), 136, 137, 177, 178, 179, 180.

Obscura, Fr. (*Physcia*), 245, 247, 248, 249.
Obscuroides, Linds. (*Lecidea*), 112, 247.
Obvoluta, Ach. (*Sticta*), 191, 192, 197.
Olivacea, Ach. (*Parmelia*), 206, 233, 235, 236.
Olivaceum, Hook. (*Collema*), 279.
Omphalodes, Fr. (*Parmelia*), 115, 185, 195, 206, 226, 229.
Orygmæa, Ach. (*Sticta*), 191, 192, 199.
Oxyspora, Tul. (*Lecidea*), 163, 204, 232, 233.

Pallida, Hook. f. (*Sticta*), 192, 201.
Pannosa, Del. (*Pannaria*), 256.
Papillaria, Hoffm. (*Cladonia*), 111, 161, 164.
Papulosa, Ach. (*Umbilicaria*), 183, 184.
Parietina, L. (*Physcia*), 239, 250, 252, 253, 254, 265, 266.
Parmelioides, Hook. (*Lecidea*), 258.
Paschale, Fr. (*Stereocaulon*), 152, 153.
Pellita, Ach. (*Gyrophora*), 184.
Pennsylvanica, Ach. (*Umbilicaria*), 183, 184.
Perforata, Ach. (*Parmelia*), 112, 116, 202, 203, 206, 208, 209, 210, 211, 212, 213, 214, 215, 219, 230, 277.
Perlata, Ach. (*Parmelia*), 116, 180, 202, 206, 208, 209, 210, 211, 212, 213, 215, 216, 218, 219.
Pertusa, Sch. (*Parmelia*), 225, 226.
Phycopsis, Ach. (*Roccella*), 138, 141.
Phyllocarpum, Pers. (*Leptogium*), 277, 279.
Physodes, Ach. (*Parmelia*), 116, 122, 123, 135, 136, 138, 206, 207, 213, 214, 218, 219, 220, 222, 224, 225, 226, 227, 230, 231, 232, 235, 237.
Placophyllus, Ach. (*Bæomyces*), 145.

Placorodia, Ach. (*Parmelia*), 226.
Plicata, Fr. (*Usnea*), 123.
Plicatile, Ach. (*Collema*), 271, 274, 275.
Plumbea, Lightf. (*Coccocarpia*), 256, 257, 258.
Plumbea, Lightf. (*Parmelia*), 258.
Polydactyla, Hoffm. (*Peltigera*), 173, 174.
Polydactyla, Flk. (*Cladonia*), 164.
Polymorpha, Ach. (*Ramalina*), 122, 126, 130.
Polymorpha, Schrad. (*Umbilicaria*), 190.
Polyphylla, Hoffm. (*Umbilicaria*), 182, 184, 185, 187.
Polyrrhiza, L. (*Umbilicaria*), 184, 186, 188.
Proboscidea, DC. (*Umbilicaria*), 182, 187, 188, 189, 190.
Proboscidea, Tayl. (*Parmelia*), 210.
Pruinosa, Nees (*Dufourea*), 141.
Prunastri, Ach. (*Evernia*), 137.
Psoromia, Nyl. (*Verrucaria*), 175.
Psoromoides, Borr. (*Phacopsis*), 175.
Psoromoides, Borr. (*Verrucaria*), 175.
Pubescens, Fr. (*Ephebe*), 267, 268.
Pubescens, Fr. (*Cornicularia*), 267.
Pulchella, Schær. (*Parmelia*), 245, 246.
Pulmonacea, Ach. (*Sticta*), 191, 192, 194, 195, 197, 198, 199, 200, 201.
Pulposum, Ach. (*Collema*), 274, 275.
Pulverulenta, Fr. (*Physcia*), 119, 229, 239, 243, 247, 248, 249.
Pulvinata, Schær. (*Omphalaria*), 270.
Pungens, Ach. (*Cladonia*), 166, 168.
Pungens, Del. (*Bæomyces*), 168.
Pustulata, Hoffm. (*Umbilicaria*), 183, 184, 186.
Pygmaea, Ag. (*Lichina*), 113, 268, 269, 270.
Pyxidata, Fr. (*Cladonia*), 112, 154, 155, 156, 157, 158, 161, 162, 163, 164.

Quercifolia, Sch. (*Parmelia*), 214.
Quercicus, Ach. (*Sticta*), 194, 196, 203.

Racemosa, Schær. (*Cladonia*), 166, 167, 168.
Radiosa, Schær. (*Parmelia*), 265.
Ramulosum, Sw. (*Stereocaulon*), 153.
Rangiferina, Hoffm. (*Cladonia*), 112, 113, 114, 154, 155, 158, 165, 166, 168, 171, 177, 268.
Recurva, Ach. (*Parmelia*), 234.
Relicina, Fr. (*Parmelia*), 215, 216.
Resupinata, DC. (*Peltigera* or *Nephroma*), 172.
Reticulata, Tayl. (*Parmelia*), 210, 216, 217, 235.
Retipora, Ach. (*Cladonia*), 170, 171.
Richardi, Mont. (*Sticta*), 197.
Richardsoni, Hook. (*Evernia*), 112, 136, 137.
Richardsoni, Hook. (*Cetraria*), 137.
Rinosa, Schær. (*Lecidea*), 263.
Rosens, Pers. (*Bæomyces*), 144, 145.
Rubiginosa, Del. (*Pannaria*), 256.
Rubiginosa, Ach. (*Parmelia*), 256.
Rubina, Schær. (*Parmelia*), 260.
Rufa, Ach. (*Sticta*), 194, 196.
Rufescens, Hoffm. (*Peltigera*), 174.
Rufus, Ach. (*Bæomyces*), 146.
Rufosa, Tayl. (*Parmelia*), 216, 217.

- Rupestre*, Schær. (*Collema*), 272.
Rupestris, Pers. (*Bovomyces*), 116.
Rupestris, Sch. (*Parmelia*), 272.
- Saccata*, Ach. (*Solorina*), 175.
Saturninum, Ach. (*Leptogium*), 271, 277, 279.
Saxatilis, Ach. (*Parmelia*), 115, 116, 123, 163, 185, 195, 202, 204, 206, 207, 213, 214, 215, 216, 217, 218, 219, 222, 225, 226, 227, 228, 230, 231, 232, 233, 235, 237, 261.
Saxicola, Ach. (*Squamaria*), 259, 260.
Scopulorum, Ach. (*Ramalina*), 122, 126, 128.
Scorigena, Mont. (*Evernia*), 266.
Scorigenum, Mont. (*Placodium*), 266.
Scortea, Ach. (*Parmelia*), 215.
Sepineolum, Hoffm. (*Platysma*), 177, 178, 180, 181.
Sinuosa, Pers. (*Sticta*), 194, 196.
Sinuosa, Ach. (*Parmelia*), 116, 206, 207, 208, 210, 214, 215, 216, 217, 218, 227, 228, 233.
Speciosa, Fr. (*Physcia*), 242, 248.
Sphaerophoroides, Lèv. (*Acrosyphus*), 151.
Squamosa, Hoffm. (*Cladonia*), 113, 157, 159.
Stellaris, Fr. (*Physcia*), 218, 239, 242, 243, 245, 246, 247, 249, 255, 261.
Stellata, Sch. (*Cladonia*), 165, 166.
Stygia, Ach. (*Parmelia*), 112, 115, 206, 207, 224, 234, 236, 250.
Stygia, Sch. (*Cetraria*), 237.
Stygium, Del. (*Collema*), 270, 275.
Submarginalis, Ach. (*Parmelia*), 215.
Subtile, Nyl. (*Leptogium*), 277, 278.
Sulcata, Tayl. (*Parmelia*), 228.
Sylvatica, Ach. (*Sticta*), 191, 193.
Symphorea, DC. (*Synalissa*), 269.
Synalissum, Ach. (*Collema*), 269.
- Tasmanica*, Tayl. (*Parmelia*), 233.
Taylori, Hook. (*Alectoria*), 113, 118, 124, 134, 135, 144, 238.
Teicholytum, DC. (*Placodium*), 265.
- Tenax*, Ach. (*Collema*), 274.
Tenuella, Schær. (*Borreria*), 243, 244, 245, 246.
Tenerum, Laur. (*Sphaerophoron*), 147, 149.
Tercebrata, Tayl. (*Ramalina*), 129, 131.
Tiliacea, Ach. (*Parmelia*), 116, 117, 122, 125, 135, 138, 234.
Tinctoria, Ach. (*Roccella*), 138, 140, 141.
Tomentosum, Laur. (*Stereocaulon*), 152.
Tomentosum, Hoffm. (*Nephromium*), 107, 112, 172, 173.
Trachiata, Fr. (*Cladonia*), 158.
Tremelloides, Fr. (*Leptogium*), 272, 276, 277, 278, 279.
Triptophylla, Ach. (*Pannaria*), 114, 256, 270.
Tristis, Web. (*Parmelia*), 112, 206, 237.
Tristis, Schær. (*Cetraria*), 238.
Tuberculata, Tayl. (*Alectoria*), 127.
Tumidula, Nyl. (*Usnea*), 132.
Turgida, Ach. (*Parmelia*), 275.
Turgida, Hoffm. (*Cladonia*), 143, 165, 166, 274.
Turgidum, Ach. (*Collema*), 275.
- Uncialis*, Hoffm. (*Cladonia*), 112, 143, 165, 166.
Ureolata, Schær. (*Sphaeria*), 175.
- Varia*, Leight. (*Umbilicaria*), 190.
Variabile, Pers. (*Placodium*), 263.
Vellea, L., Fr. (*Umbilicaria*), 182, 190.
Vellea, Ach. (*Gyrophora*), 182, 185.
Ventricosa, Schær. (*Cladonia*), 160.
Vermicularia, Linds. (*Lecidea*), 112, 135, 142, 144.
Vermicularis, Schær. (*Thamnotia*), 112, 135, 142, 143.
Vermicularis, Sw. (*Cladonia* or *Cenomyce*), 143, 144.
Verticillata, Fr. (*Cladonia*), 158, 159.
Vespertilio, Lightf. (*Synechoblastus*), 276.
Villosa, Dub. (*Physcia*), 239, 253, 254, 266.
Vulpina, Nyl. (*Chlorea*), 125.
Vulpina, Tul. (*Phacopsis*), 125.
- Xanthosticta*, Pers. (*Sticta*), 191, 198.

