

XIV. *Observations on the Lichens collected by Dr. ROBERT BROWN, M.A., F.R.G.S., in West Greenland in 1867.* By W. LAUDER LINDSAY, M.D., F.R.S.E., F.L.S.

(Plates XLVIII.—LII.)

Read February 4th, 1869.

I. *Introduction.*

THE lichens on which the following "Observations" were made were collected between June and September, 1867, by my friend Dr. Robert Brown, F.R.G.S.* They were gathered mostly in the following localities, on, or in the neighbourhood of, Disco Island, between 67° and 70° N. lat., in an area of country not differing much in its different parts as respects its cryptogamic vegetation:—

1. Jakobshavn (in English, Jacob's Harbour or Haven), lat. 67° 13' 11" N., long. 50° 56' 30" W. †; period June to August.

This was the chief centre and locality of collection. Most of the muscicolous lichens, and of the common species (e. g.) of *Cladonia*, *Stereocaulon*, and *Collema*, from Jakobshavn, were specially labelled "shady places, north end of harbour near Mr. Fleischer's house;" July.

2. Egedesminde (English, Egede's Memory), lat. 68° 42' 39" N., long. 52° 43' 48" W.; June.

3. Godhavn ‡, the "Lively" of British whalers (English, Good Harbour), on Disco Island, lat. 69° 14' 58" N., long. 53° 24' 40" W.; perhaps the best-known botanical locality in Greenland.

4. Illartlek; entrance to inlet, head of inlet, and at the glacier. About 69° 27' N. lat.; July.

5. Ounartok, lat. 70° 30" N., long. 52° W.; August.

6. Kudlesæt, lat. 70° 5' N., long. 52° 32' 35" W. (approx.); August.

7. Lyngemarken, on Disco, opposite Godhavn; September.

8. Atanakerdluk § (English, "the Rocky Promontory"), on Waigatz Strait (=Waj-

* [We have been requested to state that the collection of lichens described in this paper is the property of Mr. Edward Whymper, and that the plants were collected by Dr. Robert Brown during a visit to Greenland, undertaken at the expense of Mr. Whymper, in 1867.—SECS. L. S.]

† "The longitudes and some of the latitudes which I have given for Greenland places, are only approximate" (says Mr. Brown, in writing me), "as I have not fully wrought out my astronomical observations for positions." Those cited are from Mr. Brown's "Florula Discöana," Trans. Botan. Society of Edinb., vol. ix. p. 435, where full descriptions of all the localities are given.

‡ Not to be confounded with Godthaab, a very different locality—a Danish "Colonie" in lat. 64° 8' N., and long. 51° 37' W.

§ Regarding the spelling of Greenland names of places, *vide* author's paper on the "Lichen-Flora of Greenland," Trans. Botan. Soc. Edinb., vol. x. p. 292.

gattet), lat. 70° 2' 30" N., long. 52° W. (approx.); the chief site of the fossil (Miocene) plant-beds.

The principal *rocks* on which the *saxicolous* lichens occur are granite, gneiss, and trap; while *terricolous* forms affect a soil consisting of the débris of these rocks. *Corticulous* species were found mostly on twigs or stems of birch bushes*; while *muscicolous* forms chiefly frequent *Rhacomitrium lanuginosum* †, a moss that appears to be abundant in all northern countries ‡.

In the examination of the present collection of Greenland lichens, I have made use of the *chemical tests* recommended of late years by Nylander and Leighton as a means of determining lichen-species. All the *positive* results—all instances of reaction of a marked kind—are hereinafter recorded. In the majority of cases, however, there was *no* reaction, or none of a kind meriting record; while in species in which a decided reaction was sometimes exhibited, at other times it was obscure or absent. In other words, reaction was, in these exceptional cases, capricious or inconstant. Hence the result of the present comparatively limited series of testings only confirms that of the more comprehensive series of experiments described in a former memoir to this Society §.

The present collection contains only one strictly arctic lichen, *Dactylina arctica*. But it contains several lichens that are apparently *new*, inasmuch as I cannot refer them to any of the species or varieties described in Th. M. Fries's 'Lichenes Arctoi Europæ Grœnlandiæque,' in his 'Lichenes Spitsbergenses,' in Nylander's 'Lichenes Scandinaviæ,' in the various monographs on arctic lichens scattered through botanical serials to which I have had access; or to the specimens contained in the various public or private herbaria I have examined ||.

These *new* forms are mostly referable to the genus *Lecidea*, viz. :—*L. Grœnlandica*, *L. Campsteriana*, *L. Friesiana*, *L. Egedeana*, *L. Discœnsis*, *L. Vahliana*. But they represent also several other genera or pseudo-genera, viz. :—*Pertusaria paradoxa*, *Verrucaria tartaricola*, *V. Campsteriana*.

There are, moreover, various *parasites*—micro-fungi or micro-lichens, or their isolated pycnidia or spermogonia—to which I have not thought it proper at present to assign distinctive names.

The main interest of the collection attaches, however, not to the character or number of the apparently novel forms it contributes to science, but to the illustrations which it offers of the following, among other, characteristics or peculiarities of extreme northern, arctic, or alpine lichens, viz. the frequency of occurrence of :—

1. *Parasitic Micro-Fungi or Micro-Lichens*, or their separate pycnidia or spermogonia, affecting either the thallus or apothecia of the host, or both.

* *Betula nana*, L.

† Or a moss closely resembling it.

‡ Thus I have pointed out its abundance in Iceland and Norway: 'Flora of Iceland,' p. 23, Edinb. New Philos. Journal, July 1861; 'Lichen-flora of Northern Europe,' p. 406, Journal of Linn. Society, Botany, vol. ix.

§ 'On Chemical Reaction as a Specific Character in Lichens,' Journal of Linn. Society, Botany, vol. xi. p. 36. Vide also Trans. Botan. Soc. Edinb., vol. x. p. 82.

|| There were (in 1858) *few* Greenland lichens in the Kew Herbarium; and *none* in the Herbaria of Linnæus in the Linnean Society, nor in that of the University of Edinburgh.

Such parasites are more or less common* in species of the following genera:—*Cladonia*, *Ramalina*, *Cetraria*, *Thamnolia*, *Solorina*, *Peltigera*, *Stereocaulon*, *Parmelia*, *Physcia*, *Umbilicaria*, *Squamaria*, *Placodium*, *Lecanora*, *Lecidea*, *Endocarpon*, *Verrucaria*.

2. *More than one form*, in the same lichen-species, of apothecia, spermogonia or pycnidia, or of their contained reproductive corpuscles—sporidia, spermatia, or stylospores. Illustrations are to be found in *Lecanora subfusca*, *L. tartarea*, *L. varia*, *Squamaria chrysoleuca*, *Dactylia arctica*, and *Thamnolia vermicularis*. And I have entered more fully on the subject in my paper on “Polymorphism in the Fructification of Lichens” †.

3. *Sterility*.—Mere absence of apothecia, spermogonia, or pycnidia ‡; or their occurrence in an abortive or degenerate form.

Among the more marked illustrations are the following:—*Sphærophoron coralloides*, *Thamnolia vermicularis*, *Usnea melaxantha*, *Parmelia saxatilis* and *olivacea*, *Physcia pulverulenta* and *stellaris*, *Cetraria islandica*, *cucullata*, and *nivalis*, and *Nephroma arcticum*.

4. *Deformities of* (I.) the reproductive and (II.) the vegetative organs, the various results of:—

- (a) Hypertrophy or atrophy.
- (b) Degeneration or abortion.
- (c) Homologous or heterologous growths.

These deformities include, in regard to the

(I.) Reproductive system:—various monstrosities of the apothecia, spermogonia, or pycnidia, which are illustrated *e. g.* by the genus *Lecanora*.

(II.) Vegetative system:—

- (a) Disproportionate development, *e. g.* of the horizontal, foliaceous, or squamulose thallus in *Cladonia*, the podetia being absent or dwarfed.
- (b) Clothing of podetia with warts, granules, squamules, or folioles, *e. g.* in *Cladonia* and *Stereocaulon*.
- (c) Isidioid and Sphærophoroid growths, the former represented by the pseudo-genus *Isidium*, the latter by the var. *sphærophoroidea* of *Parmelia saxatilis*.

The development of *Isidia* is illustrated by *Lecanora glaucoma*, *tartarea*, and *parella*; by *L. spodophæa*, Whlnb., a Finmark and Nordland lichen; and by *L. aipospila*, Whlnb., a Spitsbergen one,—the two latter being figured in our own ‘English Botany’ (t. 2083). The isidioid states of these *Lecanoræ* constitute pseudo-species of the pseudo-genus *Isidium*, especially *I. corallinum* and *I. coccodes*. Mudd is wrong in referring all British forms of *Isidium* (save *oculatum*) to species of *Pertusaria*. *Isidium* cannot be referred to that genus in Green-

* *Vide* “Enumeration of Micro-Lichens Parasitic on other Lichens,” Quart. Journal of Microscopical Science, January, April, and October, 1869.

† ‘Report of British Association,’ 1867, p. 89; and ‘Quart. Journal of Microscopical Science,’ January, 1868.

‡ This includes *rudimentary* conditions, *e. g.* those constituting the pseudo-genus *Lepraria*.

land, where none of its species have yet been found, save a parasite which I assign to it doubtfully*. The truth is, that *Isidium* is a condition of several saxicolous species, both of *Pertusaria* and *Lecanora*, and probably also of *Lecidea* †.

- (d) Growth of warts or tumours, sometimes spherical, and ultimately detached or detachable, *e. g.* in *Lecanora ventosa* and *L. tartarea*.
- (e) Excessive development of the gonidic element in the form of soredia, constituting the pseudo-genus *Variolaria*.
- (f) Dwarf states, especially where the thallus is fruticulose, *e. g.* in *Stereocaulon* and *Cladonia*.

5. *Abnormalities of colour*, *e. g.* the colour-mottlings of the podetia of *Cladonia*.

6. *Unusual habitats*.

- (a) Other, generally higher, lichens, especially when old, decayed, and bleached by the weather, *e. g.* :—

(I.) *Parmelia saxatilis* on the scyphi of *Cladonia pyxidata*, and on the thallus of *Umbilicaria vellea*.

(II.) *Physcia pulverulenta* and *stellaris* on the thallus of the same *Umbilicaria*.

(III.) *Lecanora sophodes* on *Umbilicariæ* and *Cladoniæ*.

(IV.) *Lecidea myriocarpa* on *Umbilicariæ*.

- (b) On dried excrement of animals, *e. g.* *Lecanora polytropa* on that of birds.

- (c) On the bleached bones of dead animals, *e. g.* *Squamaria saxicola* on the vertebræ of Whales.

7. *Athalline conditions*: the apothecia constituting the entire plant, and growing parasitically or not, *e. g.* *Lecidea parasema*, *vernalis*, and *myriocarpa*.

8. *Variation in the character of the sporidia* in the same species, *e. g.* *Lecidea parasema*, *vernalis*, *petræa*, *atro-alba*, *geographica*, *alpicola*, *sanguineo-atra*, *Friesiana*, *insignis*.

9. Absence of any fixed or constant *anatomical distinction between spermogonia and pycnidia*, spermatia and stylospores, sterigmata and basidia, *e. g.* in *Peltigera canina*, *Nephroma arcticum*, *Lecidea cladoniaria*, *Lecanora subfusca*.

The organs known as *thecæ* and *spores* in *Lichens* being exactly what are called *asci* and *sporidia* in *Fungi*, it does not appear desirable to maintain different designations for the same organs in two groups so closely allied as *Fungi* and *Lichens* ‡. I have

* Vide *Pertusaria paradoxa*, described under *Lecanora oculata*.

† Vide author's 'History of British Lichens,' pp. 326 & 341; and paper on "Parasitic Micro-Lichens," formerly quoted (p. 307).

‡ Some Ascomycetes (says Berkeley in the 'Treasury of Botany') approach Lichens so closely as to be scarcely distinguishable, *e. g.* in their spermogonia and pycnidia. *Fungi* and *Lichens* are "so closely allied that it is often difficult to tell to which division some given species may belong." Hence he includes both under the common designation "Fungals." I have pointed out in various papers (*e. g.* "New-Zealand Lichens and Fungi," Trans. Royal Society of Edinb., vol. xxiv. p. 434) that there is a large group, provisionally termed "Fungo-Lichens," which have the characters equally of *Fungi* and *Lichens*, and which it is at present impossible to assign preferentially or exclusively to either family.

therefore, in the present memoir, adopted Berkeley's suggestion that the terms *asci* and *sporidia* should be substituted for thecae and spores. In his 'Outlines of British Fungology' (1860), he defines an *ascus* to be "a delicate sac containing sporidia," and *sporidia* as "reproductive cells produced within asci or sporangia from a transformation of their endochrome;" while *spores* are "reproductive cells borne freely on the sporophores"*. In the 'Treasury of Botany' (1866), he describes *thecæ* as a now obsolete and unnecessary term. Whether or not it is unnecessary, it cannot be considered obsolete so long as it is used by so voluminous and original a lichenographer as Nylander. Körber and Th. Fries employ the term "asci," but not "sporidia," agreeing with Nylander in preferring the term "spores." There is thus considerable difference in the nomenclature by different authors of the same organs in lichens; and hence a confusion arises, which can only be remedied by the substitution of a *uniform nomenclature*, one applicable to the same organs in *both fungi and lichens*.

I have here also followed the German school of lichenologists in describing simple sporidia as monoblastic or *unilocular*, and compound ones as 2-, 3-, or poly-blastic or *multilocular*. Mudd has adopted this nomenclature in his 'British Lichens' (1861); but Nylander prefers to designate compound sporidia as *septate spores*. It does not appear to me that the one nomenclature has any marked superiority over the other. But it is most desirable here, as in the case of "asci" and "sporidia," that there should be *uniformity of nomenclature* for the same organs, not only among lichenologists, but common to fungologists and lichenologists.

II. Enumeration of Lichens collected, with special Commentary thereupon.

Genus 1. EPHEBE.

Sp. 1. *E. pubescens*, L. Egedesminde.

Genus 2. COLLEMA.

1. *C. melænum*, Ach.—Associated with *Cladonia cervicornis*, Jakobshavn. In Europe the thallus is sometimes the seat of a parasitic *Sphæria* †.

2. *C. flaccidum*, Ach.—Jakobshavn. Agrees in characters with the English plant (E. Bot., t. 2197). I do not think the mere character of the sporidia sufficient to separate *Synechoblastus* as a *genus* from *Collema*.

The foregoing *Collemata* occur in Brown's collection as mere scraps, and not in fruit.

Genus 3. CALICIUM.

1. *C. furfuraceum*, L.—On loose soil about the Illartlek glacier. Apothecia young, still green: contain no sporidia. Has the usual citrine-yellow thallus and other characters of the European plant (E. Bot., t. 1910 ‡, and Schærer's Exs. 14). Apparently the only representative in Greenland of the large European family Calicia. It grows also in

* Glossary, pp. 411 & 414.

† *Vide* author's "Memoir on Spermogones and Pycnides," Trans. Royal Society of Edinb., vol. xxii. p. 272.

‡ The references to the plates of the 'English Botany' apply to the *second* edition (1843).

Spitzbergen*. My herbarium contains a specimen similar to the Greenland plant, on moss from Branksdale, Yorkshire (*Mudd*); but in Britain it is more common on rotten tree-roots and trunks.

There is considerable variation in the size and colour of the *sporidia* in specimens from different localities. Thus in the type in Schærer's Exs. 14, they are colourless, spherical, with a diameter of '00013". In var. *fulva*, L., Schær. Exs. 296, they are pale brown, spherical, with a diameter of '000083". In var. *sulphurella*, Fr., Schær. Exs. 639, they are pale brown, simple, spherical, very abundant, with a diameter of '00010" to '00013". In another specimen, in Nylander's Exs., they are pale brownish-yellow, sometimes granular, simple, spherical, with diameter of '000083". The *spermogonia* would appear to be rare; and, so far as I am aware, they have not been described or observed by other authors. I met with them in Schærer's Exs. no. 14, and Hepp's Exs. 154 (=var. *sulphuretia*), as very minute, brown specks, scattered in great abundance, like grains of the finest dust, over the white pulverulent thallus. The envelope was of a deep brown, the spermatia atomic, and the sterigmata apparently very short and simple. There appears to be insufficient ground for separating *Coniocybe*, as a genus, from *Calicium*.

Genus 4. SPHÆROPHORON.

1. *S. coralloides*, Ach.—Illartlek glacier; Egedesminde. Several forms occur, none of them in fruit, but some of them spermogoniferous. *Spermogonia* exist, in the typical form of the plant, only in one fragment, as deep-brown papillæ or ring-like warts, crowning the under surface of the pale nodding tips of the branchlets. The thallus in these forms is always glossy; its surface frequently deformed by expansion and wart-growth; the colour black, or black-mottled, or rusty-red—or mottled rusty-red, brown, or lilac. The tips of the ramuscles are conspicuously white, contrasting well with the buff or reddish-brown colour of other portions of the plant.

Transition-forms between *coralloides* and *compressum* are common, possessing two distinct surfaces:—the one convex and deeply coloured; its opposite pale or white, and flattened, sometimes lacunose or fossulate. Spermogonia are more common on those forms which belong to *compressum* of authors. As they occur in this so-called species in other countries, they are figured in my 'Memoir on Spermogones'† (plate v. figs. 44 & 48, 49 & 52). Spermogonia, in the larger, laxer, more ramose forms of *coralloides*, occur on the nodding apices, just as in passage-forms to *compressum*.

There are various dwarf states of *coralloides* in Greenland, one of which forms a flat, isidioid, but tessellated surface, and might appropriately be designated form *isidioidea*, were we to follow the example of systematists and give names to such mere stages of growth. Here the branches are short, simple, and compactly arranged, sometimes assuming a Pycnothelioid character, sometimes resembling forms of *Lecanora tartarea* or *L. oculata*. In other cases, they become broadened and subfoliaceous, resembling certain states of some of the foliaceous *Cladoniæ*, e. g. *cervicornis*. Sometimes these subfolia-

* Th. Fries, Lich. Spitsb., p. 47.

† The terms *Spermogones* and *Spermogonia* are synonymous, the former being simply the *English representative* of the Latin or Latinized word.

ceous states are associated with similar, very deformed, dwarf, ventricose or Pycnethelioid conditions of *Cladonia amaurocræa*.

A specimen in the Kew Herbarium from Disco (Lyall, 1852), labelled *fragile* by Nylander, is simply a short, cæspitose, sterile form of *coralloides*.

With *iodine* the white medullary tissue of passage-forms into *compressum* give, even in the same specimen, either no reaction, a pale violet, or a distinct blue. I have tried the effect of a diluted tincture of iodine on many specimens of *S. coralloides*, *fragile*, and *compressum*, from different parts of the world, collected at different times, and I am satisfied of its uselessness as a specific test. The reaction is both slow and difficult to obtain—where it occurs at all; for it is sometimes absent. It is quite capricious, therefore, being only sometimes violet or blue. With *bleaching solution* the medullary tissue of *coralloides* gives a brownish or blood-red colour like that of *Lecanora tartarea* under the same reagent; or this reaction is faint; or no reaction occurs; or colour is exhibited only in the dwarf, dense, subsidoid forms. For the development of reaction at all, the cortical layer must be bruised, and the medullary tissue exposed, by rubbing or breaking up the former, when moistened, with the stirrer.

Genus 5. CLADONIA.

1. *C. alcicornis*, Flk.—Jakobshavn, intermixed with various mosses; occurs sparingly. Under surface very white, with incurved margins. As in *cervicornis*, the folioles are sometimes very densely tufted, forming spherical masses. The podetia are very short, deformed, and inconspicuous, seated barrelwise on the folioles. The same black, punctiform parasite that infests *cervicornis* grows on the podetia, and sometimes on the under surface of the folioles, of *alcicornis*.

I regard *alcicornis*, as I do also *cervicornis*, as non-autonomous, but as mere conditions of *Cladonia* in which the horizontal foliaceous thallus is developed disproportionately to the podetia. *Alcicornis* passes, on the one hand, into *cervicornis*, and on the other into *endivicefolia**, these three so-called species differing only in the size of the thalline divisions. According to the latest (*chemical*) classification of Leighton and Nylander, *cervicornis* holds, however, position as a separate *species* †; while it has been hitherto generally assigned to *verticillata* as a *variety*. Coemans has shown that, even by so distinguished a lichenographer as Acharius, *alcicornis* was confounded not only with *cervicornis*, but with *pungens*, *degenerans*, and *pyxidata*. Some of its forms (*e. g.* in the Menziesian Herbarium ‡) I have been enabled to refer to *pyxidata*. In Leighton's Exs. no. 15, I found parasitic pycnidia on *alcicornis*—as described in my 'Mem. Spermog.' (p. 161).

2. *C. cervicornis*, Ach.—Jakobshavn, terricolous. Podetia and underside of folioles studded over with a black punctiform parasite. Upper surface of folioles becomes bright lemon-yellow with *Liquor potassæ*, while underside exhibits no reaction. The

* Coemans makes *endivicefolia* a var. of *alcicornis*, while other lichenologists have done just the reverse, regarding *alcicornis* as a var. of *endivicefolia*!

† A position also assigned by them to *Cl. cornuta*, L., *degenerans*, Flk., *fimbriata*, Hffm., *crispata*, Ach., and *emocyna*, Ach., all of which I hold to be mere conditions or *forms* of other species.

‡ Contained in the Herbarium Hall of the Royal Botanic Garden, Edinburgh.

folioles are frequently very thick—and when moist, semi-cartilaginous—when dry, brittle. They are densely arranged, and form flat tufts. These brown microphylline states resemble the thallus of *Lecidea (Psora) ostreata*, Hffm. The lobes are fringed with dark brown or blackish-brown tubercles, resembling spermogonia in site and shape; sometimes these tubercles are seated on the surface of small digitate prolongations of the lobes. They are seen only under moisture, and even then with difficulty, by reason of their minuteness. Their envelope is of such tenuity that it nearly loses cohesion under pressure of the microscope glass: it is composed of brown irregular cells, normally spherical. The contents are myriads of corpuscles, resembling the stylospores of *Peltigera*, but pale green, and shaded, not distinctly granular, mostly spherical, varying little in size and form, with a diameter of $\cdot 00015''$ to $\cdot 00020''$, sometimes adhering in twos and having then a resemblance to figure-8-shaped sporidia.

In the Kew Herbarium, certain specimens, labelled *cervicornis*, are really referable, I think, to *pyxidata*, *degenerans*, *gracilis*, and *verticillata**, while I refer no. 754 Mougeot and Nestler's Exs. to *pyxidata*.

3. *C. squamosa*, Hffm.—Jakobshavn. Various forms; sometimes corticolous (on birch). Its spermogonia are those typical of the genus, terminal, deep brown, barrel-shaped; the ostiole spherical and distinct under the lens. Spermatia straight, in myriads, on digitate sterigmata.

Various forms of *squamosa* and *gracilis* are confounded with each other in the Kew Herbarium.

4. *C. gracilis*, L.—Jakobshavn; Illartlek glacier. Various states, mostly deformed. Colour varies from white or pale, through brown, to deep ash-grey or black. Bases of podetia, which are immersed in moss (apparently *Rhacomitrium lanuginosum*), are often or constantly quite black. Sometimes the podetia are black from base to apex, or the upper portion is dark brown. These dark forms are covered sparingly with white or very pale green, irregular, tumid phyllocladia, which are very conspicuous on the dark podetia. Deformed scyphi sometimes give off secondary podetia. The phyllocladia of the podetia (in some forms only) give the beautiful lemon-yellow of *cervicornis* with potash. A pale, white and green-spotted form, growing in the shade of *Cetraria cucullata*, shows no reaction. Sometimes the most deformed conditions are the most elegant. Podetia are sometimes studded over, about their tips, with a very minute, black, punctiform parasite, which has the structure of a *Torula* †, consisting of chains of oblong, brown, spore-like cellules. The parasite is seen with difficulty even under the lens; it is to be found equally on fertile and sterile podetia. On one of the podetia I also met with a brown, 2-ocular sporidium, having the characters of the sporidia of *Buellia* or *Rinodina*; obviously it was a wanderer, and could have no relation to the *Cladonia* or its parasite. I have repeatedly met with such errant sporidia in different lichens ‡. Occasionally their presence may, to the student, be the source of considerable confusion.

* Coemans regards *cervicornis* as a macrophylline var. of *C. verticillata*, Fr.

† The same *Torula* apparently, which is probably *T. lichenicola*, Linds., occurs also on *Lecanora tartarea* and *L. oculata* (q. v.).

‡ Vide *Lecidea petræa*, n. 5.

Forms of *gracilis* are, in the Kew Herbarium, confounded with *squamosa*, *amaurocræa*, *uncialis*, *pyxidata*, and *furcata**.

5. *C. furcata*, Schreb.—Godhavn. In fruit. Some of its forms have been confounded with states of *gracilis* †, *uncialis*, and *rangiferina* ‡, in the Kew Herbarium.

6. *C. rangiferina*, L.—Egedesminde. Gives no reaction with potash. Rare and sterile in Spitzbergen, according to Th. Fries; but it would appear to be abundant in some parts, at least, of Greenland, where it ascends to 200 feet above the sea. *Cl. sylvatica* is commoner than the type in Spitzbergen, but nowhere plentiful, and always sterile (Th. Fries). The extent to which *C. rangiferina*, in some of its forms, grows in Greenland is of interest in connexion with the question of the *food of the Reindeer* in that country. Crantz, in his 'History of Greenland' § (1820, vol. i. p. 61), describes what is evidently *C. rangiferina* as "the food of the reindeer in winter; and might, in case of necessity, preserve the life of a hungry man." He assigns to this lichen, as well as to *Cetraria Islandica*, an unpleasant taste at first; "but when chewed and swallowed, they have" (he says) "a sweet flavour like rye." Hares also are said by Crantz (p. 66) to live partly on "White Moss" (*C. rangiferina*). There can be no doubt of the occurrence of the reindeer in Greenland; but it does not follow that there is a profusion of "Reindeer Moss," as it is well known that that animal can and does subsist on a considerable variety of *other* foods. Dr. Brown informs me that "The reindeer food does not consist to any great extent of *Cladonias* in Greenland, as they are rather scarce; but of other lichens, all species of grass, shoots of *Betula*, *Vaccinium*, *Empetrum*, &c."|| He adds, "the reindeer of Greenland is, in my opinion . . . only a climatic variety of the Scandinavian species, and may be characterized as *Rangifer tarandus*, var. *Grænelandicus*, Kerr (Linn. 1792)." It is certainly a fact that *C. rangiferina* occurs very sparingly in the present collection, and equally rarely in the Greenland collections of lichens I have examined in Kew or other public herbaria.

In the Kew Herbarium forms of *rangiferina* are confounded with states of *uncialis* and *furcata*. Even Acharius confounded *rangiferina* with *furcata* (Coemans). But these errors, if errors they be, are quite excusable, and indeed are unavoidable; for *rangiferina* passes into *furcata* through *pungens* and *rangiformis*. No. 754 Mougeot and Nestler's Exs. is partly referable to *furcata* (= *Lichen pungens*, Ach., in fruit). The little value of the present unnecessarily elaborate classification of the *forms* of *rangiferina*—

* *E. g.* in var. *surrecta*, Flk., according to Coemans, who points out that even Acharius confounded it with *crispata*, *amaurocræa*, &c.

† Especially var. *corymbosa*, Ach. (Coemans).

‡ Especially certain brown states thereof; the resemblance is sometimes so close that the two groups are confounded in the Kew Herbarium and all large herbaria.

§ English translation from the German.

|| In a paper "On the Mammalian Fauna of Greenland" (Proceed. of Zoolog. Soc. London, 1868, pp. 352 and 355, and Petermann's Geographische Mittheilungen, 1869, pp. 464 and 465), Dr. Brown points out that there has been a gradual decrease in the number of reindeer in Greenland, in consequence of their indiscriminate slaughter for the sake of the skin alone, of which the yearly production was at one time 10,000 to 20,000. "I can hardly think" (says he) "that . . . reindeer-moss . . . forms any great portion of its subsistence, as that lichen is nowhere found in Greenland in such quantity as to afford food for any animal." Compare certain remarks in my paper, "The Lichen-flora of Greenland," pp. 53-56, Trans. Botanical Society of Edinburgh, vol. x. 1869.

the non-necessity for the present redundancy of *names*, may be illustrated by the fact that the latest monographer of the genus *Cladonia* (Coemans) regards (and, I think, correctly) *gigantea* merely as the sterile, and *cymosa* as the spermogoniferous condition of the type. He also, quite as properly, merges *pumila* and *alpestris* [the latter not being necessarily an Alpine form] in the var. *sylvatica*, which, according to chemical testing, should stand as a separate species*.

7. *C. uncialis*, L., form.—Godhavn; Egedesminde. Deformed. Passes apparently into

8. *C. amaurocræa*, Flk.—Godhavn; Egedesminde. A monstrous form, exhibiting the most singular deformities, which defy all efforts at description, as do also similar conditions of *C. deformis*, *cervicornis*, *gracilis*, *pyxidata*, and *cornucopioides*. Very frequently there are bulgings of the podetia as in *Pyncothelia*, such deformities being confined to, or commonest in, dwarf conditions of the plant. *Cl. uncialis*, var. *adunca*, in my herbarium, from the top of Ben Mac Dhui, so named by Mudd, is deformed like Greenland states of *C. amaurocræa*; and it is moreover undistinguishable from what Mudd calls, in my herb., *C. amaurocræa* †, var. *diceræa*, from the same Scottish locality. Coemans thinks *adunca* undeserving separate nomenclature; but he assigns it to *uncialis*.

9. *C. deformis*, L.—Jakobshavn. The eccentricities of this so-called species are endless; and it is useless attempting any further description than a general one of its *leading variation-forms*. It occurs with or without podetia. In the former case there are sometimes carious, sterile scyphi, $\frac{3}{4}$ " to 1" in diameter. Sometimes the scyphi are margined by secondary podetia, crowned by the ordinary scarlet fringe. Sections of the podetia are sometimes gamboge-yellow, and exude a glutinous juice. The reaction with potash is bright lemon-yellow, or none. Podetia are frequently very granular, one of many characteristics of the northern *Cladoniæ*. At other times they are covered more or less copiously with squamules or folioles, their aspect being then completely altered. This change in character is assisted by occasional ramosity. These foliose or ramose states are sometimes brown, as in *furcata*. Sometimes the whole squamulose podetium is studded over with minute red warts. It is impossible to assign these warts to either abortive apothecia or spermogonia, inasmuch as they exhibit no normal reproductive structure. They are probably—as in other positions, in this and other *Cladoniæ*, in which they occur—sometimes the one, sometimes the other organ in an undeveloped state.

Occasionally the podetium is expanded into a single, irregular, thick, subcarious foliole, very granular, like the ordinary podetia. Sometimes the plant consists entirely of phyllocladia, ordinary podetia being absent. These folioles are tumid, irregular, densely arranged, forming a psoroid cæspitose thallus, as in similar forms of *cervicornis*. The colour is changed from the ordinary beautiful light green to a lurid brown. These folioles are frequently studded over with apothecia of a Lecidine character, flat, brown, irregular in form, though generally oblong-oval or elongate, girt with a thin exciple. They are seated directly on the thallus, or they constitute the terminations of very short, inconspicuous, terete, abortive podetia or stipes. They have the aspect of young, or degenerate, Lecidioid apothecia; but their structure is that of

* It does so stand in the recently published 'Lichenes Britannici' of Crombie (1870).

† *C. stellata* and *amaurocræa* of Mudd's 'British Cladoniæ' do not appear to me to differ in any essential respect.

Torula, their contents consisting of myriads of spherical brown spores about '00010" in diameter. These apothecia or pseudo-apothecia sometimes resemble the apothecia of *Lecidea cornea*, Sm., but they never show the structure of a normal lichen-apothecium (the hymenial elements).

The folioles of the *Cladonia* are also studded over or fringed with what appear to be various forms of spermogonia, barrel-shaped, like those typical in the genus, or verrucæ-form.

There are two series of Greenland forms of *deformis*—one with scarlet fruit-warts, which I refer to the *cornucopioides* type, the other with brown fruit-warts, referable to *pyxidata*. I do not, however, admit the distinction between erythrocarpous and phæocarpous *Cladoniæ* to be other than one of convenience. I have elsewhere pointed out that, both naturally and artificially, the scarlet apothecia in *Cladonia* became brown*; and I have to add that, where this colour-distinction is abolished, there is no other good distinction between (*e. g.*) *pyxidata* and *cornucopioides* and their respective forms and allies.

In the Kew Herbarium I found *deformis* confounded with *carneola* and *fimbriata*. Its apothecia are described by Nylander and other authors as scarlet; but they are also occasionally of a brown colour. And accordingly as these apothecia or pseudo-apothecia, with their spermogonia, whether normal, abortive, or degenerate, are red or brown, the plant is, I think, referable, as a mere *state*, to the *cornucopioides* † group on the one hand, or the *pyxidata* series on the other. The phyllocladia of *deformis*, as well as of *gracilis* and *pyxidata*, especially in certain sterile, degenerate conditions, are the common site in Greenland, as in other northern or Alpine countries, of black, punctiform, parasitic Micro-fungi, referable apparently to different species and genera. Thus in Schærrer's Exs., No. 49, I met with parasitic pycnidia, which have been described in my Mem. Spermog. (p. 164).

10. *C. bellidiflora*, Ach.—Egedesminde: a peculiar dwarf form, resembling a *Bæomyces*. Apothecia very large and deformed, seated amidst the horizontal folioles. Podetia very carious, and so short and deformed as to appear absent. The plant agrees in general aspect, save as to the phæocarpous apothecia, with *C. cæspititia* and *syncephala* of Mudd's *Cladoniæ*, (Exs.) Nos. 29 and 44. The Greenland plant may equally appropriately be referred to *cornucopioides*, as I believe the latter and *bellidiflora* are merely different forms of the same type. In the Kew Herbarium I met with specimens having brown* apothecia, the colour having probably altered by desiccation, the plant in this case being undistinguishable from *pyxidata*.

In the Menziesian Herbarium some specimens, labelled *cornucopioides* (or *coccifera*), are also referable to the protean *pyxidata*. In the Kew Herbarium *bellidiflora* and *cornucopioides* are frequently confounded,—a circumstance that merely shows their close

* *Vide* the author's 'British Lichens' (1856, p. 268).—The earlier lichenologists state that the red apothecia of *Cladoniæ* become naturally brown in moist situations, or with age; while the same change may be artificially induced by steeping in water, or exposure to ammonia. In nature the colour appears to vary with locality or conditions of growth and decay,—*e. g.* shade and moisture, age or desiccation producing the same effect as chemical reagents.

† Most of the forms I saw in the Kew Herbarium were referable to the fimbriate conditions of *bellidiflora*.

relationship. If they *are* to be separated, even as varieties or forms, it is convenient to refer all the major states of growth to *bellidiflora*, and the minor to *cornucopioides*. Sometimes the podetia of *bellidiflora* are as copiously squamulose as in *deformis*.

11. *C. pyxidata*, L.—Jakobshavn; Illartlek glacier.—Scyphiferous, but sterile. To this species I refer *degenerans* and *fimbriata*, with all their forms. In the Kew Herbarium, I met with several forms identical with states of *bellidiflora* and *cornucopioides*, save as to the colour of the apothecia—a character which is inconstant in the *Cladonia*, as it is in many other Lichen-genera, *e. g.* *Lecidea*. In the same Herbarium, some forms of *pyxidata* (*e. g.* *tubæformis*) are confounded with *uncialis*. Coemans also points out that *pyxidata* is confounded with *carneola*, Fr., by var. *carneo-pallida*; as well as with *cenotea*, *macilenta*, *cariosa*, and *deformis*.

12. *C. degenerans*, Flk.—Godhavn; Jakobshavn. Podetia blackish-brown, having a dirty or sooty aspect. No apothecia occur; but spermogonia abound, as deep-brown little barrel-shaped bodies, distinct under the lens, fringing the closed scyphi, or studded irregularly over the surface of their diaphragm, or of the podetia. Ostiole large and patent. In the Kew Herbarium *degenerans* is confounded with *uncialis*, and is partly referable to *furcata* and *squamosa*, as well as to *pyxidata*. Coemans shows that Acharius confounded it with *pungens* [by var. *nivea*, Ach.]—and with *turgida*, *cenotea* and *glauca*, Flk., as well as with *pyxidata*, *furcata*, and *squamosa*. In truth it must be regarded, like not a few other so-called species in the genus *Cladonia*, as a mere *condition* of other types.

13. *C. coralloidea*, Ach.—Jakobshavn. To this may be referred some specimens destitute of podetia, in which the horizontal thallus consists of densely aggregated phyllocladia, with tumid margins, brown and psoroid, like the thallus of *Lecidea lurida*. It is not, however, an easy matter to refer every specimen in the genus *Cladonia* to a particular “species.” The variation-forms are so extreme, the deformities so remarkable, abortive and degenerate as well as sterile conditions so frequent, passage-forms so puzzling and numerous, that all that can be properly attempted in most cases is to select the *types* of form and growth, and classify them in a general way. To “determine,” in the sense of *naming*, every specimen met with is as absurd as it is unnecessary and impossible! It is sheer waste of effort on the part of the student. Certain forms of the psoroid (horizontal) thallus of *coralloidea* appeared referable to *cervicornis*; while, on the other hand, one form of what seems to be *pyxidata*, has a parmelioid (horizontal) thallus only; that is, it consists of rounded, large-lobed folioles, either sterile or studded over with subsessile or sessile apothecia or spermogonia—variously degenerate—none fertile. According to Coemans, *coralloidea* is partly referable to *degenerans*, partly to *crispata* and *decorticata*.

14. *C. fimbriata*, Hffm.—Jakobshavn. The podetia are studded over with irregular, black papillæ, which are pycnidia. Their envelope is very deep brown; the cavity is occupied by myriads of stylospores, spherical, oval, or pyriform, about ‘00009’ in diameter, pale olive, generally granular, seated on short, thick, simple basidia. The same parasite apparently occurs also on *C. deformis* and other species—on the scyphi, podetia and squamules alike.

The specimens of *fimbriata* in the Kew Herbarium are referable mostly to *pyxidata*,

but also to *gracilis*, *cornucopioides*, and *deformis*. Coemans regards it as a var. of *pyxidata*, including as subvarieties or subforms, *glauca*, Flk., *ochrochlora*, Flk., and other pseudo-species. He describes *fimbriata* as passing into *pityrea* and *cæspititia* (other varieties of *pyxidata*). The varieties or forms *chlorophæa* and *simplex* of *pyxidata* in Mudd's *Cladoniæ* (Exsicc.) are referable to *fimbriata*. In the Kew Herbarium I found specimens labelled *fimbriata*, though generally with brown, sometimes with scarlet, fruit-warts*. The plant is therefore partly referable to the erythrocarpous† group, of which the type is *cornucopioides*; and it would appear that it is to be properly regarded, like *degenerans*, as a mere condition of several different species!

As a group the Greenland *Cladoniæ* exhibit the following peculiarities—many of which are common, not only to the lichens of Greenland in general, but to those of Arctic and Alpine countries or districts—viz., the frequency of:—

- (a) *Sterility*—both as to apothecia and spermogonia.
- (b) *Monstrosity*, or deformity, abortion or degeneration, equally of the vegetative and reproductive organs.
- (c) Growth of *parasitic Micro-fungi*.
- (d) *Discoloration* or mottling (black or other), especially of podetia.
- (e) Absence of podetia, and increased *development of the horizontal foliose thallus*, which acquires a psoroid or parmelioid character.
- (f) Clothing of podetia with *granulosities, warts, squamules, or folioles*.

The podetia are frequently very black, e.g. in *degenerans* and *gracilis*. The pulviniform warts or squamules, which are scattered over their whole length, are often chestnut-coloured, becoming olive-green under moisture. The foliose condition, without podetia, of the character of *alcicornis* and *cervicornis*, is common; sometimes microphylline, the folioles densely imbricated; sometimes broad and parmelioid, the folioles less numerous and more laxly arranged; generally of a brown tinge above, sometimes very white below.

Occasionally the *Cladoniæ* occur in a rudimentary or *Leprarioid* state. At least, from Godhavn, there are masses of a green *Lepraria* overspreading large areas of decayed vegetation, granular, mealy, and sterile, which resemble what in this country is referred to a *Leprarioid* condition of *Cladoniæ*, and especially of *C. pyxidata*‡. The nature of the pseudo-genus *Lepraria* has not, I think, been satisfactorily determined. If it is, as lichenologists assert, a mere rudimentary condition of various *Cladoniæ*, *Parmeliæ*, and other lichens, it ought to be easy artificially to develop a *Lepraria* into the genus or species to which it properly belongs. But I am not aware of the existence on record of any experiments to this effect. Nor do I know that the natural development has been observed and its various steps or phases recorded.

* I use this term to denote those most irregular warts which sometimes fringe the scyphi, sometimes are studded over the podetia or squamules, in *Cladonia*, which show no normal reproductive structure under the microscope, and which may be either abortive or degenerate apothecia or spermogonia.

† The earlier lichenologists speak of its *purple* apothecia; whence it would appear that they too recognized some of the erythrocarpous *Cladoniæ* under the name *fimbriata*.

‡ Vide *Lepraria* (or *Lepra*) in the author's 'British Lichens' (1856, pp. 266, 327, and 341).

The reaction of potash with the Greenland *Cladoniæ* is most capricious. Frequently it was lemon-yellow. Equally frequently no reaction was exhibited. Never was it of any significance, and still less of any use, in classification.

As the result of his examination of the *Cladoniæ* in the Acharian and Florkean Herbaria, Coemans points out*, as I have elsewhere done †, how useless, and mischievous to science, is excessive elaboration in the nomenclature of *varieties* and *forms*. Acharius himself admits the impropriety of attaching *names* to trivial forms, when he says ('Synopsis,' p. 258), "vix sub nominibus singularibus denotari merentur." Coemans therefore proposes, as I have done, the abolition of a large number of names of varieties or forms—names that indicate only trivial and inconstant conditions of growth!

Of the Greenland *Cladoniæ*, the following are the only types that have good claims to the position of species:—1. *C. rangiferina*, 2. *C. uncialis*, 3. *C. furcata*, 4. *C. gracilis*, 5. *C. squamosa*, 6. *C. pyxidata*, 7. *C. cornucopioides*. All the others are to be regarded as mere varieties, forms, or conditions, more or less of inconstant character, not unfrequently referable to two or more species or types. To this category belong also the pseudo-species *cæspititia*, *cornuta*, *digitata*, *polydactyla*, and many others.

The genus *Cladonia* may be regarded as the equivalent or representative among lichens of the phænogamous genera *Rubus*, *Hieracium*, and *Salix*—with no very clearly isolated types, but with hosts of crosses or intermediates, having characters so changeable as to defy definition!

Gen. 6. STEREOCAULON.

1. *S. tomentosum*, Fr.—Egedesminde; Jakobshavn. Never in fruit. Frequently occurs in a subsidioid condition, muscicolous, or growing among moss, apparently young or rudimentary, as well as sterile, no podetia being developed. The thallus is very white, very irregularly granular or tuberculate, apt to be confounded with states of various *Lecanoræ*, e.g. *tartarea* and *oculata*. The pulvinuli forming this white isidioid crust are frequently large and sparsely scattered. Were a *name* necessary for such a mere condition of development, *coralloidea* would be most appropriate. With potash, the terminal white phyllocladia, or the young, rudimentary, coralloid thallus, give a greenish (lemon) yellow reaction, which may be vivid or very faint; or there is no reaction. There is great confusion in herbaria, as well as in systematic works, between *tomentosum*, *alpinum*, *denudatum*, and other so-called species. Thus a specimen of *alpinum* from the Pyrenees, Nylander refers (in Kew Herbarium) to *denudatum*. It is unnecessary and a waste of time to endeavour to reconcile these differences in opinion between systematists, seeing that there appears no better ground for dividing the genus *Stereocaulon* into a number of species than what can be found to support similarly elaborate classification among the *Cladoniæ*.

S. alpinum, in Spitzbergen, is the seat of the parasitic *Biatorina stereocaulorum*, Th. Fries (L. Arct. p. 188), which occurs on its phyllocladia also on the Alps of Eastern

* "Cladoniæ Acharianæ;" Bulletin de l'Académie Royale de Belgique, sér. 2, t. xix; or translated by Leighton, in Ann. Nat. Hist. vol. xviii. 1866, p. 313 *et seq.*

† "The Arctic Cladoniæ," Trans. Botanical Society of Edinb. vol. ix. 1867, p. 175.

Finmark,—as well as of a parasitic *Sphæria*, which may appropriately bear the provisional name, *S. stereocaulorum*, Th. Fries (L. Spits. p. 36). The *Biatorina* occurs also in Spitzbergen on *S. denudatum*, Flk.

Gen. 7. THAMNOLIA.

1. *T. vermicularis*, Sw.—Jakobshavn. Erect forms: terminate frequently in a curling horn. Podetia also marked by various horn-like offshoots, especially towards their tips, which are sometimes ramose. Warts are also numerous, but show no special structure; they appear to be merely rudimentary offshoots. There are numerous short, thick, or broad deformed conditions, comparable with Hepp's Exs. no. 298. All are hollow and very white, much whiter than any *Cladonia*, resembling somewhat macaroni. With potash, the thallus gives a lemon-yellow reaction. Some specimens show distinctly circumscribed, discoloured patches, which are copiously studded over with very minute, black, immersed, sporidiiferous perithecia. The asci, when isolated, are very beautiful microscopic objects; 8-spored, .0024" long and .0006" broad, giving no blue with iodine. Paraphyses filiform, wavy, very delicate, tips not knobbed nor coloured, but as in *Verrucaria*. Sporidia, when mature, are brown or olive, bilocular and soleiform: .00045" to .00060" long and .00020" broad. In the young state they are ellipsoid, olive, and simple; sometimes, while in the asci, they are 1-septate (or 2-locular) and colourless. They are usually associated with much oily matter, in the form of globules. The perithecia in question appear to be parasitic. They agree with what I have already elsewhere described and figured as *Microthelia vermicularia**.

Scattered on some of the podetia, but not on special portions of the cortical layer, are similar black punctiform perithecia, considerably larger than those of the *Microthelia*. They are *spermogonia*, probably, like the *microthelia*, parasitic, and perhaps referable to it. Their envelope is composed of dark brown, cellular tissue; and they contain hosts of straight, rod-shaped spermatia, .00015" long. They do not correspond in characters either with the *spermogonia* formerly described by myself as occurring in *T. vermicularis* †, or with those described by Nylander ‡.

There is the utmost difference of opinion as to the true character and affinities of the genus *Thamnolia*, and as to the relation to it of the sporidiiferous and spermatiferous perithecia which occur on its surface. Th. Fries (L. Arct.) classes *T. vermicularis* with *Dufourea arctica* as a *Cladonia* of which, he says, the apothecia have not yet been discovered. Some authors separate *Lichen tauricus*, Wulf., as a species. It is said to have been found fertile by Floderus, in Oeland, in 1853, the apothecia having been terminal and those of a *Cladonia* (teste Th. Fries, L. Arct. p. 161). The apothecia of *vermicularis* itself, however, are described by Massalongo in the 'Flora' (1866) as belonging to the *Cladonia* group; and Körber also describes them in his 'Parerga' (p. 14), appa-

* Memoir on Spermogones, p. 528, pl. v. figs. 19, 24; and "Otago Lichens and Fungi," Trans. Royal Society of Edinburgh, vol. xxiv. p. 441.

† Mem. Spermog. p. 143, pl. v. figs. 20-23. Compare the spermogonia of *Bæomyces*, 'Mem. spermog.' pp. 143-145.

‡ Th. Fries describes its spermogonia in his 'Lich. Spitsberg.' p. 31.

rently following Massalongo. *Taurica* passes into *Cladonia gracilis*, var. *macroceras*, in Eland, says Th. Fries (L. Arct. p. 162), and is therefore not autonomous, according to him, but a monstrosity of that *Cladonia*. Mudd includes *vermicularis* in *Cladonia*, in his 'British Cladoniæ,' though not in his 'Manual.' He refers the spermogonia, described by Nylander (in his 'Lich. Scand.' p. 68), to *Endocarpon Crombii*, Mudd (Brit. Clad., p. 36), evidently another to be added to the several *parasites* that infest this puzzling lichen. My *Microthelia vermicularia* is apparently what Th. Fries refers to as a parasitic *Buellia*; it is given in Rabenhorst's Exsiccati, No. 253, and was mentioned by the late Robert Brown (*teste* Th. Fries. L. Arct. p. 161).

Gen. 8. ALECTORIA.

1. *A. jubata*, L., var. *chalybeiformis*, L.—Jakobshavn. *Chalybeiformis* does not deserve a separate name; it is a mere saxicolous form, sometimes as long as corticolous states, though generally blacker and more glossy. Sometimes pruinose or white, largish, sorediiferous warts, mostly oblong-ellipsoid, are seated at the angles of the filaments. Through *bicolor**, it appears to pass into *ochroleuca* (*rigida* and *nigricans*) and *thulensis*.

2. *A. ochroleuca*, Ehrh.—Godhavn; Jakobshavn; Illartlek Glacier. Varies considerably in colour, height, degree of ramosity, and size of its divisions. Its normal colour is beautiful lemon-yellow. In this condition it gives no reaction with potash. But it is also variously buff-coloured, grey, white, brown, or black; or it exhibits various combinations of these colours; or the thallus is variously mottled. The grey forms give a lemon-yellow reaction with potash. The black forms †, which are abundant about Godhavn, do not differ in other respects from the typical plant. There seems to be a series of forms connecting *ochroleuca*, through *thulensis* and *divergens*, with *Cetraria aculeata*. *Ochroleuca*, in Greenland, is sometimes short and cæspitose; or long and simple, corresponding to some of the simple states of *Usnea barbata*.

Var. *rigida*, Vill. (Th. Fries, L. Arct. p. 27), with black apices, is common, but is undeserving separate nomenclature.

3. *A. thulensis*, Th. Fr., does not appear to me to be autonomous. In his 'L. Arctoi,' Fries makes a separate subspecies of it, arranging it under *A. ochroleuca*; while in his 'L. Spitsbergenses,' he makes it a synonym of *A. nigricans*.

4. *A. divergens*, Ach., is sometimes, at least, confounded with, and probably belongs to, *Cetraria aculeata* ‡. It bears white sorediiferous warts, which are minute, compared with those in *chalybeiformis*.

* In specimens of var. *bicolor* in the Edinburgh University Herbarium, from Scotland, Switzerland, and the Arctic regions, the plant does not differ much from var. *nigricans* of *A. ochroleuca*. It is a mere condition or form, referable partly to *jubata* and partly to *ochroleuca*.

† In specimens of var. *nigricans*, determined by Leighton, from Great Bear Lake, in the Edinburgh University Herbarium, the thallus is black only at the tips of the ramuscles; and the plant deserves no separate name, even as a form.

‡ In the Edinburgh University Herbarium I found specimens from Great Bear Lake, Richardson, 1826, determined by Leighton; Newfoundland, Despréaux, 1833, and Lenormand, 1830; 'Arctic Regions,' Parry's Second Voyage, Edwards, and 'Overland Canadian Expedition' of 1823, Richardson; in which the plant might be referred in its various forms, partly to *C. aculeata*, and partly to *A. jubata* and *A. ochroleuca* (*nigricans*).

Gen. 9. CETRARIA.

1. *C. aculeata*, Ehrh.—Jakobshavn. Always sterile. Sometimes corticolous; on bark of birch (as are also *Lecanora tartarea*, var. *frigida*, and *Cetraria Islandica*, var. *leucomeloides*). Not mentioned by Th. Fries as a Greenland lichen at all. In the present collection, however, I met with various forms, which I cannot but refer to this type. Some states, exasperate with bristles, agree with French specimens (in Nylander's Exs.) of var. *acanthella*. *Aculeata* is not very rare in Spitzbergen, though only found sterile, says Th. Fries (L. Spitsb., p. 10); and it would be singular if it were not to occur also in Greenland. Fries has probably referred its puzzling Greenland forms to *Alectoria divergens* (= *Thulensis*, p. 29) or *ochroleuca* (e.g. var. *nigricans*), with which it is frequently associated and intermixed, and from which it scarcely differs sometimes save in colour. With forms of these *Alectoriae* it is very apt, in certain conditions of growth, to be confounded. This being the case, it is a very artificial and arbitrary classification that separates *aculeata* from *ochroleuca*, placing it in a different genus. The old genus *Cornicularia* was much more natural and convenient than its modern substitutes: and anomalous as some of its species were, they were not more so than are those of many genera of the present day; while it was better for the student's purposes to find them grouped together than scattered, as they now are, through various genera such as *Parmelia* (e.g. *stygia*, *tristis*, and *lanata*). Equally artificial is the separation of *Platysma* from *Cetraria*. *Glaucæ* is a Parmelioid form, and stands appropriately enough in a separate section (not genus); but *cucullata* and *nivalis* are too closely allied to *Islandica* to permit of such severation.

2. *C. Islandica*, L.—Godhavn, Egedesminde, Lyngemarken, Jakobshavn, Illartlek Glacier. Various forms occur, always sterile; including *crispa*, and several states intermediate between it and *C. Délisei*, *C. nigricans*, and *C. odontella*, as well as those so-called "species" themselves. It is generally terricolous; but one form, with margins as fibrillose as *Physcia leucomela*, and otherwise resembling that plant, occurs on twigs (probably of birch) near Jakobshavn. This state, with laciniae as long and flexuous as in *P. leucomela*, might appropriately bear the name (if name is required) of form or variety *leucomeloides*. The form from Lyngemarken is decayed, and as white as *P. leucomela*, with a black, Verrucarioid parasite, very conspicuous on these whitened laciniae, resembling externally that which occurs on the young thallus or prothallus of *Lecanora tartarea*, var. *frigida*.

The thallus of *Islandica* is sometimes of a beautiful vermilion colour, or is red-mottled, about the base (e.g. in Egedesminde specimens). None of its forms give any reaction with potash. Fibrilosity of the margin of the laciniae is sometimes a very marked character. The fibrillae are sometimes very long, and are split at their ends into tufts of secondary fibrillulae. The *crispa* forms are sometimes also very denticulate, with narrow laciniae, closely tufted, and of a very deep glossy brown colour.

Some forms closely resemble, save in colour, *C. cucullata*. The laciniae are broader, much curled*; the margins smooth, destitute of fibrillae, cilia, or spermogonia; the

* In the Edinb. University Herb. what is called *C. Grœnlandica* by Despréaux, collected in Labrador in 1833, is this form of *C. Islandica*, with the thallus as much curled as in *C. cucullata*.

extremities of the laciniaë rounded; the whole plant more foliaceous and membranous; the colour more of a uniform dark olive or chestnut, becoming greener under moisture. The plant grows in dense, cæspitose, dwarf masses, exactly like *cucullata*. This is probably the *C. Délisei*, Bory*, which, regarded as a separate species by Th. Fries (Arct. p. 11), is by other lichenologists referred as a mere "variety" to *Islandica*. It has, however, an equal title to belong to *cucullata*, and is, in truth, a passage-form between it and *Islandica*.

It is significant, in regard to its non-use as food or fodder, in medicine or the domestic arts, in Greenland, that Crantz, in mentioning *Islandica*, speaks of it as a lichen which, in *Iceland*, where it is the "Fjallagras," is "eaten instead of bread, or boiled with milk, like oatmeal"†.

3. What appears from Fries's description to be *C. odontella*, Ach. (Th. Fr. Arct. p. 35) occurs in the present collection as mere fragments, associated with *cucullata* from Jakobshavn and about Egedesminde. Its colour is pale chestnut; the laciniaë bristle with spermogonia. It agrees with French specimens (in Nylander's Exs.‡). Just as *Délisei* appears to connect *Islandica* with *cucullata*, *odontella* seems to associate it with *aculeata*.

4. *C. cucullata*, Bell.—Jakobshavn, Egedesminde, Illartlek Glacier. Apparently very abundant, but always sterile as to apothecia; sometimes, however, beautifully spermogoniferous (*e. g.* about the base of the Illartlek Glacier). Generally dwarf and cæspitose; never so tall and beautiful as in Norway. The fine purple mottling of the base, so common in Norway, occurs also here. In Swiss forms, the base is tinged of the same deep purple, which is found to penetrate and pervade both cortical and medullary tissues (in Schærer's Exs.). Thallus in Greenland plants gives no reaction with potash. Passage-forms into *nivalis* abound and are frequently very puzzling.

5. *C. nivalis*, L.—Jakobshavn. Intermixed with *cucullata*, from which it is generally difficult to distinguish it, by reason of the abundance of puzzling passage-forms. In the present collection it occurs very sparingly, and never in fruit, though sometimes spermogoniferous. But it would appear to occur fertile, and in quantity in some parts of Greenland. Thus Professor Dickie, of Aberdeen, sent to me (in Decem. 1859) a specimen in fruit§; and he remarks, in reference to it and its collector (the Surgeon to an Aberdeen whaler), "Covering square acres or rather miles . . . in Greenland; he only got about a dozen *in fruit*." I doubt, however, whether the Surgeon in question was right in supposing that the plant referred to was *nivalis* and not *cucullata*? In some forms of *nivalis* in Greenland, the spermogonia are of the usual (marginal) or typical kind (as described and figured in my 'Mem. Spermog.' p. 302, pl. ix. figs. 42-5), *e. g.* about the Illartlek Glacier, where the thallus is beautifully black-denticulate with spermogonia. But sometimes they are black, barrel-shaped, or rod-shaped columns, seated on the surface, as well as on the edges, of the laciniaë. These elongated and large

* Nylander's *C. nigricans* may perhaps with propriety be referred to *Délisei*.

† *Vide* reference to Crantz, under head of *C. rangiferina*.

‡ Th. Fries, however, gives it only as a Central-Lapland plant.

§ In the Kew Herb. I found a specimen of *nivalis*, from Davis Straits (Lyall, 1852), but sterile.

forms resemble the spermogonia in some states of *Islandica*; and this is an additional reason for not dissociating *nivalis* and *cucullata* from *Islandica* in a separate genus. Potash develops no reaction on the cortical, nor iodine on the white medullary, tissue. The natural colour of *nivalis*, as in *cucullata*, is a beautiful lemon-yellow; but it is seldom so brilliant or pure as in the handsomer Norwegian plant. Passage-forms into *cucullata* lose their lacunosity; while the tips of the laciniae become rounded. Wherever both lichens occur in the same district or country, they are generally intermixed, and are apt to be confounded. Hence, in the Kew Herbarium (*e. g.* some Swiss specimens) and all large herbaria, forms of the one are commonly mistaken for conditions of the other.

Genus 10. DACTYLINA.

1. *D. arctica*, Br.—On a dry mossy slope, near the Illartlek Glacier, in considerable abundance. I did not see the specimens in this collection, which Brown says (Trans. Botan. Society of Edinb., vol. ix. 1868, p. 453) were “accidentally packed in the *Fungi* parcels.” Specimens in my herbarium from the Kikerton Islands* (Taylor) sent me by Prof. Dickie have the characters partly of *Dufourea madreporiformis* (Schær. Exs. 85):—of *Dactylina arctica*, var. *madreporiformis*, Ach.; of *Thamnolia vermicularis*, var. *subuliformis* (Schær. Exs. 86); and of *Dactylina ramulosa*, Hook., a plant of Arctic America, the Rocky Mountains, and Behring’s Straits. *Dufourea muricata*, Laur., which I have not seen, is probably a transition-form between *arctica* and *madreporiformis*. I have no hesitation in referring *arctica*, *madreporiformis*, and *ramulosa* to one genus, and, indeed, to a single species, discarding the genus *Dufourea* as unnecessary. What Dickie labels *Dufourea madreporiformis* is *Dactylina arctica*, sterile, but quite agreeing with specimens of *arctica* in my Herbarium from Arctic America (Great Bear Lake, Richardson).

The Kikerton form of *arctica* bears both apothecia † and spermogonia in abundance. The thallus is quite as ramose as *madreporiformis*, whose branches, however, are narrower in general. It is very different from that of the usual sterile forms of *arctica* in my herbarium, from Arctic America and Cape Adair, which exhibit simple, ventricose, finger-and-thumb-like offshoots from a general, horizontal, hollow, podetium-like thallus, frequently 1" long and nearly $\frac{1}{2}$ " broad. In the latter case, hollowness is visible by reason of the greater size or dilatation of the podetia and their offsets. *Madreporiformis* of equal size would be equally hollow. In the latter species (if a species) the podetia are sometimes hollow, though generally filled with a spongy, white medulla, which gives no reaction with iodine. Nor does the cortical layer show any colour-change

* In Arctic plant-collections, I find three places of similar name, that are apt to be confounded, if they are different localities, viz. :—

1. *Kikerton*, or Kikkerton Islands, which Mr. Brown tells me are in Cumberland Sound, near Frobisher’s Straits, and are therefore unconnected with Greenland.
2. *Kikertait* (=“The place of Islands”) mentioned by Hayes, in his ‘Open Polar Sea’ (London, 1867, p. 68).
3. *Kikertak*, in Greenland (*teste* Th. Fries, ‘L. Arctoi’).

† It is noteworthy that, though apparently abundant in Greenland, *D. arctica* is always there sterile—according to Fries (Arct. p. 160).

under potash. In Kikerton *arctica*, potash and iodine develop no colour-reaction on either cortical or medullary tissues. A few octahedral crystals of oxalate of lime were met with in the thallus.

In the Kikerton plant, the sporidia are simple, spherical, colourless, about '00015" in diameter, with double contour, or granular, or marked with a central nuclear point. Asci blue with iodine. The *spermogonia* are distinct under the lens, scattered sparingly about the angles of the podetia, as in *madreporiformis*. Spermata straight rods on delicate arthro-sterigmata, resembling those of many *Parmelia** (e. g. *P. perlata*, *physodes*, and *encausta*), the sterigmata being associated with hypertrophied, sterile filaments, similar to those that also occur in the genus *Parmelia** (e. g. *P. tiliacea*, *acetabulum*, and *perforata*). Basal cellular tissue brown. Nylander says that the spermogonia of *arctica* have not yet been seen (Synopsis, p. 286); and Tuckerman † also describes them as "unknown." Nevertheless I figured and described them in my 'Memoir on Spermogonia' ‡ published in 1859, the date of Tuckerman's paper being 1862, and of Nylander's 'Synopsis' (vol. i.) 1858-1860.

What I figure differ, however, from those since figured by Leighton§. It does not follow that the plants examined in this case by Leighton and myself were different species or genera; for not only may the same object appear under different aspects to different observers, but I have already pointed out that the same species of lichens not unfrequently possess *two or more forms of spermogonia*, spermata, and sterigmata ||. The spermogonial contents would appear to be equally variable in *madreporiformis*; for the sterigmata and spermata figured by Nylander (Synopsis pl. viii. fig. 23) are very different from those figured by myself (Mem. Spermog. pl. vi. fig. 22).

Dufourea madreporiformis, in Schærer's Exs. 85, bears spermogonia only. They are more frequently irregular, and confluent or deformed, than those of *arctica*; otherwise they are alike. Tuckerman admits the "obvious affinity" of *D. madreporiformis* and *Dactylina arctica*, though he also refers to their "equally obvious differences" (p. 397). He regards the two as "mediated" by *Dactylina ramulosa*, Hook., which is evidently quite our Kikerton plant. He refers *madreporiformis* (and properly, I think) to the genus *Dactylina* (p. 398). The Kikerton *Dactylina* and Schærer's *Dufourea* (Exs. 85) appear to me to be the same plant.

Genus 11. NEPHROMA.

1. *N. arcticum*, L.—Godhavn. Abundant; in large masses, but without apothecia. In West Greenland, where it ascends to 300 feet above the sea, Vahl says it is always sterile. Thallus not tomentose; frequently white below, especially peripherally. At one

* *Vide* the Author's 'Mem. Spermog.' pp. 291-3, plates xi. & xii. and Explanations thereof.

† "Observations on North-American Lichens," Proceed. of American Academy of Arts and Sciences for April 22, 1862, p. 396.

‡ Page 133, plate vi. fig. 23.

§ "On the Lichens collected by Sir John Richardson in Arctic America," Journal of Linnean Society, vol. ix. Botany, p. 192, plate ii. figs. 16, 17.

|| "On Polymorphism in the Fructification of Lichens," Quart. Journal of Microscopical Science, Jan. 1868; or Report of the British Association, 1867, p. 89.

point, in one of the Godhavn specimens, *spermogonia* occur. They have the aspect of young apothecia, with the colour of the disk of *Lecanora tartarea*. They are evident under the lens only when the thallus is moistened. They then appear as marginal, irregular, buff-coloured tubercles, isolated or grouped, becoming subgelatinous under moisture. Sometimes they are confluent, in large compound, irregular masses, having quite an apothecioid character. In all their forms the spermatia are the same—simple, spherical atomic, in myriads, about $\cdot 00015''$ to $\cdot 00020''$ long and $\cdot 00060''$ to $\cdot 00075''$ broad. The sterigmata are indistinct.

N. arcticum is sometimes confounded with forms of certain of the *Peltideæ*: e. g. in the Kew Herbarium, one of two specimens labelled *P. horizontalis*, from Canada (Shepherd), is this *Nephroma*. The distinction of *Nephroma* and *Nephromium* as separate genera appears to me a most artificial and unnecessary one.

Gen. 12. PELTIGERA*.

1. *P. apthosa*, Ach.—Egedesminde. Sterile, as it generally is. In Herb. Kew. it occurs from Disco (Lyll, 1854).

2. *P. canina*, Hffm.—Lyngemarken. In fruit and pycnidiferous. The thallus is that of *canina*; but the sporidia exhibit greater variety of form and size than is common in that or any other species of the genus; the upper surface of the thallus is sometimes lurid-grey (dark lead-colour), becoming darker when moistened, and covered with a sparing white pruina; the under surface is very fibrillose-rhizinose, of the usual whitish colour, with buff or cream-coloured veinlets and rootlets. The upper surface is occasionally the site of a black, papillæform, very minute, semiimmersed parasite, which shows, however, no specific structure.

The sporidia of the *Peltigera* are (apparently) normally 4-locular: but in the young state they are simple, or 2-locular, in the former case frequently granular. They are usually fusiform or broadly ellipsoid, but sometimes pyriform, oval, or even linear-oblong. Though generally straight, they are sometimes curved. Their character varies greatly, even in the same section of one apothecium, under the field of the microscope, at the same moment—the variations relating equally to form, size, and structure. They are invariably colourless; usually about $\cdot 0009''$ to $\cdot 0012''$ long and $\cdot 0003''$ broad, associated with large numbers of oil globules of all sizes. Sometimes, instead of distinct loculi, they contain one or more large cellular nuclei. Hymenial gelatine pale blue with iodine. Tips of paraphyses pale brown.

Pycnidia occur as marginal brown buttons or warts, filled with myriads of stylospores, all very delicately muco-granular or shaded, very variable in size, the average about $\cdot 00027''$ to $\cdot 00030''$ long and $\cdot 00009''$ to $\cdot 00015''$ broad; their diameter, when subspherical, $\cdot 00022''$. Their form is oblong-oval, pyriform, or irregularly angular, many of them resembling pus or tubercle corpuscles; their outline is rendered more distinct by iodine,

* The old Acharian genus *Peltidea* is now generally known (for what reason I am not aware) as *Peltigera*. In a letter to me, of date February 1866, Nylander speaks of the "genre *Peltidea* qui diffère par ses gonidies (qui rendent leur thalle à l'état humide d'un beau vert) des *Peltigera* (dont le thalle à l'état humide devient foncé)". To *Peltidea* he refers *venosa*, Ach.

which gives them a yellow colour and a corrugated, bolder margin. In some cases the basidia remain attached. These basidia are very indistinct, and the connexion between them and the stylospores cannot be well made out with the powers of my microscope (which magnifies from 90 up to 600 diameters linear). But they appear to be thick-walled arthro-sterigmata somewhat like those of *Endocarpon* and *Umbilicaria*; and if they are so, the secondary reproductive organs of this *Peltigera* may be regarded either as spermogonia or pycnidia, having the sterigmata of the former, and the stylospores of the latter, forming, in truth, a link of connexion between these two great groups of complementary reproductive organs*. The present instance is the first in which I have succeeded in detecting fertile pycnidia in *Peltigera*, though I have searched for them carefully in numberless specimens, a circumstance that illustrates the undue proportion that negative bear to positive results in spermogonological research. In Britain, *Illosporium corneum*, Fr., occurs as a parasite on *P. canina* (Berk. 'Brit. Fungology,' p. 341), as does also *Scutula Wallrothii*, Tul.

3. *P. scabrosa*, Th. Fries, does not occur in the present collection, but is apparently a Greenland lichen. Specimens in my herbarium from the Kikerton Islands—collected by Taylor, named and given me by Prof. Dickie—appear to be merely an arctic form of what would, in more southern countries, probably be referred to *horizontalis*. The genus *Peltigera* is very much in the position of *Usnea*, *Ramalina*, *Cladonia*, and many others, as to the difficulty of dividing the many puzzling forms composing it into scientific "species." I see no difficulty in regarding *all* the British *Peltideæ* as referable to a single type—*canina*. That which stands out most distinctly from the rest is *venosa* †.

In the Kikerton *scabrosa*, the asci are blue with iodine, '0024" long and '00040" broad, 8-spored. The filaments of the paraphyses are thick and simple; the tips conglutinate and pale brown. The sporidia are very narrowly (or linear) fusiform, multilocular, '0012" to '0018" long and '00009" broad, straight or curved, so delicate, long, and narrow as to be apt to be confounded with the paraphyses.

Gen. 13. SOLORINA.

1. *S. crocea*, L. On loose soil about the Illartlek glacier; apothecia abundant.—Lyngemarken. Central portions of the thallus in some specimens have lost colour and become whitish or ashy grey; and these decolorized patches are plentifully studded over with a black, punctiform or papillæform parasite, which is conspicuous by reason of the contrast of colour. The hymenial gelatine and the constituent parts or tissues of the hymenium give no blue with iodine. Paraphyses are very delicate and not knobbed at tips, their characters being those of *Verrucaria* and *Endocarpon*. Asci in tufts, 8-spored, '0015" long and '00045" broad. Sporidia 4-locular, fusiform, colourless, '0006" long and '00015" broad.

* Compare the contrasted characters of Spermogonia and Pycnidia, given in my Papers on "Polymorphism in the Fructification of Lichens," before quoted; also the description of the spermogonia, or pycnidia, of *Peltigera* and their contents, in my 'Mem. Spermog.' pp. 173-4, and in Tulasne's "Mémoire" in the Ann. des Sciences Nat. Sér. iii. Botanique, vol. xvii. 1852, pl. ix. figs. 7-17.

† *Vide* footnote on preceding page.

This parasite does not correspond in character with any of the following parasitic Lichens, which affect species of *Solorina* or *Peltigera*, viz. :—

1. *Rhagadostoma corrugatum*, Körb. ('Parerga,' p. 472), which is parasitic on *S. crocea*. Sporidia 2 to 4, large, hyaline, simple or 2-locular, clavate.

2. *Scutula Krempelhuberi*, Körb. ('Parerga,' p. 455), which is parasitic on *S. saccata*. Sporidia 8, minute, ellipsoid, simple or 2-locular, hyaline.

3. *Xenosphaeria Engeliana*, Saut. (Körb. 'Parerga,' pp. 466 & 307; and 'Systema,' p. 376), also parasitic on *S. saccata*. Sporidia 6 to 8, arcuate-ellipsoid, 4-locular, brown.

4. *Biatorina tuberculosa*, Th. Fries. (L. Arctoi, p. 188), a parasite on *Peltigera*. Sporidia fusiform-oblong, 2-locular, colourless*.

Nor is the parasite on the Greenland plant what I have described as infesting Irish specimens† of *S. crocea*, where it consists of mere pycnidia; while it does not agree with the *Sphaeria urceolata* of *Solorina saccata*‡, which has brown sporidia.

In sterile specimens of *S. crocea*, in Herb. Kew., from Lachen, Sikkim-Himalaya, alt. 12,000 feet, collected by Dr. Hooker, the thallus, especially about its periphery, is studded over with a parasite in the form of crowded, black papillæ or points, sometimes semi-immersed. It contains deep brown, soleæform (2-locular) sporidia '0010" long and '00025" broad. This, again, differs in character from all the other parasites above mentioned on *Solorina* or *Peltigera*.

On *S. crocea*, which I collected on the top of Ben Lawers, in June 1856, a black papillæ-form parasite occurs, occupying cushion-like elevations of the thallus, closely studded over these pulvinuli, rendering them very rugged and black-warted. These cushion-like deformities are usually seated at the division-angles of the lobes. The individual conceptacles are semi-immersed in the thallus. No distinct structure can be detected: no blue reaction is developed with iodine; no asci were seen; but a large number of oil-globules of all sizes covered the field of the microscope. Externally the parasite differs from that on *S. saccata*, assigned to *Sphaeria urceolata*, in the crowding or agglomeration of the perithecia into warts. The Ben-Lawers parasite has the same external characters as that from Brandon Mountain, Kerry (Carroll), in which the stylospores are oblong or oblong-ellipsoid, colourless, simple, or 2-locular, muco-granular in the young state; '00133" to '00166" long and '00033" broad. But the want of structure in the Ben-Lawers plant leaves us at a loss as to the species or genus, lichen or fungus, to which it is to be assigned. Possibly the parasitic pycnidia of the Irish plant are referable to some of the sporidiiferous lichens or fungi already mentioned as affecting *S. crocea* or *S. saccata*.

Gen. 14. STRICTA.

1. *S. pulmonaria*, L. Not in the present collection, and not given at all by Th. Fries as a Greenland lichen. But in the Kew Herb. I saw specimens of the ordinary form labelled "Davis Straits." The labels, however, unfortunately did not inform us on which coast

* I have no means of judging whether any of the parasites I have met with on *S. crocea*, in Greenland or other specimens, bear any relation to *Bertia lichenicola*, De Not., a parasitic fungus, according to Rabenhorst ('Fungi Europ.' Exs. Cent. x.), that affects its thallus.

† Mem. Spermog. p. 175.

‡ *Ibid.* p. 175, and pl. ix. fig. 35.

the plant was collected, east or west—nor whether it was corticolous or saxicolous*. The corticolous form occurs in Lapland, Nordland, and the Samoyede country, on *Betula*, *Populus*, and *Salix caprea*—rarely fertile, but bearing sometimes the parasitic *Celidium Stictarum*, Tul., which is regarded as a *fungus* by Th. Fries (Arct. p. 50) †. The saxicolous forms, which are frequently dissociated as *S. linita*, Ach. (*e.g.* in Th. Fries's 'Arct.' p. 50), from corticolous states, occur in various parts of North America, and may also be met with on the Greenland side of Davis's Straits. Neither is this form or pseudo-species, however, recorded by Th. Fries as a Greenland lichen, while he describes it as very rare in Northern Scandinavia.

Gen. 15. PARMELIA.

1. *P. saxatilis*, L.—Jakobshavn, on granitic rocks, close to the sea; Egedesminde; Illartlek glacier.—“Very common everywhere” in the districts visited by Dr. Brown. Many and frequently puzzling forms occur, always sterile, often deformed, and occasionally the seat of parasitic Micro-lichens or Micro-fungi. All the ordinary European varieties occur (*leucochroa*, Wallr.; *omphalodes*, L.; and *panniformis*, Ach.), with innumerable passage-forms or intermediates. But that form which is both the commonest and the most remarkable, is what may be appropriately distinguished as

Sphærophoroidea—in which the greater portion of the thallus (the periphery being generally excepted) is covered and concealed by a dense compound-isidioid growth, which resembles a series, densely aggregated, of specimens of *Sphærophoron coralloides* in miniature. These anamorphoses of the thallus—these Sphærophoroid growths—convert a foliaceous thallus into the semblance of a crustaceous or fruticulose one. While generally constituting a surface which is nearly level or uniform, these growths are sometimes also developed as subspherical masses, easily detached and quite comparable with the concentric and erratic forms of *P. sinuosa* ‡, and with the spherical warts of *Lecanora tartarea* and *L. ventosa*, though they are on a smaller scale than the former, and on a larger scale than the latter, tumour-like deformities. Every gradation exists between the simply isidioid and the compound isidioid or sphærophoroid conditions, the colour of the central deformed portions of the thallus being usually deep bronze.

The sphærophoroid forms of *saxatilis* have apparently certain characters in common with *Parmelia isidiocera*, Nyl. (Syn., p. 382), collected at Cape Krusenstern, W. Arctic America, lat. 67°, by Beechey. Its thallus has the facies of *lævigata*, is smooth peripherally, white within; the apothecial exciple and isidia yellow within; the latter mostly ramulose. The plant is fertile, and is allied to *P. aurulenta*, Tuck. §, a North American species. I have not seen a specimen of *P. isidiocera*. But I doubt its being a good

* Compare remarks in paper on the “Greenland Lichen Flora,” formerly quoted, (p. 305).

† *Vide* Papers on “*Arthonia melaspermella*,” Journal of Linnean Society, Botany, vol. ix. p. 278; and ‘Otago Lichens and Fungi,’ p. 449.

‡ *Vide* the author's “Monograph of *Abrothallus*,” Quart. Journal of Microscopical Science, vol. v. 1857 (sub nom. *P. saxatilis*); or Mudd's ‘British Lichens’ (p. 96, sub *P. sinuosa*).

§ Compare also *P. crinita*, Ach. (Tuckerman, ‘Synopsis of North-American Lichens,’ 1848, p. 25).

species, as I regard what is apparently its distinctive character (the clothing with sphaerophoroid isidia) as a mere *condition* common to, or in, *various Parmeliæ* and other foliaceous lichens in Arctic or northern countries. Similar states of *omphalodes* occur in the present collection, mostly in microphylline forms, the isidia compound or ramulose, aggregated sometimes in spherical detachable masses, as in the type. The same sphaerophoroid conditions of *P. saxatilis* and other species occur in the present collection from the Vancouver-Island area of N. W. America.

Greenland varieties of *saxatilis* occasionally exhibit other forms of abnormal growths on the thallus, *e. g.* granulations, warts, squamules, or minute secondary laciniae. All forms of the plant, including those which are most sphaerophoroid, and all parts of the thallus, including the smooth peripheral laciniae, as well as all colours of the thallus, including the whitish *leucochroa* forms, exhibit the same reactions, or their absence, with chemical tests, the reaction-colour being most vivid (where developed at all) in forms with the palest thallus. Bleaching-solution gives no reaction. Potash gives a lemon-yellow, generally very vivid and beautiful—developed at once—sometimes quickly passing into a rich orange-red. *Omphalodes*, and the passage-forms into the type, give the same reaction with potash as *saxatilis*, that is, a vivid green or lemon-yellow. Lemon-yellow however, is, sometimes equally produced by the application of water; and in no case has the reaction any significance or value.

The thallus of *saxatilis* has, in the natural state, sometimes as distinctly a saffron colour as *Solorina crocea*. Its surface is occasionally smooth, free from the usual reticulations or fossulations, approaching *perlata*. In the same forms, which are usually macrophylline, the colour is frequently glaucous or bluish. These characteristics of colour and smoothness are always more visible on the peripheral laciniae, which are simpler in all respects than those which are more central.

There are various passage-forms between the type and *omphalodes*, the only difference being one affecting *colour*. The normal thallus of *saxatilis* is sometimes peripherally olive. Microphylline forms of *omphalodes* sometimes bear, to a slighter extent, the same subspherical, but more minute, sphaerophoroid growths that occur in the type—the isidia being very narrow or slender, branching considerably, closely aggregated, sometimes constituting (when isolated) small balls. Some forms (mostly microphylline) of *omphalodes* closely resemble certain conditions of *P. olivacea*, *P. fahlunensis*, and *P. arctica*. It passes into *panniformis*, which is sometimes jet-black and glossy. Sometimes a single specimen exhibits the characters, in different parts, of *saxatilis*, *omphalodes*, and *panniformis*, with a normally smooth, or an isidioid, thallus. Another abnormal or unusual condition of *saxatilis* (about Jakobshavn) resembles the *vittata* var. of *P. physodes*.

All the Greenland forms of *saxatilis* examined by me were sterile as to apothecia; but in some cases the peripheral laciniae were copiously black-punctate with spermogonia*. The thallus, moreover, was frequently the site of various parasitic growths.

* The ordinary spermogonia of *P. saxatilis* and their contents are figured and described in my 'Monograph of *Abrothallus*,' p. 61, and pl. v. figs. 3, 4; and 'Mem. Spermog.' p. 226, and pl. xii. figs. 17-19. They may be contrasted with the pyrenidia on var. *sulcata*, Tayl., from Connemara (Moore), which contain stylospores '00016" long and '00012" broad (Mem. Spermog. p. 228, and pl. xii. figs. 20, 21).

dothideoid mottling was sometimes so copious as to give the appearance of *panniformis* or *vittata*. This mottling is probably attributable to *Dothidea homostegia*, Nyl., which generally occurs in a sterile, abortive, or degenerate condition, as is too frequently the case with lichenicolous Micro-fungi in general*. In this sterile condition, I have very often met with this fungus on *P. saxatilis*, affecting generally the peripheral, and smooth or normal, laciniaë. In its fertile state I have found it only in one or two instances, *e. g.* on *P. saxatilis* from Barmouth, North Wales, collected by Mr. Leighton in June 1856. The parasite here occurs on the microphylline thallus, as black, sublecodeoid glomeruli, surrounded by a black discoloration or shading of the thallus of the *Parmelia*. This shading often connects two or more groups of glomeruli, forming large, black, irregular mottlings of the thallus. The individual fruit-clusters or perithecia vary in size accordingly as they are young and comparatively simple, or old and compound or confluent; in the former case being verrucarioid papillæ, in the latter, convex, apothecioid, superficial bodies, like the apothecia of a *Lecidea* (*e. g. parasema*).

Regarding this parasite, my friend M. C. Cooke wrote me in 1866 as follows:—"On it" (the *Parmelia saxatilis*) "are two or three clumps of *Sphæria*, in fruit, almost the only truly mature one which I have found amongst your *Sphæriæ* on Lichens. This is certainly a *Dothidea*, with 3-septate spores, and agrees with specimens sent me from Germany, under the name of *Sphæria homostegia*, Nyl. (Prodr. p. 56). I call it therefore *Dothidea homostegia*, and hope you will find it again, as it is a good *Dothidea*."

On some degenerate conditions of the thallus of *P. saxatilis*, what appears to be a *Torula* studs the surface, as numerous, minute, irregular, black papillæ. This structure, however, is indistinct; and the parasite may therefore really be some of the other lichenicolous Micro-fungi, which infest the thallus of many of the *Umbilicariæ*, *Cladoniæ*, *Lecanoræ*, and other genera.

But the most important *parasite* on Greenland forms of *P. saxatilis* is what I propose to distinguish by the name of the pioneer of Greenland colonization (Hans Egede) as

Lecidea Egedeana.

It occurs plentifully on some forms, on the central portions of the thallus, on old cracked laciniaë. The apothecia have the colour and appearance of those of *L. cornea*, Sm., than which they are smaller; they are flat, margined, crowded, with difficulty seen even under the lens. Fertile asci are very delicate; 8-spored. Hymenial gelatine very faint lilac or blue with iodine. Paraphyses with pale brown, agglutinated tips. Sporidia brown, 2-locular, broadly ellipsoid; '0006" to '0009" long, and '0003" to '00045" broad. Their general appearance is that of the sporidia of *Physcia stellaris* and its allies, rather than those of *Lecanora sophodes* or *Lecidea disciformis*. As is frequently the case in alpine, arctic, and even old, specimens or species of lichens, *degenerate* asci are common, having the aspect of brown, ribbon-like masses.

Some of the Greenland forms of *P. saxatilis* examined by me occupied unusual positions: thus, I met with it on some large scyphi of *Cladonia pyxidata*, and on the lower surface of the old thallus of *Umbilicaria vellea*, just as I have found *Physcia pulverulenta*

* What is probably this parasite is figured in my 'Mem. Spermog.' pl. xii. fig. 2, on *P. physodes*. It also occurs on the thallus of saxicolous forms of *P. Borreri*, Ach., in Bolivia (Nyl. Lich. Exot. p. 215).

and *P. stellaris* on the old thallus of various *Umbilicariæ*. The forms of *saxatilis* growing on *U. vellea* are microphylline, sterile, but dotted over with a black papillæform parasite, which exhibits no distinct (or normal) structure. Curiously, I met with no traces of *Abrothallus** in Greenland. But the sphaerophoroid deformities (before-mentioned) of *saxatilis* frequently resemble, in their globularity, the anamorphoses of thallus associated with the growth of that peculiar pseudo-genus.

2. *P. arctica*, Nyl.—Jakobshavn. On granitic or gneissose rocks; sterile. When moistened, the thallus assumes an olive colour, like that of *olivacea*, some of whose forms the plant otherwise closely resembles. It has the character, so far, of a Norwegian specimen of *arctica*, collected by me on the top of Sneehätten, Norway, in August, 1857, and determined by Nylander. But the Norwegian plant is blacker, especially centrally. In both the Greenland and Norwegian plant there are, especially centrally, erosions of the superficial or cortical layer of the thallus, exposing the white medullary tissue. I have seen no fertile specimen of Nylander's *arctica* (Synopsis, p. 394); but I doubt the propriety of its classification as a distinct species. It certainly does not belong to *encausta*, or *alpicola* † Th. Fries (Arct. p. 57), but probably to some of the puzzling broad-lobed or macrophylline forms of *olivacea* or *fahlunensis*.

3. *P. olivacea*, L. All its forms are sterile. Sometimes there is a tendency to an isidioid condition of the centre of the thallus and margins of the laciniaë, its character then approaching *exasperata*. But the isidia are generally large and discrete warts. Sometimes the thallus is curled up into spherical masses, resembling the similar anamorphoses of *P. saxatilis* and *P. sinuosa*. Some of its macrophylline forms resemble certain conditions of *P. saxatilis* and its var. *omphalodes*. The laciniaë, in such states of the plant, are fossulate, with subretuse ends; the colour is light olive, rendered much greener by moisture; the surface smooth and glossy. Microphylline forms, on the other hand, resemble *fahlunensis*.

4. *P. fahlunensis*, L. Like *olivacea*, *saxatilis*, *arctica*, and the majority at least of the Greenland *Parmeliæ*, I found it only sterile, occurring in various puzzling forms, differing in colour and in the size and flatness of the laciniaë. Some of these forms resemble conditions, or possess certain characters, of *saxatilis*, *omphalodes*, and *olivacea*. Thus the plant is sometimes macrophylline, of lighter colour than usual, becoming greener when moistened; the surface dull or glossy; the laciniaë terminating retusely, as in *saxatilis*, and similarly fossulate. There are several sterile Greenland *Parmeliæ*, which I am puzzled to refer either to *omphalodes*, *olivacea*, *arctica*, or *fahlunensis*, combining, as they do, some of the characters of all these species or varieties. All the species or pseudo-species referred to frequently form very handsome, round, dark, conspicuous patches on quartzose, granitic, or gneissose rocks and stones. Macrophylline and microphylline conditions of the same species are sometimes curiously associated.

5. *P. stygia*, L.—Jakobshavn, in fruit; Illartlek Glacier. Thallus becomes deep olive-

* *A. Smithii* occurs in Europe, both on *P. saxatilis* and var. *omphalodes*; and *A. oxysporus* on the type (Monograph of *Abrothallus*, pp. 35-38).

† The name *P. arctica*, Th. Fries, in my "Lichen-Flora of Northern Europe" (Journal of Linnean Society, Botany, vol. ix. p. 409) is an error, as I find no such *Parmelia* in his 'Lich. Arctoi.'

green under moisture. Some of its forms apparently pass into *fahlunensis*. In the hymenium a blue colour is indistinctly elicited under iodine. Sporidia simple, colourless, oval or oval-oblong, 0006'' long, and 00025'' to 0003'' broad.

6. *P. lanata*, L.—Jakobshavn, on granite, sterile; Illartlek Glacier, in fruit. Thallus sometimes as brown as that of *olivacea*—or paler, a fine chestnut colour,—a variation in character that is important in connexion with the close interresemblances already referred to of forms of *omphalodes*, *olivacea*, *arctica*, *fahlunensis*, and *stygia*.

7. *P. encausta*, Sm.—Jakobshavn. Colour of thallus sometimes green, especially when moistened, or buff or brown. Young and pale (etiolated) states occur on the under, shaded and moist surfaces of rocks. These states give a greenish-yellow reaction with potash. In the specimens examined by me, the thallus is mostly white and decayed. It is studded over with a parasite in the form of minute, subspherical or very convex, crowded, black apothecia or perithecia, resembling the apothecia of *Abrothallus Smithii*. They exhibit, however, no structure.

Gen. 14. PHYSCIA.

1. *P. pulverulenta*, Schreb.—Jakobshavn. A few fragments only occur, sterile, of olive-green colour, some terricolous, others growing on the underside of *Umbilicaria vellea*. Th. Fries does not give *pulverulenta* as a Greenland lichen, though he describes *muscigena*, Ach., as fruiting and as common throughout the area of his 'Lichenes Arctoi' (p. 63). In the Kew Herbarium I saw the ordinary form (the type) in fruit, with the thalline edges or periphery much eroded, labelled as from the "North Pole" (Parry*); and in that herbarium it appeared to be a very Arctic species. It passes into, and is apt to be confounded with *obscura* and *stellaris*. Var. *pityrea*, Nyl., is just a white-pruinose form, in which the pruinosity is so abundant as to cover the whole thallus. Th. Fries (L. Spitsberg. p. 13) mentions another form with the thallus densely white-pruinose, giving it the facies of *stellaris* or *cæsia*. In Europe *Karschia pulverulenta*, Anzi (Körb. Parerga, p. 460), is sometimes parasitic on the upper surface of the thallus.

2. *P. cæsia*, Hffm.—Kudlesæt: sterile, with a dark lead-coloured thallus. Jakobshavn, on granite and gneiss; microphylline, with both apothecia and spermogonia. The apothecia are wholly black and lecideoid, exciple and disk alike; flat and regularly round in outline. The spermogonia are very minute black papillæ, conspicuous under the lens when the thallus is moistened. The laciniaë are sorediiferous, and of the usual lead-grey colour. Some macrophylline forms approach *stellaris*. In Scandinavia, the thallus of *cæsia* is the site of the parasitic *Buellia convexa*, Th. Fries (Arct. p. 234).

3. *P. stellaris*, L.—Jakobshavn. Associated with *Placodium elegans*; a fragment merely, but bearing both apothecia and spermogonia. Disk of apothecia cæσιο-pruinose. Sporidia 2-locular, ellipsoid, brown or olive, straight or slightly curved, 00040'' to 00060'' long, and 00020'' broad. The spermogonia are black papillæ; the sterigmata 0006'' long, sometimes comparatively simple, or composed of few articulations. Spermatia straight rods 00015'' long. Various microphylline, sterile forms of the plant grow both on the under and upper surfaces of the thallus of *Umbilicaria vellea*.

* Vide author's "Lichen-Flora of Greenland," Trans. Botan. Society of Edinburgh, vol. x. pp. 52 & 33.

Gen. 15. UMBILICARIA.

1. *U. cylindrica*, L.—Jakobshavn, fruit abundant; Egedesminde, on granite and gneiss, without apothecia, but spermogoniferous. Thallus sometimes very thick and coriaceous, dwarf and complicate; colour of upper surface sometimes ashy grey, becoming olive-green on moisture, sometimes very white, these white or grey conditions apparently being accompaniments of age. The white forms are sometimes also sparingly white-pruinose. Under surface sometimes beautifully peach, pink or buff-coloured. The cortical or medullary tissues give no reaction either with bleaching-solution or potash. Marginal fibrillæ of thallus seldom very prominent or long. Sometimes, however, they are long, tufted, and as pale as the under surface of the thallus. This under surface is sometimes very fibrillose or densely rhizinose, at other times almost nude. Apothecia frequently deformed or degenerate, most irregular or angulose; sometimes in form resembling those of *anthracina*, save as to gyri; compound from the opening up of these gyri; sometimes, when degenerate, white in all their parts, like the thallus; frequently stipitate (in age) to various degrees. Sporidia of same size and form as in *arctica*. Spermogonia frequently, or generally, only peripheral; sometimes large and verrucarioid, conspicuous on the ash-grey thallus; more generally punctiform, frequently immersed and inconspicuous compared with those of *arctica*; become more prominent and brown under moisture; vary in size; frequently clustered. Spermatia in myriads; oblong corpuscles, atomic in size, shorter and broader than those of *arctica*.

2. *U. arctica*, Ach.—Jakobshavn, on granitic stones; fruit abundant, with characters of the Scotch plant. Passes into *proboscidea* on the one hand, and *hyperborea* on the other, if the latter is not to be associated with *arctica* under a single type. The thallus gives no reaction either with bleaching-solution or potash. In Greenland specimens in the Kew Herbarium, the thallus is sometimes complicate; and these forms are generally the most plentifully spermogoniferous. Spermogonia occur as conspicuous, minute, black papillæ, perched on the rugosities of the thallus, chiefly about the periphery, semiimmersed. Spermatia rod-shaped, in myriads. Sporidia simple, oval, colourless; 00040" long, and 00022" broad. Some specimens of *arctica* are copiously studded over with a minute, black, papillæform parasite, which may be confounded externally with the spermogonia. Unfortunately it exhibits no structure, so that it is impossible to refer it to *Dothidea lichenum*, Smrf. (Th. Fries, L. Arct. p. 165), or *Tichothecium grossum*, Körb. (Parerga, pp. 40 & 469), which have been described as parasites on *arctica*, the one as a fungus, the other as a lichen.

3. *U. hyperborea*, Ach.—Jakobshavn, in fruit; Illartlek Glacier, about its base, also in fruit; Egedesminde, a few sterile fragments. Thallus only once gave a faint red colour with bleaching-solution. In the British-Museum Herbarium I found a large patch of *hyperborea* from Greenland. In that of Kew, in a specimen of the same species, from Walden Island, the sporidia are simple, oval-oblong, and 00050" long by 00020" broad. It seems to me to be a very arbitrary and unphilosophical classification which separates *hyperborea* and *arctica*. In truth, among the European *Umbilicariæ* there are very few types that stand clearly forth by easily distinguishable characters, while not a

few of the so-called "species" are to be regarded as mere *conditions*, e. g. *erosa*, *cylindrica*, and *proboscidea*.

4. *U. vellea*, L.—Egedesminde, sterile. The natural grey of the thallus is changed into deep olive-green by potash,—a reaction which, however, is equally produced by bleaching-solution and by water—one which is common in the foliaceous lichen-thallus, and one that has no significance or value. Various forms of *Parmelia saxatilis* and *Physcia stellaris* grow on its old thallus, sometimes on its upper grey cracked surface, sometimes on the lower, copiously fibrillose, black or brown one. In the Kew Herbarium, apothecia are rare in this so-called "species," while Greenland specimens are sterile.

My herbarium contains two specimens apparently of *vellea*, collected by the late Henry Paul, of Edinburgh, in or before 1851, the one labelled "Norway," the other "Dunoon" (Argyleshire). I examined both in 1852, and found them to possess 2-locular sporidia, a condition apparently not previously observed, or recorded as occurring, in the genus *Umbilicaria*, none of the British species, as then described, having sporidia of other character than simple. I found, however, that in several European species of *Umbilicaria* there is a tendency, not only to bilocularity of the sporidia, but to muriform division, as well as to the acquisition of colour (e. g. *spodochroa*). These conditions of the sporidia have been, long subsequent to my observations, found by other authors in various foreign *Umbilicariae* (e. g. *flavovirescens* and *haplocarpa*). In the Dunoon *vellea* the sporidia are large and distinct, generally 2-locular, sometimes simple; loculi pale yellow or colourless, granular or not, according to age; generally broadly oval, frequently pyriform, variable in size and form, having sometimes a projection at one end, indicating the commencement of germination. Asci sometimes 1-spored; that is (as is common in the genus), only one sporidium reaches maturity. In other cases there are 4 to 8 sporidia in each ascus.

Possibly there may have been some transposition of the labels in Paul's 'Dunoon' plant, both suites of his specimens being really Norwegian. But not necessarily; for Mudd (Brit. Lichens, p. 120) gives *vellea* as a British species, he having seen specimens from Lancashire. My own Dovrefjeldt specimens, collected in 1857, are sterile.

U. flavo-virescens, Leight. (Journal of Linn. Soc. vol. x. Botany, p. 33), a South-African species (if it is an *Umbilicaria* at all), has 2-locular, brown sporidia, as has also *U. haplocarpa*, Nyl., a Peruvian species, in which there are 6 sporidia in each ascus. Such irregularities in the number of sporidia in each ascus would now appear to be common. The spermatia and sterigmata of *U. flavo-virescens*, as figured by Leighton (Pl. iv.), are not those usual in *Umbilicaria*, while the apothecia are flat, simple and lecidine, a condition, however, less unusual.

Paul's Norwegian specimens bear a white parasite—possibly a fungus—which grows on and about the apothecia. It possesses, however, the structure of the apothecia already described in the Dunoon plant; and though Mr. Leighton, who kindly examined the specimens, refers the 2-locular sporidia "indubitably" to the said fungus, I believe they really belong to the normal apothecia of the *Umbilicaria*. The asci give a pale blue with iodine, a circumstance which is at least suspicious in any reference of them to a parasitic fungus. The paraphyses cohere at the apices, which are brown; their filaments are very delicate. The asci are large, 8-spored; one or more

sporidia sometimes become abortive. The mature sporidia are 2-locular, the loculi pale yellow, oval, sometimes pyriform, ellipsoid or figure-8-shaped. The young sporidia are colourless and simple; their contents muco-granular; their shape within the asci more or less spherical.

I can make out no good distinction between *U. vellea*, *U. spodochoa*, *U. hirsuta*, and *U. murina*. All of them, with the exception of *spodochoa*, are sterile or nearly so in my herbarium. The under surface of the thallus in all may be naked or hirsute, pale or black. *U. vellea* of Hepp's Exs. No. 117 is what Nylander calls, in my herbarium, both *spodochoa* and *vellea*. Schærerer's Exs. No. 137-140 (= *U. depressa*, var. *hirsuta*, in fruit) are also what Nylander calls *spodochoa*; while Schærerer's Exs. Nos. 141-142 (= *U. depressa*, var. *spodochoa*) represent what he designates, in my Norwegian specimens *U. vellea*!

5. *U. spodochoa*, Hoffm.—Norwegian specimens, collected by myself in 1857, bear a few, mostly degenerate, apothecia. In those which are degenerate, all the elements of the hymenium are fused into an obscure, brown, striated mass, giving no reaction with iodine. The asci and sporidia are undistinguishable. This degenerate condition of the apothecia and their contents is common to all the Arctic or Northern *Umbilicariæ*. When the apothecia are normal in *spodochoa*, the asci give a pale blue with iodine, as does the whole hymenium. Asci 2-4-spored. Sporidia, in the normal and mature state, oval, simple, colourless, finely granular or not, '0006" to '0009" long and '00045" to '0006" broad. In age they are occasionally deep brown, and muriform as in *Urceolaria scruposa*, '0009" long and '0006" broad.

6. *U. anthracina*, Wulf. In 1857 I collected two distinct suites of specimens on Sneehåtten (Dovrefjeldt mountains, Norway), which Nylander refers to this species (or *atro-pruinosa*, Schær.). Both forms have simple lecidine apothecia. The larger form has a thallus somewhat like that of *arctica*. Its upper surface is grey, whitish, or mouse-coloured; the under pale and rhizino-fibrillose. There is none of the tessellated character to be found in the smaller black form. In the grey, larger forms, the apothecia are larger, flatter, rounder, more scattered over the surface, and more sessile than in the other. The hymenium becomes beautifully blue with iodine. Sporidia simple, oblong-oval, with generally a thick margin or double contour, '0003" long and '00022" broad. This major form is perhaps *U. stipitata*, Nyl. (L. Scand. p. 289), a species that is not mentioned by Th. Fries as a Greenland or Spitzbergen lichen (either in his 'L. Arctoi' or 'L. Spitsberg.'). In my list of Northern Lichens *U. vellea* and *U. anthracina* have probably been confounded, as they are occasionally in all herbaria.

In the smaller form with black tessellated thallus, the apothecia are angular, stipitate, and subperipheral; the normal sporidia ellipsoid-oblong, simple, generally slightly curved; '00040" to '00050" long and '00010" to '00015" broad. Hymenium becomes deep blue with iodine. In the same hymenium the sporidia are sometimes only (exceptionally) normal, the majority being old or degenerate, both within and without the asci deep brown, longer than the normal ones, and sometimes obscurely 2-locular.

7. *U. Pennsylvanica*, Hoffm., represents, in Greenland and Arctic regions generally, the very common *U. pustulata* of Scandinavia. A specimen of *Pennsylvanica* in the Kew Herb., collected during Franklin's first journey in the Arctic Regions, has lecideine, large,

flat apothecia, somewhat like those of *pustulata*, but larger and flatter. There is a distinct black border (exciple), lighter in colour than the deep-black, sooty, or subpulverulent disk.

Genus 16. PANNARIA.

1. *P. brunnea*, Sw.—Jakobshavn; Illartlek glacier, abundant; Lyngemarken, abundant; Ounartok; Godhavn. One of the most abundant (musci-colour) lichens in the area examined by Brown. Several forms occur, exhibiting some of the characters of *Pannaria hypnorum*, Vahl. (E. Bot. t. 2119, or Th. Fries's L. Arct. p. 78); and of var. *coronata*, Hffm., of *P. brunnea* (= *Biatora coronata*, Fr., Leight. Exs. No. 235; *Lecidea coronata*, E. Bot. t. 2110). The plant is, I believe, one of those species or types which may be made properly to include several of the so-called "species" of authors. Sometimes it is athalline, only its large apothecia being scattered over the surface of decaying or dead mosses (*e. g.* about Jakobshavn). In age, the apothecia sometimes become very large, and black, or black-mottled, the disk expanding and becoming flattened, the margin thin and cracked, and the whole outline variously irregular or deformed. The plant has then quite the character of the British *Squamaria isidioides*, Borr. (E. Bot. t. 2130). The paraphyses are agglutinated at their tips, which are very pale brown. The asci, and hymenial gelatine generally, usually become blue under iodine. Sometimes, however, there is no reaction in either. The asci are 8-spored; the sporidia are arranged in single or double series, the shape and size of the asci varying accordingly. Asci usually '0021" to '0024" long, '0006" to '0009" broad. The sporidia vary considerably in size, shape, and contents. They are always simple, and generally colourless, their contained nuclei being sometimes lemon-yellow. Their shape varies from narrowly ellipsoid to oval or sub-spherical, exhibiting occasionally various irregularities in outline (*e. g.* becoming subpyriform). Their size is usually about '0006" long and '00022" to 00040" broad. Within the asci, as well as when mature and free, they are frequently granular. Sometimes, apparently in the young state, they contain one, two, or more large, prominent, spherical, button-like nuclei, conspicuous even within the asci. These nuclei become more distinct under iodine. In the old state the sporidia frequently show double contour.

In var. *coronata* (Leight. Exs. no. 235) the paraphyses and asci are shortish, the latter faint blue with iodine. The sporidia are colourless or very faint yellow, broadly ellipsoid and simple. Var. *coronata* Auct., and *Pannaria nebulosa* of Nylander's Exs., do not deserve rank even as separately named *varieties*.

In the present collection I met with a few sterile fragments of what appears to be *P. muscorum*, Ach. (= *Massalongia carnososa*, Dicks.), according to Schærer's Exs. No. 482, and Nylander's description (Scand. p. 128). But it is not mentioned in the 'L. Arctoi' as a Greenland lichen, though common in Scandinavia. Nylander objects to the name *carnososa*, and Fries to that of *muscorum* (Arct. p. 80)!

Genus 17. SQUAMARIA.

1. *S. chrysoleuca*, Sm.—Kudlesæt. The thallus varies in colour; usually straw-yellow or greenish, with black-mottled margins. Medullary tissue white. The colour and mottling resemble those of *Usnea melaxantha*. Apothecia abundant and crowded; disk black.

Tips of paraphyses deep brown and granular, their outline irregular. Asci and hymenial gelatine deep blue with iodine. Asci 8-spored, .0018" long and .0006" broad. Sporidia simple, oblong-ellipsoid (as in *Lecanora subfusca*), .0003" long and .00022" broad. Several forms of the plant occur, including *opaca*, Ach., and *feracissima*, Th. Fries. The *Placodium chrysoleucum* of Dickie, from Davis Straits, east side, collected by Taylor, is quite the Greenland *S. chrysoleuca*, growing apparently in larger and compound patches. The spermogonia of *chrysoleuca* have already been described and figured in my 'Mem. Spermog.' (pp. 259, 260, plate xv. figs. 15-17).

In *S. chrysoleuca* and its var. *opaca* (= *Parmelia rubina*, vars. *chrysoleuca* and *opaca*) of Schaerer, Exs. nos. 345, 346, the sporidia are the same as in the Greenland plant, ellipsoid, simple, colourless, .00033" to .00041" long and .00016" to .00020" broad. The asci are 8-spored, .00013" to .00016" long, and .0005" to .0006" broad. The paraphyses are discrete, their tips yellow or brownish-green.

In var. *pellata*, Fr.* (Nyl. Scand. p. 131, and Exs.), the sporidia are simple, ellipsoid to oval, colourless, .00033" long and .00020" broad. Asci blue with iodine, .0013" to .0016" long and .0005" broad. The epithecium is black-mottled with *Phacopsis clemens*, Tul. †; while the thallus is the site of other black, punctiform or papillæform verrucarioid parasites, associated with and externally resembling the spermogonia of *chrysoleuca*. These parasites include the *Sphæria* described by Nylander (Scand. p. 133) as parasitic on the thallus of *S. saxicola*, which consists of minute, black, punctiform, immersed conceptacles containing fusiform colourless sporidia, associated with spermogonia, also black and punctiform, containing minute, straight spermatia. The thallus of *chrysoleuca* appears also to be the site of a parasitic *Celidium* (Tul. Mém. p. 125), by which it is rendered black-maculate.

2. *S. saxicola*, Poll. Jakobshavn; Godhavn. Some of its forms (*e. g.* on Disco Island) are athalline, or nearly so, and are undistinguishable from *Lecanora polytropa*. The apothecia, asci, and sporidia are the same in the *Squamaria* and *Lecanora*. The apothecia are frequently very large, from being compound or confluent, irregular in outline and surface, immarginate, generally more or less convex and pulvinate. The sporidia, asci, and paraphyses are also identical with those of *S. chrysoleuca*. The normal apothecia are small, crowded, with a thalline, thin exciple. A variety in the Kew Herbarium, from Cape York (Lyll, 1852), occurs on the old weathered vertebræ of whales.

The apothecia of Norwegian specimens collected by myself about Jerkin (Dovrefjeld, 4600 feet, in August 1857) are the site of a parasite, which unfortunately exhibits no structure. In the young state the disk is mottled over with very minute, round, blackish-brown spots. These gradually increase in size, coalesce, and cover the whole disk. The margin also becomes involved; and finally the whole apothecium (disk and exciple) become black and granular, resembling the black degenerate apothecium of some *Lecideæ* (*e. g.* *L. parasema*). The parasite destroys at length not only the exciple but the disk, and thereby the whole general form of the apothecium; the disk becomes

* This and certain other forms, Nylander appears (Scand. p. 131) to refer to *S. melanophthalma*, Ram.,—probably one of the many instances that abound in Nylander's works of excessive and unnecessary elaboration!

† Referred to the genus *Arthonia* by Th. Fries (L. Spitzberg. p. 46); and to *Conida* by Körber (Parerga, p. 458).

convex instead of flat; and ultimately a black, irregular, verrucæform, shapeless mass is the result.

Various parasites, mostly hitherto considered Lichens*, have been described as occurring either on the apothecia or the thallus of *S. saxicola*, or on both, *e. g.* :—

(1.) *Conida clemens*, Tul. (Körb. Parerga, p. 458). On the apothecia. Sporidia 8, small, unequally oblong, 2-locular, hyaline.

(2.) *Cercidospora Ulothii*, Körb. (Par. p. 466). On thallus. Sporidia 4, fusiform or cymbiform, equally 2-locular, hyaline.

(3.) *Thelidium epipolytropum*, Mudd (Brit. Lich. p. 298). On thallus. Sporidia 4–8, oblong or subfusiform, 2-locular, hyaline.

(4.) *Lecidea episema*, Nyl. (Prodr. p. 125). On thallus. Sporidia ellipsoid or oblong, and simple; or oblong, cylindrical, and 2–4-locular.

(5.) *Sphaeria Squamariæ* (Nyl. Scand. p. 133), already described under *S. chrysoleuca*. On thallus. I have given it the provisional specific name *Squamariæ*, as it is desirable, if not necessary, for convenience in reference, that it should bear some short distinctive appellation.

3. *S. elegans*, Link. Jakobshavn, in fruit. Many forms or conditions occur—some of them passing into *Physcia parietina*, or undistinguishable from certain of its states. The colour of the thallus varies greatly with locality—from the brilliant vermilion of the type to the dull green of certain forms of *parietina*. It is a pale dirty green (*e. g.*) in shady places, on portions of the thallus shaded by stones, or on revoluted portions of the thallus. Sometimes the thallus is covered with sorediiferous spots, which become quite green under moisture. The cortical layer is frequently eroded in patches, as in *P. parietina*, exposing the white medullary tissue, and thus producing white-mottling of the thallus. This erosion sometimes involves large patches of the thallus. Potash struck a deep vermilion-red only in one specimen, while in many cases there was no reaction: thus there was none where the thallus was pale-green; but in other cases there was every gradation of colour-development between none and a distinct reaction. The apothecia exhibit similar changes of colour to those of the thallus. The disk, however, is sometimes deep vermilion where the thallus is very pale. Sometimes on a white (eroded) thallus the disk of the apothecia is black, the exciple thick and involute. The disk is also occasionally, in part or in whole, eroded similarly to the thallus, the hymenium being more or less destroyed. The paraphyses are very beautiful and distinct microscopic objects, discrete, hyaline, with thick filaments, resembling the medullary tubes of many lichens. Hence *S. elegans* is one of the best lichens in which to study the structure of their paraphyses and their connexion with the tubular tissue constituting the medullary layer. They are distinctly articulated, the last two or three terminal cells being subspherical, frequently granular, or containing prominent nuclei. The terminal cells, or joints, which constitute the tips of the paraphyses, are much larger than the others; the seat of greenish

* A detailed list of the *Parasitic Micro-lichens*, that affect species which occur in Greenland in common with other countries, will be found in my "Enumeration of Micro-Lichens parasitic on other Lichens." Quart. Journal of Microscopical Science, January, April, and October, 1869.

colouring-matter; generally subovate or subpyriform. They are more granular, and more frequently contain nuclei than the other articulations. Hence, when detached, they have the aspect of many sporidia or stylospores. Their colouring-matter is sometimes distinctly limited, *e. g.* to the terminal cellule, or to a portion only thereof*. The sporidia are very variable in size and form, hyaline, very delicate, generally oval, sometimes slightly curved, sometimes simple; or polari-bilocular and physcioid; or equally 2-locular, with a median septum, and with (or without) a central constriction, giving a figure-8 character; about $\cdot 00040''$ long and $\cdot 00020''$ broad.

The thallus, as well as the apothecia (disk and exciple alike) are the seat of a parasite, which occurs in the form of scattered or crowded, sometimes confluent, black papillæ, containing sporidia, that are about $\cdot 00020''$ long and $\cdot 00009''$ broad, oblong-ellipsoid, 2-locular, brown in maturity, olive in the young state. These sporidia are very different from those of the *Squamaria*, and cannot be confounded therewith. Nor can the parasite be mistaken for the spermogonia of *S. elegans*, which are described and figured in my 'Mem. Spermog.' (p. 300, plate xv. figs. 27-29). The Greenland parasite has the characters of some species of the genus *Ticothecium*, Fw., emend., as they are described by Körber (in his 'Parerga,' p. 467). But none of the said species are represented as infesting the *apothecia* of the Lichens on which they occur.

In the Kew Herbarium several specimens of *S. elegans* occur from Greenland and different parts of the Arctic regions (*e. g.* Igloolik, Sir Edward Parry), all of them saxicolous, and in fruit. In Spitzbergen, they sometimes occupy unusual habitats, *e. g.* the old weathered horns of Reindeer (Th. Fries, 'L. Spitsberg.' p. 14).

In some districts of Greenland, *S. elegans* would appear to occur in such abundance as to give a character to the rock-scenery. Thus Hayes, speaking of Port Foulke, says that the rocks are almost everywhere covered with a lichen of an orange-red colour, growing in "immense patches," imparting "a cheerful hue to the rocks;" while "Tripe de roche," which was still more plentiful, gave them, on the other hand, "a mournful look" ('Open Polar Sea,' p. 398) †.

I see no good ground for separating *Placodium* and *Squamaria* as genera. On the contrary, it would be much more convenient, and quite as scientific, to arrange in a single group all the Lichens, having a subfoliaceous thallus intermediate between *Parmelia* or *Physcia* and *Lecanora*, with sections founded perhaps on the character of the thallus, on the one hand, or of the sporidia, on the other. The character of the sporidia, however, is unsafe even for the establishment of sections, inasmuch as there are (*e. g.* among the *Lecanoræ* and *Lecideæ*) many Lichens whose sporidia are, at different stages or in different states of growth, both simple and compound. This difficulty meets the student in connexion with the numerous subgenera into which Continental lichenologists have divided the heterogeneous genera *Lecanora*, *Lecidea*, and *Verrucaria*.

Genus 18. LECANORA.

The subdivision of this great genus into the numerous genera quoted by Th. Fries (*e. g.*

* This limitation is even more distinct in *Lecidea Greenlandica* (*g. v.*).

† Compare remarks on the physiognomy of the Greenland Lichen-flora in my paper on "the Lichen-Flora of Greenland" (pp. 36-39 & 65).

in his 'L. Arctoi') and other Continental authors, such as Körber, Stizenberger, and Massalongo, appears to me to be unscientific, inasmuch as their characters are not constant—and unnecessary, inasmuch as it is sufficient for the purposes of classification to give them place (if separate place they ought to have) as *sections* only. The following subgenera, however, made use of by Th. Fries, in his 'L. Arctoi,' being those only that are represented in Greenland, suffice to illustrate their very arbitrary definitions:—

(1.) *Caloplaca*, Th. Fries. Sporidia ellipsoid, colourless, polari-bilocular.

(2.) *Dimerospora*, Th. Fries. Sporidia oblong, 2-locular, colourless.

(3.) *Rinodina*, Mass. Sporidia 2-locular, brown.

(4.) *Dimelæna*, Norm., emend. Sporidia 8, 2-locular, biscociform, brown.

(5.) *Hæmatomma*, Mass. Sporidia acicular, 5- to poly-locular, hyaline.

(6.) *Gyalecta*, Ach., emend. Sporidia ovoid-oblong, or fusiform, 4- or multi-locular, colourless.

(7.) *Aspicilia*, Mass. Sporidia simple, colourless, ellipsoid.

(8.) *Acarospora*, Mass. Sporidia myriad, very minute, simple, hyaline. His true genus

(9.) *Lecanora*, includes species referable to the following genera or subgenera:—

Ochrolechia, *Cryptolechia*, and *Lecanidium* of Massalongo; *Polyzosia* and *Zeora* of Körber.

1. *L. tartarea*, L.—Jakobshavn; Godhavn, fruit abundant; Lyngemarken, apothecia compound; Illartlek Glacier, in fruit. One of the most abundant lichens in the area examined by Brown. Especially common in its muscicolous forms, which include *frigida*, Sw.; *gonatodes*, Ach.; *grandinosa*, Ach.*; and *theleporoides*, Th. Fries (L. Spitsberg. p. 21). Though frequently fertile as to apothecia, it is more generally sterile, the thallus occurring in an abortive or degenerate condition. This sterile thallus is very common, covering large patches of dry, decayed vegetation, mostly mosses. In its earliest stage of development, the thallus appears as a thin, very white, effuse, smooth coating. Next, wartlets gradually become developed here and there; these gradually multiply and coalesce into a tartareous thallus; and lastly the spicula (which are typical in *gonatodes*) are exhibited. Sometimes the thallus forms large loose crusts on mosses, having little hold, and being therefore easily detachable in patches, which have the appearance of rough plaster moulds of the subjacent decayed vegetation. Frequently the sterile thallus is sorediiferous, less often isidioid. Though generally white, especially in the young state, the colour varies to tawny yellow. These cream- or buff-coloured forms are more frequently uniformly granular than verrucæform, and are very different from the ordinary verrucose thallus of the type. They give, however, the same beautiful blood-red reaction with bleaching-solution, and are so frequently and intimately associated with the more usual conditions of *tartarea*, that they too appear to be referable to it. Sorediiferous forms have frequently a greenish tint, probably from growing in the shade. Occasionally there is apparently no filmy or rudimentary stage, or prothallus—the earliest form of thallus consisting of a series of smooth subspherical warts, scattered irregularly over the surface of herbage, varying greatly in size, frequently agglomerated

* Not mentioned as a Greenland form by Th. Fries in his 'L. Arct.' p. 100.

into groups, often also becoming on their surface very irregular, sorediiferous, or granular. Sometimes the thallus is inconspicuous, or appears to be altogether absent, the apothecia being scattered directly over the surface of various mosses, especially *Racomitrium lanuginosum*. In other cases the moss is coated only with an obscure thin white film; or there are only a few isolated verrucæ. The spicula, which are the characteristic feature of the forms known as *gonatodes* and its allies, are thus developed:—The leaves of mosses become first covered with the thin, white crust of the lichen. In course of growth, this crust assumes the form of nodules or warts on the surface, spicula being protruded at its margins. The ends of the primary spicula are frequently the seat of minuter, secondary, divergent ones. Occasionally the spicula are so long and vermiform, that the states of thallus bearing them might appropriately claim the designation *vermicularia*, resembling, as they do, moreover, certain conditions of *Thamnolia vermicularis*.

With potash, the young white smoothish thallus gives a beautiful lemon-yellow, becoming orange. With bleaching-solution, the same condition of thallus gives a bright blood-red reaction; as a general rule, all forms of thallus, including the muscicolous ones, developed a beautiful blood-red, or more brilliant crimson, or vermilion colour, slight attrition being required. The colour was most easily developed, and proved richest, on the denser, verrucæform states of thallus. In other cases, however, there was either no reaction, or it was very faint. Thus there was none with the young apothecia scattered, without thallus, over *Racomitrium lanuginosum*. With *gonatodes*, it was frequently very feeble, though at other times very brilliant; while with the verrucæform sterile young thallus, there was sometimes no reaction, either with potash or bleaching-solution. Greenland forms of the type and of its varieties *frigida* and *gonatodes* yielded at once, under ammoniacal maceration, a port-wine-red colour—a result which I obtained also in Icelandic, Norwegian, and Faroese forms*.

The apothecia are frequently very large, irregular in outline, and as if composed of a series of confluent individuals. They are also variously deformed by erosions or otherwise. I measured one old apothecium, which was nearly $\frac{1}{2}$ " across. Sometimes new and smaller apothecia are developed on the surface of the old ones. Occasionally eroded portions of the hymenium are replaced by new tissue. Sometimes there is central erosion through all the tissues, or to various degrees, as in the apothecia of *Parmelia perforata*, the edges being generally very irregular, becoming thickened, and assuming the pale colour and characters of the thalline exciple. Where the hymenium disappears, the excipular subjacent tissue, which is of a whitish or cream-colour, becomes exposed. Where only part of the hymenium decays, the brownish red of the remainder contrasts curiously with the paler colour of the denuded exciple. The central parts of the disk, where not eroded, are frequently much areolate or fissured. The thalline margin (exciple) is sometimes very thin and inconspicuous, or it disappears, or is concealed by the swelling subconvex disk; in other cases it becomes greatly swollen and involute on the hymenium. Apothecia, both old and young, normal and deformed, occur sometimes, apparently or really, by themselves, the thallus being either obscure or absent.

* "Northern Lichen-flora," Journal of Linnean Society, vol. ix. Botany, p. 415.

In corticolous forms, occurring on *Betula*- and willow-stems, the asci are 8-spored, the sporidia oval, colourless, simple, granular; sometimes, in the young state, $\cdot 0009''$ to $\cdot 0012''$ long, and $\cdot 0006''$ broad.

On various forms of *tartarea*, I met with a black verrucarioid parasite, possessing both sporidiiferous perithecia and spermogonia. It occurred (*e. g.*) on the verrucæform thallus of the *Lecanora*, about Godhavn, seated, like *Abrothallus*, apparently on special growths of, or from, the said thallus. The parasite is punctiform or papillæform, the perithecia being seated on the irregularities of the thalline warts. When occurring as large papillæ, these perithecia resemble in external character the smaller apothecia of *Abrothallus Smithii*. The asci are 1- to 4-, never 8-spored, their size about $\cdot 0024''$ long, and $\cdot 0004''$ broad. The sporidia vary considerably, equally in length and breadth; their length ranges from $\cdot 0006''$ to $\cdot 0009''$; their breadth from $\cdot 00015''$ to $\cdot 00030''$. In form they are oval, sometimes fusiform, generally straight, sometimes slightly curved. In maturity they are 3- to 8-locular, the number of septa varying considerably, 2 or 3 being common, while there are sometimes 4 or upwards. The episporium frequently bulges in maturity opposite the loculi of the endospore. In the young state, within the asci, the sporidia are sometimes simple and very granular, or they exhibit only rudimentary divisions into loculi. Their colour, according to age, varies from hyaline or pale olive (within the asci) to deep or blackish brown. The sporidia are frequently abortive or degenerate, and are then of a deep brown colour. Even in this condition they are also sometimes simple, or show only traces of division. Sometimes only one sporidium is developed in an ascus, acquiring in that position a brown colour, though the remaining protoplasm of the ascus is hyaline. Occasionally chains of 4 sporidia occur, the wall of the ascus having disappeared; or 2 sporidia adhere, and carry as a sort of caudal appendage the degenerate protoplasm, or the pedicle of the ascus. In young asci, the protoplasm (as it generally is in lichen-asci) is granular, usually colourless, sometimes becoming pale olive.

This parasite has not, so far as I can discover, been previously detected or described. As an apparently new form, therefore, I give it the appropriate name *VERRUCARIA TARTARICOLA*.

What appear to be its spermogonia occur on similar, but separate, thalline warts, studding more copiously their verrucosities, much more numerous, minute, and crowded than the sporidiiferous perithecia.

Parasitic perithecia, externally resembling those of *Verrucaria tartaricola*, occur on the thallus of var. *gonatodes*, which, about the Illartlek glacier, coats grass, leaves, stems, twigs, and mosses. Here the black parasite is very conspicuous on the beautiful white, thin, papery thallus, being dotted copiously over its periphery. But the internal structure differs from that of *V. tartaricola* in the asci being always 8-spored, and the sporidia colourless. The paraphyses are filiform and very delicate, hyaline throughout, flexuous and interwoven, sometimes indistinct. The asci are subsaccate and subarthonioid, with a very short, inconspicuous pedicle. They occur in tufts amidst the web of the paraphyses. They exhibit a brownish-red reaction under iodine,

which develops a blue colour in the hymenial gelatine. The sporidia are fusiform or ellipsoid, varying considerably in all dimensions; usually about $\cdot 0006''$ long, and $00015''$ broad, 3- to 6-locular. Within the asci the loculi of the sporidia sometimes resemble rows of button-like nuclei, subspherical or transversely oblong. According to prevalent rules or customs as to botanical nomenclature and classification, this parasite appears to require a separate place or name, at least provisionally. I therefore distinguish it from *V. tartaricola* as *VERRUCARIA CAMPSTERIANA**.

On some Greenland forms of var. *frigida* occurs still another parasite, as very minute, black, punctiform, crowded perithecia, full of round, brown or olive, simple, usually granular spores, varying from $\cdot 00009''$ to $\cdot 00022''$ in diameter, partly cohering in large irregular masses, partly having the appearance of *Torula* spores.

2. *L. parella*, L. Kudlesæt, on willow- and *Betula*-stems and leaves, decayed and dry; also muscicolous. Some of its forms have the characters of *upsaliensis*, others of var. *frigida* of *L. tartarea*. It is obvious that the one variety passes into the other, just as do the types†. I have long been of opinion that *tartarea* and *parella* belong properly to a single type, and cannot be specifically separated. I have met with innumerable passage-forms from very different parts of the world, but especially from alpine and arctic regions. In many cases I have found it impossible to refer individual specimens to the one plant or variety rather than to the other. But such difficulties are obviated by uniting *tartarea* and *parella* and abolishing *separate names for varieties*, which are mere inconstant states of growth, depending on the nature of the habitat (*e. g.* whether rock or stone, wood, leaves, or moss). *Upsaliensis* gives no reaction with bleaching-solution. But after all I have elsewhere said‡ of the capriciousness of this reaction in lichens, and particularly in *L. tartarea*, it would be obviously absurd to make its presence or absence a character for separating or establishing *species*.

3. *L. oculata*, Dicks. Illartlek glacier, terricolous, with quite the characters of the British *Isidium oculatum*, Dicks. (E. Bot. t. 2267). It also occurs corticolous on birch-bark, associated with *L. tartarea*. The young thallus is exactly like that of *L. tartarea*, coating leaves and mosses with a very vividly white crust. The mature state exhibits a series of beautiful tall, white, thick pillars, resembling greatly magnified *isidia*, digitately branching below their tips, which are subdiscoid. These pseudo-disks have a darker shade of colour than their thalline margin. An intermediate condition between these two states of thallus, the typical young and the typical old ones, resembles the dwarf, compact form of *Spherophoron coralloides*, with which it is apt at first sight to be confounded. Here the podetia-like columns are very short and stunted, closely arranged, producing a subtartareous thallus. But the columns are always very fragile and spongy, occupied by a light, soft, cottony tissue; whereas the branchlets of *Spherophoron* are always comparatively tough. The plant appears to be generally sterile in Greenland, as it is also

* Vide *Lecidea Campsteriana* for origin of the *specific* name.

† In Hepp's Exs. No. 673, *L. pallescens*, var. *upsaliensis* is quite the *frigida* var. of *tartarea*, except as to the colour of the disk.

‡ "On Chemical Reaction as a Specific Character in Lichens," Journal of Linnean Society, vol. xi. Botany, p. 36; and Trans. Botanical Society of Edinburgh, vol. x. p. 82.

in Spitzbergen, and generally throughout the arctic lands and islands. The asci and sporidia are those of a *Pertusaria*, or Pertusarioid *Lecanora*, such as *L. bryontha*. The hymenium gives a blue reaction with iodine. The thallus, especially when young, gives a lemon-yellow with potash. No reaction occurs with bleaching-solution. Water has the same effect as potash, in a minor degree—a circumstance that renders this greenish-yellow coloration under potash of little or no significance in the lichens in which it occurs.

I met with two or three different *Parasites* on Greenland forms of *L. oculata*. Of these the following is of an unusual character. It occupies small wartlets of the horizontal thallus of the *Lecanora*, clustered at the base of the columns. These wartlets are crowned with an irregular, stellate-fissured, ostiolar disk of the same obscure brownish-green colour as the apothecia of the *Lecanora*. The disk expands under moisture. The wartlets in question might be supposed at first sight to be the spermogonia of the *Lecanora*. But they contain hymenial tissue and sporidia, not sterigmata and spermatia. The hymenium gives a yellow (no trace of a blue) colour with iodine. The asci are 8-spored, sublinear, .0012" to .0015" long, and .00022" broad. The young protoplasm is, as usual, granular. Neither the paraphyses, which are very delicate and indistinct, as in *Verrucaria*, nor the hypothecial tissue is coloured as is usual in the higher lichens. The sporidia are arranged in a single series in each ascus, about .00015" to .00020" in diameter, being spherical, like those of *Lecidea lugubris**, than which they are smaller. This parasite has the external aspect of a verrucæform or papillar *Pertusaria*, and I therefore assign to it the name

Pertusaria paradoxa†.

Its sporidia are very different from those of *Pertusaria*; but I know of no better provisional position than in that somewhat heterogeneous genus. The colour of the disk and hymenium, and their occupation of the ordinary wartlets of the thallus of the host, are also striking peculiarities.

While examining the lichens of the Kew Herbarium in 1858, I met with a plant having very similar characters to *Pertusaria paradoxa*. The specimen was labelled by Borrer, 1805, was apparently referred to *Lecidea luteola*, Ach., and was no doubt English, though no locality was given. The apothecia or perithecia were precisely of the character of those of *P. paradoxa*, being subconical warts, with a radiate disk having a very torn, irregular margin. The sporidia were simple, colourless, oval, resembling those of *Lecanora subfusca*, but much smaller. Both this lichen and *Pertusaria paradoxa* are apparently closely allied to *Lecanora protuberans*, Smrf. (Th. Fries, L. Arct. p. 102).

* *Vide* author's paper on *L. lugubris*, Quart. Journal of Microscop. Science, vol. v. 1857, pl. xi. The sporidia of the *Lecidea* are more regularly spherical, and usually exhibit a distinct double contour. Somewhat similar, also, are the sporidia of *Lecidea fuscescens*, Smrf., in Nylander's Exs. No. 135, which I found spherical, not ellipsoid, as described by Th. Fries (L. Arct. p. 197).

† A somewhat similar lichen Th. Fries has apparently described as var. *pertusarioides* of *L. tartarea* (L. Arct. p. 100). But, unless we admit *L. oculata* to have two forms of apothecia on the same thallus, the pertusarioid apothecia in our Greenland plant must be considered *parasitic*.

Both the columns, and horizontal, verrucose thallus of the Greenland *L. oculata* are studded over with a very minute, black, punctiform parasite, which is partly of the nature of *pycnidia*, containing myriads of stylospores, resembling those of similar pycnidia in *Cladonia fimbriata*; brown or olive, spherical to pyriform; when spherical, about $\cdot 00015''$ in diameter; sometimes oblong and cohering in chains, like the spores of *Torula*; then deep brown, $\cdot 0003''$ long and $\cdot 00022''$ broad. The envelope is deep brown and cellular. The constituent tissues give no reaction with iodine. It is extremely unlikely that these pycnidia are referable, as a secondary form of fructification, either to the *Lecanora* or *Pertusaria*. It is possible, however, that the perithecia, which contain the deep-brown, concatenate, oblong spores are referable to a different parasite from that, which contains the much smaller, more delicate, isolated or free stylospores. In this case, the first-mentioned group of perithecia may belong to *Torula lichenicola**

On a specimen of *L. oculata* (sub nom. *Lichen dactyliferus*, Whlnb.) in the Kew Herb., I find a parasite of a very different kind from any of those which occur on the Greenland plant. Seated on and partially immersed in some of the thalline warts are apothecia, black, flat, rough on the surface, slightly urceolate sometimes, which appear to be developed in, and ultimately to burst through, though they do not project above, the thalline warts. The asci and sporidia resemble those of certain *Calicia*, the sporidia being brown, 2-locular, oval, or figure-8-shaped (having a constriction at, or opposite to, the central septum), $\cdot 00050''$ to $\cdot 00066''$ long and $\cdot 00025''$ broad.

4. *L. bryontha*, Ach.—Illartlek. A most interesting lichen, having certain characters both of *Lecanora* and *Pertusaria*, and forming a connecting link between these genera. The apothecia are those of *Lecanora*. There is an open, convex disk, concealing the thalline exciple. The sporidia and asci are those of *Pertusaria*. The sporidia are very large, $\cdot 0060''$ long and $\cdot 0024''$ broad, simple, oblong-oval; double contour distinct; protoplasmic contents finely granular or muco-granular, intermixed with much oil-globules, as is common in *Pertusaria*. The asci are also very large, $\cdot 0075''$ long and $\cdot 0024''$ broad, 1-spored, blue with iodine; none of them seen in their entire length on the field of the microscope. Both asci and sporidia resemble those of *Pertusaria communis*.

The Greenland plant is quite the *Pertusaria macrospora*, Næg., of Hepp's Exs. No. 424, and of Mudd's 'Brit. Lichens,' p. 277, with certain trivial modifications. The disk has the same dull greenish-brown colour as in Hepp's Swiss specimens; but the apothecial verrucæ in the Greenland plant are more elongated, more like the columns of *L. oculata*, more isidioid or stipitate; while the disk is so convex and tumid as to conceal the usual thalline margin.

It would be equally proper to class this lichen as a *Lecanora* or a *Pertusaria*. Inasmuch as the external (morphological) characters should always, if possible, take precedence of internal (structural) ones, I prefer arranging it, on account of its apothecia, as a *Lecanora*, beside *L. oculata*. Th. Fries (L. Arct. p. 117) gets over the difficulty of the Pertusarioid sporidia by creating specially for this single lichen a separate (sub-)genus, *Pionospora*, characterized by large single sporidia, and which he conveniently considers

* A new species described in "Observations on new Lichenicolous Micro-Fungi," Trans. Royal Society of Edinburgh, vol. xxv. pp. 515 & 530; and Proceedings, vol. vi. p. 534.

intermediate between the true *Lecanora* and the *Pertusaria*. Whatever its position in classification, the plant illustrates the close affinity between these two great genera.

5. *L. ventosa*, Ach.—On granitic rocks about Jakobshavn; not common. Apothecia and spermogonia abundant, as well as the parasitic *Sphæria ventosaria*, Linds.* The thallus is of an unusually vivid green, a character, however, which is common to all northern or arctic lichens with a greenish thallus. The spermogonia and the *Sphæria* are externally alike, the perithecia of both consisting of black, irregular warts; but their contents at once distinguish them. The Greenland *Sphæria* has polysporous asci, $\cdot 0015''$ long and $\cdot 00045''$ broad, the sporidia being ellipsoid, olive or brown, 2-locular, sometimes figure-8-shaped, and very minute, $\cdot 00022''$ long and $\cdot 00009''$ broad.

In specimens of *L. ventosa*, collected in the Braemar Highlands, in August 1856, I very frequently met with the *Sphæria*, but rarely with the spermogonia, which are usually externally undistinguishable from the parasite. The spermogonia, however, were abundant in a specimen from Morchone, as irregular, flattish, longish, conspicuous, elevated warts, seated on individual areolæ of the thallus, their surface black, or bluish-black, pierced by several irregular blacker openings or ostioles. The spermatia were numerous, as straight rods, about $\cdot 00025''$ long, arising from the apices of delicate, linear, irregularly digitate, and sometimes bulging sterigmata, subsimple or consisting of only a few articulations. Interspersed with these spermogonia were a number of black, papillæform perithecia, much more like ordinary spermogonia, but which really belonged to the parasitic *S. ventosaria*.

On another specimen, bearing normal apothecia (from the summit of Lochnagar), I found spermogonia abundant, external to the region of the thallus occupied by the apothecia. Here, again, they occurred as large, irregular, prominent warts, of a darker green than the thalline verrucæ upon which they were seated, their apices covered with irregular, black, or bluish-black ostioles, indicating compound perithecia. These ostioles are the only external distinguishing feature, as they are never seen in the *Sphæria*.

6. *L. subfusca*, L.—Jakobshavn, on twigs of birch; a form with very small apothecia, very sparingly distributed. Muscicolous forms (= *epibrya*, Ach.) are more common. In Britain, *L. subfusca* is very frequently the seat of various parasitic Fungi or Lichens†. Of these by far the most common I have met with is, especially in Irish specimens, *Torula lichenicola*, Linds., which occurs both on its apothecia and thallus.

7. *L. frustulosa*, Dicks.—Jakobshavn. Its white, tartareous thallus, of pulviniform areolæ, gives a beautiful lemon-yellow reaction with potash, a reaction that is common, however, on white, tartareous thalli, both in *Lecanora* and *Lecidea*. Hymenial gelatine beautiful pale blue with iodine. Tips of paraphyses agglutinate and pale brown. Sporidia simple, oval, or broadly ellipsoid, about $\cdot 0006''$ long and $\cdot 00022''$ broad; sometimes with granular or muco-granular contents; frequently exhibiting 1, 2, or 3 large, prominent nuclei.

* Described in the author's "New Zealand Lichens and Fungi," Trans. Royal Society of Edinburgh, vol. xxiv. p. 439.

† E. g.:—1. *Sphæria apotheciorum*, Mass.; 2. *S. epicymatia*, Wallr.; 3. *Arthonia varians*, Dav.; 4. *Pharcidia congesta*, Körb.; 5. *Lecidea parasitica*, Flk.

8. *L. badia*, Ach.—Jakobshavn; Ounartok. On gneiss; copiously in fruit and spermogoniferous. The young apothecia are sometimes suburceolate, while the old ones become convex and pulviniform, the disk sometimes covering the exciple; frequently crowded, and then variously deformed from external pressure. The central ones are largest and most crowded, but they never coalesce into compound apothecia. Sporidia simple, colourless, ellipsoid, .0003" long and .00015" broad. In the Ounartok specimens the apothecia are large and scattered, many of them with the disk partly or wholly eroded, similar to the condition that is commoner in *L. tartarea*. This is a beautiful form of the species. The spermogonia on the Jakobshavn (ordinary) form of the plant are scattered over the irregularities of the thalline areolæ, which are convex or pulviniform, and mostly discrete. They are to be met with on the peripheral areolæ, as minute brown points of irregular size and form, several being dotted over each areola.

9. *L. polytropa*, Ehrh.—Jakobshavn; Godhavn; Ounartok; Egedesminde. Most usually it has crowded and confluent or compound, deformed and livid apothecia, and a very verrucose thallus. Some forms occur on the same rocks and in the same localities with *Squamaria saxicola*, and appear to me to pass into that lichen (*e. g.* in Disco-Island specimens). On the one hand *polytropa* sometimes acquires a rudimentary, subfoliaceous thallus; and on the other, as already shown, *S. saxicola* is frequently athalline, with crowded apothecia of the same colour and external character, and with the same contents as *polytropa*, though generally there is less tendency in *saxicola* to coalescence and deformity of apothecia. In the ordinary forms of *polytropa* in Greenland, the hymenial gelatine gives a beautiful blue with iodine. The sporidia are simple, ellipsoid to oval, showing double contour or not; granular or muco-granular in the young state: about .0003" long and .00015" broad. In Nylander's Exs. I found the sporidia of *polytropa* pale yellow, about .00033" long and .00013" broad, simple, and narrowly ellipsoid. Sometimes *polytropa* occupies, like *Squamaria elegans* and *saxicola*, unusual habitats; *e. g.*, it occurs on the old excrement of birds (probably the *Lagopus alpinus*) in Spitzbergen (Th. Fries, L. Spitsberg. p. 22).

10. *L. cervina*, Ach.—Lyngemarken, on decayed twigs, very sparingly.

11. *L. smaragdula*, Whlnb. Only in the young state and sparingly, on granite and gneiss. Thallus and apothecia of light colour, approaching the characters of var. *cinereo-rufescens*, Ach. *Smaragdula* has quite as good a position in the genus *Endocarpon* as in *Lecanora*. Th. Fries's description of the range of his *Aspicilia cinereo-rufescens* and var. *diamarta*, Whlnb. renders it doubtful whether he includes it in the Greenland lichen-flora*.

12. *L. sopherodes*, Ach. Several forms occur—forms that systematists would probably refer to several different so-called species, *e. g.* *turfacea*, *mniarcea* †, and *atro-cinerea*. They are mostly corticolous—on birch bark or on whitened (bleached) twigs; or muscicolous, corresponding to the *epibrya* forms of *L. subfusca*, associated with sterile (vari-

* He says (L. Arct. p. 134) "Per totam regionem Floræ nostræ frequens;" and as his "Flora" refers to the 'Lichenes Arctoi Europæ Groenlandicæque,' it is to be inferred that all lichens so described, though not specially mentioned as Greenland plants, are nevertheless common in that country.

† *Turfacea* and *mniarcea* appear to me to constitute a single species.

olarioid or sorediiferous) states of *L. tartarea*. They also grow occasionally on old *Umbilicariæ*, or the rudimentary horizontal squamules of *Cladonia*. The apothecia are sometimes very large, at other times very small; their disk very black, or as brown as in *subfusca*, convex or flat. The larger apothecia have sometimes a squamulose or crenulate, or irregularly wavy, exciple, like that of *Pannaria brunnea*. The exciple is sometimes very white, and then conspicuous, or very dark, and then apt to be confounded with the disk. The whole apothecium, especially when small, may then be mistaken for that of a *Lecidea*—the more so that the *Lecanora* is frequently associated with various forms of *Lecidea parasema*. The examination of the sporidia, however, at once distinguishes the two very different plants. In the *Lecanora* they are normally deep brown and 2-locular, ellipsoid or oval, with or without a central constriction opposite the septum (becoming in the former case figure-8-shaped), varying considerably in size, from .0006" to .0009" long and .00030" to .00045" broad. In the young state they are sometimes simple and olive; or the contents show a tendency to, or distinct, bilocularity, the loculi having bold outlines, surrounded by a broad hyaline envelope so delicate as to resemble mucus. Occasionally the young sporidia are slightly curved as in *Physcia* and *Ramalina*. There is considerable variety in structure, resembling, in this respect also, some of the *Physciæ* (e. g. *stellaris* or *pulverulenta*). Sometimes there are three large prominent nuclei. Occasionally there is a protrusion of the epispore at each end—apparently the first effort at germination. Sometimes the loculi assume a bipolar character—isolated, or connected, as in certain *Physciæ*, both of the *stellaris* and *parietina* groups. In the young state, the sporidia are more frequently pale-olive than colourless. Sometimes the loculi are granular, or exhibit both nuclei and granules as in *Abrothallus Smithii* and many other lichens, which have brown 2-locular sporidia. The hymenial gelatine assumes a beautiful blue colour with iodine, as do also the asci; and the latter when full of young sporidia, whose loculi are nuclear and 2-polar, pale olive, prominent, button-like bodies, are fine objects under the microscope. The asci are 8-spored, about .0024" long and .00075" broad. The paraphyses are agglutinated at the tips and indistinct throughout their length.

13. *L. cinerea*, L.—Jakobshavn; Kudlesæt; in both cases on trap. Occurs in various "forms," some of them having the aspect of different "species." The young thallus sometimes consists of a series of dull lead-grey, pulvinate areolæ, resembling those of some forms of *Lecidea atro-alba*. The mature thallus is frequently uniformly white-granulose or farinose; and in this condition it generally gives a deep greenish-yellow reaction with potash. Other forms of the white mealy thallus, however, give a beautiful lemon-yellow, while some exhibit no reaction. The apothecia are sometimes lecanorine, with a distinct thalline margin, or lecideine and immarginate; very convex, flat, or urceolate. Sometimes the disk is slightly white-pruinose as in *Lecidea abietina*. The urceolate forms are seated on or sunk in an areolate thallus—frequently of a leaden hue. Sometimes the apothecia are very minute in the young state and crowded, but always conspicuous. The lecideoid apothecia are sometimes as subspherical and prominent as in *L. calcarea*, into which *cinerea* undoubtedly passes by a series of gradations. In an intermediate stage between the lecanorine and lecideine apothecia, the disk is flat—sometimes with a thin, black, wavy margin. Between the forms bearing concave (urceolate) and convex

(lecideoid) apothecia there is the widest difference; and it is perhaps not surprising that systematists should have variously referred the very numerous and puzzling forms of this most variable of all the *Lecanoræ* to the genera *Lecanora*, *Urceolaria*, and *Aspicilia*, and to a considerable number of supposed species of these genera!

In Kudlesæt specimens especially, crystals of *hornblende*, which protrude through the thallus, are apt to be mistaken for apothecia. When fresh these crystals are black and glistening, and under the lens their crystalline structure is at once apparent. When weathered they become brown and assume more of a biatorine aspect than the apothecia of *cinerea* usually present. In all cases their outline and surface are irregular and linear or angular, as contrasted with the smoothish surface and rounded outlines of the lichen-apothecia. The difference can therefore be easily detected on careful examination under the lens. In all the Greenland forms of *cinerea* the asci and hymenial gelatine assume a very deep blue under iodine. The paraphyses are generally indistinct; in all cases short, and compactly arranged. The sporidia vary considerably in size, form, and structure. Their length varies from $\cdot 00015''$ to $\cdot 00020''$ in microsporous, and to $\cdot 0006''$ in macrosporous conditions; while their breadth in the former states is $\cdot 00009''$ to $\cdot 00015''$, in the latter $\cdot 0003''$ to $\cdot 00045''$. Their shape varies from ellipsoid, through oval, to sub-spherical. They are always simple and colourless, sometimes possessing double contour, occasionally finely granular or muco-granular; or they exhibit one or more (generally central) largish, prominent nuclei.

What was given to me while in Norway in 1857 by the late Professor Blytt as *L. Myreni* is apparently only one of the many forms of *cinerea**. Here the apothecia are sometimes lecanorine, resembling those of *atra*, having a prominent raised thalline margin. But in other parts of the same thallus they are lecideine and immarginate, sub-convex sometimes, even substipitate, or at least prominently seated on thalline elevations. In the latter case the thallus is generally old, having become subgranular and thin, worn away by weathering—a circumstance that is further shown by the relatively greater size and prominence of the protruding hornblende crystals. The old apothecia are sometimes deformed—a condition that is common to those of all *Lecanoræ* and *Lecideæ* in arctic and alpine countries.

L. cinerea is one of the many crustaceous lichens (abundant in most parts of the world) the forms of which exhibit a diversity as great as is the variety of conditions regulating growth. Few of these forms or conditions deserve separate rank or nomenclature, by reason of the inconstancy of their characters. Yet systematists manufacture out of them both genera and species, and are constantly altering the names and rank of these subdivisions—*e. g.*, “species” being reduced to the position of “varieties,” while the latter are elevated to the rank of species †.

14. *L. calcarea*, Ach.—Jakobshavn and Kudlesæt, on the same trap rocks as *L. cinerea*, to which, indeed, I refer it as a mere form. Thallus frequently very white or cream-coloured, and farinose, or irregular and tartareous, giving at once with potash a

* The assignation of *L. Myreni* in my ‘Northern Lichen-flora’ (p. 385) to *Lecidea amylicca*, Ach. and Whlbn., is therefore an error.

† *Vide* my ‘Northern Lichen-Flora,’ p. 382.

beautiful lemon-yellow. Like *cinerea*, it occurs in several forms; but it is far from being so variable. In one form (Kudlesæt) the apothecia are slightly white-pruinose, black, irregular in outline and surface, sessile, flat or more or less convex. The sporidia are simple, colourless, oval, .0003" long and .00022" broad. In what appears to be simply another condition from the same locality, the sporidia are smaller, oblong, or ellipsoid; the apothecia flat, regular in outline, with a distinct exciple. The appearance of these two forms is very different—nearly as much so as it is different from the associated urceolate forms of *cinerea*. All the forms described here, under both *cinerea* and *calcareo*, appear to me to be properly referable to a *single type*. In Central Europe *Leciographa parasitica*, Mass. (Körb. 'Parerga,' p. 463), is sometimes parasitic on the thallus of *calcareo*.

15. *L. leucoræa*, Ach. About the Illartlek glacier, both terricolous and muscicolous; Jakobshavn. This plant seems to me referable to *L. ferruginea*, which is more properly to be regarded as a *Lecidea* than as a *Lecanora*—the exciple, where it exists, having, usually at least, the same colour as the disk.

Genus 19. LECIDEA.

Even to a greater extent than *Lecanora* does, the genus *Lecidea* illustrates the tendency of the modern or Continental school of lichenologists to split up the generally excellent genera of the Acharian era into subgenera, founded on the too frequently variable characters of the sporidia. Differences in the character of the *sporidia*, when constant, and especially the degree to which their contents are divided into loculi by septa or interspaces, may be and are useful, in large genera like *Lecidea* and *Lecanora*, in subdividing them into *sections* or groups. But it is not, I think, desirable to give these sections generic importance or rank. This elaboration, which appears to me (as I have elsewhere explained) unscientific and unnecessary, is sufficiently exhibited in Th. Fries's 'L. Arctoi,' who classes the arctic *Lecideæ* under the following separate genera* :—

- (1.) *Lecidea*. Apothecia black. Sporidia 8, simple, ellipsoid, colourless.
- (2.) *Thalloidima*. Apoth. Lecideine. Sporid. 2-locular, ellipsoid, colourless.
- (3.) *Buellia*. Apoth. Lecideine. Sporid. oblong, 2- to 4- or multilocular, brown.
- (4.) *Rhizocarpon*. Apoth. Lecideine. Sporid. oblong, 4-locular to muriform, brown.
- (5.) *Arthroraphis*. Apoth. Lecideine. Sporid. acicular, multilocular, colourless.
- (6.) *Rhexophiale*. Apoth. Lecideine. Sporid. fusiform, 4-locular, colourless.
- (7.) *Biatorina*. Apoth. variously coloured, not black †. Sporid. 2-locular, colourless.
- (8.) *Biatora*. Apoth. Biatorine. Sporid. ellipsoid, simple, hyaline.
- (9.) *Psora*. Apoth. Biatorine. Sporid. linear, 4- to multilocular, colourless.
- (10.) *Bilimbia*. Apoth. Biatorine. Sporid. oblong, 4-locular, colourless.
- (11.) *Blastenia*. Apoth. Biatorine. Sporid. polari-2-locular, ovoid, colourless.

* Restricting these illustrations—as in the case of the genus *Lecanora*—to sub-genera represented in *Greenland*.

† The distinction between *brownish* or *reddish*, and *black*, apothecia in *Lecidea* is far from being constant or satisfactory. Illustrations of the inconstancy of this character may be found in the *Greenland* forms of *L. parasema*, *L. sanguineo-atra* and *L. Friesiana*. There is therefore no good (scientific) ground for separating *Biatora* and *Lecidea* as genera.

(12.) *Bacidia*. Apoth. Biatorine. Sporid. acicular, multilocular, colourless.

(13.) *Lopadium*. Apoth. Biatorine. Sporid. oblong, muriform, coloured.

The genus *Lecidea* is in some respects the most important Lichen-genus in Greenland. The individuals constituting its species are most abundant—especially on rocks and stones—though occurring largely also on stems and twigs of bushes, on decayed mosses, and on the soil. Its species are generally extremely variable, and afford ample scope for the ingenuity of systematists in the manufacture of varieties and the devising of names! It contains, moreover, a greater number of unusual or *novel* forms than any other Greenland genus.

1. *L. greenlandica*, n. sp. Kudlesæt: associated with a form of *Parmelia saxatilis* approaching *omphalodes*, and with *Lecanora tartarea*, and its var. *frigida*; generally terricolous, sometimes also muscicolous, or growing on the decayed fibres of twigs, &c. Apothecia sometimes athalline, and parasitic on the crust of the *Lecanora*, on which they are conspicuous by contrast of colour. Only a few fragments exist of what is, in many respects, a peculiar and most interesting lichen. The thallus is subfoliaceous, microphylline—sometimes resembling that of *Lecidea squalida* (e. g. of Nylander's Exs.), or that of *Umbilicaria arctica*. It is smoothish or irregularly papillæform or verrucose-granular; the colour variously grey, buff, or lurid (brown or blackish-brown). These lurid forms resemble *L. lugubris* both as to the thallus and apothecia.

The apothecia are wholly black (margin and disk alike), generally flat; the exciple is usually distinct and regular, sometimes tumid, at others (in age) thin and wavy. Apothecia generally scattered centrally; sometimes crowded and becoming deformed from mutual pressure; frequently degenerate, and then usually irregular in outline. The hymenial gelatine gives no reaction with iodine, or yellow (the colour of the reagent itself); while the asci give sometimes no reaction, sometimes one which is permanently red or violet, or a temporary red or violet, passing slowly into a faint, or more distinct, blue. In the young state the protoplasm of the asci is granular, sometimes partly oily, and colourless. Gradually a single sporidium is developed, granular and simple in the young state, but gradually exhibiting loculi and septa as it approaches maturity. Asci very large and delicate, varying in shape and size with age, .0030" long and .0008" broad in the young state, .0045" long and .0009" to .0012" broad in maturity.

The paraphyses are among the most peculiar and beautiful I have met with in lichens. They are discrete and distinct throughout their length, with a thickish filament .00015" broad or upwards, which is sometimes obscurely granular. Total length of the paraphyses about .0024". In the young state the tip is simply thickened, or bulging and rounded, and of a pale-brown colour. There is no distinct articulation; but as maturity is approached, a septum is developed, and there is a distinctly articulated terminal cell of very various shape, from lanceolate to spherical. The colour, deep brown, is frequently limited distinctly to a mere segment (often the upper half) of the interior of this terminal cell, rarely occupying its whole cavity. These terminal cells are easily detached from their filaments (e. g. by gentle friction of the glass covering the object on the microscope-slide); and frequently, especially in old apothecia, they are found in masses away from their filaments, and then resemble the irregular cellules of the tissues of *Co-*

*niothecium** or other parasitic lichenicolous fungi, or the spores of *Torula lichenicola*. They are frequently, in this isolated form, .0003" to .0006" long and .0003" broad. The colour of the paraphyses is generally limited to the terminal cell or a portion thereof; and this limitation is a peculiarity among lichens, the colour in paraphyses generally extending some way down the filaments and gradually disappearing. There is great irregularity in the form and size of the terminal articulation. Frequently it is obpyriform or rhomboid. Invariably it is of greater breadth than the filament, into which it sometimes tapers, *e.g.* in the young state. But more usually there is a constriction at the articulation, and the terminal cell, from its size and shape, appears altogether a body of a different kind from the filament.

The very large sporidia are associated with much oil-globules, as usual of varying size. The sporidia themselves are generally oblong, with rounded ends—about 8-locular at first—the loculi transverse, but breaking up gradually in a longitudinal direction into smaller loculi and assuming a muriform character. Their size varies considerably with age—from .0009" to .0030" long and .0004" to .0015" broad. In all cases and in all stages of growth they are colourless—a circumstance that separates them from the similarly shaped sporidia of *Rhizocarpon*, *Lopadium*, *Umbilicaria*, and *Stenographa*. In the old state they break up into the subcubical or subspherical cellules of which they are composed, which cellules have, when isolated, a nuclear appearance. In the young state the sporidia are simply granular like the protoplasm of the asci. No spermogonia nor pycnidia were observed.

2. *L. geminata*, Flot. I have seen no Greenland specimens. But in specimens collected by myself in Romsdal, Norway, in August 1857, and determined by Nylander, the asci, though generally 2-spored, are sometimes 1-spored, about .0036" to .0045" long and .0006" to .0009" broad. The protoplasm of the asci frequently becomes degenerate—then assuming the appearance of irregular, linear or ribbon-like masses, brown and granular. The hymenium becomes beautifully blue under iodine; and its section forms, in this condition, a fine object under the microscope. The large sporidia are generally oblong, with rounded ends, sometimes oval or subspherical, muriform, with sometimes a central constriction of the general mass of loculi within the broad hyaline sac which envelopes them. Sometimes, in the old state, these loculi occur as an irregular agglomeration of subspherical corpuscles of nearly equal size. The colour of the loculi in question is brown or olive, according to age. The size of the sporidia varies from .0015" to .0018" long and .0008" to .0010" broad. They resemble the muriform sporidia of some species of *Sphaeromphale* (Mudd, Brit. Lich. p. 281). Tips of paraphyses and hypothecial tissue deep brown. Externally this lichen has frequently the characters of *L. petraea* and *L. atro-alba*, from which its sporidia, however, distinguish it. But even as respects the sporidia there is a gradual transition from *atro-alba* to *geminata*; and the group includes several other lichens which have a most doubtful claim to the position of separate species.

3. *L. petraea*, Wulf.—Jakobshavn, on gneiss and trap; associated frequently with *Lecanora cinerea*. Apparently comparatively common in the area examined by Brown.

* Described in Paper on "New Lichenicolous Micro-Fungi" formerly quoted, pp. 518 & 534.

Thalline areolæ frequently pulviniform, unaffected by potash. Most variable in its sporidia, which are frequently simple in the young state, and muriform in the old, their outline and size varying correspondingly. The young sporidia are sometimes colourless or pale olive; oval or ellipsoid, straight or suberescentic; granular, or containing a single, large, eccentric nucleus or endospore; or their contents resemble those of the sporidia of many *Lecanoræ* (e. g. the *tartarea* group) in consisting of a mass of nuclei-form oil-globules and granular matter (sometimes they maintain this condition to maturity, but are then to be considered abortive); gradually acquiring the deeper olive or brown colour of the normal sporidia. As the normal sporidium is developed, its protoplasm becomes divided transversely into a varying number of loculi. The septa or division-spaces are either straight across, in which case the loculi are equal in size or nearly so; or they are variously oblique, giving rise to great irregularities in the size and form of the loculi. At first 3 transverse septa, equivalent to 4 loculi, were common in one form of the plant; while in another there were, at a later stage, the colour being dark brown, 7 to 10 such septa. Longitudinal division of the loculi sooner or later occurs as a general rule. At first it affects only one or a few loculi, and is subcentral; that is, there is a subcentral division longitudinally of the transverse loculi. But as age advances, this longitudinal division becomes much more general, and it goes on till a muriform structure results—that is, till the loculi are converted into a series of subcubical or subspherical cellules or corpuseles, as in the sporidia of *L. grænelandica* and *L. geminata*. In the old state the sporidium becomes broken up, as in *grænelandica*, into irregular masses of these subcubical corpuseles, which are of a dark brown colour. This brown colour of the mature and old sporidia is sometimes so deep as to obscure the contained loculi and their subdivisions. In the middle stages of development, when the transverse septa are distinct, the sporidia are frequently broadly ellipsoid or oblong-oval, straight, slightly curved, or plano-convex. Sometimes there is a bulging of the epispore opposite to each locule. In the old state (the muriform condition) the form is much more irregular and variable, resembling in this respect the sporidia of *Urceolaria scruposa*. Thus they are obovate, pyriform, or oblong, with irregular bulgings of the epispore. Linear-oblong forms, with 7–10 transverse septa, sometimes resemble, save as to colour, the sporidia of *Graphis*. With such a variety of *shape*, there must be corresponding differences in *size*. These differences, as well as other variable characters of the plant, are illustrated by the following chief forms, under which it occurs in Greenland:—

(1.) Growing on the under or shady side of stones. Areolæ, as usual, lead-coloured, or ash-grey, sometimes slightly white-pruinose, and as flat and brown as in *L. fusco-atra*, with which it is apt to be confounded. The sporidia, however, at once distinguish it. Apothecia flat and simple, though frequently or generally convex or subspherical, often deformed in age. Sporidia sometimes girt with a broad, hyaline margin, as in *geminata*; oval or oblong-oval and simple, or oblong, with a central constriction, and muriform; .0009" long and .00045" broad. Colour from deep olive-green to dark brown, in oldish or mature apothecia.

(2.) Thallus consisting of the ordinary lead-grey, discrete areolæ. Sporidia very large,
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·0024" long and ·0009" broad; muriform, consisting of a close aggregation of irregular cellules. Colour very deep brown. Apothecia flat.

(3.) Sporidia irregularly oblong, pyriform or ellipsoid, with about 7 transverse septa, having longitudinal central subdivisions; deep olive or bottle-green; ·0012" long and ·00045" broad. In the older, muriform condition, there is sometimes a central constriction of epispore, the sporidia showing at this point a great tendency to split. Half-sporidia, split in this way, occur, intermixed with fully formed ones. In the old, muriform state, the colour is so dark that the contained or constituent cellules are undistinguishable. The younger sporidia exhibit no longitudinal subdivision, or only through one of the central or polar loculi. The contained cellules in the muriform state are sometimes few and discrete (sometimes only two or three in a row) as in *Urceolaria scruposa*. In other cases they are usually more minute, numerous, and crowded.

(4.) Sporidia linear-oblong, ·0009" to ·0012" long and ·00045" broad. At first exhibiting only about 7 to 10 transverse septa, which, by division longitudinally, gradually become muriform, the colour in the early stages being deep olive, in the older brown.

(5.) On the thallus of different *Lecideæ* (e. g. on forms of *L. parasema*), I found sporidia apparently referable to *L. petræa*; old, very dark brown, and very irregular in outline resembling those of *U. scruposa*; about ·0009" long and ·00045" broad. I have occasionally, in like manner, met with stray individual or single sporidia of very different genera or species on the thallus of many lichens, mostly crustaceous*. In all the Greenland forms of the variable *petræa*, the hymenial gelatine and the asci give a very deep beautiful Prussian-blue colour with iodine.

In Schærer's Exs. No. 177 (= *L. confervoides*, DC., f. *concreta*, Sch.), the sporidia are colourless, 9-locular, becoming muriform; pyriform: ·0010" to ·0012" long and ·0005" broad. In its colourless sporidia this form of *petræa* resembles *L. grænländica*.

4. *L. atro-alba*, Ach.—Jakobshavn; Egedesminde; Atanakerdluk. In various forms, differing in their thallus, apothecia, and sporidia. The thalline areolæ are sometimes discrete and pulviniform, convex or even subspherical; or the young peripheral ones alone are so. Though whitish or grey in the dry state, they become green when moistened. Sometimes the thallus is rather tartareous, thick, verrucose, without distinct areolæ, buff or cream-coloured. In other cases the areolæ are very black, glossy, convex, confluent, and deformed. This condition is sometimes common in large patches, e. g. on granite about Egedesminde. Occasionally the areolæ are flattish and thin. The apothecia are sometimes flat, especially when young, with thin exciple, which is sometimes wavy. In age they occasionally become convex and subspherical (the disk concealing the exciple), and variously deformed. They differ considerably also in size, being largish or small. Sometimes they are compound; or several young ones cover the surface of a decayed or degenerate old one, producing various irregularities of surface and outline. Frequently also, in age, the disk becomes convex and rough on the surface, with irregularity of outline. The asci are small generally, about ·0015" long and ·00045" broad; 8-spored. The sporidia are never large, as described by Th. Fries (L. Arct. p. 230), but vary in size from about ·00045" to 00060" long and ·00022" to

* Vide *Cladonia gracilis*, and *Lecidea parasema*, No. 3.

·00030" broad. In some forms of the plant they appear to be nearly double their size in others. Normally, in maturity, they are 2-locular, and olive-green of various shades. But sometimes, in the young state, they are simple, slowly (and occasionally only obscurely) developing a septum. Sometimes, in age, they become elongated, multilocular and muriform, in which case they assume the characters of the sporidia of *petræa*. In the young state, and especially in the asci, they are frequently granular; their form is usually oval, less frequently oval-oblong or ellipsoid, occasionally figure-8-shaped or soleæform from constriction at the septum; straight generally, but sometimes slightly curved. The colour of the young sporidia is sometimes very pale—and of the old or mature, sometimes brown.

In Schærer's Exs. No. 44 (= *L. confervoides*, DC., var. *atro-alba*), the asci are 1-spored; the tips of the paraphyses a deep purplish-brown, their filaments indistinct. The sporidia are colourless when young, but acquire a dark bottle-green or brownish-green colour with age. In the young state they are sometimes 4-locular, but in maturity they are muriform. Their shape varies from oval to ellipsoid; their size is about ·0020" to ·0023" long and ·0010" broad.

In Schærer's Exs. No. 178 (= *L. confervoides*, var. *fusco-atra*, Hoffm.), the asci are about ·0040" long and ·0011" broad; the paraphyses ·0050" long, closely agglomerated, their tips deep brown; the sporidia 2-locular, deep brown, ·0010" long and ·0005" broad.

5. *L. badio-atra*, Flk.—which is placed by Nylander (Scand. p. 233) between *L. atro-alba* and *L. petræa*, and which is sometimes referred to the one, sometimes to the other species by different lichenologists—has, in Schærer's Exs. No. 179, the characters rather of *L. geminata*. The asci are ·0050" long and ·00133" broad; variously 1- 2- or 4-spored, frequently only one sporidium attaining maturity, as (*e. g.*) in *Umbilicaria pustulata*. The tips of the paraphyses are brown. The sporidia are colourless when young, bottle-green in maturity, muriform, ·0013" to ·0016" long and ·00065" to ·00100" broad. The specimen in Nylander's Exs. has apothecia externally resembling those of *Lecanora intumescens*, Rebent., with large, deep-brown, 2-locular sporidia, ·0010" long and ·0005" broad.

This and many of the other *Lecideæ* above described (under the species, or so-called species, *geminata*, *petræa*, and *atro-alba*) show that a close connexion exists between these species by means of numerous passage-forms of the most variable character.

6. *L. insignis*, Næg.—About the base of the Illartlek glacier. On a white thallus, resembling that of the muscicolous forms of *Lecanora tartarea*, coating mosses. Asci and paraphyses delicate; the former beautifully blue with iodine. Sporidia normally 2-locular, olive or brown, straight or slightly curved, ellipsoid or oval, sometimes figure-8-shaped, the central constriction more or less marked. Size ·0009" to ·0012" long and ·0003" broad, but size and form equally variable, some of the more elongated, narrow, ellipsoid being nearly twice as long as the short, broad, oval ones. Sometimes they exhibit four loculi from subdivision of the two primary ones. Occasionally there is no distinct septum, the sporidia being then simple, their contents consisting only of granules or larger nuclei, variable in size and position. In age the sporidia frequently present bulgings at the ends, the beginnings of germination. Sometimes, also, in age they split

into two, giving exit to the contained granules or nuclei. The sporidia, in all their stages of growth, bear a general resemblance to those of *Physcia stellaris*. *Insignis* appears to me to pass into *disciformis*, just as the latter graduates into *myriocarpa*. All three may very properly be referred to a single aggregate species or type, the varying size of the apothecia and sporidia being altogether a subordinate "character," just as it is in the *petræa* group.

7. *L. myriocarpa*, DC.—Egedesminde; Illartlek glacier; Jakobshavn, on birch-bark, associated with minor forms of *Lecanora subfusca*. Several states occur, athalline as well as thalline, including forms having the characters of *L. punctata* and *L. pinicola* of authors. The following were the chief forms met with:—

(1.) Saxicolous, Egedesminde. On a very irregular, whitish, verrucose (tartareous) thallus, associated with a state of *Lecanora polytropa*. Apothecia subspherical, black, small, crowded. Hymenial gelatine beautifully blue with iodine. Hypothecial tissue and tips of paraphyses deepish brown. Sporidia 2-locular, oval or ellipsoid, brown, .00030" to .00045" long and .00015" to .00022" broad.

(2.) On dead twigs, Illartlek glacier. Apothecia minute and subspherical, black, maintaining their black hue under moisture. Hymenial gelatine blue with iodine. Tips of paraphyses very deep brown; filaments very deep blue with iodine. Asci pale blue with iodine, .0015" long and .0006" broad; 8-spored. Sporidia 2-locular, brown or olive, ellipsoid, straight or slightly curved, sometimes figure-8-shaped. In young state frequently simple, sometimes containing nuclei instead of loculi. Size about .0005" to .0006" long and .0002" to .0003" broad.

(3.) Athalline; parasitic on the white (bleached) decayed thallus of various *Umbilicariae*. Apothecia small, black, crowded, subspherical, nearly superficial, the base only being slightly sunk in the alien thallus. Hymenial gelatine blue with iodine. Asci 8-spored, .00150" long and .00045" broad. Sporidia variable in size and shape, 2-locular, ellipsoid or oval, sometimes figure-8-shaped*, olive, .00045" long and .00015" broad.

I believe, on the one hand, that systematists of the modern Continental school of lichenology would make a separate species of the last-named "form" or condition of *myriocarpa*, simply because it is athalline, and occurs in an unusual habitat in a foreign country; and, on the other, that many so-called athalline parasitic "species" of *Lecidea* are mere conditions of commonly spread types (e. g. *parasema* and *disciformis*).

8. *L. discoënsis*, n. sp. † Thallus subfoliaceous or parmelioid, microphylline, whitish or grey, resembling that of some forms of *Physcia stellaris*. Apothecia (only one mature) those of a *Lecidea*, both the flat disk and inconspicuous exciple being black. Sporidia resembling those of the *stellaris* group of *Physciae* in size, colour, and form, being 2-locular, oval or ellipsoid, straight or somewhat curved, deep olive, .0006" to .0009" long, .00030" to .00045" broad. Asci 8-spored, .0030" long, .0009" broad. The plant bears certain resemblances to *L. grænländica*, which differs in the colour of its thallus and the structure of its sporidia. It has also certain points of resemblance to *Physcia obscura*,

* Figure-8-shaped sporidia differ from those that are soleæform by the equality of the halves of which they consist. The upper half of the soleæform sporidium is broader, longer, or otherwise larger than the lower.

† The specific name *discoënsis* is borrowed from the island of Disco.

var. *adglutinata*, and to *Lecidea adglutinata* of Nylander's Exs. The latter, however, has simple sporidia, while the colour of the thallus is also very different.

9. *L. alpicola*, Sch.—Jakobshavn. On gneiss, associated with *L. geographica*, L., both in fruit. The former has paler areolæ, generally also subconvex or pulviniform. The apothecia also are more convex and more frequently seated on, as well as between, the areolæ. The sporidia of *alpicola* are here regularly 2-locular, olive or brown, oblong or oval, sometimes figure-8-shaped or soleæform, or assuming various irregularities of outline and size. Size about .0006" to .0009" long and .0003" to .0004" broad. In the young state, occasionally simple and granular, or full of nucleiform corpuscles. In age, the sporidia frequently split at the septum, the halves occurring on the field of the microscope intermixed with full-sized sporidia.

Th. Fries (L. Arct. p. 236) considers *alpicola* a variety of *geographica*; and in one sense he does so correctly, inasmuch as the 2-locular sporidia become in some cases muriform; that is, their characteristic form in *alpicola* passes into that supposed to be peculiar to *geographica*. But in the Greenland plant the sporidia are constantly 2-locular. In a specimen of *geographica* on basalt, collected by myself on the hills above Balthayock, near Perth, in April 1858, besides sporidia of the ordinary (muriform) character, are others, apparently young ones, which are colourless, broadly ellipsoid, and 2-locular.

If *alpicola* is to be associated with *geographica*, the same principle would require the association of *atro-alba* with *petraea*, and *myriocarpa* with *disciformis*. Such a procedure would reduce to a very large extent the present enormous number of *Lecideæ*, by enlarging, or adding to, the comprehensiveness of the definitions of "species," and degrading from the rank of species many *Lecideæ* which at present hold this separate position in classification. Of the general principle involved in such a procedure, and of the consequent practice, I most thoroughly approve. But there are great difficulties in carrying the principle out in practice, sometimes from the extreme variability of organs, sometimes from the unequal values in different genera of the same organs as specific characters.

10. *L. galbula*, Ram. A sterile thallus (only), which I assign to this species, occurs in the present collection. It is of a much more brilliant green than that of *L. geographica*, and has more convex or pulviniform areolæ. Only sometimes does this species, so called, exhibit the beautiful citrine yellow of *Lecidea citrinella*, *L. lucida*, *Coniocybe furfuracea*, or *Evernia vulpina*. The plant is not mentioned as a Greenland lichen by Th. Fries (L. Arct. p. 176, where it is described as *Catolechia pulchella*, Schrad.). It seems to me referable to the section *Buellia*, and undeserving a separate generic name.

11. *L. fusco-atra*, L.—Jakobshavn. On gneiss; apothecia abundant; associated and apt to be confounded with *L. atro-alba*, requiring microscopical examination for its distinction. The thalline areolæ are sometimes small, subconvex, and pale, resembling those of *atro-alba*. In the young state they are sometimes sparsely scattered, and their convexity is such that they have the character externally of certain immarginate apothecia. The disk of the apothecium is sometimes white-pruinose, as in *L. abietina*. In Europe, the thallus of *fusco-atra* is occasionally the seat of certain parasites, e. g. *Verrucaria gemmifera*, Tayl.

12. *L. atro-brunnea*, Ram. I have seen no Greenland specimens; but in Nylander's Exs. the paraphyses are '0023" long, their tips indigo-blue; the sporidia irregular in form and size, simple, '00025" long and '00013" broad.

13. *L. Vahliana*, n. sp. Thallus with the characters of that of *fusco-atra* and *atro-brunnea*; and its sporidia are also simple, but their colour is constantly olive or brown. The hymenial gelatine gives a beautiful blue with iodine. The tips of the paraphyses are agglutinated and pale brown. The sporidia vary considerably in size, generally '00030" long and '00022" broad; their form generally oval or oval-oblong; frequently granular in the young state; generally with double contour in maturity. They are very numerous and distinct, in which characters they contrast with the sporidia either of *fusco-atra* or *atro-brunnea*. I name this lichen after the distinguished Danish botanist, J. Vahl, by whom the greater part of the Greenland lichens described in Fries's 'L. Arctoi' were collected.

14. *L. Campsteriana*, n. sp.—Atanakerdluk. Thallus resembling that of *L. geographica* as to colour. It is, however, thicker, and more tartareous, its areolæ more pulviniform. The apothecia are black, convex, becoming sometimes subspherical; immarginate, or having sometimes a spurious thalline border. They thus resemble the apothecia of *Lecanora sulphurea*, in being sometimes sublecanorine, though more properly or usually they are lecideine. *Polytropia* is another *Lecanora*, which, like *sulphurea*, has a better title to rank as a *Lecidea*, its apothecia being much more frequently immarginate and lecideine than possessing a conspicuous thalline exciple. The sporidia of *Campsteriana* are small, ellipsoid, simple, and colourless.

Campsteriana possesses some of the characters of the following *Lecideæ*, with which I have carefully compared it. But it differs sufficiently to induce me to give it separate rank, until at least it is fully examined in different conditions and stages of growth.

(1.) *Lecidea sulphurella*, Th. Fries (L. Arct. p. 221), if *it* deserves specific rank. *Campsteriana* appears to agree more closely with this than with the species that follow; but I have seen no specimen of Fries's plant.

(2.) *Lecanora calcarea*, Kudlesæt. Sporidia and apothecia the same; but the colour and farinosity of the thallus constitute points of difference.

(3.) *Lecidea elata*, Schær., Hepp's Exs. No. 250. Thallus not so green as that of *Campsteriana*; while the apothecia are generally flatter, and more frequently have no exciple.

(4.) *L. viridi-atra*, Mudd (Brit. Lich. p. 205; E. Bot. t. 2030), not at all Hepp's No. 255. Thallus and apothecia as in *L. elata*.

(5.) *L. Kochiana*, Sch., Hepp's Exs. No. 239; and *Lecanora sulphurea*, Ach.

The coincidence in name between the enterprising explorer of Vancouver Island and the collector of the Lichens described in the present memoir, on the one hand, and the late distinguished Director of the Botanical Department of the British Museum, on the other, forbids my attaching the name of *Robert Brown* to any of the new species now described, as not being a sufficiently distinctive designation*. Desirous, nevertheless, of

* The more especially seeing that various arctic lichen-collections were named by *the late* Robert Brown, F.R.S., *e. g.* those made during the discovery-voyages of Sir John Ross, Sir Edward Parry, and Dr. Scoresby. [*Vide* my Paper on the "Greenland Lichen-flora," pp. 35 and 47.]

marking my opinion of the value of the explorations and botanical collections of *the present* or first-named Robert Brown (Junior or Secundus), I have borrowed a specific name from the ancestral acres in Caithness, which were at one time, I believe, in his possession, or in that of his family, viz. the small estate of Campster (also his birth-place); and I have attached *its* name to the most beautiful of the *Lecideæ* which occur in his Greenland collection of 1867.*

15. *L. parasema*, Ach.—Illartlek glacier; Godhavn. Corticolous, muscicolous, and athalline. Occurs in various forms, of which the following were the chief met with:—

(1.) Associated with corticolous forms of *Lecanora sophodes*; athalline, on bleached, whitened twigs; or with a thin white thallus, coating the bark of birch; or seated on the thallus of the *Lecanora*. Apothecia very minute, black, flat, margined, becoming convex and immarginate, resembling in size and other external characters those of *L. pinicola*, Auct., or some forms of *Abrothallus Smithii*. Hypothecial tissue brown. Tips of paraphyses agglutinated, irregular and brown; filaments indistinct throughout their length. Asci 8-spored, very pale blue with iodine; sublinear or ribbon-like; in tufts; frequently bulging from the pressure of the contained sporidia, which are generally arranged in single series. The sporidia are most variable in form, less so in size. In this respect, as well as frequently in their granular or nucleiform contents, they resemble gonidia on the one hand, and stylospores on the other. Their size is usually $\cdot 00045''$ long and $\cdot 00030''$ broad. In maturity, and especially while still within the asci, they are frequently spherical, as much so as those of *Lecideia lugubris*, *Pertusaria paradoxa*, or *Sphaerophoron coralloides*, than which, however, they are much larger. Frequently also they are oval or oblong-oval, becoming variously pyriform or otherwise irregular in outline. They are always simple and colourless. Generally, especially in the young state, they are finely granular or muco-granular, the degree of granularity being in proportion to their immaturity. At other times they exhibit one large, spherical, central nucleus, or two or more prominent, subcentral nuclei, differing in size. Sometimes they possess double contour.

(2.) On birch-bark, associated with *Lecanora sophodes*. Accompanies the same *Lecanora* also on moss, grass-stems, twigs, and other forms of decayed and generally bleached vegetation. Athalline. Apothecia subspherical, immarginate; black when dry and young. After being thoroughly moistened, in mass or only on section, they assume a port-wine-red colour—a colour that is sometimes also obscurely exhibited in the natural state in old or degenerate apothecia. This character constitutes a link of connexion with *L. sanguineo-atra*, into which *parasema* in Greenland seems to pass. So intimate is this connexion, that it is frequently difficult to determine to which species to assign certain specimens with reddish-black apothecia and simple sporidia. Both apothecia and sporidia are generally longer than in form No. 1 (above described). But there is here also great variability of size and form. The largest sporidia occur in the old, subspherical, reddish apothecia. Their size is sometimes nearly $\cdot 0006''$ long and $\cdot 00040''$ broad, the shape being oval or ellipsoid. More frequently they are spherical, and then are often about $\cdot 00045''$ in diameter. In this case, as in form No. 1, they are apt to be confounded with gonidia, which they resemble, save as to colour. They are always simple, seldom granular, pro-

* The same name has also been conferred upon a *Verrucaria*, described under *Lecanora tartarea*.

bably because here they are mostly either old or mature; but frequently they contain one or more large spherical nuclei, which become lemon-yellow and distinct under iodine.

(3.) Muscicolous; associated with *Lecanora tartarea* and *L. oculata*. Apothecia black, convex, and immarginate. Sporidia oval or ellipsoid, simple, colourless: $\cdot 0006''$ long and $\cdot 00022''$ broad; very granular in the young state, the granules being large, uniform in size, and nucleiform; with double contour in maturity; sometimes tapering at one end into a filament or tubule, as the first step towards germination. Hymenium deep blue with iodine. The apothecia are the seat of a minute, black, papillæform parasite, containing olive or brown spores, frequently associated in ramose chains. Intermixed with the sporidia of *parasema* on, or in, some apothecia, I have met with stray sporidia of *L. petræa**.

(4.) Also associated with *Lecanora tartarea*, about the Illartlek glacier. Hymenium giving a more vivid blue with iodine than the other Greenland forms of *parasema*; while the sporidia are larger, more numerous and distinct. They are broadly ovate, with double contour, full of large nucleiform granules, $\cdot 0006''$ long and $\cdot 0005''$ broad.

(5.) Godhavn; associated with *Squamaria saxicola*, on stones and rocks. Sporidia differing from those in the other forms by their inferior size and breadth, being simple, narrowly ellipsoid, or ellipsoid-oblong, $\cdot 0003''$ long and $\cdot 00009''$ broad.

16. *L. sanguineo-atra*, Ach.; associated with *Lecanora tartarea* and *Parmelia saxatilis*, var. *panniformis*; on decayed mosses, foliaceous lichens, and other vegetation. Thallus a grey or white, thin crust, sometimes verrucose and very irregular, resembling that of some forms of *L. tartarea*. Apothecia convex, adnate, immarginate, minute, crowded, apparently black when dry. Under moisture they become semitranslucent and port-wine-red. Hymenium pale violet, or pale or deep blue, with iodine. Hypothecial tissue and tips of paraphyses brown. Sporidia very variable in size and form; always colourless and simple; oval, broadly or narrowly ellipsoid, or subspherical; with double contour; margin varying in breadth and distinctness, being sometimes as broad as in *Pannaria brunnea*; sometimes granular or muco-granular when young. Size $\cdot 0004''$ to $\cdot 0009''$ long, $\cdot 0003''$ to $\cdot 0004''$ broad. Spermogonia apparently occur as very minute, scattered, brown, punctiform conceptacles; but they exhibit no structure. The plant has much of the character of *Biatora tornoënsis*, Nyl. (Th. Fries, L. Arct. p. 196); and it may be compared also with *Biatora uliginosa*, *Lecidea sabuletorum*, and *L. turgidula*, as defined in the 'L. Arctoi.' In Nylander's Exs. No. 72, the sporidia of *sanguineo-atra* are very much smaller and narrower than is common in the Greenland plant. *L. sanguineo-atra* has many close allies, such as *fusco-rubens*, Nyl., *atro-rufa* and *uliginosa*, Ach. Many of these so-called species would be more properly arranged as mere forms of one variable type!

17. *L. Friesiana*, n. sp. On moss; associated with *Lecanora tartarea*, *L. sophodes*, and *Pannaria brunnea*, about the Illartlek glacier. The apothecia vary in size, thickness, colour and form. Their normal condition appears to be flat, round, marginate, very thin sometimes, and of a beautiful port-wine-red colour. More frequently, however, they are variously convex, confluent, very compound, large and deformed, sometimes verrucæform.

* Vide *L. petræa*, No. 5, p. 354.

Occasionally they resemble minute saucers made of red-coloured gelatine, or they are opaque, as if from intermixture of their colouring-matter with a whitish pruina. The translucency is in all cases assisted by moisture. Sometimes the disk is covered with a peach-coloured or whitish bloom, pruinosity being less common in the convex, deformed apothecia. The colour of the disk is sometimes that of light sherry or of flesh, or it assumes various dusky shades of buff- or reddish brown; in some cases it becomes black. The brown and black hues are usually the results of age. The exciple, where it exists, is very thin. The outline and surface of the whole apothecium become, when flattish, sometimes wavy or flexuous. Very seldom there is slight concavity of the disk. In all forms of apothecium the hymenium and its contents are the same. The hymenium gives, occasionally only, a very pale blue with iodine. The paraphyses and asci are indistinct. The sporidia vary considerably in structure. In all cases they are colourless. Their shape is generally fusiform or narrowly ellipsoid, and straight, sometimes slightly curved or crescentic. Their size varies from $\cdot 0006''$ to $\cdot 0009''$ long and $\cdot 00020''$ to $\cdot 00025''$ broad. In the young state, they are usually simple—sometimes granular or muco-granular—occasionally with faint double contour. In maturity and age they are from 2- to 4-locular, the septa frequently being obscurely marked. Those sporidia which are 2-locular, sometimes split in age at the central septum; whence it happens that half-sporidia occur with the entire forms on the microscope-field. Both in the young and the old state, instead of distinct loculi and septa, they exhibit sometimes two or more large spherical nuclei, usually central, sometimes bipolar, with irregular outline in age.

The plant has many of the characters of *Biatora castanea*, Hepp (Exs. No. 270, and Th. Fries, L. Arct. p. 195), and of *Biatora Berengeriana*, Mass., as I collected it in Norway in 1857, and as it is described (sub nom. *B. miscella*) in L. Arct. p. 194*. In certain respects, however (*e. g.* the sporidia), it differs from both.

I dedicate this beautiful Greenland *Lecidea* to the distinguished author of the 'Lichenes Arctoi' and 'Lichenes Spitsbergenses' as an acknowledgment of the value of his many Contributions to the Lichen-Flora of Scandinavia and the Arctic regions.

18. *L. vernalis*, L. (according to the restricted definition of Th. Fries, L. Arct. p. 191, who places it in *Biatora*, which has *simple* sporidia). Muscicolous, about the Illartlek glacier; associated with *Lecanora sophodes* and *Peltigera canina*, Lyngemarken; on decayed stems of herbaceous plants, Jakobshavn. The colour of the apothecia is very variable, and to a less extent their size, convexity, number, and degree of crowding. They are always convex and immarginate. They sometimes exhibit externally the varying characters of those of *Lecanora cerina*, *ulmicola*, and *leucoræa*, and of *Lecidea luteola*; from all which, however, the sporidia distinguish *vernal*. In all the Greenland forms the sporidia are simple, but they vary considerably in size and shape. Most usually they are fusiform or narrowly ellipsoid, with or without a faint double contour. Sometimes they are granular in the young state. Their size is about $\cdot 00045''$ to $\cdot 00090''$ long and $\cdot 00015''$ broad. In one form (from Lyngemarken) they are oval, like the larger sporidia of *parasema*, and $\cdot 00050''$ to $\cdot 00060''$ long by $\cdot 00025''$ broad. In this form the asci are 8-spored and bulge

* The reader may also compare certain North-American corticolous *Biatoræ*, *e. g.* *B. porphyritis*, Tuckerman (Synopsis, p. 61) and its allies.

from the pressure of the contained sporidia; they are $\cdot 0018''$ long and $\cdot 0006''$ broad. The hymenial gelatine always gives a blue with iodine, varying, however, in tint, pale in Illartlek forms—dark Prussian blue in those from Lyngemarken. In the latter forms, paraphyses, asci, and sporidia are all indistinct. In other forms, the constituents of the hymenium are also indistinct. In some cases the tips of the paraphyses are very deep brown: more generally they are pale brown and agglutinated. The section of the hymenium under the action of iodine is sometimes a beautiful microscopic object, *e. g.* in the Lyngemarken forms.

The sporidia of *vernalis*, as defined by Nylander (Scand. p. 201), are simple or 2-ocular*; and I have frequently met with British lichens, referable, I think, to *vernalis*, whose sporidia are variable in their structure. But the present rigid system of classification, according to the character of the sporidia, places those forms with simple sporidia in *Biatora*, and those having 2-ocular ones in *Biatorina*! This is only one of many illustrations that may be cited to show the awkwardness and arbitrary character of the too elaborate generic distinctions of modern systematists! Th. Fries himself remarks upon the multiplicity of forms included under *vernalis*, and the repulsive confusion of its nomenclature or synonymy.

Genus 20. NORMANDINA.

1. *N. viridis*, Ach.—Lyngemarken. Sterile as usual. Thallus covered with a vermilion-red, roe-like powder or granular matter, having the characters of soredia, and containing gonidia of the normal type. Both genus and species occupy a position in relation to *Cladonia* as provisional and anomalous as that of *Thamnobla vermicularis*. The apothecia of the *Normandina* are unknown. Fries, father and son, are disposed to refer it to *Cladonia*; but its thallus is much more delicate than the phyllocladia of that genus usually are, while it differs also in its concentric striation or banding. By other authors it is associated with *N. Jungermannia*, which has endocarpoid apothecia.

Pseudo-genus 21. PYRENOTHEA.

1. *P. grænländica*, n. sp. Consists only of *spermogonia*, which therefore cannot be referred to the species to which they must belong. The thallus is olive-coloured and verrucæform. The spermogonia are perched on the apices of the thalline verrucæ; they are always black and conspicuous, but they vary considerably in size and form. They are mostly small and papillar, but sometimes large and discoid, having quite the aspect of some lecideoid apothecia. The outline of these flattish, large, discoid forms is generally more or less irregular. The spermatia are apparently straight rods seated on sterigmata, which consist of only two or three linear simple articulations.

The plant has various of the characters of the British *P. corrugata* (as regards its perithecia), of *P. sulphurea* and *P. lithina* (as respects its thallus). The two latter are probably referable to *Verrucaria chlorotica*, Ach. (= *trachona*, Ach.), which, however, does

* Thus they are both simple and 2-ocular in an athalline form which grows on the decayed thallus of various *Peltideæ*.

not appear to occur in Greenland. Possibly *P. grænländica* may belong to *Verrucaria clopima*, Whlnb., which does occur in Greenland, according to Th. Fries.

Closely resembling *P. grænländica* is a saxicolous lichen sent me in 1858 by Mr. Carroll as an unknown *Lecidea*, collected by Miss Hutchins, and doubtless Irish; but no locality was given. The perithecia, supposed to be apothecia, are *spermogonia*, containing rod-shaped spermatia about '00014" long and '00005" broad—borne on simple, linear, filiform sterigmata—branching simply (generally bifurcating) at their base: about '0005" long with spermatia attached. The thallus (on which the spermogonia are scattered, unassociated with apothecia of any kind) is deep olive-green, crustaceous, verrucose-rugose, frequently becoming subpulverulent. They are seated on the wart-like elevations of the thallus, at first partly immersed, their apex always protruding, latterly quite emergent. In their young, semiimmersed state they are verrucarioid, with regular or irregular ostioles. As they become older they gradually expand and become flattened out, so as to assume a lecideoid character. There is then a sort of disk with a thin margin, which is flexuous but entire. In this condition the perithecia frequently resemble in size and appearance the apothecia of *Lecidea chalybeia*, Borr., or the spermogonia of *Lecanora Ehrhartiana*, Ach. *, which constitute *Cliostomum corrugatum*, Fr. The spermogonial walls consist of a deep blackish-brown cellular tissue. The spermogonia of the Irish *Pyrenothæa* are probably what Leighton describes and figures as *P. lithina* †. By some lichenologists *P. lithina* is assigned to *Verrucaria chlorotica*, Ach., by others to *V. umbrina*, Whlnb. ‡ as their spermogonia. The thallus is quite that of some saxicolous *Verrucariæ*, but it is also that of certain saxicolous *Lecideæ*, to which it is equally likely it may belong. *V. chlorotica* is represented as possessing both pycnidia and spermogonia.

Possessing certain characters common to both *P. grænländica* and *P. lithina* are:—

(1.) *P. sulphurea*, Leight. (Ang. Lich. p. 69, pl. 29. fig. 5), which is referred by some lichenologists to *V. chlorotica* as spermogonia; and

(2.) *P. mollis*, Leight. (Ang. Lich. p. 67, pl. 29. fig. 2.), which is a *Verrucaria*, according to Taylor, but is undoubtedly, like the other *Pyrenothææ* above-mentioned, the spermogonia of some lichen, if I may judge from a specimen in my herbarium—on rock from the top of Carig mountain, co. Kerry.

* Mudd, 'Brit. Lichens,' p. 177.

† 'Angiocarpous Lichens,' p. 68, pl. 29. fig. 3.

‡ = *Endocarpon lithinum*, Leight., Mudd, 'Brit. Lichens,' p. 281.

DESCRIPTION OF THE PLATES.

PLATE XLVIII.

- Figs. 1-5. *Calicium furfuraceum*, L.
 1. Schærer's Exs. 14: *a*, sporidia; *b*, sterigmata and spermatia.
 2. Var. *fulva*, L. Schær. Exs. 296: sporidia.
 3-5. Var. *sulphurella*, Fr.
 3. Schær. Exs. 639: sporidia.
 4. Nylander, Exs.: sporidia.
 5. Hepp, Exs. 154: sections of spermogone, showing sterigmata and spermatia.
- Fig. 6. *Cladonia alcicornis*, Flk., Leighton, Exs. 15: stylospores of parasitic pycnidia.
- Fig. 7. *C. cervicornis*, Ach., Jakobshavn: *a*, portion of thallus, showing the pseudo-spermogonia; *b*, cellular tissue of one of their perithecia; *c*, spores.
- Fig. 8. *C. gracilis*, L., Jakobshavn: *a*, spore-chains of parasite; *b*, alien sporidium (Buellioïd).
- Fig. 9. *C. bellidiflora*, Ach., Ireland: *a*, portion of thallus, showing the parasitic *Lecidea Cladoniaria*, Nyl.; *b*, section, showing its apothecia and pycnidia.
- Fig. 10. *C. deformis*, L., Jakobshavn: *a*, portion of thallus, showing the pseudo-apothecia; *b*, one of these stipitate pseudo-apothecia isolated; *c*, spore-chains.
- Fig. 11. *C. degenerans*, Flk., Godhavn: *a, b*, portions of thallus, showing the marginal spermogonia; *c*, spermogonia isolated.
- Fig. 12. *C. fimbriata*, Hffm., Jakobshavn: *a*, portion of a podetium covered with the parasitic pycnidia; *b, c*, sections of one of the latter; *d*, isolated stylospores; *e*, isolated stylospores with basidia still attached.
- Fig. 13. *C. deformis*, L., Schær. Exs. 49: stylospores of parasitic pycnidia.
- Fig. 14. *Lecidea cladoniaria*, Nyl., on *Cladonia uncialis*, L., Birnam Hill: stylospores and basidia of pycnidia.
- Fig. 15. *Thamnolia vermicularis*, Sw., Jakobshavn: *a*, cornute condition; *b-g*, *Microthelia vermicularia*, Linds.: *b*, perithecia; *c*, spermogonia; *d*, asci; *e*, sporidia; *f*, spermatia; *g*, oil-globules.
- Fig. 16. *Cetraria islandica*, Ach., Norway, bearing the parasitic *Lecidea cetraricola*, Linds.: *a*, portion of thallus, showing the deformed apothecia of the *Lecidea*, and the cyphellæ of the *Cetraria*; *b*, sections of the said apothecia; *c*, section of hymenium in Braemar forms, showing an ascus (under iodine), and sporidia.
- Fig. 17. *C. nivalis*, L., Jakobshavn: portions of thallus showing the marginal spermogonia.
- Fig. 18. *Dactylina arctica*, Br., Kikerton Islands: *a*, portion of thallus, showing spermogonia; *b*, section of a spermogone, showing sterigmata and spermatia; *c*, sporidia.
- Fig. 19. *Nephroma arcticum*, L., Godhavn: *a*, portion of thallus, showing marginal spermogonia; *b*, free spermatia.
- Fig. 20. *Peltigera canina*, Hffm., Lyngemarken: *a*, portion of thallus showing an apothecium and marginal pycnidia; *b*, stylospores and basidia of pycnidia; *c*, sporidia; *d*, oil-globules.
- Fig. 21. *P. canina*, on tufts of *Bolax*, Falkland Islands, Dr. Hooker, in Herb. Kew: sporidium.
- Fig. 22. *P. canina*, Schær. Exs.: *a*, ascus and its protoplasm under the action of iodine; *b*, sporidia.
- Fig. 23. *P. canina*, Scotland: *a*, section of hy-

- menium, showing ascus and paraphyses; *b*, sporidia, one under iodine.
- Fig. 24. *Lecidea Egedeana*, Linds., on *Parmelia saxatilis*, Ach., Jakobshavn: *a*, section of hymenium under iodine; *b*, sporidia.
- Fig. 25. *Peltigera scabrosa*, Th. Fr., Kikerton Islands: *a*, ascus; *b*, sporidia.
- Fig. 26. *Physcia stellaris*, L., Jakobshavn: *a*, sporidia; *b*, spermatia and sterigmata.
- Fig. 27. *Parmelia stygia*, L., Jakobshavn: sporidia.
- Fig. 28. *Cladopodium lichenicolum*, Linds., on *Peltigera canina*, Braemar.
- Fig. 29. *Parmelia saxatilis*, Barmouth, bearing the parasitic *Dothidea homostegia*, Nyl.: *a*, sections of parasitic perithecia.
- Fig. 30. *Dothidea otagensis*, Linds.: sporidia [after Cooke*].
- Fig. 31. *D. homostegia*, Nyl.: *a*, section of a compound perithecium; *b*, sporidia [both after Cooke*].
- Fig. 32. *Lecanora frustulosa*, Ach., Jakobshavn.: sporidia.
- Fig. 33. *L. badia*, Ach., Jakobshavn: sporidia.
- Fig. 34. *L. badia*, G. Don, 1805, in Herb. Kew: sporidia.
- Fig. 35. *Lecidea badio-atra*, Flk., Nyl. Exs.: sporidium.
- Fig. 36. *L. atro-brunnea*, Ram., Schær. Exs. 444: sporidia.
- Fig. 37. *L. atro-brunnea*, Nyl. Exs.: sporidia.
- Fig. 38. *L. galbula*, Ram., Pyrenees, Spruce & Babington, in Herb. Kew: sporidia.

PLATE XLIX.

- Fig. 1. Parasite on *Solorina crocea*, L., Ben Lawers: *a*, sections of its perithecia.
- Fig. 2. Parasite on *S. crocea*, Kerry: *a*, stylospores.
- Fig. 3. Parasite on *S. crocea*, Lyngemarken: *a*, free sporidia; *b*, section of hymenium.
- Fig. 4. Parasite on *S. crocea*, Himalayas: sporidia.
- Fig. 5. *Umbilicaria cylindrica*, L., Jakobshavn: *a*, apothecia; *b*, sporidia.
- Fig. 6. *U. cylindrica*, Nyl. Exs.: sporidia.
- Fig. 7. *U. cylindrica*, Scotland: sporidium.
- Fig. 8. *U. arctica*, Ach., Jakobshavn: sporidium.
- Fig. 9. *U. anthracina*, Wulf., Norway: *a*, section of hymenium under iodine; *b, c*, two forms of sporidia.
- Fig. 10. *U. spodothroa*, Hffm., Norway: *a*, ascus with rudimentary sporidia; *b*, free sporidia.
- Fig. 11. Parasite on *U. vellea*, L., Dunoon and Norway: *a*, section of hymenium, showing asci (one under iodine) and rudimentary sporidia; *b*, free sporidia.
- Figs. 12, 13. *Pannaria brunnea*, Sw., Jakobshavn and Illartlek: *a*, sections of hymenium, showing asci with young sporidia, and paraphyses; *b*, free sporidia.
- Fig. 14. *Squamaria chrysoleuca*, Sm., Kudlesæt: *a*, section of hymenium under iodine; *b*, free sporidia.
- Fig. 15. *S. chrysoleuca*, Schær. Exs. 345: *a, b*, two forms of sterigmata and spermatia.
- Fig. 16. *S. chrysoleuca*, Nyl. Exs.: sporidia.
- Fig. 17. *S. elegans*, Link., Jakobshavn: *a*, tips of paraphyses; *b*, isolated articulations of paraphyses; *c*, sporidia; *d*, sporidia of parasite.
- Figs. 18, 19. *Lecanora calcarea*, Ach.; Jakobshavn and Kudlesæt: sporidia.
- Fig. 20. *L. calcarea*, Ach.: *a*, Northumberland, W. Robinson, 1812; *b*, Switzerland; *c*, Pyrenees, Spruce and Babington; *d*, var. *concreta* = Schær. Exs. 476: all in Herb. Kew; sporidia.
- Fig. 21. *L. subsophodes*, Nyl., Arctic America, Franklin's first land journey; in Herb. Kew: sporidium.
- Fig. 22. *Lecidea petraea*, Wulf., Schær. Exs. 178: sporidium.
- Fig. 23. *Lecanora sophodes*, Ach., Schær. Exs. 569: sporidium.

* In letter of date 1867.

PLATE L.

- Fig. 1. *Lecanora tartarea*, L., and its parasite *Verrucaria tartaricola*, Linds., Godhavn: *a*, perforate apothecium of the *Lecanora*, and section thereof; *b*, sporidia; *c, d*, warts bearing the parasitic perithecia (*c*) and spermogonia (*d*); *e*, section of said perithecia; *f*, asci, with young sporidia; *g*, free sporidia.
- Fig. 2. Parasite (*Verrucaria Campsteriana*, Linds.) on var. *gonatodes*, Ach., Illartlek glacier: *a*, sections of perithecia; *b*, section of hymenium under iodine; *c*, free sporidia.
- Fig. 3. Parasite on *L. tartarea*, Braemar: *a*, section of thalline warts, and the parasitic perithecia.
- Fig. 4. Parasite on var. *frigida*, Sw., Lyngemarken: spores.
- Fig. 5. *L. oculata*, Ach., and its parasites, Illartlek: *a*, punctiform parasite, with its *Torula* spores (*b*) and stylospores (*c*); *d*, *Pertusaria paradoxa*, Linds.; *e*, section of one of its perithecia; *f*, section of hymenium; *g*, free sporidia.
- Fig. 6. *L. oculata* (sub *Isidium*, Ach.), named by Acharius himself, in Herb. Kew: sporidium.
- Fig. 7. *Lecidea fuscescens*, Smrf., Nyl. Exs., 135. *a*, section of hymenium (one ascus under iodine); *b*, free sporidia.
- Fig. 8. *Lecanora bryontha*, Ach., Illartlek: one-spored asci (one under iodine); *a*, oil-globules.
- Fig. 9. *L. ventosa*, Ach., with its parasite, Lochnagar: *a*, section of hymenium; *b*, sections of perithecia; *c*, spores.
- Fig. 10. *L. ventosa*, Lochnagar, bearing the parasitic *Sphaeria ventosaria*, Linds.
- Fig. 11. *L. ventosa*, Spittal of Glenshee: *a*, sections of apothecium of the *Lecanora*, and of the parasitic perithecia (*Sphaeria*).
- Fig. 12. Sporidia of *Sphaeria ventosaria*, Linds.: Glenshee.
- Fig. 13. *Lecanora ventosa*, Schær. Exs. 320: sterigmata and spermatia.
- Fig. 14. Sporidia of *Sphaeria ventosaria*, Jakobshavn.
- Fig. 15. Spermogonium on an apothecium of *Lecanora subfusca*, L., Corramulzie.
- Fig. 16. Two parasites on apothecia of *L. albella*, Pers., Morchone: sporidia.
- Fig. 17. Pycnidia on *L. subfusca*, Kinnoull Hill: basidia and stylospores.
- Fig. 18. Pycnidia of *L. albella*, Pers., Hepp 187: section showing stylospores and basidia.
- Fig. 19. Spermogonia on *L. subfusca*, Dunglass: sterigmata and spermatia.
- Fig. 20. Pycnidia on *L. subfusca*, Scotland: stylospores.
- Fig. 21. Spermogonia on, or accompanying, *L. subfusca*, Carrigaloe: sterigmata and spermatia.
- Fig. 22. *L. polytropa*, Ehrh., Egedesminde: sporidia.
- Fig. 23. *Thelidium epipolytropum*, Mudd, parasitic on *L. polytropa*, Ben Lawers: *a*, asci of the *Thelidium* (one ascus under iodine), containing sometimes 4, sometimes 8 sporidia; *b*, free sporidia (one under iodine); *c*, ascus of *L. polytropa*; *d*, sporidia of *L. polytropa*.
- Fig. 24. *L. polytropa*, var., Scotland, Carmichael; referred by Nylander to *L. alpicola*!, by other annotators to *L. frustulosa*; in Herb. Kew: sporidia.
- Fig. 25. *L. polytropa*, Nyl. Exs.: sporidia.
- Fig. 26. *Thelidium epipolytropum*, Mudd, Braemar: ascus and sporidium.
- Figs. 27, 28. *Lecanora sophodes*, Ach., Jakobshavn and Egedesminde: sporidia.
- Fig. 29. *L. sophodes* (form) Illartlek: *a*, apothecium and section; *b*, sporidia.

PLATE LI.

- Fig. 1. *Lecanora sophodes*, Lyngemarken: *a*, section of hymenium under iodine; *b*, free sporidia.
- Figs. 2, 3. *L. cinerea*, L., Jakobshavn, Ounartok, Atanakerdluk, and Kudlesæt, different forms: sporidia.
- Fig. 4. *Endococcus erraticus*, Mass., parasitic on *L. cinerea*, Scur-na-Gillean: *a*, ascus with young sporidia, hymenial gelatine under iodine; *b*, mature free sporidia.
- Fig. 5. *Lecanora leucoræa*, Ach.; Scher. Exs. 215: sporidia.
- Fig. 6. Alien sporidia on *L. leucoræa*, Hepp, 200.
- Fig. 7. *Lecidea grænlandica*, Linds., Kudlesæt: *a*, portion of psoroid thallus with apothecia; *b*, sections of apothecia and thallus; *c*, section of hymenium, showing asci with young sporidia and paraphyses; *d*, tips of paraphyses and isolated terminal articulations; *e*, free sporidia and oil-globules.
- Fig. 8. *L. geminata*, Flot., Norway: *a*, asci; *b*, free sporidia.
- Fig. 9. *L. geminata*, Schær. Exs. 443: ascus and sporidium.
- Fig. 10. *L. petræa*, Wulf., Egedesminde: sporidium.
- Fig. 11. *L. petræa*, Jakobshavn: sporidia.
- Fig. 12. *Lecidea petræa*, Godhavn: sporidia.
- Fig. 13. *L. petræa*, Illartlek: sporidium.
- Fig. 14. *L. petræa*, Schær. Exs. 183: sporidia.
- Fig. 15. *L. petræa*, Leight. Exs. 93: sporidia.
- Fig. 16. *L. petræa*, Leight. Exs. 159: sporidia.
- Fig. 17. *L. petræa*, Leight. Exs. 184: *a*, spermogonia and section; *b*, sterigmata and spermatia.
- Fig. 18. *Verrucaria rimosicola*, Leight., parasitic on *L. petræa*, Schær. Exs. 183: ascus and sporidia.
- Fig. 19. *L. petræa*, Ounartok: sporidia.
- Fig. 20. *L. atro-alba*, Ach.: Atanakerdluk: *a*, section of hymenium; *b*, free sporidia.
- Figs. 21, 22, 23. *L. atro-alba*, Ach., different forms, Jakobshavn, Egedesminde, Godhavn: sporidia.
- Fig. 24. *L. atro-alba*, [sub *L. ocellata*, Flk. "Gryphiæ"] in Herb. Kew: sporidia.
- Fig. 25. *L. atro-alba*, Kerry: sporidium.
- Fig. 26. *L. myriocarpa*, DC., Illartlek: *a*, section of hymenium under iodine; *b*, free sporidia.
- Fig. 27. *L. myriocarpa*, Jakobshavn: sporidia.
- Fig. 28. *L. myriocarpa*, Hepp 159: sporidia.
- Fig. 29. *L. myriocarpa*, form *terrestris*, Nyl. Exs.: sporidia.
- Fig. 30. *L. myriocarpa*, Anglesea: sporidia.

PLATE LII.

- Fig. 1. *Lecidea insignis*, Næg., Illartlek: sporidia.
- Fig. 2. *L. myriocarpa*, Egedesminde: *a*, section of hymenium, under iodine; *b*, free sporidia.
- Fig. 3. *Lecidea discoënsis*, Linds., Godhavn: sporidia.
- Fig. 4. *L. alpicola*, Sch., Jakobshavn: sporidia.
- Fig. 5. *L. alpicola*, Himalayas, 13,000 ft., in Herb. Kew: sporidia.
- Fig. 6. *L. alpicola*, Schær. Exs. 173: sporidia.
- Fig. 7. *Endococcus erraticus*, Mass., parasitic on *L. geographica*, L., f. *conglomerata*, Schær. Exs. 577: *a*, perithegium; *b*, asci, young and mature; *c*, sporidia; *d*, sporidium of *L. geographica*.
- Fig. 8. *Lecidea geographica*, f. *atro-virens*, Schær. Exs. 623: sporidia.
- Fig. 9. *L. geographica*, f. *pulverulenta*, Schær. Exs. 624: sporidia.
- Fig. 10. Sporidia on the apothecia of *L. geographica*, Leight. Exs. 93.
- Fig. 11. Sporidia of *Endococcus erraticus* on *L. geographica*, Schær. Exs. 322.
- Fig. 12. *Ticothecium stigma*, Körb., parasitic on *L. geographica*, Hepp, 153: *a*, asci with young sporidia, under iodine; *b*, portion of thallus showing the

- perithecia; *c*, sterigmata and spermatia.
- Fig. 13. *Lecidea geographica*, f. *alpicola*, Leight. Exs. 129: sporidia.
- Fig. 14. *L. Vahliana*, Linds., Illartlek: sporidia.
- Fig. 15. *L. Campsteriana*, Linds., Atanakerdluk: *a*, portions of thallus, showing the apothecia; *b*, sections of apothecia; *c*, sporidia.
- Fig. 16. *L. parasema*, Ach., muscicolous form, Illartlek: sporidia.
- Fig. 17. *L. parasema*, Ach., Godhavn: sporidia.
- Fig. 18. *L. parasema*, Ach., Jakobshavn: *a*, sporidia; *b*, spores of a parasite.
- Fig. 19. *L. parasema*, Ach., Egedesminde: sporidia.
- Fig. 20. *L. parasema*, Ach., Ounartok: *a*, section of hymenium; *b*, sporidia.
- Fig. 21. *L. parasema*, Ach., microsporous form, Farringdon, Berkshire: sporidia.
- Fig. 22. *L. parasema*, Ach., f. *elæochroma*, Ach., Nyl. Exs. 140: sporidia.
- Fig. 23. *L. sanguineo-atra*, Ach., Illartlek: *a*, portion of thallus with apothecia; *b*, sections of apothecia; *c*, sporidia.
- Fig. 24. *L. sanguineo-atra*, Jakobshavn: sporidia.
- Fig. 25. *L. sanguineo-atra*, Nyl. Exs. 92: sporidia.
- Fig. 26. *L. Friesiana*, Linds., Illartlek: sporidia.
- Fig. 27. *L. vernalis*, L., Lyngemarken: *a*, section of hymenium, under iodine; *b*, sporidia.
- Fig. 28. *Lecidea vernalis*, Illartlek: sporidia.
- Fig. 29. *L. vernalis*, Jakobshavn: sporidium.
- Fig. 30. *Pyrenotheca grænlandica*, Linds., Jakobshavn: *a*, portion of thallus with spermogonia; *b*, sections of thallus and spermogonia; *c*, sterigmata and spermatia.
- Fig. 31. *P. lithina*, Leight., Ireland: *a*, portion of thallus with spermogonia; *b*, isolated spermogonia; *c*, sections of thallus and spermogonia; *d*, sterigmata and spermatia.
- Fig. 32. *Endocarpon lithinum*, Leight. Exs. 98: sterigmata and spermatia.
- Fig. 33. Pycnidia on or accompanying *Verrucaria umbrina*, Whlnb., Leight. Exs. 101: basidia and stylospores.
- Fig. 34. *L. fossarum*, Duf.: *a*, perithecia on or associated with *Lecidea luteola*, Ach., Borrer, 1805; *b*, sporidia: Thornhill, 1806; both in Herb. Kew.
- Figs. 35, 36. *L. elata*, Schær. Exs. 229 (= *L. amylacea*, Ach., Nyl.): ascus and sporidia.
- Fig. 37. *Diplotomma calcareum*, Weiss, England: *a*, portion of thallus, showing apothecia and pycnidia; *b*, sections of apothecia and pycnidia; *c*, sporidia of the *Diplotomma*; *d*, stylospores and basidia of the pycnidia.



W.L. Lindsay, del. W. Fitch, lith.

J. N. Fitch, imp.



W.L. Lindsay, del. W.Fitch, lith.

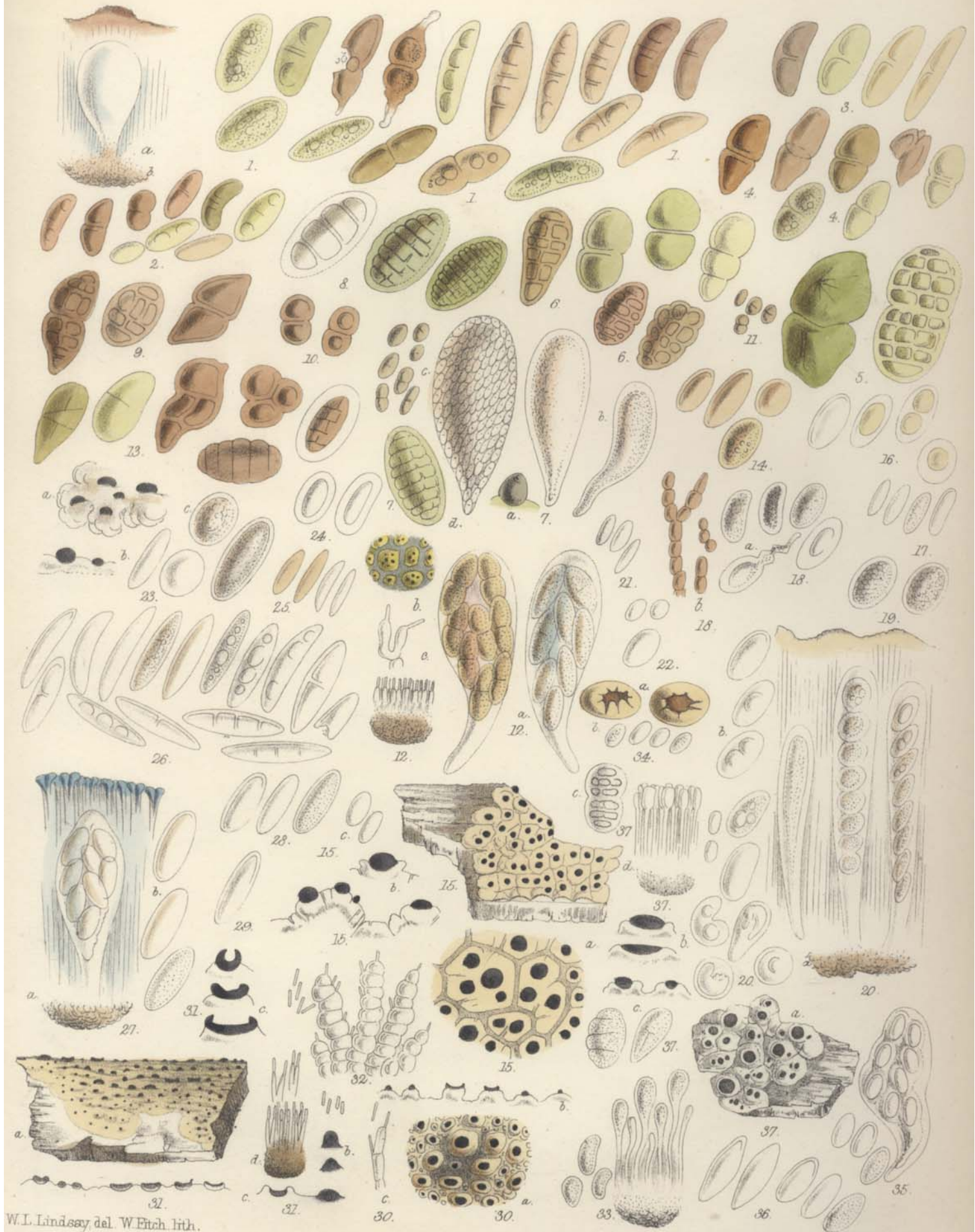
J.N.Fitch, imp.





W.L. Lindsay, del. W. Fitch, lith.

J.N. Fitch, imp.



W.L. Lindsay del. W. Fitch lith.

J.H. Fitch, imp.