

XXX.—*Observations on New Lichens and Fungi collected in Otago, New Zealand.*

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(Read 2d January 1866.)

INTRODUCTION.

In 1861, in a part of the province of Otago, New Zealand, not previously botanically explored, I made, among other botanical collections,* one of Lichens and Fungi. The number of *new species* and varieties proved to be considerable, amounting to about 20 per cent. of the whole *lichens*, and 40 per cent. of the whole *fungi*, collected. Since my return home, I have submitted (with a view specially to the study of *the minute anatomy of the reproductive organs and their contents*) the new species (and varieties) in question—some of them repeatedly—to microscopical examination: the results whereof are contained in the notes which follow.

I hold that he only is fully competent to determine and describe species from *new countries*, who, in addition to the requisite analytical and descriptive power, has, on the one hand, constant access to, and an intimate knowledge of, the now overwhelming and ever-increasing mass of Botanical Literature in all the principal European languages; and, on the other, equally habitual access to Herbaria which contain the largest collections of specimens from all parts of the world, such, for instance, as those of Kew or Paris. By no other means does it appear possible now-a-days accurately to ascertain or *distinguish what is new from what is already known in the plant-world*. This virtually restricts systematic and descriptive botany to the Naturalists of London or Paris, or of similar centres of botanical knowledge; and as virtually excludes Provincial Botanists, who are isolated from the sources of the necessary fundamental information. It were easy for a collector or observer in a new field to name and describe, what to himself, according to his limited opportunities for judging, appears to be new. But if he do so, however otherwise qualified, without that knowledge, which can, generally speaking, only be acquired in the Botanical Libraries, and from the Herbaria, of the largest European cities, he cannot fail to add to the confusion of synonyms, and impede the true progress of botanical discovery and science, by

* *Vide* "Contributions to the Flora of Otago, New Zealand:" Transactions of Botanical Society of Edinburgh, vol. viii. p. 250: and "List of Lichens collected in Otago, New Zealand," *ibid.* p. 349.

publishing as new, and under new names, species, which a wider experience speedily proves to be identical with, or mere forms of, other plants already known as natives of other parts of the world. Collectors are, as a body and as a rule, naturally desirous of naming and describing their own collections; and, *in certain respects*, no other Botanists *can* be so well qualified to do so. Nor is it always possible to secure the co-operation of those overworked, eminent authorities, who have the largest knowledge of the special departments of botanical science which they respectively cultivate and adorn.

Holding such views, and in the absence, on my own part, of the necessary qualifications, advantages, or opportunities, I have gladly availed myself, *in the determination of species* (and to a certain extent also, in their description), of the valued assistance of my friends Dr NYLANDER of Paris (for Lichens), and FRED. CURREY, F.R.S., of London (for Fungi),—the one, the most eminent living authority in systematic and descriptive Lichenology; the other, one of our most accomplished British Fungologists.*

In reference to the following enumeration of Otago *Lichens*,—with one or two exceptions,—the *names* assigned are those of Dr NYLANDER,† who writes as follows regarding the Lichen collection:—

“ Les votres sont d’une grande valeur pour la Flore Antarctique, surtout à cause des saxicoles et espèces d’un ordre inférieur qu’elle renferment et qui avant étaient trop imparfaitement représentés parmi les matériaux rapportés de ce bout du monde.‡ . . . Certainement les espèces . . . et les variétés sont *toutes nouvelles pour la Science*. La Flore de la Nouvelle Zélande a par vos découvertes fait des acquisitions importants dans le domaine lichénographique.”§

In regard to the *Fungi*, in several cases I am indebted to Mr CURREY, not only for names, but also for specific diagnoses and notes on structure or affinities. In a few other cases (of fungi or fungo-lichenes), where complete materials do not exist in my collection for full description, the plants not being in a perfect state as to fruit or otherwise, I have assigned names with much diffidence, but not without due deliberation, in the belief that the subsequent researches (to which the names and notes now given may perhaps lead) of Local Botanists, who

* I use the term *Fungology* in preference to *Mycology* (referring to that department of botanical science which treats of *Fungi*), because, though less euphonious or elegant, it is also less open to misunderstanding; the term *Mycology* being equally applicable and applied to that department of *anatomical* science which treats of the *muscular* system in man and animals. I am borne out, in the preference of the term *Fungology*, by the recent and high authority of BERKELEY (“Outlines of British Fungology,” 1860, p. 2).

† Since my “Observations” were committed to the printer, a paper by Dr NYLANDER, entitled “Lichenes Novæ Zelandiæ, quos ibi legit anno 1861 Dr LAUDER LINDSAY,” has been published in the Journal of the Linnean Society: Botany, vol. ix. p. 244, which contains the specific diagnoses of the majority of the Lichens referred to in the following and aforesaid “Observations.” Fortunately the paper has been issued in time to enable me to insert references thereto at their proper places in the present text.

‡ Letter, dated August 3, 1864.

§ Letter, dated August 22, 1865.

may have at command, for investigation, ample series of *living specimens*, in all their forms or conditions of growth, will prove the plants in question—what I here presume them to be—in reality new species.

I. LICHENES.—(PLATE XXIX.)

1. *Abrothallus Curreyi*, nov. sp. (figs. 1 to 5.)

Parasitic on the thallus of *Parmelia perforata*, Ach., (which is copiously covered with apothecia and spermogones): on the trunks and branches of dead trees,* Greenisland Bush.

In characters, this species is intermediate between *A. Smithii*, Tul., and *A. oxysporus*, Tul.† These species, when they occur (as they most frequently do) on the thallus of *Parmelia saxatilis*, Ach., are almost invariably found occupying special growths from, or anamorphoses of, its thallus. But *A. Curreyi* occurs directly on the ordinary thallus of *P. perforata* (fig. 1, *a b*), towards its periphery, in the position usually occupied by the spermogones of the *Parmelia* (*c*). In this respect it resembles other species of *Abrothallus*, which are parasitic on the thallus of other species of *Parmelia*, and on species of *Platysma* and *Stictina*.

The apothecia of *A. Curreyi* are less prominent and tuberculiform, and smaller than those of *A. Smithii*; more convex and protuberant than the discoid, flattened, sub-immersed ones of *A. oxysporus*. In *A. Curreyi*, the apothecia are typically minute, black, convex, and immarginate; partly immersed in the thallus, in whose superficial tissues they have been originally developed (figs. 1 *b*, 2 *a*). They vary, however, considerably in form and size, having a tendency on the one hand to become tuberculiform, and on the other, discoid. In the young and old states they are apt to be confounded with the *spermogones* of *P. perforata*, which are generally more or less abundant on adjoining lobes of the thallus. In the young state, the apothecia of *A. Curreyi* appear as very minute papillæ; in the old, when the tuberculiform hymenium has fallen away, it frequently leaves a black, stellate-fissured scar, resembling that characteristic of old emptied spermogones of the *Parmelia*. I have elsewhere‡ described the characters of these *spermogones* of the *Parmelia*, which are easily distinguishable from the apothecia of the *Abrothallus* on microscopical examination, though sometimes not otherwise. In my Otago specimens of *P. perforata*, I find its spermogones (figs. 1 *c*, 3) though generally sub-marginal, punctiform, and immersed, occasionally occupying also central positions on the

* Especially "Goai" (*Sophora tetraptera*, Aiton). *P. perforata* is equally abundant sometimes also on *living* trees in Saddlehill Bush, and other remnants of the primitive forest.

† "Monograph of the genus *Abrothallus*;" with two coloured plates.—*Quart. Journal of Microscopical Science*. January 1857.

‡ "Memoir on the Spermogones and Pycnides of the Higher Lichens."—*Trans. Royal Society Edinburgh*, vol. xxii. p. 211 (Plate II. figs. 4, 5).

thallus; large, prominent, and sub-papillate; seated on, or immersed in, minute thalline wartlets or elevations. They become, moreover, with age occasionally confluent and difform, frequently irregularly stellate or radiate (fig. 3 *b*). Generally speaking, corticolous forms of *P. perforata* are abundantly, while saxicolous ones in Otago are sparingly, spermogoniferous. In the former, spermogones sometimes abound to such an extent as to give the thallus, to the naked eye, a black-punctate character.

The constituents of the hymenium of *A. Curreyi* (fig. 4 *a d*), are somewhat indistinct, from their state of close aggregation. The tips of the paraphyses are dark-brown (*b*), very granular, and agglutinated; and they are covered by a colourless epithelial membrane (*a*). The hypothecial tissue is also very granular and dark (*d*). The thecae (*c*) are of the typical form, $\cdot 0012''$ long, and $\cdot 0006''$ broad,* containing eight spores arranged in one or two rows. In the young state, and while crowded in the thecae, these spores are generally sub-angular or otherwise difform from mutual pressure (*c*). The thecal lichenine gives a beautiful blue reaction with iodine; in this respect resembling *A. oxysporus*. The spores (fig. 5) are simple, colourless, sometimes showing a double contour, $\cdot 0003''$ long, and $\cdot 00025''$ broad; broadly ellipsoid or sub-oblong; sometimes slightly curved like those of the genus *Ramalina*; and also, like them, sometimes exhibiting a tendency to central division into two loculi (*a*), with occasionally a slight constriction opposite the septum. The spores thus resemble those of *A. oxysporus*, rather than those of *A. Smithii*, which are brown, solæform, and 1-septate. The tendency, however, to division and constriction is an approach to the characters of the latter. They are always much smaller, broader, more rounded at the ends, or more oblong, than those of *A. oxysporus*. With this species I have associated the name of my friend, the eminent Fungologist, FRED. CURREY, F.R.S.

2. *A. oxysporus*, Tul. (fig. 6),

also occurs in Otago, apparently identical in its characters with its Scotch prototype.† I found it parasitic on the larger-lobed forms of *Parmelia conspersa*, Ach., which grow plentifully on basalt, in the gullies or glens of the Greenisland hills (*e.g.*, near Greenisland church). The apothecia are typically flattish or discoid; in the young state, however, they are frequently tuberculiform or sub-papillæform; and under moisture, in the mature condition, they swell so as to become sub-convex, and to assume somewhat the characters of those of *A. Smithii* and *A. Curreyi*. In the old state, generally from the falling away of the hymenium, they leave a black urceola, which may become irregular in its outline, or stellate-

* The microscopical analyses were made with a Næchet's microscope: objective $\frac{1}{8}''$, ocular, No. 3—magnifying 425 diam.-linear; and the measurements here given are in decimal fractions of the English inch.

† "Monograph of Abrothallus," p. 80; "Memoir on Spermogones," p. 232-3.

fissured. As in *A. Curreyi*, the constituents of the hymenium are indistinct and closely united. The *paraphyses* contain much brown colouring matter about their tips, which are intimately agglutinated. The hymenial lichenine gives a blue reaction with iodine. The *spores* (fig. 6) are narrowly ellipsoid, almost fusi-form; simple; sometimes with a double contour (*b*); colourless; $\cdot 00075''$ long, and $\cdot 00025''$ broad.

The genus *Abrothallus* (which is properly to be considered only a group of lower, parasitic, athalline *Lecideæ*), and the two species above recorded, are new to the New Zealand Flora.

From their minute size and inconspicuous character, the plants composing the genus in question are apt to be overlooked by all but the practised Lichenologist. From what I have myself seen, I have no reason to suppose them rarer in New Zealand than in Britain; and I have therefore to recommend their being carefully looked for by local Botanists on the thallus of the higher or foliaceous Lichens, especially in the genera *Parmelia* and *Stictina*.

3. *Melanospora Otagensis*, nov. sp.

(LINDSAY "On a New *Melanospora* from Otago, N.Z.," Trans. Bot. Soc. Edin., vol. viii. p. 426, Plate V. figs. 7-12.)

Thallus sub-determinate, tartareous, thick, of cretaceous texture and chalk-white colour, sub-farinose, smoothish, sub-areolate. *Apothecia* vary in form from lirellæform (Opegraphoid) to angulose-patellæform (Lecidine): most usually they are short, sub-oblong, broadish pseudo-lirellæ, generally straight, black, simple, solitary and scattered, sub-sessile, base only sub-immersed. *Epithecium* rimæform or exposed, flat or concave; margin distinct, thickish, generally entire, sometimes more or less involute on the disk. *Spores* abundant and distinct, brown, 1-septate; about $\cdot 0006''$ long, and $\cdot 0003''$ broad; oval-oblong, constricted or not at the septum, sometimes figure-8 shaped or solæform.

Habitat on columnar basalt, Greenisland Bluff; associated with a sterile condition of *Pertusaria velata*, Turn. This species (which has been described from an imperfect specimen—the only one in my herbarium) appears closely allied to the British *M. cerebrina*, DC. (Mudd, "Manual," 226, E. Bot., Pl. 2632, fig. 1), so far as I can judge from figures and descriptions only. The family or tribe to which the genus *Melanospora* (Mudd) belongs, viz., the *Xylographidei*, Nyl., as well as the genus itself, and *M. Otagensis*, are alike new to the New Zealand Flora.*

4. *Lecidea Otagensis*, Nyl., Lich. N.Z., 255 (figs. 7, 8).

On stockyard fences of "Goai" timber; in the Bush, ravines of the Chain Hills, Greenisland: associated with *Arthonia excedens*, Nyl.

* Vide "List of Otago Lichens," pp. 356-8.

The apothecia somewhat resemble externally those of *L. grossa*, Pers., and *L. pulverea*, Borr. They are sometimes angular, or sub-lirellæform; sometimes sub-pedicellate. The hymenial gelatine and the thecæ become beautifully blue under iodine (fig. 7 c). Both hymenium and thecæ also contain large quantities of oil globules (b). The thecæ (c) are somewhat small; .0015" long, and .00045" broad; 8-spored, and of the ordinary form. The paraphyses are indistinct, and the dark-brown clavate heads are closely agglutinated (a). The spores (fig. 8) are .0012" long, and .00001" broad; acicular or very narrowly fusiform; colourless; generally slightly curved; poly-septate (frequently 3 to 5 septa); like the majority of lichen-spores, granular in the old and young states (a), with no distinction of loculi or septa.

5. *L. flavido-atra*, Nyl., Lich. N.Z., 257 (fig. 9).

On stockyard palings of "Goai," Martin's Bush, Chain Hills.

Externally it differs from *L. grossa*, Pers., *L. marginiflexa*, Tayl., and other *Lecideæ*, only by the colour of its thallus—a lemon yellow.

The paraphyses are indistinctly seen, but are sub-discrete, delicate, filiform, sub-hyaline, colourless even at their tips, which are not knobbed or clavate. The thecæ are large and distinct; 8-spored; .0036" long, and .0015" broad; giving a beautiful blue with iodine. The spores (fig. 9) are broadly ellipsoid; 1-septate; colourless; .0009" to .0012" long, and .0006" broad. In the young state (a) they are polari-bilocular, and save as to colour resemble those of *Physcia pulverulenta*, Fr. In the young state (a) also, the septum is generally wanting, and the loculi have a pale lemon-yellow tint.

6. *L. melanotropa*, Nyl., Lich. N.Z., 255 (fig. 10).

On trees and shrubs, Stoneyhill Bush; and on the bark of dead trees, Saddlehill Bush; associated with *Arthonia excedens*, Nyl., and *Collema leucocarpum*, Tayl.

The apothecia in the young state are sometimes waxy or corneous, of a glaucous or olive hue, becoming, however, with age pitch-black, and then resembling those of *L. grossa*, Pers.

The constituents of the hymenium are most indistinct, and the spores (fig. 10) are with difficulty seen. The latter are globose or sub-globose; 1-septate, colourless, about .0003" in diameter. The hymenium and thecæ give a blue reaction with iodine.

7. *L. amphitropa*, Nyl., Lich. N.Z., 256 (fig. 11).

On rocks and the ground, Woodburn Ravine, Saddlehill.

The plant consists of a patch of white thallus, with a very few straggling black apothecia, resembling in general aspect our *L. epigæa*, Schær., or *L. Hookeri*, Schær.

The constituents of the hymenium are indistinct and closely aggregated. The

thecæ are smallish, but give a distinct deep blue with iodine. The *spores* (fig. 11) are fusiform, colourless, 3-septate, .0009" long, and .00015" broad.

8. *L. leucothalamia*, Nyl., Lich. N.Z., 255.

On the bark of dead trees, Saddlehill Bush.

Though the disk of the apothecium is generally whitish, its colour is variable, being sometimes glaucous or brownish, with a corneous aspect. It resembles somewhat *L. melanotropa*, Nyl., and *L. pulvereæ*, Borr., from which the spores, however, at once distinguish it. A similar pallor of disk occasionally occurs in *L. marginiflexa*, Tayl., and other *Lecideæ*, whose apothecia are typically and usually pitch-black. The constituents of the hymenium are very indistinct and closely aggregated. The hymenial lichenine becomes blue with iodine. Both paraphyses and thecæ are shortish; I saw neither satisfactorily; nor did I see any spores.

Var. *melachroa*, Nyl., which occurs in the same locality, is simply a form with black apothecia, which then resemble those of *L. marginiflexa*, Tayl., *L. grossa*, Pers., and many other *Lecideæ*, with typically black apothecia.

9. *L. allotropa*, Nyl., Lich. N.Z., 254.

On Mica slate, Glen Martin, Chain Hill Range.

There was no result of microscopical examination worthy of record.

10. *L. coarctata*, Ach.; var. *exposita*, Nyl., Lich. N.Z., 254 (fig. 12).

On tertiary grits and conglomerates, base of Saddlehill.

The apothecia are mostly convex, resembling some forms of *L. parasema*, Ach. Sometimes they are sub-diform, or irregular in outline. At other times they exhibit remains of a coarctate or urceolate character, and they then resemble—as does the thallus—some forms of *Lecanora cinerea*, L.

The hymenium gives a very faint blue with iodine. The *paraphyses* are very indistinct and closely aggregated; they are obscured, especially about their tips, by much granular matter of a deep reddish-yellow colour. The *thecæ* approach in size and other characters those of *Urceolaria* and *Pertusaria*; they are .0030" to .0036" long, and .0006" to .0009" broad. The *spores* (fig. 12) are simple, colourless, ellipsoid-oblong, with double contour; frequently .0006" long, and .00045" broad.

11. *L. trachona*, Nyl.; var. *marginatula*, Nyl., Lich. N.Z., 254.

On columnar basalt, Greenisland Bluff.

It has a general resemblance to various small forms of *L. lenticularis*, Ach., *L. parasema*, Ach., and *L. contigua*, Fr.

The hymenium gives a deep blue with iodine; the thecæ and paraphyses are

very small, and very closely aggregated. I did not succeed, under power 425 of my Nacet's microscope ($\frac{1}{8}$ -inch objective), in distinguishing the spores, which are also very small.

12. *Lecanora homologa*, Nyl., Lich. N.Z., 251 (figs. 13, 14).

On the trunks of living trees, Greenisland Bush: associated with *Physcia plinthiza*, Nyl.

It has a general close resemblance to some forms of *L. subfusca*, Ach.; but its spores (fig. 14) at once distinguish it. These are broadly ellipsoid or oblong, colourless; sometimes convex on one side, and straight on the other (plano-convex); 1-septate, and constricted (c) or not at the septum (in the old state); $\cdot 0009''$ long, and $\cdot 00045''$ broad. In the young state they are occasionally polari-bilocular (a); or there are three loculi (b), (the central one by far the largest), round, oval, sub-angular or quadrilateral, united generally by a tubule running up the centre of the spore as a kind of longitudinal canal. Very commonly they are 3-locular, with loculi resembling those of the spores of *Verrucaria nitida*, Schrad.

The *thecæ* (fig. 13 b) are large, distinct, and ventricose; 8-spored; $\cdot 0036''$ to $\cdot 0045''$ long, and $\cdot 0012''$ broad; beautifully blue under iodine, as are also the hymenial lichenine generally, and the tips of the paraphyses (a). The *paraphyses* are very delicate, filiform, colourless, indistinct, devoid of clavate or coloured heads.

13. *L. peloleuca*, Nyl., Lich. N.Z., 251 (fig. 15).

On columnar basalt, Greenisland Bluff.

The *paraphyses* are delicate and indistinct, without coloured, clavate heads. The *thecæ* are closely aggregated, of medium size, deep blue with iodine. The *spores* (fig. 15) are broadly ellipsoid or oval; of various shades of olive or brown, according to age; being deepest brown in the old state (c), palest olive in the young (a); $\cdot 00075''$ long, and $\cdot 00045''$ broad: in the young state polari-bilocular (a), the loculi sometimes connected by a median longitudinal tubule or canal: in the old state 1-septate (b), with a constriction or not opposite the septum, sometimes having the figure of 8-form of (c), and otherwise resembling, the spores of *Physcia pulverulenta*, Fr.

14. *L. thiomela*, Nyl., Lich. N.Z., 252 (fig. 16).

On basaltic porphyry, Forbury Heads, Dunedin.

The *thecæ* and spores are best seen in young apothecia, which have much the aspect of spermogones, being yellow papillæ, perforated apparently by a darker, brownish-yellow ostiole, which is, however, the unexposed and unexpanded disk. The *paraphyses* are delicate, filiform, indistinct, without coloured, clavate heads. The hymenial gelatine gives a beautiful dark-blue colour with iodine. The *thecæ*

are broadly and irregularly obovate above, 8-spored; $\cdot 0045''$ long, and $\cdot 0009''$ to $\cdot 0012''$ broad. The *spores* (fig. 16) are broadly ellipsoid or oval; $\cdot 0009''$ to $\cdot 0012''$ long, and $\cdot 00045''$ to $\cdot 0006''$ broad; 1-septate; olive or brown, according to age. In the young state, and in young apothecia, no septum is visible (*a*); the spores are polari-bilocular, as in *L. peloleuca*; the locules connected or not by a median canal; and there is almost no colour, or a very faint olive. In old spores there is generally a constriction opposite the septum (*c*), where they frequently split, giving exit to a globose nucleus (*c*), about $\cdot 00045''$ in diameter, which is either colourless, or of a faint lemon-yellow tint. Sometimes the spores are seen in the process of elongation at both ends preparatory to germination (*d*).

15. *Placopsis perrugosa*, Nyl., Lich. N.Z., 250 (fig. 17).

On basaltic boulders, top of Kaikorai Hill (1092 feet); associated frequently with *P. gelida*, L., to which it has a close affinity, and for which it may readily be mistaken.

The *thallus* is greyish or brownish, thick, and crustaceous, consisting of, or divided into, a series of pulvinuli or isidiiform cushions, arranged, especially peripherally, in sublinear rows, having a general resemblance, in this respect, to the thallus of *Lecanora ventosa*, Ach. When sterile, it generally bears cephalodia resembling those of *P. gelida*. It is one of the saxicolous lichens, whose thallus is apt to occur sterile, and isidiiferous or sorediiferous.

The *apothecia* are closely crowded, assuming various angulose forms from mutual pressure. The disk is of a port-wine-red colour, assuming a more brilliant pink or crimson under moisture; and in this respect also—the characters of the apothecia—the plant resembles *L. ventosa*. Its *spores* (fig. 17), however, are very different. They are ellipsoid-oblong, simple, colourless, generally with double contour (*b*); $\cdot 0006''$ long, and $\cdot 00045''$ broad, arranged in a linear series, eight in each theca: in riband-shaped *thecæ*, $\cdot 0045''$ long, and $\cdot 00045''$ broad, which give, as does the hymenial lichenine, a beautiful blue colour with iodine.

The disk of the apothecium is occasionally the seat of the parasitic *Microthelia perrugosaria*, nov. sp., described in the 3d section (Fungo-Lichenes).

16. *Opegrapha subeffigurans*, Nyl., Lich. N.Z., 258 (fig. 18).

On the bark of the "Totara" pine (*Podocarpus Totara*, A. Cunn.), Greenisland Bush; associated with *Arthonia platygraphella*, Nyl.

The *paraphyses*, as in all the New Zealand *Opegraphæ*, are delicate, filiform, indistinct, without coloured, clavate heads. The hymenial lichenine gives a yellow or pale wine-red tinge, with iodine; the *thecæ* a very pale blue. The latter are ventricose; $\cdot 0021''$ to $\cdot 0030''$ long, and $\cdot 0006''$ to $\cdot 0009''$ broad; 8-spored. The *spores* (fig. 18) are ellipsoid-oblong, dark-brown, 1-septate, $\cdot 0006''$ to $\cdot 0008''$ long, and $\cdot 00025''$ to $\cdot 0003''$ broad. In the old state, there is frequently a constriction oppo-

site the septum, giving them a figure-of-8 form (*b*); occasionally also they are solæform, with one end or half broader, and generally also shorter and rounder, than the other (*b*.) In the latter case, they resemble the spores of *Abrothallus Smithii*, Tul.

17. *O. agelæoides*, Nyl., Lich. N.Z., 257 (fig. 19).

On the trunks of living trees; Greenisland Bush.

The thallus is whitish and thin, following the rugosities and furrows of the bark. The lirellæ have a general resemblance to those of our common *O. varia*, Pers., which occurs in the North Island (KNIGHT and MITTEN), or of *O. saxatilis*, DC.

The *thecæ* are ventricose, $\cdot 0021''$ long, and $\cdot 0006''$ broad, 8-spored, and give a wine-red reaction with iodine. The *spores* (fig. 19) are fusiform, colourless, poly-septate (frequently 5-septa); $\cdot 0009''$ long, and $\cdot 00025''$ broad.

18. *O. spodopolia*, Nyl., Lich. N.Z., 257 (fig. 20).

On basalt; Shaw's Bay, The Nuggets, mouth of the Clutha.

Its microscopical characters differ little from those of the preceding species. The *spores* (fig. 20) are of the same character and dimensions. The *thecæ* are somewhat longer and broader— $\cdot 0030''$ long, and $\cdot 0012''$ broad—and are unaffected by iodine; while the hymenial gelatine assumes a very pale wine-red tinge.

Professor CHURCHILL BABINGTON, in the "Flora Novæ Zelandiæ" of Dr HOOKER, remarks on the absence of the large and widely-diffused genus *Opegrapha* from the Lichen-Flora of New Zealand as one of its marked peculiarities. This statement arose evidently from the circumstance that, at the period when he wrote (1855), no species of the genus had been collected in New Zealand, or had been sent home, so as to be accessible for examination in the Kew or other public Herbaria. But KNIGHT and MITTEN* have since described several species from the province of Auckland. My Dunedin herbarium contains the three species just mentioned; and, I doubt not, the further researches of Botanists, and especially of Lichenologists, accustomed to the detection of minute or microscopic, inconspicuous corticolous and saxicolous Lichens, will discover other species of this genus in all parts (of the lowlands at least) of New Zealand. Similar remarks might be made in regard to other Lichen-genera at present supposed to be altogether absent from the Lichen-Flora of New Zealand; and until, indeed, its Lichen-Flora has been *fully* investigated by competent *resident* Botanists, we must be cautious in asserting that any given families, genera, or species are absent,—unless we do so distinctly with the qualification, that our statement is simply *provisional*, and is intended to direct the attention of local Botanists to the supply of a desideratum in our knowledge of the New Zealand Lichens.

* "Contributions to the *Lichenographia* of New Zealand, being an account, with figures, of some new species of *Graphideæ* and allied Lichens." By Dr KNIGHT of Auckland, New Zealand, and W. MITTEN, of Hurst-Pierpoint, Sussex (the eminent Muscologist).—*Trans. Linnean Soc., London*, vol. xxiii, p. 101, plate xii.

19. *Arthonia platygraphella*, Nyl., Lich. N.Z., 258 (fig. 21).

On "Totara" bark, Greenisland Bush; associated with *Opegrapha subeffigurans*, Nyl.

The apothecia are frequently roundish and sub-convex, with a Lecideiform aspect, exhibiting a thin, white, obscure, thalline margin. Sometimes they are oblong and irregular, sometimes confluent.

The *thecæ* and *paraphyses* are unaffected by iodine; the former (*a*) are broadly saccate, as is the general character of thecæ in the genus *Arthonia*; 8-spored; '0009" long, and '0006" broad. The *spores* (*b*) are irregularly fusiform or obovate, colourless, 3-septate; '00045" long, and '00025" broad. They have frequently much the appearance of half-spores—halves of fusiform, and 1-septate spores—with minor nuclei, or granular contents.

20. *Platygrapha longifera*, Nyl., Lich. N.Z., 258 (figs. 22-3).

On the bark of dead trees; Saddlehill Bush.

The *paraphyses* (fig. 22 *a*) are subdiscrete, delicate, filiform, without clavate heads. The *thecæ* (*b*) are somewhat sac-shaped, 8-spored; '0030" to '0036" long, and '0006" broad; generally untinged by iodine, but occasionally violet. The *spores* (fig. 23) are acicular or narrowly fusiform, sometimes slightly curved; poly-septate (generally about 10-septa). They vary considerably in dimensions, from '0009" to '0018" long, and '00015" to '00025" broad.

21. *Pertusaria perfida*, Nyl., Lich. N.Z., 253 (figs. 24, 25).

On tertiary grits and conglomerates, base of Saddlehill; on trappean rocks, Shaw's Bay, The Nuggets.

The *thallus* varies in colour from dark slate or lead-colour to whitish. The sterile portions are made up of a series of *Isidia*; and the plant, in this state, would have been described by the earlier Lichenologists under the genus *Isidium*. The fructiferous portions of thallus bear a great general resemblance to certain forms of *Lecanora cinerea*, L.

The *paraphyses* (fig. 24 *a*) constitute a network of very delicate, indistinct, hyaline filaments, without clavate, coloured heads; and are thus typical, or possess the ordinary characters of those of the genus *Pertusaria*. The *thecæ* (*bc*) vary in length from '0069" to '0090", and in breadth from '0015" to '00075", according as the 8-spores are arranged in one (*c*), or a double (*b*) series, being in the one case ribband-like, and in the other ventricose or obovate superiorly; they strike a beautiful blue with iodine (*b*), while the hymenial gelatine gives a violet. The *spores* (fig. 25) vary considerably in length, from '0006" to '0015", with a general breadth of '0006"; they are broadly ellipsoid; simple, colourless, generally exhibiting a double contour (*b*); granular, or full of oil globules in the young

state (a). They have the general characters of the spores of *Lecanora* and *Psoroma*, rather than of *Pertusaria*, especially as regards size.

22. *P. perrimosa*, Nyl., Lich. N.Z., 253 (figs. 26, 27).

On columnar basalt; Greenisland Bluff.

This is one of several local saxicolous Lichens, whose thallus is apt to occur abundantly sterile, and isidioid or variolarioid (sorediiferous). The plant differs greatly from the majority of our British types of *Pertusaria*, in the extreme smallness of its thecae and spores. The paraphyses also are scarcely typical, inasmuch as they are colourless, delicate, and filiform, without coloured or clavate heads; they are, nevertheless, sub-discrete, regularly arranged linearly, with their apices readily seen (fig. 26 a). The thecae (fig. 26 b) are unaffected, moreover, by iodine; are 8-spored; $\cdot 0021''$ long, and $\cdot 0003''$ to $\cdot 0006''$ broad, according to age and maturity of contents. The spores (fig. 27) are simple, ellipsoid, colourless; $\cdot 0004''$ long, and $\cdot 00015''$ broad.

23. *Pannaria immixta*, Nyl., Lich. N.Z., 249 (fig. 28).

On the branches of trees, East Taeri Bush.

The thallus is sub-coralloid; the paraphyses very delicate, filiform, indistinct, without coloured, clavate heads; the thecae indistinct, 8-spored; the hymenial gelatine pale blue with iodine. The spores (fig. 28) are ellipsoid, simple, colourless; $0006''$ long, and $\cdot 00025''$ broad.

24. *P. gymnocheila*, Nyl., Lich. N.Z., 250 (fig. 29).

On trees; Martin's Bush, Chain Hills; associated with *Collema leucocarpum*, Tayl.

The plant has a general resemblance to *Coccocarpia plumbea*, Lightf., or *C. molybdæa*, Pers.

The hymenium gives a beautiful blue with iodine. The paraphyses do not much exceed in length the thecae; they are sub-discrete and filiform; their clavate heads (epithecium) are of a brownish or yellowish colour, and are intimately united and covered by a colourless, transparent membrane; the hypothecial tissue has also a brownish or yellowish tint. The thecae are $\cdot 0036''$ to $\cdot 0045''$ long, and $\cdot 0006''$ broad; 8-spored, with the spores arranged in one or two rows. The spores (fig. 29) are $\cdot 0009''$ long, and $\cdot 0003''$ broad; ellipsoid, simple, colourless; exhibiting generally, in the mature state, a double contour (a).

25. *Psoroma sphinctrinum*, Mnt. (figs. 30, 31).

On stockyard fences of "Goai" timber, Martin's Bush, Chain Hills; on living trees, East Taeri Bush; on the bark of dead trees, Saddlehill Bush.

An abundant corticolous species in Otago, fruiting freely. The colour of the

thallus varies from pale grey to lurid (blackish-brown). The minutely squamulose character of the thallus gives the plant the aspect of a *Pannaria*. The hymenium and thecae give a beautiful blue with iodine. The latter are 8-spored (with the spores generally arranged in a single series), $\cdot 0036''$ long, and $\cdot 0006''$ broad. The sub-discrete, filiform paraphyses are united by yellow clavate heads. The spores (fig. 30) are broadly ellipsoid, oval or oblong; simple, colourless; with double contour generally in the mature state (*a*); $\cdot 0006''$ long, and $\cdot 00045''$ broad. What appear to be *spermogones* are marginal, brown tubercles, resembling the spermogones of *Peltigera* and *Nephroma*, containing myriads of atomic or ellipsoid spermatia (fig. 31), about $\cdot 0001''$ long, and $\cdot 00005''$ broad; possessed of vivid Brownian movements, borne apparently on arthosterigmata, which are indistinct.

The species is confined to warm countries, such as South America and Australia. In specimens in the Hookerian Herbarium, from the Cape (MILLER) and the Mauritius, I found the spores of the same character as those in my Otago plants, differing only as to size, being here $\cdot 00038''$ long, and $\cdot 00020''$ broad.

Var. *pholidotoide*, Nyl., Lich. N.Z., 250.

On living trees, East Taeri, and Saddlehill, Bush.

The *thallus* is rudimentary, consisting of a few minute, sparsely scattered scales, seated on the black hypothallus, the plant having thus the aspect of certain of the smaller *Endocarpa*. The *apothecia* are large, closely crowded in the centre of the thallus, almost constituting the plant; becoming, from mutual pressure, irregular and difform, sometimes sub-confluent. They have a thickish, rugose or crenulate thalline margin, and a disk of chestnut colour, without any tinge of black. This form frequently bears considerable resemblance to various *Pannariæ*, e.g., *P. brunnea*, Sw., or *P. nebulosa*, Hffm. Its thecae and spores are exactly those of the type.

26. *Physcia plinthiza*, Nyl., Lich. N.Z., 249 (fig. 32).

On the trunks of living trees, Greenisland Bush; bearing both apothecia and spermogones.

The *thallus* is distinct and foliaceous; sometimes lobulate, of a slate-grey colour, apt to be obscured by overgrowing *Jungermannia*. The apothecia become with age convex, and have a widened, flattened exciple. The hymenium, thecae, and tips of the paraphyses all assume a more or less deep and beautiful blue with iodine; this tinge is sometimes comparatively deep on the tips of the paraphyses, while it is very pale on the apices of the thecae. The *thecæ* are 8-spored, $\cdot 0036''$ long, and $\cdot 0009''$ broad. The spores (fig. 32) vary considerably in their characters, combining the features of those of *Verrucaria nitida* and *Physcia pulverulenta*. Their usual length is from $\cdot 0009''$ to $\cdot 00135''$, breadth about $\cdot 00045''$; their general form broadly ellipsoid or ellipsoid-oblong. Sometimes they are

convex on the one side, and straight on the other (plano-convex) (*c*); sometimes where septa exist in the old state, there are constrictions opposite each of generally 3-septa. The colour varies from pale olive (*a*) to deep brown (*c*), according to age; darkness of tint, as is generally the case in the spores of lichens, being proportionate to age. For the most part, especially in the young spores, there are no distinct septa (*a*); but a number of loculi, varying from 4 to 8 (most frequently 4), which are sometimes globose, sometimes lenticular or quadrilateral, connected or separate, according apparently to age; sometimes becoming longitudinally divided, giving the spore a sub-muriform character (*c*).

27. *Ricasolia herbacea*, DN., var. *adscripta*, Nyl., Lich. N.Z., 248 (fig. 33).

On the bark of dead trees, Saddlehill Bush; bearing both apothecia and spermogones. There are also specimens from Tarndale, Nelson, *ex* Herb. Dr Sinclair, of Auckland; some bearing apothecia, others sterile.

The plant appears to me hardly to deserve a separate name as a variety; I do not see wherein it differs sufficiently from its type. The *paraphyses* are sub-discrete, filiform, united by yellow tuberculated tips. The *thecæ* are 8-spored, blue with iodine; .0036" long, and .0009" broad. The *spores* (fig. 33) are more or less fusiform, 1-septate; sometimes with the loculi of unequal size (*b*), colourless or pale yellow; .0009" long, and .00025" broad. The spermogones are those of the type, which I have elsewhere described.*

28. *Sticta subcoriacea*, Nyl., Lich. N.Z., 247 (figs. 34-36).

On trees, Saddlehill Bush; bearing both apothecia and spermogones; also from Wellington, sent me by Dr MÜLLER of Melbourne (identical in external characters with my Otago specimens).

The plant has much of the aspect, and most of the general external characters of various *Ricasoliæ*, e.g., *R. herbacea*, DN., and *R. coriacea*, Hook. and Tayl. It seems indeed a connecting link between the genera *Sticta* and *Ricasolia*. The main difference consists in the presence in the *Sticta* of *cyphellæ*; but in some *Stictæ* these are absent, or they (or Pseudo-cyphellæ†) occur on the *upper* instead of *lower* surface of the thallus (e.g., in the following species *S. episticta*, Nyl.) The mere presence or absence of *cyphellæ* is not, I think, a sufficient character for the separation as genera of *Ricasolia* and *Stictina* from *Sticta*. Not unfrequently in the same species of either of these genera, *cyphellæ* occur or not. In my Otago specimens of *Ricasolia coriacea* occur a few *cyphellæ*, which are exactly like those of *S. subcoriacea*. I do not know, indeed, in what essentials *S. subcoriacea*

* "Mem. Spermogones," p. 202, Plate X. figs. 6-11.

† I am not satisfied that there is any essential distinction (anatomical, morphological, or functional) between *Cyphellæ* and *Pseudo-cyphellæ*. Though the former are typically urceolate and smooth, they become pulverulent and shallow; and pass thus, by imperceptible gradations, into the latter. (*Vide* "History of British Lichens," 1856, pp. 42-336.)

differs from *Ricasolia coriacea*, save as to the greater size of thallus, and the more general presence of cyphellæ in the former. Both plants, moreover, grow in the same habitat, though the *Ricasolia* is more generally found fertile than the *Sticta*.

There is the same rigidity of thallus, the same white-pilose apothecia and thaline margins. Under water, the lower surface of the thallus of the *Sticta* exhibits well its beautiful velvety-pilose character, while the upper surface assumes a greenish tint.

In my Otago specimens the hymenium gives a beautiful blue with iodine. The *paraphyses* (fig. 34, *b*) are sub-discrete, united by yellowish tuberculated heads, which are covered by a colourless membrane (epithecium) (*a*). The *thecæ* (*c*) are 8-spored; like the hymenium, blue with iodine; from '0024" to '0036" long, and '00045" to '0009" broad. The *spores* (fig. 35) are more or less ellipsoid, 1-septate; '0006" to '0009" long, and '0003 broad; of olive (*b*) or brown (*a c*) colour, and otherwise resembling the spores of *S. fossulata*, Duf.

In Wellington specimens, the *thecæ* are '0024" to '0030" long, and '0008" broad; the *spores* (fig. 36) '0010" long, and '00045" broad; broadly ellipsoid or ellipsoid-oblong; 1 or 3-septate, according to age; brown. In young apothecia and within their thecæ, they are almost uniformly 1-septate, and more or less deep brown in colour; but in old apothecia and out of their thecæ, they are frequently, if not generally (typically), 4-locular or 3-septate (*b*). In other respects, Wellington and Otago specimens agree in internal as well as external characters.

29. *S. episticta*, Nyl., Lich. N.Z., 248.

On trees, Saddlehill Bush; on columnar basalt, Greenisland Bluff.

The saxicolous forms have much the aspect of thick, rigid, coriaceous states of *Parmelia saxatilis*, Ach.; while the corticolous ones resemble *Ricasolia herbacea*, DN.

In this species there is a reversal of the ordinary position of the *Pseudo-cyphellæ*, which are here on the *upper* surface of the thallus, and being whitish, are somewhat conspicuous on the buff-coloured epithallus (cortical tissue). Corresponding to the *Pseudo-cyphellæ* above, the under surface of the thallus is marked by a series of minute buttons or papillæ of the same pale reddish-brown colour as the under surface of the thallus, and nestling among the fine fibrillose tomentum, with which it is copiously covered. On the upper surface there occasionally occur small sub-globose isidia or *cephalodia*, of a bright gamboge-yellow colour.

All my specimens are sterile, so that I have had no opportunity of examining its apothecia or spermogones.

30. *S. filix*, Hffm., Nyl., Lich. N.Z., 246 (fig. 37). (LINDSAY, Spermog., p. 194, Plate X. fig. 28. *Stictina flicina*, Ach., Nyl., Synopsis, 349.)

On trees, East Taeri Bush; Signal Hill, Dunedin (*ex* Herb. Dr Sinclair).

One of the most beautiful of the New Zealand *Stictæ*. Some specimens show the tendency to multifid division of the edges of the laciniae, so common among these *Stictæ*. Similar minute squamules or granules occur occasionally also on the margins of old apothecia, as well as on the surface of the thallus. These old apothecia frequently lose their disk, and assume the colour of the thallus, or a paler or whitish tint. The colour of the upper surface of the thallus in the Herbarium varies from buff to bright reddish-brown. The prominent ribs of the lower surface, which, in the Herbarium, have generally a dark-brown colour, give the plant somewhat the aspect of certain marine *Algæ* (*e.g.*, species of *Fucus*). These costae have, moreover, frequently corresponding sulci on the upper surface of the thallus. The stout, rigid stem in the larger forms, frequently becomes sub-fistulose, from incurving of its margins.

In Signal Hill specimens the *thecæ* are '0030" to '0036" long, and '0006" broad; the *spores* (fig. 37 *a*) broadly ellipsoid, 3-septate, colourless or pale yellow; '0009" long, and '0003" broad.

Var. *parvula*, Nyl., Lich. N.Z., 247 (fig. 37).

Tarndale, Nelson (*ex* Herb. Sinclair); bearing both apothecia and spermogones.

One of the most elegant of the lesser *Stictæ* of New Zealand. The thallus is very smooth and glistening, divided into very narrow, minutely cut laciniae. The whole plant resembles in size and shape (it is under an inch high) some forms of *Cladonia cervicornis*, Ach., and its allies.

The *paraphyses* are sub-discrete, with coloured and irregular, tuberculiform heads, closely united. The *thecæ* are 8-spored, blue with iodine; '0036" to '0045" long, and '0006" to '0009" broad. The *spores* (*b*) are narrowly ellipsoid, 3 to 5-septate, colourless; '0015" long, and '00025" broad.

31. *S. damæcornis*, Ach., var. *subcaperata*, Nyl., Lich. N.Z., 247 (figs. 38-42).

On trees, East Taeri Bush; bearing both apothecia and spermogones.

In colour and other characters it resembles *Ricasolia herbacea*. The *paraphyses* are discrete, filiform, united by yellow clavate apices, which are covered by a yellow thin membrane. The hymenium gives a beautiful blue with iodine, and its whole constituents are very distinct. The *thecæ* are 8-spored, '0045" long, and '0009" broad. The *spores* (fig. 41) are broadly fusiform, colourless, 3-septate; '0012" to '0015" long, and '00045" broad. The *spermogones* (fig. 38 *b*) are those of the type,

and have been described by me elsewhere.* They are sub-marginal, papillæform, with darker brown ostioles (fig. 39). The *spermatia* (fig. 42 *a*) are rod-shaped; .00015" long, and .00005" broad; borne on arthrosterigmata (*b*) about .00015" broad, and of varying lengths, generally about .0015" long.

II.—FUNGI (PLATE XXX.)

GENUS I. *Sphæria*.

Species 1. *S. Lindsayana*, Currey MSS. (figs. 1 to 7).

Diagnostic characters: Division, *Caulicolæ*.—"Perithecia very small, round; rupturing the epidermis by a circular, rimose, or radiate fissure. Sporidia 8, biserial, colourless, irregularly cymbiform, 0.0014 to 0.002 inch long."

"The perithecia are so adherent to the epidermis, that it is impossible to make out the nature of the ostiolum. There is apparently no Rostellum; or if any, it is not visible above the epidermis. The plant, when dry, has somewhat the appearance of *Sphæria nebulosa*, Fr." (Currey MSS.)

Habitat.—Covers, in the form of very minute, point-like, black dots, the dry, incurled, yellowish, dead leaves of *Phormium tenax*, Forst. (fig. 1), (the familiar and abundant "New Zealand flax"); in the swamps of Glen Martin, Saddlehill.

I have little doubt it will be found, if looked for, in profusion on dead flax leaves throughout the New Zealand islands.

In the specimens, which I have myself examined under the lens and microscope, the plant has very much the aspect of certain minute, corticolous *Verrucariæ*. There is, perhaps, a distinction, however, in the non-action of tincture of iodine† on the hymenium of the *Sphæria*, and in the intimate adhesion of the perithecia of the latter to the epidermis of the *Phormium* leaf—an adhesion, which renders it difficult to manipulate them for microscopical examination, save after boiling and maceration.

In the mature state, the Fungus appears as a distinct, but minute, epidermal papilla; its circumference marked by a dark, well-defined ring; its apex pierced by a black, very small ostiole, normally punctiform, but becoming with age, compression, or other causes, rimose or irregularly radiate (fig. 2 *a*). In old and emptied perithecia, this ostiole widens variously, producing an *urceola* instead of

* "Mem. Spermogones," p. 194, Plate X. figs. 16-19.

† The reaction of this tincture with the hymenial "gelatine" (so-called, but which is really that modification of starch designated by chemists *Lichenine*), is too variable and uncertain to constitute a safe or good character for distinguishing *Lichens* from *Fungi*. Though this gelatine, and the thecæ specially, in the great majority of *Lichens*, give a reaction with tincture of iodine, which varies in colour, from beautiful Prussian blue, to an obscure port-wine red, of every intensity of shade, there is, in a minority of cases, no distinct coloration; while, on the other hand, the blue coloration, formerly supposed peculiar to *Lichens*, occurs, Mr CURREY informs me (MSS. 1859), among indubitable *Fungi*. In other parts of this Paper I have shown that in the same species of *Abrothallus*, in which there is generally no coloration by iodine, it nevertheless sometimes occurs in foreign specimens.

a *papilla* (figs. 3, 4, *b*); or into a ragged, black, rent-like mouth; the apex of the epidermal papilla falling away, and the margins of the torn or fissured leaf-epidermis fringing the irregular remanent basilar cavity (fig. 2 *b*). The upper half of the perithecium is formed by the epidermis of the *Phormium*, which is gradually elevated, as the Fungus is developed and approaches maturity; and this epidermal papilla is perforated apically by the ostiole of the *Sphaeria*, the discharge outlet for its spores (fig. 3). The lower half of the perithecium is sub-epidermal, seated in the subjacent fibro-cellular tissues of the *Phormium*-leaf. Maceration causes the site of the perithecium to become more apparent; the epidermis of the *Phormium* becomes detached, as a somewhat translucent thin membrane (fig. 4 *c*), from the subjacent tissues, carrying with it the projecting papilla, which contains the ostiole and upper half of the perithecium; while the black, circumscribed base remains as an irregular mass, resembling somewhat the old Lichen-genus *Pyrenotheca* (fig. 4 *b*, 2 *b d*). Moisture or maceration, moreover, alters the appearance of the epidermal papilla, which now becomes wholly black, instead of exhibiting a mere black ostiole and ring (fig. 2 *c*). The epidermal papilla frequently appears to fall off, leaving a black ring alone, as an indication of its former presence—of its medial circumference.

The perithecia vary in size, number, and closeness of aggregation. For the most part, they are, to the naked eye, punctiform, greatly crowded, and frequently confluent or sub-confluent. Normally, they are round, but from pressure on each other in a state of close aggregation, they become ellipsoid, or otherwise variously elongated. Sometimes they are flattened on the surface or apex, and they then have, under the lens, somewhat the aspect (save as to colour and size) of the wart-like apothecia of a *Pertusaria*, the epidermis of the *Phormium* appearing as if covered with a series of minute blisters.

Their position is equally on and between the rugæ and furrows, which mark the surface of the *Phormium* leaf. Occasionally they are disposed in rows, especially when they occur in the leaf-furrows. More generally, their distribution is quite irregular or scattered.

Notwithstanding many examinations, I have not succeeded in satisfying myself as to the form and size of the *thecae*, which are extremely delicate and hyaline. But, in a few cases, the *spores* were abundant and distinct. Those I saw were normally ellipsoid, 6 to 8 locular; colourless; hyaline; with a very delicate envelope; $\cdot 0003''$ to $\cdot 00025''$ broad, and $\cdot 0016''$ to $\cdot 0013''$ long; resembling closely the septate spores of many Lichens (fig. 5). Occasionally (apparently only aged ones), I found them slightly curved, a condition which is likewise common in the old state of the fusiform and ellipsoid spores of Lichens; but this appeared to me to be an accidental condition, or one depending on age. Occasionally, intermixed with the normal fully developed spores, were half spores, apparently the result—if not, sometimes at least, of artificial division by friction of the glass

slides during examination—rather of abortive development, than of the partition of the full-sized, mature spore (fig. 6). Sometimes these half spores occurred in considerable numbers.

In certain old perithecia, in their *Pyrenotheca*-like bases seated below the epidermis of the flax leaf—and in the same perithecia, moreover, that had apparently contained thecae and normal endothecal spores (fig. 4 *b d*)—I found myriads of extremely minute corpuscles, resembling in size and other features the spermatia of various Lichens,—differing, however, in their irregularity of form (fig. 7). They were ellipsoid, fusiform, or rod-shaped; occasionally slightly curved; about $\cdot 00016''$ long, $\cdot 000083''$ to $\cdot 000066''$ broad, endowed with a vivid Brownian or molecular movement. Materials are probably imperfect for determining whether these corpuscles really belong to the *Sphaeria*. If they do, they are probably to be considered its *stylospores*. In reference to these corpuscles, and to the observation connected with their discovery, Mr CURREY writes—“ It is not, I think, improbable that you may have found *spermatia* and *asci* within the same perithecium in *S. Lindsayana*, although such an occurrence is not common in the genus. Indeed, I do not know that it has ever been observed. *Conidia* (the bodies resembling *spermatia*, but which are larger, and capable of germination) have been noticed by TULASNE in the same perithecium with *asci*. You will find a figure of this in the second volume of his ‘*Selecta Fungorum Carpologia*.’* In *S. Lindsayana*, you have probably come upon perithecia in what is called a *Sphaeropsoid* state, *i.e.*, having only very minute *stylospores* and no *asci*. These imperfect perithecia are found in some *Sphaeriæ*, and are probably more common than has been supposed. But further observation alone can determine whether they are universal.”†

Sp. 2. *S. Otagensis* (figs. 8 to 15).

Diagnostic char.: “Div. *Villosæ*.—Perithecia erumpent, or flattened, with a mammillate ostiolum, tomentose. *Sporidia* (? biseriate) brown, curved, 3–6 septate, constricted at the septa, variable in length; $0\cdot 0006$ to $0\cdot 001$ or more inch, sometimes with one (or more?) longitudinal septa. Not in good condition.” (Currey MSS.)

Hab. On a stockyard fence of old, weathered “Goai” timber (*Sophora tetraptera*, Aiton); farm of Fairfield, Saddlehill.

To the naked eye, the perithecia appear to be a series, closely aggregated, of very minute, irregular tubercles or buttons: but, when moistened and carefully examined under the lens, they resolve themselves into two main forms—the cone or papilla, and the disk. The former resemble the perithecia of various of the larger black *Verrucariæ*; the latter the young apothecia of various *Lecideæ*. The papil-

* Letter, March 22, 1865.

† Letter, November 6, 1865.

late condition is characteristic of the young state only. The cone is sometimes quite symmetrical and well-formed, and generally exhibits distinctly the apical ostiole (figs. 11, 12 *a*). The discoid form is characteristic of maturity and age, and is more common than the conical. Here the papilla becomes flattened; the ostiole is so transformed that it loses all its ordinary characters, and is not recognisable as such; most frequently it occurs as a saucer-like cavity, surrounded by a thickened margin, resembling the apothecial exciple of Lichens (*Lecideæ*). Sometimes, the cavity becomes funnel-shaped, the perithecium having the form of an inverted cone (figs. 10, 12 *b*).

Frequently the perithecia are confluent, and then they lose their normal appearance, and become variously deformed (fig. 9). They are generally seated in the lacunæ or interstices of the woody fibres; and there, from pressure apparently by these fibres, they become variously elongated (fig. 8). Sometimes, from their state of close aggregation and form, they resemble our common *Dichæna rugosa*, Fr.

They are originally hypophlæod, developed in the superficial tissues of the bark or wood. Through these they gradually burst in process of development, until they become sub-sessile; their base only being seated in a hollow of the wood. Sometimes they are seated on pedicle-like projections of the superficial layers of the wood; the portions of the latter not protected by the growth of the parasite being eroded or worn away by weathering. Generally the fabricated timber on which this *Sphæria* grows is more or less bleached or whitened by weathering; and on this whitish base the pitch-black perithecia are prominently visible.

In the old state, the upper half, or three-fourths of the perithecium, fall away, leaving the base as a black, saucer-like hollow or scar in the wood; or as a saucer, sessile, or semi-sessile, adnate, not immersed (fig. 13).

The spores vary in length from $\cdot 0009''$ to $\cdot 0006''$, and in breadth from $\cdot 0002''$ to $\cdot 0003''$; they are septate (3 to 6, or more septa, though frequently 3); becoming sub-muriform from longitudinal division of the loculi; colour varying from olive green to dark brown: outline irregular from bulgings opposite the loculi (fig. 14). They exhibit a double contour (the cell-wall or general envelope being distinct from its loculi) usually in their mature state (*b*); but it is indistinct, or apparently absent, in the young (*a*). They have a close general resemblance to the spores of *Urceolaria scruposa*, L., and *Lecidea petræa*, Wulf. They do not differ much, even in size, from those of my New Zealand specimens of the former Lichen. I saw them frequently germinating from one or both ends—the terminal cell becoming gradually discharged of its colouring matter, and sending forth from its distal end, or extending itself into, a tube about $\cdot 00015''$ in diameter; with a double wall, hyaline, or of a brown tinge, especially towards its tip (*c*).

In very minute, black, punctiform conceptacles, semi-immersed in the wood,

resembling in external character the spermogones of many Lichens, and apparently bearing a similar relation to the *Sphæria* (figs. 11, 12, 13 c), I found myriads of globular or oval corpuscles—spermatia—about '00006" to '000075" in diameter—given off apparently from the ends of extremely minute, simple sterigmata (fig. 15).

The *Sphæria* occurs on the same wood with *Patellaria atrata*, Fr., from which, however, its perithecia may be distinguished by their less size, greater thickness, more verrucarioid aspect, and greater closeness of aggregation. The disks of the *Patellaria* are largish, thin, very irregular in form, with incurved or corrugate margins; frequently angular or lirellæform, and resembling the difform apothecia of various *Umbilicariæ*, *Graphideæ*, *Lecanoræ*, or *Lecideæ*. The *Patellaria* is distinguished further by the microscopic characters of the hymenium. The *thecæ* (fig. 16) are large and distinct; '0045" to '0030" long, and '0009" broad, resembling those of Lichens. The *hymenium* contains a large quantity of oil globules (*b*). The *spores* (fig. 17) are large and very distinct, resembling those of certain *Arthoniæ* and *Verrucariæ*. They are, moreover, *colourless*, somewhat irregular in form; ellipsoid, obovate, or pyriform (broad at one end, and tapering at the other); '0009" to '0012" long, and '0003" broad; 8–10 septate. In the old and young states (*c*), their contents are a mass of granules instead of distinct loculi; and in the former state, also, they frequently become greatly elongated—narrowly fusiform; '0018" long; apparently preparing to germinate, and extend themselves into the tubular or mycelioid condition (*c*).

Sp. 3. *S. Martiniana* (figs. 18 to 22).

"Fruit 0·0007 inch, rather larger than in *S. pulvis-pyrius*; otherwise exactly like latter, but it can hardly be a rostrate form of that species." (Currey MSS.)

Hab. On trunks of living trees (apparently chiefly "Goai"); Greenisland Bush.

The bark, on which the perithecia occur, is very rugose and whitish; they are jet-black, and consequently very prominent, and easily seen under the lens. They are very minute and punctiform; but vary considerably, both in form, size, and surface, having greatly the external characters of the Lichen-genera *Pyrenotheca* and *Microthelia*. They are generally granular or powdery on the surface, and on this account, as well as by reason of the minuteness of the perithecia themselves, their ostiole is seldom or never visible. The young perithecia exhibit only a punctiform, black papilla on the surface of the bark; while their large black body is sub-epidermal or immersed—requiring to be enucleated from the woody tissue for examination (fig. 20). In maturity and age, however, they become—gradually emerging from the woody tissue—sub-sessile,—the base only being immersed, or occupying a saucer-like hollow of the matrix. As in the case of

S. Otagensis, in age the upper portion of the perithecium frequently falls away, leaving only the saucer-like hollow in the matrix occupied by its base: this assuming the appearance of a black scar, or being whitish with a black ring, according as the base remains or disappears (fig. 19 *b*). The perithecia vary greatly also as to their closeness of aggregation, being isolated, closely aggregated, or confluent; and in the latter case necessarily becoming difform.

The thecæ and paraphyses are very delicate, and are seldom, or with difficulty, distinctly seen. The thecæ are apparently 8-spored, and the spores biseriate, as in most Lichens. The thecal wall seems closely to envelope the spores like a sac, as is common in the *Arthoniæ* (fig. 21). The spores are 3-septate; brown; $\cdot 00045''$ long, and $\cdot 00015''$ to $\cdot 00025''$ broad; irregularly ellipsoid; generally bulging more or less, according to age, opposite each locule; very seldom muriform, but having a tendency to longitudinal division of the loculi (*c*); sometimes slightly curved (fig. 22).

With this species I have associated the name of my friend WILLIAM MARTIN of Fairfield, Saddlehill, Otago, one of its few resident Botanists and pioneer settlers, to whom I was indebted for much assistance in my Otago excursions and collections, and on whose property in Greenisland a great portion of these collections was made.

I have no doubt that many new species of the large and ubiquitous genus *Sphaeria*, and of allied spheriaceous Fungi, have yet to be added to the New Zealand Flora; but their discovery and determination will require all the care of experienced local Fungologists.

GENUS II. *Nectria*.

Sp. 1. *N. Otagensis** (*N. armeniaca*, Currey MSS.), (figs. 53 to 60).

Diagnostic characters.—"Perithecia cæspitose; pale-apricot coloured, with ostiolum darker; sporidia biseriate, colourless, about $0\cdot 0007$ inch." (Currey MSS.)

Hab. On stockyard fences of old "Goai" timber, ravines of the Chain Hills.

A beautiful little Fungus of a pale orange-red colour, and waxy aspect; forming a bright contrast to the greenish bark on which it grows (figs. 53, 55). It generally nestles in the rough and deep furrows between the irregular rugæ of the very rugose bark of "Goai," and is best seen when the latter has a dark olive tint. The plant has much the appearance of masses of certain fish-roes;

* The name originally bestowed by CURREY was the very appropriate one, *armeniaca* (apricot-coloured); but, in the meantime, the same designation has been conferred by TULASNE (*Selecta Fungorum Carpologia*, vol. iii. p. 75, plate x.) on a French and very different species; and it appears easier and preferable to render the name of the Otago plant more distinctive, rather than to raise trivial questions of priority of nomenclature.

occurring generally in the form of irregular glomeruli (fig. 54), which are compound—made up of an aggregation of individual perithecia. These perithecia are found isolated only in the young state of the plant (figs. 55, 56). They are then seen to be isidiiform or sub-columnar warts, having a rounded apex, marked by a sub-papillate ostiole (*a*), of a darker red, which leads to a flask-shaped imbedded nucleus (*b*), of similar colour. Under moisture, the whole perithecium becomes more beautiful and distinct; it swells, and assumes a brighter or purer colour; the ostiole becomes quasi-pellucid or gelatiniform, and much more papillate and prominent; and the nucleus shows itself on section as a viscid or gelatiniform mass, of colour resembling that of the ostiole, having more of a brownish or reddish tinge than the exterior or envelope of the perithecium.

These perithecia coalesce or become aggregated in numbers of from two to twenty or upwards, to form the compound glomeruli. From mutual pressure, they undergo changes of shape, but they never entirely lose their individuality; for each perithecium in a glomerule may be distinguished by its red punctiform ostiole (figs. 54, 58), and on section, by the dissepiments between the separate nuclei.

The glomeruli vary necessarily greatly in size and form, according to the number and closeness of aggregation of the constituent perithecia (fig 53). They, as well as the ostioles, also vary much in deepness of colour, being sometimes comparatively pale, at other times darker, and more red or brown, than usual. The ostioles, moreover, vary greatly in size and form; sometimes they are mere points—in large glomeruli of closely aggregated perithecia; sometimes they are so large and distinct as to resemble the disks of *Lecanorine* apothecia (fig. 58). Their form is determined by that of the perithecia; which again is regulated by the amount and direction of mutual pressure in their condition of aggregation in the glomeruli. In the old state, the nucleus frequently falls out, leaving an inverted conical cavity of a much paler (whitish) colour than the exterior walls of the perithecium (figs. 57, 59). In this state, the perithecium bears some resemblance to certain species of the old Lichen-genus *Gyalecta*.

The *spores* (fig. 60) vary considerably in their characters. Their length is generally about $\cdot 0006''$ to $\cdot 00075''$; their breadth $\cdot 00015''$ to $\cdot 00025''$; they are colourless, and very delicate, resembling those of certain *Verrucariæ*. Their form is generally narrowly ellipsoid; but they may be convex on one side only, and straight on the other; or fusiform; or variously curved in the same or opposite directions. Sometimes they are simple, or occupied by two to four or more nuclei or granules, or with fine granular matter alone. There is, however, a tendency to division of the cell-contents into two or four loculi (*a b*), producing the appearance of 1 to 3 septa; and sometimes also there is a tendency to constriction opposite the septum (*a*).

GENUS III. *Æcidium*.Sp. 1. *Æ. Otagense* (figs. 61 to 74).

1. Parasitic on the flowers, flower-petioles and leaves of *Clematis hexasepala*, DC. East Taeri Bush; Novem.; in abundant flower; a beautiful bush-climber, known to the Maoris as the "Pūawānanga," or "Pōanānga."

The flowers and flower-petioles are completely deformed by the growth of the parasite; their aspect is so entirely changed, that were the diagnosis of the plant dependent on specimens possessing these diseased organs, its species and genus would probably not be recognisable. The filiform or slender petioles, in particular, not only become twisted and curled variously, but are the seat of irregular, succulent, gouty swellings—of cucumber or cactus-like growths (figs. 61 *a*, 62 *c*), whose nature is rendered apparent by the beautiful buff-coloured Peridia, by which they are covered.

When the *flower* is the seat of the parasite, the sepals become thickened and somewhat coriaceous or fleshy, at least toward their bases or insertions. They also acquire adhesions to each other at their proximal ends, forming a sub-campulate or sub-urceolate perianth (fig. 62 *a*). On the *outer* surface of the sepals the Peridia exhibit themselves as *Urceolæ* (fig. 66 *a*), resembling the cyphellæ of some *Stictæ*; while, on their *internal* surface, the position of each urceole is marked by a corresponding *papilla* (fig. 66 *b*). When the Fungus occurs on the *leaf* of the *Clematis* (fig. 63), it alters its texture and appearance to this extent, that the leaf becomes thickened and coriaceous; its margin notched, thickened, and curled up (*a*); and its colour assumes a russet-brown or faded autumnal tint.

In the young state, the Peridia appear as epidermal papillæ (figs. 65, 67 *a*), gradually pierced by an apical ostiole, which rapidly expands into an urceola (figs. 66 *a*, 65 and 67 *b*), developing or exposing the concealed disk. Frequently, also, they are verrucæform or disk-like, having a more or less flat surface, with or without a thick, rounded, prominent rim (figs. 64, 65, 67 *c*). Normally, in the mature and old state, the Peridia are urceolate; their disk being sunk below the level of the epidermis of the *Clematis*; with raised margins projecting above the same level, varying much in thickness (fig. 67 *b*). Sometimes this margin is as thick as the apothecial exciple of many *Lecanoræ*; at other times it is thin and sub-membranous. Normally, the shape of the Peridia is round; but from pressure on each other, when more or less closely aggregated, they become variously ellipsoid or elongated (fig. 64 *d*). They vary greatly in their numbers and closeness of aggregation. Sometimes they are isolated, or occur in twos or threes (fig. 63), or in very small, scattered groups. This is the case on the *leaf* of *Clematis* in my specimens. At other times they are so closely crowded, that there is left between each Peridium no intervening tissue of the matrix (figs. 61, 62, 64).

This form is common on the *flower-petiole* of *Clematis*. Between the widely segregated and the closely aggregated forms there is every variety of distribution. It is in the former that the thick margin and verrucæform character generally occur; while in the latter we usually find the thin margin and regular urceola, with flattened disk (best seen on the flower petiole in my specimens).

In this country, similar deformities are produced on our common Nettle and Elder by *Æcidium Urticæ*, DC.* In the one case, the leaf-petioles and stem, and in the other, the stem, become twisted, curled, and swollen in a similar way. My friend M. C. COOKE, author of a recent "Synopsis of the British Æcidiacei"† (who was kind enough to examine my Otago species or forms), remarks of the one under description—"The *Æcidium* on *Clematis*, producing gouty swellings, &c., just corresponds with our *Æ. Ranunculacearum*, DC., which I have on *Clematis vitalba* from France and Germany." It does not, however, follow that it is the same species; indeed, its characters do not correspond with those of *Æ. Ranunculacearum*, as given in the "Flora Novæ Zelandiæ"‡ (in which work the said *Æcidium* is described as hitherto found only in the North Island, growing on *Ranunculus rivularis*, Banks and Sol.)

When exhibiting the monstrosities of *Clematis hexasepala* above described, and explaining or demonstrating their causes—the growth of the parasitic *Æcidium*—to the colonists of Otago, I was informed by them of the existence of similar deformities of parts or organs of a variety of trees and shrubs, which, from the descriptions given, may prove to be attributable to a similar cause—the development of a co-generic or co-specific parasitic Fungus. There is every reason to believe, therefore, that the study of *local vegetable teratology*—of the *diseases of local plants*—their causes and effects, offers a wide and novel field of research to the local Botanist.

2. Parasitic on the leaf (under surface)§ of *Epilobium junceum*, Forst., on plants growing 8 to 15 inches high on the Chain hills and flanks of Saddlehill; December; in flower.

The leaves on which the parasitic Peridia are scattered, are generally somewhat altered in colour and texture (fig. 69). The colour becomes russet-brown; the leaf looks faded, and presents a premature appearance of age (for the plant, on which the parasite occurs in my Herbarium, is a young one, with unexpanded flower-buds) (a). Sometimes the margin of the leaf becomes puckered or curled

* Excellent coloured plates of this and other British species—including the deformities they produce—may be found in an admirable popular "Introduction to the Study of Microscopic Fungi," by M. C. COOKE. London, 1865.

† Journal of Botany, vol. ii. p. 33, with a plate.

‡ Of Dr HOOKER, vol. ii.—Cryptogamia, 1853.

§ It is of interest to note that the British *Æ. Epilobii*, DC., occurs on the under (rarely upper) side of the leaves of *Epilobium montanum*, L.; *E. hirsutum*, L.; and *E. palustre*, L. (British species of *Æcidium*, COOKE's "Introduction," p. 190.)

inwards or upwards.* Its texture becomes thickened and sub-coriaceous; and this change is most evident, when leaves affected by the parasite are compared with those unaffected; which, in the latter case, are thin, sub-membranous and altogether of greener colour, with a healthier, fresher, younger appearance, and more flaccid consistence. The mal-conditions, or deformity here produced by the parasite, are, however, much less marked than in the case of *Clematis* or of *Microseris*.

The Peridia on the specimens examined by me were generally regularly round and deeply urceolate (fig. 70); the sunk disk was always of a lighter colour than the raised margin, both being, however, pale buff or brownish. Sometimes both disk and margin assumed the same colour as the faded-looking leaf—a russet brown.

“Possibly,” says Mr COOKE, “your *Æcidium* on *Epilobium* is *Æ. Epilobii*, DC., which has some of the habits of the present species.”

3. Parasitic on the leaves of *Microseris Forsteri*, Hook. fil.; growing in marshy places, Abbott’s Creek, Greenisland; October to December; in flower.

Generally the Peridia occur as oblong or ellipsoid papillæ or tubercles, unmarked or unpierced by an ostiole in the young state, but exhibiting various forms of urceolæ—for the most part with irregular margins—in the old state (figs. 71, 72). Essentially they resemble in appearance and structure the Peridia which occur on *Clematis*. They also resemble, however, more than do the Peridia on *Clematis* or *Epilobium*, the wart-like apothecia of *Pertusaria*, including both the normal and variolarioid conditions of the latter.

Mr COOKE makes the following interesting remarks regarding this form of the parasite:—“I should say that your specimen on *Microseris* is closely allied to *Æ. Tragoponis*, Pers., and that it certainly is *not* the very common and variable *Æ. Compositarum*, Mart. All the marginal teeth are gone, and most of the spores. If it could be determined whether the Peridia were seated on any definite coloured spot (I think they were not), and what the colour of the spores in the fresh state, and whether that colour was fixed or mutable, we could say definitely whether it really is *Æ. Tragoponis*. My own impression is that it would prove to be *an undescribed species*; but there is not sufficient material to state for certain, or to describe it if new. The colour of the spores, when fresh, is of specific value—as at present acknowledged—whether rightly or wrongly. . . . You will observe that . . . the Peridia are scattered, and *not* collected in definite clusters. These are not so numerous or close as in *Æ. Tragoponis*, as you will see by reference to Plate I. fig. 1 of my ‘Microscopic Fungi.’ . . . In *Æ. Tragoponis* the spores are at first yellow, then blackish. If, from a better specimen, you can determine that the spores are permanently yellow in your

* Similar thickening and involution of the edges of the leaves on which they grow are sometimes caused by British species, e.g., *Æ. Asperifolii*, Pers., and *Æ. Euphorbiæ*, Pers. (Cooke, “Introd.,” p. 191–2.)

species, it might be regarded as a *distinct species of which I know of no description*. It is not the *Æ. australe* of BERKELEY, which is a *Ræstelia*, I think."

So far as my data enable me to judge, it appears to me to be the same Fungus, which is parasitic on the three Phænogams above mentioned; and it seems doubtful, so little do they vary in their characters, whether the three *forms* deserve separate consideration or classification as *varieties*. The Peridia occur—most generally on the *leaves* of the plants on which they grow—as a series of minute cups or saucers sunk in the tissues of the matrix; pale buff-coloured in the centre, with a darker projecting margin. In shape and colour, these have considerable resemblance to the urceolate apothecia of the old Lichen-genus *Gyalecta* (fig. 64 *b*). To the naked eye they generally appear to be a series of minute, round, buff-coloured spots, sometimes from their abundance giving the leaf on which they grow a yellowish or reddish tinge, with a dry, withered, or puckered character (fig. 69 *b*). For their proper examination, however, they require the aid of the microscope and lens; and the examination should be made *on fresh or living specimens*—for this is one of the many genera of Fungi, whose species can only in this way be accurately determined or fully described. In so far as my specimens were all examined in the dried state, in the Herbarium, my data for determination and description are confessedly imperfect.* It remains, therefore, for *local Botanists* to settle such questions in the natural history of the genus *Æcidium* and its species (as developed in New Zealand) as the following:—

1. Whether the genus is autonomous, and not a mere form or condition of other *Uredineæ*, as OERSTED and DE BARY suggest?

2. Whether, assuming that it is a good genus, it contains so many good species as is at present supposed? This is a subject regarding which the most eminent Fungologists are somewhat at issue. On the one hand, Mr CURREY writes me—"I have no faith in the *species* of *Æcidia*: I think that in all probability they are reducible to two or three, if not to *one, species*." On the other hand, Mr COOKE, though admitting, doubtless, their great variability and complexity, describes no less than *thirty-one British species alone*.

3. Whether *Æ. Otagense* differs so essentially from species already described as to deserve a permanent place as a separate species? It differs from the only two species recorded in the "*Flora Novæ Zelandiæ*," *Æ. Ranunculacearum*, DC., and *Æ. monocystis*, Berk. (which is apparently confined to New Zealand). Nor does it appear to agree in all particulars with any of the thirty-one British *Æcidia*. The

* In all three cases of the parasite on *Clematis*, *Epilobium*, and *Microseris*, the Fungus was determined to be a true *Æcidium* (as the genus is at present established), by the presence of its characteristic spores. "*Æcidia*," says Mr CURREY, in reference to some difficulties that occurred to me in my microscopical examination, "*never bear thecæ*. . . . In the early state of *Æcidium*, the perithecia produce minute *spermatia*; but neither in that state, nor in the more advanced condition, have *asci* (thecæ) ever been observed. . . . The spores are always produced in chains; and when they fall apart, after the opening of the cups, they produce the yellow dust (or white) with which the cups are filled."—*Letter*, March 22, 1865.

probability at present therefore is, that if it is proper to maintain upon botanical records the names of so many species as at present established, this merits at least one separate place among their number.

4. Whether the forms occurring on *Clematis*, *Microseris*, and *Epilobium* are *species*, *varieties*, or *conditions*?

It will be a further and interesting problem for the *local Botanist* to determine—Whether the same species or forms of *Æcidium* affect plants of different species, genera, and orders; or, on the other hand, whether certain species, genera, or orders of Phænogams are characterised by their specific parasitic *Æcidia*. The present probability is all in favour of the first supposition. The genus in all its forms is eminently deserving of study by resident Fungologists; because, in addition to the points of interest already enumerated, some at least of its species are most destructive to the flowering plants on which they are parasitic.

In all probability several, if not many, species or forms of this large genus *Æcidium* remain to be added to the Flora of New Zealand.

III. FUNGO-LICHENES. (PLATE XXX.)

I have elsewhere* pointed out the desirability or propriety of instituting and maintaining an intermediate provisional class between Lichens and Fungi for the purpose of separately grouping a number of doubtful organisms—mostly parasites on the thallus or apothecia of Lichens—regarding which our knowledge cannot yet be said to be either complete or satisfactory, and which, so far as they have been at all specially studied, are the subject of most opposite opinions among Lichenologists and Fungologists. They are placed now among Lichens, now among Fungi, by different authors, whether Lichenologists or Fungologists. They partake of the characters of both these classes of Cryptogams. They are in great measure lost sight of in the ranks of either; while their interest as connecting-links between Lichens and Fungi is such as to render it most desirable to keep them prominently under the notice of Botanists till present conflicting views are reconciled, and their true place in classification is established. Some, if not most, of the parasites in question are to this day equally the puzzles of Lichenologists and Fungologists—the “opprobria,” of Lichenology and Fungology. Lichenologists, regarding them as *Fungi*, give them no special examination; while Fungologists, considering them mere degenerations or imperfect conditions of Fungi (if Fungi at all), and with equal probability *Lichens*, also appear to give them no adequate attention. The consequence of this common neglect is, that there is perhaps no group either of Lichens or Fungi of which we really know so little of a precise character. The group of Fungo-Lichenes is incapable of precise scientific definition. It is a

* On *Arthonia melaspermella*, Nyl.—*Journal of Linnean Society*, vol. ix. (Botany), p. 268.

heterogeneous assemblage of genera (such as *Microthelia*, *Celidium*, and *Phymatopsis*) * of very varied character.

Nor are these genera themselves satisfactorily or perfectly defined—consisting of an equally heterogeneous collection of species of diverse character—species which improvement in our knowledge regarding them will probably, in course of time, lead us to draft off for the most part to existing genera of Lichens or Fungi, though a minority may become the basis of really new, separate, and properly definable genera, whether of Lichens, Fungi, or Fungo-Lichenes. The genera *Microthelia*, *Celidium*, and *Phymatopsis* are here then regarded and adopted—as the group to which they have been here referred is also—simply as *provisional*; an adoption, however, which is convenient, if not necessary, for reference, and for the facilitation of their further study. The genera referred to agree with those lower Fungi, which are possessed of several forms of fructification, in rarely, if ever, exhibiting all these forms contemporaneously in the same specimen or locality, or it may be, country. I am not aware at present of any instance of complete or perfect fructification—that is, the co-existence of apothecia and spermogones or pycnides—in a given specimen in any given species. Usually fructification, where it occurs, is imperfect, only one form of the reproductive organs occurring (as the sporiferous perithecia in *Microthelia*). Frequently (in *Celidium* and *Phymatopsis*) there is no normal fructification at all; neither spores, spermatia, nor stylospores can be distinguished by repeated and careful examination—the plant existing only in a sterile or degenerate, rudimentary or protothalline condition—the dark-brown irregular and indistinct cellular tissue of the maculæ or wartlets furnishing no clue to the Order even to which the plant belongs. From these circumstances, it happens that an observer may examine—as I have done—in the long course of years, many thousand Lichens from every part of the known world, before he finds a fertile condition of some of these parasites, that is, their apothecia, spermogones, or pycnides; before he is in a position, therefore, to venture to assign the sterile Fungiform Maculæ, so familiar to him, to their proper Natural Order, family, genus, or species. In plants of such a character there cannot fail to be extreme difficulty—frequently for the time, and for years insuperable—in tracing the connection of the several forms of fructification, or their relation to a common species; and it is not surprising, considering the nature of the material, that errors should and must continue to occur in the assignation of names and affinities. Though the connecting links may appear to have been discovered, it may, and probably will, in a certain proportion of cases, prove, in course of time,

* The same genera are classed as "*Pseudo-Lichenes*" by KREMPELHUBER ("Die Lichenen-Flora Bayerns," 1859, p. 275); and by ANZI, *Celidium* and *Abrothallus* are included among "Genera inter Lichenes et Fungos incedentia;" while *Microthelia* is placed among the *Verrucariæ* ("Catalogus Lichenum quos in Provincia Sondriensi et circa Novum-Comum collegit" MARTIN ANZI, 1860; Como: Introduction, xvi.)

that certain apothecia, spermogones, or pycnides, which usually or always occur by themselves, unassociated with their complementary forms of fructification, are really properly referable to plants even of a different order or family. In the absence of *spores*, it is generally impossible or unsafe to determine either species or genus; but their presence does not always render diagnosis facile—for numbers of plants presently classed in the genus *Microthelia* possess essentially the same small, brown, solæform, 1-septate spores, while their habitats or other characters are diverse.

There are several parasites on Otago Lichens, which I prefer, for the reasons above assigned, to describe in a group as Fungo-Lichenes, rather than either as Lichens or Fungi.* In my Dunedin Herbarium, some of these exhibit only perithecia (*Microthelia*); others only spermogones (*Phymatopsis*); while a few occur only as sterile maculæ or warts, which are presumably rudimentary or degenerate perithecia or apothecia, or confluent clusters thereof (*Celidium*). In the two latter classes of cases my New Zealand specimens do not in themselves furnish sufficient means or characters for their determination. But on the same or similar Lichens from other parts of the world, I have found what seem to be links connecting the maculæ or spermogones in question with the relative apothecia, and which enable me—though doubtfully, and with reservation after the explanation already given—to refer them to apparently new forms of *Celidium* and *Phymatopsis*. The nature and relations of these Otago parasites cannot, however, possibly be understood (in so far, at least, as they are imperfect or infertile) without reference to the fertile condition of the most closely allied European plants; and I have the less hesitation in here recording the results of a comparative examination of the latter, that they themselves are little known to Lichenologists and Fungologists, and hence possess an inherent interest warranting their description.

GENUS I. *Microthelia*, Körb. Syst. Lich. Germ. 372 (Syn. *Verrucaria*, Pers.; *Pyrenula*, Ach.; *Endococcus*, Nyl.; *Tichothecium*, Mass.; *Phæospora*, Hepp; *Buellia*, De Not.; *Lecidea*, Ach.; *Abrothallus*, De Not. (*Lichens*), pr. p.: *Sphæria*, Hall (*Fungi*), pr. p.

Typical species have papillæform, superficial perithecia: whence the generic name (*μικρος*, small, and *θηλή*, a wart or papilla). In recedent or exceptional forms, the perithecia are punctiform and immersed, or semi-immersed. In all cases the perithecia are extremely minute or microscopic; and they resemble in size and external aspect the black papillæform or punctiform spermogones of many

* In the Society's "Proceedings," vol. v. p. 528, I have classed them provisionally as *Sphæriæ*, to which they have a more or less resemblance, and to which some at least may hereafter really prove to be referable. Nos. 4, 5, 7, and 8 are now described as *Microtheliæ*; No. 6 as a *Phymatopsis*; and No. 9 as a *Celidium*.

Lichens, especially the lower crustaceous groups. By KÖRBER, STIZENBERGER,* MUDD, and others, the genus is classed among the *Verrucariaceæ* (*Lichens*);† but while KÖRBER proposes enlarging his genus at the expense of the *Sphæriæ* (*Fungi*), MUDD‡ is apparently disposed to hand over the genus itself, with all its species, to the *Fungi*. My own impression is, that in course of time the genus *Microthelia* will be partitioned mainly, if not entirely, between the *Verrucariaceæ* and *Sphæriacei*—between *Lichens* and *Fungi*.

Sp. 1. *M. perrugosaria*, nov. sp. (figs. 23 to 28).

Hab. Perithecia parasitic on the apothecia of *Placopsis perrugosa*, Nyl., which I found somewhat plentifully on basaltic boulders on the top of Kaikorai Hill (1092 feet).

The parasite is best seen by moistening the apothecia of the *Placopsis*. The disk or epithecium is naturally of a dark or dull port-wine red or crimson colour. Under moisture this colour becomes lighter, the epithecium swells and becomes waxy, and the black punctiform parasitic perithecia then become prominent (figs. 23, 24). They occur in considerable numbers on a single apothecium; generally discrete or isolated; sometimes confluent. The perithecium is found, on careful examination, to be, in its upper half, a papilla seated *on* the epithecium of the *Placopsis*, while the lower half is immersed *in* its tissues (figs. 25, 26). Its walls are formed of dark-brown, small, irregularly formed, and densely aggregated cells (figs. 26).

The *paraphyses* are delicate, filiform, indistinct; without clavate heads; coloured yellow by iodine (fig. 27 *a*). The *thecæ* are ·0021" long, and ·00045" broad; ribband-shaped or ventricose, according as the spores are arranged in one or two rows; 8-spored; coloured yellow by iodine (fig. 27 *c d*), and thereby distinguished from the thecæ of the *Placopsis*, which (with its hymenial gelatine), under the same reagent, assume a beautiful Prussian blue, and which are ·0045" long, and ·00045" broad (fig. 29). The *spores* are broadly ellipsoid or oval; olive or brown; 1-septate; seldom or never constricted at the septum; polari-bilocular in the young state, and otherwise resembling, on a small scale, the spores of *Physcia pulverulenta*, Schreb, and other Lichens; ·00045" long, and ·00025" broad (fig. 28). They are readily distinguished from the spores of the *Placopsis*, which are oblong-ellipsoid; with double contour; *simple*; *colourless*; and ·0006" long, ·00045" broad (fig. 30).

* "Beitrag zur Flechten-systematik," 1862, p. 147.

† The most recent arrangement of the *Verrucariæ* is by Prof. GAROVAGLIO of Pavia ("Tentamen Dispositionis Methodicæ Lichenum in Longobardio nascentium," with Plates and Dried Specimens, 1865), who includes in the comprehensive genus *Verrucaria*, no less than 35 Massalongina genera, and among these *Microthelia*, Körb., and its allies, *Thelidium*, Mass.; *Tichothecium*, Flot.; and *Thrombium*, Wallr.

‡ "Manual of British Lichens," 1861, p. 306.

The plant does not appear to differ materially, save in its site, from two British species, *M. gemmifera*, Tayl., and *M. rugulosa*, Borr. (Mudd, "Manual," p. 306). It has further the characters of various Lichenicolous *Sphaeria*, as these are described, especially by MUDD. It is, however, most doubtful whether, on the one hand, many, at least, of the *Sphaeria* so-called, should not properly, as KÖRBER thinks, be referred to his Lichen-genus *Microthelia*; and, on the other, whether the latter genus itself should not be wholly transferred to the *Fungi*. The whole question, as it at present stands, is beset with difficulty and confusion.

The *Sphaeria* and allied *Fungi*, which occur parasitic on the apothecia and thallus of Lichens, are at once so little known and so interesting, that I append, for the sake of comparison, a few illustrative examples.

1. *Sphaeria squamarioides*, Mudd, p. 130; parasitic on the thallus of *Placopsis gelida*, L.; a Lichen which occurs equally in Otago and Britain, and is so closely allied to, and so frequently associated with, *P. perrugosa*, Nyl., as to be apt to be confounded therewith. *Microthelia perrugosaria* has many of the characters of *S. squamarioides* as described by MUDD, though the habitat differs—being *thallus* in the latter, *apothecia* in the former.

2. *Sphaeria gelidaria*, Mudd, p. 130; parasitic also on the thallus of *Placopsis gelida*, L. Its characters at once distinguish it from *M. perrugosaria*.

3. *Sphaeria cerinaria*, Mudd, p. 136; parasitic on the apothecia of *Lecanora cerina*, Ach., in Britain.

4. *Sphaeria leucomelaria*, Mudd, p. 105; parasitic on the thallus of *Physcia leucomela*, Mich., and *P. ciliaris*, L.

5. *Sphaeria epicymatia*, Wallr. (Nyl., Prodr. 85; *S. lichenicola*, Sommrff; Dur. and Mont. Fl. D'Algér. p. 529, Pl. I. No. 130; probably also the *S. apotheciorum*, Mass. Rich. p. 26, fig. 41).

Parasitic on the epithecium (of the apothecia) of *Lecanora albella*, Pers., throughout Europe and Northern Africa; and also, according to TUL. (Mém. Lich. p. 126), on that of *Physcia parietina*, L. Interesting from the possession of spermogones and pycnides, in addition to perithecia.

6. *Sphaeria homostegia*, Nyl. (Prodr. 56; *Dothidea*, Syn., 389).

Parasitic on the thallus of *Parmelia saxatilis*, Ach., and *P. Borreri*, Turn. Possesses spermogones.

7. *Sphaeria urceolata*, Schær. (Linds. Mem. Spermog. p. 175, Plate IX. fig. 35; Mudd, Manual, p. 267; Hepp exs. 475; described by some authors as an *Endocarpon* or *Dacampia*).

Parasitic on the thallus of *Verrucaria psoromia*, Schær, and *Solorina saccata*, L.

8. *Sphaeria Hookeri*, Nyl. (Prod. p. 175). Parasitic on the thallus of *Endocarpon rufescens*, Ach. It would appear to be the same parasite, which occurs so frequently on the thallus of *Lecidea Hookeri*, Schær. (Nyl. Prodr. 139); which has been confounded with that Lichen in our Scottish Alpine (Ben Lawers)

specimens: which is described by MUDD (Manual, 271) as *Verrucaria Hookeri* (Borr. E. Bot. Suppl. plate 2622; Leight. exs. 318): and which has been variously mentioned by other authors as a *Lecidea*, *Verrucaria*, *Endocarpon*, and *Dacampia*.

9. *Sphaeria ventosaria*, nov. sp.

Parasitic on the thallus of *Lecanora ventosa*, Ach.—a Lichen which is closely allied, especially in its apothecia, to *Placopsis perrugosa*. In 1856, I collected this *Sphaeria* and *Lecanora* largely in the Scottish Highlands; and in 1860, in some communications on the subject with Mr CURREY, I proposed for it, as a new British species, and in reference to its habitat, the name *S. ventosaria*.* I have not, however, up to this date, published a description of this parasite; and meanwhile, it appears to be the same plant, which is described by MUDD (Manual, p. 307), as *Microthelia ventosicola*, he arranging it, though expressing great doubt as to the true position of the genus *Microthelia* (p. 308), among *Lichens*. It is, however, says Mr CURREY (in MSS. 1861), “a true *Sphaeria*, but the species is quite new to me. It presents a very interesting peculiarity of fructification. Most of the *Sphaeriæ* have only 8 spores in each ascus. A very few have an unlimited number; but the spores in these cases are almost colourless, and always simple (*i.e.* not septate), and slightly curved. In your specimen the spores are brown, 1-septate, elliptical, and very numerous in each ascus.” HEPP (exs. 644, sub nom. *L. ventosa* var. *spermogonifera*) figures and describes oblong-ellipsoid spermatia, which do not agree with the ordinary spermatia of the *Lecanora*, as observed by myself in 1856, or as described by MUDD (157); the latter spermatia being cylindrical or acicular—that is, *linear*.

There are many other Lichenicolous *Sphaeriæ*, which, however, have never been properly studied, either by Lichenologists or Fungologists. Besides which, species affecting parasitically the thallus or apothecia of both higher and lower Lichens are to be found—and yet remain to be fully studied and accurately determined—in the following *Fungus*-genera, *inter alia* :—

Dothidea, <i>Fr.</i>	Epilithia, <i>Nyl.</i>
Stictis, <i>Pers.</i>	Gassicurtia, <i>Fée.</i>
Spilomium, <i>Nyl.</i>	Illosporium, <i>Mart.</i>
Sclerococcum, <i>Fr.</i>	Peziza, <i>Link.</i>
Hymenobia, <i>Nyl.</i>	

Sp. 2. *M. Cargilliana*, nov. sp. (figs. 31 to 34).

Parasitic on the apothecia of *Parmelia perforata*, Ach., which latter grows

* Mr CURREY proposed for it the name *Sphaeria lichenicola* (in letter, January 28, 1861). But this was unsuitable or inadmissible, not only because many other *Sphaeriæ* are equally lichenicolous—parasites on the thallus or apothecia of Lichens; but the term itself had been previously applied by SOMMERFELT, and other of the earlier Lichenologists and Fungologists, *inter alia*, to various species of *Sphaeria* (*S. epicymatia*, Wallr.), and *Microthelia* (*M. propinqua*, Körb., and *M. pygmæa*, Körb. Syst. Lich. Germ. 374).

plentifully on the branches and trunks of old or dead trees in Greenisland Bush.

In site and in general characters, this species resembles *M. perrugosaria*, from which, however, it differs in the character of its spores. The perithecia are black and papillæform; the upper half seated *on* the epithecium, generally of old deformed apothecia, the lower immersed *in* its tissues; generally isolated or discrete; scattered in considerable numbers on a single apothecium (fig. 31). Like those of *M. perrugosaria*, they have externally the characters of a minute *Verrucaria*. No thecæ were seen, but the perithecia contained abundance of brown, round spores, about '00015" to '00025" in diameter; simple, or with double contour (fig. 34). They cannot be confounded with the spores of the *Parmelia*, which are greatly larger, '00045" long, '0003" broad; *colourless*; and oblong or oval; though they are also simple, with or without a double contour, according to age (fig. 35). The beautiful blue reaction with iodine of the thecæ and hymenial gelatine of the *Parmelia* further sufficiently distinguish it from the hymenium of the parasite. Nor can the *Microthelia* be confounded with the parasitic *Abrothallus Curreyi*,* which affects the *thallus* of the same *Parmelia*, and which may in some of its conditions or parts be mistaken for the spermogones of the *Parmelia*. The *Abrothallus* is distinguished as a *Lichen* by the blue reaction of its thecæ and hymenial gelatine with tincture of iodine, and by the presence of distinct paraphyses with very granular and dark brown tuberculated heads, as well as by its general analogies.

Materials scarcely exist for the accurate determination or full description of *M. Cargilliana*, whose name is in honour of my friend JOHN CARGILL, F.R.G.S., of Greenisland, Member of the Legislative Assembly of New Zealand, and one of the best known pioneer settlers of Otago, to whom I was indebted for many acts of kindness in the course of my Otago excursions.

Sp. 3. *M. Ramalinaria*, nov. sp. (figs. 44-6).

Parasitic on the thallus of *Ramalina calicaris*, Fr., as it grows on the branches of trees (especially dead "Goai") in Greenisland Bush.

It occurs as extremely minute (microscopic), black, punctiform perithecia, scattered in great numbers, and in a state of close aggregation, over the surface of some of the branchlets, to which they give a dirty or blackish aspect (fig. 44). They are distinct only under the lens. Their wall consists of closely aggregated, dark brown, very small cells (fig. 46); but they contained no spores; and my present materials are, therefore, imperfect for full description or accurate determination. It appears, however, to be the same parasite, which occurs occasionally in this country on *R. scopulorum*, Ach. (Linds. Mem. Sperm. p. 130), and which I

* Described in the Section on *Lichens*, p. 409.

have found also on the apothecia of var. *fraxinea*, L. (of *R. calicaris*), rendering them black-punctate, on specimens in the Hookerian Herbarium, Kew, from Concepcion, Chili.

Sp. 4. *M. vermicularia*, Linds. (sub nom. *Lecidea*, Mem. *Spermog.* p. 143, plate v. figs. 19, 24, and 25).

Parasitic on the thallus of *Thamnolia vermicularis*, Schær. (specimens, as usual, sterile, bearing neither apothecia nor spermogones); Tarndale Mountains, Nelson; Dr ANDREW SINCLAIR.

I did not find this Lichen in Otago; but I have no doubt it occurs in the central and western alps, which I had no opportunity of visiting.

In New Zealand specimens the parasite exists only in a degenerate or abortive state. It occurs as very minute microscopic, black, punctiform, immersed perithecia, which sometimes become elongated or variously difform; under moisture assuming a brown tint and sub-corneous aspect. The envelope or wall of the conceptacle consists of brown, minute, closely aggregated cells; as do the perithecia of all the allied *Microthelia* (figs. 26, 46); but it contains no spores. The plant is, however, so similar otherwise to the parasite, which occurs abundantly in a fertile or normal state on the same *Thamnolia*, in the Falkland Islands, that I have little difficulty as to its identification.

M. vermicularia diverges—as does also *M. Ramalinaria*—from ordinary types of the genus, in so far as the perithecia are not papillæform and epithalline, but wholly immersed. In other respects, their characters are those of *Microthelia*, though they have, I think, equal claims to rank as *Fungi*.

These two species, moreover, are of interest as types of a group of parasites on the thallus or apothecia of Lichens, whose true position or affinities are not at present thoroughly understood or recognised, because, as a group, it has never been made the subject, as it deserves, of special study. Hitherto these parasites have been by myself, as well as other Lichenologists, classed, though *provisionally*, with *Lichens*; but I feel, and have always felt, that they have probably at least equal claims to be considered *Fungi*, and that, as such, they should be made the subject of a mutual re-examination and arrangement by and between Lichenologists and Fungologists. I refer to such parasites as the following, described or mentioned in my “Memoir on Spermogones:” *—

1. *Lecidea obscuroides*, Linds. (*Spermog.* 247; plate xiii. figs. 36–8; Mudd, 212). Parasitic on the thallus of a leprose form of *Physcia obscura*, Ehrh.
2. *L. Alectoris*, Linds. (*Sperm.* p. 135; plate i. figs. 12–13). Parasitic on the

* Compare also the species of the genus *Microthelia*, Körb., and certain species of the genus *Thelidium*, Mass, as described by Mudd (Manual, pp. 306 and 298); as well as certain species of the genera *Tichothecium*, Fw., and *Endococcus*, Nyl.)

thallus, as well as on the back or lower surface of the apothecia, of *Neuropogon Taylori*, Hook. fil.

3. *L. Cladoniaria*, Linds. (Sperm. p. 163, plate vii. figs. 14–16; Nyl. Enum. Suppl. p. 359). Parasitic on the folioles of the horizontal thallus; on the Podetia, or on their scales; in *Cladonia uncialis*, Hffm., and *C. bellidiflora*, Ach.

4. *Microthelia alciornaria*, Linds. (Sperm. p. 161).

5. *M. prunastria*, Linds. (Sperm. p. 137).

6. *M. Solorinaria*, Linds. (Sperm. p. 175). Parasitic on the thallus of *Solorina crocea*, Ach.

7. *M. Collemaria*, Linds. (Sperm. p. 272). Parasitic on the thallus of *Collema melcenum*, Ach.

GENUS II. *Phymatopsis*, Tul. (*Abrothallus*, De Not.)

I adopt TULASNE'S name for the genus, as being much more correct and appropriate than that of DE NOTARIS, especially when applied to such forms or species as *P. dubia* and its allies. The original name, *Abrothallus* (ἀβρός, thin or delicate), was based on an entire misconception—all species of the genus being strictly athalline and parasitic on an alien thallus, as I have elsewhere pointed out.* But TULASNE'S designation† (φῶμα, a tuber or excrescence, and ὅψις, like) appropriately represents the external aspect of certain, at least, of its species. Like *Microthelia* and *Celidium*, I regard the genus as in the meantime simply a *provisional* one, made up of species of diverse character. The majority of modern Lichenologists class the genus with the *Lecideæ*, and include all its species, so far as at present known. NYLANDER, however, while he ranks *A. oxysporus* as a *Lecidea*, removing it altogether from *Abrothallus*, considers *A. Smithii* a Fungus.‡ I am at a loss to understand on what principle such a distinction is made. One of the principal supposed tests for distinguishing Lichens from Fungi—the blue coloration of the hymenial Lichenine of the former under iodine—cannot be depended on; for, on the one hand, it does not follow that a plant, whose hymenium does not give this reaction, is not a Lichen, or which does give it, is not a Fungus; while, on the other, I have sometimes met with blue coloration in foreign forms or specimens of the same plant, which in Europe does not usually yield any colorific reaction.

Sp. 1. *P. dubia* (figs. 36–42).

Parasitic on the apothecia of *Usnea barbata*, Fr., var. *florida*, L., as it grows plentifully on trees in the Bush, Pelichet Bay, Dunedin; a dwarf form of the *Usnea*, with articulate branches, and in abundant fructification. Some of the mature

* Monograph of *Abrothallus*, p. 7.

† Mém. Lich. p. 113.

‡ He also alters the name—both specific and generic—recording it as *Habrothallus parasiticus*, Prod. 55.

and normal apothecia are marked by irregular, flat, brown, superficial maculæ, two or three of which generally nearly cover the epithecium (fig. 36). They are scarcely raised above the surface of the epithecium, of which they appear simply a discoloration; but when moistened and closely examined under the lens, they are found to be the seat of numerous extremely minute (microscopic), brown papillæ, which are semi-immersed. These papillæform conceptacles contain, instead of spores, myriads of rod-shaped *spermatia*, varying in length from '00010" to '00015," and about '00007" broad, borne on the apices of very short, simple, sterigmata (fig. 38). These conceptacles have externally, save as to colour, the aspect of certain *Microthelice* (e.g., *M. perrugosaria* and *M. Cargilliana*); but their contents show them to be *spermogones*, whose relative sporiferous perithecia remain yet to be discovered or determined. As regards their sterigmata and spermatia especially—as well as in other characters—these spermogones do not agree with those of the only species of *Abrothallus* in which they are yet known to occur.* The knowledge we possess of the genus is, however, both fragmentary and unsatisfactory. It does not follow, then, that a difference of character excludes them from the genus; while, on the other hand, it must be stated as a possibility that they may ultimately prove referable to some other genus or order.

The parasitic spermogones in question are, moreover, quite different in all their characters from the spermogones of the genus *Usnea* or any of its species.† The latter are minute wartlets, of the same colour as the thallus, scattered upon the tips of the ultimate ramuscles, as well as over the apothecial marginal cilia. The sterigmata are much larger, and are compound or articulated; the spermatia, though also linear, are longer.

Beneath the brown maculæ of the parasite the hymenium of the *Usnea* has its normal character, striking its usual blue colour with iodine, and the thecæ containing the ordinary spores, which are oblong-ellipsoid, or sub-globose; simple; colourless; '0003" long, and '0002" broad; with or without double contour, according to age (fig. 43).

On *U. barbata*, Fr., var. *ceratina*, Ach., growing on the branches of trees in Saddlehill Bush. I found both apothecia and thallus infested with various forms of a parasite.

The one form consists of very minute, black, punctiform, or difform, semi-immersed perithecia, abundantly scattered over the surface of the roughened branchlets (fig. 39 a). In or on some of these I found *brown*, simple, oblong-ellipsoid spores; '0003" long, and '0002" broad; but they are of the same size and form as the normal spores of *Usnea*, to which they probably really belong, having

* In *A. oxysporus*, Tul., as described by myself ("Monograph Abrothallus," p. 33). TULASNE (Mém. 113) described the spermogones as *unknown* in the genus.

† Which are described and figured in my "Mem. Spermog." p. 121, plate i. figs. 1-8.

acquired *colour* only from the parasite, with which they have come into accidental contact (fig. 42).

The other form occurs as maculæ, more or less raised and difform, sometimes apparently destroying the superficial tissues of the apothecium or thallus—sometimes simply seated thereon (fig. 39 *b*). These maculæ have much the external characters of the *Celidia* of the *Stictæ*. They contained no spores, and were in an imperfect and unsatisfactory condition for determination. It remains for Local Botanists to determine whether the parasitic spermogones, perithecia, and maculæ above described are referable to the same plant, or to different species, genera, or orders.

The nature or relations of these isolated forms of fructification cannot be understood without comparison with a suite of European and foreign specimens of the same or allied species of *Usnea*, on which I have found at various times similar parasites in more perfect conditions. Of these it will be most instructive first to describe the highest forms of the most nearly allied parasites—those which exhibit sporiferous apothecia.

1. Sub. nom. *Abrothallus Usneæ*, Rabenhorst exs. ("Lichenes Europæi") No. 537; sent me some years ago by Dr RABENHORST himself from Germany; a fine specimen, abounding in the parasitic apothecia in every stage of their growth; affecting var. *florida*, L., of *Usnea barbata*, Fr., in abundant fructification. The parasite, if all its diverse forms are referable to one species, equally affects the thallus from base to apex; the apothecia normal and degenerate—upper and under surface; and the cephalodia of the *Usnea*.

The latter, as they occur in the genus *Usnea*, are so little known, and their true nature so much misunderstood, that they demand some description before we proceed further. I have repeatedly met with them both in British and foreign forms of *U. barbata*, and in foreign allied species, and I was long puzzled with their true character. A careful examination of a series of specimens leads me to concur with NYLANDER (Syn. p. 15), in regarding them as warts or excrescences of the cortical layer or tissue of the thallus, having, however, a modified structure, consisting of a very dense, finely striated (filamentous) tissue, not unlike that of many hymenia, where the paraphyses are very closely aggregated; a circumstance, which, along with the frequently pale-bluish or violet coloration with iodine, gave certain grounds for the apparently common belief that the growths in question were really degenerate apothecia. This coloration with iodine is, however, a fallacious indication of hymenial structure; for, in the cortical tissue of the thallus of the *Usnea* on which the *Abrothallus* is parasitic—far removed from all forms, both of apothecia and cephalodia—towards the base of attachment of the plant, I sometimes met with a distinct, though pale, violet-blue colour under iodine. I doubt not that the thallus of other of the higher Lichens, containing Lichenine in their tissues, will be found to yield a similar reaction.

The *cephalodia* of *Usnea* are not mentioned by MUDD (Manual, 1861); but they appear to have been familiar to the earlier English Lichenologists, who contributed to the "English Botany" of Sir JAMES E. SMITH. In that work they are both figured and described, apparently as of a twofold character, viz., partly as "*orbillæ*," or abortive apothecia, partly as "warts" or excrescences (p. 71). The "*orbillæ*" are best marked and commonest in var. *florida*, L. (p. 71, plate 2250). They agree in aspect with the *cephalodia* of *U. longissima*, Ach., from Sikkim (Himalayas) in the Hookerian Herb., Kew. In var. *hirta*, Fr., they are described as "flesh-coloured, solid warts" (p. 72, plate 2252); and in the type *U. barbata*, Fr., as "fleshy tubercles or warts." The writer adds in regard to the latter (the type *U. barbata*) a reference to the "absence of '*orbillæ*,' which have never yet been discovered upon it in Britain or elsewhere" (p. 72, plate 2253): thus drawing an unnecessary distinction between the "warts" and "*orbillæ*," which are evidently, nevertheless, of essentially the same nature.

RABENHORST appears to regard the *cephalodia* affected by the parasitic *Abrothallus* as a diseased condition of the apothecia of the *Usnea*. But the latter, in their normal condition, are large, handsome, flat, broad, peltate; with a disk of similar colour to the thallus, or pale flesh-coloured as in *Ramalina*, the margin fringed with cilia, having the characters of the ultimate thalline ramuscles. In exceptional cases (as in a specimen of var. *florida* lately sent me from Lagos, West Africa, E. L. SIMMONDS) the apothecium is Parmelioid; the disk red and sub-urceolate; the margin raised, and furnished with few and short cilia, or sub-simple. Here the apothecia are seated at angles of the thalline ramules, a circumstance which, though common or general in *cephalodia*, is rare in *apothecia*. Exceptionally *cephalodia* are apotheciiform—that is, they are flattish, with a raised, generally thickish margin, the parasite occupying the cavity resembling the disk. But I have never been able to trace any distinct transition between *cephalodia* and *apothecia*; hence I regard them as essentially differing in character and function. The *cephalodia* so common on the genus *Usnea* may be regarded as analogous to those of *Stereocaulon* (Nyl. Syn. 15), save that in *Usnea* they are solid, while in *Stereocaulon* they are hollow; in both cases, they must be considered morbid growths of and from the cortical layer of the thallus. In *Usnea*, they usually have the aspect of Cladonioid or Biatorine, compound or confluent, apothecia; being irregularly tuberculated, and more or less of a pale brownish or flesh-colour. Almost universally, where they occur, they produce angularity of the thalline ramules, so that they appear to have their normal seat at natural angles of the branchlets. The *cephalodia* are abundant all over the plant; so that in regard to their site, they are in marked contrast to the normal apothecia of *Usnea*. In Sikkim specimens of *U. longissima* I have found *cephalodia* terminal on two of the divergent cilia or fibrillæ of the thallus; in which case they had greatly the aspect of Cladonioid apothecia.

The apothecia of *Abrothallus Usneæ* in RABENHORST'S specimen are frequently, especially towards the base of the thallus, isolated, large, and epithalline; convex, Biatorine, immarginate; of a blackish-brown colour; and having all the aspect of the usual apothecia of *A. Smithii*. Frequently, also, they become aggregated, confluent, and difform, then assuming the aspect of species of *Phacopsis** (e.g., *P. vulpina*). Another—the most rudimentary, and a sterile, probably a protothalline, condition of the plant—occurs in the form of maculæ—most irregular in form, size, and position; sometimes raised or convex; occupying occasionally such exceptional sites as the under surface of the apothecia, or the tips of the ultimate thalline ramuscles; in the latter case, giving the appearance of Cetrarioid spermogones. Between the large, isolated, sporiferous, Biatorine tubercles, and the aggregated or confluent sterile maculæ, there is every gradation of character. Of the isolated fertile apothecia, forms occur, which, though generally rounded or sub-spherical, are sometimes conoid or flat and wart-like, sub-immersed and emergent; sometimes girt with a thick distinct thalline border. The aggregate or confluent conditions, which are less frequently found fertile, generally produce irregular one-sided swellings of the branchlets, or apothecial cilia, on which also they find a site. Very seldom do they, in any of their conditions, surround the branchlet or fibril, being almost invariably seated only on one side thereof, producing angularities, swellings, and other deformities. Occasionally they are sub-terminal clusters of tubercles; in this, and in all other cases, of a blackish-brown colour, which, under moisture, becomes a pure, though dark, *brown*. The flattened disk passes gradually into the macula, frequently becoming stellate or irregular in outline.

The structure and contents of the hymenium must be examined in the isolated, large, regular, Biatorine apothecia. The aggregated, confluent, and difform conditions are almost invariably degenerate and sterile. The whole hymenium is generally obscured by more or less abundance of brown granular colouring matter; sometimes, however, it is very free from this colouring matter, and in such cases the thecæ and spores are very distinct, though the paraphyses are always indistinct, delicate, and obscured by much dark brown granular colouring matter about their tips. The *thecæ* are generally indistinct; 8-spored; the spores generally arranged in two rows; .0018" long, .00045" broad; giving no reaction with iodine. The *spores* are plentiful and distinct; oblong-ellipsoid;

* Contrast with the genera *Phymatopsis* and *Celidium* this genus *Phacopsis*, Tul. "Mém. Lich." p. 124 (name from *Φακίς*, a *nævus* or lentigo, a skin-wart); and especially the species *P. vulpina*, Tul. (p. 126), Linds. "Mem. Spermog." plate iv. fig. 22, p. 125; Hepp exs. 474. Than this species no *Lichen* could more resemble, in its external aspect and habit of growth, a *Fungus*; but no *Lichen* gives, at the same time, a more distinct and beautiful blue or violet colour (varying in shade, and sometimes very pale) with iodine (thecæ and sometimes hymenium). While in *Phymatopsis* (*Abrothallus*) and *Celidium* the apothecia or groups of perithecia are essentially *brown* (though frequently of a dark blackish-brown), in *Phacopsis* they are essentially *black* ab initio.

simple in outline or solæform;* generally 1-septate; sometimes no septum visible in young state; olive or brown according to age; '0003" to '0004" long, '00015" broad. Associated with the full-sized spores are numerous half spores; probably the result of the friction of the glass slides under examination; generally sub-oblong or sub-spherical. In one sub-degenerate and oldish apothecium—not apparently in any distinct or separate conceptacle—I met with multitudes of corpuscles, having the characters of *stylospores*; colourless, irregular (sub-spherical, oval, oblong, or pyriform); about '00015" long, and '00009" broad.

So far as regards the highest or most perfect condition of the apothecia, it will be observed that those of *A. Usneæ* agree with those of the microspermous varieties of *A. Smithii*. But the spores are greatly smaller than those of the commoner forms of *A. Smithii*, which are generally '00066" to '00090" long, and '00030" to '00040" broad; while the stylospores (should they really prove to be so) are also greatly inferior in size to those of *A. Smithii*, in which they are '00040" to '00066" long, and '00033" to '00040" broad. No spermogones and no separate or isolated pycnides were detected. There are two forms of *A. Smithii*, which it is instructive to compare with *A. Usneæ*, viz.:—

2. Sub nom. *A. microspermus*, Tul. (Hepp exs. 477. *Lecidea thallicola*, Mass.), on the thallus of *Parmelia caperata*, Ach. The mature apothecia are usually papillæform; but in the old state they become flattened and maculæform, resembling the genus *Celidium* in external aspect. This maculæform condition is much more unlike typical species of *Abrothallus* than are the majority of forms of *A. Usneæ*. The apothecia are accompanied with pycnides; and associated also are the spermogones of the *Parmelia*, which are apt to be confounded with the said pycnides; but which are immersed, black, and punctiform.

3. *A. Smithii*, Tul. var.; parasitic on the thallus of *Ricasolia pallida*, Nyl. (Syn. 372. *Sticta pallida*, Kunth; *S. Kunthii*, Del. Linds. Mem. Spermog. 205); Mexico; in Herb., Kew. Apothecia small, black, leciidiiform; rounded or flattened; epithalline or sub-immersed. Hymenium, *blue with iodine*; a reaction which is exceptional in this species, and which is noteworthy as connecting it with *A. oxysporus*, and retaining it within the category of the *Lichens* (from which NYLANDER dissociates it, regarding it as a *Fungus*, Prodrum. 55). Paraphyses with deep brown tips. *Thecae* 8-spored; '0013" long, '0006" broad. *Spores* brown; 1-septate; figure-8 shaped, or without constriction opposite the septum; variable as to size—frequently elongated and narrow; '0006" long, '00016" broad.

4. Var. *ceratina*, Sch. (*U. barbata*, Fr.); Rio Janeiro, HENRY PAUL, 1846; in

* "Shoe-sole-shaped"—"Schuhsohlenförmig" (Körb. Syst. Lich. Germ. 373), a graphic and appropriate term in reference to spores, which are 2-locular, with one division (upper) broader and shorter, and the other (lower) narrower and longer (as in *Abrothallus Smithii*, Tul. Linds. Monog. Abroth. plate iv. fig. 12).

my Herb.; exhibits sporiferous perithecia, cephalodia, and difform sterile tubercles and maculæ. The perithecia are scattered among the spermogones of the *Usnea*, and may be confounded therewith, or overlooked among them; but they are at once distinguished by the brown, 1-septate, figure-8 spores, which agree with those of *A. Usneæ*. The cephalodia resemble those in specimen No. 1 (var. *florida*), being generally difform-biatorine, or irregularly tuberculated, producing angularities of the branchlets. They occur also, however, as minute isolated papillæ or warts; sometimes becoming difform or maculæform; scattered on the ramules from base to apex of the plant; sometimes sub-terminal; generally producing angularities or deformities, like the larger more common forms—always more or less dark brown; and frequently assuming the aspect of species of *Celidium* or *Phacopsis*. These cephalodia are equally abundant and variable also in specimens of var. *ceratina* from Tasmania (LAWRENCE), and in *U. longissima* from Sikkim (Himalayas), both in Herb., Kew.

5. Var. *plicata*, Fr., Mauritius; in Herb., Kew; exhibits sporiferous maculæ and cephalodia, as variable in character as those described under No. 4. The maculæ are brown; they contain spores irregular as to size and form; always brown; sometimes simple and oval; sometimes 1-septate and figure-8-shaped; .0004" to .0008" long, and .0002" broad. The cephalodia are abundant, generally small, wart-like, resembling the apothecia of *Alectoria jubata*, Ach., producing, as usual, angularities of the ramules; occasionally having on their surface brown spores of the character of those of the parasite just described, and evidently referable to it.

6. Var. *ceratina* (*U. barbata*, Fr.), Hepp exs. 561. Some of the branchlets exhibit tuberculate, irregular, brown gouty swellings, resembling those produced by the spermogones on *Neuropogon melaxanthus*, Ach. and *N. Taylora*, Hook. fil. (Mem. Spermog. plate iv. figs. 9, 10, and 13, 14.) The parasite wholly surrounds the branchlet; is distinctly limited above and below; its brown colour is much heightened by moisture; it has no connection with any forms of either cephalodia or apothecia, but it exhibits no reproductive structure. The whole aspect of the parasite or deformity is Fungoid. In a specimen of *U. angulata* from New South Wales (also in Hepp's exs. 561), I find simple brown maculæ, which sometimes envelope the branchlet, sometimes colour its tip; but exhibiting no reproductive structure.

GENUS III. *Celidium*, Tul. Mém. Lich. p. 120; plate xiv. figs. 9–13; *Delisea*, Fée; *Plectocarpus*, Fée; *Dothidea*, Smrf. pr. p.; *Sphaeria*, De Not. pr. p.

The essential character of the genus is the close aggregation of the sporiferous perithecia in round sori or maculæ (whence the generic name κηλιδιον, a macula), with central spermogones, as in *Phacopsis*. These sori or maculæ are blackish-brown; less or more raised above the thallus on which they are parasitic;

more or less irregular in their surface, though generally with a defined roundish form; immarginate; epithalline (not hypophloeod). Sometimes all—sometimes only the central perithecia—coalesce or become confluent—their apices only appearing and remaining somewhat free and distinct—forming the projecting prominences, which roughen the surface of the maculæ. The spermogones are spherical, simple, seated in the centre of the cluster of perithecia; spermatia straight, linear, very delicate, imbedded in hyaline mucilage. Pycnides have not been discovered.

Its species form parasites affecting the thallus and apothecia of various of the higher (foliaceous) lichens. The genus is variously regarded as a *Fungus**, and *Lichen*,† whether by Lichenologists or Fungologists. Those who regard it as a *Lichen* class it usually among the *Lecideæ*,‡ though it appears to me, if it is to be considered a Lichen, to have at least an equal affinity to certain genera of the *Graphideæ* and *Verrucariæ*.

Sp. 1. *C. dubium* (figs. 47 to 52).

Parasitic on the thallus of various species of *Sticta*.

1. On *S. granulata*, Bab. (sterile specimen), Signal Hill, Dunedin; Dr SINCLAIR. The parasite affects generally the sterile, larger, and more granulose forms of the thallus, and seems most abundant towards the ends of the laciniae. In what appears to be the young state of the plant, the perithecia are isolated and papillæform, with visible ostiola (figs. 47, 50 *a*); they gradually, however, become confluent, forming difform groups (*b*); and lastly, maculæform, exhibiting no distinct ostiola. Both papillæ and maculæ vary greatly in size; in both, the colour varies from deep umber to black (in the dry state). Both are raised more or less above the thalline surface; both are only partly or apparently sub-immersed by their bases. Interspersed among both occur much more minute, punctiform conceptacles, which may (when their normal contents are discovered) prove to be spermogones or pycnides (figs. 47, 50 *c*).

2. On *S. fossulata* Duf. (fructiferous and sterile specimens); corticolous (on trees), Saddlehill Bush.

In regard to site and external aspect, the parasite here has the characters described in No. 1. It is abundant on some specimens of the *Sticta* towards the tips of the laciniae, to which it sometimes gives, even to the naked eye, a black-mottled appearance (fig. 49). There is the same transition from papillæ to maculæ (figs. 51–2), the latter apparently being always due to the confluence of the former. Here, however, the papillæ are more irregular in form, and the ostiole is never distinct. The maculæ are generally more or less raised or convex on their surface; and they are sometimes regularly spherical (figs. 49, 51 *a*), in which case they closely resemble the apothecia of certain *Arthoniæ* (e.g., *A. lurida* Ach). More generally, from the coalescence of several maculæ, or difform sori

* NYLANDER, Prod. 52.

† STIZENBERGER, 163.

‡ Ib. 163.

of confluent perithecia, the plant forms most irregular blotches of a dark-brown colour (figs. 49, 52 *b*). The parasite can scarcely be confounded with the spermogones of the *Sticta*. The latter are confined to the thalline rugæ* (fig. 48 *b*), while the parasite is irregularly and generally scattered over fossæ and rugæ alike (fig. 48 *a*). The spermogones are, moreover, paler brown, wholly immersed, punctiform, and greatly more minute than the smallest or papillæform condition of the parasite. The latter occurs on the larger (sterile) darker-coloured, and more fossulate forms of thallus; while the spermogones are most distinct on paler and fertile forms. I have found similar parasitic perithecia or papillæ, isolated, variable as to size, but containing neither spores, spermatia, nor stylospores, in Tasmanian (and fertile) forms of *S. fossulata*, sent me by my friend M. C. COOKE.

3. On *S. rubella*, Hook. and Tayl. (sterile specimens), on trunks of dead trees, Greenisland Bush.

In some specimens of the *Sticta* the thallus is covered with blackish or brown blotches, apparently allied to the larger maculæ described in No. 2. But here they are not distinctly defined—the blotch gradually merging or fading into the beautiful red colour of the thallus. Nor are they distinctly raised above the thalline surface. Under the microscope, all the structure these blotches exhibit consists of a brown or blackish-brown filamentous tissue, composed of jointed cells, thick-walled, and varying much in length and breadth; whereas the perithecia, composing the maculæ in *S. granulata* and *S. fossulata*, though they exhibit no spores, possess a distinct envelope, consisting of small, irregular, dark-brown, closely packed cells; a structure which resembles that of the conceptacle of the parasitic *Microthelidæ* (figs. 26, 46).

It remains for the Local Botanist to determine whether it is the same parasite, which affects *S. granulata*, *S. fossulata*, and *S. rubella*; whether all the forms of Perithecia, Sori, and Maculæ above described, are referable to a single plant.†

Inasmuch as the parasite in all my Otago specimens was in an imperfect (infertile) condition for description and determination, it is necessary, in order to an approximate understanding of the nature and relations of the perithecia and maculæ referred to, to append some description of authentic and fertile conditions of the nearest European species. Of these, the most closely allied which I have seen appears to be—

4. *Celidium Pelvetii*, Hepp exs. 372 and 589. Parasitic on the thallus of *Sticta aurata*, Ach. (*S. aurata* var. *abortiva*, Schaer.); Brazil; excellent specimens. The maculæ are so large and conspicuous, as well as so abundant, that the thallus is prominently black-mottled to the naked eye. Typical (fertile) maculæ are regularly round; convex or sub-conoid; isolated; of a deep blackish-brown colour; resembling in general aspect the apothecia of *Arthonia lurida*. In

* Lindsay, Mem. Spermog. p. 198, plate x. figs. 26–7.

† Compare *Sphaeria homostegia*, Nyl.

the rudimentary condition (prototalline), they are flat, dendritiform maculæ; while, in the old state, from coalescence of sori, they also assume the condition of difform, flattened maculæ or blotches. At no stage of growth did I observe that division into separate, though agglomerated perithecia, which are described by TULASNE as characteristic of the genus; the surface of the sori is smoothish and uniform as in the apothecia of *Arthonia*. The maculæform condition frequently resembles various species of *Dothidea* (Fungi). Sometimes the maculæ, which are usually distinctly raised and epithalline, are sub-saccate, like the apothecia of *Solorina saccata*, Ach.; seated in a depression or pit of the thallus, and surrounded by an indistinct, raised, spurious thalline border. The maculæ vary greatly in size—the sterile rudimentary or degenerate, especially compound or confluent, ones being the larger. The latter especially have a decided Fungoid aspect. Fertile and sterile forms generally do not occur on the same thallus; hence, while spores are common and distinct in HEPP'S exs. 589, they are with difficulty discovered or seen in No. 372. The hymenium, as examined especially in No. 589, whose constituents are extremely indistinct in the absence of any reagent, gives no blue reaction with iodine; but the paraphyses, which are closely aggregated and indistinct, acquire at their tips, which are naturally pale brown, a deep brownish red (Port wine) colour, or a violet red—sometimes very intense—which extends frequently to the thecæ and throughout the hymenium. The thecæ are 8-spored; short; sub-saccate; '0018" long, '00045" to '0006" broad; their protoplasm in the young state is very granular. The spores are solæform (1-septate), as in *Abrothallus Usneæ*; '00045" long, '00022" broad; but they are colourless or pale yellow. Under iodine, the epispore becomes more easily distinguished from the contained loculi, which are most distinct without the addition of any reagent, and which resemble somewhat those of the spores of various forms of *Verrucaria epidermidis*, Ach. The spores must be looked for in the youngish, or mature, regularly formed, spherical, convex sori. The same *Sticta* (*S. aurata*) in SCHÆRER'S exs. 558, and in my Herb. from Rio Janeiro, PAUL, shows on its thallus a few irregular flattish maculæ, devoid of reproductive structure, and probably in their rudimentary or prototalline condition; apparently referable to *Celidium Peltetii*.

5. *Celidium Stictarum*, Tul.; Mém. Lich. p. 121, plate i. fig. 17 c. and plate 14, figs. 5–8 (var. *pleurocarpa*, Ach., of *Sticta pulmonacea*, Ach.: "apothecia Fungosa abnormia"—of *S. pulmonacea*—Wallr. and Fr.; *Dothidea Lichenum*, Smrf.; *Sphaeria Stictarum*, De Not.) Affects the apothecia (disk or epithecium) and the apotheciiform cephalodia of *Sticta pulmonacea*, Ach. NYLANDER refers the parasite to the Fungi; but points out its affinity to certain species of *Arthonia* (e.g. *A. varians*, Dav., and *A. Abrothallina*, Nyl., Prodr. 52, Syn. 352). The parasite covers the apothecia with an irregular black crust, which consists of considerable numbers of closely aggregated perithecia, sub-confluent, having in

the centre of the group the spermogones, which are small, spherical, frequently confluent; the walls thick and black; the spermatia straight, very slender, and about '00012" long.

A. NYLANDER exs. Covering the disk of the apothecia (the larger and more mature) of *Sticta pulmonacea*, Ach. *Thecæ*, pale blue or dirty purple with iodine; a fact of some significance in relation to the question, whether the genus *Celidium* is a *Lichen* or a *Fungus*; 8-spored; '0023" long, '00066" broad. *Spores* fusiform or ellipsoid; somewhat variable as to form and size; colourless; 3-septate; sometimes not exhibiting the epispore in the young state; sometimes seen in process of germination; in the old state brown and obscurely granular; '00066" long, '00025" to '00016" broad. Tips of paraphyses deep brown.

B. SCHLÆRER exs. 550, sub nom. *B. pleurocarpa*, Ach., of *S. pulmonacea*, Ach. Here the paraphyses are extremely indistinct; the *thecæ* are 8-spored, and '0020" long, '00063" broad. *Spores* '00083" to '00066" long, '00025" broad; 3-septate; pale yellow; ellipsoid, sometimes sub-pyriform; sometimes exhibiting bulgings of the epispore opposite the septa.

Scattered irregularly over the thallus are numerous maculæ or papillæ of variable size and appearance, wholly devoid of reproductive structure, and evidently partly rudimentary or protothalline, partly degenerate; but apparently referable to the parasitic *Celidium*, whose sporiferous perithecia (perfect or fertile condition) are to be found only on the apothecia of the *Sticta*. The papillæ resemble young lecidiiform apothecia, or *Verrucaricæ*, or spermogones. The maculæ are sometimes sufficiently raised or convex, and regular in their outline (spherical), to approach in character some forms of *Abrothallus* or certain lecidiiform *Arthoniæ*. Both papillæ and maculæ are blackish brown of various shades, and are isolated and somewhat regular in form, or confluent and difform; in the latter case frequently with ragged margin. The flat, thin (rudimentary) maculæ are sometimes irregularly stellate and Arthonioid; sometimes sub-dendritic; seldom confluent; sometimes elongated, or sub-oblong, and with a general Fungoid aspect; generally, with the other forms, seated on the thalline rugæ.

In HEPP'S exs. 590, the *Celidium* of the apothecia (of all sizes) of *S. pulmonacea* is accompanied with maculæ on the thallus, similar to those just described, and, as usual, without reproductive structure. Similar *Celidia*,* whether in their fertile and perfect—or, as is more generally the case, in their sterile and imperfect—state, occur on a large proportion of the *Stictæ*; sometimes on the apothecia or thallus, or both (as in *S. scrobiculata*, Ach., and *S. Freycinetii*, Del.); sometimes on the verrucose or tuberculose thalline cephalodia (as in *Ricasolia corrosa*, Ach. Nyl. Syn. 372): in which latter case the parasite is analogous to *Abrothallus*

* Yet apparently undescribed.

Usneæ on the cephalodia of *Usnea barbata*. In general terms it may be stated, that I have examined, with a view specially to the detection of this or other parasites, few species of the genera *Sticta*, *Stictina*, or *Ricasolia* (and especially belonging to the groups represented in this country by the types *Sticta pulmonacea*, *S. linita*, Ach., or *S. scrobiculata*, Ach., or in foreign countries by *S. fossulata*), without succeeding in finding some traces thereof.

The sterile or imperfect states of various *Celidia* are not distinguishable from each other, even on the most careful examination; without the spores, the species cannot be safely determined. The rudimentary or degenerate maculæ of *C. Stictarum* and *C. Pelvetii* are alike; but the spores are very different, regularly 3-septate and ellipsoid in the one, and equally regularly 1-septate and solæform in the other; while their site, also in the perfect or fertile condition, is generally diverse, being apothecia in the one case, and thallus in the other.

Explanation of Plates XXIX. XXX.*

PLATE XXIX.

Figs. 1-5. *Abrothallus Curreyi*, Linds.

1. Portion of thallus of *Parmelia perforata*, Ach.; nat. size; bearing

a. Apothecia (of *Parmelia*).

b. *A. Curreyi*; parasitic apothecia.

c. Spermatogones (of *Parmelia*).

2, 3. Diagrammatic sections (variously magnified) of

2. *A. Curreyi*, apothecia.

a. Young.

b. Mature.

3. Spermatogones of *Parmelia*.

a. Young.

b. Old.

4. Section of hymenium of *A. Curreyi*, mag. 425 diam. linear.

a. Epithelial membrane.

b. Paraphyses.

c. Thecæ.

d. Hypothecial tissue.

5. Spores of *A. Curreyi*.

Fig. 6. *Abrothallus oxysporus*, Tul.

Spores; a. Young.

b. Mature.

Figs. 7, 8. *Lecidea Otagensis*, Nyl.

7. Section of hymenium.

a. Paraphyses.

b. Oil globules.

c. Thecæ.

d. Hypothecium.

Fig. 8. Spores; a. Young.

b. Mature.

Fig. 9. *Lecidea flavido-atra*, Nyl.

Spores; a. Young.

b. Mature.

Fig. 10. *L. melanotropæ*, Nyl.

Spores; Mature.

Fig. 11. *L. amphitropa*, Nyl.

Spores; Mature.

Fig. 12. *L. coarctata*, Ach.

var. *exposita*, Nyl.

Spores; a. Young.

b. Mature.

Figs. 13, 14. *Lecanora homologa*, Nyl.

13. Section of hymenium.

a. Paraphyses.

b. Theca.

c. Hypothecium.

14. Spores; a. Young.

b. Mature.

c. Old.

Fig. 15. *Lecanora peloleuca*, Nyl.

Spores; a. Young.

b. Mature.

c. Old.

Fig. 16. *L. thiomela*, Nyl.

Spores; a. Young.

b. Mature.

c. Old.

d. Do. in process of germination.

Fig. 17. *Placopsis perrugosa*, Nyl.

Spores; a. Young.

b. Mature.

* From the colours being printed, and not done by hand, the tints, in many cases at least, are more approximate than exact copies from Nature.

- Fig. 18. *Opegrapha subeffigurans*, Nyl.
Spores; a. Young.
b. Mature.
c. Old, in process of germination.
- Fig. 19. *O. agelæoides*, Nyl.
Spore; Mature.
- Fig. 20. *O. spodopolia*, Nyl.
Spores; a. Young.
b. Mature.
- Fig. 21. *Arthonia platygraphella*, Nyl.
a. Theca.
b. Spores.
- Figs. 22, 23. *Platygrapha longifera*, Nyl.
22. Section of hymenium.
a. Paraphyses.
b. Theca.
c. Hypothecium.
23. Spores; a. Young.
b. Mature.
- Figs. 24, 25. *Pertusaria perfida*, Nyl.
24. Section of hymenium.
ad. Paraphyses.
bc. Thecæ; b. to which iodine has been applied.
e. Hypothecium.
25. Spores; a. Young.
b. Mature.
- Figs. 26, 27. *P. perrimosa*, Nyl.
26. Section of hymenium.
a. Paraphyses.
b. Thecæ.
c. Hypothecium.
27. Spores; a. Young.
b. Mature.
- Fig. 28. *Pannaria immixta*, Nyl.
Spores; a. Young.
b. Mature.
c. Old.
- Fig. 29. *P. gymnocheila*, Nyl.
Spores; a. Mature.
b. Old.
- Figs. 30, 31. *Psoroma sphinctrinum*, Mut.
30. Spores; a. Mature.
b. Old.
31. Spermatia.
- Fig. 32. *Physcia plinthiza*, Nyl.
Spores; a. Young.
b. Mature.
c. Old.
- Fig. 33. *Ricasolia herbacea*, DN.
var. *adscripta*, Nyl.
Spores; Mature.
- Figs. 34-36. *Sticta subcoriacea*, Nyl.
34. Section of hymenium.
a. Epithelial membrane.
b. Paraphyses.
c. Theca.
d. Hypothecium.
35. Spores in *Otago* specimens.
a. Young.
b. Mature.
c. Old.
36. Spores in Wellington specimens.
a. Young.
b. Mature.
c. Old.
- Fig. 37. *Sticta filix*, Hffm.
a. Spores; young and mature.
var. *parvula*, Nyl.
b. Spores; mature.
- Figs. 38-42. *Sticta damacornis*, Ach.
var. *sub-caperata*, Nyl.
38. Portion of thallus; nat. size.
a. Apothecia.
b. Spermogones.
39. Same spermogones, considerably magnified.
40. Diagrammatic section of ditto, considerably magnified.
41. Spores; a. Mature.
b. Old, beginning to germinate.
42. a. Spermatia.
b. Sterigmata.

PLATE XXX.

- Figs. 1-7. *Sphæria Lindsayana*, Curr.
1. Portion of leaf of *Phormium tenax*, Forst., bearing the perithecia of the *Sphæria*; nat. size.
a. Larger, segregated forms of perithecia.
b. Smaller, crowded forms.
2. Perithecia; greatly magnified.
3, 4. Diagrammatic sections of ditto, greatly magnified.
5. Normal spores, magnified 425 d. l.
a. Young.
b. Mature.
c. Old.
6. Abortive spores.
7. Stylospores.
- Figs. 8-15. *Sphæria Otagensis*, Linds.
8. Perithecia and spermogones, slightly mag.
9, 10, 11. Do. greatly mag.

- 12, 13. Diagrammatic sections of ditto.
 14. Spores; *a.* Young.
 b. Mature.
 c. Old, in process of germination.
 15. Sterigmata and spermatia.
 Figs. 16, 17. *Patellaria atrata*, Fr.
 16. Section of hymenium.
 a. Theca.
 b. Oil globules.
 c. Paraphyses.
 d. Hypothecium.
 17. Spores; *a.* Young.
 b. Mature.
 c. Old.
 Figs. 18–22. *Sphaeria Martiniana*, Linds.
 18. Perithecia; nat. size.
 19. Do. magnified.
 20. Diagrammatic section of ditto, considerably magnified.
 21. Theca, with its spores.
 22. Spores; *a.* Young.
 b. Mature.
 c. Old.
 Figs. 23–28. *Microthelia perrugosaria*, Linds.
 23. Portion of thallus of *Placopsis perrugosa*, Nyl.; showing its apothecia bearing the perithecia of the *Microthelia*; somewhat magnified.
 24. Section of one of same apothecia; considerably magnified.
 25, 26. Diagrammatic sections of apothecium of *Placopsis* and perithecia of *Microthelia* variously (but greatly) magnified.
 27. Section of hymenium of *Microthelia*.
 a. Paraphyses—Coloured by iodine.
 b. Hypothecium.
 cd. Two forms of thecae.
 28. Spores; *a.* Young.
 b. Mature.
 Figs. 29, 30. *Placopsis perrugosa*, Nyl.
 29. Theca, with its spores—under iodine.
 30. Spores; *a.* Young.
 b. Mature.
 Figs. 31–34. *Microthelia Cargilliana*, Linds.
 31, 32. Apothecium of *Parmelia perforata*, Ach.; bearing the perithecia of the *Microthelia*; nat. size.
 32. Section; *a.* the central perforation.
 33. Diagrammatic section of same apothecium and perithecia; greatly magnified.
 34. Spores; mature.
 Fig. 35. *Parmelia perforata*, Ach.
 Spores; *a.* Young.
 b. Mature.
 Figs. 36–41. *Phymatopsis dubia*, Linds.
 36. An apothecium of *Usnea barbata*, Fr. var. *florida*, L.; bearing the parasitic spermogones; somewhat magnified.
 37. Section of same apothecium.
 38. Sterigmata and spermatia.
 39. Portion of a branchlet of *U. barbata*, Fr. var. *ceratina*, Ach.; bearing the parasitic perithecia and maculae; somewhat magnified.
 40, 41. Sections of same branchlet maculae (40), and perithecia (41).
 Fig. 42. *Usnea barbata*, Fr. var. *ceratina*, Ach. Spores; discoloured and abnormal.
 Fig. 43. *U. barbata*, Fr. var. *florida*, L. Spores—normal; *a.* Young.
 b. Mature.
 Figs. 44–46. *Microthelia Ramalinaria*, Linds.
 44. Portion of a branchlet of *Ramalina calicaris*, Fr.; black-punctate, with the perithecia of the *Microthelia* (*b*); *a.* apothecium of the *Ramalina*; all somewhat magnified.
 45. Section through the epidermis (cortical layer) of same branchlet, and through perithecia of the *Microthelia*; considerably magnified.
 46. Section through one of same perithecia; greatly magnified.
 Figs. 47–52. *Celidium dubium*, Linds.
 47–49. Portions of thallus (all somewhat magnified) of *Sticta granulata*, Bab. (47); *S. fossulata*, Duf. (48, 49).
 48. More fossulate, brown form.
 49. Smoother, green form.
 50–52. Sections of thallus of the *Sticta* and of the parasitic maculae and perithecia; all considerably magnified.
 50. *S. granulata*, Bab.
 51, 52. *S. fossulata*, Duf.
 Figs. 53–60. *Nectria Otagensis*, Curr.
 53. Agglomerated perithecia; nat. size.
 54, 55. Do. more or less magnified.
 56, 57. Sections of do., considerably magnified.
 58. Perithecia; mature; viewed from above.
 59. Do. old and empty; viewed from above.
 60. Spores; *a.* Young.
 b. Mature.
 c. Old.
 Figs. 61–74. *Æcidium Otagense*, Linds.
 61–68. On *Clematis hexasepala*, DC.
 69, 70. On *Epilobium junceum*, Forst.
 71–74. On *Microseris Forsteri*, Hook. fil.

61. Less than nat. size.
 a. Flower and flower-stalk of *Clematis* affected by the parasitic *Æcidium*.
 bc. Normal flower and flower-stalks.
62. Nearly nat. size.
 a. Deformed perianth of *Clematis*.
 b. Normal anthers and stamina.
 c. Deformed flower-stalk.
63. Leaflet of *Clematis*; about nat. size; Peridia of *Æcidium*, somewhat magnified.
- 64, 65. Portions of flower-stalk (64), and leaf (65), of *Clematis*, with the parasitic peridia; considerably magnified.
- 66, 67. Sections of peridia of *Æcidium*
- in different stages of development; considerably magnified.
68. Spores of *Æcidium*; mature.
69. *Epilobium junceum*; bearing the parasitic peridia on its leaves; about nat. size.
70. Portion of one of the leaves of the *Epilobium*, with the peridia considerably magnified.
71. Leaf of *Microseris Forsteri*; bearing the peridia of *Æcidium*; about nat. size.
72. Portion of same leaf and peridia; considerably magnified.
- 73, 74. Diagrammatic sections of same peridia; considerably magnified.



