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STUDIES IN FRUTESCENT LECIDEACEAE (LICHENIZED DISCOMYCETES)¹

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GENERAL REMARKS

ACCORDING to Reinke (17) and Zukal (27), frutescent development in the lichenized Ascomycetes has occurred in response to the need for greater development of surface area for purposes of photosynthesis by the algal symbiont. Sättler (22), on the contrary, considers the requirements for effective spore distribution to have played the more important determining role. As this must have been the sole operative selective factor in the non-lichenized Discomycetes (Geoglossaceae), there is no reason to discount its possible effectiveness in the lichenized forms also, especially since in certain of them (*Baeomyces*) the elongation of the apothecial stipe may take place independently of any investment with assimilative thalline tissue.

In the present author's preliminary paper on the genus *Stereocaulon* (Lamb, 14), an attempt was made to indicate the probable lines of its phylogenetic development from more primitive forms, and it was concluded, in agreement with views expressed by Kajanus (10, 11), that the ancestral prototypes of *Stereocaulon* must have been similar to certain species of *Toninia*. It was pointed out (Lamb, *op. cit.*, p. 576) that certain existing species of *Toninia* possess stipes of medullary origin upon which the assimilative squamules are elevated. Duvigneaud (4) considers *Stereocaulon* to be derived from the closely related genus or

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subgenus *Psora* in the Lecideaceae. The object of the present paper is to focus closer attention on such primitive frutescent forms among the Lecideaceae, in the hope that the question of the phylogenetic origin of the Stereocaulaceae may thereby be made somewhat clearer.

It has long been known that the podetium (*sens. lat.*) of the lichen fungi may arise in two different ways, either as an outgrowth of the carpogenous or apothecial tissues (true podetia) or as an upward growth of the thallus tissues supporting the apothecia (pseudopodetia); the stipes of *Stereocaulon* are pseudopodetia, those of *Baeomyces* are true podetia. Smith (23) has suggested that in some species of *Baeomyces* the podetial structures are pseudopodetia of thalline origin, but this does not appear to be the case; on the contrary, *Baeomyces* seems to offer a particularly clear instance of the development of a true carpogenic podetium. As Galløe (8, pp. 77-79) has shown, the stipe in *B. placophyllus* originates as a solid medulla inside the apothecial primordia; it is derived from the tissues of excipulum + hypothecium (= calyx), and becomes secondarily clothed from below by corticate thallus tissue containing algae. Dughi (2) is of the opinion that such stipes are formed by the ascogenous hyphae as they rise upwards before giving rise to the hymenial tissues. Choisy (1), on the contrary, believes that in podetia of apothecial origin the ascogonia are always formed at their summits. In actual fact, either of these two conditions may be realized, as has been shown by Galløe (*op. cit.*), who demonstrated that in *Baeomyces roseus* and *B. rufus* the ascogenous cells arise in the head of the developing podetium, whereas in *B. placophyllus* formation of ascogenous cells takes place in the still sessile apothecial primordium before stipe-formation; cfr. his figures on Pl. 117, figs. 780, 781; Pl. 119, fig. 796; Pl. 122, fig. 812. It seems therefore that the podetium may arise by elongation of the apothecial tissues either before or after the formation of ascogonia.

In the genus *Cladoniopsis* Zahlbr., which is closely related to *Baeomyces*, differing chiefly in the branched podetia, the thalline tissue invades not only the apothecial stipe, but also the sterile apothecia themselves, converting them into shield-shaped assimilative bodies (Lamb, 15).

Pilophoron is included by Duvigneaud (4) in the family Stereocaulaceae, largely on the evidence of the presence of cephalodia and chemical similarities; it appears nevertheless to have true podetia of carpogenic origin (Lamb, 14, p. 524, footnote), as was already suggested by Vainio (24, pp. 20–21).

In *Cladonia*, vegetative transformation of the podetia has proceeded so far that in most species their carpogenic origin is not at all obvious, but studies of certain species having very short or rudimentary podetia confirms the correctness of Vainio's statements (24) that they are derived from the apothecial tissues as in *Baeomyces*. In the North American endemic species *C. linearis* Evans, in which the apothecia are borne on short pedicellate podetia not over 2 mm. in length, the central core of the podetium merges gradually above into the hypothecium, and the reflexed excipulum of radiating palisade-hyphae also shows a gradual transition into the podetial cortex. As a rule the podetia lack algal cells altogether, but occasionally small groups of algae are present (Evans, 5, p. 46). The primitive podetia of this species differ from those of most *Cladoniae* in being solid internally, lacking a central canal and an inner cartilaginous layer; these characteristics in *Cladonia* are apparently secondary and derived. Additional evidence for the carpogenic origin of the podetia is provided by the findings of Weise (26), who proved by alga-free cultures of the fungal component of *Cladoniae* that the colonization of the podetium by the assimilative thalline mantle is a secondary phenomenon.

Other frutescent genera placed in the Cladoniaceae (*Glossodium*, *Gomphillus*, *Heteromyces*, *Thysanothecium*) will not be considered here, because their ontogeny is mostly too little known to allow their phylogenetic relationships to be determined. *Thysanothecium*, and also the subgenus *Clathrina* of *Cladonia*, according to Duvigneaud (4), possess pseudopodetia of thalline origin, and for that reason have been removed from Cladoniaceae to autonomous monotypic families, Thysanotheciaceae and Clathrinaceae (*op. cit.*, p. 155). It is very doubtful whether *Gomphillus* belongs to Cladoniaceae. *Gymnoderma* has been found by Evans (5, p. 50) to be inseparable from *Cladonia*. *Pseudobaeomyces* Satô (19, 20, 21) is of doubtful taxonomic position. Its author first placed it in the Cladoniaceae, then

subsequently in the Stereocaulaceae. It differs from *Baeomyces* in the possession of cephalodia, its longer and more septate spores, and its lecanorine apothecia. The type-species is *P. insignis* (Zahlbr.) Satô (Syn. *Baeomyces insignis* Zahlbr., *Baeomyces soboensis* Yasuda ex Räs., *Pseudobaeomyces pachycarpus* var. *stipitatus* Satô). The fact that the apothecia rise from a well developed, crustaceous, rimose-areolate thallus seems to indicate that the stipes are probably true podetia of carpogenic origin, secondarily clothed, up to the apothecial margin, with assimilative thalline tissue. The genus may possibly be better placed in Lecanoraceae than in Cladoniaceae.

Baeomyces, in particular, shows clear relationships to some of the non-lichenized Discomycetes. Le Gal (Bull. Soc. Mycol. France, LXII, 1946, p. 50) has emphasized its affinity to *Leotia*, showing that "*Leotia Batailleana*," described as a new species by Bresadola, is a typical *Baeomyces roseus*. Duvigneaud (4) points out the close analogy between *Baeomyces* and two other genera of inoperculate Helotiaceous Discomycetes, *Cudonia* and *Cudoniella*. Rizzini (Arquivos Jard. Bot. Rio de Janeiro, XII, 1952, p. 139) has described a Brazilian species of *Cudoniella* which he calls a "hemilichen"; it appears to be parasitic on pleurococcoid algae, these occurring also on the stipes and apothecial discs.

Reinke (17) included *Baeomyces* in the Lecideaceae as "der aufsteigende Stamm der Tribus." Kajanus (10) placed it, together with *Cladonia* and *Pilophoron*, in a subdivision *Baeomycei* of the order Lecideales, and kept the genera *Catillaria*, *Toninia*, *Stereocaulon*, and *Argopsis* apart in a separate order *Catillariales*. The view that *Baeomyces* represents an intermediate condition between the Lecideaceae and the Cladoniaceae (excl. *Stereocaulon* and *Argopsis*) seems to be correct, but Kajanus' segregation of the Catillariales as a separate order can hardly be maintained, as it attaches too much importance to the character of spore-septation. The genus *Toninia*, for instance, shows considerable variation in this respect; it is usually divided into the sections *Thalloidima* (spores 1 or rarely 2-septate) and *Eutoninia* (spores 3 to multiseptate), but the limits between the two sections are not at all well defined. (It should be noted that the placing of species under sections in

Zahlbruckner's *Catalogus Lichenum Universalis* is unreliable and in some instances quite erroneous.) The artificiality of the two sporological sections *Thalloidima* and *Eutoninia* is also well seen in the separation of *Toninia subcandida* B. de Lesd. from the habitally indistinguishable *T. candida* (Web.) Th. Fr. Furthermore, the species in which the spores are entirely or predominantly simple transgress into the genus *Lecidea* (sect. *Psora*), and have been placed in various systematic positions. Some, like *T. bossoniana* and *T. conglomerata*, are retained in *Toninia* sect. *Thalloidima*; some were placed in *Lecidea* (*L. thalloedaemiformis* Szat., *L. fujikawae* Satô, the latter as the type of a new section, *Tonniopsis* Satô).

In the family Lecideaceae as defined in Zahlbruckner's classification, frutescent development is found in several genera, and the production of stipes may be either from the apothecial tissues (true podetia) or from thalline tissues (pseudopodetia).

Among the Lecideaceae examined by the author, true podetia have been observed only in the genus *Bacidia* (incl. *Bilimbia*). Here the formation of stipes, derived from the tissues of the excipulum (calyx) and the hypothecium, is rather common, although often they are buried in the thallus and for that reason not externally visible. A similar downward prolongation of the hypothecial and excipular tissues is occasionally found also in some non-lichenized Ascomycetes with a mycelial subiculum (rudimentary thallus), e.g. *Eriopezia* in the Helotiales; see Korf (13), fig. 15, p. 147. Galløe (7) describes and figures stipes of parallel hyphae, formed from the base of the excipulum, in *Bacidia beckhausii* (Körb.) Arn. (*op. cit.*, p. 65, Pl. 113, fig. 364). In the Philippine species *B. robinsonii* (Vain.) M. Lamb (see revision on p. 119), the apothecia, although delimited on the under side by the entire excipulum, are subtended by a strand of dark tissue, obviously of carpogenic origin, running down into the underlying thallus to a depth of up to 400 μ . Galløe (*op. cit.*, Pl. 119, fig. 386) figures a section through an apothecium of *Bacidia acerina* (Pers.) Arn., showing a very short but distinct pedicellate stipe, which appears to be derived from the lower hypothecium, referred to by Galløe as the "inner calyx." On Pl. 61, fig. 207 of the same volume is shown a section through the thallus and apothecia of *Bilimbia sphaeroides* (Dicks.) Körb.

with distinctly raised-stipitate apothecia; an interesting feature here is the presence of a group of algal cells inside one of the stipes, indicating the beginnings of a tendency towards investment of the podetium with assimilative thalline tissue. Galløe (*op. cit.*, p. 47) points out the resemblance of the excipular stipes of *Bilimbia*-species to the stratum chondroideum in the podetia of *Cladonia*, and does not hesitate to regard the two structures as homologous. Other species of *Bacidia* in which the apothecia are raised on distinct pedicellate stipes are *B. gomphillacea* (Nyl.) Zahlbr., *B. kuopioensis* (Vain.) Vain., *B. obscurata* f. *substipitata* (Nyl.) Zahlbr., *B. ophiospora* (Hellb.) Th. Fr., and the exotic species *B. buchanani* (Stirt.) Hellb. and *B. exaltata* Zahlbr. Of these, only two, *B. gomphillacea* and *B. buchanani*, have been examined by the author, and the origin of the pedicellate outgrowth was found to be different in each.

In *Bacidia gomphillacea* (see revision on p. 124) the apothecial pedicels are undoubtedly of carpogenic origin, but, as suggested by Vainio (25), they seem to be derived from the tissues of older apothecia upon which new apothecia have grown by proliferation. In *B. buchanani*, on the contrary, the rudimentary pedicel, when present, is of purely thalline origin, and is not in any way derived from the apothecial tissues (see revision on p. 121).

Bacidia marginalis (Vain.) R. Sant. (18, p. 447) has pseudo-stipitate apothecia, the whole stalk-like base being formed from the lower part of the hymenium with the surrounding excipulum, as is also the case in the genus *Gomphillus*.

In other genera of Lecideaceae studied, the stipes are of thalline origin (pseudopodetia). As pointed out by the author in connection with *Stereocaulon* (Lamb, 14), a pseudopodetium may be formed either by the elongation of all parts of the thallus (medulla, algal stratum, and cortical layer when present) or by the vertical growth of the medullary or hypothalline tissue only, which then raises the assimilative part of the thallus upwards on its summit. These two types may be termed *holostelidious* and *enteropodious* pseudopodetia respectively, corresponding to the two subgenera of *Stereocaulon* distinguished by the author (14, pp. 564, 566) on that basis.

The beginnings of orthotropic elongation of the thallus to form pseudopodetia may be observed in *Catillaria columnatula*

(Nyl.) Zahlbr., in which the areolate thallus is formed of a number of minute, erect, connate columns (see revision on p. 114).

Well developed holostelidious pseudopodetia are found in the monotypic genus *Sphaerophoropsis* Vain. *S. stereocauloides* Vain. has been anatomically investigated by Reinke (17, pp. 98–99), and the thallus shown to consist of homoeomerous stipes of thick-walled hyphae intricated in various directions, without differentiation of medulla or cortical layer, the symbiotic algae being disposed quite at random through the tissue. The author's revision of the type material (p. 148) fully confirms Reinke's observations. The algae occur in all parts of the stipes, in which they are buried, and do not form granulose excrescences on the surface. Sections of the apothecia show that the excipular and hypothecial tissues are abruptly differentiated from those of the stipes, which are obviously purely thalline formations.

In the genus *Toninia* the development of pseudopodetial stipes is rather a common phenomenon, and they are of the enteropodious type, being derived from the lower medullary tissue of the squamules, and usually of purely mycelial composition, without symbiotic algae. They are not constantly present in the species in which they occur, and do not constitute a taxonomic character of great importance in this genus. *Toninia ruginosa* (Tuck.) Herre, in its typical form, shows little or no development of stipes, but in the newly described variety *andicola* M. Lamb they are very conspicuous, and partially corticate in their upper parts (pp. 144–148). In other species of *Toninia* examined they are ecorticate, formed of vertically parallel, often more or less fibrous-dissolute hyphae. The thalline squamules are raised up on the summits of these mycelial stipes, which spring from their under side and are continuous with their medulla. The apothecia may be formed either directly on the thalline squamules or on stipes of their own. Usually the stipes are more or less buried in the earthy substratum, and may form at their base a mass of fibrous root-like strands, as in some states of *T. coeruleonigricans* (Lightf.) Th. Fr.; in a specimen of this species collected by the author in Canada, boundary between Alberta and British Columbia (M. Lamb no. 6481), the radicate stipes are up to 14 mm. long and at their base fibrous-floccose or dissolute into sheets of pale mycelium. Such forms have been described in the literature: "*Lichen radicatus*" Villars,

Hist. Plant. Dauphin. III (1789), p. 948, Pl. 55 ("La partie inférieure de tout le lichen se prolonge en un faisceau de racines fibreuses d'environ un pouce"). Possibly *T. coeruleonigricans* f. *caulescens* Lettau represents the same modification.

Descriptions are here given of three representative caulescent species of *Toninia* with simple, 1-septate, and multiseptate spores respectively: *T. conglomerata* (Ach.) Boist. (p. 137), *T. bumamma* (Nyl.) Zahlbr. (p. 139), and *T. squalida* f. *caulescens* (Anzi) M. Lamb (p. 142). As the stipes are in close contact with the substratum, they naturally tend to be commonly conspurcated with accidentally adherent soil particles and groups of Cyanophyceous algae, but in a specimen of *T. squalida* f. *caulescens* colonies of blue-green algae were observed enclosed by hyphae in the upper stipes and lower sides of the thalline squamules (fig. 10, p. 143), a fact which suggests the formation of primitive cephalodia, and this is interesting in view of the probable close relationship between *Toninia* and the cephalodia-bearing genus *Stereocaulon*.

Toninia bornmülleri (Stein) Zahlbr. is stated to have *hollow, branching* stipes up to 2 cm. high, terminated apically by inflated-verrucose heads of squamules; "erinnert an eine *Dufourea* und weicht habituell von allen europäischen *Thalloedema*-Arten weit ab." Unfortunately no material of this interesting species has been available for examination, and nothing can be said regarding its systematic position and morphological features.

A few species of *Lecidea*, such as *L. alboradicata* B. de Lesd. and *L. glomerans* Nyl., are stipate-radicate, probably with the same type of enteropodious pseudopodetia as in *Toninia*, but they have not been examined by the author. In some *Lecideae* of the section *Psora*, e.g. *L. rubiformis* Wbg., the tendency towards formation of this kind of stipe is often very obvious.

Enteropodious pseudopodetia are now described in one species of *Catillaria* and two species of *Bacidia*, genera in which this type of thalline development was not previously known. The resulting difference in habitus and structure is so marked that it has been felt necessary to create new sections of the genera for these species: *Catillaria* n. sect. *Hypocaulon* and *Bacidia* n. sect. *Thamnopsis* (pp. 116, 125). In both of them the stipate pseudopodetia consist of purely fungal tissue of intertexted

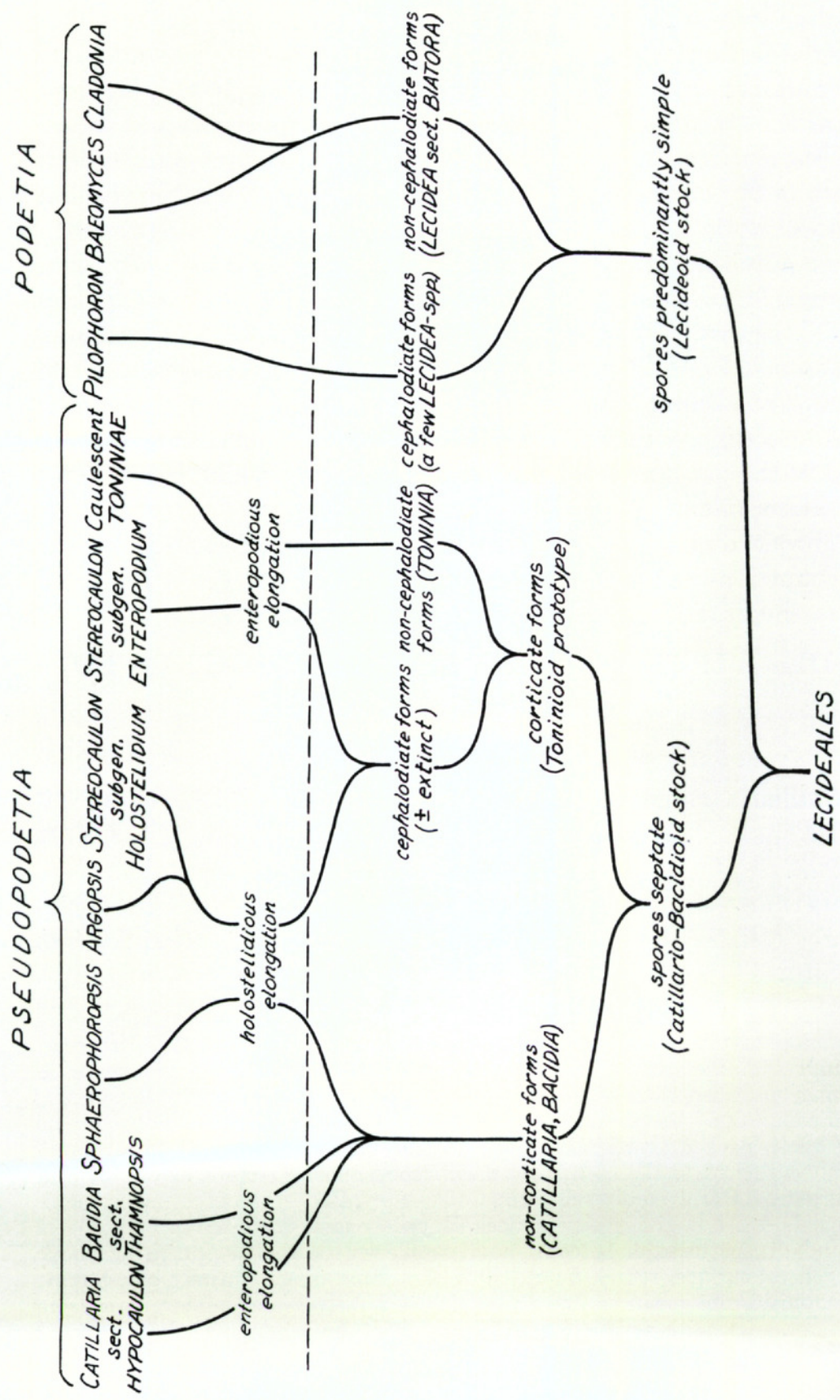


FIG. 1. Scheme of probable phylogenetic derivation of fruticose forms in Lecideaceae, Stereocaulaceae and Cladoniaceae. The dotted line represents the level at which frutescent development took place.

hyphae, without cortex and with few or no algae, and formed from the lower medulla or perhaps the hypothallus. The assimilative granules containing the symbiotic algae are raised up at the apices of the pseudopodetia. The apothecia and spores are normal for *Catillaria* and *Bacidia*. Strangely enough, both these new sections are represented by endemic Antarctic species. Antarctica is known to be the home of fruticulose representatives of elsewhere purely crustaceous genera (*Caloplaca* sect. *Thamnoma*, *Lecania* sect. *Thamnolecania*). *Bacidia* sect. *Thamnopsis* shows considerable similarity to *Stereocaulon* subgen. *Enteropodium*, and indeed one of the species was first described as a *Stereocaulon*; however, it differs in the absence of cephalodia and of a differentiated central chondroid pseudopodetial strand, and in the aeruginose epithelial pigmentation which is unknown in *Stereocaulon*.

The accompanying diagram (Fig. 1) is intended to show the presumed phylogenetic origin of the frutescent genera derived from the order Lecideales.

DESCRIPTIONS OF THE SPECIES INVESTIGATED

CATILLARIA Mass. emend. Th. Fr.

Sect. *Biatorina* (Mass.) Th. Fr.

Catillaria columnatula (Nyl.) Zahlbr. Cat. Lich. Univ. IV (1926) p. 34. Syn. *Lecidea columnatula* Nyl. in Flora, LX (1877) p. 228.

MATERIAL EXAMINED: the type-specimen from Ireland, Kylemore, coll. *Larbalestier*, 1875, in herb. Nylander, Helsinki (no. 19140).

On a chip of gneissic-schistose rock 2.4×0.7 cm. Thallus seen from above granulate-areolate, dirty gray with a faint brownish tinge, matt, of irregular, sinuate-angulose areolae 0.3–0.7 (–0.9) mm. diam. separated by narrow or $\pm$ gaping, very deep cracks. Areolae plane, with obsoletely granulose surface, as if composite. Seen from the side, the thallus, about 0.5 mm. thick, consists of closely packed, vertical, simple, whitish columns about 0.1 mm. diam., firmly attached to the rock. No dark hypothallus. Thallus externally and internally KHO + sordid yellowish, CaCl_2O_2 – , PD – ; sections under microscope I – , not giving any noticeable yellow mist with KHO. Apothecia abundant, scattered or $\pm$ contiguous, sessile on the thallus and rising above its general surface, round, minute, 0.25–0.40 mm. diam., entirely black, matt or subnitid, not pruinose, mostly moderately convex and immarginate from the first, a few with indistinct, hardly prominent, moderate, concolorous proper margin.

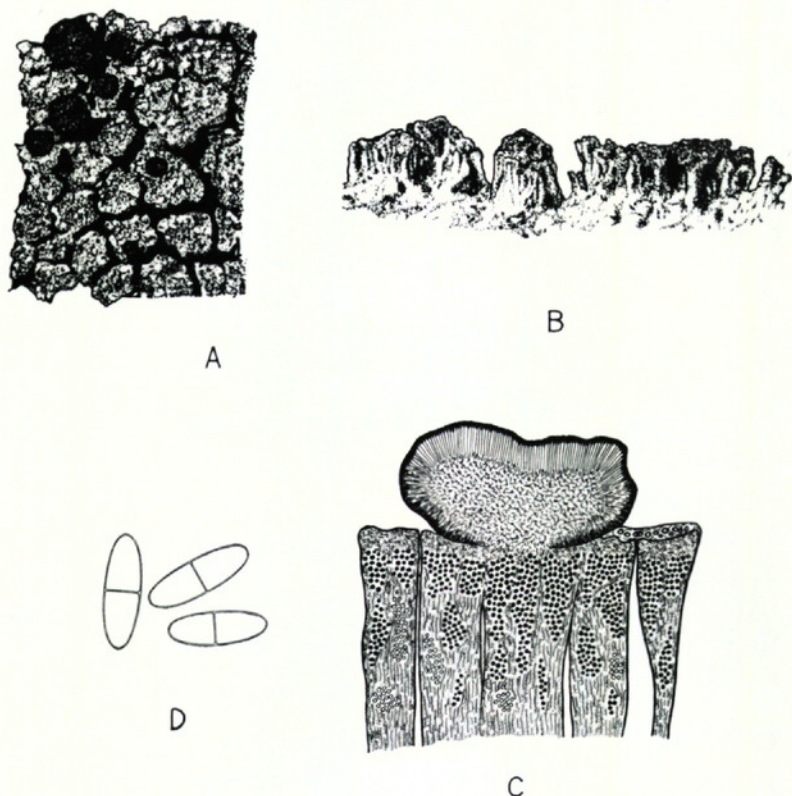


FIG. 2. *Catillaria (Biatorina) columnatula* (Nyl.) Zahlbr. The type-specimen. A, part of thallus and apothecia seen from above ($\times 10$). B, part of thallus seen from the side ($\times 10$). C, vertical section of thallus and apothecium. D, Spores.

Thallus without distinct cortex, the upper surface of the areolae with an ill-defined outer layer up to $30\ \mu$ deep of indistinct, shortly septate or cellular, thin-walled, grayish-nubilated hyphae entangled and fused in various directions, $3\text{--}4\ \mu$ diam. Interior of columnar areolae with numerous unevenly distributed symbiotic algae, not forming a distinct stratum, but more abundant in upper parts. Algae pleurococcoid, pale green, round, $4\text{--}7\ \mu$ diam., cohering in clumps by the thin but $\pm$ gelatinous walls (Micareoid type), multiplying by transverse fission. Numerous blue-green algae also present in the thallus, of various types; also present in places over the surface of the areolae, with hyaline or reddish sheaths. Internal medullary tissue sordid yellowish-gray-nubilated (becoming clear in KHO), of indistinct, gelatinized, compacted, $\pm$ vertically parallel, thin-walled hyphae $2\text{--}3\ \mu$ thick. Sides of columnar areolae formed by the exposed medulla, in places covered by a hyaline, amorphous, necrotic layer up to $12\ \mu$ thick.

Apothecia lecideine (biatorine), without symbiotic algae. Excipulum $45\text{--}75\ \mu$ thick, in outermost $6\text{--}12\ \mu$ brown-blackish or partly sordid aeruginose, internally gradually pale reddish-brown or $\pm$ colorless; composed of parallel-radiating, indistinct, thick-walled, gelatinized hyphae $3\text{--}4\ \mu$ thick; in its upper part with gradual transition into the hymenium. Hypothecium $\pm$ colorless and hyaline, obconical, up to $200\ \mu$ deep, composed of gelatinized, thick-walled, colorless hyphae $3\text{--}5\ \mu$ thick compactly intricated in various directions; at its sides merging gradually into the excipulum. Hymenium about $50\ \mu$ high, unevenly sordid aeruginose-blackish in upper $6\text{--}11\ \mu$, otherwise colorless or

very faintly brownish. Dark epithecium and parts of outer exciple HNO_3 + dark crimson-red (not HNO_3 -, as stated by Nylander). Paraphyses $\pm$ discrete in water, about $1\ \mu$ thick, simple or branched, not anastomosing, not or only slightly thickened at the tips, where they bud off round moniliform cells. Asci clavate, $32\text{--}48 \times 9\text{--}11\ \mu$, with gelatinous wall $1\text{--}2\ \mu$ thick at sides, at apex often spuriously gelatinously thickened up to $8\ \mu$; persistently blue with Iodine (blue then vinose-fulvescent according to Nylander). Spores 6-8 in ascus, biseriate, colorless, ellipsoid-fusiform, with distinct thin transverse median septum, minute, $9\text{--}10 \times 3\text{--}4\ \mu$ (Nylander describes them as up to $16\ \mu$ long).

Some of the apothecia show signs of proliferation, the original excipulum persisting as a fold below the secondary upper one.

Sect. *Hypocaulon* M. Lamb (n. sect.)

Thallus frutescens, stipitibus e parte infima thalli evolutis et (summitatibus ipsis exceptis) algis destitutis, homoeomeris, ecorticatis, e hyphis compositis compactis et irregulariter contextis. Pars gonidiifera thalli apicibus stipitum enata, e verruculis vel granulis sorediiformibus formata. Apothecia terminalia aut subterminalia, biatorina aut lecideina, margine thallino destituta; sporae solitae generis. Typus sectionis: *C. corymbosa* (Hue) M. Lamb.

Catillaria corymbosa (Hue) M. Lamb (n. comb.). Syn. *Alectoria corymbosa* Hue in Expéd. Antarct. Franç. 1903-5, Lichens (1908) p. 12.

MATERIAL EXAMINED: the type-specimen from Antarctica, Palmer Peninsula, Booth (Wandel) Island, in herb. Hue, Paris (ster.); South Orkneys, Laurie Island, Whitton Bay, coll. "Discovery" Exped. 1931-33, no. 1095a (fert.); Palmer Archipelago, Port Lockroy, Goudier Islet, coll. 1944, *I. M. Lamb*, 2124 (ster.).

Thallus directly adnate to the rock, caespitose, forming small pulvinate or irregular clumps 0.7-1.8 cm. diam., composed of crowded, intricate, flattened or irregularly angular, often longitudinally striate and cariose, irregularly branching stipes 4-10 mm. high, 0.2-0.8 mm. thick, often splitting into several strands, dull sordid yellowish, matt*, firmly attached to the rock by a thin effuse holdfast of concolorous, felted or in places almost root-like, fungal tissue (hypothallus). At their summits, and on their sides near the summits, the stipes are covered with masses of sorediiform granules up to 0.1 mm. diam., concolorous with or slightly paler than the stipes, and aggregated in cauliflower-like formation. No distinct reactions with KHO , CaCl_2O_2 , or PD. Apothecia rare, terminal or perhaps partly lateral (attachment not well seen in the formalinized and $\pm$ crushed material), on the upper parts of the stipes among the assimilative granules; scattered, 0.7-1.5 mm. diam., pale dull reddish or reddish-brown and semipellucid (probably dull yellowish and matt in natural unformalinized material), naked, at first flat and scutelliform with

* In formalinized material, such as the type specimen, the thallus appears pellucid and reddish.

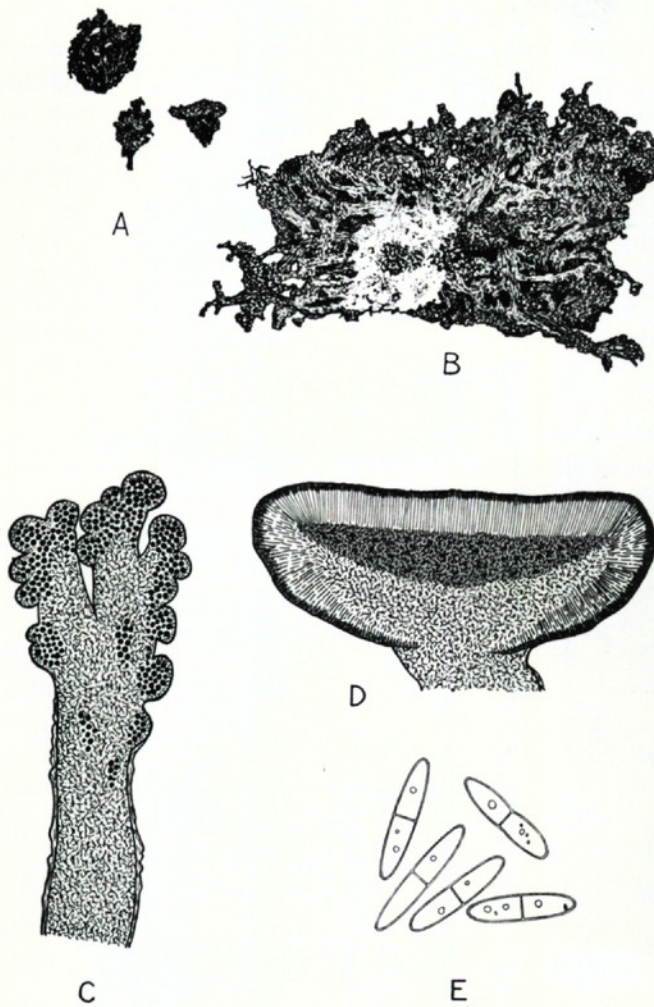


FIG. 3. *Catillaria (Hypocaulon) corymbosa* (Hue) M. Lamb. A, part of the sterile type-material in herb. Hue, Paris ($\times 1$). B, fertile specimen from South Orkneys, showing attachment to rock ($\times 2$). C, longitudinal section of a thallus-branch. D, vertical section of apothecium. E, spores.

a slightly raised, moderate, entire, concolorous proper margin, then becoming plane-immarginate or finally slightly convex.

Stipes ecorticate, of homogeneous structure, formed of $\pm$ colorless, clear, branching hyphae $2-5\ \mu$ thick running in various directions and closely compacted; their walls thick, gelatinized and conglutinated, with tubular lumina $1-2\ \mu$ wide. Outer surface of stipes covered with a $\pm$ colorless, amorphous or indistinctly granulose, necrotic stratum $2-6\ \mu$ thick. No central axis is developed. No algae present in the stipes except near the apices, where a few scattered clumps may be imbedded. Assimilative granules borne on the irregularly and minutely multifid apices of the stipes, and on their sides near the summits; each consisting of a central mass of algae surrounded by a $\pm$ colorless hyphal envelope $3-6\ \mu$ thick of rather indistinct, irregularly angulose, $\pm$ isodiametric, thin-walled cells $2-5\ \mu$ diam. Algae cystococcoid, pale or bright green, globose, $10-20$ (-27) μ diam., with gelatinous walls up to $4\ \mu$ thick. Stipes and granules KHO — in section.

Proper margin (excipulum) well developed at sides, 60–80 μ thick, colorless or faint yellowish in section, slightly nubilated in outermost 12–15 μ ; inner part without algae, composed of flabellate-radiating, conglutinated hyphae 1.5–2.0 μ thick with walls about 1 μ thick. Underneath the apothecium the exciple gradually decreases in thickness and terminates, not being produced downwards into the stipe. Lower part of apothecium filled with a compact, colorless, hyaline, medullary tissue consisting of thick-walled, gelatinized and $\pm$ conglutinated hyphae 3–4 μ thick, intricately interwoven in various directions, only the fistulose lumina (1.5–2.0 μ diam.) distinctly visible. This medullary tissue continues downward into the stipe, and seems to be a “central cone” intruded from the thallus, as in *Stereocaulon*. Although the apothecia are clearly biatorine, occasionally one or two isolated clumps of symbiotic algae from the upper part of the stipe penetrate into this medullary tissue. Hypothecium 70–130 μ deep, not well delimited from the medullary tissue, sordid yellowish-nubilated and opaque except in very thin sections, also containing scattered or $\pm$ crowded, dull yellowish, granular inclusions; composed of closely compacted and interwoven hyphae 1.5–3.0 μ thick running in various directions, or in places $\pm$ cellular with cells 2–3 μ diam. Hymenium 55–65 μ high, not well delimited from the hypothecium, sordid yellow-brownish in uppermost 10–12 μ , otherwise $\pm$ colorless. Paraphyses discrete in water, about 1.5 μ thick, simple or branched, not anastomosing, at tips slightly capitate-thickened (up to 3 μ), but not noticeably pigmented. Asci clavate, 50–60 $\times$ 9–13 μ , with wall 1.0–1.3 μ thick at sides, at apex thickened up to 9 μ . Spores 6–8 in ascus, irregularly biserial, colorless, fusiform, rounded or obtusely pointed at ends, thinly 1-septate, often with small vacuoles or oil-droplets in the protoplasm, 12–15 (–17) $\times$ (4.0–) 4.5 μ . With Iodine, hymenium blue then dark wine-reddish; hypothecium blue then aeruginose. With KHO added to sections under microscope, excipulum gives distinct yellow mist.

No pycnidia were found in the material seen.

Hue described the sterile material under *Alectoria*, considering that it might be placed near *A. virens* Tayl., but adding “auquel cependant il ne ressemble nullement.” Even from his description it was obvious that the plant could be no *Alectoria*; Du Rietz (3, pp. 28–29) was not able to form any opinion as to its systematic position, and Köfaragó-Gyelnik (12, p. 252) hazarded the guess that it might be a *Ramalina*. The author succeeded in finding the type specimen of this species in Herb. Hue, Muséum d'Histoire Naturelle, Paris, in 1936. It is no. 272 pr. p. of Charcot's first expedition; Hue mentions also two further numbers from the same locality, 277 and 299, but these could not be found. It was hard to say to what genus the sterile material might be referred; it could be compared only to a fruticulose *Lepraria*. For some years the problem remained unsolved, but finally some material collected by one of the British “Discovery” expeditions in the South Orkney Islands supplied the

answer. It was identical with Hue's type material of "*Alectoria corymbosa*", but somewhat better developed, and bore several apothecia in several stages of development. These on sectioning were found to be biatorine, with colorless 1-septate spores. From consideration of all the characters now afforded, it became apparent that the lichen was best to be included in the genus *Catillaria*, as the type of a new section analogous to the sect. *Thamnolecania* of the genus *Lecania*, characterized by the frutescent habitus. The stipes are derived from the lower medulla or possibly the hypothallus, and are enteropodious pseudopodetia, devoid of symbiotic algae except at the tips, where they bear the mass of assimilative granules. *Catillaria* sect. *Hypocaulon* differs from *Sphaerophoropsis* Vain. in the enteropodious formation of the pseudopodetia; in the latter genus these are clearly holostelidious.

At a later date the author saw *Catillaria corymbosa* in the living state on an islet in the Palmer Archipelago off the Palmer Peninsula of Antarctica, and was able to study its development. The lichen commences as minute scattered groups of granules, similar to those on the apices of the tufts, but sessile on the rock. At a later stage the stipes are formed, and the mass of assimilative granules is carried up on them. Around fully developed clumps there are few or no granules left sessile on the rock. The color in the living state is dull sordid yellowish, sometimes with a faint pinkish tinge. The specimen seen was sterile, and occurred in small quantity near sea level, on a granodiorite stone protected by an overhanging rock, a somewhat bird-frequented and possibly nitrogenous position.

BACIDIA De Not. emend. Zahlbr.

Sect. *Eubacidia* Zahlbr.

Bacidia robinsonii (Vain.) M. Lamb (n. comb.). Syn. *Toninia Robinsonii* Vain. in Ann. Acad. Sci. Fennic., ser. A, XV, no. 6 (1921) p. 62.

MATERIAL EXAMINED: the type-specimen from Philippines, Luzon, Laguna, Mt. Banajao, coll. 1909, C. B. Robinson, 6545, no. 20356 in herb. Vainio, Turku (Åbo).

On bark. Thallus up to 0.8 (–1.0) mm. thick, pale sordid olivaceous buff-colored, matt, not pruinose, granulose to indistinctly subsquamulose with crowded granules or indistinct minute soft squamules not over 0.25 mm. diam.

which are $\pm$ conerescent and irregularly imbricated to form an uneven, spongy crust; not changing color when moistened. Periphery of thallus not seen. The thallus is not distinctly frutescent, but the squamulose granules are somewhat elevated on a $\pm$ undifferentiated, paler (whitish to pale sordid brownish), $\pm$ fibrous basal hypothalline layer or subiculum. Apothecia scattered, sessile on the crust, round, moderately to well constricted at base, 0.6–1.0 mm. diam., versicolorous, at first dark reddish, then becoming black, persistently plane or scutelliform with matt, naked disc and moderate to thickish, entire, slightly prominent, concolorous proper margin.

The thalline granules are not corticate, but are surrounded by a lax weft of colorless, partly intertexted, partly loosely protruding hyphae 2–4 μ thick, enclosing masses of pale green pleurococcoid algae 3–7 μ diam. in coherent clumps (Micareoid type, *Coccomyxa*?).

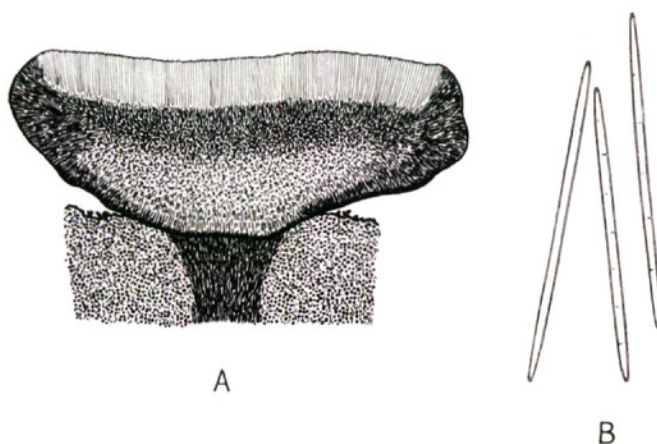


FIG. 4. *Bacidia* (*Eubacidia*) *robinsonii* (Vain.) M. Lamb. The type-specimen. A, vertical section of apothecium and subtending strand of carpogenic tissue in thallus. B, spores.

Apothecia completely biatorine, containing no algae. Excipulum entire, scutelliform, well developed all round the apothecium, 120–145 μ thick at sides and below, at the sides entirely pale to dark dull red in section, at the base pale to deep red (almost sanguineous) in the lower 50–70 μ , but $\pm$ colorless in the upper inner part; tissue $\pm$ clear, not nubilated. The excipulum is of radiate structure, with fused, gelatinous-chondroid, somewhat thick-walled hyphae 2.5–3.5 μ thick, the inner $\pm$ colorless part at the base becoming indistinctly pseudoplectenchymatous with $\pm$ isodiametric, thin-walled cells 2.5–3.5 μ diam. Hypothecium 100–135 μ deep, dark red or dull sanguineous, not nubilated, of closely compacted hyphae 2.5–4.0 μ thick, those of the lower two-thirds intricate and shortly cellular or indistinctly pseudoplectenchymatic, those of the upper subhymenial third $\pm$ vertical. Hymenium 100–135 μ high, entirely faintly yellowish, without any epithecium, composed of strictly parallel and very crowded paraphyses and narrow asci, the latter not distinctly visible in section. The hymenium is very gelatinous and its parts difficult to see, even after crushing in HNO_3 . The paraphyses appear to be simple, thickish (1.2–2.0 μ), septate, and the asci cylindrical, very narrow (about 7–8 μ broad), gelatinous, soon evacuating their spores and then collapsing. The spores are rather abundantly produced, but none were seen inside the ascus; acicular, straight, attenuate and $\pm$ pointed at both ends, indistinctly 5–7-septate, or often apparently euseptate, $45\text{--}50 \times 1.5\text{--}2.0 \mu$. The red

pigment of the apothecial tissues is HNO_3 —, but with KHO turns $\pm$ violet-purple. Iodine stains the hymenium streakily pale blue, the paraphyses not colored, the asci staining in their entirety. From the lower side of the basal excipulum is developed a dark red or reddish-brown, compact tissue of intricate or $\pm$ parallel pigmented hyphae which runs down in irregular strands into the subtending thallus to a depth of at least $270\ \mu$ (or $400\ \mu$, according to Vainio).

The apothecia are of a remarkably tenacious, cartilaginous-chondroid consistency.

In this species the apothecia are not visibly stipitate, but there can be seen the beginnings of a tendency in this direction with the outgrowth of downwardly running strands of pigmented tissue from the lower side of the apothecium; this tissue is obviously of carpogenic origin, although it is not part of the actual excipulum or hypothecium.

Vainio in his original description gives no details of the anatomical structure of the thallus, and placed the species in the genus *Toninia* apparently on account of the subsquamulose thallus. It is however not a *Toninia* but a *Bacidia* (sect. *Eubacidia*), for the subsquamulose granules of the thallus are quite ecorticate and of primitive, undifferentiated, almost soredioid structure. It seems to be related to *B. trichophora* (Müll. Arg.) Zahlbr. (from Peru) and *B. vestita* (Mont.) Zahlbr. (from Brazil).

Bacidia buchanani (Stirt.) Hellb. in Bih. Kgl. Svensk. Vet.-Akad. Handl. XXI, Afd. III, no. 13 (1896) p. 98. Syn. *Stereocaulon Buchanani* Stirt. in Trans. and Proc. N. Zeal. Inst. VII (1875) p. 367. *Lecidea subglobosa* Nyl., Lich. Nov. Zeland. (1888) p. 93. *Patellaria Wilsoni* Müll. Arg. in Flora, LXXI (1888) p. 541. *Gomphillus baeomyceoides* Wils. in Journ. Linn. Soc. Lond., Botan., XXVIII (1891) p. 370. Probably also *Bacidia pedicellata* Kn. in Trans. and Proc. N. Zeal. Inst. XII (1880) p. 372 (non vidi).

MATERIAL EXAMINED: the (lecto-) type-specimen of "*Stereocaulon Buchanani*" from New Zealand, near Wellington, coll. J. Buchanan, 1874 (?), in herb. Stirton, Glasgow; the type-specimen of "*Patellaria Wilsoni*" from Australia, Victoria, Black Spur, coll. F. R. M. Wilson, comm. Knight, 1888 (this is also the type-material of "*Gomphillus baeomyceoides*"). The following description is made from Stirton's type.

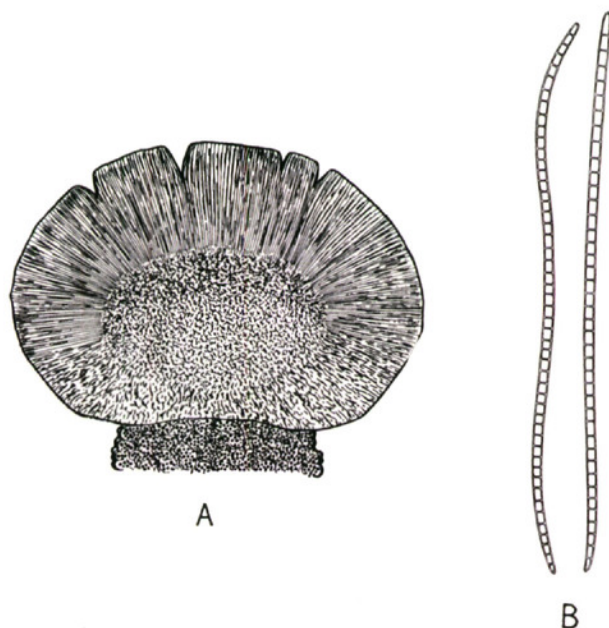


FIG. 5. *Bacidia (Eubacidia) buchanani* (Stirt.) Hellb. The lectotype-specimen. A, vertical section of apothecium and rudimentary thalline pedicel. B, spores. The clefts in the surface of the hymenium are art facts produced on sectioning.

Growing over a Jungermanniaceous hepatic on bark, and to a certain extent spreading over the bark itself. Thallus effuse, in scattered ill-defined patches, entirely furfuraceous-dissolute or $\pm$ powdery, now pale sordid ochroleucous in color ("cinerascens vel cinereo-virescens" in the fresh state, according to Stirton), matt, the hypothalline tissue (visible in a few places where the furfuraceous thallus has been worn away) whitish, of matted hyphae. Thallus KHO + dull brownish (probably a spurious coloration), CaCl_2O_2 -, PD-. Apothecia moderately abundant, irregularly scattered over the thallus, sessile to elevated-sessile (or according to Stirton occasionally borne on very short stipes coated with granules; no such distinct stipes are now to be seen in the material), 0.7–1.0 mm. diam., convex and immarginate from the first, pale to dark brown, matt, smooth, naked; very well constricted at the base; sometimes 2–3 approximated and $\pm$ conerescent.

Thallus ecorticate, of undifferentiated sorediose structure, composed of granules 40–75 μ diam. consisting of masses of symbiotic algae surrounded by a colorless weft of indistinct, colorless, clear, gelatinous hyphae. Algae of the Micareoid type (*Coccomyxa* ?), pale yellow-green, small, 3–5 (–6.5) μ diam., round, conglomerated in clusters embedded in hyaline mucilage.

Apothecia in section entirely sordid or brown-yellowish, with the hypothecium forming a darker brownish stratum. Excipulum reflexed to underside but distinctly developed, at least 170 μ thick (merging gradually into the hypothecium), pale brown-yellowish, clear, of generally radiate structure but with the hyphae not strictly parallel; hyphae thick-walled, mucilaginously concrete, 3.5–4.5 μ thick, with lumina 1.0–1.5 μ wide. The excipulum is entire below the apothecium, but somewhat indistinctly differentiated in the central part below, and on the upper side it grades into the hymenium. Hypothecium up to 350 μ deep in center, not well delimited from the excipulum; in upper third pale- to medium-brown, in lower two-thirds pale brown-yellowish; composed of indistinct and very compacted hyphae 1.5–2.0 μ thick

intricated in various directions. Hymenium very high (about $270\ \mu$), entirely yellow-brownish in section, in places gradually darker yellow-brownish in uppermost $17\text{--}27\ \mu$; in squashed-out preparations with only a faint brownish tinge, almost colorless. Paraphyses concrete in water, embedded in mucilage, very slender and filiform, $\pm$ sinuose, $1.0\text{--}1.2\ \mu$ thick, after treatment with KHO, HCl, and Iodine seen to be branched and sparingly anastomosing; not thickened or colored at the tips. Asci cylindrical, about $240\ \mu$ long, $9\text{--}12\ \mu$ broad, with wall about $1.5\ \mu$ thick at the sides and thickened up to $14\ \mu$ at the apex, containing $4\text{--}6$ (-8 ?) vermiform spores packed closely parallel, not spirally twisted. Spores outside ascus straight or $\pm$ sinuose, colorless, $170\text{--}205\ \mu$ long, $3.0\text{--}3.5\ \mu$ thick, rounded at upper end, gradually tapered at lower end, transversely $30\text{--}75$ -septate. Asci persistently blue with Iodine. Sections of apothecium KHO—.

There are in herb. Stirton three specimens of "*Stereocaulon buchanani*," none being designated as the type. They are all identical, and were collected near Wellington, New Zealand, by J. Buchanan in 1866, 1874 (?) and 1882 respectively. As lectotype has been chosen the one marked by Stirton "rec'd 18 Sept. 1874," this probably being the one on which he based his description. The type-specimen of "*Patellaria Wilsoni*" Müll. Arg. in Herb. Boissier, Geneva, collected in Australia by F. R. M. Wilson, was originally written up (by Wilson ?) as "*Gomphillus baeomyceoides* ?." It is scanty and rather poor material, spread over and spoiled by too much glue, but it appears to be identical with Stirton's type-material of *B. buchanani*. The apothecia are dark brown to black, not distinctly stipitate. "*Patellaria Wilsoni*" and "*Gomphillus baeomyceoides*" were described on the same material. Stirton's original description of 1875 is followed by a short note by Knight, in which it is stated that "*Stereocaulon buchanani*" is identical with *Lecidea subglobosa* Nyl. in litt. (subsequently published by Nylander in 1888), and that the algae of the thallus are "gonimia," i. e., Cyanophyceous; his figure (*loc. cit.*, Pl. XXV, figs. 2 and 3) represents them as nostocoid. Obviously he misinterpreted the very small Micareoid algae.

None of the specimens seen showed distinct stipes below the apothecia, but the latter are usually slightly elevated above the surface of the thallus; sections show that the rudimentary pedicel is part of the thallus, and is not a prolongation of the apothecial tissues.

In spite of the branched and somewhat connected paraphyses it seems that this species belongs to the Ascohymeniales, not

the Ascoloculares, and is best placed, following Hellbom (1896) in the genus *Bacidia*, in which the paraphyses may be to a certain extent branched and connected (see Santesson, 18, pp. 437, 455). In Ascohymeniales with very high hymenium and filiform paraphyses, a tendency for the latter to branch and anastomose is often seen, *e.g.* in *Stereocaulon piluliferum* Th. Fr.

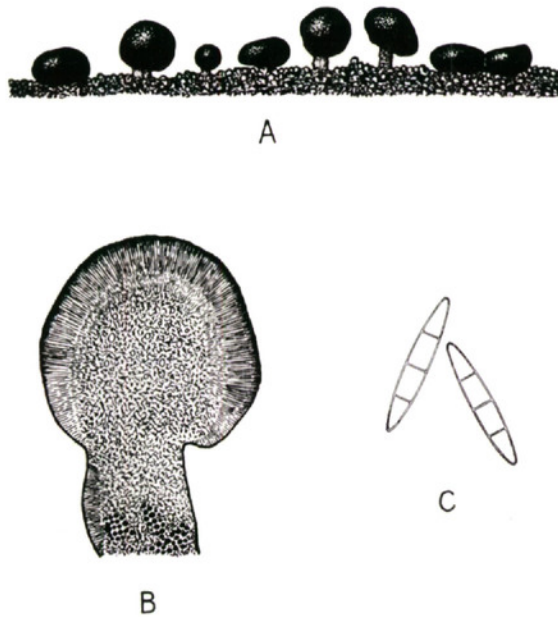


FIG. 6. *Bacidia* (*Weitenwebera*) *gomphillacea* (Nyl.) Zahlbr. The type-specimen. A, habitus of plant on rock ($\times 20$). B, vertical section of apothecium and stipe. C, spores.

Sect. *Weitenwebera* Zahlbr.

Bacidia gomphillacea (Nyl.) Zahlbr. Cat. Lich Univ. IV (1926) p. 114. Syn. *Stereocauliscum gomphillaceum* Nyl. in Flora, XLVIII (1865) p. 211. *Bilimbia gomphillacea* Vain., Lichenogr. Fennic. II (1922) p. 251.

MATERIAL EXAMINED: the type-specimen from Finland, Hollola, Tiirismaa, coll. Norrlin, 1863, no. 40216 in herb. Nylander, Helsinki.

On quartzitic rock. Thallus crustaceous, effuse, indeterminate, patchy and discontinuous, very thin, subfurfuraceous to minutely granular, now dull yellowish-cinereous ("glauescens" in fresh state, according to Nylander). Apothecia irregularly scattered, abundant, many of them shortly stipitate on $\pm$ cylindrical stipes $\pm$ concolorous with the thallus or darker (brownish); apothecia minute, up to 0.25 mm. diam., black, strongly convex and immarginate from the first, finally $\pm$ globose; matt, not pruinose, often several $\pm$ coalescent.

The apothecia themselves contain no algae. Excipulum reflexed, merging into the hymenium on its inner side, faintly sordid yellowish or almost colorless, composed of conglutinated, parallel-radiating hyphae with gelatinized walls, the indistinct tubular lumina about $1\ \mu$ diam. Hypothecium colorless or faintly sordid yellowish or in places with a faint aeruginose tinge, composed of compacted, indistinct, gelatinized hyphae running in various directions, in the upper part predominantly $\pm$ vertically parallel; only the tubular lumina, about $1\ \mu$ wide, distinctly visible. Interspersed among the hypothecial hyphae are a few larger, thin-walled, $\pm$ rounded cells $6\text{--}11\ \mu$ diam. (the remains of carpogonia?). Hymenium mostly entirely faintly aeruginose, darker greenish in uppermost $5\text{--}10\ \mu$ (KHO —), the pigmentation in many places forming a distinct epithecium; $50\text{--}60\ \mu$ high, not well delimited from the hypothecium below. Paraphyses embedded in mucilage, $\pm$ distinct, about $1.5\ \mu$ thick, occasionally branched but no anastomoses seen (according to Vainio, *loc. cit.*, they are branched and connected towards the base), not thickened or colored at the tips; the greenish epithecial pigment is in the mucilage surrounding the tips. Asci clavate, $36\text{--}40 \times 10\text{--}12\ \mu$, with wall up to $1.5\ \mu$ thick at sides, at apex thickened up to $12\ \mu$. Spores $4\text{--}6$ (-8 ?) and bi- to triseriate in ascus, fusiform, equally bluntly pointed at both ends, 3-septate, colorless, $22\text{--}28 \times 4\text{--}5\ \mu$.

The stipe is anatomically similar to the hypothecium, except that the occasional larger thin-walled cells (carpogonial remains?) are lacking. In its upper part it contains no algae, but in the lower half has numerous algal cells embedded in scattered irregular groups in its tissue. There is no indication of any central strand of parallel-running hyphae. In one part of the stipitate apothecium sectioned, the outer part of the upper stipe on one side shows an indistinct parallel arrangement of the hyphae at right angles to the axis, and looking like an old degenerated hymenium; it suggests that Vainio's view, that the stipes are composed of superimposed proliferating apothecia, may well be correct. In any case the pedicel is undoubtedly of apothecial origin, although at its base it contains symbiotic algae.

Th. Fries (6, p. 383) relates the species doubtfully to *Bilimbia milliaria*: "potius crederemus monstrosum." Hedlund (9, pp. 82, 94) places it in the genus *Micarea* on account of the characteristic small symbiotic algae, as *M. ligniaria* f. *gomphillacea* (Nyl.) Hedl. According to the present author's examination of the type-specimen, the paraphyses do not seem to be sufficiently branched and connected for paraphysoid interthecial filaments, and it seems doubtful whether the plant belongs to the ascolocular genus *Micarea*, despite the similar algae. The species has been recorded also from several localities in Sweden by Hellbom and by Magnusson.

Sect. *Thamnopsis* M. Lamb (n. sect.)

Thallus frutescens, congesto-caespitosus, stipitibus subteretibus, ramosis, ecorticatis, homoeomeris, hyphis irregulariter contextis compositis et e medulla (vel hypothallo) oriundis, apicem versus granulis gonidiferis crebre munitis. Apothecia apicalia, lecideina aut biatorina, sporis

ut in sect. *Weitenwebera* aut *Arthrosporum*. Typus sectionis: *B. stipata* M. Lamb.

***Bacidia stipata* M. Lamb (n. sp.)**

MATERIAL EXAMINED: the type-specimen from Antarctica, Palmer Peninsula, Hope Bay, summit of hillock above Boeckella Lake, altit. circ. 115 m.s.m., on stone, coll. 29. x. 1945, *I. M. Lamb*, 2550, in Herb. Brit. Mus. (Nat. Hist.), London; South Shetlands, Deception Island, Whalers' Bay, on agglomerate cliff face, coll. 1945, *I. M. Lamb*, 2311.

Thallus minute fruticulosus, congesto-caespitosus, pulvinulos compactos, confluentes, 8–20 mm. latos et ad 7 mm. altos formans, nigrescens aut partim pallescens (sordide isabellinus), opacus, stipitibus saxo arcte adhaerentibus, congestis et intricatis, subteretibus, 0.15–0.30 (–0.40) mm. crassis, conferte ramosis, apicem versus granulis gonidiiferis congestis, pallidis aut nigrescentibus, circ. 0.1 mm. latis superspersis. Apothecia sparsa, apicalia, pulvinulos haud vel vix superantia, lecideina, rotundata aut nonnihil lobata, 0.8–1.2 (–1.6) mm. lata, juventute interdum margine proprio indistincto pallescenti (fusco) praedita, mox immarginata, plana vel leviter convexa, omnino nigra, nuda, opaca. Excipulum prope hymenium fusconigrescens, caeterum hyalinum. Hypothecium isabellinum, 50–60 μ crassum, strato myelohyphico (cono centrali) hyalino impositum. Hymenium 60–70 μ altum, superne intense aeruginoso-nigrescens, caeterum hyalinum. Paraphyses discretae, simplices aut parce ramosae, apicibus aeruginoso-capitatae. Sporae 8nae, incolores, cylindricae aut subvermiformes, rectae aut curvatae aut leviter sigmoideae, apicibus vulgo rotundatis, septis transversis 4–7 (saepe indistinctis): 24–34 $\times$ 2.5–3.0 μ . Thallus KHO–, CaCl₂O₂–, PD–, extus intusque I–; hymenium I+ obscure aeruginosum; epithecium in HNO₃ solutionem violaceam effundens.

Description of the type-specimen (Lamb 2550):—On fine-grained metamorphic rock. Thallus fruticulose, congested-caespitose, forming pulvinate clumps 8–18 mm. diam., up to 7 mm. high, which finally become confluent to form irregularly spreading, pulvinate-crustose patches up to 7 cm. across. No hypothallus or primary thallus visible. Surface of clumps $\pm$ evenly crustose, compact, consisting of the very crowded terminal branchlets, variegated in color: in most places black or blackish, in some places pale, sordid isabelline; matt, not pruinose. Stipes firmly attached to the rock, but without root-like or expanded holdfasts; $\pm$ terete or slightly flattened, occasionally slightly longitudinally cariose, 0.15–0.30 (–0.40) mm. thick, mostly pale, copiously irregularly branched; in upper parts covered with minute, concolorous, scattered or crowded, ill-defined, simple granules about 0.1 mm. diam., not aggregated in cauliflower-like formation. In the dark parts of the thallus the uppermost branches and the granules on them are blackened. No soredia. Thallus KHO–, CaCl₂O₂–, PD–; tissue of stipes I–. Apothecia not common, irregularly disposed, apical on thicker stipes, not or hardly elevated above the surface of the cushions, lecideine, round or slightly irregularly lobed, when mature plane to slightly convex, 0.8–1.2 (–1.6) mm. diam., immarginate, entirely black, matt, not pruinose; in young stages a faintly indicated paler (brownish), thin, entire, non-prominent proper margin may be present. (No pycnidia found.)

Stipes consisting of a homogeneous fungal tissue of compacted, conglutinated, somewhat thick-walled hyphae $3-4\ \mu$ diam. interwoven in various directions, only their tubular lumina distinctly visible, $1.0-1.5\ \mu$ wide. Tissue colorless and hyaline in thin section, faintly yellowish in thick sections, not nubilated. No cortex developed, but in places on the outer side the hyphae are thicker-walled and with larger lumina, mainly longitudinally parallel: $3-4\ \mu$ thick, lumina $2.0-2.5\ \mu$ wide. An outermost colorless amorphous necrotic stratum $6-10\ \mu$ thick is present in some places. Irregularly scattered here and there in the stipe tissue, mainly in the upper parts, are sporadic small groups of symbiotic algae; cystococcoid, bright green, $\pm$ round, thin-walled, $8-13\ \mu$ diam. The ill-defined assimilative granules on the upper parts of the stipes consist of a core of algae invested by a $\pm$ hyaline hyphal envelope $6-10\ \mu$ thick consisting of indistinct, often tangentially compressed, rather thin-walled cells $3-4\ \mu$ diam.

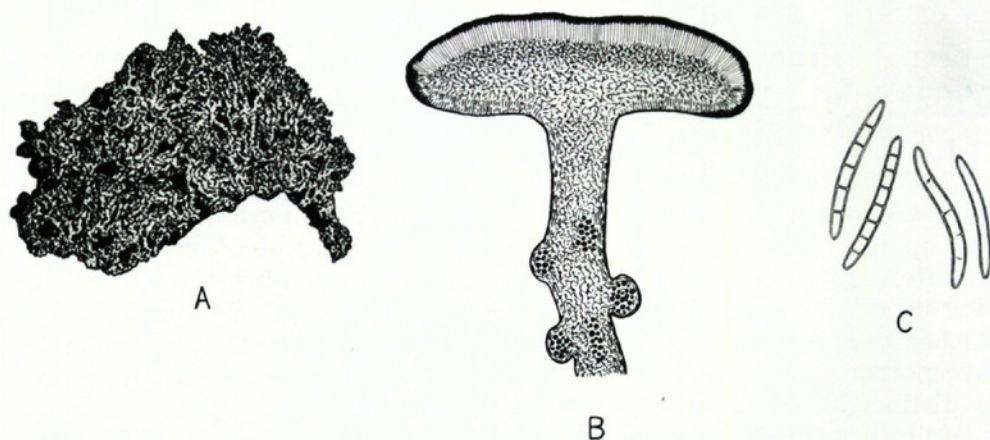


FIG. 7. *Bacidia (Thamnopsis) stipata* M. Lamb. The type-specimen. A, part of fertile thallus on rock ($\times 2$). B, vertical section of apothecium and pseudopodetium. C, spores.

The apothecia contain no algae. Excipulum well developed at sides and below, $60-70\ \mu$ thick, the upper part next to the hymenium brown-blackish in outermost $12-15\ \mu$, otherwise entirely colorless and hyaline; composed of flabellate-radiating, conglutinated, gelatinized, thick-walled hyphae of which only the tubular lumina, about $1.5\ \mu$ wide, are visible. Inner medullary tissue (central cone tissue) well developed and obviously a continuation of the stipe-tissue, up to $180\ \mu$ deep. Hypothecium $50-60\ \mu$ deep, isabelline in section, $\pm$ cloudy but without visible granules, composed of compactly intertexted hyphae $2.5-3.5\ \mu$ thick running in various directions, in places $\pm$ cellular. Hymenium $60-70\ \mu$ high, intensely blue-green-blackish in upper $15-32\ \mu$, otherwise colorless and hyaline. Paraphyses discrete in water, simple or sparingly branched, not anastomosing, about $2\ \mu$ thick, at tips clavate-capitate to 3.5 (-4.0) μ and there $\pm$ dark aeruginose. Asci clavate, $40-50 \times 9-12\ \mu$, with wall about $1.5\ \mu$ thick at sides, at apex thickened to 8 or $9\ \mu$. Spores 8 in ascus, lying straight or sometimes slightly spirally twisted; cylindric-vermiform, straight or curved or slightly sigmoid, $\pm$ equally rounded or bluntly pointed at both ends, transversely $4-7$ -septate (the septa often indistinct or apparently lacking), $24-34 \times 2.5-3.0\ \mu$. Hymenium blue then blue-blackish with Iodine; upper part of hypothecium $I +$ blue. With HNO_3 , the epithelial pigment is dissolved to form a violet-blue solution.

The material from the South Shetlands is very similar to the type-specimen described above: only the hymenium is somewhat lower (50–55 μ). All the specimens seen in the field grew usually in crevices or cracks of the rock, forming in the living state masses of small dark greenish cushions covering a fairly extensive area.

Bacidia fibrosa M. Lamb (n. nom.) Syn. *Stereocaulon laseroni* Dodge in B. A. N. Z. Antarct. Research Exped. 1929–1931, Reports, ser. B, VII (1948) p. 141; non *Bacidia laseroni* Dodge, op. cit., p. 108.

MATERIAL EXAMINED: the type-specimen from Antarctica, George V (Adélie) Land, Madigan Nunatak, 143° 20' E. long., 67° 07' S. lat., 1912, coll. C. F. Laseron, 25–3, in Herb. Missouri Bot. Gard.

Growing on or among particles of granitic rock. Forming tiny compact tufts up to 6 mm. diam., 1–4 mm. thick, consisting of a minutely fibrose-dissolute, spongy-felted, sordid cream-colored or whitish-ochraceous mass rising up off the substratum, to which it was originally apparently $\pm$ firmly attached. The mass is of purely hyphal composition, at any rate in the lower parts, which contain no algae, and seem to be of hypothalline origin. No distinct stipes are developed, and under low power magnification the felted fibrillose mass looks somewhat like frayed sisal fibers (but more spongy-anastomosing). Towards their apices the minute clumps are thickly covered with very small, somewhat irregular granules, which are concolorous with the fibrose basal mass or in places darkening to blackish, less than 0.1 mm. diam., crowded together and forming a $\pm$ compact surface. No cephalodia. Apothecia scarce, superficial on the clumps among the assimilative granules, minute, up to 0.5 mm. diam., pulvinate-convex and immarginate from the first, blackish, matt or subnitid, not pruinose. On account of its scantiness, the thallus was tested only with PD; the result was negative.

The fibrose strands are of undifferentiated structure, consisting of colorless, thin-walled hyphae 1.3–3.0 μ thick loosely or in places $\pm$ compactly interwoven in various directions to form a spongy-arachnoid tissue. Near the surface of the tufts the fibrose strands contain embedded, $\pm$ rounded clumps of symbiotic algae, either buried in the tissue or emergent on the surface. Algae very pale green, cystococcoid, globose, 5.0–8.5 μ diam., thin-walled. No cortex developed in any place.

Apothecia in section lecideine, without algae. Excipulum reflexed, consisting of radiating, parallel-conglutinated, gelatinized, thick-walled hyphae 4–7 μ thick with indistinct outlines, but with the fistulose lumina (1.0–1.5 μ wide) $\pm$ distinct; between the hyphae black or purple-blackish pigment in irregular streaks, becoming dense on the outer side of the excipulum. Hypothecium 65–85 μ deep, colorless (or faintly yellowish in thick sections), clear, composed of compacted hyphae divided into short ellipsoid cells 3–4 μ diam., their walls 1.0–1.2 μ thick, gelatinously confluent, the cells becoming more compressed and elongated towards the sides where they merge into the excipulum.

Upper subhymenial 10–24 μ of hypothecium in places very faintly brownish (at least in thicker sections). No distinct myelohyphic stratum or central cone developed. Hymenium 55–60 μ high, in its uppermost 10–14 μ densely black or aeruginose-blackish (not dark brown as stated by Dodge), the pigment also penetrating in irregular streaks downwards into the rest of the hymenium. Paraphyses discrete in water, simple or often branched, rather stout (2–3 μ), septate and often slightly articulated, at the tips clavate-capitate, often in $\pm$ moniliform fashion, up to 3–4 (–5) μ , and there dark aeruginose (KHO—). Asci 35–45 μ long, 7–12 μ broad, clavate, with somewhat gelatinous wall 1–2 μ thick at sides and at the apex spuriously thickened up to 5 μ . Spores 6–8 in ascus, packed vertically at different levels; colorless, straight, cylindric-fusiform; seen only immature inside the ascus, transversely 3–5-septate, 17–25 $\times$ 2.5–3.0 μ (according to Dodge, about 7-septate, 16–18 $\times$ 2 μ).

It is not impossible that this species may represent an extremely weathered and depauperated condition of the foregoing, but this could be satisfactorily demonstrated only by further study in its natural habitat. It seems to differ from *B. stipata* in the absence of distinct separate stipes, these being replaced by spongy-fibrose strands; also in the smaller apothecia without distinctly differentiated central cone tissue, and possibly in the shorter spores.

The *Bacidia laseroni* described by Dodge, *op. cit.*, p. 108 is epiphytic or parasitic on the weathered thallus of this species, and appears to be distinct, as it is described as having its own glebose, dark green to blackish thallus.

[To be continued]

BETULA LENTA VAR. UBER ASHE

ALBERT G. JOHNSON

THE exact status of a peculiar small birch collected by the late W. W. Ashe in Wythe County, Virginia, in 1914 has been something of a botanical enigma. A low tree, originally designated as *Betula lenta* var. *uber* Ashe (1918), it was raised to specific rank by Fernald (1945).

Ashe in describing his find said little about the plant beyond the fact that it looked like a small-leaved form of *B. lenta* L. and that it was found on the "bank of Dickey Creek, south of Rye Valley Station, Wythe County, Virginia, January (*sic*) 1914, 2800'." The specimen being in leaf and young fruit indicates that the date should have read June rather than Janu-



Mackenzie, Elke. 1954. "STUDIES IN FRUTESCENT LECIDEACEAE (LICHENIZED DISCOMYCETES)." *Rhodora* 56, 105–129.

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