# NOTES ON CHILEAN FUNGI. I

CONTRIBUTIONS FROM THE CRYPTOGAMIC LABORATORY OF HARVARD UNIVERSITY, LXVI

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(WITH PLATES XVIII AND XIX AND ONE FIGURE)

During the months of February and March 1906, it was my good fortune to pass six weeks of the antarctic summer and early autumn in the town of Punta Arenas, on the Straits of Magellan. These months being in many respects the most favorable for botanizing in this cold and wind-swept region, I had an excellent opportunity to become acquainted with its fungus flora, which was much richer and more varied than might have been expected, in view of the comparatively scanty phanerogamic flora and the general severity of the climate. Although for about a week in late February the mercury rose above 60° F. every day, and once even reached 70°, the mean diurnal temperature during the remainder of my stay was below 60°. Freezing temperatures were not uncommon, and it was not unusual in the morning to see the green beech forest on the hills to the west of the town loaded with snow. The small pools, in the localities where I collected, were often frozen over as late as the middle of the forenoon, while icicles might be seen hanging from flowers and grass growing on the dripping south slopes of the ravine which led to my usual collecting ground.

The town of Punta Arenas is not favorably situated as a base from which to make botanical excursions, since the whole shore of the Strait, as far as one can see to the south and for many miles to the north, has been devastated by fire; and the general aspect presented to the newcomer, as his steamer drops anchor in the open roadstead opposite the town, is to the last degree unattractive and forbidding. Formerly a superb forest of the antarctic beech (*Nothofagus*) covered the whole region, extending from the water's edge over a somewhat undulating plain, which gradually rises to the base of a range of hills or low mountains, the highest not

2000 feet above the sea, which form a wooded background for what is now a ghastly waste of dead trees still standing or fallen in confused heaps; and forming in many places, as one approaches the limits of the living forest, an almost impenetrable barrier.

Nearer the shore the dead trees have been largely cleared away, and the forest has given place to a firm turf which has taken possession in the vicinity of the town, and is grazed by divers domestic quadrupeds, so that there is no chance for reforestation. Over this area are scattered stunted specimens of the so-called varieties *bicrenata* and *uliginosa* of *Nothofagus antarctica*, some larger trees of the latter persisting in thin groves near the shore; while everywhere are clumps of "califate" bushes (*Berberis buxifolia*), associated with a flora of low annuals and perennials, which, though not very varied as to species and genera, is yet of the greatest interest to one unacquainted with its features.

The fungi occurring in connection with this coastal region are, like the flowering plants, for the most part different from those of the beech forest, and are more numerous than might have been expected, including a variety of striking forms. Among these the hexenbesen of the superb *Aecidium magellanicum*, to which it is my purpose to refer in a future note, are everywhere conspicuous on the califate, which harbors also several other rusts. Familiar forms are not altogether wanting, and *Psalliota campestris* grows in profusion over the turfy area, as well as a large puff ball which I took to be *Lycoperdon coelatum*. *Coprinus comatus* and *C. atramentarius*, entirely typical in appearance, were also occasionally seen about the town, and all of these formed a most welcome addition to the canned diet which prevails in these latitudes.

In order to reach the living forest where most of my collecting was done, it was necessary to traverse the coastal region above described: and this is most readily accomplished by following a narrow-gauge railroad which skirts the bed of the Rio de las Minas, traversing a portion of the deep gorge cut through the hills by this small stream, which, flowing from the west, empties into the Strait, after passing through the northern portion of the town. Even this broad ravine, which one enters somewhat abruptly after a tiresome walk of several miles against the biting wind which blows

almost without cessation from the west, has not been spared by fire, and its steep banks were capped by a skeleton forest; on the north more recently burned than elsewhere and carpeted for miles with fruiting *Marchantia*. It is thus not till one has passed the small coal mine from which the stream takes its name, and which forms the objective point of the railroad, that, after a walk of six or seven miles from the town, he finds himself in the living forest. Even here destruction of another kind was steadily progressing during my visit, and the lumberman's axe was rendering worse confounded the confusion already existing in the tangle of fallen trunks which seems to be characteristic of these woods.

When one considers that the trees composing this forest in the immediate vicinity of my collecting ground belong to only two species of a single genus, the variety of fungi which inhabit it is unexpectedly great. That a heavy forest of often very large trees should develop under such climatic conditions as have been described, is surprising; but that beneath its shade a considerable flora of the more fragile and perishable forms of fungi should develop, is even more difficult to understand. Yet here are found Amanitas, and other softer agarics, among which a very fine and large *Coprinus* is conspicuous, growing in masses from beneath fallen logs; Hymenogastreae are common and other soft hypogaeous forms, as well as Pezizae, Myxomycetes, etc., all flourishing and maturing in this valley; where, though the surrounding hills afford some shelter, the mercury can seldom rise much above 60° F., while freezing temperatures are common at night even in mid-summer, with frequent cold squalls of rain, hail, or snow. Although I made no special effort to collect them, I gathered about forty species of Myxomycetes, and I have never seen Hymenogastreae more abundant, in numbers of individuals at least. The more resistant forms of fungi were duly represented, especially the Pyrenomycetes; although the Polyporei, as elsewhere in the Chilean forests, were scanty, and here in bad condition. Of all these fungi, however, the most peculiar was the discomycetous *Cyttaria*, and the nearly spherical distortions of the esculent *C. Darwinii*, often reaching a diameter of several feet, were everywhere conspicuous on the trunks and branches, although I was too late to see in the

best condition the curious fructifications which sometimes hung by dozens from their under sides.

It had just rained heavily as I stepped into these dripping woods, and I shall not soon forget the first day that I passed in them amid almost a surfeit of new botanical sensations. Not only were the fungi for the most part entirely new to me, but the trees were covered with unfamiliar lichens. One small filmy fern was common; but, in marked contrast to the forests farther north, hepatics were not abundant or conspicuous, with a very few exceptions like *Lepidolaena magellanica*, which covered fallen logs in many places. Mosses were abundant, especially along the ravine, and in the woods about the mine I found the lovely *Dissodon mirabile* Cardot, growing in tufts on cow dung, often in company with *Tayloria Dubyi* Broth., and conspicuous from its large pearly-white hypophyses.

Apart from the rather meager gatherings brought back by the various expeditions which have visited the Magellan region, our knowledge of its fungi is largely due to the fruitful investigations of Professor CARLOS SPEGAZZINI, an active collector and keen observer, whose published papers on the fungus flora of Tierra del Fuego and southern Patagonia bear witness to the varied character of this flora even in a portion of the forest much farther south; and this, too, notwithstanding the fact that a large portion of his collections were lost by shipwreck. During my stay on the Straits, although my collecting grounds were very limited and the forest so difficult of access, I was able to recognize a considerable number of the forms described by SPEGAZZINI, as well as certain others not included in his enumeration, or referred to, as far as I have been able to ascertain, in the works of other students of antarctic fungi; and it is the object of the present note to give some account of several of the latter, which were among the first that I met with in these fascinating woods.

On returning along the Rio de las Minas from my first excursion to the beech forest, I noticed on many of the smaller trees of *Nothofagus bicrenata* which covered the lower slopes of the ravine, especially on those which, from constant cropping by cattle, had assumed a bushy habit, but occasionally, also, on the lower

branches of larger trees, certain leaves, sometimes one or two together, but more often all the leaves of a twig or small branch, which were peculiar in appearance. These leaves were conspicuous from their paler yellowish-green color, which contrasted with the deep green of the healthy leaves, and were thicker and often distinctly larger than those of the normal foliage, as indicated in the accompanying text figure, photographed from dried material. Although every leaf of such twigs or branches was invariably affected, the latter showed little if any modification or distortion, and little if any tendency was observable to the formation of a witches broom, through the growth of adventitious shoots. The under side of these leaves were livid white in color, owing evidently to a continuous covering of asci, and I was greatly pleased to know that I had added a *Taphrina* to my overflowing basket of treasures.

On examining sections of this material, the asci proved to be rather stout, distally truncate or rounded, seated on a broader basal cell between the ruptured cutis and the epidermis, the outline of which was unbroken by any rhizoidal intrusion of the fungus between its cells. The asci were so densely filled with a very uniform coarsely granular fatty protoplasm, that no structures resembling spores were at first observed, and the material was laid aside on the assumption that it was immature. On reexamining it, however, and breaking the asci by crushing them, the coarse protoplasm was forced out, and I was astonished to see mingled with it great numbers of peculiar appendiculate bodies (fig. 6), so unlike any described ascospores of this group that it was not till I had actually seen them emerge from within the ascus when under pressure, that I was convinced of their true nature. After remaining in glycerin for some days, the granular contents of the ascus become modified, so that the spores, in different stages of development, are clearly visible (figs. 3, 4), and the origin of this singular habit in the mature spore is readily made out by a comparison of these stages (figs. 5, 6). The primary spores are always eight in number, relatively small in proportion to the size of the ascus (fig. 3), regularly oval in outline, and very uniform in size. As their development progresses, a bud appears at either extremity, which enlarges to form a stout, nearly cylindrical or somewhat

clavate, terminal appendage very constant in its form and dimensions, the axis of which coincides with that of the primary spore, and usually exceeds it in length. While these terminal appendages are developing, subterminal buds begin to appear about the base of each, normally four in number, less often two or three, which form a whorl of threadlike, divergent, slightly tapering appendages, rigid, straight or usually somewhat curved, and two to three times as long as the terminal ones. The origin of these subterminal

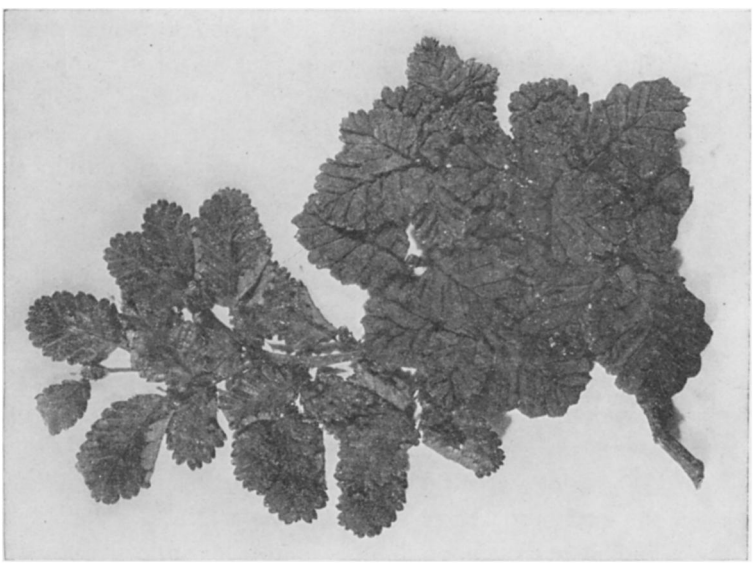

FIG. 1.—Branchlet of *Nothofagus antarctica* var. *bicrenata*, showing natural foliage at the left; the leaves at the right all attacked by the *Taphrina* and distinctly hypertrophied; slightly reduced from dried material.

appendages is often distinguished at maturity by a slight swelling, more or less clearly visible between the body of the primary spore and the base of the terminal appendage. As a result of the formation of these appendages, the primary spore is left nearly empty and is usually seen to be traversed by a single strand of protoplasm, while the terminal appendages, as they mature, become filled with dense refractive contents. These terminal appendages, moreover, evidently become the functional spores, since they readily separate from the empty primary spore, carrying with them the whorl of

threadlike subterminal appendages, which may perhaps be assumed to aid in their dissemination and lodgment after discharge. In crushed specimens these appendiculate terminal buds predominate, entire spores being comparatively infrequent.

That these extraordinary spores owe their peculiar structure at maturity to a specialization of the phenomenon which occurs in so many species of *Taphrina*, and which, through the budding of the primary spore, fills the ascus with yeastlike elements, seems highly probable; yet it is very remarkable that a phenomenon which, in other instances, is wholly indeterminate in character, the yeastlike elements being produced without regularity as to number, association, or differentiation as to function, should, in the present instance, be replaced by such a definite association of buds, which not only differ from one another in form and function, but are constant in number as far as the terminal buds are concerned, and at least subconstant as regards the subterminal ones. No further development nor any indication of germination in the primary buds was seen in any of the material examined.

The relation of the parasite to its host is a matter concerning which I have been unable to satisfy myself. In none of the sections examined, which were made from dried material, have I been able to detect any signs of fungus filaments penetrating the leaf or stem tissues, or extending themselves in any position except between the cutis and the epidermis. Nevertheless, the fact that all the adjacent leaves in branchlets of considerable size are completely involved, would point to the perennial nature of the disease, which may be presumed to extend from a hibernated mycelium in the young shoots to the unfolding leaves.

This species was subsequently found in abundance, not only along the ravine above mentioned, but on the larger trees of the forest, especially on the lower branches of such as grew along the margins of the open swampy glades characteristic of the region where I collected. It was also found less abundantly in the coastal region, not only on *Nothofagus antarctica* var. *bicrenata*, but also on the so-called var. *uliginosa*, a tree quite different in habit, leaves, and fruit, and growing in scattered colonies, especially to the south of the town of Punta Arenas. I may mention, in regard to these

hosts, that Professor SARGENT informs me that the determinations above given are confirmed by HEMSLEY, who suggests that the var. *uliginosa* should be considered a distinct species.

I saw no other species of *Taphrina* during my stay at Punta Arenas, nor did I find indigenous species elsewhere in Chile. About Santiago and in the central valley, where the Lombardy poplar is extensively planted, attaining a great size and forming one of the most conspicuous features of the landscape, the brilliant *T. aurea* was common, attacking the leaves of this host. *T. Ulmi* was also abundant on an introduced species of *Ulmus* planted about the Baños de Apoquindo, near Santiago; and throughout this whole region of the central valley the familiar *T. deformans* is destructive to the peach.

The *Taphrina* on *Nothofagus*, to which I have given a name suggested by the peculiarities of its spores, may be characterized as follows:

**Taphrina entomospora,** nov. sp.—Stratum ascorum livide-albidum, totam paginem inferiorem folii occupans, mycelio inter cuticulam et epidermidem nascente ortum: ascis dense confertis, subcylindricis, apice rotundatis vel subtruncatis, cellula basali latiore instructis; supra epidermidem positis: sporidiis entomomorphis, octonis, plasmate dense granuloso obscuratis; primum simplicibus, ovalibus; deinde appendiculatis, appendicibus biformibus; alteris utrinque terminalibus, rectis, cylindraceis vel subclavatis; alteris subterminalibus, saepissime quaternis, rigidis, tenuibus, divergentibus, subcurvatis, subattenuatis, utrinque cyclo oriundis: ascis $55-60\times13-15\ \mu$. Sporidiis $9-10\times3-4\ \mu$. Appendicibus terminalibus $8-12\times3.5\ \mu$, subterminalibus $15-25\times0.8\ \mu$.

In foliis vivis lutescentibus *Nothofagi antarcticae* var. *bicrenatae* et var. *uliginosae*. Punta Arenas, Magellanes, Chile.

My first day's foray yielded another remarkable fungus, associated with the *Taphrina* just described. While gathering material of the latter, I noticed that in some instances the leaves were covered by a glistening powder, and further examination showed that when the *Taphrina* occurred on twigs growing protected among the dense branches of small bushy trees, the powder was associated with reddish-brown perithecia evidently belonging to one of the Ery-

sipheae. This secondary parasite proved also not uncommon when sought for; but seldom fruited unless somewhat protected as above described. In one instance it was found spreading copiously from a twig affected by the *Taphrina* to the healthy foliage of the host; but in all other cases observed it was practically confined to leaves already affected by the other parasite. The perithecia being small and inconspicuous when scattered on the healthy leaves, it is not impossible that I may have overlooked it, and that it may naturally grow apart from the *Taphrina*. The reaction between the two, however, was very evident, the growth upon leaves invaded by the *Taphrina* being very much more luxuriant and the perithecia much more abundant. A similar phenomenon is seen in the case of the *Microsphaera* on *Berberis* referred to below, and may be comparable in a way to that seen in the Erysipheae inhabiting the hexenbesen of *Phytoptus* on *Celtis*, or the erinoses of *Fagus* and *Cephalanthus*. When examined microscopically, this fungus proved to be an *Uncinula* almost as peculiar as the *Taphrina* with which it was associated, owing to the very unusual modification of its appendages, which become distally twisted in a close spiral of striking appearance. The perithecia (fig. 7), which are usually epiphyllous, although sometimes amphigenous, are often densely crowded, of a reddish-brown color, globose-depressed, coarsely areolate. They show considerable variation in size (70–100 $\mu$), and in the number of asci (5–8) contained in each. The appendages (figs. 7, 8) are 4–8 in number, without septa, the basal portion thick-walled and suffused with reddish brown, the suffusion involving also one or sometimes more than one turn of the spiral portion, which is otherwise quite hyaline and may show as many as eight turns, sometimes but half this number, ending in a helicoid extremity (figs. 8, 9), of characteristic contour, thin-walled, and somewhat inflated. The appendages are quite rigid, and curve somewhat upward from their insertion on the equatorial region, whence it is evident that the twisting does not assist in freeing them from the substratum, but, if it has any significance, must be supposed to enable them to become more readily attached to objects with which they may come in contact. A somewhat similar phenomenon is seen in *Sphaerotheca spiralis* Neger, discovered by DUSEN on *Escal-*

*lonia rubra* near the Lago Argentina in Patagonia, and very kindly communicated to me by Dr. NEGER. The spiral twisting of the appendages in this form, although distinct, is, however, more or less indefinite and decidedly irregular. A somewhat similar tendency is also seen in other species of *Uncinula*, and a variety on poplar of the common *U. salicis* has been distinguished as *U. heliciformis* by E. C. HOWE, owing to a similar though slight tendency to the production of a terminal spiral in the appendages. It seems certain, however, that no species of *Uncinula* hitherto described could be interpreted with sufficient liberality to include this antarctic form which may be characterized as follows:

**Uncinula Nothofagi,** nov. sp.—Epiphyllus vel rarius amphigenus: peritheciis mycelio albido persistenti effuso insedentibus, dense congestis vel discretis, globoso-depressis, 80 $\mu$ diam. (70–100 $\mu$), rufo-brunneis, cellulis 10–20 $\mu$ diam.: appendicibus 5–15, aseptatis, 70–100 $\mu$ longis, inferne rectis vel curvatis, rigidis, induratis, brunneo-suffusis; superne spiraliter arcte 4–8 convolutis, apice helicoideo-subinflatis, spiris basalibus plus minus suffusis, ceteris hyalinis: ascis late ovalibus, 5–8 in quoque perithecio, suboctosporis; sporidiis oblongo-ellipsoidiis 18–20$\times$10 $\mu$: conidiis subcylindraceis, 25–32$\times$10–15 $\mu$.

In foliis *Nothofagi antarcticae* var. *bicrenatae*, *Taphrina* occupatis vel rarius eis in folia sana migrans. Punta Arenas, Magellanes, Chile.

Much to my surprise, the *Uncinula* above described proved to be not the only species having this peculiar habitat, and among the small shrubby trees of *N. bicrenata* which grow to the south of the town in the califate pastures, I several times encountered a very different species, always on leaves attacked by the *Taphrina*. This form was decidedly rare and only a small amount of material was obtained by diligent searching. The two species were easily distinguished with a hand lens, the large perithecia of the second form being sparingly produced, its long irregularly flexed appendages, which in many perithecia are undeveloped, lacking the spiral coils of its ally and ending in an open hook, or half-helix, more or less characteristic in contour, and recalling the tip of a golf stick or the curved handle of an umbrella (fig. 12). In general these appendages are decidedly more than twice as long as the

diameter of the perithecium (fig. 11), quite hyaline, their outline somewhat uneven with an occasional slight irregular swelling. The perithecia which almost always occur on the upper side of the leaf, as far as I have seen, are much larger than those of *U. Nothofagi*, and contain many more (10–20) asci, each with three or four spores instead of eight. Since it does not seem possible to refer this form to any of the described species of *Uncinula* it may be characterized as follows:

**Uncinula magellanica,** nov. sp.—Plerumque ephiphyllus. Peritheciis mycelio albido effuso exiguo insidentibus, discretis vel subgregariis, globoso-depressis, opacis vel subopacis, atro-brunneis, 130 $\mu$ (90–150 $\mu$) diam., cellulis 10–20 $\mu$ latis; appendicibus 10–22, hyalinis, longis, tenuibus, curvatis vel subflexuosis, subrigidis, 225–400×5–6 $\mu$, apice subinflatis et subrecurvatis: ascis late clavatis, 55×25 $\mu$, plerumque 3–4 sporis, sporidiis 20×10–12 $\mu$: conidiis subcylindraceis, 35–40×15–18 $\mu$.

In foliis *Nothofagi antarcticae* var. *bicrenatae*, *Taphrina* obsessis. Punta Arenas, Magellanes, Chile.

Three other species of Erysipheae were also found in the neighborhood of Punta Arenas. Of these a form, encountered but once on a species of *Galium*, appears to be *Erysiphe Chicoracearum;* while another not uncommon on several Compositae does not seem to differ from *Sphaerotheca fuliginea*. The third, however, is quite remarkable on account of its habitat; since, like the two species of *Uncinula* just described, it appears to be invariably associated with another fungus. Toward the end of February I noticed that the distortions on *Berberis buxifolia* caused by *Aecidium magellanicum* were assuming a whitish appearance from the invasion of an *Oidium* that covered the leaves and twigs which were attacked by the rust; and early in March it was almost impossible to find a specimen that was not more or less completely covered by it. I looked in vain for perithecia, however, and it was not until the very last days of my stay (March 10) that I was able to obtain a rather scanty supply of leaves bearing scattered perithecia, many of which were fully matured. The latter proved to belong to a species of *Microsphaera* which I am unable to distinguish from *M.*

*Alni*. Indeed it appears to be closer to the typical form of this species than most of the varieties of the latter. The habitat, however, is certainly remarkable; and although I made a special effort to find even the *Oidium* apart from the *Aecidium*, I never succeeded in doing so.

I find but one other species of this family recorded from Punta Arenas, in fact the only other species, I believe, which has been hitherto recorded from this locality. This was found by SPEGAZZINI on *Ribes magellanicum* and is mentioned in his *Fungi Patagonici* (p. 34). It was also found by him on the same host in Tierra del Fuego and described as *Phyllactinia antarctica* Speg., a name which is not recognized in SALMON'S *Monograph*, where it is placed as a synonym of *P. Corylea*. Although *Ribes magellanicum* was not uncommon along the ravine of the Rio de las Minas, I did not discover this *Phyllactinia*, not being aware at the time that it should be sought for on this host.

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## EXPLANATION OF PLATES XVIII AND XIX

The figures were drawn with camera lucida from preparations, in glycerin, of sections cut from dried material, and are reduced about one-fourth. The following combinations of objectives and oculars were used in making the drawings: figs. 1, 2, Zeiss D, oc. 4; figs. 3–6, Leitz water immers. 10, oc. 4; fig. 7, Leitz C, oc. 4; figs. 8–10 and 12, 13, Leitz water immers., oc. 1; fig. 11, Zeiss A, oc. 4.

### *PLATE XVIII*

### *Taphrina entomospora* Thaxter

FIG. 1.—Portion of the lower surface of a leaf showing the ascus primordia lying between the cutis and the epidermis; one at the right beginning to develop.

FIG. 2.—Portion of section showing asci.

FIG. 3.—A single ascus containing eight ascospores which have not yet begun to bud.

FIG. 4.—A more mature ascus in which the spores have developed their characteristic appendages.

FIG. 5.—Three ascospores in which the appendages are in process of formation.

FIG. 6.—Six mature or nearly mature spores with their appendages.

*PLATE XIX*

*Uncinula Nothofagi* Thaxter

FIG. 7.—Two perithecia showing variably developed appendages, the upper shown in surface view, the lower showing the appearance of the eight asci seen partly in optical section.

FIG. 8.—A single well developed appendage enlarged.

FIG. 9.—The tips of two appendages enlarged.

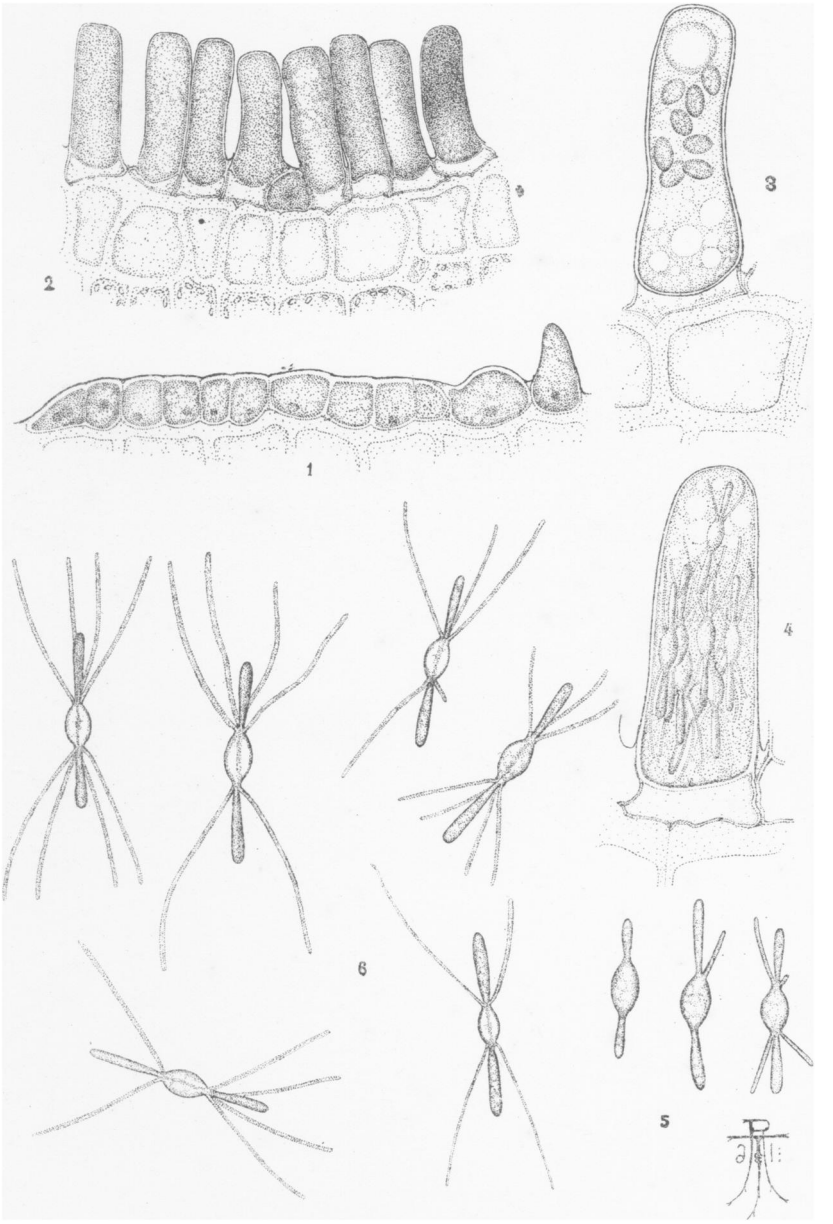
FIG. 10.—Two asci.

*Uncinula magellanica* Thaxter

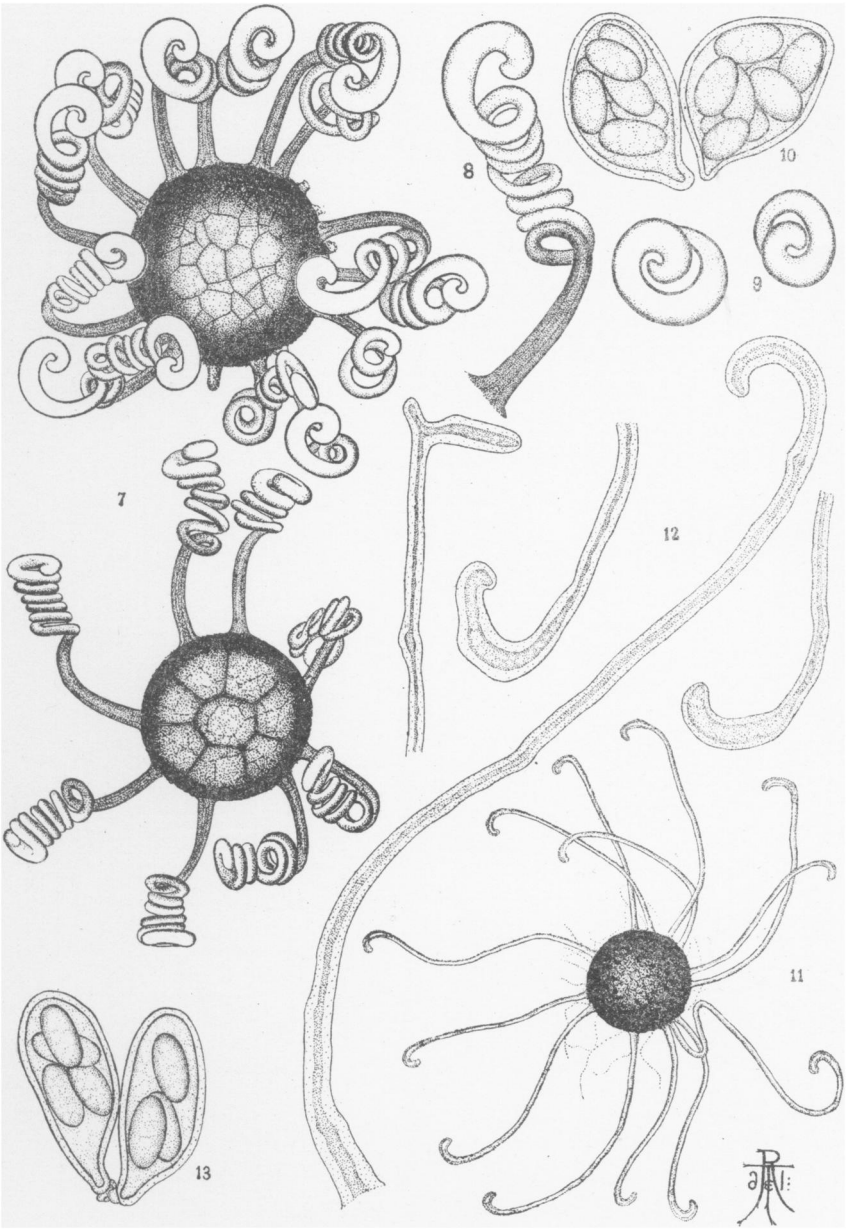
FIG. 11.—A single perithecium.

FIG. 12.—A single appendage and three tips of appendages enlarged, showing variations in the terminal hooks.

FIG. 13.—Two asci.




THAXTER on CHILEAN FUNGI




THAXTER on CHILEAN FUNGI