XXVI. *On the Fructification of certain Sphæriaceous Fungi.*

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The inquiries which have been carried on of late years with regard to the reproductive organs of Fungi, although they have caused but little progress towards the solution of the problem of sexuality, have nevertheless been by no means barren or unproductive. They have revealed the existence of a diversity in those organs, not only amongst genera and species, but in the same individual plant, to an extent which would excite surprise, if not incredulity, in the mind of an observer unacquainted with the subject or approaching it for the first time.

It has been proved, that in a vast number of cases the same Fungus, or to speak more correctly, the same mycelium or vegetative system, has the power of producing fruits differing so much in form and appearance, that it would never occur to a casual observer to suppose that they were the produce of the same plant. Many Fungi placed by former observers in different genera and even in different families, are now ascertained to be different forms of fruit of one and the same plant.

Without going into details, one striking instance may be mentioned. Dr. De Bary has shown that the common cheese-mould, *Aspergillus glaucus*, and *Eurotium herbariorum*, an ascigerous fungus too well known to botanists as the pest of herbaria, are two forms of fruit produced from the same mycelium, and numbers of other instances of a similar nature have also been published.

This polymorphism of fructification, which is of the greatest interest in a physiological point of view, is of hardly less importance when considered with reference to the effect which it must produce upon the systematic arrangement of Fungi. Its obvious effect (if it should be proved to exist as extensively as there seems reason to suspect) must be the striking out of a number of ill-founded genera, thus affording relief to the overloaded terminology of the science of Mycology.

In the present state of the question accumulation of observations is the great desideratum, the means by which it may hereafter be possible to arrive as it were by a process of induction, at more general conclusions than have hitherto been reached.

In the present paper my object is to lay before the Society the result of some observations upon certain Fungi of the division Sphæriacei, a division which seems likely to be productive of a greater number of instances of the diversity of fructification above alluded to than any other tribe. The observations in question have been conducted certainly with care, and I believe with accuracy, and I venture to hope that they may not be considered without importance in their bearing upon the general subject.

1. *Sphæria verrucæformis*, Ehr.—The first plant which I have to mention is *Sphæria verrucæformis*, one of the most common of the genus, at least in this country. It occurs at all seasons of the year, principally on fallen branches of Oak, but also on Spanish Chestnut, Beech, Alder, and other trees, in the form of prominent black warts protruding through, and surrounded by the laciniæ of, the ruptured epidermis. The ordinary fruit of this Sphæria consists of minute curved sporidia of a yellowish tinge. In most Sphæriæ the number of sporidia in each ascus is limited to eight, but *Sphæria verrucæformis* is one of the comparatively few species in which the number is quite unlimited; the sporidia indeed are so densely crowded that it is difficult to arrive at even an approximate calculation of the number contained in any one ascus. Plate XXIV. fig. 1 represents an ascus of the ordinary form filled with sporidia, and fig. 2 a few of the latter detached from the ascus, all magnified 315 diameters. The colour of the sporidia, when in a mass, is a dull yellow, but they are almost colourless when viewed singly. Their mean size is $\frac{1}{2800}$th of an inch, and there is usually a globular nucleus at each end. I am not aware that any second form of fruit has hitherto been observed in this Fungus, but in the course of last autumn (1856) I found some very young specimens of the Sphæria growing in close proximity to a species of *Cytispora*, and subsequent investigation convinced me that the latter was merely a cytisporous condition of the former. The appearance of the perithecia of the young Sphæriæ was different from that of their mature condition; they were of a light ochrey-yellow colour, instead of being black, or nearly so. The perithecia of the Cytispora were so exactly like those of the Sphæria, that without a microscopical examination of the contents, it was not possible to distinguish the one from the other. The association in growth, the exact similarity of the perithecia, and the fact, now well established, that other species of Sphæriæ possess a cytisporous as well as an ascigerous fructification, would seem almost sufficient grounds for assuming the identity of these two plants, but a further argument in favour of such identity was afforded by the occurrence of the perithecia of the Cytispora and of the Sphæria within the same circumscribing line. *Sphæria verrucæformis* belongs, as is well known, to the division Lignosæ, one of the characteristics of which is the existence of a black line surrounding the base of the stroma, in which the perithecia are imbedded. If a thin section of the substance of this black line be examined under the microscope when the Sphæria is ripe, it appears to be composed of dry carbonaceous matter in which it is hardly possible to trace any structure; but if examined at the period of growth of the above-mentioned specimens, it is seen to consist of strings of oval cells of a clear dark brown colour. Precisely similar cells are frequently to be seen near the base of the perithecia of other species of *Sphæria*, which doubtless belong to the mycelium, and I suspect therefore that the black line above alluded to, and which has been supposed to be the outer coat of the stroma, is in fact formed by the cells of the mycelium. If this be so, the occurrence of the Sphæria and the Cytispora within the same circle would seem to make it reasonable to assume that the two are the produce of the same mycelium.

Fig. 3 represents the oval cells above-mentioned, and fig. 4 the sporidia of the

Cytispora, which are fusiform and strongly curved. They are all magnified 315 diameters.

2. *Sphæria favacea*, Fr.—This Sphæria is closely allied to *S. verrucæformis*, and extremely liable to be confounded with it. Differences, however, exist which on careful examination suffice to distinguish the one from the other. The asci are usually clavate, instead of fusiform as in *S. verrucæformis*; the sporidia have not ordinarily the globular nuclei, and their size is somewhat less, being about $\frac{1}{3250}$th of an inch; the plant is moreover larger and of a coarser habit. No reliance is to be placed upon the arrangement of the perithecia in two tiers, for this occurs indifferently both in *Sphæria verrucæformis* and *S. favacea*. I notice the latter plant here in order to call attention to some strange modifications in the shape of the asci which have come under my observation. The ordinary fruit is shown in fig. 5, while fig. 6 (*a*—*m*) represents aberrant forms in which the asci have become most fancifully distorted. But perhaps the most curious instance of change is that shown in fig. 7, where the outer membrane of the ascus assumed a perfectly globular shape. In this instance the inner membrane remained unaffected, and lay bent almost in its natural shape along one side of the globose external membrane, the sporidia being entirely confined within it; but in other instances, as in fig. 8 (a much smaller ascus), the inner membrane shared the change of form of the outer one, and the sporidia filled the whole of the globe. The specimens in which this abnormal fructification occurred had been subjected to an unusual amount of moisture, by which the change in the form of the asci might possibly have been produced. The figures in this instance are all magnified 220 diameters.

A similar change of form occurred in another Sphæria, the only difference being, that in the latter case the irregular ascus was not exactly globular, but slightly ellipsoidal. Figs. 9 and 10 represent the common and the abnormal forms of fructification in this latter Sphæria, which belongs to the division Concrescentes, the figures being magnified 415 diameters. I may add, that the sporidia are of a clear brown colour, and sometimes, though not usually, nucleated at one or both extremities. I cannot ascertain that it has been previously described, and propose therefore to call it *Sphæria stipata*, the perithecia being very closely packed. The mean size of its sporidia is $\frac{1}{1150}$th of an inch.

3. *Sphæria Tiliaginea*, Currey.—This species is new to this country, and I have not been able to find any description of it elsewhere. I have met with it at different seasons of the year in my own neighbourhood (Blackheath), always on small dead branches of Lime. It belongs to the division Circinatæ, but the perithecia are more deeply immersed in the inner bark than is usual in that division. The ostiola sometimes penetrate through the epidermis, but sometimes remain concealed by it; in the latter case raising the epidermis into a number of small pustules. When the epidermis is stripped off, the inner bark is seen to be covered with small, green, circular umbonate disks, the umbonate appearance being caused by the ostiola, which, as in other Circinatæ, are in contact at their apices, and protrude through the exact centre of each of the

green disks. The fact that each one, without exception, of the circular masses of perithecia is always crowned by one of these green disks, would seem to point to something more than an accidental connexion between them; and although it is possible that the disks might be only a fungoid growth parasitic upon the ostiola of the perithecia, it seems far more probable that they really belong to the latter, forming an integral portion of their structure. If a very thin vertical section be made passing through the centre of the mass of ostiola, and consequently through the centre of the disks, it is seen that the latter are composed of densely packed filamentous tissue, hardly differing, if at all, from the tissue of which the ostiola are composed. The tissues moreover are in actual contact, so close that it is hardly possible to distinguish any line of demarcation between the two. Such a section is shown in fig. 11, magnified 45 diameters; and it must be taken whilst the plants are quite young, for in a later stage, when the ostiola have become black, hardened and brittle, it could not be made.

The perithecium in fig. 11 was just beginning to fructify, and fig. 12, Plate XXV. shows one of the asci with its sporidia, which, although of a greenish tinge and therefore, I should think, not perfectly ripe, were nevertheless fully formed, constituting the normal fruit of the Sphæria. Their average length is $\frac{1}{1225}$th of an inch. The filaments of which the disks are composed produce two different sorts of fruit; the one being minute, colourless cylindrical bodies, answering exactly to the spermatia which have been observed in the Lichens generally, and in many other Fungi; the other being of the same nature as the bodies which M. Tulasne has called stylospores. I have not been able to ascertain the mode of attachment of the spermatia, but the stylospores are borne upon the apices of the filaments, and are formed by the swelling out of their tips, which afterwards become divided from the main filament by a septum. These stylospores, when viewed in a mass, are of a peculiarly rich, bluish-green colour, and when sufficiently magnified, are seen to be very narrowly elliptical bodies, sometimes simple, sometimes with one, two, or even three septa, with an endochrome which is sometimes smooth and refractive, and sometimes granular. I found them vary in length from $\frac{1}{1225}$th to $\frac{1}{700}$th of an inch. These bodies are shown in figs. 13 *a* and 13 *b*, and the spermatia in fig. 14. Figs. 12, 13 *a*, 13 *b* and 14, are magnified 315 diameters.

If the plants are kept in a sufficiently moist atmosphere, these stylospores are sometimes ejected through the bark in tendrils, after the fashion of a *Melanconium*; they differ from the spores of the latter genus in being septate, and from *Stilbospora* by the formation of tendrils. If the green disks were autonomous Fungi, these differences would require consideration, as it would in strictness prevent their classification under either of the two genera just mentioned; but there being, as it seems to me, sufficient grounds for considering the disks only as forming part of the accompanying Sphæria, and not as independent vegetable productions, the differences in question cease to be of much practical importance.

4. *Sphæria vestita*, Fr.—This Sphæria belongs, like the last, to the division Circinatæ,

and has not hitherto been recorded amongst the British Sphæriæ; but, not long since, I found a considerable number of specimens growing upon a fallen branch of Beech in company with *Sphæria quaternata*, *Sphæria turgida*, and a third Sphæria which I am unable to name, and upon these specimens the following observations were made. One peculiarity of *Sphæria vestita*, and that from which it derives its specific name, is a dense woolly covering of a dirty white or yellowish colour, which in their early state clothes the young perithecia, and which covering has always been considered as properly belonging to the Sphæria. It consists of a dense filamentous tissue, not altogether unlike that which forms the green disks in the Sphæria above described, and like the latter tissue it produces a secondary kind of fruit, which I will presently describe. Before doing so, however, I must mention a striking peculiarity in the mode of growth of some of the specimens which came under my observation. Ordinarily the perithecia of *Sphæria vestita* are seated beneath the epidermis upon the surface of the inner bark, but in the above specimens the perithecia were imbedded in the substance of the bark, or rather they were enclosed in a sort of conceptacle formed from the bark and having a perforation at its apex.

The perithecia themselves were surrounded on all sides by a dark dense mass, which the microscope proved to be composed entirely of spores having all the appearance of the spores figured by Corda under the name of *Steganosporium pyriforme*. The perforation at the top of the conceptacle served as a common orifice for the escape of the sporidia of the Sphæria, and of what I may call the Steganosporium spores. The perithecia, which were enclosed in the conceptacles, had for the most part lost their woolly covering, and the conceptacles themselves were surrounded on all sides by vast numbers of the Steganosporium spores which had been ejected through the orifices. Fig. 15 represents one of these latter spores, which are of a dark brown colour with a granular endochrome, and, when ripe, have two and sometimes three transverse septa. Now if the woolly covering of the perithecia be examined before it loses its pale colour, it will be found that the threads of which it is composed produce a number of pale-coloured globular bodies, bearing a strong resemblance to the immature spores of many species of *Uredines*; and it will also be seen that these bodies by degrees lose their globular form and assume a pyriform or turbinate shape, shortly after which a septum is formed across the lower extremity. When the spore has reached this latter condition, it is impossible not to see that it is the young state of the dark-coloured Steganosporium spores, which subsequently become developed in enormous quantities, and which are afterwards found surrounding the perithecia, both when the latter are naked and when they are enclosed in conceptacles.

A case precisely analogous to the above was noticed some time since by Messrs. Berkeley and Broome, and was published in Hooker's 'Journal of Botany,' in which a well-known Stilbospora (*Stilbospora macrosperma*) was found growing on the outer surface of the perithecia of *Sphæria inquinans*, the Stilbospora and the Sphæria being both situated beneath the bark, and having a common orifice for the escape of both the

kinds of spores. This latter has been admitted to be a case of double fructification, and there seems no reason to doubt that the instance above recorded must be classed in the same category, and that the Steganosporium spores must henceforth be considered as a secondary fruit of *Sphæria vestita*.

The perfect fruit of the Sphæria, *i. e.* the sporidia which are produced in the asci in the interior of the perithecia, are of an oval shape, with transverse and longitudinal or oblique septa, somewhat irregular in number and position. Fig. 16 Plate XXV. represents an ascus with sporidia in its interior, and fig. 17 some free sporidia. In this, as I believe to be the case in many if not most Sphæriæ, the sporidia appear to increase in size after their escape from the ascus. The smaller ones (fig. 16) were drawn from fresh specimens in which the asci were only just matured, and measured $\frac{1}{1450}$th of an inch in length; the larger ones (fig. 17) from a dried specimen in the Hookerian herbarium, in which the asci were completely absorbed. These latter measured $\frac{1}{1225}$th of an inch in length.

5. *Sphæria fragiformis*, Pers.—There is a peculiar state of this Sphæria of not unfrequent occurrence, in which the base of the pulvinate stroma is surrounded on all sides by a small pale brown arborescent growth, having the appearance of being parasitical upon the Sphæria.

This state is figured by Sowerby, who, mistaking the unripe stroma of the Sphæria for a species of *Lycoperdon*, gave it the name of *Lycoperdon acariforme*. It is mentioned also in the 'English Flora,' where it is suggested that the growth in question is a species of *Isaria* parasitical upon the stroma of the Sphæria. I have long suspected it to be an essential part of the Sphæria itself, but it was some time before I was able to find specimens in a state favourable for examination. During the last autumn (1856) some such occurred in the neighbourhood of Tunbridge Wells, which enabled me to verify my previous suspicions. The stroma of *Sphæria fragiformis* is covered in its early stage with a veil of dense cellular tissue of a rusty brick-red colour, which disappears as the Sphæria ripens. If a specimen be taken covered with its veil and accompanied by the supposed Isaria, and a very thin vertical section be made passing through the stroma, the veil, and one of the Isariæ, it will be seen, on examining it with a sufficient magnifying power (about 200 diameters), that the threads which form the Isaria are in fact the outlying portions or ragged edge of the mass of cellular tissue which constitutes the veil. In fig. 18 (*a*, *b*), some of these threads are drawn as they appeared under a magnifying power of 415 diameters; these are barren, and have nothing remarkable in their structure. Fig. 18 (*c*) shows some fertile threads similarly magnified, which it will be seen produce at their summit small heads of minute cellules arranged something in the manner of the spores of a Botrytis, and which must be considered as a conidioid form of fruit of *Sphæria fragiformis*. These cellules are elliptical, colourless, and very minute.

6. *Sphæria salicina*, Pers., and *Coniothecium Amentacearum*, Corda.—The latter Fungus is exceedingly common upon the branches of Willows. It appears to the naked eye in the form of small, round or irregular patches of black powder, which leave a sooty mark upon the fingers when touched. The microscope shows that these patches are

composed of multitudes of spores of all sizes and shapes, sometimes strung together in moniliform rows, sometimes united together in a tabular form, presenting altogether a most irregular appearance. It is probable, indeed there can be little doubt, that the moniliform rows of spores are the extremities of fructifying threads proceeding from the mycelium, and upon the point of breaking up into spores. Until lately I had always found the black patches of Coniothecium unconnected with any other sort of fungoid growth; but in some specimens which I met with during the last summer (1856), I found upon stripping off the epidermis of the Willow branch, that the Coniothecium was in immediate connexion with a perithecium which lay buried beneath the outer bark of the Willow. Upon extracting the perithecium the Coniothecium continued adherent to it, the threads of the latter projecting from the apex of the perithecium, and giving it the appearance of being crowned with a little brush. The question then arose, whether the Coniothecium really belonged to the perithecium, or whether it was merely parasitical upon it, and I satisfied myself that the former was the case; for upon examining the perithecium with the microscope, there was no trace to be seen of any threads traversing its outer surface, and that being the case, the only other conclusion in accordance with the facts was, that the threads of the Coniothecium were in connexion with and formed a continuation of the threads constituting the lining of the perithecium.

In this instance most of the perithecia had nothing in their interior but a tangled mass of colourless filamentous tissue, but one or two of them contained a number of spores not enclosed in asci, but intermixed irregularly with the filamentous tissue. The spores were colourless, subelliptical, slightly acuminate at each end, and constricted in the middle with a single central septum. It could hardly be doubted that the perithecia belonged to some species of *Sphæria* of which the free spores might either be an imperfect or stylosporous state of fruit, or normal sporidia set free by the absorption of the asci. Since then, I have had the satisfaction of finding the Coniothecium and the Sphæria connected in the same manner, the latter being in perfect fruit, and proving to be, as might almost have been anticipated, *Sphæria salicina*, Pers. The asci and sporidia of this Sphæria are shown in fig. 19, Plate XXV. The mean length of the sporidia is $\frac{1}{1100}$th of an inch.

There is another species of *Coniothecium* almost as common as the last, known by the name of *Coniothecium betulinum*, and which is to be found upon twigs and small branches of Birch. It bears a strong resemblance to *Coniothecium Amentacearum*, and I have some grounds for supposing that, like that species, it is a conidioid form of fruit of a Sphæria (*Sphæria lanciformis*) which is not uncommon in this country upon Birch. I have not yet been able to prove satisfactorily the connexion between the two, but further observation may possibly establish it.

In the plants above described, the two forms of fruit, assuming them to arise from the same mycelium, must be considered as essentially distinct, that is, the secondary form has no further connexion with the normal fructification, than the fact of being

produced upon the same mycelium; but other cases occur in which the normal form of fruit is so far modified and altered by external circumstances, as to appear at first sight as if belonging to a different species or even genus.

It is an opinion rapidly gaining ground, that by far the greater number of the plants composing the genera *Diplodia*, *Sporocadus*, *Sphæropsis*, *Hendersonia*, *Phoma* and others, are only imperfect forms of different species of *Sphæria*, and a wide field of observation is thus opened in order to allot to each individual member of these pseudo-genera its proper place in the mycological system.

The following instances of this change of form in the fruit have come under my own observation:—

1. *Sphæria angulata*, Fr.—This Sphæria is very common, being found upon almost every small dead fallen branch of Oak. It belongs to the division Incusæ, the perithecia being imbedded in a stroma formed from the bark in small circular patches. The perithecia, with the exception of the ostiola, are usually completely hidden by the bark; but the space which they occupy beneath it is generally well defined by a circular mark surrounding the base of the broad-angled cone, into which the bark is raised by the growth of the ostiola. The sporidia are oblong, but constricted in the middle, varying in length from $\frac{1}{1225}$th to $\frac{1}{815}$th of an inch, and having a septum at the constriction. They are colourless, and their appearance varies considerably according to the state in which the endochrome happens to be at the time of observation. This difference in the endochrome will be seen by referring to figs. 20, 21 and 22, Plate XXV.; in the former the endochrome has a clear oleaginous nucleate appearance, and fills each cell of the sporidium, leaving however a manifest interval between it and the outer membrane; in figs. 21 and 22, on the other hand (the latter representing free sporidia), the endochrome is broken up into a granular mass, which fills each cell of the sporidium so completely as to render the outline of the outer membrane no longer distinguishable. I may observe that this change of state in the endochrome, although striking at first sight, is not uncommon in the sporidia of Sphæriæ, and it is a circumstance which must always be carefully attended to when the form and structure of the sporidia are resorted to for distinguishing species. In this instance the difference between what may be called the nucleate and the granular sporidia is so great, that they might at first sight be supposed to be different forms. In fig. 20 (*a*) is magnified 315 and (*b*) 415 diameters. Figs. 21 and 22 are magnified 315 diameters.

There is another peculiarity connected with this Sphæria, which is, the existence in all the *free* sporidia of four delicate cilia, one proceeding from each pole, and one from each side, which are not perceptible as long as the sporidia are enclosed in the ascus. The fact of these cilia being invisible in the ascus might seem to point to germination as their origin, but the constancy and regularity in their appearance, size and position almost preclude this supposition.

The above varieties in the sporidia are not, however, the main peculiarity in the fructification of this Sphæria, for I have found its perithecia producing in lieu of the

regular asci, immense numbers of the bodies drawn in fig. 23, Plate XXVI. These bodies are shaped like the spores in the genus *Cryptosporium*, and if the perithecia producing them had existed singly, or if a number of perithecia in one group had produced nothing but similar bodies, the plant would have had to be classed with the Cryptosporia and not with the Sphæriæ. But in the specimens upon which my observations were made, the same stroma produced contiguous perithecia, of which some produced the regular asci and sporidia, others the Cryptosporium fructification. The origin of the latter is, I think, sufficiently obvious: it seems to arise from an arrest of growth taking place in the asci, by which not only do the latter not acquire their usual size, but the endochrome, instead of breaking up into separate portions and forming sporidia, remains united in one mass which is uniformly distributed through the ascus. The real nature of these bodies must depend upon whether they possess the power of germination, a fact which I have not yet ascertained. If they have such power, they would rank as real fruit; if not, then they must be regarded simply as abortive productions, worthy of notice only from their resemblance to the spores of a distinct genus.

2. *Sphæria lanciformis*, Fr., and *Hendersonia polycystis*, B. & Br.—There is, as I have stated above, a prevalent opinion amongst mycologists, to the effect that certain Fungi, including those of the genus *Hendersonia*, are only Sphæriæ in an imperfect condition. The species just mentioned (*Hendersonia polycystis*) was first described by Messrs. Berkeley and Broome in their notices of British Fungi in the 'Annals of Natural History,' and it may be found figured, though under a different name (*Myxocyclus confluens*), by Fresenius in his 'Beiträge zur Mykologie.' It is remarkable for the beauty of its spores, which are club-shaped, multicellular, and of a deep olive-brown colour, with the exception of the pedicel-cell, which is hyaline and colourless: the spores are surrounded by a broad gelatinous margin and usually grow singly, but occasionally (as is shown in fig. 24) one pedicel serves as a support to two spores. The double spore in fig. 24 is magnified 415 diameters.

The plant grows upon Birch and is in perfection in very moist weather, when it may be easily recognized by the large, black, soft, gelatinous protuberances on the bark, formed by spores escaping and depositing themselves upon and about the apex of the perithecium. This Hendersonia I suspect to be an abnormal state of a well-known Sphæria (*Sphæria lanciformis*), which also grows upon Birch, and upon Birch only.

The regular fruit of this Sphæria (see fig. 25) consists of asci having eight large, elliptical, dark olive-brown sporidia, of an average length of about $\frac{1}{500}$th of an inch; the sporidia are furnished with several septa, and when seen under the microscope are very beautiful objects. Fig. 25 is magnified 315 diameters.

In the first place, the sporidia of *Sphæria lanciformis* are apt to assume irregular forms. Some of the irregular forms are shown in fig. 26 (*a–e*) and fig. 27, amongst which it will be observed that the spore (*e*), fig. 26, which occurred singly in an ascus, bears considerable resemblance to the fruit of *Hendersonia polycystis*. It is true that it is not divided by longitudinal as well as transverse septa; but that this is not a safe mark

of distinction, may be seen by referring to the sixth spore from the top in the ascus, Plate XXVI. fig. 25, where the cell is divided by a longitudinal septum. Besides this variety in the sporidia, which establishes at least a capacity if not a tendency to change of form in the fructification, I have found perithecia in the same stroma producing the very dissimilar bodies shown in fig. 28, *a*, *b*, *c*, *d*, of which *a* and *b* do not differ from the ordinary form of sporidium of *Sphæria lanciformis*, and *c* and *d* are exactly the fruit of *Hendersonia polycystis* minus the gelatinous border. The absence of the latter is easily accounted for, since all sporidia which have gelatinous envelopes lose them in process of time, and the specimens in which these different forms were found were unfortunately so far past their prime that the perithecia were almost empty. This latter circumstance may perhaps be considered as throwing some doubt upon the observation, and it certainly would have been more satisfactory to have found the Sphæria and Hendersonia in full fruit in the same stroma; but if the facts I have stated be not considered sufficient to establish the identity of the two plants, they must, I think, be admitted to afford reasonable grounds for a suspicion of relationship between them.

If the Hendersonia be an imperfect form of the Sphæria, then the so-called perithecia and fruit of the former will be (to adopt M. Tulasne's terminology) the pycnidia and stylospores of the Sphæria. In the last vol. of the 'Annales des Sciences,' M. Tulasne has described what he considers to be the conidioid form of fruit of *Sphæria lanciformis*, and which from his description (there being no figures) I take to be a species of *Coryneum*, which occurs in the neighbourhood of London upon dead branches of Birch.

3. *Sphæria siparia*, B. & Br., and *Prosthemium betulinum*, Kunze.—This Sphæria, perhaps the most beautiful of all the British species in regard to fructification, was first described in the 'Annals of Natural History' by Messrs. Berkeley and Broome. It belongs to the division Obtectæ, and occurs upon twigs of Birch. The perithecia are large and depressed, and furnished with a short central ostiolum, and are stated in the 'Annals' to be clothed with a more or less dense ferruginous wool. This description quite accords with specimens in my herbarium, with the exception of the colour of the wool, which I find quite white, a difference which may depend upon the period of growth at which the plants are examined. Fig. 29, Plate XXVI. represents an Ascus with sporidia and two free sporidia. The sporidia are oblong-elliptic, but sometimes slightly curved, and divided into a number of cells by transverse and longitudinal septa. There is a slight constriction at each transverse septum, and each sporidium is surrounded by a gelatinous border, which, after the sporidia have escaped from the ascus, is of some width. The colour of the sporidia, when in their prime, or rather, I think, just before maturity, is a bright golden yellow, which subsequently changes to a clear brown tint, after which the gelatinous coat disappears. Their mean length is $\frac{1}{445}$th of an inch. The brown colour is precisely that of the spores of *Prosthemium betulinum*, which latter plant I suspect to be an altered form of the Sphæria.

In the first place, *Sphæria siparia* and *Prosthemium betulinum* are almost always associated in growth. Whenever the one is found, a very slight search will usually

enable the observer to detect the other; and although the mere fact of their growing together would hardly afford any ground for suspecting a relationship between the two, it is a circumstance which, taken in connexion with others, must be allowed to be of considerable weight. But besides their companionship, there is a very strong external resemblance between the Sphæria and the Prosthemium, so much so that it is frequently impossible, without a microscopical examination of the fruit, to decide whether a particular specimen belongs to the one or the other. The perithecia of the Prosthemium are large and depressed, with a central ostiolum, and, although not invariably, are sometimes clothed with the dense wool which is one of the characteristics of the Sphæria. There is, no doubt, a total dissimilarity at first sight between the eight-spored ascus of the Sphæria and the fascicle of spores of the Prosthemium; but there is no great difference, on the contrary, there is not unfrequently a strong resemblance, between the individuals constituting the fascicle and the free sporidia of the Sphæria after the latter have lost their gelatinous coat, which takes place soon after their escape from the ascus. Upon tracing the asci and the fascicles from their earliest stages, it will be found that they originate in precisely the same manner, viz. in the form of a clavate cell proceeding from the wall of the perithecium. This shape is retained throughout its existence in the case of the ascus; but in the fascicle, very shortly after the endochrome has begun to form distinct masses, *i. e.* shortly after the state shown in fig. 30, *a*, a bulging-out of the membrane takes place as shown in fig. 30, *b*, *c*, and the contents of the cell become distributed between the branch-cell and the original one (see fig. 30, *d*. The contents of the branch-cell become separated into distinct masses, precisely as in the primary cell, septa or pseudo-septa are formed at the point of bifurcation as well as in the body of the cell, and after the formation of a similar branch-cell on the other side of the original cell the fascicles eventually assume the form shown in fig. 30, *e* and *f*, and in fig. 31.

The small processes which project from the central cell with the principal spores I take to be only abortive spores, *i. e.* bodies originating in the same manner as the spores themselves, and failing to become perfect from a deficiency in quantity or vitality of the formative matter in the interior of the primary cell.

Figs. 29 and 30 are magnified 220, and fig. 31, 315 diameters.

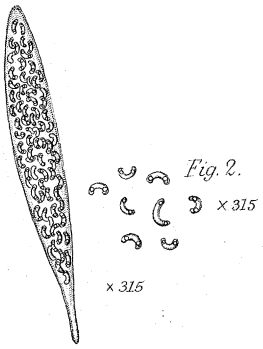


Fig. 1.

Fig. 2.

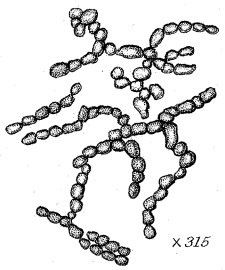
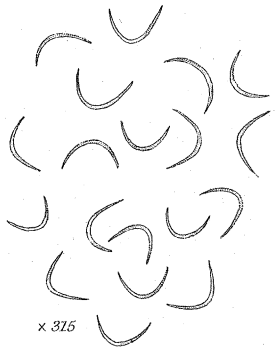


Fig. 3.



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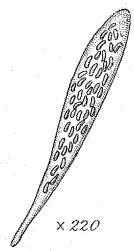

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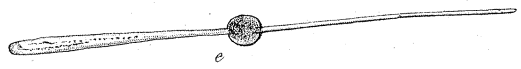

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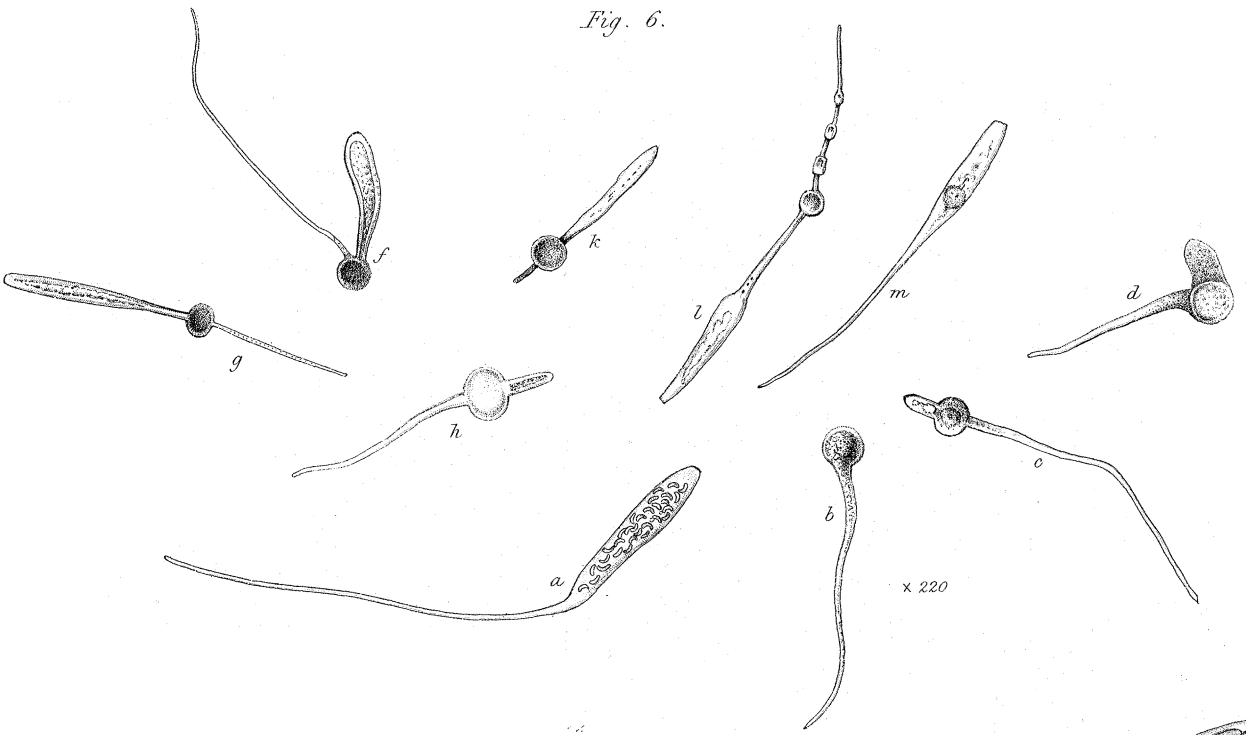
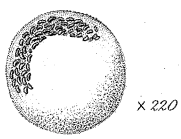


Fig. 8.

Fig. 7.



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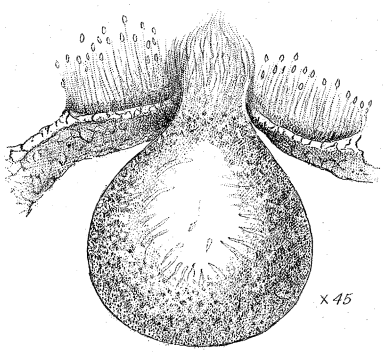

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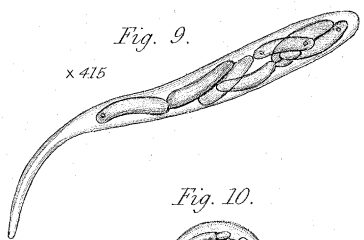

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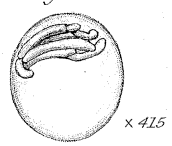

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Fig. 12.

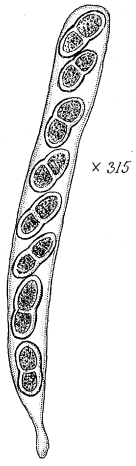


Fig. 13.a

Fig. 13.b

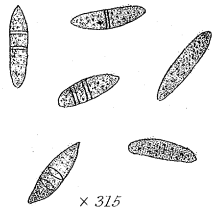
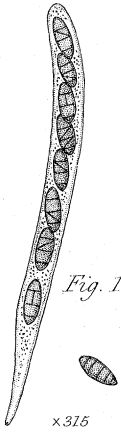


Fig. 14.

Fig. 15.

Fig. 16.



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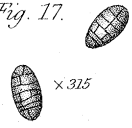

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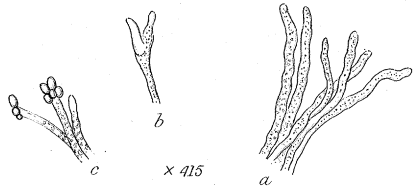

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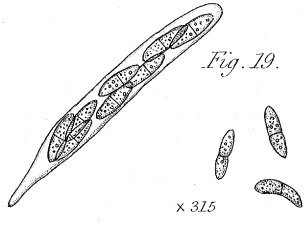

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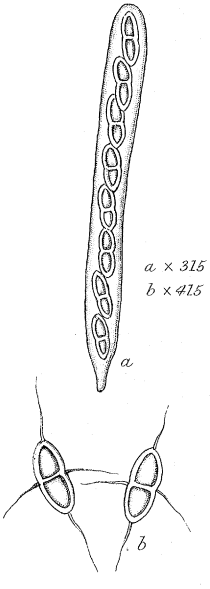

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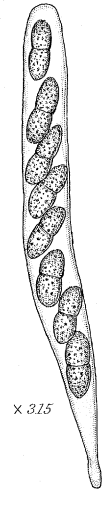

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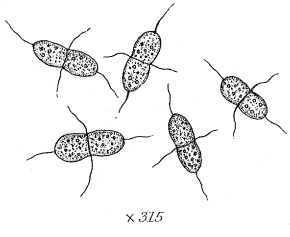

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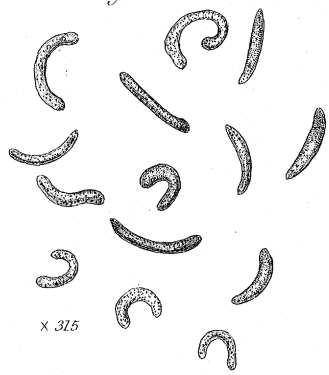

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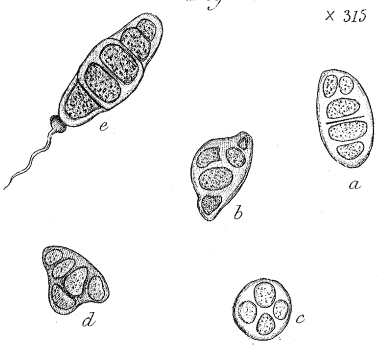

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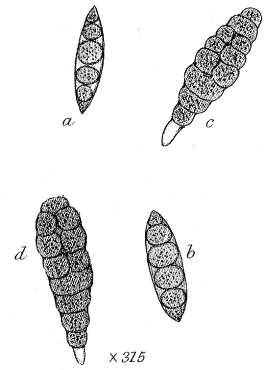

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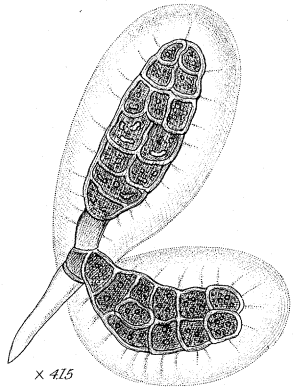

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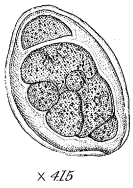
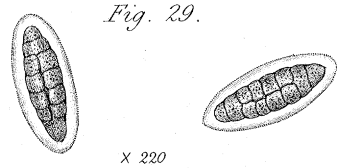


Fig. 29.



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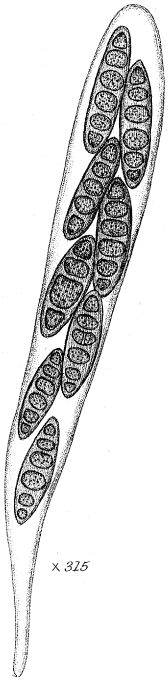

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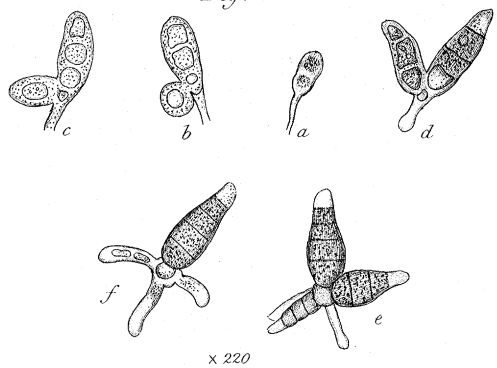

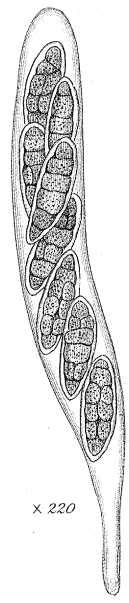

Fig. 31.