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The development of *Armillaria mellea*.

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(With 2 plates.)

In 1861 H. HOFFMANN described the structure and partial development of *Agaricus melleus*[1]). While he studied and described quite small specimens, they were too far advanced to determine the origin and differentiation of the different parts of the plant, and whether the hymenium was of endogenous or exogenous origin.

R. HARTIG in 1874[2]) made a more careful study of the development, and also determined that the fruit bodies were organically connected with the rhizomorphs known as *Rhizomorpha fragilis*, *R. subcorticalis*, etc. As his illustrations show he had access to a large number of very young carpophores directly connected with rhizomorphs free in the soil, but also breaking out from underneath the bark of roots and the bases of tree trunks. He states that the development of *Armillaria mellea* in essential points differs completely from that described by DE BARY in 1866[3]) for *Agaricus campestris.* In the very early stages he says it develops in exactly the same way as the forms without a veil (gymnocarpous forms), that is, the young carpophore is first differentiated into a stem and pileus part by the formation of a superficial annular furrow which marks the primordium of the hymenium. In the beginning this is completely open to the outside, but is enclosed by the subsequent downward growth of hyphae from the edge of the pileus and the upward growth of hyphae from the stem, which meet and interlace, thus bridging over the annular furrow. Although HOFFMANN[4]) and later DE BARY (l. c. 68) had correctly described the development of *Agaricus campestris*, HARTIG declared his conviction, that, judging from de Bary's figures, the formation of the veil in *A. campestris* agreed in all respects with that of *Armillaria* as described by him. Influenced by the weight of HARTIG's authority,

1) HOFFMANN, H., Icones Analyticae Fungorum, Abbildungen und Beschreibungen von Pilzen mit besonderer Rücksicht auf Anatomie und Entwicklungsgeschichte, 1861. *Armillaria* on pages 90—92, Pl. 21, figs. 1—17.

2) Wichtige Krankheiten der Waldbäume usw., *Agaricus (Armillaria) melleus* L., p. 12—42, pls. 1, 2, 1874.

3) Morphologie und Physiologie der Pilze, Flechten und *Myxomyceten*, p. 68—70, Fig. 26, 1866.

4) HOFFMANN, H., Pollinarien und Spermatien bei *Agaricus* (Bot. Ztg. **14**, p. 137—148, 153—163, pl. 5, 1856). See also Beiträge zur Entwicklungsgeschichte und Anatomie der *Agaricineen* (Bot. Ztg. **18**, p. 389—395, 397—404, pls. 13—14, 1860) and Icones Analyticae Fungorum, Abbildungen und Beschreibungen von Pilzen mit besonderer Rücksicht auf Anatomie und Entwicklungsgeschichte, p. 1—105, pls. 1—24, 1861).

de Bary [1]) later reversed his position, and accepted the idea that, in *A. campestris*, as well as in other forms with a marginal veil, the primordium of the hymenophore was exogenous in origin, and later was covered by the over-growth of hyphae from the margin of the pileus and surface of the stem.

But Fayod [2]) (p. 284), in view of his results in the study of a large number of *Agaricaceae* with marginal veil, challenges the correctness of Hartig's studies of *Armillaria mellea*, although this species was not included among the forms investigated by Fayod.

An interesting situation in regard to the development of the fruit bodies in the angiocarpous agarics was thus created by Hartig's account of the early stages of development in *A. mellea*. From the work of Fayod it became evident that in a large number of the angiocarpous forms, at least, the origin of the hymenophore is endogenous, although he studied neither *A. mellea* nor *Agaricus campestris*. From the conflicting statements of the earlier students, in the light of the work of Fayod, it was desirable that further studies of development should be undertaken, especially in the case of the two species last named. More particularly was this desirable because Hartig and de Bary, as well as the other early investigators did not have the advantage of our modern technique in sectioning and staining material, particularly that of the very young and delicate stages, but depended on free hand sections. When one attempts to make free hand sections of such minute carpophores, one readily comprehends how difficult it is to make them thin enough for correct interpretation, and at the same time to retain the delicate mycelial elements in their normal position. Criticism, therefore, of these early investigations is not a reflection upon the ability or judgment of their authors. Such results are matters of history and the few errors are in themselves of little moment in contrast with the larger body of material in them which constitutes a real addition to knowledge.

For more than two decades the situation in regard to these two species was one of confusion and doubt. Stimulated by the desirability of having this situation clarified, the writer, in 1905, having secured material of these two speecies in the necessary stages, undertook the study of development from the undifferentiated primordium of the carpophore through to the mature stage, by the paraffine and microtome method. The results of this study were presented before Section G of the „American

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1) de Bary, A., Vergleichende Morphologie und Biologie der Pilze, *Myxomyceten* und Bacterien, p. 312—315, 320, 1884. English Edition, p. 290 to 292, 297, 1887.

2) Fayod, V., Prodrome d'une histoire naturelle des *Agaricinés* (Ann. Sc. Nat. Bot. VII, **9**, p. 181—411, pls. 6, 7, 1889). He says, "I am not in accord with de Bary and R. Hartig on the development of the angiocarpic forms." "Although I have not been able up to the present time to see primordia of *Agaricus melleus* sufficiently young, I do not hesitate to declare that this point of view is incorrect. It can only rest on poor sections of stages already too old, for it is in absolute contradiction with the observations which I have made on well stained sections exactly in the median line of a considerably larger number of primordia of angiocarpous agarics. Besides, the figure of Hartig reproduced by de Bary in his „Pilze" (fig. 133), approaches so little the appearance of my sections of stages of this agaric 3 mm long. that I willingly believe that this author has to a large extent made it diagrammatically. The lamellae of the angiocarpic forms are always developed on the interior of the universal veil (primordial cuticle), the continuity of which is only broken when the pileus grows more rapidly than it".

Association for the Advancement of Science", at the New Orleans Meeting [1]), in the winter of 1905—6. The paper on *Agaricus campestris* was published in September 1906 [2]), while the only published notice of that on *Armillaria mellea* was by title. The photomicrographs obtained at that time, of the stages of development in this species, were not so satisfactory as could be desired. This led to a postponement of the publication in the hope that new material might provide better sections, or that another trial of the old sections might result in better photomicrographs. After a delay of seven years the old sections have been reexamined with the result that they appeared to be more promising than was at first supposed. Accordingly in July 1913 I photomicrographed a number of the sections thus providing for the illustrations accompanying this paper.

In the meantime BEER has briefly described the development of *Armillaria mellea* [3]). His work does not support HARTIG's account, for he finds that the primordium of the hymenophore is endogenous in origin, from the first covered by the veil. However, the case of *A. mellea*, is a rather critical one, since HARTIG, in speaking of DE BARY's fig. 25 [4]) of *Agaricus campestris*, showing the annular cavity covered by the marginal veil, said, in comparing it with his fig. 20, "it appears [5]) from the agreement of the two figures that the conjecture is justified that, also by this last fruit body in the region of the hymenial tract, a subsequent growing together of the hyphae of the pileus and stem has taken place". Now, since BEER neither describes nor figures stages of the primordial carpophore prior to and at the moment of the first appearance of a structure indicating the differentiation of the primordium of the hymenophore, it might be contended that, the earliest stage presented, his fig. 13, could be interpreted as in support of HARTIG's account. BEER's fig. 13 really represents quite an advanced stage of the young hymenophore, and the very delicate veil with the hyphae from the margin of the pileus cortex curved downward leaves the situation still within a reasonable measure of doubt. Really, the principal justification for interpreting this figure to indicate an endogenous origin of the hymenophore primordium, lies in the proof presented for an endogenous origin of the hymenophore by the studies on *Agaricus campestris* [6]), *Armillaria mucida* [7]), *Hypholoma* [8]), and by the work of FAYOD on other forms with a marginal

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1) ATKINSON, G. F., The development of *Armillaria mellea*; The development of *Agaricus campestris* (Proc. A. A. A. Sc. 53rd Meeting, Dec. 1905 to Jan. 1906. Ibid. Science N. S. **23**, p. 203, 1906).

2) ATKINSON, G. F., The development of *Agaricus campestris* (Bot. Gaz. **42**, p. 215—221, pls. 7—12, 1906).

3) BEER, R., Notes on the development of the carpophore of some *Agaricaceae* (Ann. Bot. **25**, p. 683—689, pl. 52, 1911).

4) DE BARY, A., Morphologie und Physiologie der Pilze, Flechten und *Myxomyceten*, p. 68, 1866.

5) HARTIG, R., Wichtige Krankheiten der Waldbäume usw., p. 25, 1874.

6) ATKINSON, G. F., The development of *Agaricus campestris* (Bot. Gaz. **42**, p. 241—264, pls. 7—12, 1906).

7) FISCHER, C. C. E., On the development of the fructification of *Armillaria mucida* SCHRAD. (Ann. Bot. **23**, p. 503—507, pl. 35, 1909).

8) ALLEN, CAROLINE L., The development of some species of *Hypholoma* (Ann. Myc. **4**, p. 387—394, pls. 5—7, 1906). — BEER, R., Notes on the development of the carpophore of some *Agaricaceae* (Ann. Bot. **25**, p. 683 to 689, pl. 52, 1911).

veil, the reasonable conclusion being that in *Armillaria mellea* with a marginal veil, also, the hymenophore has an endogenous origin. Therefore, although Beer is correct in his interpretation of *A. mellea*, it seems desirable to present convincing evidence from the material of *A. mellea* alone, of the origin of the hymenophore. In connection with this we may well call attention to some peculiarities in the structure of the young carpophore which are not treated of by Beer in the paper referred to.

The young fruit bodies of *A. mellea* vary considerably in form according to the conditions under which they are developed. Sufficient observations have not been made to state, with any degree of assurance, just what the correlations of form and conditions are. But it appears probable that where the rhizomorphs are more or less exposed, that is, very near or at the surface in a somewhat firm substratum, the very young carpophores are "bulbous", having a stout bulb or base, from the upper surface of which the minute pileus and stem are developed, very much as in certain large species of *Lepiota*, as *L. rhacodes*, etc. Under other conditions where the substratum retains more moisture and the young carpophores are protected for some time, they are slender and at the earliest differentiation of the pileus it is equal in diameter with the base of the plant. Such young carpophores are nearly cylindrical or oblong in outline. Most of the forms which I obtained for sectioning were of the latter type, the others being already too far advanced when collected. It would appear from the figures presented by Beer that most of his carpophores were of the "bulbous" form.

The youngest carpophore sectioned was about 0,5 mm in diameter. It appears that at a very young stage the primordium of the carpophore is differentiated into three regions, especially the upper portion where later the differentiation of pileus and stem takes place (fig. 1). At just what stage was not determined. There is 1st an outer zone of radiating hyphae; 2nd, an illdefined cortex; and 3rd, a central core of undifferentiated tissue. The cortex is more conspicuous over the part later marked off as the pileus, though the primordium of the pileus cannot yet be regarded as differentiated from the stem.

The radial hyphae of the outer zone in the youngest fruit body studied are 60—100 μ long by 6—8 μ in diameter. They are septate, the cells usually 12 μ to 20 μ long or rarely some are 30 or 40 μ long. They soon become constricted at the septa, especially from the middle region toward their free ends, the cells becoming elliptical to subglobose, 10 to 15 or even 20 μ in diameter in the older specimens. They taper gradually to the narrower base where they arise from an irregular cortex of radiating cells gradually merging into a pseudoparenchyma of elongated cells, the cells irregular in length and form, but 3—6 μ in diameter. The radial hyphae stain rather deeply, more so than those of the cortex or middle zone, which itself is stained more deeply than the central zone. The protoplasmic content as well as the thick walls take the stain. These hyphae are quite characteristic, as Hartig has remarked, for they are present in older specimens where they are even more characteristic. The tissue of the central zone adjacent to the inner portion of the cortex is similar to it in texture but very faintly stained. Farther within the hyphae are in a more or less longitudinal direction in the core, curving

outward toward the surface. This central zone is stained very faintly and the cell walls are thin. But scattered through it are slender, flexuous, curved, hyphae, which pursue a winding course, are 3—4 μ in diameter, rich in protoplasm and deeply stained.

A slightly older stage is shown in figs. 2—4, the young carpophore measuring 0,75 mm in diameter. The radiating hyphae are longer, measuring up to 150 μ while in still older carpophores they reach 200—300 μ. This carpophore is interesting since it shows the very earliest primordium of the hymenophore. Just above a in figs. 2 and 4 are seen five or six slender, curved hyphae growing in a downward direction. On the opposite side is seen another group of similar hyphae. One of these groups is just exterior to a minute puncture in the fruit body, which of course must not be taken for the gill cavity. The hyphae constituting the first elements of the primordium of the hymenophore appear to be of the same character as the delicate hyphae rich in protoplasm scattered through the central zone of the fruit body described above. The direction of the hyphae forming the hymenophore primordium indicates that epinastic growth has entered in an annular region of the fruit body at this point. It will be observed that the radial hyphae of the outer layer of the "universal veil", in an annular zone at this point, are affected by this epinastic condition, and are bent in a decidedly downward direction. Were it not for the fact that in younger fruit bodies, as shown in fig. 1, the hyphae of this outer layer are all radial, the condition represented in figs. 2—4 might be taken to justify HARTIG's theory of a downward growth of hyphae from the margin of young pileus to cover the hymenophore primordium. This is a good illustration of the difficulty of determining the exact order of events in *Armillaria mellea* if the stages at the time of, and immediately following, the differentiation of the hymenophore primordium, are the only ones considered, since this zone of radial hyphae of the "universal veil" is rather loose and there is only a slight development of the "cortex" at this point. The hyphae are quickly drawn into a direction suggesting downward and upward growth forming a thin and loose veil. The condition is very different in the enveloping layers of radial hyphae and cortex in *Lepiota clypeolaria* (described elsewhere) since the epinastic influence does not extend to these layers but is confined to the margin of the pileus primordium. But the condition found in the very young carpophores as shown in figs. 2—4 indicates clearly when compared with the condition shown in fig. 1, that, the primordium of the hymenophore is of endogenous origin in *Armillaria mellea,* and that the radial hyphae in the annular żone exterior to the hymenophore primordium, have not grown in a downward direction, but are later bent downward as the result of epinasty of the tissue in this region. Furthermore no annular external furrow is as yet visible over which the hyphae were said by Hartig to grow, though the epinasty of the hyphae at this point suggest at first, when seen under the microscope, a superficial annular furrow.

Later stages of fruit bodies 1 to 1,5 mm in diameter show the primordium of the hymenophore well differentiated, often with the annular gill cavity formed, though in some cases the loose textured tissue of the marginal veil completely fills the area between the hymenophore and stipe for some time. With the growth of the carpophore, intercalary

growth of the veil primordium takes place providing for the amount of material present in the veil and annulus of the mature plant. Figs. 5 and 6 represent the dense layer of palisade hyphae of the hymenophore primordium many of which are still slender and pointed below, the layer in section appearing in the form of an arch above the gill cavity. Because of the rich protoplasmic content of these hyphae the young hymenophore is deeply stained and in strong contrast with the adjacent tissue. The cortical tissue just beneath the zone of radial hyphae is becoming more active and also begins to stain more deeply, quite as much so or a little more strongly than the radial hyphae of the outer zone. In more advanced stages it is very distinct showing clearly its differentiation into the cortex or outer portion of the pileus.

This is interesting as indicating that the tissue, which ultimately gives rise by growth and increase to the cortex of the pileus, is recognizable in a primordial condition at a very young stage of the carpophore, as a middle zone of tissue before the differentiation of pileus and stem primordia. There is some question as to the homology of these two outer zones in the young fruit body, i. e., the zone of radial hyphae and the irregular zone of pseudoparenchymatous tissue here spoken of as a cortex. The two zones seem to be homologous with two similar zones much better differentiated in the young carpophores of *Lepiota clypeolaria* which will be fully described in another paper. This much may be said here, however, that there is evidence in *L. clypeolaria* of the homology of these two outer zones with the volva or "universal veil" in certain species of *Amanita* and *Amanitopsis*. But in certain species of the latter genera the "universal veil" becomes clearly separated as a volva by a method which I shall describe in another forthcoming paper on *Amanitopsis vaginata*. In *Lepiota* the universal veil is "concrete with the epidermis of the pileus", and it would appear that a simular situation exists in *Armillaria mellea*. In this connection a study of the development of *Armillaria imperialis* Fries would be extremely interesting. From what I have observed in the development of the later stages of this plant, from material collected in the Jura Mountains of France at Boujeailles near Pontarlier, in August, 1905, it appears that the univeral veil, in part at least, separates distinctly from the surface of the pileus and forms the lower ring on the stem, this species being said to possess a duplex annulus [1]). It is interesting that certain species of two different genera possess an outer zone of radial hyphae arising from a zone of cortical tissue, but the radial hyphae in *Armillaria mellea* do not form so compact a zone as in *Lepiota clypeolaria*.

Although the primordium of the pileus is not well seen at the time of the origin of the hymenophore primordium, the latter indicates the beginning of the differentiation of the young carpophore into the pileus and stem portions. The epinasty of the threads which form the hymenophore primordium, as well as of the superficial threads which assist in forming the veil, is an indication that the pileus is being organized, since the epinastic growth is one of the special peculiarities of the pileus in its early stages of growth, especially the marginal portions of the pileus. At the very earliest beginning, however, of the differentiation in the region

1) Fries, E., Icones Hym. **18**, pl. 17, 1867. — Gillet, C. C., Champ. France, 78, fig. opposite p. 73, 1878. — Saccardo, P. A., Syll. Fung. **5**, 79, 1887.

of the hymenium, the pileus end of the carpophore does not show any differential staining in the specimens I have seen, though its elements are of a finer composition than the piliferous outer layer, as described above. Very soon, however, the tissue of the young carpophore in the end above the hymenophore primordium begins active growth and the hyphae are richer in protoplasm. This region, which is the pileus primordium, thus shows differential staining by taking a much deeper tint than the peripheral layer of radiating hyphae. These hyphae become somewhat longer and stouter and as the pileus grows older those toward the margin turn more and more downward and come to lie radially on the surface.

The tissue of the veil becomes loose providing for aeration of the hymenophore. The piliferous layer (including the outer portion of the pseudoparenchyma), which forms the rudiment of the veil and clothes the young carpophore, probably represents the "universal veil". As the carpophore becomes larger this "universal veil" can be recognized for some distance down on the stem as a looser layer, although now the hyphae are no longer radial in this region. Just inside of this the outline of the stem cortex can often be seen, indicated by a deeper stain. As the veil grows it appears to be added to also in some cases by the growth of hyphae from the upper part of the stem, the hyphae often growing close up under the young hymenophore and then curving downward and outward. The position of the veil with reference to its being close up in the gill cavity or at some distance away seems to vary. Sometimes it is as described by HOFFMEISTER, but it is too variable to permit of assigning to it a definite position and a definite angle in the direction of the threads composing it. In a few cases the loose hyphae which form the "universal veil" down on the stem, seem to be separated from the young stem cortex by a thin layer which seems to be in a partial state of gelatinization, and higher up next the gill cavity threads from the stem cortex pass over outward and unite with the portion from the "universal veil".

Later stages in development than those presented in the figures were not studied in microtome sections, nor for the purpose of this article. The further development of the hymenophore probably offers nothing unusual and the early stages of the origin of the gill folds are figured by BEER (l. c.). But it is well known that *Armillaria mellea* is a very variable species not only in the size of the carpophores but in the character of the surface, being described as smooth or scaly, the latter form with pointed tufts of scales particularly abundant and strong over the center of the pileus probably being the more common form. The annulus also varies greatly, from thin and membranous to tumid, and with a duplex margin. How the annulus becomes so very thick as it sometimes is in mature specimens, would be interesting to determine, i. e., whether in some examples it is quite stout from the first, with the primordium of the hymenophore of much deeper origin than found by BEER or myself, or whether there is a very great increase in the tissue of the marginal veil after its differentiation.

Summary.

1. The very young carpophores, before any differentiation into their principal parts, show a differentiation into three zones, a central zone or area of fundamental tissue, an outer zone of septate radial hyphae and an intermediate zone of pseudoparenchyma, of small, irregular, mostly radially arranged cells forming a cortex. In the fundamental tissue are scattered slender, flexuous threads, rich in protoplasm and probably representing elements active in growth.

2. The first evidence of a differentiation into the fundamental parts of the fruit body is manifested in an endogenous, annular, limited area of more active hyphae not at first compacted into a tissue, forming the early primordium of the hymenophore. The direction of growth and curvature of these hyphae, suggests the influence of epinasty.

3. This epinastic influence extends to the tissue external to the annular primordium of the hymenophore, and thrusts the radial hyphae in this region, which were horizontal, downward at an oblique angle. Coincident with the further organization and development of hymenophore and pileus, the epinastic condition spreads upwards from this annular region causing the radial hyphae over the pileus to curve downward, more strongly toward the margin of the pileus, less so toward the center. The outer half or two thirds of these hyphae become more or less constricted at the septa giving to them a moniliform appearance.

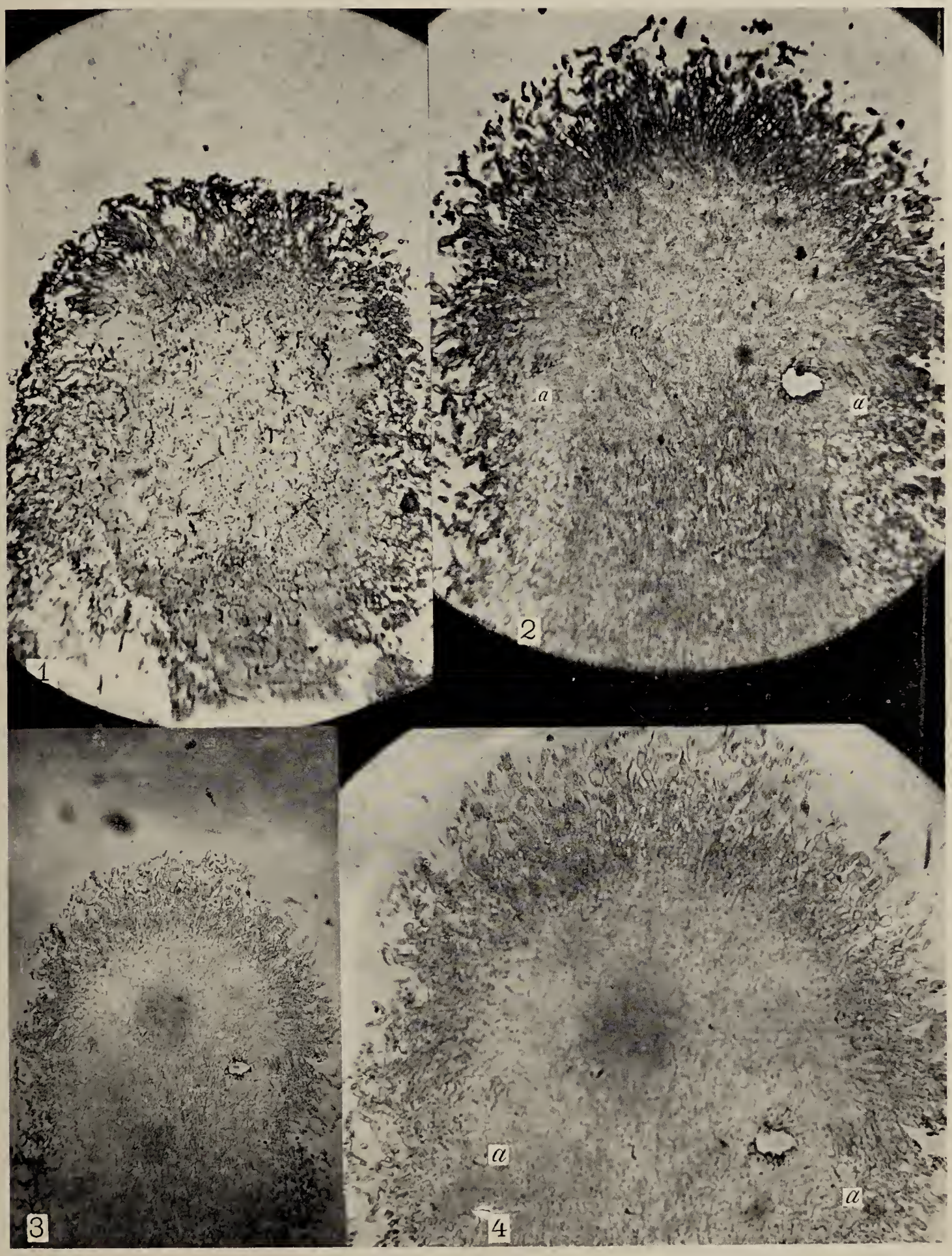
4. Beneath the hymenophore primordium, growth is less active, resulting in a loose meshed tissue which separates from the hymenophore and forms the internal annular gill furrow. In some cases active growth of this loose meshed tissue takes place, added to perhaps by growth of the tissue enveloping the stem, completely filling the gill cavity for a time. A palisade layer of active, rapidly growing hyphae next forms the well defined young hymenophore which soon becomes arched due to continued epinasty. These hyphae are at first very slender and sharp pointed but gradually change to, or are replaced by, a palisade of blunt hyphae. This is at first plain and even but later is thrown into radiating folds by the more rapid growth along the lines where the lamellae arise.

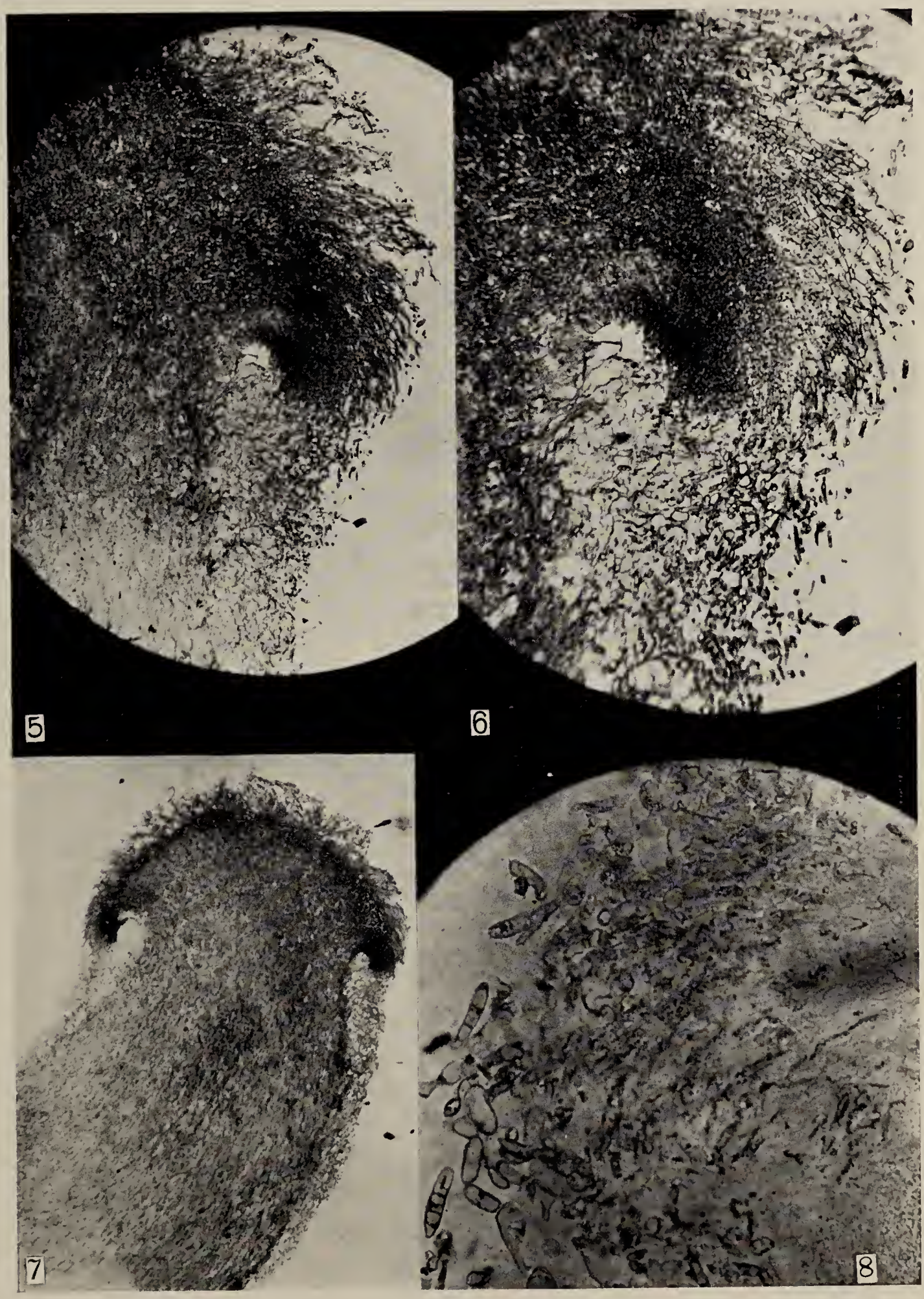
5. The fundamental tissue beneath the young hymenophore becomes looser in texture forming with the zone of radial hyphae, the "marginal veil". This increases in extent by growth and eventually is separated from the margin of the pileus and forms the annulus. The inner zone of this, of more delicate hyphae between the "universal veil" and the stem and continuous with the margin of the pileus, is the "partial veil".

6. The zone of radial hyphae, and a part at least of the cortical zone of the young carpophore of *Armillaria mellea*, probably is homologous with the radial and cortical zone in *Lepiota clypeolaria*, and thus homologous with the "universal veil" in certain species of *Amanita* and *Amanitopsis*, but does not become differentiated from the pileus as it does in these two genera.

Explanation of Plates.

The photomicrographs for figs. 1—6 and 8 were made with a Zeiss microscope, the object being 370 mm. from the sensitive plate. The combinations employed for the different figures were as follows: figs. 1, 2, oc. 8, ob. 16 mm.; fig. 4, oc. 12,





ob. 16; figs. 3, 5, oc. 6, ob. 16; fig. 6, oc. 12, ob. 16; fig. 8, oc. 6, ob. 3 mm. Fig. 7 is magnified 25 diameters.

Fig. 1, longitudinal section of a young fruit body before there is any differentiation of the parts. Scattered in the primordial tissue are irregular hyphae richer in protoplasmic content and deeply stained. Surrounding the primordium is the "universal veil" of radiating hyphae.

Figs. 2, 3 and 4, longitudinal sections of a young carpophore showing the earliest stage in the differentiation of the hymenophore, and pileus margin, different degrees of magnification. Above *a* on either side can be seen a group of downward growing hyphae in the primordial tissue, these are deeply stained and represent the earliest stage of the hymenophore primordium. Just external to these two groups of hyphae the radial hyphae of the "universal veil" are bent downward under the influence of epinasty. In fig. 8 which is a more highly magnified illustration the primordium of the hymenophore lies just above the numeral 8.

Fig. 5, longitudinal section of a still older carpophore, showing the arched primordium of the hymenophore, the gill cavity, the margin of the pileus, and the organization of the pileus surface in connection with the inner zone of the "universal veil". The latter is shown extending down over the stem, and between it and the stem the increasing elements of the partial veil.

Fig. 6, a more highly magnified illustration of the same stage in which the "universal veil" is shown more distinctly from the elements of the partial veil between it and the stem.

Fig. 7, slightly older stage showing surface of the pileus organized, "universal veil" "concrete" with it, and lower part of "universal veil" extending far down over the stem. Partial veil between margin of the pileus and stem.

Beitrag zur Kenntnis der Gattung *Calonectria*.

Von **Josef Weese**, Wien.

(Mit 2 Textabbildungen.)

Das Bedürfnis nach monographischen Bearbeitungen einzelner größerer *Ascomyceten*-Gattungen macht sich immer mehr und mehr fühlbar. Der Wust der bereits beschriebenen Arten ist bereits so gewaltig angewachsen, daß es in vielen Fällen eine fast unlösbare oder wenigstens eine das Gefühl höchster Unsicherheit auslösende Aufgabe darstellt, ohne Originalexemplare etwas seltenere Arten einer größeren Gattung bestimmen zu sollen. Die Arten älterer Autoren sind vielfach für die Bestimmung dadurch ausgeschaltet, daß sich niemand aus der dürftigen Diagnose ohne gutes Vergleichsmaterial eine klare Vorstellung von ihnen machen kann. Und die neueren Arten leiden wieder sehr häufig daran, daß sie ohne Kenntnis der früher aufgestellten Formen falsch oder ungenügend beschrieben und vielfach in ganz unrichtige Gattungen gestellt wurden. Das ist natürlich ein ganz unhaltbarer Zustand, der wieder unter allen Bedingungen beseitigt werden muß. Und der einzige Weg zur Beseitigung der großen Confusion ist der der monographischen Durcharbeitung der Gattungen. Da aber bei größeren, schwieriger zu untersuchenden Gattungen eine vollständige Monographie auf Grund der schwer erhältlichen Originalexemplare eine zu hoch geschraubte Forderung ist, so müssen wir uns vorderhand damit begnügen, einzelne Formen gründlich zu studieren, genau zu beschreiben, richtig einzureihen und unnötig aufgestellte Arten zu eliminieren.