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The Validity of the Genus Pilaira

by

ROBERT S. ANDERSON

The Genera of the Dacrymycetaceae

by

G. W. MARTIN and M. C. FISHER

A Morphological Study of Certain Species of Tremella

by

ALPHA MAE LOONEY

Published by the University, Iowa City, Iowa

THE VALIDITY OF THE GENUS PILAIRA

ROBERT S. ANDERSON

The genus Pilaira, as established by van Tieghem,[1] was recognized as closely related to Pilobolus, and as similar to that genus in the character of the sporangium wall, which is entirely cuticularized except for a ring immediately below the insertion of the columella. In Pilobolus, however, the sporangium is shot into the air at maturity, breaking at the noncuticularized ring. The rupture is caused by the increasing pressure of the contents of the sporangiophore and this pressure is correlated with the characteristic swollen tip of that organ. In Pilaira, on the other hand, the sporangium, instead of being shot off, is merely raised by the lengthening of the sporangiophore to a height of ten or twelve centimeters and then either falls off or is detached by contact with any foreign object. Four species of Pilaira are listed in Saccardo's Sylloge Fungorum. Fitzpatrick,[2] however, in his recent treatment questions the validity of the genus, suggesting that the species described may have been based on abnormal developments of Pilobolus. In view of this statement it seemed worth while to re-investigate the matter. The studies were made in the mycological laboratory of the State University of Iowa, under the direction of Professor G. W. Martin.

Both *Pilobolus crystallinus* and *Pilaira anomala* occur commonly on rabbit dung collected in the vicinity of Iowa City when placed in moist chambers. Each lot of dung was carefully wrapped when collected, and every precaution was taken to exclude contamination. In most cases sporangia appeared in from two to five days—the Pilaira usually in two days, the Pilobolus in three or four.

Small glass bottles were sterilized by holding them over an open flame for two minutes. A single sporangium was introduced into each bottle, which was then plugged with cotton and marked. Pilaira sporangia were taken from fresh cultures by means of flamed forceps filed to needle points. In the case of Pilobolus, new sterile covers were put on the culture dishes when the sporangia

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1 Ann. sci. nat. bot. (VI) 1 : 51. 1875.

2 The Lower Fungi. Phycomycetes. 253. 1930.

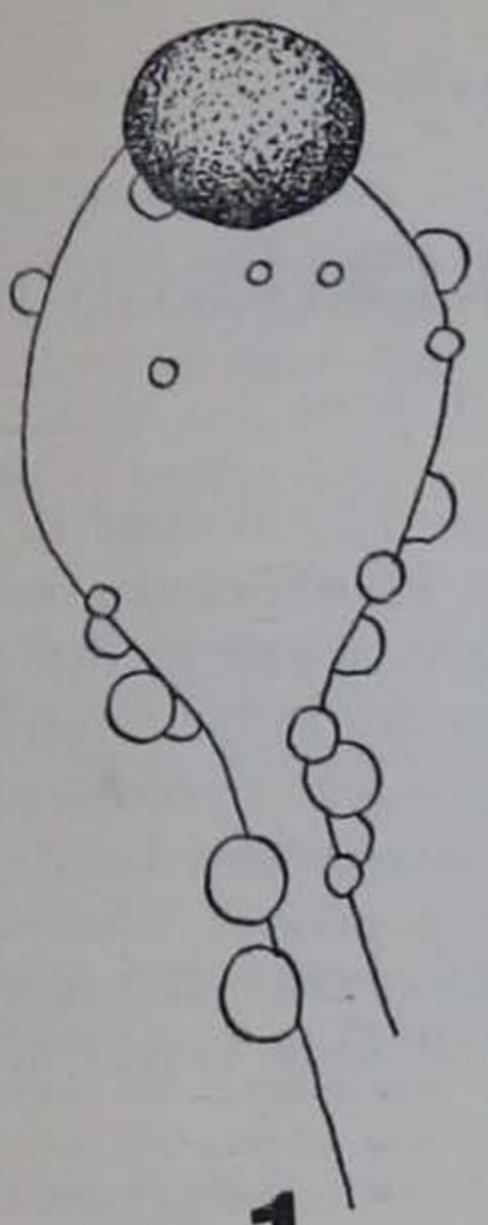
DESCRIPTION OF PLATE

All figures x 22.

Fig. 1. *Pilobolus crystallinus.* Typical sporangium and tip of sporangiophore.

Fig. 2. *Pilobolus crystallinus.* Aberrant sporangium, with lower portion as in Pilaira, but borne on a typical swollen sporangiophore.

Figs. 3-8. *Pilaira anomala.* Showing variation in sporangia.



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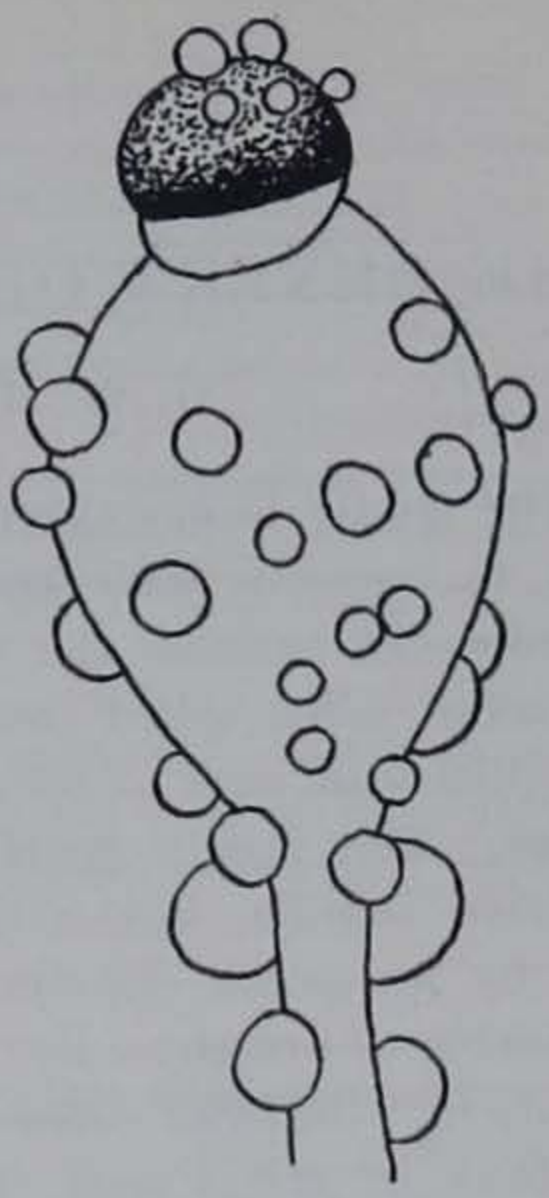

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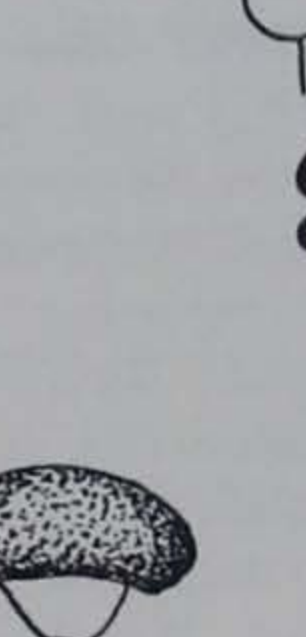

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THE GENERA OF THE DACRYMYCETACEAE

G. W. Martin and M. C. Fisher

The family Dacrymycetaceae was established by Brefeld in 1888 (2) to include those tremellaceous fungi in which the mature basidia are furcate, the cylindrical base giving rise to two thick branches, often called sterigmata, but which are better referred to as epibasidia, each of these being tipped by a true sterigma and a spore. The family itself is adequately characterized by its distinctive basidia, but within the family the generic distinctions are by no means clearly defined. Because of that fact it seems desirable to present a key to the genera which seem worthy of recognition, with brief comments on these.

Many of the Fungi included in the family have long been familiar. In the *Systema mycologicum* and *Elenchus fungorum* Fries mentions several genera and a number of species, but because of his relative neglect of microscopic characters they are not coherently grouped. Tulasne (12) was the first to demonstrate the peculiar characteristics of the basidia of the group but did not propose taxonomic readjustment. Brefeld, in erecting the family, regarded it as the lowest family of the Autobasidiomycetes, recognizing, however, its close relationship with the Tremellaceae. Patouillard (10) reunited the family, as the Caloceraceae, with the tremellas, rusts and smuts, in his group Heterobasidieae. Hennings (6) follows Brefeld, but most later writers, including Coker (3), Rea (11), Bourdot and Galzin (1), and Killermann (7), have adopted Patouillard's view. In Gäumann and Dodge (5) the family is regarded as constituting an independent order, coördinate with the Cantharellales of their treatment, both groups being derived independently from the Ascocorticium group. It is not our purpose to discuss at this time the arguments offered in support of these various viewpoints, since all recognize the distinctness of the family itself.

The following key is intended to make possible the recognition of the nine genera which seem to be fairly clearly definable:

a. Fructification broadly effused, thin; surface smooth; waxy when moist .... 1 *Arrhytidia*
a. Fructification pulvinate, cupulate or more or less pileate and erect ..... b
b. Sessile, or with a root-like base immersed in the substratum c
b. Erect, narrowly attached, usually stipitate and pileate ..... d
c. Discoid or pulvinate, often becoming cerebriform; attached by a point or more or less rooted ..... 2 *Dacrymyces*
c. Cupulate; tough gelatinous; spores large, becoming many-celled; hymenium inferior ..... 3 *Femsjonia*
d. Erect, subulate, simple or branched; hymenium covering entire exposed portion, hence stipe practically lacking ..... 4 *Calocera*
d. Stipitate and pileate ..... e
e. Pezizaeform; stipe short, thick, gelatinous except at base, which is fibrous; cortex of swollen, capitate cells; hymenium superior ..... 5 *Heterotextus*
e. Not pezizaeform; stipe tough; cortex not composed of swollen, capitate cells ..... f
f. Pileus subglobose or flattened as in Dacrymyces ..... g
f. Pileus not as in Dacrymyces ..... h
g. Stipitate or substipitate, the white fibrous, tough stalk separating into branches and deeply penetrating the substratum ..... 6 *Ditiola*
g. Stalk tough-gelatinous, cylindrical, not deeply rooting; head flattened ..... 7 *Dacryopsis*
h. Gelatinous, with a stout stalk and a swollen morchella-like, usually conical hymenophore ..... 8 *Dacryomitra*
h. Tough or cartilaginous; spathulate or cupulate; hymenium unilateral, inferior; stem more or less lateral ..... 9 *Guepiniopsis*

1. Arrhytidia Berkeley

Hooker's Jour. Bot. 1:234. 1849.

In configuration of the hymenium, this genus is similar to Corticium among the Hymeniales. Berkeley's diagnosis is very unsatisfactory. He believed the genus to be close to Merulius. He sent a portion to Fries, however, and the latter (Novae Symbolae Mycologicae p. 114, 1851) noted its relationship to Dacrymyces. This is confirmed by Lloyd (Myc. Writings 6: 899, 1919), who saw the type in Europe.

In 1885 Cragin published the genus Ceracea (Bull. Washburn College Lab. Nat. Hist. 1: 82). Cragin's diagnosis was copied in the Journal of Mycology, 1: 58, the same year, and this is often incorrectly cited as the place of publication. Cragin's name has been generally adopted, but his diagnosis is no better than Berkeley's, and since Berkeley's name was validly published, and the material upon which it was based has been verified by Fries and by Lloyd, Arrhytidia is clearly to be preferred. Cragin's type has apparently been lost.

The only specimens available to us for study are those distributed by Krieger as *Ceracea aureo-fulva* Bres., Fungi saxonici 1909. This material is characterized by a very flat, irregularly discoid fructification, the disks mostly less than a centimeter in diameter, but often much larger, up to 10 cm., the larger growth being apparently by confluence. The attachment is by a central point, the rest of the lower portion merely appressed to the substratum and following its irregularities. Von Höhnel regards it as the same as *Dacrymyces confluens* Karst. However, the texture is waxy, not gelatinous, and the spores are 1-septate, both of which characters suggest Arrhytidia. A typical Arrhytidia would undoubtedly be more broadly attached.

2. Dacrymyces Nees ex Fries
Syst. Myc. 2:228. 1823.

Nees wrote *Dacryomyces* and his spelling has commonly been adopted. Fries, however, maintained his spelling in several later works, suggesting that the change was intentional, and since it is not etymologically incorrect, this usage should be followed.

Dacrymyces is the best-known genus of the family and includes several of our commonest species. Nevertheless, the limits of the genus have not been clearly defined, and it has been confused with Femsjonia, Heterotextus, Ditiola and Dacryopsis. Most descriptions allude to the pileus as completely covered by the hymenium. This is incorrect, as the free portions which are not exposed to the air are always sterile. This is well brought out in the discussion and illustrations of Fisher (4). Since the attachment is always narrow, the lower portion of the hymenophore is always contracted at the base, which may be a mere point of attachment or may merge into a fibrous, root-like portion, but neither stem nor root are sharply delimited, as in the other genera named. Once the characters are understood, it is usually easily distinguished from all but Ditiola.

3. Femsjonia Fries
Summa Veg. Scand. 341. 1849.

The original description is as follows: "Cupularis, gelatina firma distenta, heteroplaca, subtus villosa, disco crasso discreto gelatinoso laevi, sporophoris immersis monosporis, sporis secedentibus."

Emphasis is here placed upon the cup-like character and the

smooth, gelatinous hymenium. Later writers, in discussing the genus, have emphasized the large spores, which before germination become divided into 12 to 20 or more cells. The cup-like fructification suggests Heterotextus, from which genus it is separated, however, according to the descriptions, by the lack of a firm, stem-like base, the absence of the capitate cortical hairs, the inferior hymenium and the large multi-septate spores. Istvanffi's figure, in Brefeld, shows a peziza-like base with a distinct margin, and the hymenium superior. Buller (Res. II, p. 165) publishes a photograph in which the margin is less apparent, and states that the hymenium is always directed downward. Our diagram is based on his statement and photograph. The cortex is evidently distinct from the interior, but Lloyd, who knew Femsjonia and established Heterotextus, thought them distinct. We have seen no examples.

4. Calocera Fries

Syst. Myc. 1:485. 1822.

Clearly diagnosed in the original description, although placed between Clavaria and Geoglossum, since Fries paid little attention to microscopic characters. Tulasne seems to have been the first to point out its true relationships (12). Usually spoken of as stipitate but Fisher has shown that our common species, *C. cornea,* is practically stemless and we assume that that is true of other members of the genus. In any event, the erect, narrowly attached, subulate fructifications are easily recognizable.

Calocera striata, as illustrated by Istvanffi in Brefeld's treatment, has a distinct stalk and a swollen, long-conical head marked with longitudinal striations, strongly suggesting *Dacryomitra pusilla* as illustrated by Tulasne, and if not that species, would at least seem to be congeneric with it.

5. Heterotextus Lloyd

Myc. Writings 7:1151. 1922.

The distinctive cortical cells characterize this genus satisfactorily, and it is not likely to be confused with any other after microscopical examination. Very old basidiocarps became highly deliquescent and suggest old fructifications of Dacrymyces, but even in such the cortical hairs persist. The genus has been discussed in a recent paper by Martin (9). It is there stated that

the hymenium is probably inferior. Professor Paul F. Shope of the University of Colorado, who has collected a typical species abundantly, informs us that in his experience the hymenium is always superior.

6. Ditiola Fries

Syst. Myc. 2:169. 1823.

As originally described, this genus was placed with more or less gelatinous Ascomycetes, following Bulgaria. In the Elenchus fungorum 2:17, 1828, note is made of its possible dacrymycetaceous affinities. The best-known species, *D. radicata,* has been studied by Lindau (8) and his treatment and figures are usually copied. It is undoubtedly close to Dacrymyces, differing in the more globose head and the short but firm stalk which merges into a usually branching, deeply-penetrating root.

7. Dacryopsis Massee

Jour. of Mycology 6:180. 1891.

This genus is like Dacrymyces in the character of its head, but it has a stalk resembling that of Dacryomitra but tougher and more cylindrical, which is little or not at all rooted, as contrasted with that of Ditiola. There has been a tendency in recent years to discard this genus, merging it with Ditiola and Dacryomitra, but we believe it should be retained provisionally, pending further study, as stated by Fisher. The citation Grevillea 20:24, 1891, sometimes given for the genus, is incorrect, as this is merely a copy of the earlier publication in the Journal of Mycology.

8. Dacryomitra Tulasne

Ann. Sci. Nat. Bot. 5 ser., 15:217. 1872.

Based on a species, *D. pusilla,* described and illustrated as erect, 8-10 mm. tall, with a gelatinous stem and somewhat swollen, clavate, conical pileus. The latter is marked by broad, shallow, longitudinal, anastomosing ribs. A second species, *D. glossoides,* was described by Brefeld (2) as having a broadly conical or rounded head, with much more pronounced ribs, giving it a strikingly morchelloid appearance. His species is much larger, attaining over 30 mm. in height. The drawing by Istvanffi accompanying Brefeld's description is the illustration of the genus commonly reproduced. Brefeld also notes that the spores of this genus be-

come 3-septate before germination while those of Calocera become 1-septate only, but the value of such a character as a generic distinction in the present family is distinctly subordinate. Bourdot and Galzin say the head may be either morchelloid or smooth, which again raises the question of the distinction between this genus and Dacryopsis. Note also the comment on *Calocera striata*.

We have not seen authentic specimens, although a small form occasionally collected in Iowa may belong to this genus, but the illustrations and descriptions of Tulasne and Brefeld seem to justify the retention of the genus as well as the segregation from it of Dacryopsis.

9. Guepiniopsis Pat.

Hyménomycètes, d'Europe 159. 1887.

This is the genus to which Fries' name Guepinia is often applied. Fries, however, founded the genus on the large funnel-shaped form often known as *Gyrocephalus rufus* which has longitudinally septate basidia; hence Guepinia is a genus of the Tremellaceae, and Guepiniopsis must be used for those gelatinous fungi with basidia of the dacrymycetaceous type commonly referred to Guepinia (see Martin, 9).

Fisher (4) has recently studied the two species occurring in Iowa, *G. spathularius* and *G. elegans*. The tough gelatinous, almost rubbery consistency of the pileus, the definite stalk and the sharp delimitation of the hymenium to the inferior side of the pileus make this genus easy of recognition.

Doubtful genera

The genera Apyrenium, Collyria, Myxomycidium, Hormomyces and Cladosterigma are listed as doubtful genera by Killermann (7). Of these, Myxomycidium Massee is said to be merely a pendent Calocera. The others are probably not to be included in the Dacrymycetaceae.

Dacryopsella v. Höhnel is an Hymenomycete, as shown by an examination of the type collection.

DESCRIPTION OF PLATE

All figures diagrammatic to show relation of hymenium, hymenophore and stipe, if present.

Fig. 1. *Ceracea aureo-fulva* Bres., x10.

Fig. 2. *Dacrymyces deliquescens* Fr., x17.

Fig. 3. *Femsjonia luteo-alba* Fr., x5, Diagrammatic section based on descriptions and illustrations of Brefeld and Buller.

Fig. 4. *Calocera cornea* Fr., x 12.

Fig. 5. *Heterotextus alpinus* (T.&E.) Martin, x5.

Fig. 6. *Ditiola radicata* Fr., x6. After Lindau.

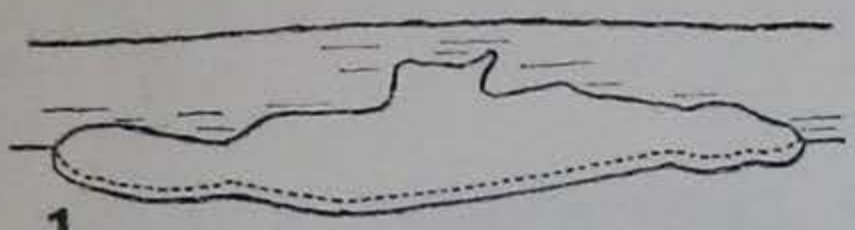
Fig. 7. *Dacryopsis nuda* Massee, x12.

Fig. 8. *Dacryomitra glossoides* Bref., x2. After Brefeld.

Fig. 9. *Dacryomitra pusilla* Tul., x5. After Tulasne.

Fig. 10. *Guepiniopsis spathularius* (Fr.) Pat., x6.

Fig. 11. *Guepiniopsis elegans* (Fr.) Pat., x 6.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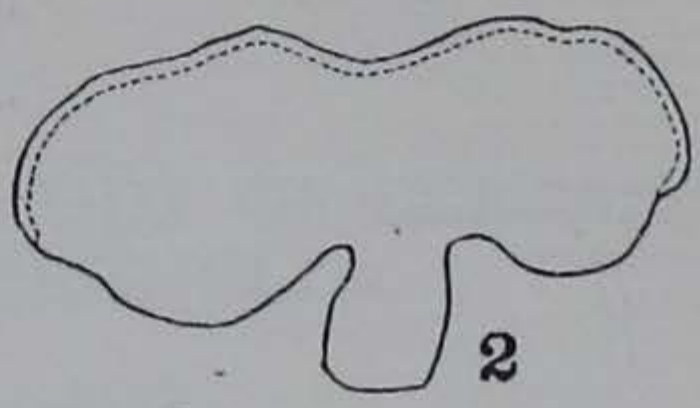
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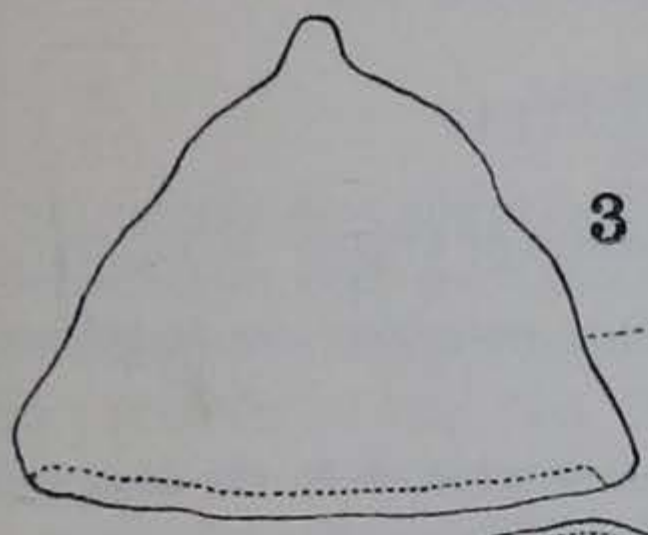
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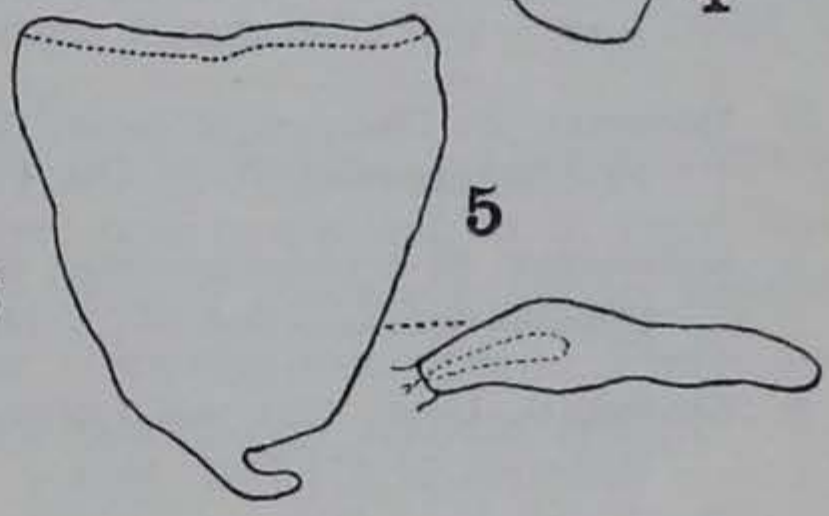
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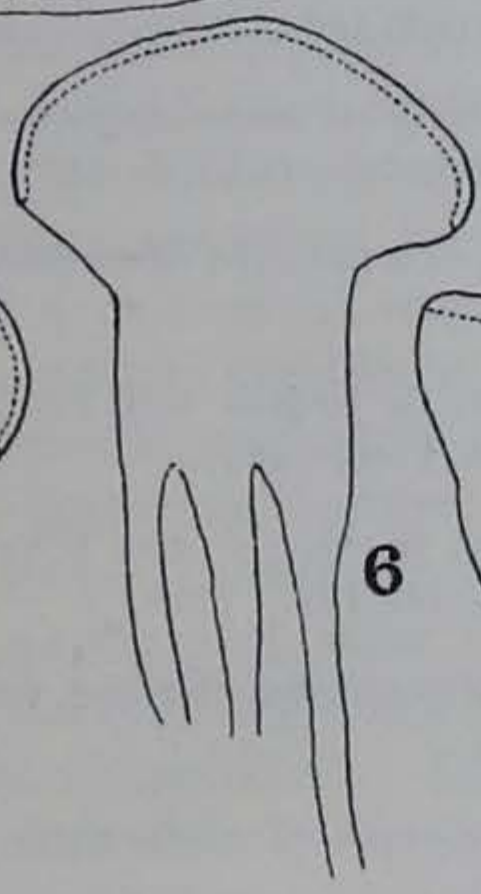
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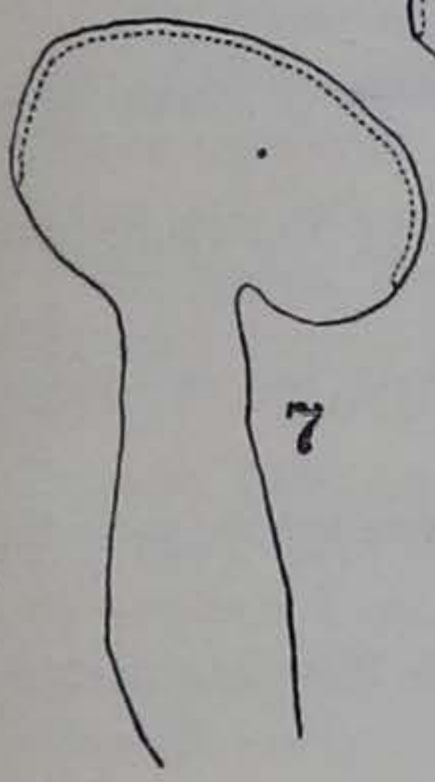
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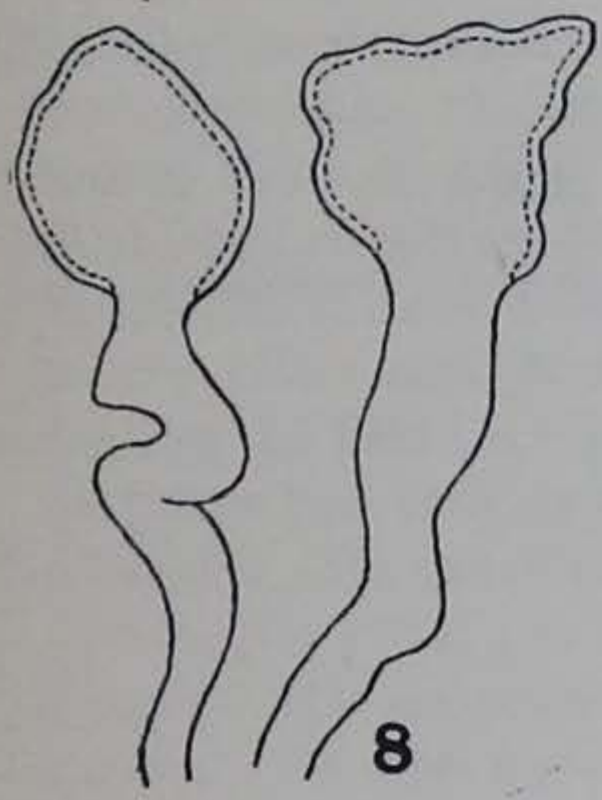
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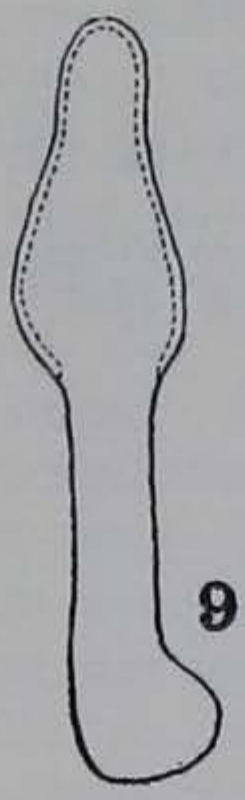
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A MORPHOLOGICAL STUDY OF CERTAIN SPECIES OF TREMELLA

ALPHA MAE LOONEY

This study was suggested by the great confusion existing in the Tremellaceae and particularly in Tremella, its type genus. The tremellas have never received adequate attention, a circumstance due probably to the fact that it is only during or immediately after wet weather that their fructifications are conspicuous, these structures at other times drying to mere films or at most shrivelled skeletons of the forms assumed under moist conditions. Although the fructification produces spores only when in an expanded state, the wood-inhabiting mycelium is active for a much greater part of the time and a number of these fungi have been suggested as important wood-rotting organisms.

The genus Tremella, so named by Dillenius in 1741 because of its soft, tough, quivering texture, was conceived in a very wide sense. Pre-Friesian authors generally included in it nostocs, lichens, tubercularias and even Gymnosporangium. Their descriptions, deplorably scanty, are practically useless except when accompanied by illustrations. Bulliard, however, gave full descriptions, accompanied by unusually satisfactory illustrations. Though many of the forms he included in the genus are not now regarded as tremellas, he did have an idea of the great variation possible within the species. Persoon (25) in 1801 excluded aquatic forms as algae. He retained twenty-five species, most of which are now placed in other genera, and divided them into four groups, the division based wholly on form. Albertini and Schweinitz (1, 1805) and Martius (20, 1817) made unimportant modifications of Persoon's grouping. By the time of Link (17, 1833) the genus had been fairly well cleared of the obviously erroneous inclusions. He provides a useful synonymy.

Fries (13, 1823) put into more logical form the work of his predecessors. His classification was largely on the basis of form and texture. By the exclusion of Exidia, Naematelia, Dacrymyces, Agyrium, and Hymenella from the genus Tremella it was greatly narrowed; even so, it included a number of foreign species and

synonyms. The genus was divided into three tribes: Hygromitroideae (stipitate and expanded into a head), with one species; Mesenteriformes (caespitose, foliately expanded, flaccid, naked), with five species, and Cerebrinae (pulpy-gelatinous, turgid, at first subcompact, pruinose with spores), with six species. His subdivision Coryne, synonomous with Persoon's Acrospermum, included certain species regarded as helotiums by Persoon. The other subdivision, Phyllopta, included forms parasitic on living fungi, and is, according to Fries, related to Sclerotium.

Thirty years after this work of Fries came that of the Tulasnes. In 1853 L. R. Tulasne published observations on certain tremellaceous forms (28). Though his taxonomic conclusions were fallacious in some cases, his accurate observations, clear discussions and drawings make this a work of fundamental importance.

Brefeld (5, 1888) recast the genus on the basis of spore shape. After separating species of Exidia, Ulocolla, and Craterocolla, the last two genera created by himself, only "round-spored" forms remained. Naematelia was included in Tremella. Brefeld is regarded by many as the great morphologist of the Tremellales, consequently, his taxonomic following is very extensive. It appears, however, that many points emphasized in his taxonomic decisions are of little or no significance.

Winter (29, 1884), using Fries' generic classification, with some modifications, retained the divisions Cerebrinae and Mesenteriformes; his Tuberculiformes, small erumpent forms, and Crustacea, flat fructifications, seem both to have been segregated from Cerebrinae. Winter did not separate forms with separate conidial fructifications.

The work of A. P. Morgan (21, 1888) of Ohio, territorially limited and with only brief descriptions, is of significance only as one of the first attempts in this country to classify the Tremellaceae of a particular area.

Berkeley and Curtis did little of critical nature with the tremellas. The same might be said of Cooke, whose work was not sufficiently accurate and thorough to be of value. He followed Brefeld in his classification.

The work of Patouillard (23, 1900) has been unduly neglected in this country. He adopted Karsten's Ditangium for forms with separate conidial fructifications. He included Naematelia in Tremella and divided the genus into (A) Foliaceae, with erect,

variously contorted lamellae, (B) Cerebrineae, with obtuse and contorted veins on the surface, (C) Crustaceae, expanded and with smooth surface (e.g. *T. nucleata*), and (D) Tuberculiformes, minute fructifications appearing as round or flat tubercles.

In America, in the last twenty years, a number of mycologists have studied the Tremellales. Gilbert (14, 1910) presented descriptions, discussions and a history of the group as represented in Wisconsin, accompanied by a most excellent bibliography. Coker (8, 1920), of North Carolina, worked on the species of his state. Burt's notes (7, 1921) on the Tremellales are very accurate. Lloyd's voluminous notes, resulting from an extensive examination of native and foreign species, have never been compiled. Martin and Huber (19, 1927) treated all species of Tremella known at that time from Iowa.

Of the modern European mycologists, four should be considered in connection with their work with the Tremellales. Rea's treatment (26, 1922) of the genus *Tremella* is not especially notable. In addition to the usual subgeneric divisions, Foliaceous, Cerebriform, Crustaceous, and Tubercular, a fifth, characterized by a firm, hard nucleus, accommodates naematelias.

The taxonomic arrangement given by Bourdot and Galzin (4, 1927) is probably the best for the genus Tremella, the genus here including Naematelia as one of the four subdivisions, the other three being Mesenteriformes, Cerebriformes, and Tuberculiformes. The descriptions of the species are the result of careful research. Furthermore, the number of species considered is great enough to permit the application of the key and descriptions in countries other than France.

Killermann, in Engler and Prantl, 2 ed. Vol. 6 (1928), in his treatment of the genus follows Brefeld in including Naematelia and recognizing the separate genus Craterocolla. He divides Tremella into six sections, Crustaceae, Cerebrinae, Mesenteriformes, Tuberculiformes, Claviformes, and Phaeotremella, the last division to accommodate Rea's dark-spored *Phaeotremella pseudofoliacea*.

The standard work of Saccardo, even though it is only a combining of the results reported by other investigators, must be consulted frequently, but with caution.

Neuhoff (22, 1931) provides a critical key to the European species of Tremella, recognizing nineteen species and listing a number of additional species he regards as doubtful.

It will be observed in a review of the literature of the genus Tremella that the progress can be divided into rather definite steps; after the early confusion, when various foreign forms such as algae, imperfects, lichens, etc. were included, came, beginning with Persoon, the attempt at organization, excluding the most obviously foreign members, and finally with the Tulasnes and Brefeld, the use of basidial and spore measurements and descriptions to further delimit and organize the genus. While comparatively little intensive research has been done on Tremella, the genus has gradually been defined until today it possesses at least some degree of homogenity. Now that classification is on a more fundamental basis than habit characters and texture afford, it appears that comparative stability within Tremella and related genera may soon be achieved. However, if the varying responses of particular species under different circumstances were to be observed, it is probable that many of the present specific boundaries would fall.

I have attempted, in the two discussions following, to make the work as accurate as possible and to base it, so far as facilities permitted, on objective standards. Colors describing the specimens are to be found in Ridgway's *Color Standards*. A camera lucida was used in making the drawings, all from material under the oil immersion lens and 10x ocular at the uniform magnification of 1600x. In selecting subjects for the drawings and measurements, an attempt was made to include the forms appearing most commonly within an individual specimen. Though it was not always possible to interpret all hymenial structures observed, drawings of them have been included for reference in future research. It is hoped that the history included in this introduction and the two discussions following may be of assistance to others attempting to meet the problems encountered in the genus Tremella and other related genera.

The work has been done in the mycological laboratory of the State University of Iowa under the direction of Professor G. W. Martin.

Tremella frondosa and *Tremella foliacea*

Both Coker and Lloyd express doubt whether *frondosa* and *foliacea* are distinct; I attempt to offer proof of their probable synonomy.

Tremella frondosa, a common species, has been described by a number of authors. All agree substantially as to habit of growth,

greater diversity of opinion occurring as to color. It is believed by all except Cooke that with age *frondosa* becomes darker, approaching black. Disagreement exists as to the color of the young stage, which is described as yellow or reddish yellow, fleshy brown, tawny and russet. Cooke describes it as yellow, growing pale. In material used for this study I found only one specimen which was not bearing spores; in color it ranged from cinnamon buff to honey yellow, which may or may not mean that the young stage is really lighter. I find little or no correlation between size of spores and color of specimen, and it is doubtful if there is much, if any, correlation between size of spores and size of fructification.

The spore measurements reported by unassociated workers are extremely inconsistent. Schroeter reports 5-7 μ, Bourdot and Galzin 7.5-10 x 7-9 μ, Martin and Huber 7-9 μ, Rea 8-10 μ, Coker 5.5-7.7 x 6-10.5 μ, Brefeld 10-17 μ*, Cooke 7-12 μ and Neuhoff 7-10 x 7-9 μ. My own data, 3.5-7.5 x 5-10 μ, include the greater part of these figures. Saccardo and Cooke alone call the spores globose, Rea subglobose, Coker, and Martin and Huber, spherical to short-oval or broadly oval, Brefeld pyriform to globose, Bourdot and Galzin elliptical to subspherical, all of them apparently describing the same shape. I find the spores to be broadly oval to subglobose.

Few basidial measurements are given. Saccardo and Cooke describe the basidia as globose and 15 μ in diameter. Bourdot and Galzin record them as 14-18-24 x 11-12-18 μ, Neuhoff as 16-20 (—24) x 12-18 μ. Coker calls the basidium pear-shaped, and ranging from 7.7-9.3 x 11-15 μ, with a few reaching 18 μ. My own measurements, 7.25-14.8 x 8.6-16 μ, include those of Coker, but the upper limits of those of Bourdot and Galzin have not been approached by several microns, though it is not doubted that such a divergence is easily possible.

Much misunderstanding exists concerning *Tremella foliacea*. Some authors recognize it as a species distinct from *Tremella frondosa*, some place it in a different genus, *Ulocolla*, and still others consider it synonymous with *T. frondosa*.

Tremella foliacea of Persoon's original description was a caespitose, concave (Peziza-like), undulate-plicate, cinnamon red form, crinkled at the base, each individual measuring one inch in diameter. He describes the substratum merely as rotting trunks. He considered *T. mesenteriformis* a synonym, citing in Bulliard's

* Neuhoff (Bot. Archiv. 8:253, 1924) points out that Brefeld's measurements are always too large, due to errors in the scales he used.

Plate 406, figs. *A* and possibly *a*, which are very similar to the illustrations of *T. frondosa*.

The indefiniteness of the original description makes it impossible to say whether or not Fries has misinterpreted *T. foliacea*, as conceived by Persoon. Fries describes the species as dull rufous, lobes undulate, with furrows connate at the base, an autumnal form from one to two inches high and appearing on old fir, pine, and birch trunks. The importance of the concave character, given by Persoon, but not mentioned by Fries, can be determined only by examination of type specimens, if such exist.

In *T. frondosa*, his own species, Fries describes a very large caespitose form with gyrose undulate lobes and plicate base. As opposed to *T. foliacea*, it is firm, pallid yellow, and is reported on oak and beech. This would not of itself establish a new species.

With no basidial or spore characterization by Persoon or Fries, *T. foliacea* is subject to varied interpretations. The descriptions by Bourdot and Galzin and Rea agree in most points. To Bourdot and Galzin the species is brownish- or flesh-red, becoming lighter with age, undulate-sulcate, base plicate, 3-10 cm. in height and approaching roundness, the basidia nearly hyaline but becoming umber-brown and measuring 10-14 x 13-16 μ, the spores ovoid, spherical, 6-9 x 8.9-13 μ. Rea, however, records the spores as globose and 5-7 μ.

To Bourdot and Galzin *T. frondosa* is lighter, more yellowish than *T. foliacea*, slightly larger (5-12 cm.), on beech and holm oak. Neither spores (elliptical or subspherical, 7-9 x 7.5-10 μ) nor basidia (11-12-18 x 14-18-24 μ) differ significantly. However, they do not record brown basidia for *T. frondosa*. Rea finds greater differences in height, *T. frondosa*, 10-12 cm., beginning at the upper limits of *T. foliacea*. This relatively greater size, 8-10 μ, is true also for the globose spores, which agree with those of Bourdot and Galzin.

It is highly probable that Bourdot and Galzin and Rea do not describe two species,—only different expressions of *T. frondosa*. I have found the brown basidia, as reported by Bourdot and Galzin, but I cannot, from data available, regard those specimens containing them as anything other than variations of *T. frondosa*.

Tremella foliacea, in the sense of Bresadola, as quoted by Coker, varies from hyaline-saccharine to fleshy-isabelline with umber violet, 4-8 cm. in height and width, spores globose and 7-10 x 7-9

μ, just beyond the figures by Rea, and the basidia 14-16 x 16-18 μ, beginning at the upper limits of measurements by Rea, and Bourdot and Galzin. He finds this species on Larix and Abies.

A new genus, Ulocolla, was established by Brefeld, on the basis of rod-shaped conidia produced at the ends of the germination tubes of the spores, to include *Exidia saccharina* and *Tremella foliacea,* with the latter possibly only a variety of the former. This *U. foliacea* Brefeld described as of the color of brown sugar, but darkening with age, lighter and sterile below, margins folded or the entire surface furrowed, the basidia and spores like those of an exidia, the spores being reniform and measuring 5-6 x 10-12 μ.

T. frondosa, to Brefeld, was a large tough-gelatinous tremella with distinct irregular ear-like lobes, weak red-yellow to chestnut brown in color, darkening with age, spores pear-shaped or globose and 10-12 μ, and found on both coniferous and deciduous wood. Obviously, Brefeld has two distinct species, but since the form he describes and figures as *Ulocolla foliacea* agrees in practically no respect either with Persoon's original description of *T. foliacea* or with that of Fries, one can hardly believe him justified in his synonomy. It seems also that he has interpreted *T. frondosa* too narrowly.

Cooke and Saccardo follow Brefeld in recognizing *U. foliacea.* Cooke, though agreeing essentially with Brefeld, describes the fructification as caespitose, 5-8 cm. broad, undulate, with plicate base, flesh or cinnamon, spores and conidia as described by Brefeld.

Cooke believes *T. frondosa* to be a large caespitose form reaching 15 cm. in diameter, with gyrose undulate surface, plicate base, color yellow growing pallid, not darker as Brefeld states, the spores globose and 7-12 μ, the globose basidia 15 μ.

Saccardo has merely combined the data of Brefeld and Cooke, except to note that *U. foliacea* occurs on fir, pine, and birch. He gives also for *T. frondosa* Schroeter's spore measurements, 5-7 μ, as well as those of Brefeld.

Gilbert describes *T. foliacea* as a form 2-5 cm. in height and 2-10 cm. in diameter, pinkish cinnamon, rarely deep brown, plicate base, with lobes so thick that a specimen can rarely be called foliaceous, spores and conidia as given by Brefeld. His figures, like his description, resemble very closely *Exidia recisa.* Gilbert's

description of *T. frondosa* is very indefinite. He finds it to be an extremely variable form, ranging in color from clear yellow to reddish brown, the lighter forms being the smaller. This species occurs most frequently on oak and may become 10-12 cm. in height and 25 cm. in length.

Lloyd suggests that possibly no distinction exists between *T. frondosa* and *T. foliacea,* except that the latter is supposed to be darker. He finds the hymenium the same, the spores hyaline, globose, usually 8 μ but some beyond 12 μ, and the basidia brown, varying greatly. Lloyd believes that *T. frondosa,* in the original sense, was only a large *T. foliacea,*—a commendable conception.

Coker, too, doubts, that a distinction can be made between *T. frondosa* and *T. foliacea.* However, his description of *T. frondosa* does not accommodate smaller and lighter forms previously segregated. His new species, *T. aspera,* includes forms distinguished from *T. frondosa* by larger spores (7-10 x 7-9 μ) and much larger basidia (16-18 x 14-16 μ), crumpled, thicker, less simple and less perfect lobes, more tender structure and darker color.

Neuhoff recognizes both species, agreeing essentially with the characters given for them by Bourdot and Galzin, except for the establishment of the variety *succina* to include those smaller, red-brown forms of *foliacea* found on coniferous wood and having brown basidia. He notes that the variety and the species are connected by transitional forms.

When one recognizes the importance of the study of basidia and spores, it becomes apparent how nearly impossible it is to distinguish between *T. foliacea* and *T. frondosa,* as described by the original authors, particularly with the great variation given for *T. frondosa.* Only by study of the type herbarium specimens can the distinction, if there is one, be established.

Taking into account the previous work on these two species and the data from specimens examined, *Tremella frondosa* may be characterized as follows:

Tremella frondosa, the largest species of the genus, may attain a height of nine centimeters or more; it is commonly elongated and slightly wider than high. The base of the fructification is laterally flattened and greatly elongated; the conspicuous furrows or plications, gyrose at times, are very close together at the base, becoming spread, branched, and less distinct as they progress upward,

disappearing in the lower half or fourth of the lobes arising from the base.

The lobes, frequently greatly contorted and fused at points with associated lobes, may be large, thin, undulate, with ruffled or only shallow scalloped margins, or there may be, even on the same fructification, coarse ridges which form a low, gyrose mass. The margins or even the entire free portions of the lobes are usually lighter than the body and certainly than the base of the fructification. This lighter portion, frequently cinnamon or clay color, may be as pale as cinnamon-buff or honey yellow. The base of the lobes, typically between Mars brown and Prout's brown, may be nearly umber, olivaceous brown, tawny, or russet. One specimen studied was a clear homogenous chestnut color. The base is always very nearly or quite black.

The basidia vary in shape from a somewhat compressed form, with the transition from hypobasidium to epibasidium abrupt (Fig. 8,d), to the comparatively slender oval or obovate basidium with a gradual transition from hypobasidium to epibasidium (Fig. 4,b). In size the hypobasidia range from 7.25 μ to 14.8 μ in width by 8.6 μ to 16 μ in length. The ratio of width to length, as estimated from averages of basidial measurements of each specimen, ranges from 1:1 to 1: 1.4. Since there is much variation in size and outline of basidia, these characters cannot be used as diagnostic characters except in connection with other characters also. In the specimens studied the gradations between the basidial types, as well as in the size of spores, and the external characters, harmonize to the extent that one can do little other than call them all *Tremella frondosa.*

The spores are broadly oval to almost spherical or with one slightly flattened side (Plate I) ; the large mucro is displaced somewhat toward the flattened side. Though the spores show a remarkable range in size, the gradation is perfect. The width ranges from 3.5 μ to 7.5 μ, the length from 5 μ to 10 μ, the ratio from 1 :1.1 to 1 :1.7. Though the range is great, other characters of the individuals are such as to tie them all definitely into a single species. The spores, like the basidia, vary from hyaline to pale yellow, the contents usually evenly and finely granular, very seldom with large globules.

From the examined material labeled *T. foliacea* no conclusions can justly be drawn. Only fragments were available; they appear

much like the typical *frondosa*. The basidia, however, are outstanding in their cream and finally deep yellow or decided brown color. Frequently they are borne at the tips of much enlarged stalks (Fig. 12,a,b). They range from 8.5-15.5 μ in width by 10-19 μ in length. The yellow or brownish yellow spores range from 4.5-6.8 μ by 7-9 μ. The specimens studied for *T. foliacea* appear, from basidial and spore characters, to represent only a variation of *T. frondosa*.

At present it does not seem possible to prove that *T. foliacea* is only an expression,— environmental, age, or otherwise —, of *T. frondosa*. The descriptions of Persoon, Fries, Cooke, Bourdot and Galzin, Rea, Saccardo, Brefeld, Lloyd, Gilbert, Coker, Neuhoff, Martin and Huber, and specimens from both Europe and America have been reviewed in the investigation of this point. Though I feel that they furnish less than absolute proof, I find much evidence for the synonomy of the two species.

Tremella lutescens and *Tremella mesenterica*

Among modern mycologists doubt has arisen that *Tremella lutescens* and *Tremella mesenterica* are distinct species. Coker recognizes only *T. lutescens*, but he presents no evidence in support of his decision. The purpose of this treatment is to offer proof of the synonomy of the two species.

As diagnostic characters habit, color, and texture have always been important in distinguishing between the two species. The season of appearance was emphasized by early students, but today it is disregarded; basidial and spore measurements are now considered very important.

In the sense of Fries and other very early mycologists, *Tremella mesenterica* Retz., is a simple, ascending, gyrose, plicate-undulate, smooth, tough, orange fructification appearing in winter and particularly in spring. Cooke later adds that the spores are shortly ellipsoid and 6-8 μ in diameter. Brefeld believes *T. mesenterica* a flatter, soft form with the lobes forming reticulate folds and the spores 10-12 μ.

The indefinite descriptions of earlier students have resulted in hopeless confusion among modern workers who have failed to observe the extreme variability in the form of the fructification. Bourdot and Galzin find *T. mesenterica* to be smaller and more nearly foliaceous than Rea indicates; otherwise their descriptions are essentially the same, regardless of the slight non-conformity

in basidial and spore measurements. Bourdot and Galzin find the spores to be ovoid or spherical, 7-10-12 x 6-9-10 μ and Rea broadly elliptical, 13-14 x 7-8 μ, the basidia 15-20 x 10-18 μ and 15-20 x 12-18 μ respectively.

Among the recent American mycologists Gilbert, Lloyd, Martin and Huber, and Coker have worked on the species. Only in spore measurements does noticeable difference of opinion appear. Martin and Huber report the spores as measuring 12-14 x 8-10 μ, included in the measurements of Bourdot and Galzin and Rea. Gilbert agrees with Cooke in spore measurements (6-8 μ), while Lloyd finds the spores to be ovoid and 6 x 8 μ. Only Lloyd reports basidial measurements, 14 μ.

Persoon recognized the species *T. mesenterica,* but he described the new species *T. lutescens* to accommodate those forms resembling *T. mesenterica* except that they are paler, much softer, and appear in the autumn; Fries described it more fully as caespitose, with lobes crammed together and later connected, the fructification almost fluid in consistency, and whitish yellow in color.

Cooke, agreeing with previous conceptions as to habit, color, and texture, adds that the globose spores of *T. lutescens* measure 12-15 μ, four microns above the measurements for *T. mesenterica.* Brefeld, in disagreement with Cooke, considers *T. lutescens* the larger form. He adds also that the fructification when young is orange, but with age it becomes paler, even clear and crystalline. The basidial measurements given by Brefeld agree with those reported by Cooke, and begin at the upper limit of those of *T. mesenterica.*

T. lutescens in the sense of Bourdot and Galzin is slightly larger than *T. mesenterica,* definitely foliaceous, much paler—sulphur or very pale citron cream, almost hyaline when very moist, the spores possibly slightly longer, 10-11 (-22) x 7-10 μ (*T. mesenterica* 7-10-12 x 6-9-10 μ) and the basidia 12-25 x 16-18 μ (*T. mesenterica* 15-20 x 10-18 μ). Rea finds about the same difference in the two species except that *T. lutescens* is much smaller. The spore measurements are the same as those given by Bourdot and Galzin and little different from those given by Rea for *T. mesenterica.* The basidia range somewhat larger for *T. lutescens,* 19-25 x 17-18 μ (*T. mesenterica* 15-20 x 12-18 μ); Bourdot and Galzin find a greater range of basidia, but the upper limits are the same as those of Rea.

Gilbert distinguishes between *T. mesenterica* and *T. lutescens* by the form and change in color, with *T. mesenterica* more brain-like and growing paler, and *T. lutescens* more mesentery-like, becoming more yellowish. Gilbert finds the spores of *T. lutescens* subglobose and much larger (12-16 μ) than those of *T. mesenterica* (6-8 μ in diameter). Lloyd finds no difference in the two species except that one, *T. lutescens*, is very pale yellow; his spore measurements (6 x 8 μ), like the basidial (14 μ), are not sufficiently extensive.

Martin and Huber have described *T. lutescens* as composed of hollow capitate lobes, rather firm, with the globose or broadly oval spores 6-9 μ. Martin now believes the two species are only different expressions of the one, *T. lutescens*.

T. lutescens to Coker is a lobed mass with many of the larger lobes hollow, color pale to clear orange, firmly gelatinous, and with the spherical to short elliptic spores measuring 6.3-9 x 7-13 μ.

Neuhoff, like Bourdot and Galzin, finds the spores of *lutescens* (10-16 (-20) x 8-12 μ) to be slightly larger than those of *mesenterica* (6-10 x7-10 (-12 μ)); he reports the same relationship in respect to the basidia (*lutescens*, 15-20 x 18-25 μ and *mesenterica*, 14-20 x 12-18 μ). Though Neuhoff's conception of the two species agrees in important particulars with that of Bourdot and Galzin, he differs in regarding *mesenterica* the larger and more deliquescent, less stable of the two species. He states that no conidia are produced in *lutescens*.

After an extensive, critical review of the literature and microscopic examination of specimens, I can recognize only one species, *Tremella lutescens*. The species is extremely variable. In color it ranges from practically hyaline through cream, baryta yellow, Naples yellow, buff yellow, warm buff, cinnamon buff, honey yellow, through the brilliant deep chrome, cadmium yellow, capucine yellow and orange, up to the intense Mars yellow. The most frequent coloration ranges from deep chrome or cadmium yellow to capucine yellow or orange.

The form assumed is dependent upon age and position on the limb. The fructification first appears as a tiny pale button, which grows into a thin lobe gathered at the base and often cupped; this stage is extended to form a linear, ribbon like series. As growth progresses folding appears in the upper part of the fructification. The form of the mature fructification is determined by position on substratum, those appearing dorsally being more or less cerebri-

form, and those appearing ventrally or laterally tending to grow upward, adhering to the bark, the free surface with the usual configurations, the adnate surface characterized by gyrose striations. In all forms there is a striate or sulcate area above the point of attachment beyond which the fructification quickly assumes a cerebriform-gyrose, or even more or less foliaceous character.

On account of this variation in the form the fructification assumes and the fact that the fungus begins fruiting quite early, it is obvious that measurements of habit are practically worthless. I have record of fruiting bodies from 3 mm. to 5.5 cm. in height, while a resupinate form spreads laterally 7 cm., and extends 3.5 cm. from point of origin directly out to the tip of the primary procumbent lobe.

Ordinarily the fructification is gelatinous, even deliquescent, but one finds specimens which apparently have been dried before their decline and, on being soaked, appear brittle and horny. Fresh conidial forms and declining specimens, which are commonly nearly or entirely hyaline, are extremely watery in consistency.

Tremella lutescens very early begins the production of conidia. The forked and branched conidiophore (Fig. 24) bears conidia which range from spherical and 2-3 μ in diameter to elongated forms with a length two or three times their width. It is difficult to draw a line between the larger conidia and certain other hymenial structures which are very confusing. One finds a great many globose surface bodies supported by an elongated inflated cell (Fig. 22c) with the greatest diameter nearly approaching or exceeding that of the superior structure; others show simply a heavy wall about the whole with no surface constriction, yet a distinct dividing line exists (Fig. 18f). Again, one finds a much inflated cell supporting the smaller globose end cell (Fig 22e). A branch may bear two spore-like bodies on opposite points (Fig. 21c). Chains of somewhat enlarged and rather elongated heavy-walled cells (Fig. 17b), sometimes with clamp connections, are frequently seen. There are also large bodies approaching the size of basidia (Fig. 22f), commonly hyaline, though sometimes containing protoplasm that has occasionally divided longitudinally (Fig. 22g), much as do basidia.

I have no suggestion as to the significance of these hymenial monstrosities. In them one can find a reasonably convincing trans-

ition from conidia to basidia, and this may be the proper interpretation, especially since they appear, for the most part, in an area intermediate between the conidial and the basidial regions and amidst the basidia.

Within a single hymenium one finds much variation in shape and size of basidia. There is a perfect gradation from the somewhat elongate basidia (Fig. 16a) with a ratio of 1:1.4 (of average width to length) to those slightly compressed (Fig. 17a) with a ratio of 1:0.89. In width they range from 12 to 27 μ and in length from 12 to 18 μ. However, the variation as gathered from the averages of the individual specimens would be 13 to 21.5 μ for width and 15.6 to 23 μ for length. In color they vary from hyaline to distinctly yellow.

The spores (Plates II, III) vary from subspherical to obovate, broadly elliptical, and ovate. In width they range from 6 μ to 12.5 μ and in length from 8.5 μ to 15.7 μ. Expressed in averages the range would be from 6.7 to 10.5 μ in width by 9 to 13.2 μ in length, which probably includes the more frequent sizes. In color the spores may be hyaline, light cream, or rather a decided yellow.

Paraffin sections (Fig. 27) show that the cavities within the fructification are produced by lobes falling over. Where a lobe touches another part of the fructification coalescence occurs to a certain extent, yet leaving an appreciable open area which usually displays at least some of the peculiar hymenial structures previously described. However, it appears probable that some hollowness may result in older parts of the fructification from the breaking down of interior hyphae.

I have found no justification for retaining the two species. After a study of the forms assumed at different stages of development, I find it almost certain that what most authors refer to as *T. lutescens* is either a young or late form of *T. mesenterica*, as ordinarily described, or can be explained as a response to environmental conditions. No true distinctions can be established on relative size, spores, and basidia, for no sufficient agreement exists. I have found in a single collection all variations from the pale young forms through the orange cerebriform or prone lateral forms, to the soft, pallid deliquescent stage. Fries indicates that *Tremella lutescens* may be described as foliaceous and *T. mesenterica* cerebriform, but I have seen specimens which were partially foliaceous, some areas remaining cerebriform. Furthermore, with-

in a single specimen I have found a range of spore and basidial measurements sufficient to indicate both *T. lutescens* and *T. mesenterica* as reported.

After a microscopic examination of a great number of specimens of a single species, it becomes apparent that the seeming disagreement in spore and basidial measurements reported is not to be taken too seriously. The spores are to be considered somewhat longer than broad,—shortly ellipsoid, ovoid, occasionally spherical. Some authors report only one dimension. Considering the shorter dimension one finds most authors agree substantially. Neither in the basidial data is appreciable disagreement reported; most seeming discrepancies are practically negligible.

With the results of this study in mind, I cannot consider substantial the differences between *T. lutescens* and *T. mesenterica*, as described by Fries. Consequently I am combining the two species. Since the name *lutescens* appears first in Fries *Systema Mycologicum*, a pedantic application of the International Rules of Nomenclature requires that this name be used. However, in modern literature it is the descriptions of *T. mesenterica* that apply to the brilliant orange, usually cerebriform phase most commonly collected; hence, much confusion would be prevented by the retention of this name. Furthermore, it seems indeed unfortunate to apply to this tremella, brilliant and substantial the greater part of its existence, an utterly inappropriate name, which has always been associated with a pale, washed-out, yellow, deliquescent form, which proves to be the declining or unusual environmental expression of the species. However, if the taxonomic system is to be relieved of its present confusion, a strict following of the International Rules is necessary, even though in some cases, as this, such strictness may bring about inappropriate naming.

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PLATE I

Tremella Frondosa and T. Foliacea

All figures of microscopic details drawn with camera lucida at a magnification of 1600 diameters, and reduced to 800 diameters in reproduction.

Fig. 1. G. W. M. 704. a. basidium; b. spores.

Fig. 2. G. W. M. 154. a.-b. basidia; c. spores.

Fig. 3. L. 61. a.-c. basidia; d. spores.

Fig. 4. L. 62. a.-b. basidia; c. spores.

Fig. 5. G. W. M. 154. a. basidia; b. spores.

Fig. 6. L. 67. a.-b. basidia; c. tip of epibasidium; d. spores.

Fig. 7. L. 65. a. basidium; b. spores.

Fig. 8. M. B. G. H. 59652 a.-e. basidia; f. tip of epibasidium with young spore attached to lateral sterigma; g. spores.

Fig. 9. G. W. M. 159. a.-b. basidia; c. spores.

Fig. 10. L. 60 spores.

Fig. 11. M. B. G. H. 60496 a.-c. basidia; d. spores.

Fig. 12. G. W. M. 148. a.-b. basidia (brown) raised above the hymenial layer on stalks; c.-d. basidia of usual type; e. chlamydospore (?) f. spores.

Fig. 13. L. 44. a.-b. basidia; c. swollen anastomosing hyphae tipped by basidia-like cells; d. peculiar dark hymenial structure which by division shows a relationship to the basidia.

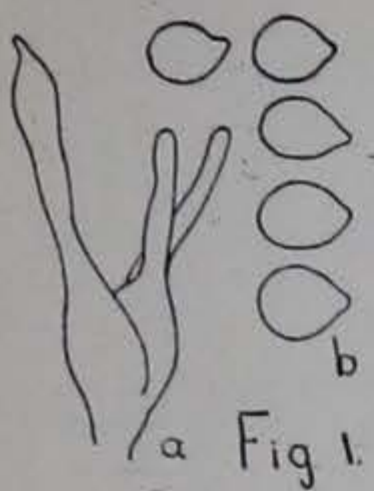

Fig 1.

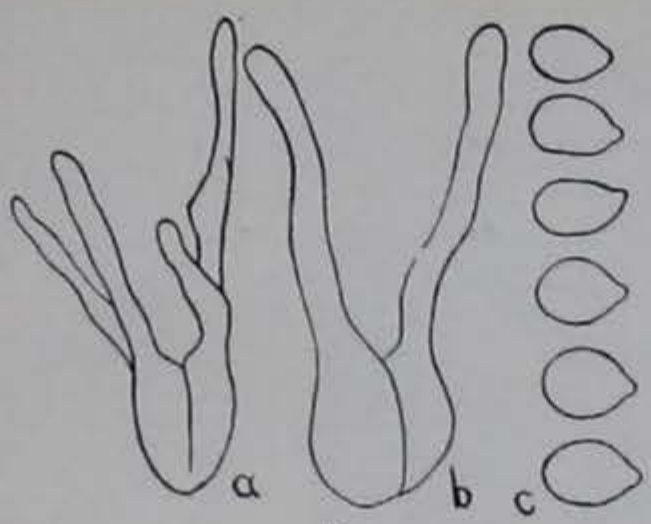

Fig 2.

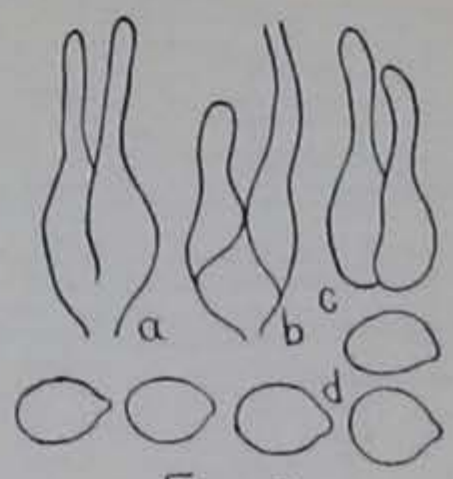

Fig 3.

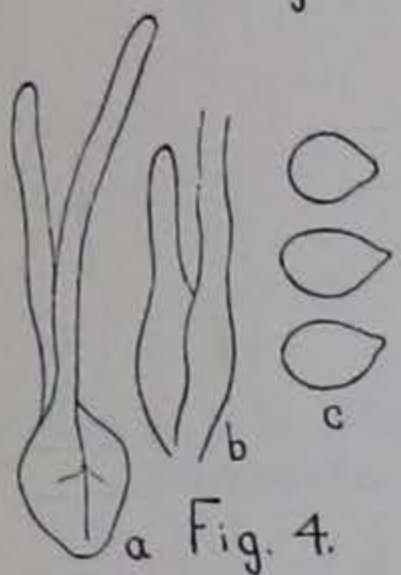

Fig. 4.

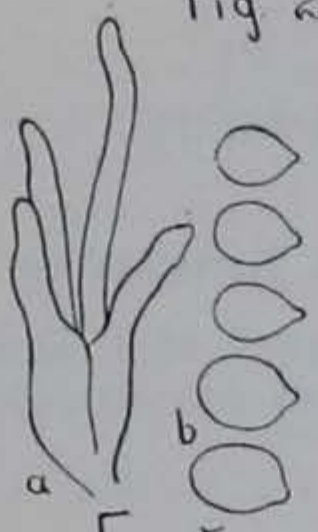

Fig 5.

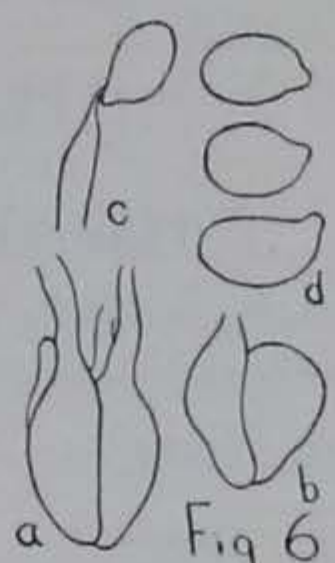

Fig 6

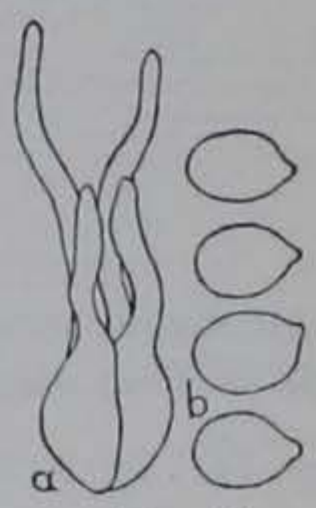

Fig. 7

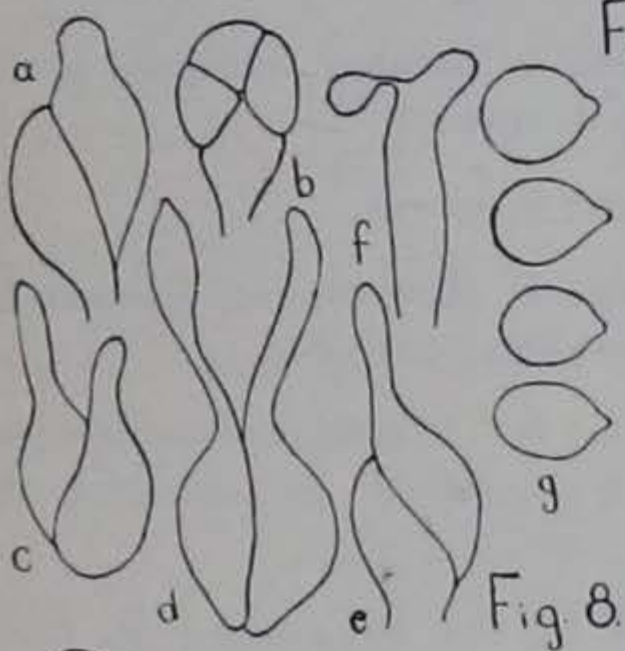

Fig. 8.

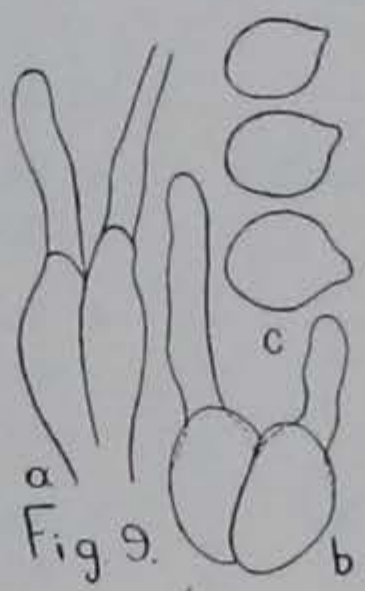

Fig 9.

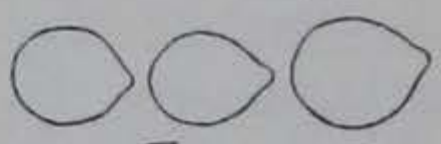
Fig. 10.

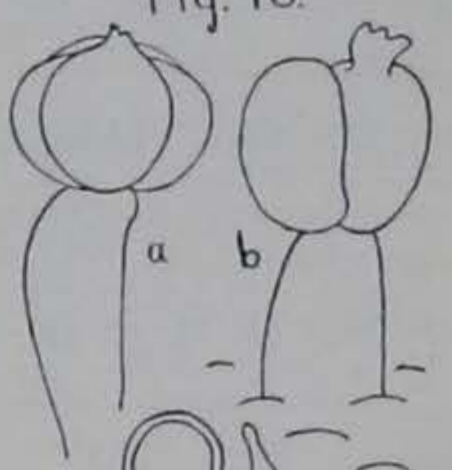

Fig 12.

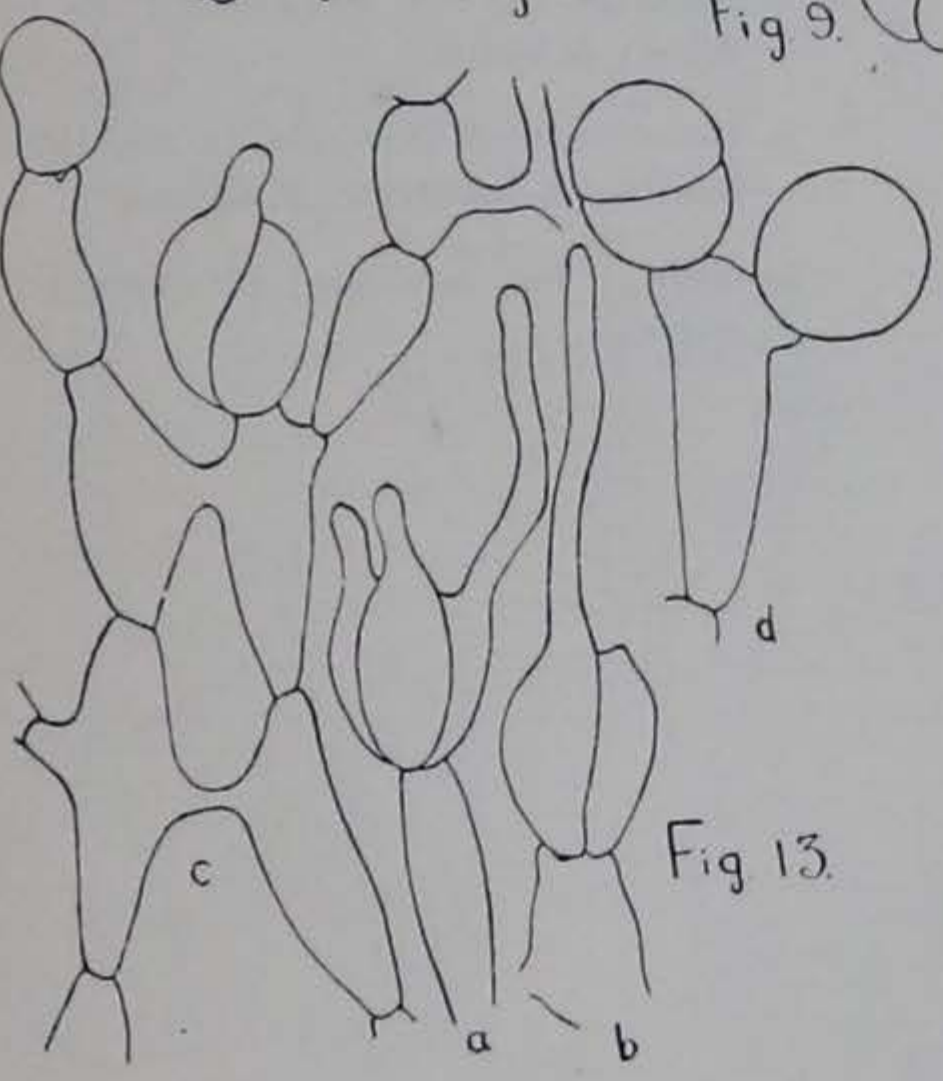

Fig 13.

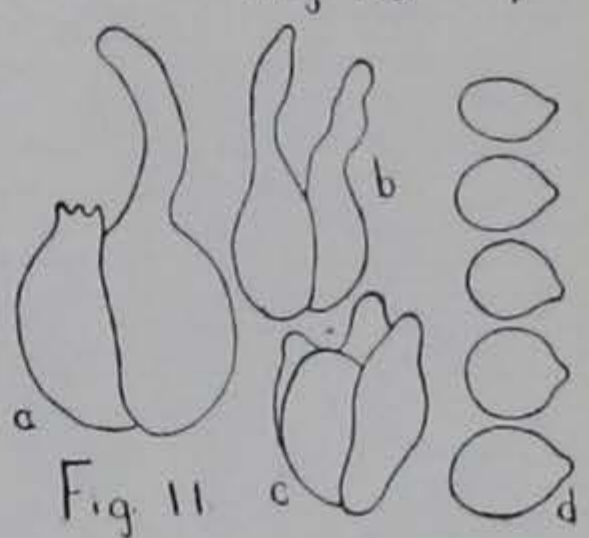

Fig 11

PLATE II

Tremella Lutescens

All figures of microscopic details drawn with camera lucida at a magnification of 1600 diameters, and reduced to 800 diameters in reproduction.

Fig. 14. M. B. G. H. 57664. a-b. basidia; c. spores.

Fig. 15. M. B. G. H. 60627. a-b. basidia; c. peculiar hymenial structure; d. spore.

Fig. 16. L. 71 a. basidium; b. spores.

Fig. 17. M. B. G. H. 59655. a. basidium; b. heavy-walled filament in the hymenium; c. spores.

Fig. 18. Dav. 215. a. basidium; b-f. hymenial structures; g. spore germinating by conidia; h. spores.

Fig. 19. M. B. G. H. 5362. a. filament in the hymenium; b. basidium; c. spore.

Fig. 20. Dav. 648. a. basidium with surrounding conidia-like bodies; b. basidium; c. spores.

Fig. 21. M. B. G. H. 57685. a. oidia; b-c. hymenial structures; d. spores.

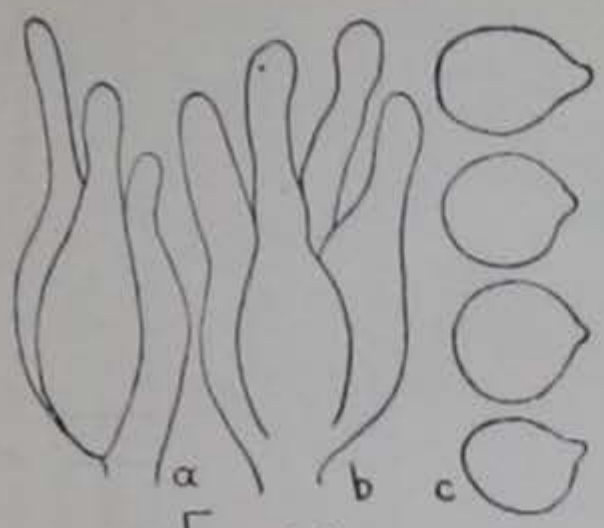

Fig 14

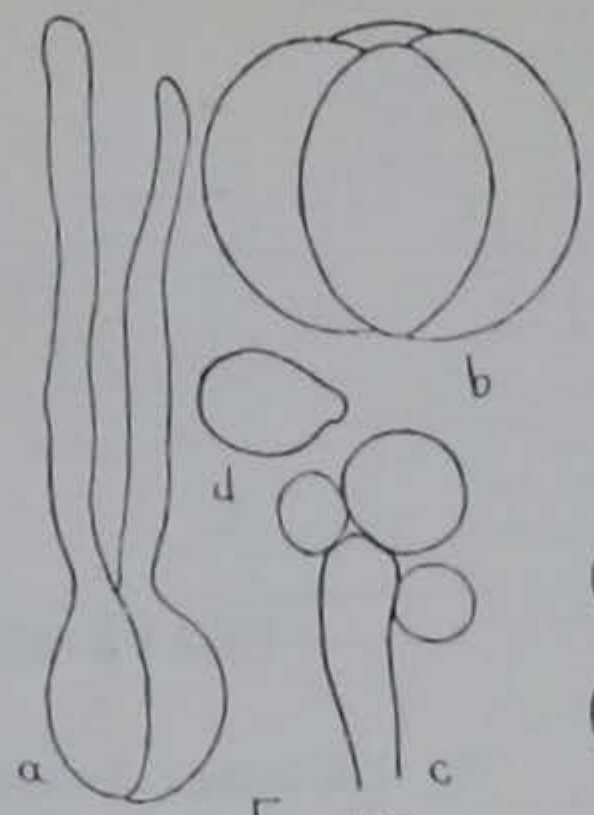

Fig. 15.

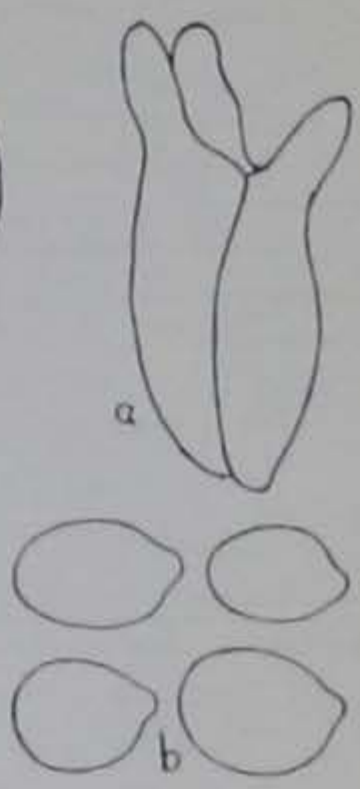

Fig. 16.

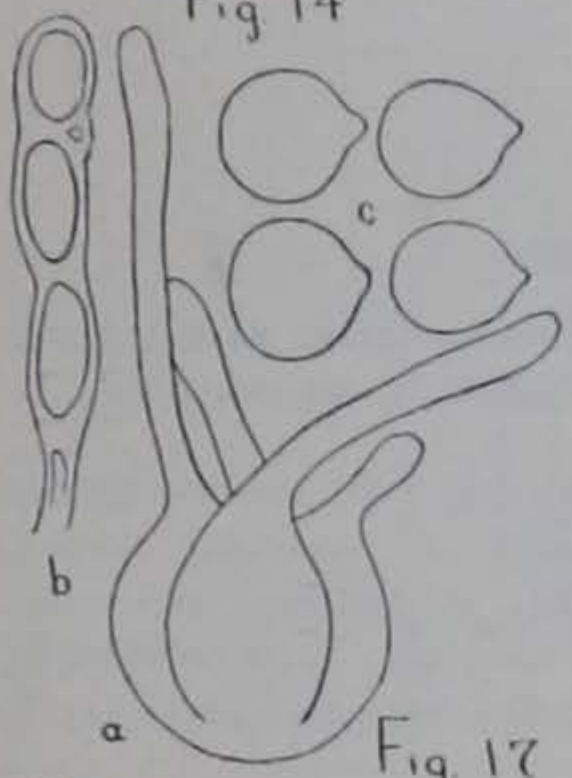

Fig 17

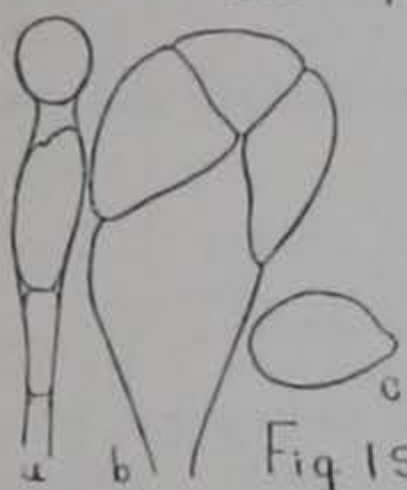

Fig 19.

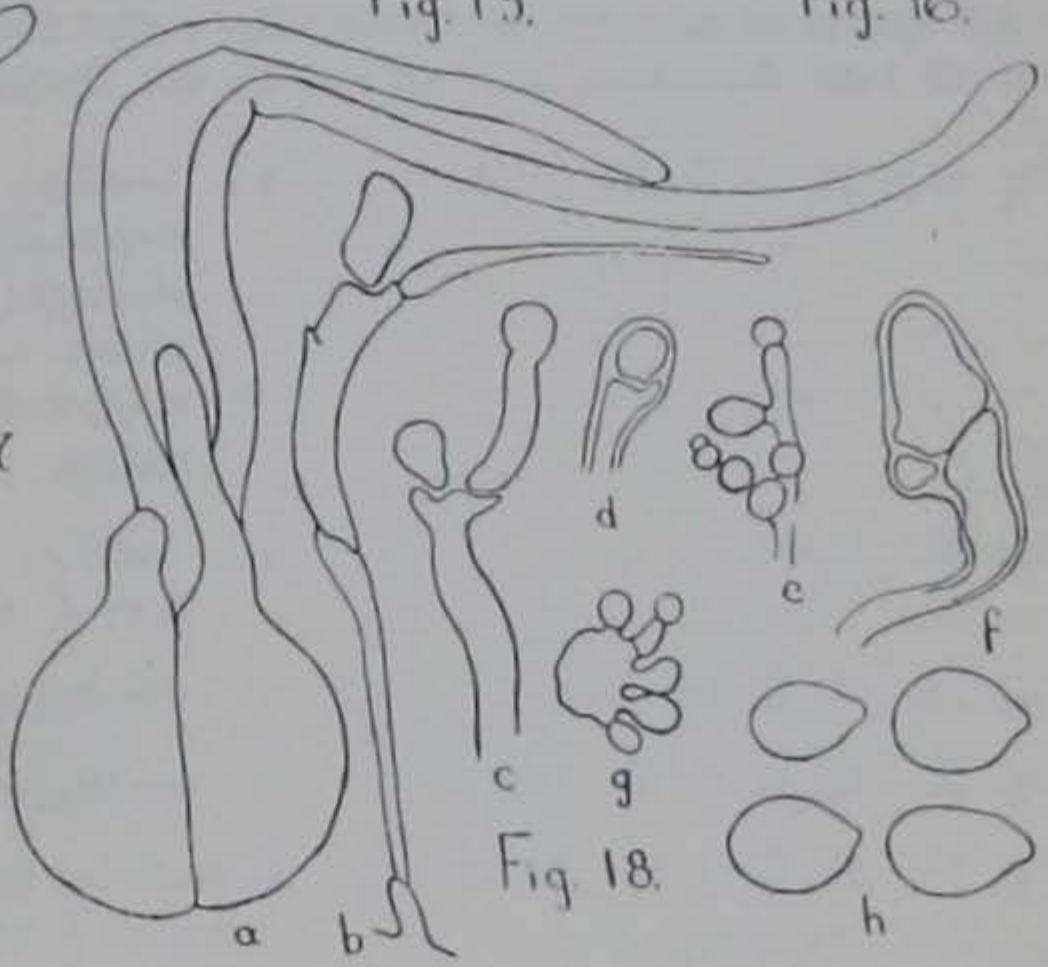

Fig 18.

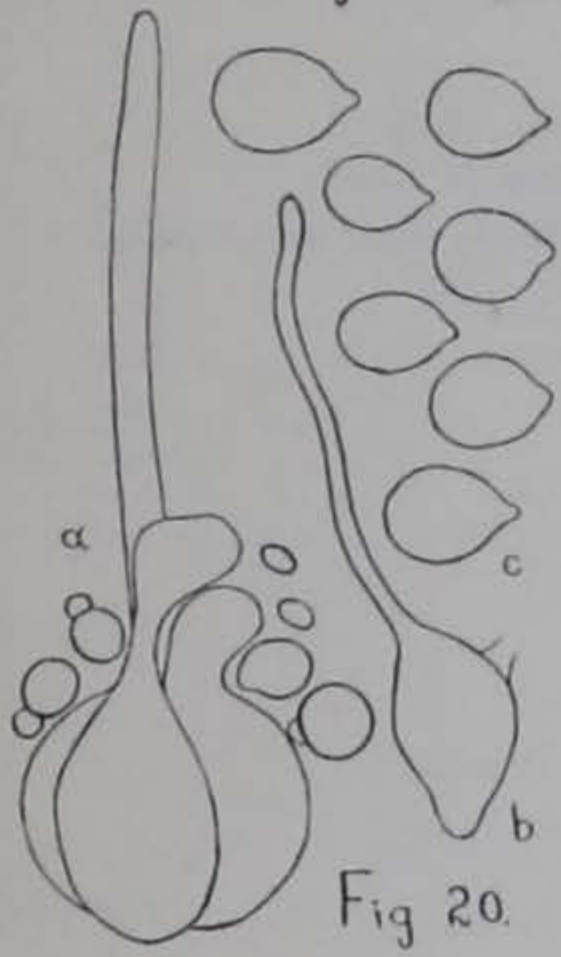

Fig 20.

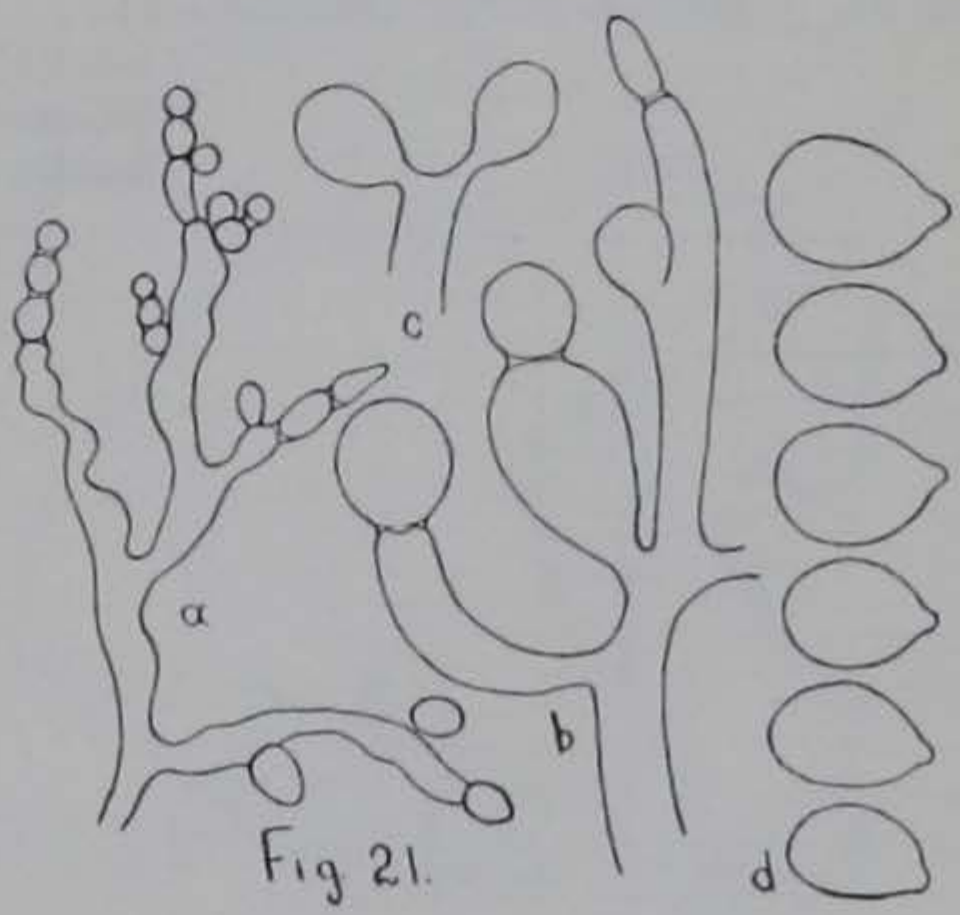

Fig 21.

PLATE III

Tremella Lutescens

All figures of microscopic details drawn with camera lucida at a magnification of 1600 diameters, and reduced to 800 diameters in reproduction.

Fig. 22. M. B. G. H. 5355. a-b. basidia; c-e, h-j., swollen hymenial structures; f. vesicular hymenial structure; g. vesicular structure in which contents have divided; k. thick-walled hymenial filament; 1-m. spores.

Fig. 23. L. 63. a-b. basidia; c. conidiophore and conidia; d. spores.

Fig. 24. G. W. M. 395 conidiophore and conidia.

Fig. 25. M. B. G. H. 19435. conidiophore and conidia.

Fig. 26. M. B. G. H. 56591. a. vesicular hymenial structure; b. heavy-walled hymenial filament; c. spores.

Fig. 27. Section of mature fructification:
conidial area stippled;
vesicular area in lines;
basidia present, lines and circles.

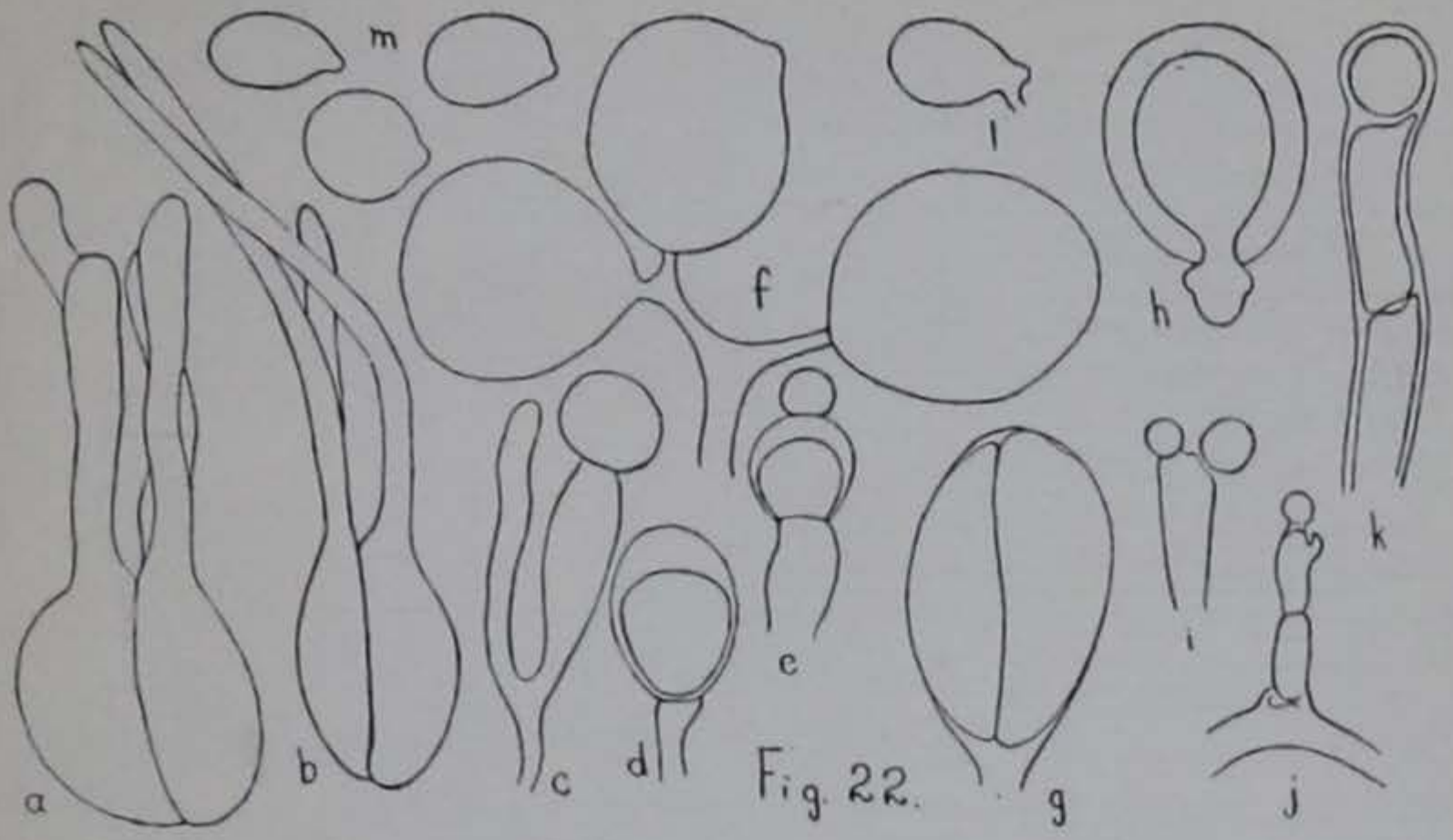

Fig. 22.

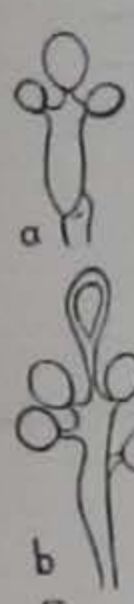

Fig. 25.

Fig 24.

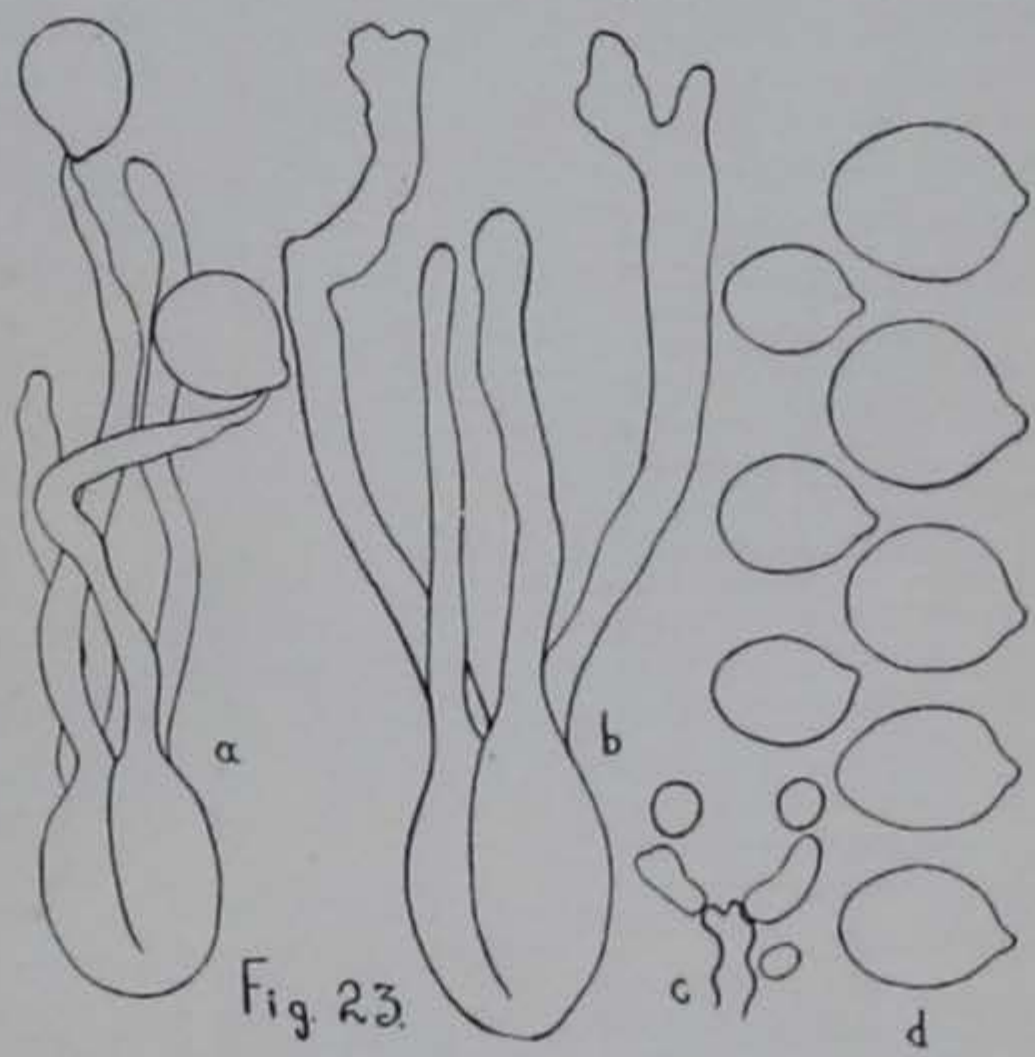

Fig. 23.

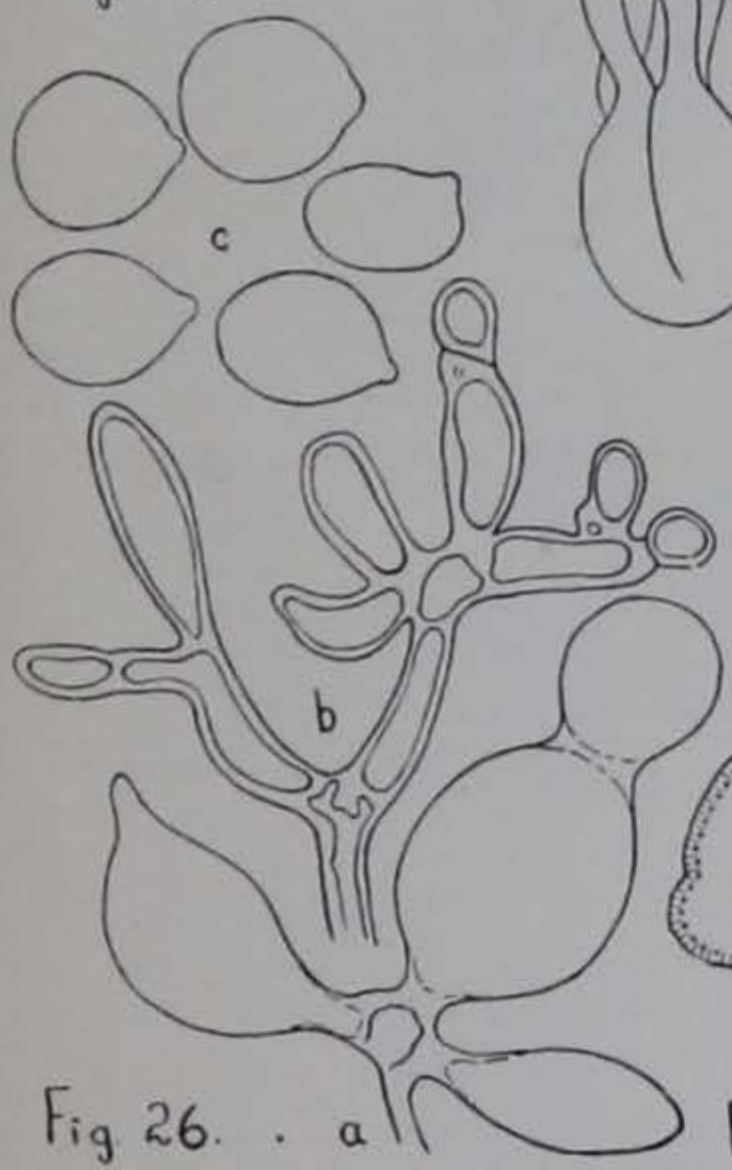

Fig 26. . a

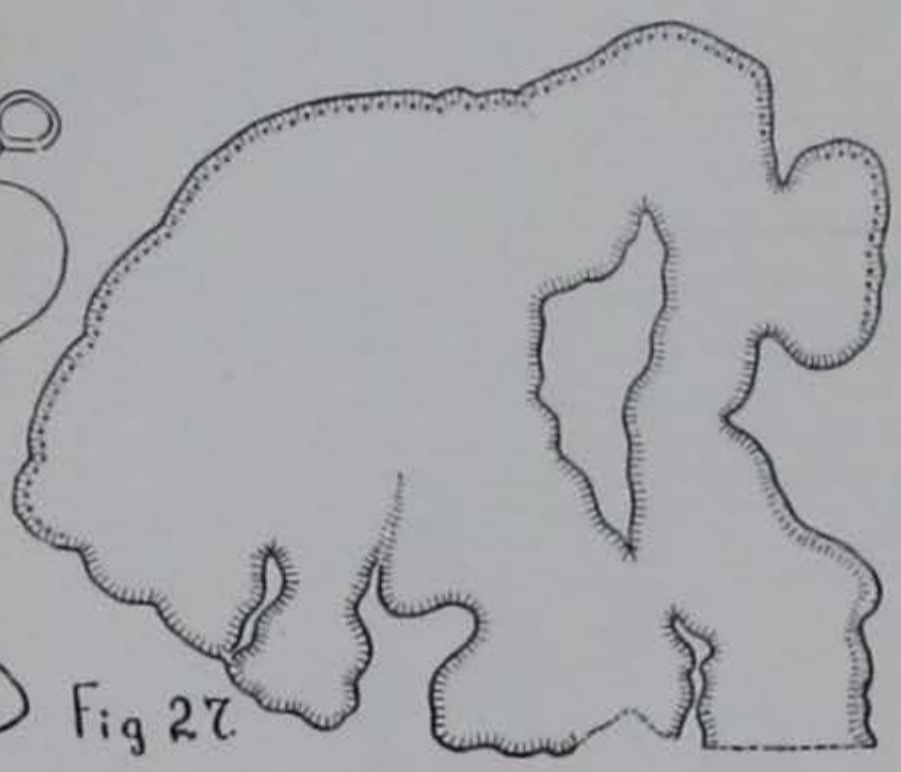

Fig 27.