3.1.1. Mesenterica group

In the sense of Fries, *Tremella mesenterica* Retz.: Fr. has a simple, ascending, plicate-undulate, gyrose, tough, and orange fructification. Among modern mycologists doubt has arisen whether or not *T. mesenterica* and *T. lutescens* are distinct species. The diagnostic characters such as habit, color, and texture have always been important in distinguishing the two species. However, the indefinite descriptions of earlier studies have resulted in hopeless confusion among ascent and modern mycologists who have failed to give more clear illustrations and to observe the variability in the form of the basidiocarps. Since the taxonomic states of the two taxa are not certain and the studies in the literature are not helpful for identification, the taxonomic dispute of both species will not be discussed here.

Vesicles are present in some species of this group, which will be discussed in the remarks of *T. mesenterica*. Although such cells are prominent and easy to be observed in the microscopy, they were rarely described in the literature. Furthermore, many large terminally swollen cells mixing with basidia in the hymenium were also rarely reported. In addition, the terminal and subterminal swollen cells on the sterile surface of basidiocarps close to the substrate were totally neglected by the mycologists before. They belong to parts of basidiocarps and should be studied carefully, because they are also important for taxonomy.

The construction of hymenium and subhymenium is built up by hyphae and basidia, and/or hyphidia. It gives more information for understanding the representation of basidiocarps. For example, *Tremella mesenterica* has a loosely structured subhymenium whereas *T. fuciformis* has a very stout one because of numerous anastomoses.

Hyphidia exist in the Mesenterica group and in some species of the Aurantia group. Although they can be abundant, e. g. in *T. coalescens*, or sparse, e. g. in *T. brasiliensis*, they support additional message in the taxonomic characters. For example, *Tremella cerebriformis* resembles *T. coalescens* because both species possess large basidia and abundant hyphidia.

Many species of *Tremella* with yellowish, reddish to orange basidiocarps are morphologically related to *T. mesenterica*. Those fungi are characterized by following properties:

1) basidiocarps conspicuous, mostly larger than 1 cm and whitish yellow to orange yellow.
2) hymenial and subhymenial structure loose.
3) hyphidia in the hymenium present; terminally swollen cells in the inner part of basidiocarps lacking.

According to the above features, I assume some species as shown below belonging to this group. Since I did not study the type of every species and because it is difficult to make a definite conclusion from literature, a few of the species my be clarified not belonging to this group in future. The following species are suggested to belong to the Mesenterica group:

T. auricularia Möller 1895
T. brasiliensis (Möller) Lloyd 1922

T. cerebriformis C.-J. Chen sp. nov. 1998 ibidem
T. coalescens Olive 1951
T. fibulifera Möller 1895
T. mesenterica Retz.: Fr. 1822
T. neofibulifera Kobayasi 1939
T. philippinensis Lloyd 1922
T. roseolutescens Bandoni & Carranza 1996
T. rubromaculata Lowy 1964
T. rufobrunnea Olive 1948
T. subrubiginosa Lowy 1976
T. taiwanensis C.-J. Chen sp. nov. 1998 ibidem
T. tropica C.-J. Chen sp. nov. 1998 ibidem
T. vesiculosa McNabb 1990 (Bandoni & Buchanan, 1990)

Key for some species of the Mesenterica group

1. Hyphidia abundant in clusters
   2. Basidiocarps yellowish brown, dry nearly black; hyphidia thick-walled; basidia 19-37 x 16-29 µm ---------- ***Tremella coalescens***
   2. Basidiocarps whitish yellow, dry yellowish white; hyphidia thin-walled; basidia 31-36 x 30-40 µm ----------***Tremella cerebriformis***
1. Hyphidia sparse and scattered
   3. Basidia width larger than 20 µm
      4. Conidia dikaryotic, 4-7 x 3.5-4.5 µm ---------- ***Tremella brasiliensis***
      4. Conidia monokaryotic, 6-9 x 5-7 µm ----------***Tremella taiwanensis***
   3. Basidia width smaller than 20 µm
      5. Vesicles present
         6. Basidia broadly ellipsoid to oval, 20-31 x 16-22 µm; spores 12-15.5 x 9-10 µm ---------- ***Tremella mesenterica***
         6. Basidia globose to subglobose, 13.5-18 µm ø; spores 9-12.5 x 6.5-8 µm---- ---------- ***Tremella rufobrunnea***
      5. Vesicles absent
         7. Basidiocarps whitish yellow, dry film ----------***Tremella fibulifera***
         7. Basidiocarps light yellow to orange yellow, dry crust
            8. Basidiocarps orange yellow; basidia 19-21 x 15-17 µm; spores 12-13 x 8-11 µm----------***Tremella tropica***
            8. Basidiocarps light yellow; basidia 13-18 x 12-16 µm; spores 9.5-12.5 x 8-10.5 µm---------- ***Tremella philippinensis***

Tremella brasiliensis (Möller) Lloyd 1922 (Figs. 1-5)

Möller, Protobas. 100. 1895 (basionym); Lloyd, Myc. Notes p. 1152, fig. 2239.

=*Tremella lutescens* Pers.: Fr. f. *brasiliensis* Möller, Protobas. 100. 1895.

Macromorphology

Basidiocarps erupt from the cortex of dead branches, at first cerebriform, then becoming foliose, the lobes gelatinous thick, pale yellow when dry. The type material was broken into pieces, some of them are pale yellow, but some are brown. The brown pieces are probably from the basal part of the basidiocarps close to the substrate.

Micromorphology

Basidia: two types: type I, subglobose to broadly ellipsoid; (27-)30-42 x (23-)26-32(-35) µm [Q* =(1.00-)1.07-1.25 (-1.35)]; type II, pyriform, 35-40 x 24-33 µm [Q=1.21-1.50] (measurements not including stalks); stalks 2-5(-7) µm in length, 2-3 µm ø; thin- to thick-walled, longitudinally or obliquely cruciate-septate, 4-spored; sterigma up to 115 µm in length, 3-5 µm ø, apically swollen up to 8 µm ø.

Spores: ± globose, rarely subglobose, (11-)13-20 x (12-)13-21 µm [Q=(0.88-)0.92-1.04(-1.13)], sometimes broader than long; hyaline, smooth; germinating by budding or repetition.

Conidia: mostly ellipsoid to fusiform, sometimes subglobose to globose, 4-7(-8) x 3.5-4.5 µm [Q=(1.0-)1.13-2.0(-2.29)]; hyaline, smooth, clamped, dikaryotic.

Vesicles: variable in shape, ellipsoid to cylindrical, occasionally clavate, mostly 17-34 x 12-22 µm [Q=1.18-2.54], thick-walled, only seen in the subhymenium and hymenium.

Swollen cells: not seen.

Hyphidia: smooth, hyaline, 2-3(-4) µm ø, thin- to slightly thick-walled; sometimes bearing haustoria.

Hyphae: clamped, thin- or slightly thick-walled, gelatinous, 2-4 µm ø, smooth, hyaline.

Haustoria: abundant, mostly 5-8 x 3-5 µm [Q=1.11-1.78], clamped, branched.

Habitat and substrate: on the cortex of dead branches.
Type locality: Brazil, Blumenau.
Distribution: Brazil, Panama.
Specimen studied: BPI 718395, neotype (selected by Bandoni, 1957a).

* Q value = length / breadth ratio (Bas, 1969).

Remarks

Möller (1895) considered *T. brasiliensis* is a variety of *T. lutescens*, but Lloyd (1922) thought even they have the same color and the same basidia and spores, their habits and shape are different. The holotype of *Tremella brasiliensis* was lost and Möller (1895) gave no clear and detailed description. Bandoni (1957a) suggested that BPI 38792 should be designated as the neotype for the species. Lowy (1971) thought that BPI 444 is in excellent condition and would serve better as the neotype, though conidia are lacking in this specimen. I personally do not agree with Lowy selecting BPI 444 as neotype, because for taxonomy the conidial stage is often much more important than the basidial stage. I agree with Bandoni, that specimen BPI 38792 is more useful for a neotype than BPI 444. Although Bandoni and Lowy studied this species excellently using two different specimens of Lloyd, however, they neglected to give more detailed structures of conidial morphology. Furthermore, some important structures, for example, dikaryotic conidia and vesicles, were not mentioned by them. The hymenial basidia are similar to those of *T. mesenterica*, however, the size of the basidia of *T. brasiliensis* is probably the biggest of *Tremella* species. The morphology of dikaryotic conidia is different from those of *T. mesenterica*. The conidial stage of *Tremella* probably is also variable in the species, however, they presumably give more useful information for classification.

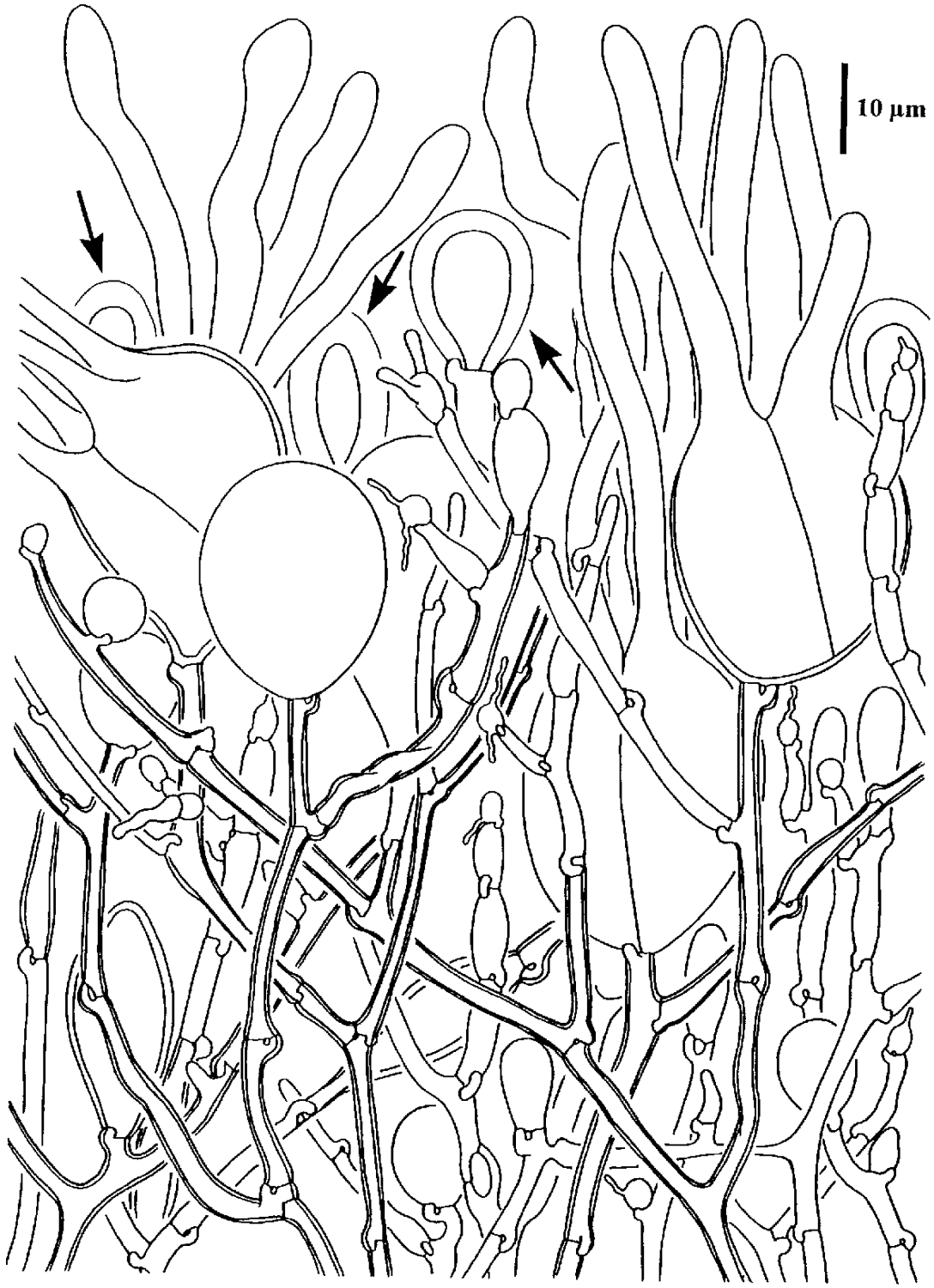


Fig. 1. *Tremella brasiliensis* BPI 718395 (neotype). Part of hymenial structure on the surface of a mature basidiocarp. Arrows indicate vesicles.

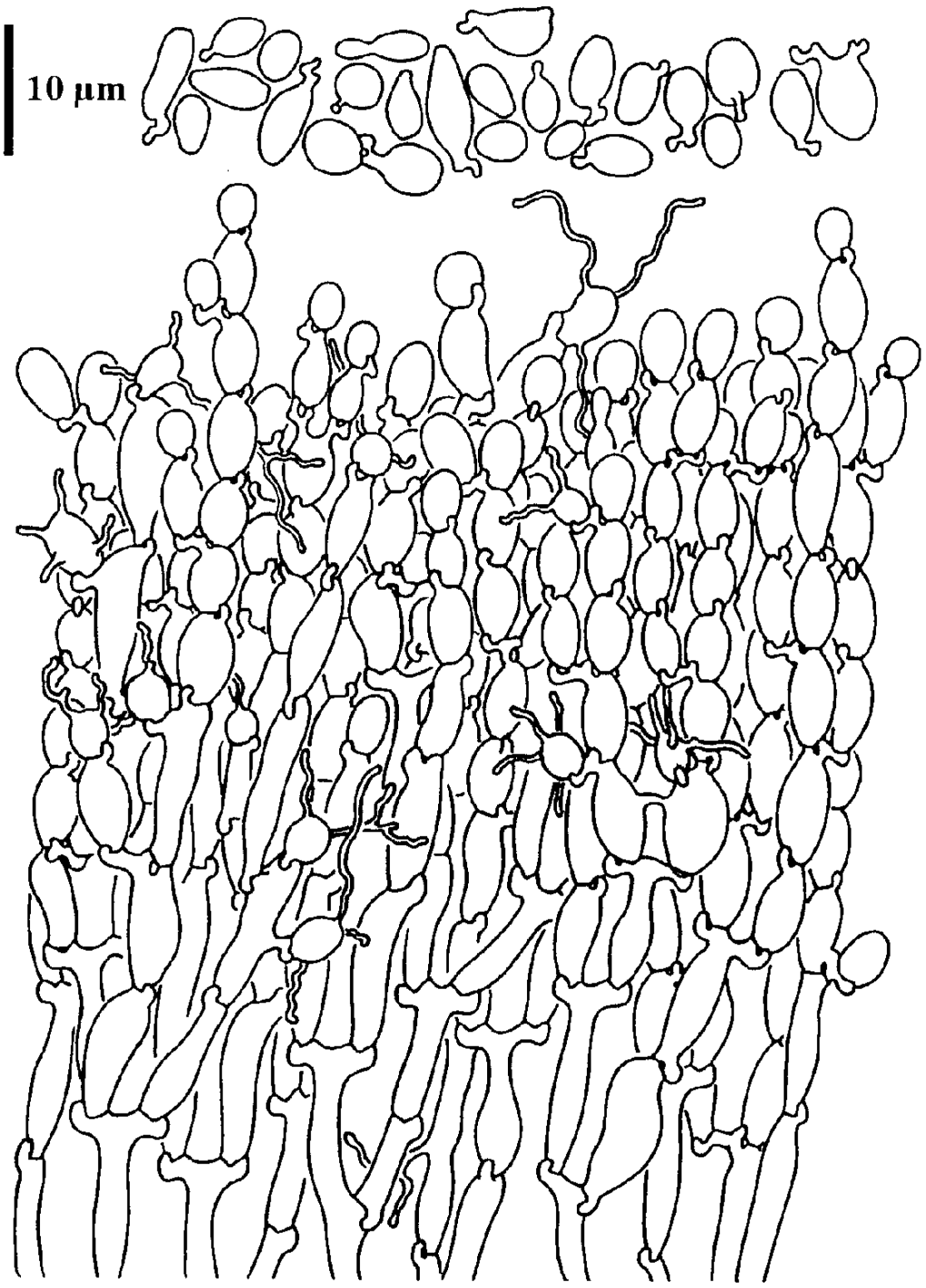


Fig. 2. *Tremella brasiliensis* BPI 718395 (neotype). Part of hymenium close to the substrate with conidiogenous cells producing clamped conidia in chains, branched haustorial hyphae and detached conidia variable in shape.

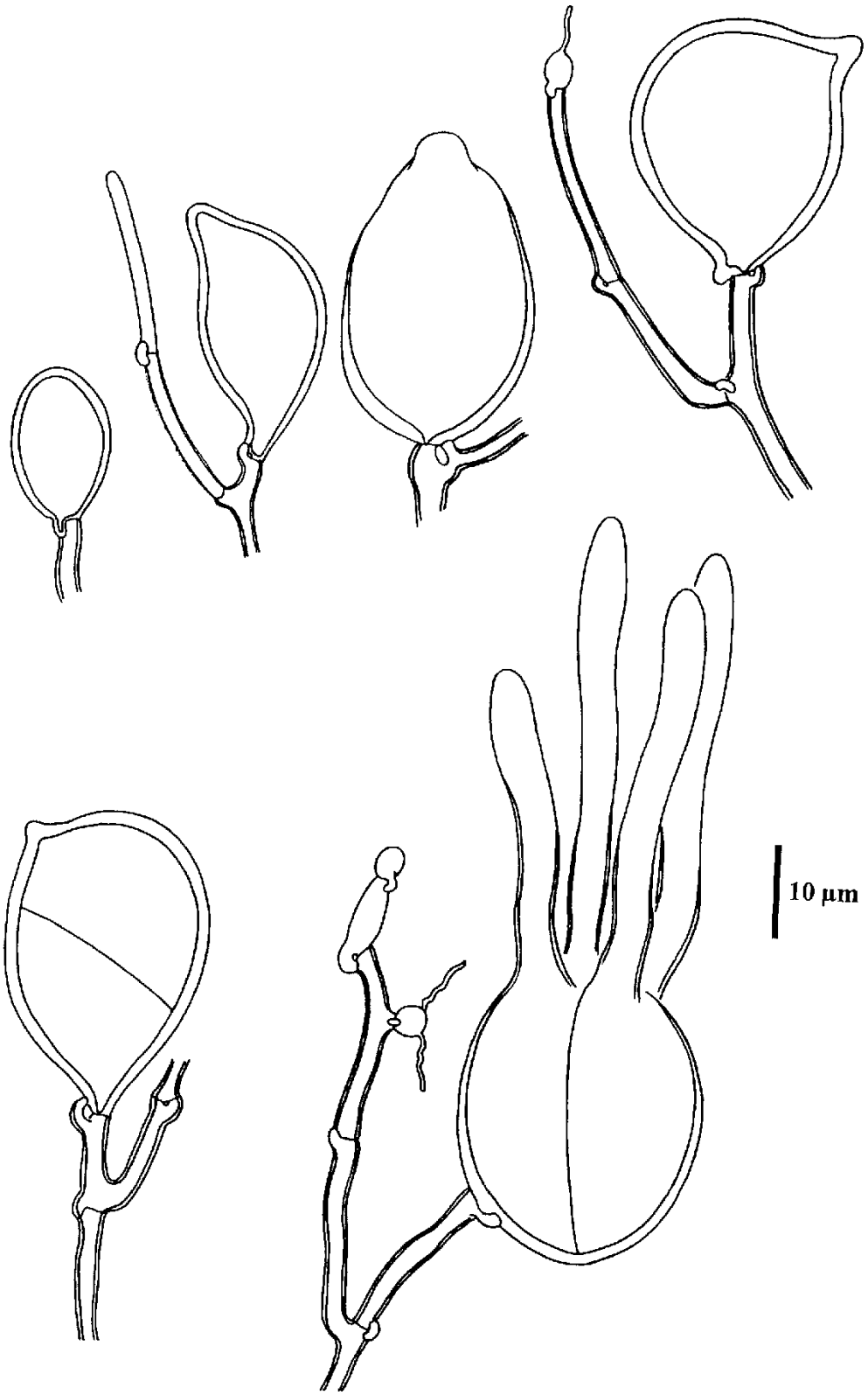


Fig. 3. *Tremella brasiliensis* BPI 718395 (neotype). Ontogeny of basidia.

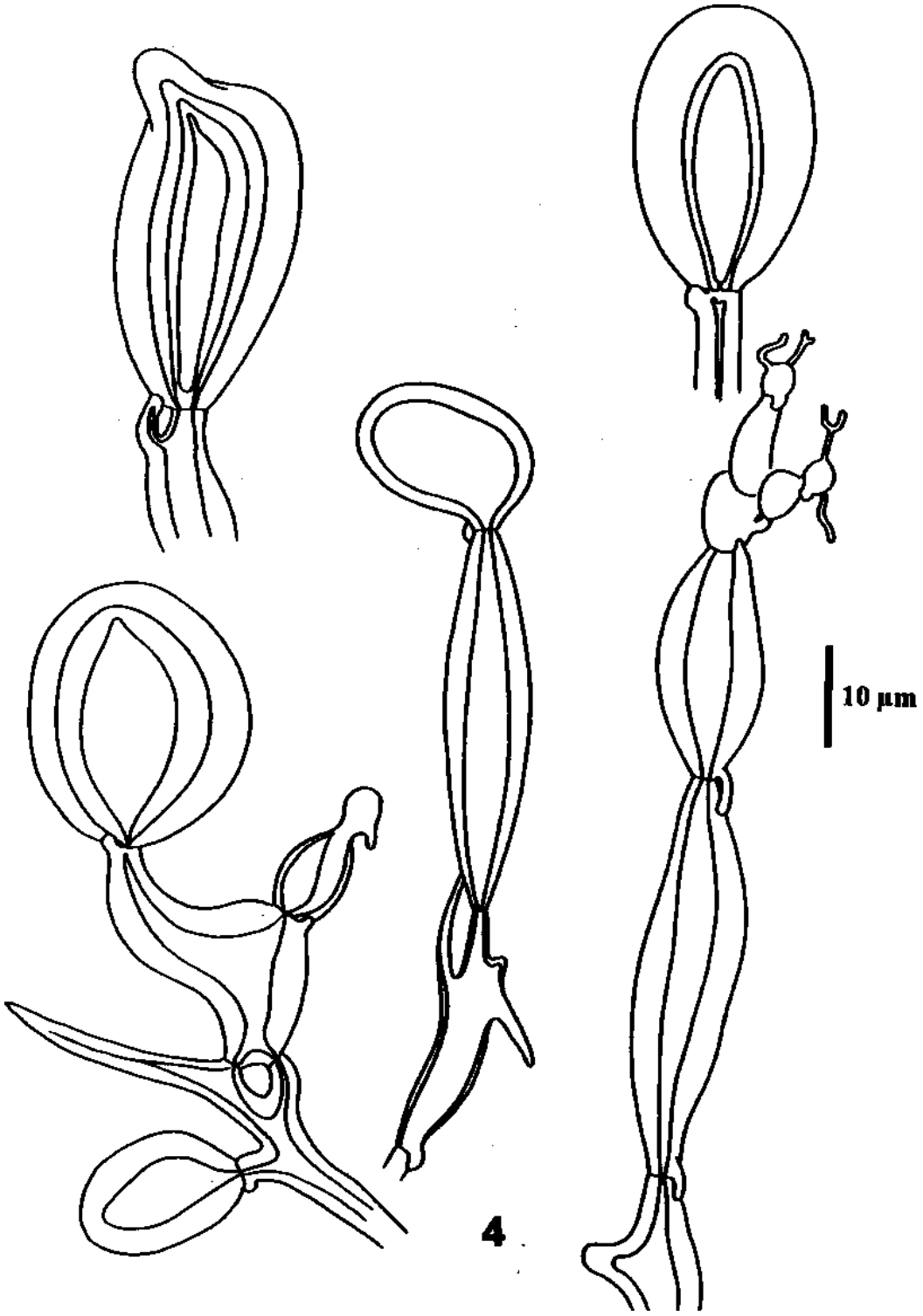


Fig. 4. *Tremella brasiliensis* BPI 718395 (neotype). Various vesicles in shape.

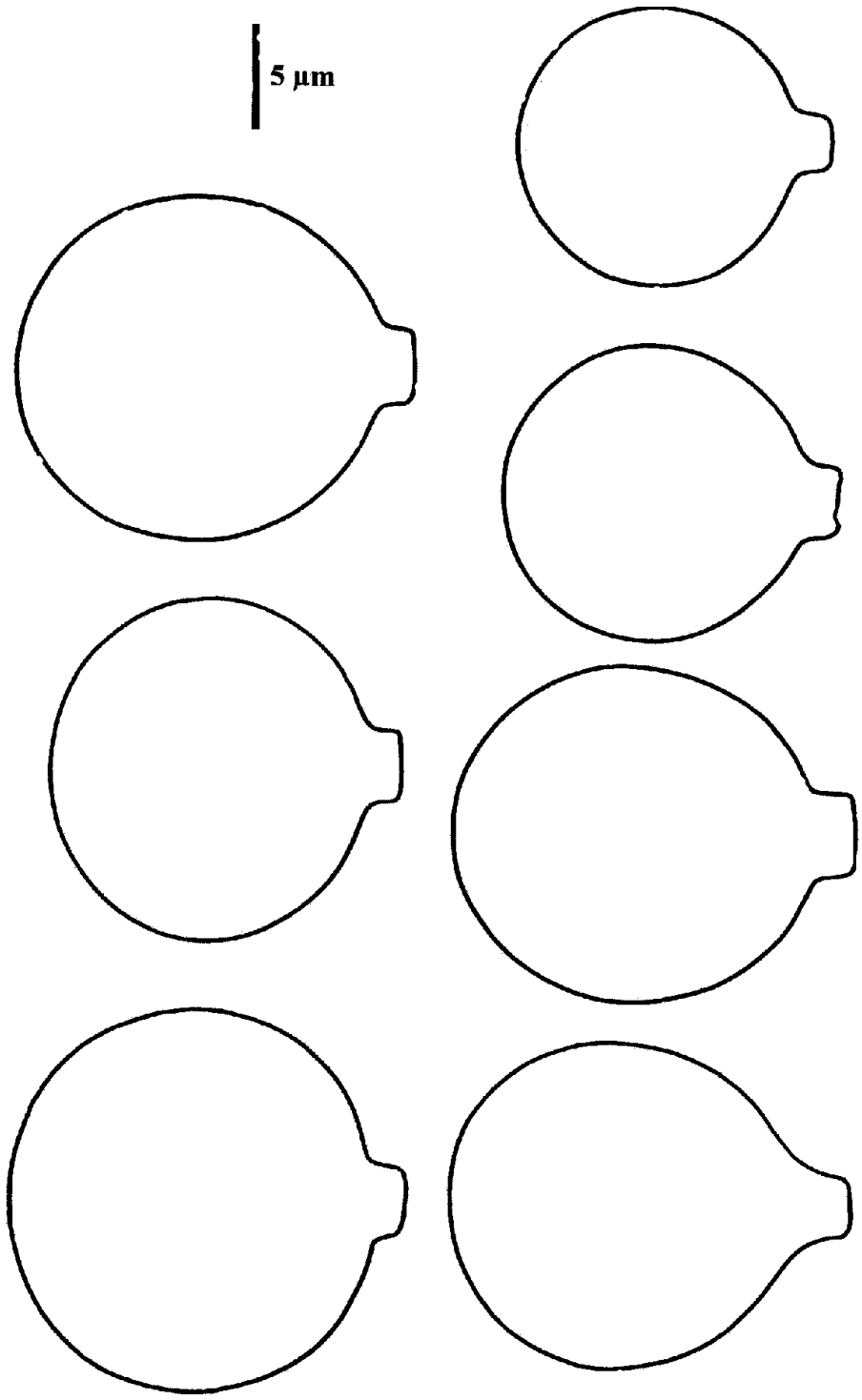


Fig. 5. *Tremella brasiliensis* BPI 718395 (neotype). Basidiospores.

Tremella cerebriformis C.-J. Chen sp. nov. (Figs. 6-8)

Latin diagnosis

Fructificatio gyrosa vel cerebriformis, lucida, gelatinosa, pallide lutea. Basidia 31-36 (-40) x 30-40 µm, oblique septata. Basidiosporae globosae vel ellipsoidae, 17-23(-25) x 18-24 µm. Hyphidia 2-4 µm ø, muris tenuibus.

Macromorphology

Basidiocarps gyrose to cerebriform, lucid, soft gelatinous, 2-3 cm ø, slightly whitish yellow when fresh, drying pale yellow, flat on the substrate.

Micromorphology

Basidia: ± globose, subglobose to ellipsoid, occasionally oval, 31-36(-40) x 30-40 µm [Q=0.85-1.23(-1.33)], longitudinally or obliquely septate, 4-spored; sterigmata up to 180 µm in length, 5-8 µm ø, apically swollen up to 12-14 µm ø; thin-walled, smooth.
Spores: ± globose, 17-23(-25) x 18-24 µm [Q=0.94-1.04], smooth, hyaline, germinating by budding or repetition.
Conidia: absent.
Vesicles: absent.
Swollen cells: absent.
Hyphidia: smooth, thin-walled, mostly 2-4 µm ø, branched, often anastomosing; new hyphae branching from clamps or below septate; hyphidia and basidia derived from the same generative hyphae.
Hyphae: hyphae clamped, 2-4(-6) µm, thin- or very slightly thick-walled, gelatinous; anastomoses abundant; hymenia amphigenous.
Gemmae: absent.
Haustoria: rare, subglobose, clamped, haustorial hyphae short and rarely branched.

Type: CCJ 1142
Etymology: from Latin, cerebriformis, brain like, referring to the shape of the basidiocarp.
Type locality: Taiwan, Taichung county, Tahsueh Shan Forest, ca. 2000-2300 m.
Type deposited: NTU-TW-Mycological Herbarium, Dept. Botany, National Taiwan University, Taipei, Taiwan (holotype); Universität Tübingen, Herbarium of Lehrstuhl Spezielle Botanik, Auf der Morgenstelle 1, D-72076 Tübingen, Germany (isotype).
Distribution: Taiwan
Habitat and substrate: on decayed branches of Fagaceae.
Specimen studied: Taiwan, Taichung county, Tahsueh Shan Forest, leg. C.-J. Chen, 12. VII. 1995, CCJ 1142.

Remarks

The morphology of *Tremella cerebriformis* is similar to *T. coalescens* and *T. brasiliensis*. However, the basidia and the basidiospores of *T. coalescens* are smaller, and the hyphidia are conspicuous with thickened walls. In *T. brasiliensis,* the basidia are frequently thick-walled and hyphidia are not conspicuous. Furthermore, many vesicles exist in the hymenium of *T. brasiliensis* but lacking in that of *T. cerebriformis*. In addition, *Tremella grandibasidia* Olive has large basidia and basidiospores. It is perhaps close to *T. cerebriformis* but distinguishable by the basidia and basidiospore measurements.

1. Basidia thick-walled ---------- *T. brasiliensis*
1. Basidia thin-walled
   2. Hyphidia abundant in clusters ---------- *T. coalescens*
   2. Hyphidia lacking or present but not in clusters
      3. Basidiospores globose, 17-23(-25) x 18-24 µm ----------*T. cerebriformis*
      3. Basidiospores globose to subglobose, 15.5-17 µm---------- *T. grandibasidia*

Fig. 6. Fresh basidiocarp of *Tremella cerebriformis* CCJ 1142.

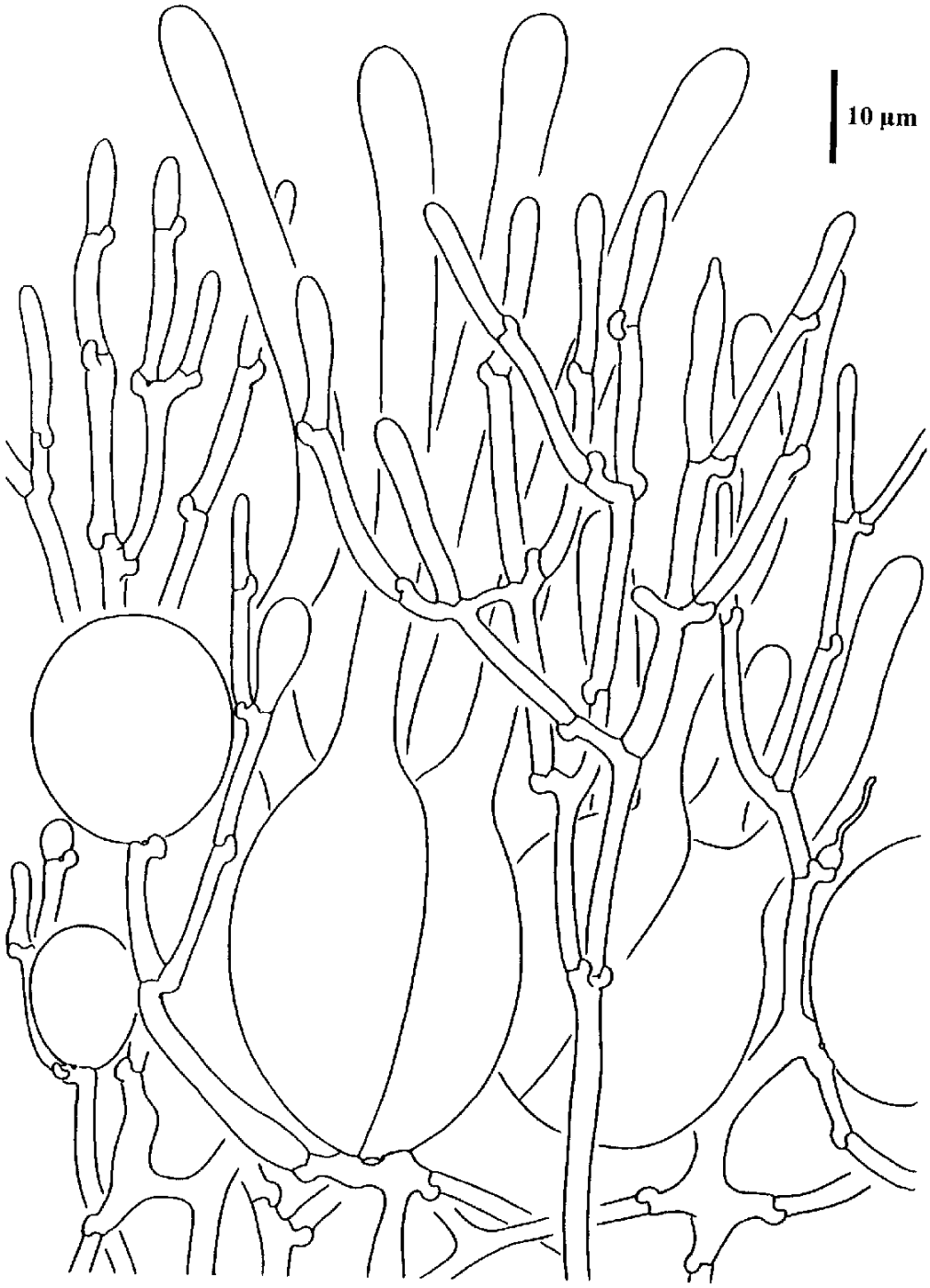


Fig. 7. *Tremella cerebriformis* CCJ 1142. Part of the hymenial structure on the surface of a mature basidiocarp. Note that abundant hyphidia are in the hymenium.

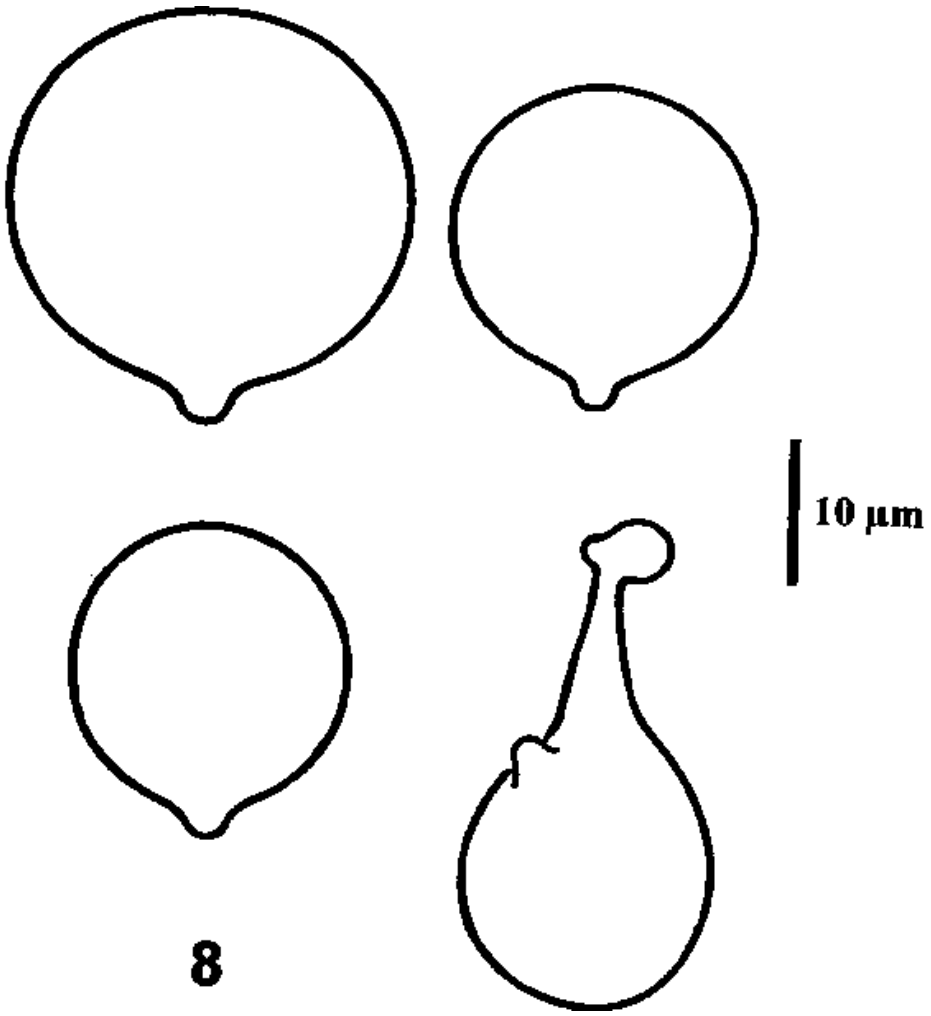


Fig. 8. *Tremella cerebriformis* CCJ 1142. Four basidiospores, one of them producing a secondary spore by repetition.

Tremella coalescens Olive 1951 (Figs. 9-10)

Mycologia 43: 678.

Macromorphology

Basidiocarps growing on corticate oak branches, blackish brown to cinnamon-brown, sessile and pulvinate or discoid, or substipitate, with short tapered base to a narrow stalk, many individual fruiting bodies expanding and coalescing into conspicuous, gyrose-folded, up to 2-3 cm ø, soft, gelatinous; drying to a black crust (according to Olive, 1951, and Bandoni, 1957a).

Micromorphology

Basidia: two types: type I, big sized, ± globose, ellipsoid to oval, (24-) 26-37 (-40) x 24-29 µm [Q=0.83-1.42(-1.60)]; longitudinally or obliquely cruciate-septate, mostly 4-spored, occasionally 2-spored; sterigmata up to 100 µm in length, 3-4 µm ø, slightly swollen apically; type II, small sized, ± globose, ellipsoid to oval, 19-25(-28) x 16-21 µm [Q=0.95-1.31(-1.56)], longitudinally or obliquely septate, 4-spored; sterigmata up to 85 µm in length, 2-3 µm ø, slightly swollen apically.

Spores: ± globose, subglobose, to broadly ellipsoid, (10-)13-18.5 x (11-)12-16.5 µm, thin walled, hyaline, smooth, germinating by repetition or budding, or sometimes by germ tubes.

Conidia: absent.

Vesicles: absent.

Swollen cells: absent.

Hyphidia: thin- or thick-walled in the hymenium, hyaline, smooth, mostly shorter than 30 µm in length; when thick-walled, 3-5(-10) µm ø; if thin-walled, mostly (1-)1.5-3.0 µm ø.

Hyphae: clamped, thin- or slightly thick-walled, gelatinous, mostly 2-3 µm ø; hymenia amphigenous.

Haustoria: abundant, mostly globose to subglobose; haustorial hyphae short, rarely branched.

Habitat and substrate: on corticate oak branches.
Type locality: U. S. A., Louisiana, Baton Rouge.
Distribution: U. S. A., Canada.
Specimen studied: U. S. A., Louisiana, Baton Rouge, 27. XI. 1948, La 129 (holotype).

Remarks

During the study of the type material, I supposed that the type is a mixture of two different species because of the quite different sizes of the basidia from different basidiocarps. However, the similar structures, especially abundant hyphidia in the

hymenium, imply that they belong to one species. The original measurement of basidia was 24.5-33 x 19-26 µm. This fits more or less with my measurements, (24-)26-37(-40) x 24-29 µm, but basidia of some other basidiocarps in the package of the type material are measured 19-25(-28) x 16-21 µm, which was not included in Olive's publication. Therefore, the real size of basidia of *T. coalescens* should be redefined to be 19-37(-40) x 16-29 µm. Unfortunately basidiospores are not abundant in the material. I saw only a few basidiospores in my preparations.

Hyphidia can also be found in the species of *T. mesenterica* and *T. brasiliensis,* although they are not abundant.

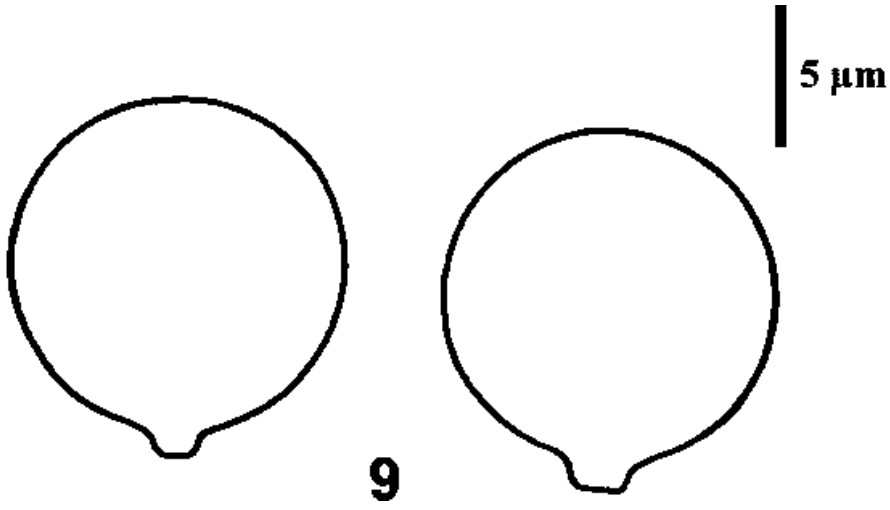


Fig. 9. *Tremella coalescens* La129 (type). Two basidiospores.

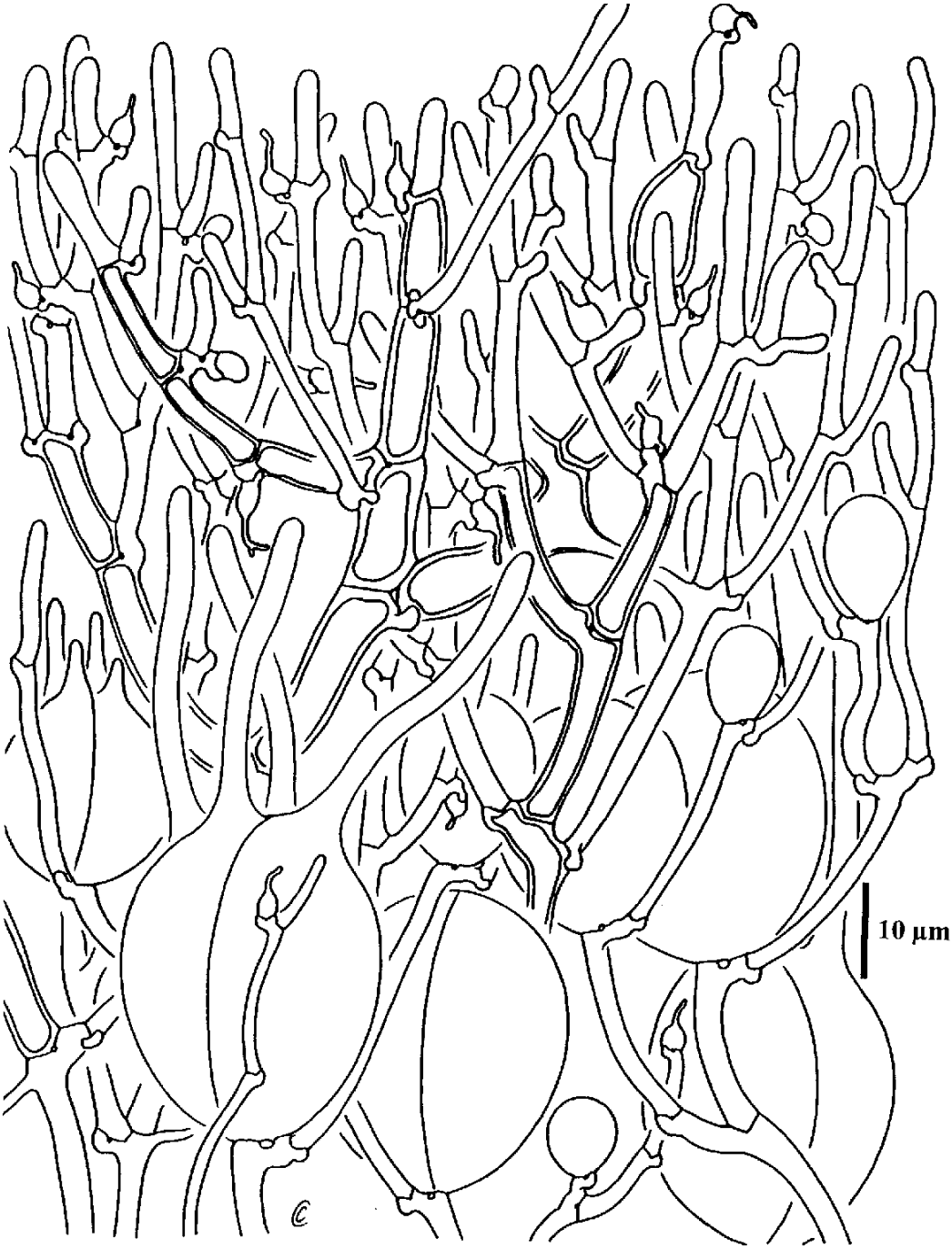


Fig. 10. *Tremella coalescens* La 129 (type). Part of hymenial structure on the surface of a mature basidiocarp with basidia of different developmental stages, abundant hyphidia, and haustoria. Note that hyphidia are thin- to thick-walled.

Tremella mesenterica Retz.: Fr. 1822 (Figs. 11-24)

Fries, Syst. Myc. 2: 214.
?=*T. lutescens* Pers.: Fries, Syst. Myc. 2: 213.

Macromorphology

Basidiocarps large and conspicuous, ca. 5 cm ø, gelatinous, pustular when young, foliose when mature, lobes undulate-plicate; pure yellow to yellowish orange; pallid to whitish yellow under dark environment; young basidiocarps orange, color reduced when basidiocarps are mature; dry becoming pure yellow to yellowish orange.

Micromorphology

Basidia: two types: type I, subglobose to broadly ellipsoid, 20-23(-25) x (17-)18-22(-23) µm [Q=(0.95-)1.12-1.31]; type II, oval, (20-)24-31(-35) x (15-)16-20 µm [Q=1.40-1.82(-2.19)]; longitudinally or obliquely cruciate-septate, 4-spored; sterigmata up to 105 µm in length, 2-3 µm ø, apically swollen up to 5-7 µm.

Spores: broadly ellipsoid to oval, (10-)12-15.5 x (7-)9-10(-12) µm [Q=1.20-1.40(-1.61)], smooth, hyaline, germinating by repetition or budding.

Conidia: ellipsoid, fusiform to cylindrical, 3-5(-7) x 1.0-2.0 µm [Q=1.5-3.3(-7)], smooth, hyaline, clamped; orange in cluster.

Vesicles: variable, sometimes bearing from hyphae, occasionally bearing from swollen vesicle-like cells, globose, subglobose to ellipsoid, (12-)14-21 x (9-)11-16.5(-19) µm [Q=1.00-1.18(-1.42)]; when ovate to clavate, mostly 22-27 x 15-17 µm [Q=1.35-1.92]; sometimes lanceolate (lance-shaped), mostly 34-35 x 7-10 µm [Q=3.5-4.86]; thick-walled, 2-3.5 µm in thickness.

Swollen cells: constantly on basal parts of mature basidiocarps close to the substrate, big, clamped, colorless; when citriniform, mostly 26-37 x (13-)16-22 µm [Q=1.30-1.85(-2.19)]; when broadly pyriform, 18-24 x 13-18 µm (not including stalks) [Q= 1.14-1.40], stalks often 2-5 x 1-2 µm, sometimes up to 16 µm [if data including stalks, then mostly 20-39 x 13-18 µm, Q=1.31-1.95]; when subglobose to oval, (15-)21-29(-34) x (12-)17-26 µm [Q=(1.00-)1.06-1.42(-1.61)]; bearing on citriniform, broadly pyriform (mostly with short stalk) or subglobose to globose cells. Terminally swollen cells in the hymenium colorless, globose to ellipsoid, mostly 3-9 x 3-8 µm [Q=1.00-1.23], sometimes oval, 7-10 x 4-5 µm [Q=1.71-2.22]. Some terminally and laterally swollen cells in subhymenium and mostly in the inner part of basidiocarps, oval, 12-17 x 5-6 µm [Q=2-3.4], smooth, thin- to mostly thick-walled.

Hyphidia: present but not abundant, 2-4 µm ø; thin- to slightly thick-walled, gelatinous.

Hyphae: mostly 2-3 µm ø, sometimes up to 4 µm in the inner part of basidiocarps; thin- to thick-walled, gelatinous; clamps abundant,

closed or medallion-like, sometimes loop-like forming a big hollow.

Haustoria: abundant in the inner part of basidiocarps close to bark, globose to oblong, 3-6(-7) x 2.5-4 µm [Q=1.3-2.0(-2.3)], mostly with slender, long branched, tortuous hyphae.

Habitat and substrate: on decayed branches of *Fagus sylvatica* or *Abies alba.*

Specimen studied: Germany, Baden-Württemberg: Schönbuch in Tübingen, leg. Z.-L. Yang, 26. V. 1996, CCJ 1543; France, Wintzfelden, leg. C.-J. Chen, 10. V. 1997, CCJ 1542; Germany, Baden-Württemberg: Schwarzwald, Wildenreute-Sexau, bei Emmendingen, leg. F. Oberwinkler, 02. IX. 1975, FO 23014; Taiwan, Taichung county, Tahsueh Shan Forest, 2000-2300 m, leg. C.-J. Chen, 21. III. 1995, CCJ 1040 & CCJ 1041; Germany, Baden-Württemberg, Tübingen, Schönbuch, leg. R. Kirschner, 6. IX. 1996, CCJ 1556.

Type locality: Europe.

Distribution: China, Europe, Japan, North America, Taiwan (Bandoni, 1957a; Binyamini, 1983; Bjørnekaer, 1944; Bourdot, 1932; Breitenbach & Kraenzlin, 1986; Kobayasi, 1939; Looney, 1933; Lowy, 1955; McIlvaine, 1900; Neuhoff, 1931; Olive, 1946; Roberts, 1995; Torkelsen, 1968; Wojewoda, 1981).

Remarks

Brefeld (1888) treated *Tremella lutescens* as a synonym of *T. mesenterica* because they are apparently not specifically distinct. Since then these two names have been used as synonyms by a number of mycologists (Coker, 1920; Looney, 1933; Whelden, 1934; Olive, 1947; Donk, 1966; Lowy, 1971; Binyamini, 1983), while most European and some other mycologists still had retained them as distinct taxa until 1960th (Neuhoff, 1936; Kobayasi 1939; Olive 1946, Lowy, 1955, Pilát, 1957). However, they have been generally accepted to be synonyms by most of the mycologists right now. Both taxa were originally described from Europe according to an existing (*T. mesenterica*) or absent (*T. lutescens*) conidial stage. Bandoni (1957a) thought that these two taxa can only be cleared by studying and comparing the European material since the taxonomy is in such a confused state. A number of mycologists have studied both species (listed in Table 7), however, those data are ambiguous to understand their measurements of basidia and basidiospores.

Tremella mesenterica is one of the few European species of *Tremella* which produces typically abundant minute and globular conidia (Donk, 1966). The globular conidia of *T. mesenterica* were detected very often (Bandoni, 1987). However, in European material the conidia are definitely dikaryotic and oblong to cylindrical in shape. Torkelsen (1968) observed that the young orange basidiocarp is owing to the density of the orange conidia.

In the specimens FO 23014 and CCJ 1543, two kinds of basidia, globose to subglobose and ellipsoid to ovoid, are existing in the hymenium. However, the specimen FO 23014 has 70-80% globose to subglobose basidia, but, in contrast, the specimen CCJ 1543 has 70-80% of ovoid basidia which are obviously larger, 26-31(-35) x (15-)18-20 µm, than reported before. Basidiospores are not variable,

while few mycologists might probably mistake them with secondary spores (see Table 7). Based on observations in the field, Bjørnekaer (1944) thought that *T. mesenterica* was the winter stage and *T. lutescens* the summer stage of the same fungus.

Almost all mycologists thought that the conidia are monokaryotic, however, Whelden (1934) indicated that mostly spherical binucleate conidia are existing. The binucleate conidia of specimen CCJ 1543 are ellipsoid, fusiform to cylindrical, they seem quite different comparing with the descriptions of Whelden, or even other mycologists. Alternatively, the specimen CCJ 1041 has globose to subglobose conidia. Whelden also mentioned large binucleate abnormal “conidia” in *T. mesenterica*. Those large binucleate abnormal “conidia” are probably similar to big, colorless, swollen cells of the specimen CCJ 1543. Whelden (1934) was the only one who had proved dikaryotic conidia of *T. mesenterica*. He also observed abortive cells (10-16 µm) of *T. mesenterica*, that might be the same vesicle-like mentioned by Olive (1948b). Bandoni (1957a) called similar structures "sterile hymenial structures with thick walls" in some species of *Tremella*, e. g. *T. aspera* and *T. foliacea*, but he did not mention this structure in *T. mesenterica*. Olive (1948b) called similar structures "vesicles" in his new species *T. rufobrunnea* Olive. These vesicles are thick walled, always appearing together with basidia in the hymenium. Both specimens, FO 23014 and CCJ 1543, have similar shape and size of vesicles. The typical orange conidia are extremely variable in contrast to literature reports published before. In most descriptions the shape of conidia is spherical or ovoid to ellipsoid, however, in specimen CCJ 1543 they are ellipsoid, fusiform to cylindrical.

Tremella rufobrunnea Olive (1948b) seems to be similar to *T. mesenterica*. The conidia of the latter collected from Europe are oblong to clindrical, yellowish brown, 2.5-8.5 x 2.5-4.5 µm. However, its vesicles (15-48.5 µm), basidia (13.5-18 µm ø) and basidiospores (9-12.5 x 6.5-8 µm) are distinct from those of *T. mesenterica*.

Table 7. Comparison of described T. mesenterica and T. lutescens from literature.

authors	basidia (µm)	spores (µm)	big colorless conidia and/or conidiophore (µm)	Vesicles-like	small orange conidia
specimen FO23014	**mostly globose-subglobose (ca. 70%)** 20-22(-24) x (19-)20-22(-23) Q=0.95-1.15 broadly ellipsoid - ellipsoid (20-)21-24(-25) x 17-20 Q=1.18-1.29-(-1.35)	ellipsoid - ovoid (10-)12-14(-15) x (7-)9-10(-12) Q=1.20-1.40(-1.50)	conidiophore when citriniform, mostly 26-37 x 19-22, Q=1.30-1.85(-2.18) conidiophore when ovoid and pyriform (but ohne stalk calculation), mostly 29-34 x 18-25, Q=1.31-1.61 conidia, if they are, when globose - subglobose, mostly 23-31 x 21-26, Q=1.00-1.15	globose to subglobose to broadly ellipsoidal (14-21 x 11-19 µm, Q=1.00-1.18), ovate to clavate (22-27 x (11-)15-17 µm, Q=1.35-1.92(-2.03)), or lanceolate (lance-shaped) (34-35 x 7-10 µm, Q=3.5-4.86) , at least 1 µm	none
specimen Yang D88	subglobose - broadly ellipsoid 22-23(-25) x (17-)18-20 Q=1.12-1.31 **mostly ovoid (ca. 70-80%)** 26-31(-35) x (15-)16-19 Q=1.4-1.82(-2.19)	ovoid 12-15.5 x (8-)9-10 Q=1.30-1.61	conidiophore when citriniform, mostly 27-35 x 13-16, Q=1.46-2.19 conidiophore when ovoid and pyriform (but ohne stalk calculation), mostly 18-24 x 13-18, Q=1.14-1.40 conidia, if they are, when subglobose to ovoid (≧10 µm diam.), mostly 15-21 x 12-17, Q=1.00-1.27 conidia when globose - ellipsoid (＜10 µm diam.), mostly 9-9 x 3-8, Q=1.00-1.23	globose to subglobose to ellipsoidal ((12-)15-21 x (9-)12-16.5 µm, Q=1.07-1.42), thick walled, 2-3.5 µm	ellipsoid, fuciform to cylindrical 3-5(-7) x 1.0-2.0 Q=1.5-3.3-(-7)
specimen CCJ1355	subglobose - ellipsoid (18-)19-21(-24) x (14-)15-17 Q=1.13-1.33(-1.40)	subglobose - ellipsoid 12-13(-14) x 8-11(-12) Q=(1.17-)1.20-1.36(-1.50)	conidia, if they are, when globose - ellipsoid(≧10 µm), mostly 15-20x 12-17, Q=1.00-1.20 conidiophore when ovoid-fuciform (stalk without calculation), mostly 22-28 x 13-16, Q=1.67-2.22 conidia when globose - subglobose (≦10 µm), mostly 2-7 x 2-6, Q=1.00-1.11 conidia when ovoid-fuciform (≦10 µm), mostly 4.5-8 x 3-6, Q=1.50-1.67		none
Binyamini, 1983	10-17 x 8-14	10-14 x 8-12	-	-	-

Bourdot, 1932	-	7-9-10 x 6-7, 10-14-16.5 x 8-10-12 7(-9) x 5-6, 6-10-12 x 5-6-10	-	-	-
Breitenbach, 1986	20-25 x 12-17	10-16 x 7-8 7-12 x 6-10 (Pilat, 1957) 10-16(-22) x 7-10 (lutescens)	-	-	3-4.5 x 2.5-3.5 µm
Coker, 1920	3916: 18-20 x 13.7-15.5 4069: 16-20 x 14.8-16.6 4204: 14-20 x 11.2-15.5	8-11 x 7.4-9 9.3-14.8 x 7.4-10 9.3-12.5 x 7-8.5	-	-	3.4-5 x 2.8-3.7 - -
Courtecuisse, 1990	20x13	6-7 x 4-5 (maybe second spores)	-	-	-
Donk, 1969	13-22 x 10-20	7-13 x 6-9	-	-	3-6.5 x 2-4 µm
Ingold, 1982		ovoid, 10-14 x 7-9	-	-	-
Liu, 1992	(12-)16-23 x 10.5-18	10-14.5 x 7.5-12.5 (lutescens)	-	-	-
Lowy, 1971	12-17.5 x 1.5-16	subglobose - ovoid, 10-14.5 x 8.5-12	(lutescens)	-	2.5-3.5 µm
McIlvaine, 1900	-	subglobose, 12-16 (lutescens) 6-9 (mesenterica)	-	-	1-1.5 µm(mesenterica)
Neuhoff, 1931	18-25 x 15-20	10-16(-20) x 8-12	(T. lutescens)	-	-
Neuhoff, 1931	14-20 x 8-12	7-10(-12) x 6-10	(T. mesenterica)	-	mostly spherical, 2-4 µm
Olive, 1946	13.6-16.4 x 15.5-23.3	7.8-9.7 x 9.7-13.6 (15.5)	-	-	-
Olive, 1947	-	11.7-15.6 x 8.5-10.4 (lutescens)	-	-	-
Olive, 1948	-	12.2-15.7 x 7.8-10.4 (lutescens)	-	-	2.6-5.9 x 1.8-4.2
Pérez-Silva, 1992	-	5-7 x 3.5-4.5 (lutescens)	-	-	-
Robert, 1995	15-21 wide	(8.0-)10-16(-18.0) x 6.0-9.5(-12.0) Q=1.2-1.8)	-	-	subglobose, ovoid, or ellipsoid 2.0-3.0 x 2.0-2.5 µm
Torkelsen, 1968	15-22 x 12.5-20	11.25-13.75 x 7.5-9	-	-	elliptical to subglobose 2.5-3.5 x 2
Whelden,1934	15 x 9.7	9 x 7	large binucleate abnormal “conidia”	abortive structure 10-16 µm	mostly spherical binucleate conidia, 2.5-3.0 µm
Wojewoda, 1975	10-26 x 10-20	7-18(-22) x 6-10(-12)	-	-	2.5-3.5 x 2 µm
Wong, etc. 1985	average range of 46 collections		-	-	dikaryophyses absent

	20.7-22.8 x (16.5-)17.5-18.8 authors' own study (19-)20-24(-25) x (14.5-)15.5-20(-21)	12.3-13.3 x 9.0-10 (9.5-)10.5-16 x (7.5-)8.5-10.5 (-11.5)			ellipsoid to subglobose 3-5 x 2-3 µm

Fig. 11. Fresh basidiocarp of *Tremella mesenterica* CCJ 1542 collected from Wintzfelden in France neighboring to Freiburg in Germany.

Fig. 12. Fresh basidiocarp of *Tremella mesenterica* CCJ 1041 collected from Tahsueh Shan Forest in Taiwan located in high mountain at altitude 2200 m.

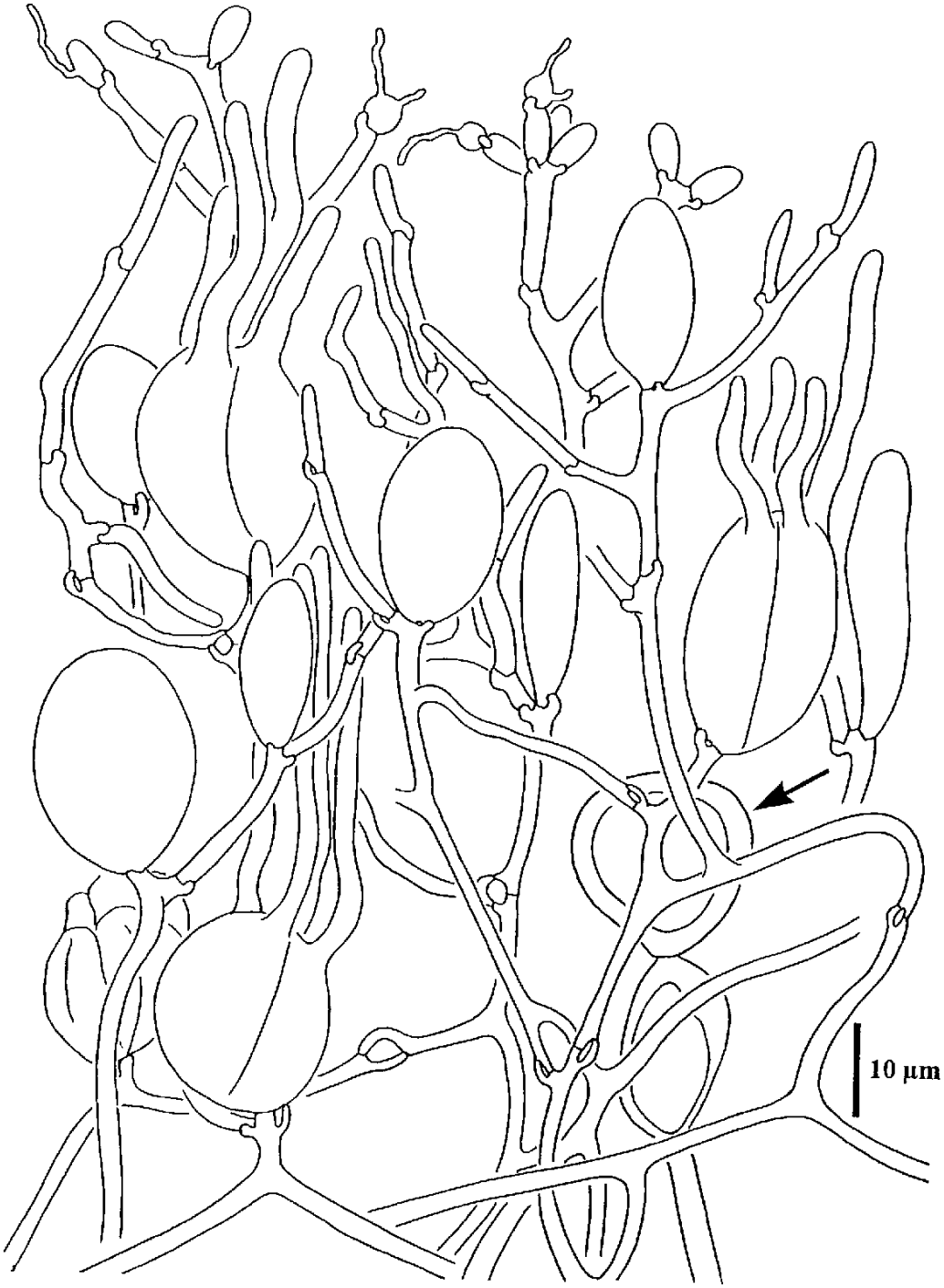
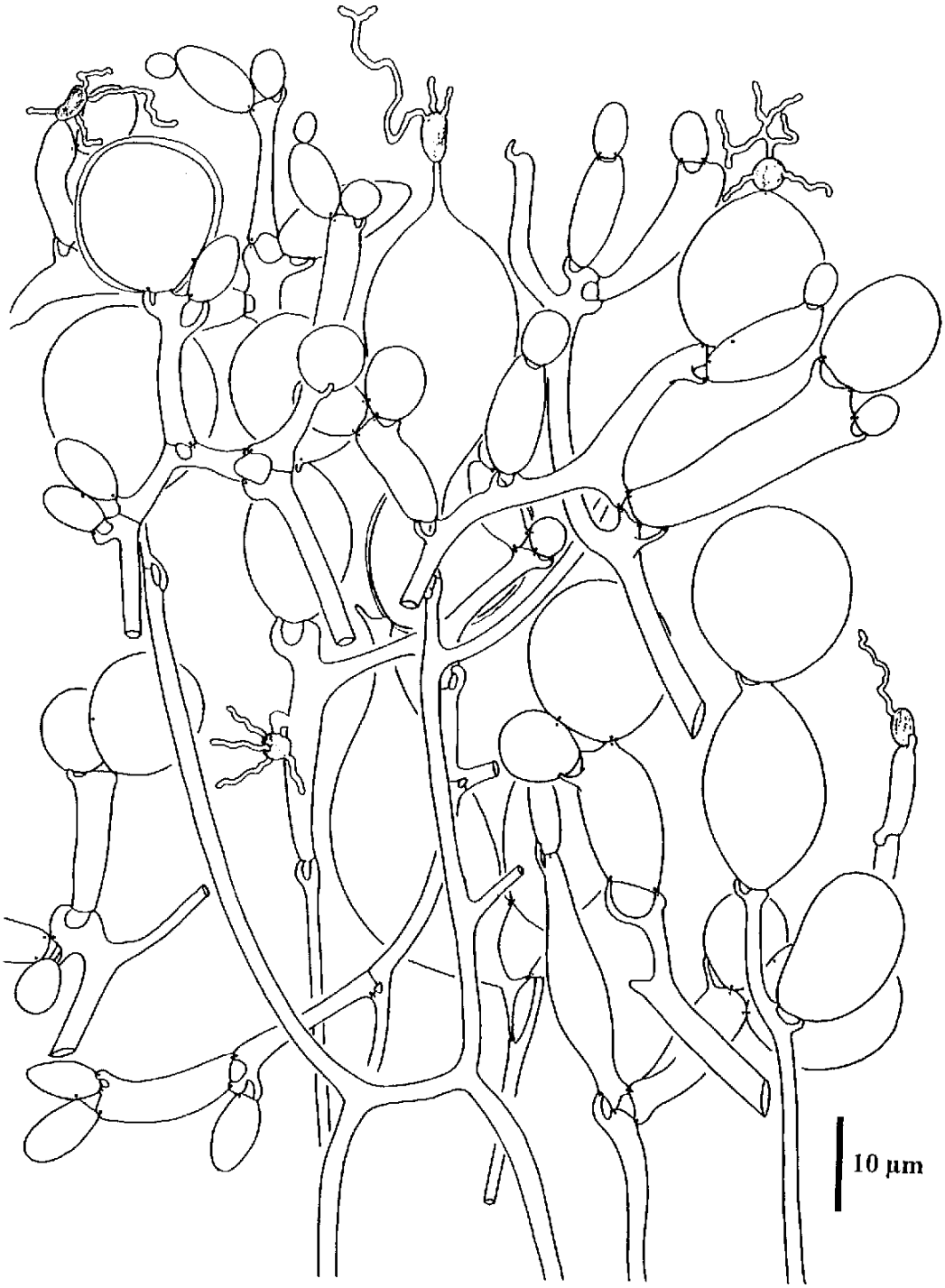


Fig. 13. *Tremella mesenterica* CCJ 1543. Part of hymenial structure on the surface of a mature basidiocarp with basidia of different developmental stages, hyphidial hyphae, and haustoria on the top of hyphidia. Note that the hymenial structure is loose and with hyphidia and vesicles (arrow).



ig. 14. *Tremella mesenterica* CCJ 1543. The swollen cells of hymenial structure in the basal part of a mature basidiocarp close to the substrate.

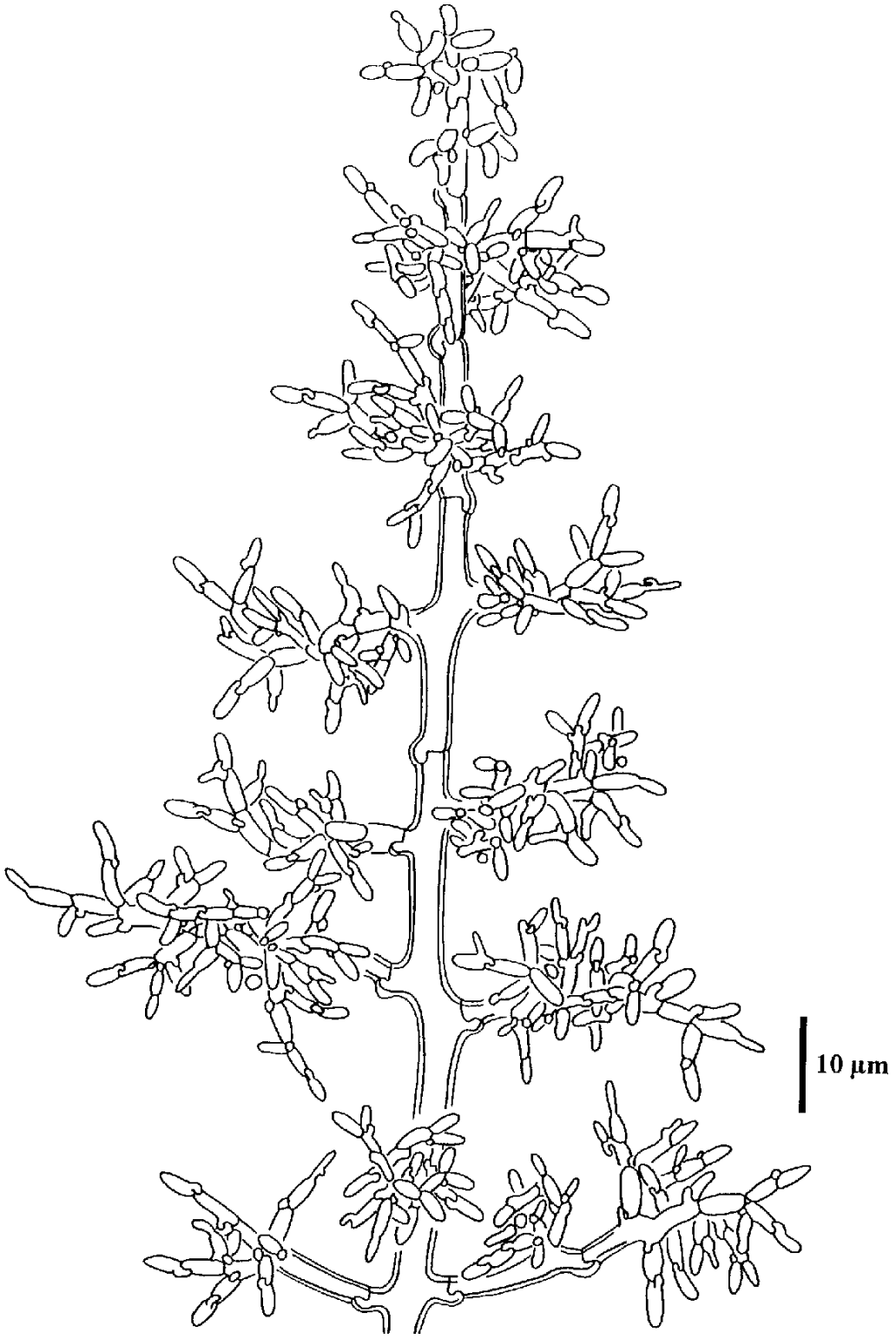


Fig. 15. *Tremella mesenterica* CCJ 1543. The conidial stage. Note that the clamped conidia are dikaryotic.

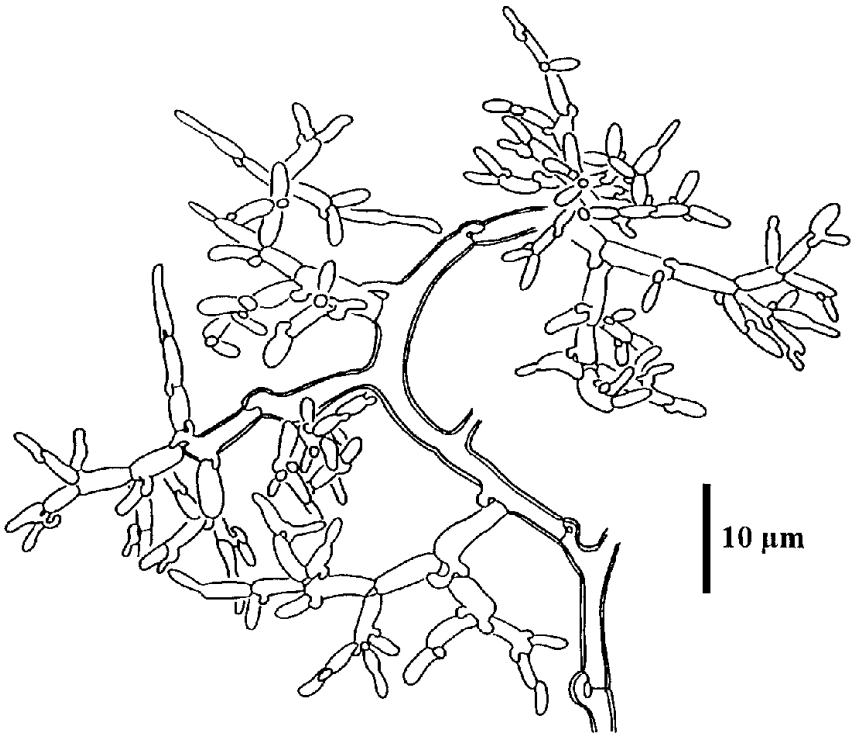


Fig. 16. *Tremella mesenterica* CCJ 1543. The oval to fusiform dikaryotic conidia.

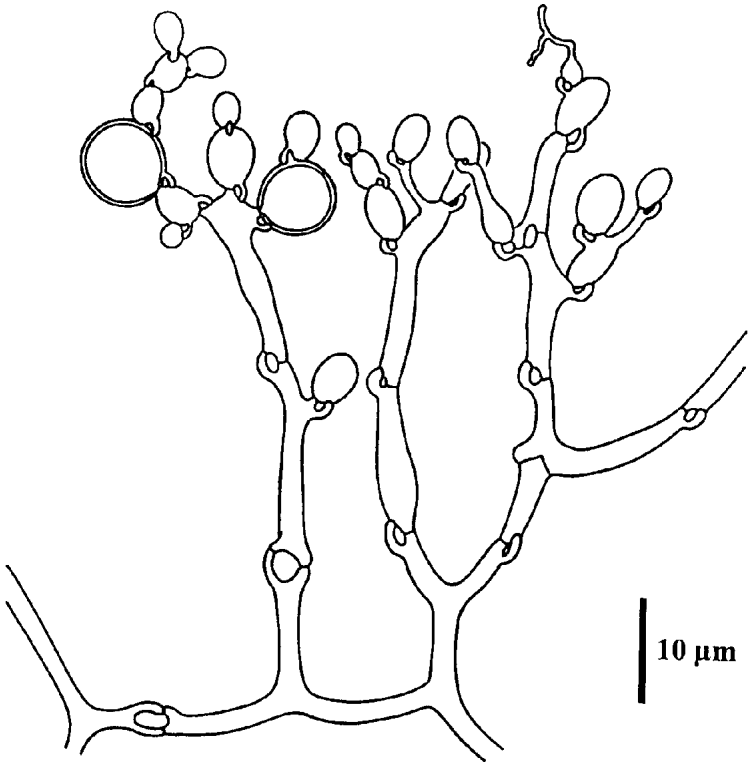
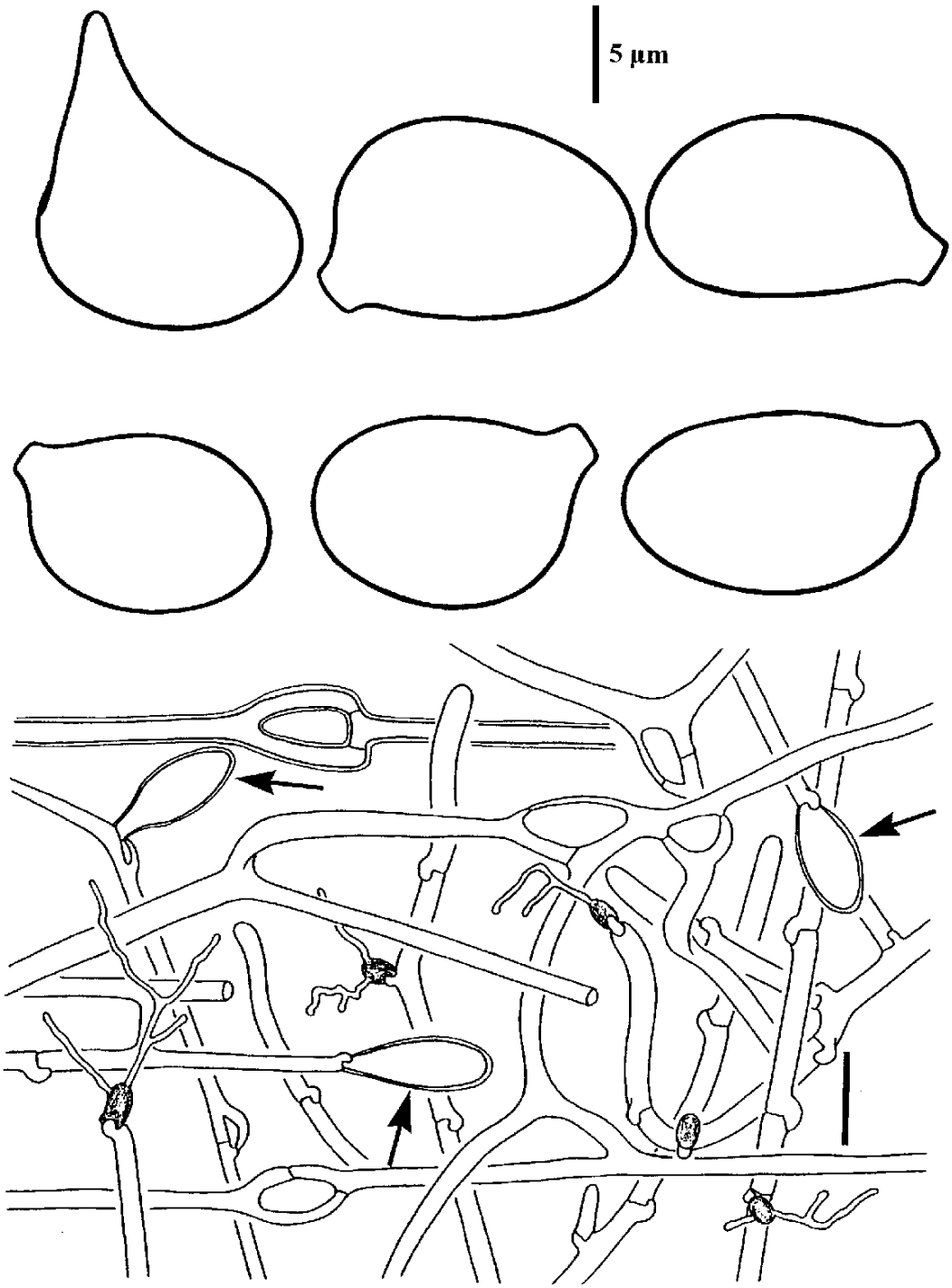


Fig. 17. *Tremella mesenterica* CCJ 1041. The globose to subglobose dikaryotic conidia.



Figs. 18-19. *Tremella mesenterica* CCJ 1543. 18. Basidiospores. 19. Structure in the inner part of the basidiocarp. Note the terminally swollen cells (arrows).

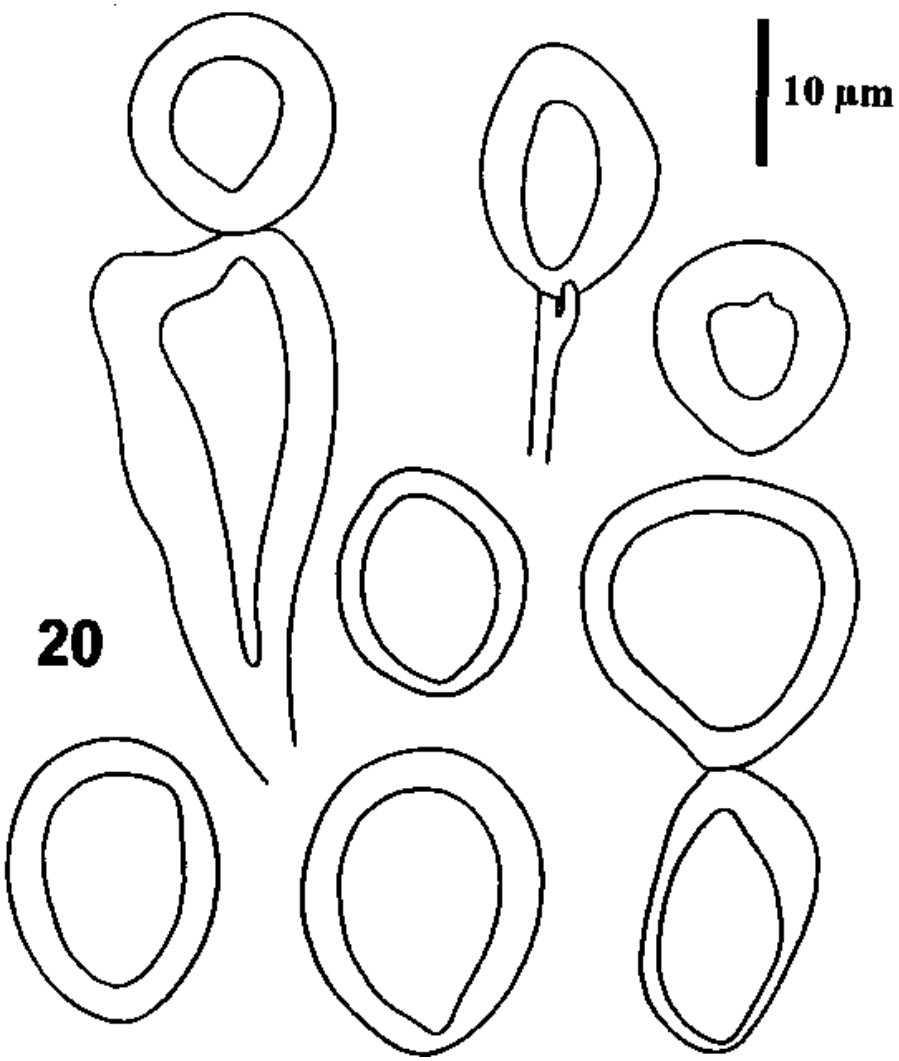


Fig. 20. *Tremella mesenterica* CCJ 1543. Various vesicles.

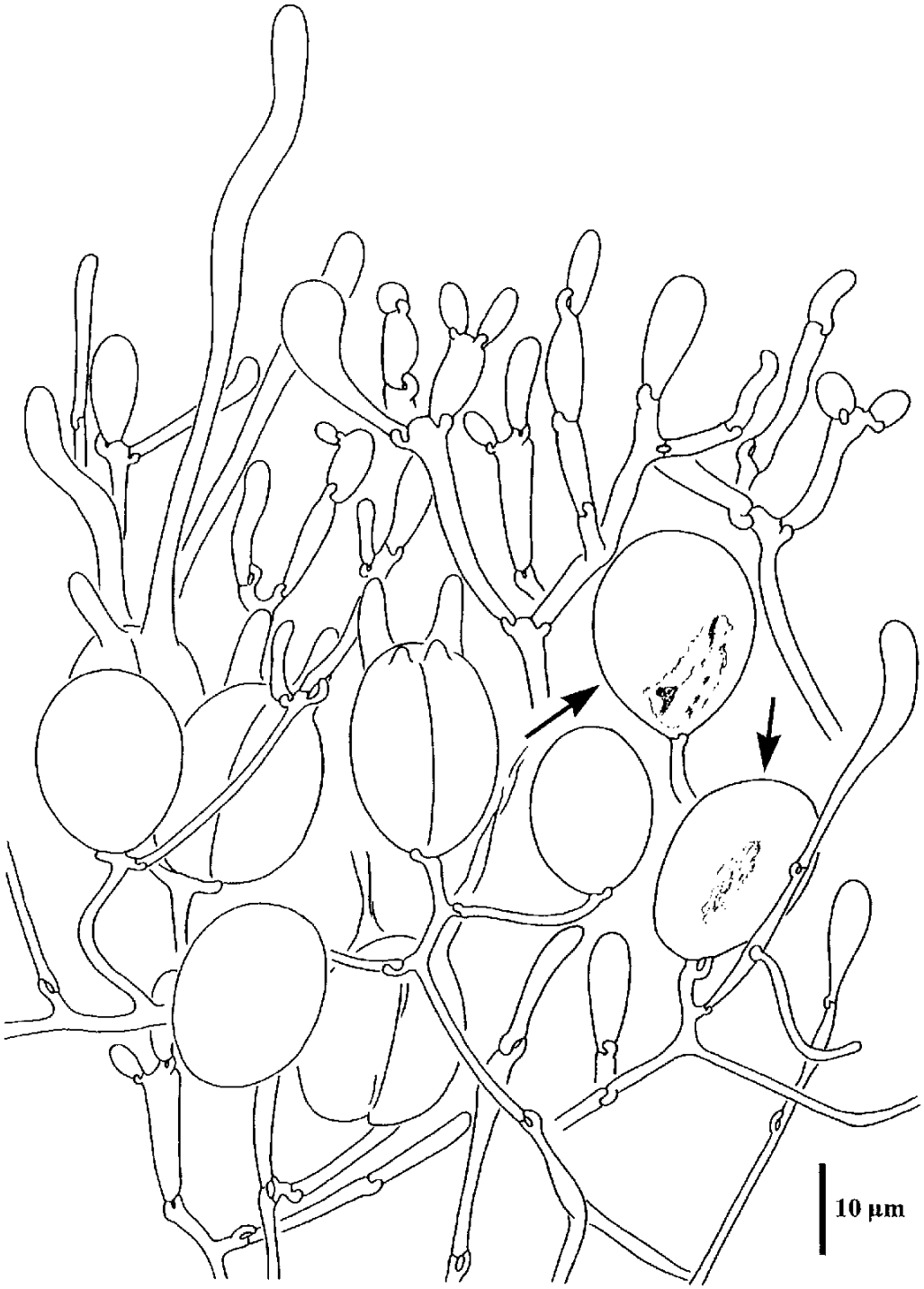


Fig. 21. *Tremella mesenterica* FO 23014. The hymenial structure on the surface of a mature basidiocarp. Note that the hymenial structure is loose and hyphidia are present. Arrows show the vesicles.

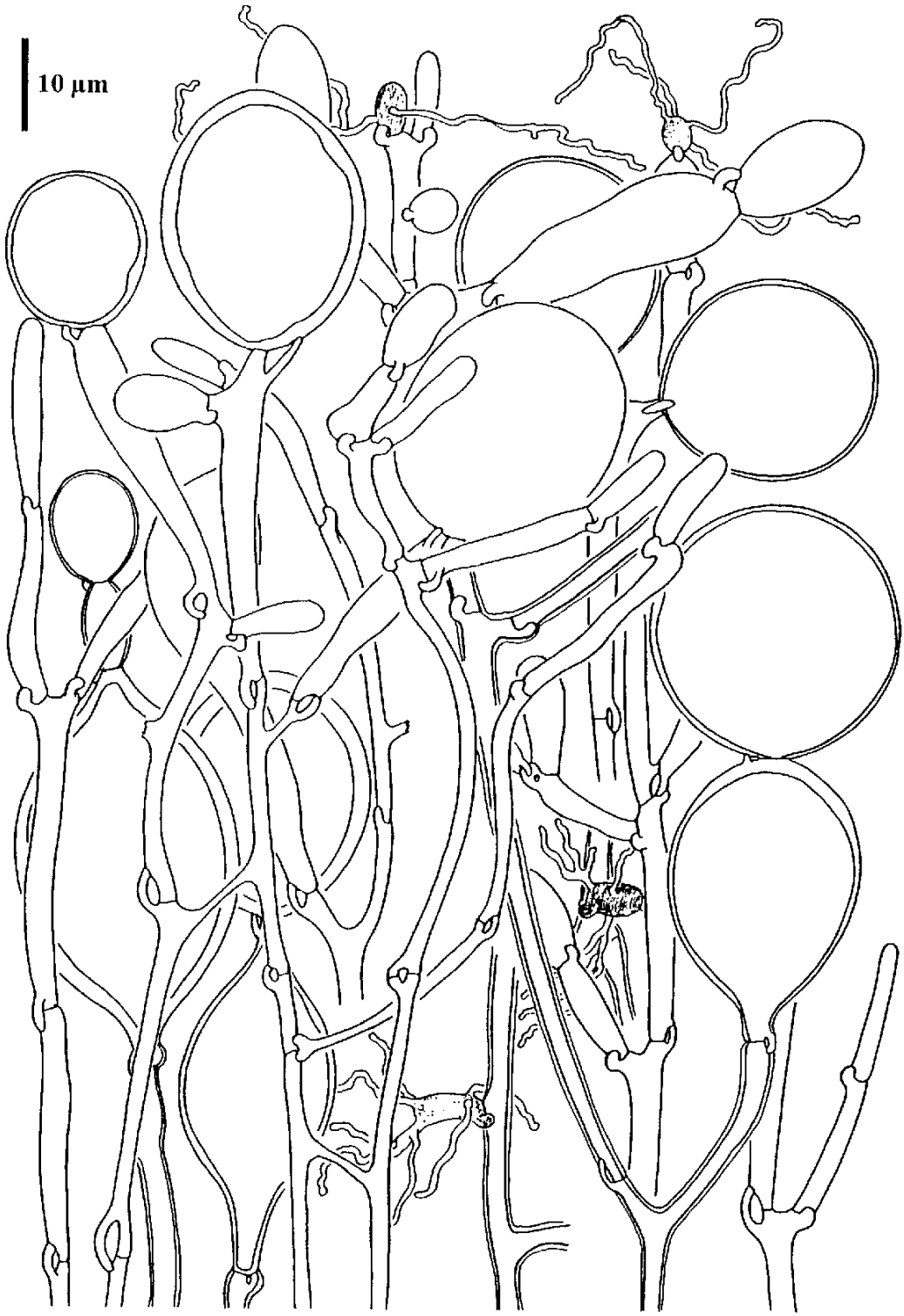


Fig. 22. *Tremella mesenterica* FO 23014. The swollen cells of hymenial structure in the basal part of a mature basidiocarp close to the substrate. Note that the haustorial hyphae are branched.

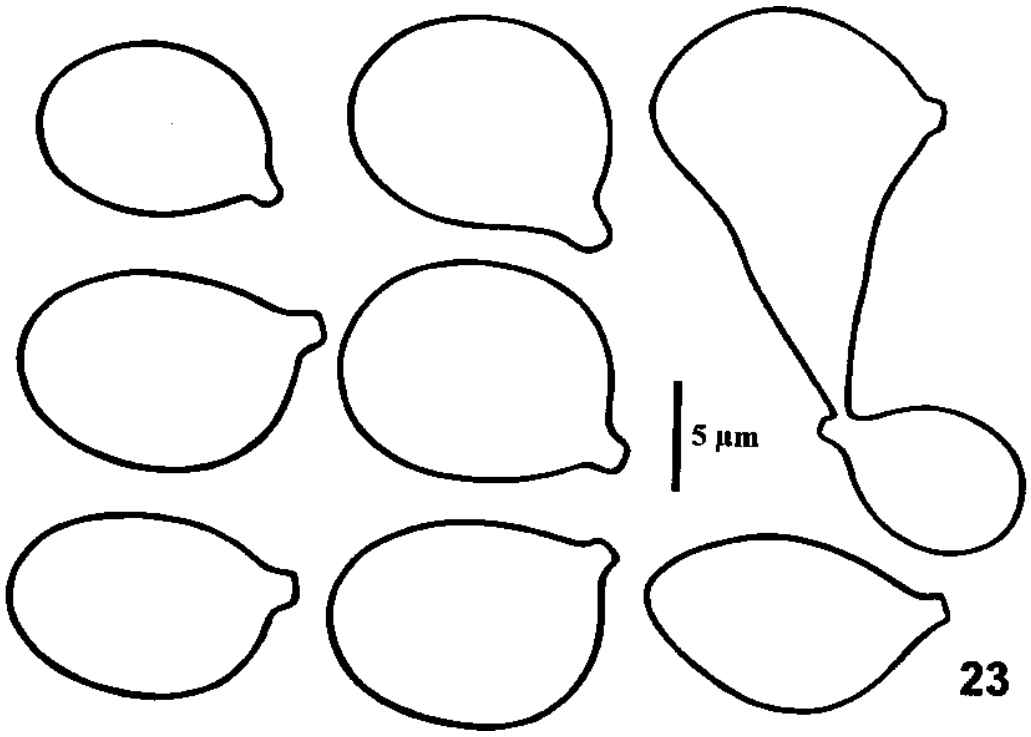


Fig. 23. *Tremella mesenterica* FO 23014. Basidiospores, one of them producing a secondary spore by repetition.

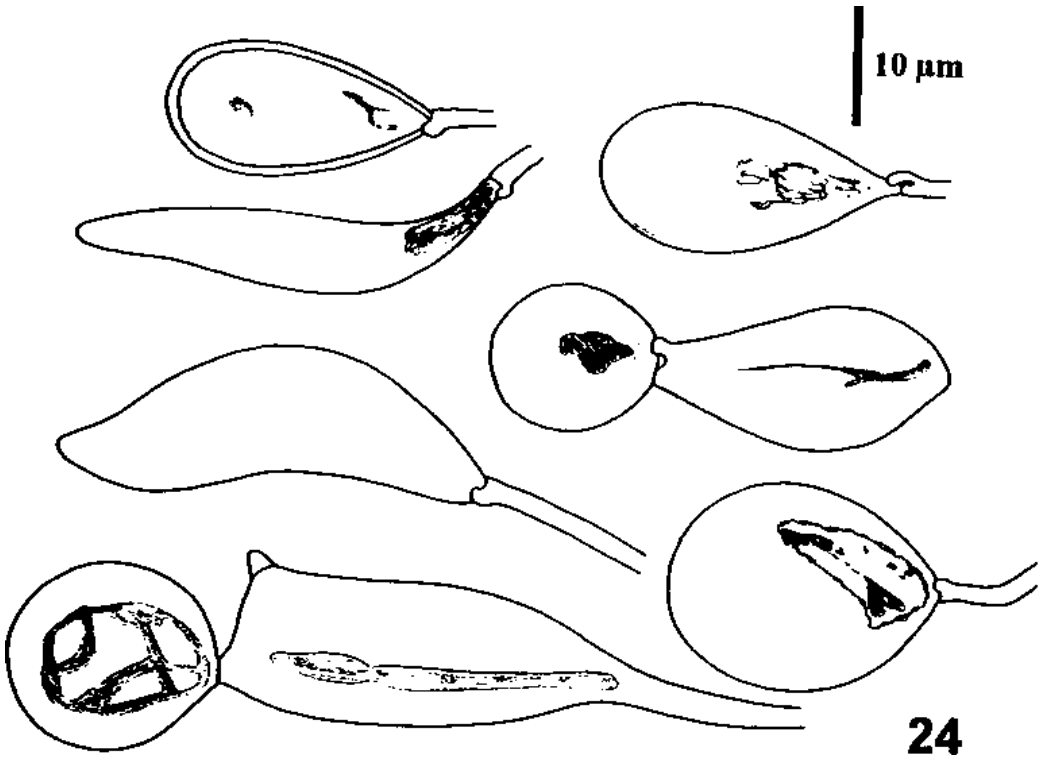


Fig. 24. *Tremella mesenterica* FO 23014. Various vesicles.

Tremella taiwanensis C.-J. Chen sp. nov. (Figs. 25-28)

Latin diagnosis

Fructificatio pulvinata vel cerebriformis, gelatinosa, cava, albo-lutea. Basidia subglobosa vel ellipsoidea, (21-)23-29(-31) x (20-)22-27 µm, oblique septata. Basidiosporae globosae vel subglobosae, (12-)14-18 x (12-)14-20 µm. Hyphidia 2-3(-4) µm ø, muris tenuibus.

Macromorphology

Basidiocarps pulvinate to cerebriform, whitish yellow, hollow, 0.5-1.7 cm ø, dry light yellow, flat on the substrate.

Micromorphology

Basidia: ± subglobose to ellipsoid, (21-)23-29(-31) x (20-)22-27 µm [Q=0.91-1.20(-1.45)], longitudinally or obliquely cruciate-septate, mostly 4-, occasionally 2-spored; sterigmata up to 120 µm in length, 5-8 µm ø, sometimes apically swollen up to 10 µm ø; infrequently producing conidia directly from basidia or sterigmata.
Spores: ± globose to subglobose, (12-)14-18 x (12-)14-20 µm [Q=0.86-1.15]; mostly broader than long, hyaline, smooth; germinating by budding.
Conidia: monokaryotic, mostly subglobose to ellipsoid, 6-9(-11) x 5-7 µm [Q=(1.00-)1.09-1.55(-2.00)], hyaline, smooth, thin-walled; frequently budding from apex of sterigmata, sometimes from the side of sterigmata or basidia, occasionally directly from basidia instead of sterigmata.
Vesicles: absent.
Swollen cells: absent.
Hyphidia: rare, 2-3(-4) µm ø, thin-walled.
Hyphae: smooth, hyaline, 2-4(-5) µm ø, sometimes slightly swollen.
Haustoria: clamped; very rare, growing out from hyphal clamps.

Type: CCJ 1151.
Etymology: referring to type locality.
Type locality: Taiwan, Taitung county, Fuli village, 200 m.
Type deposited: NTU-TAI-Mycological Herbarium, Department of Botany, National Taiwan University, Taipei, Taiwan. R.O.C. (holotype); Universität Tübingen, Herbarium of Lehrstuhl Spezielle Botanik, Auf der Morgenstelle 1, D-72076 Tübingen, Germany (isotype).
Distribution: Taiwan.
Habitat and substrate: on branches of decayed wood.
Specimen studied: Taiwan, Taitung county, Fuli village, 200 m, leg. C.-J. Chen, 05. VIII. 1995, CCJ 1151; Taiwan, Pingtung county, Kenting National Park, Nanzenshan, 300 m, on *Mallotus paniculata*, leg. C.-J. Chen, 01. IX. 1995, CCJ 1153.

Remarks

The whitish yellow basidiocarps are easily to be associated with the Mesenterica group, and their big basidia in big size are close to those of *T. brasiliensis* but distinct in measurements. *Tremella taiwanensis* has loose hymenial structures, large basidia and big sized basidiospores. The conidia are produced from the side or the top of sterigmata, or even the side of basidia. Sometimes the basidia produce conidia directly from the position of sterigmata (Fig. 28). Such conidial characters can be found also in *T. globospora* (Fig. 68), however *T. taiwanensis* differs from them in distinct substrate, basidiocarps, size and shape of the basidia and the basidiospores.

Figs. 25-26. Fresh basidiocarps of *Tremella taiwanensis*. 25. Specimen CCJ 1151. 26. Specimen CCJ 1153.

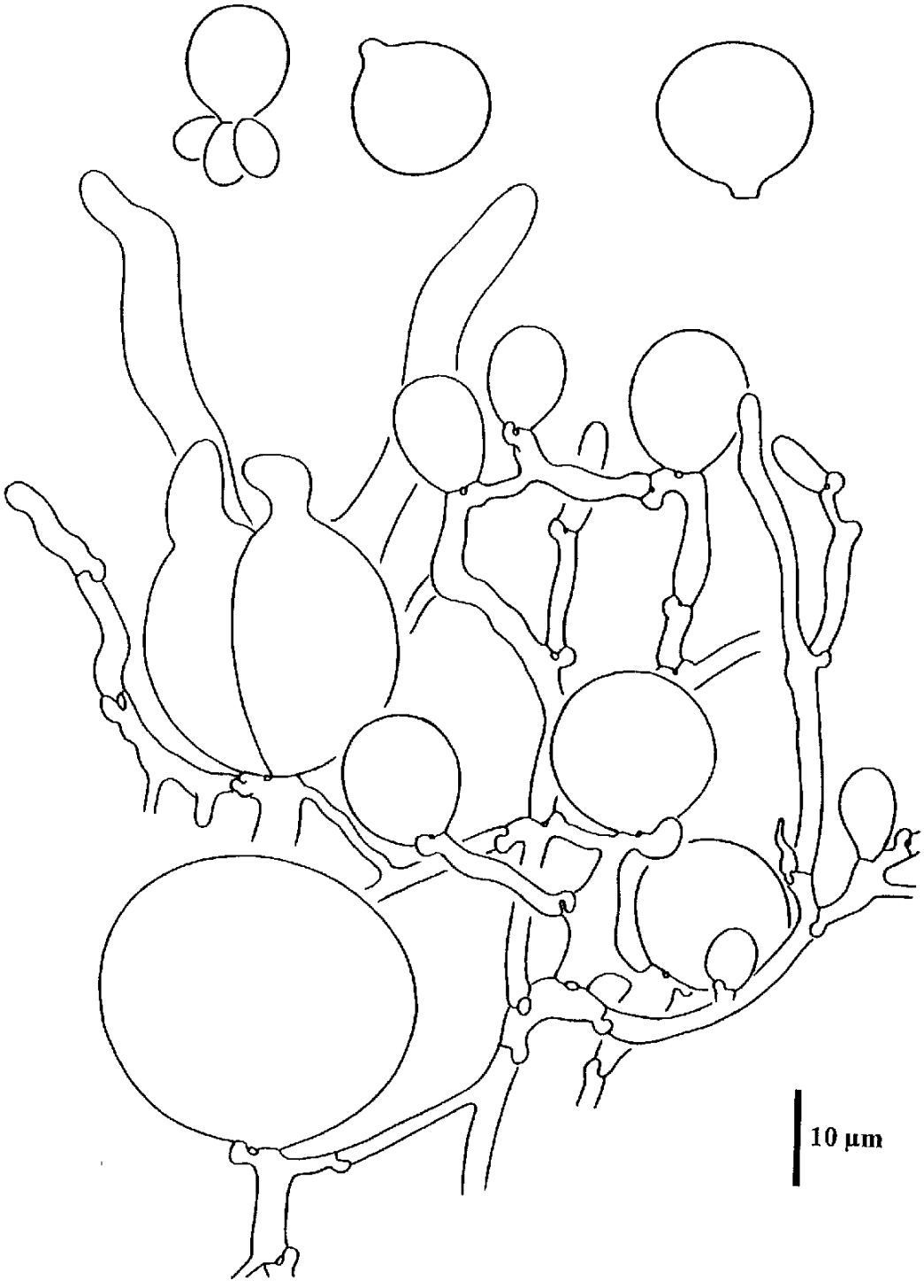


Fig. 27. *Tremella taiwanensis* CCJ 1151. Basidiospores and the hymenial structure on the surface of a mature basidiocarp. Note that the hymenial structure is loose.

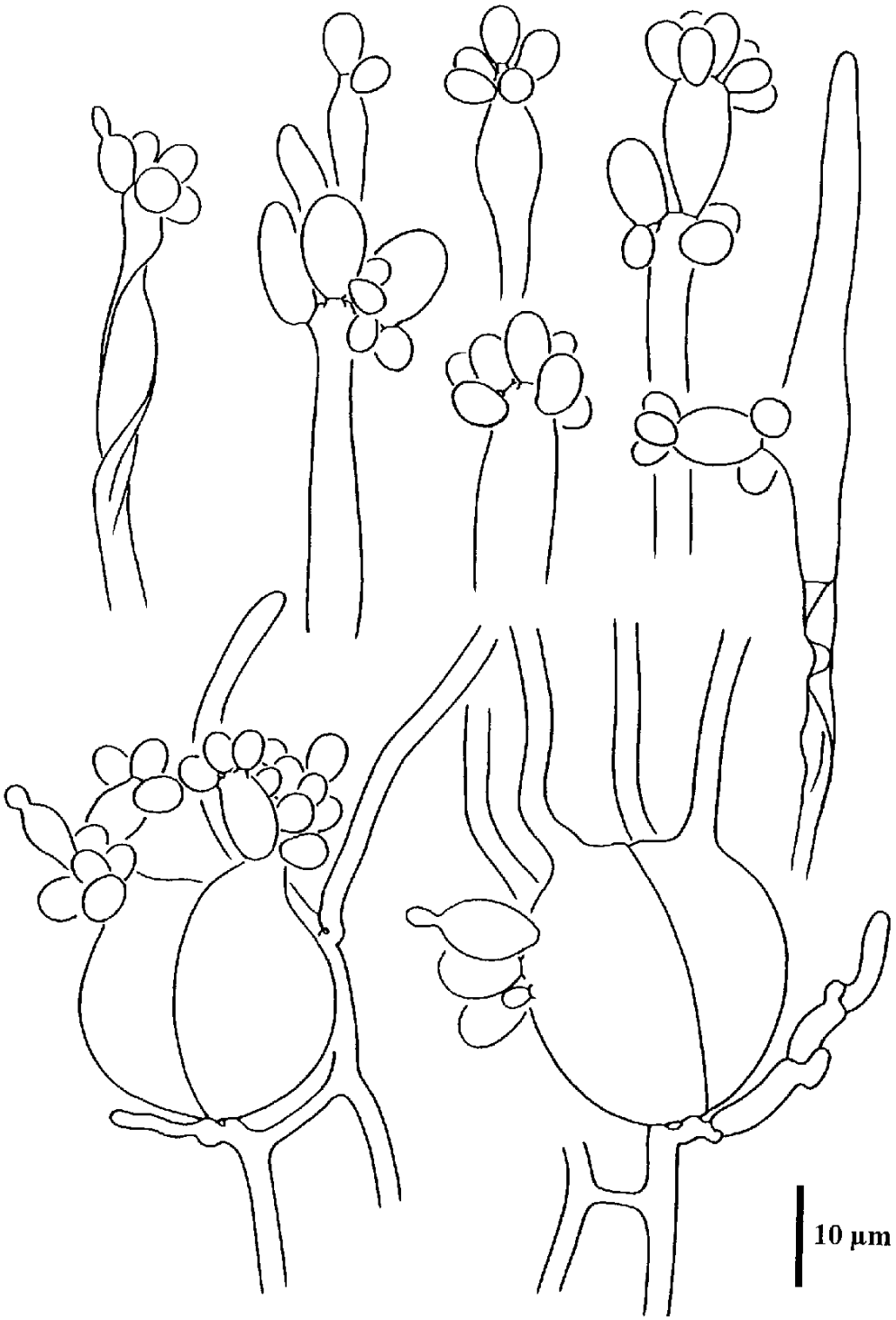


Fig. 28. *Tremella taiwanensis* CCJ 1151. Conidia produced from the sterigmata and the basidia.

Tremella tropica C.-J. Chen sp. nov. (Figs. 29-36)

Latin diagnosis

Fructificatio cerebriformis vel foliacea, gelatinosa, lutea vel aurantia. Basidia subglobosa vel ellipsoidea, (18-)19-21(-24) x (14-)15-17 µm, oblique septata. Basidiosporae subglobosae vel ellipsoideae, 12-13(-14) x 8-11(-12) µm. Cellulae inflatae globosae vel subglobosae, 2-7(-9) x 2-6(-7.5) µm. Hyphidia 2-3(-4) µm ø, muris tenuibus.

Macromorphology

Basidiocarps gelatinous, cerebriform to foliose, often large, up to 8 cm ø, yellowish orange when young, luteous when old, dry yellowish.

Micromorphology

Basidia: subglobose to ellipsoid, (18-)19-21(-24) x (14-)15-17 µm [Q=1.13-1.33(-1.40)], longitudinally or obliquely septate, mostly 4-, rarely 2-spored; sterigmata up to 170 µm, 3-4 µm ø, apically swollen up to 5-6 µm ø.

Spores: subglobose to ellipsoid, 12-13(-14) x 8-11(-12) µm [Q=(1.17-)1.20-1.36(-1.50)], germinating by repetition, budding or germ tubes.

Conidia: monokaryotic, globose, 2-5 µm; occasionally becoming haustoria-like, producing short hyphae, ca. 0.5-1.0 µm ø; conidiogenous cells globose or subglobose to ellipsoid, mostly 15-20 x 12-17 µm [Q=1.00-1.20 (-1.24)], occasionally oval to fusiform, 22-28 x 13-16 µm [Q=1.67-2.22(-3.00)], thin-walled, hyaline, smooth.

Vesicles: absent.

Swollen cells: located in the lower part of mature basidiocarps, colorless, conidia-like, clampless, globose to subglobose, 2-7(-9) x 2-6(-7.5) µm [Q=1.00-1.11], sometimes ovoid, 4.5-8(-12) x 3-6 µm [Q=1.50-1.67(-1.85)], smooth, hyaline.

Hyphidia: rare, hyaline, smooth, thin-walled, gelatinous, clamped, 2-3(-4) µm ø.

Hyphae: hyaline, smooth, thin-walled, gelatinous, clamped, 2-4 µm ø.

Haustoria: rare, some formed by small globose or subglobose conidia with slender, single hyphae functioning as haustoria.

Type: CCJ 1355

Etymology: indicating a tropical fungus.

Type deposited: NTU-TAI-Mycological Herbarium, Department of Botany, National Taiwan University, Taipei, Taiwan. R.O.C. (holotype); Universität Tübingen, Herbarium of Lehrstuhl Spezielle Botanik, Auf der Morgenstelle 1, D-72076 Tübingen, Germany (isotype).

Type locality: Taiwan, Nantou county, Chushan town, Tropical Botanical Garden of National Taiwan University.

Distribution: Taiwan.
Habitat and substrate: on branches of decayed wood.
Specimen studied: Taiwan, Nantou county, Chushan town, Tropical Botanical Garden of National Taiwan University, leg. C.-J. Chen, 29. V. 1996, CCJ 1355.

Remarks

The yellowish orange basidiocarps of *Tremella tropica* are resembling those of *T. mesenterica* macroscopically, but they are remarkably different from each other in micromorphology. The size of basidiospores of *T. tropica* are in the range of *T. mesenterica*, however they are clearly distinct from the conidial and hymenial structures. The conidia are frequently present in the whole basidiocarps of *T. tropica*. Meanwhile, the conidiogenous cells and basidia grow from the same generative hyphae (Fig. 31) which was not found in *T. mesenterica*. The swollen conidiogenous cells have been rarely investigated before in the genus *Tremella*. This new taxon is close to *T. philippinensis*, but their measurements of basidia and basidiospores are distinct enough to be separated.

Some conidia on top of basidiocarps form haustoria though they are clampless, however.

Fig. 29. Fresh basidiocarp of *Tremella tropica* CCJ 1355.

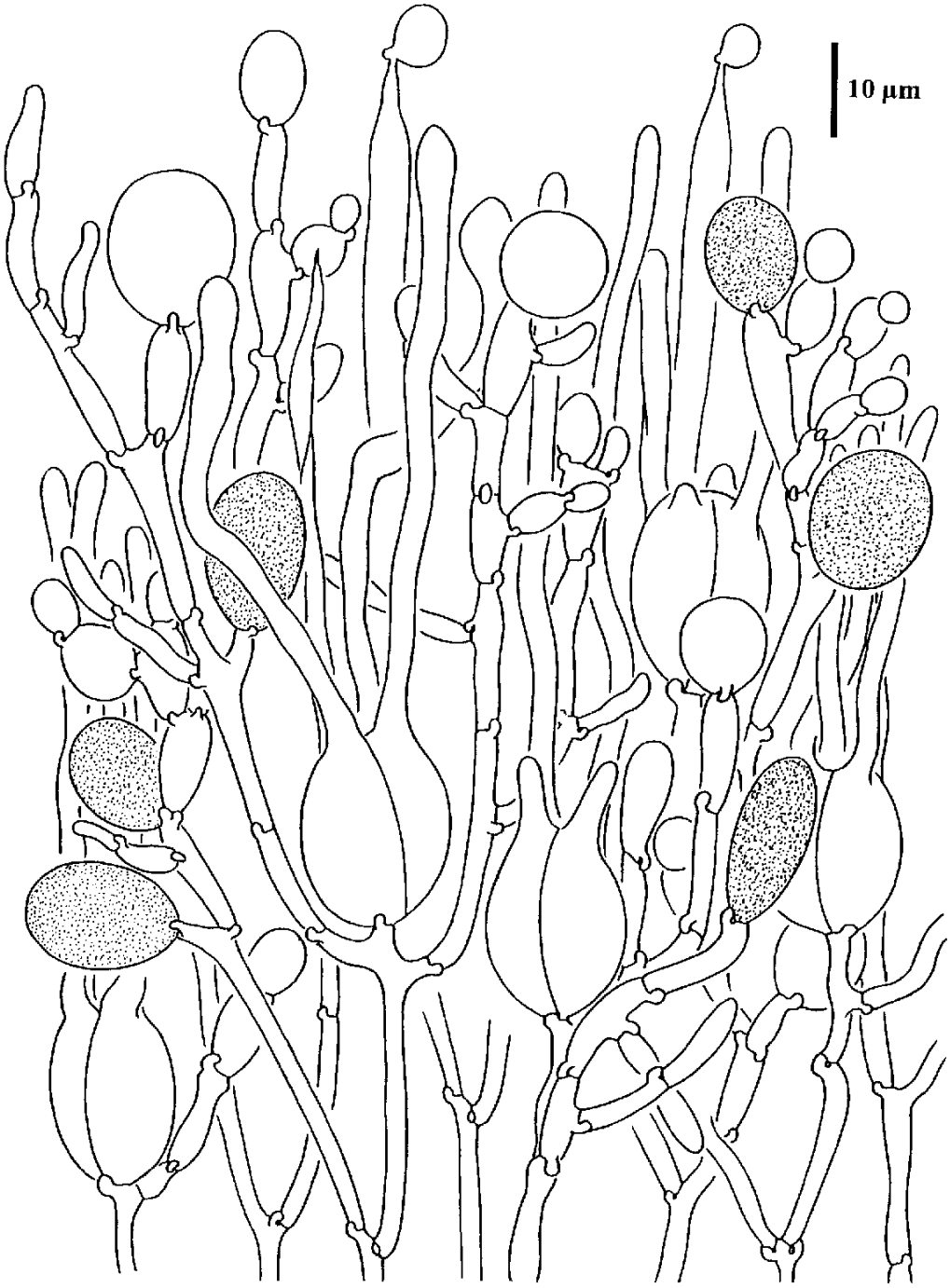


Fig. 30. *Tremella tropica* CCJ 1355. Part of hymenial structure on the surface of a mature basidiocarp with basidia of different developmental stages. Note that the hymenial structure is loose and the small cells in chains probably function as conidia.

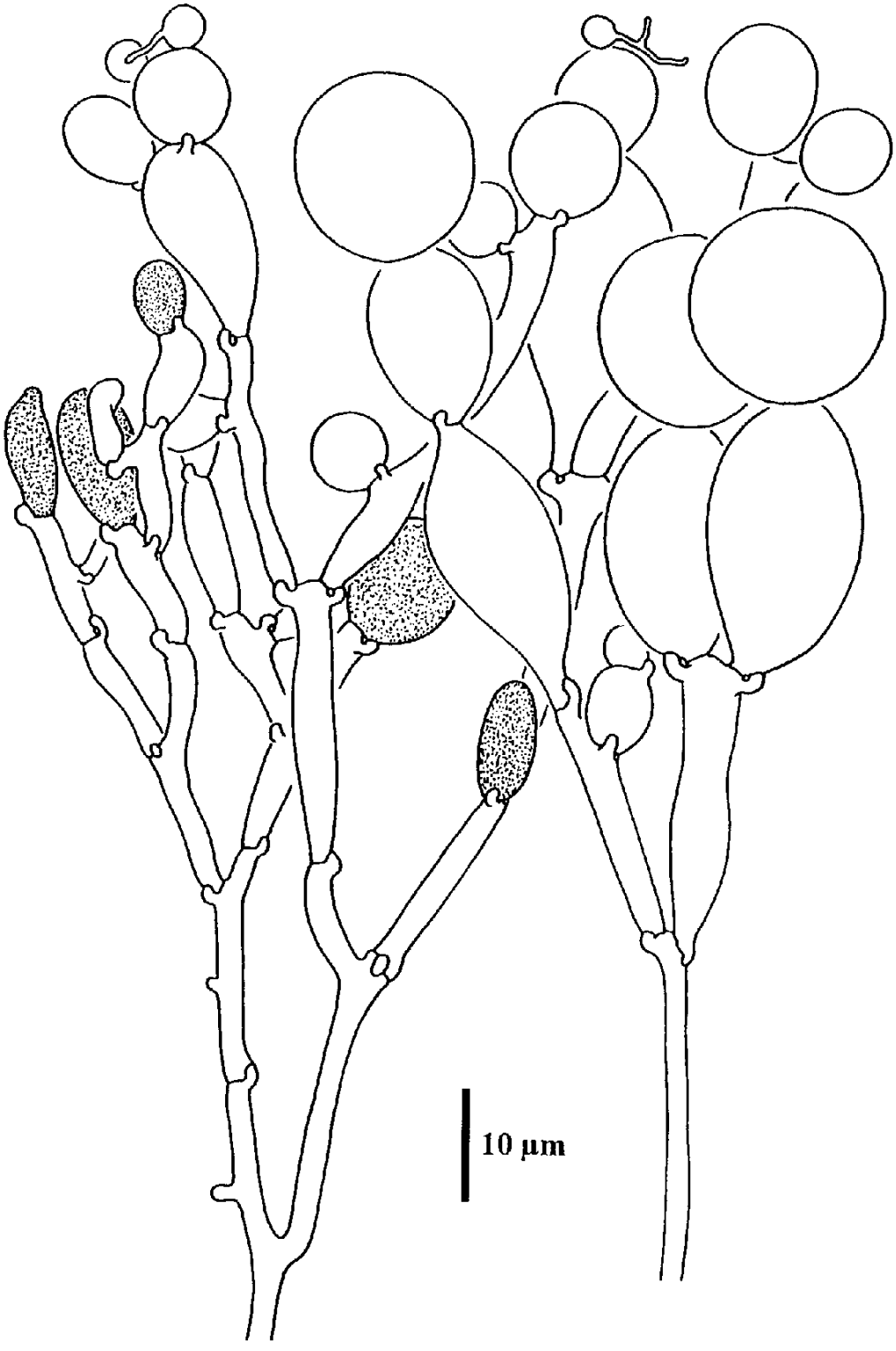


Fig. 31. *Tremella tropica* CCJ 1355. Part of hymenial structure on the surface of a mature basidiocarp with probasidia (solid) and conidiogenous cells (hollow) growing from the same generative hyphae. Note that two conidia producing shortly slender hyphae might function as haustoria.

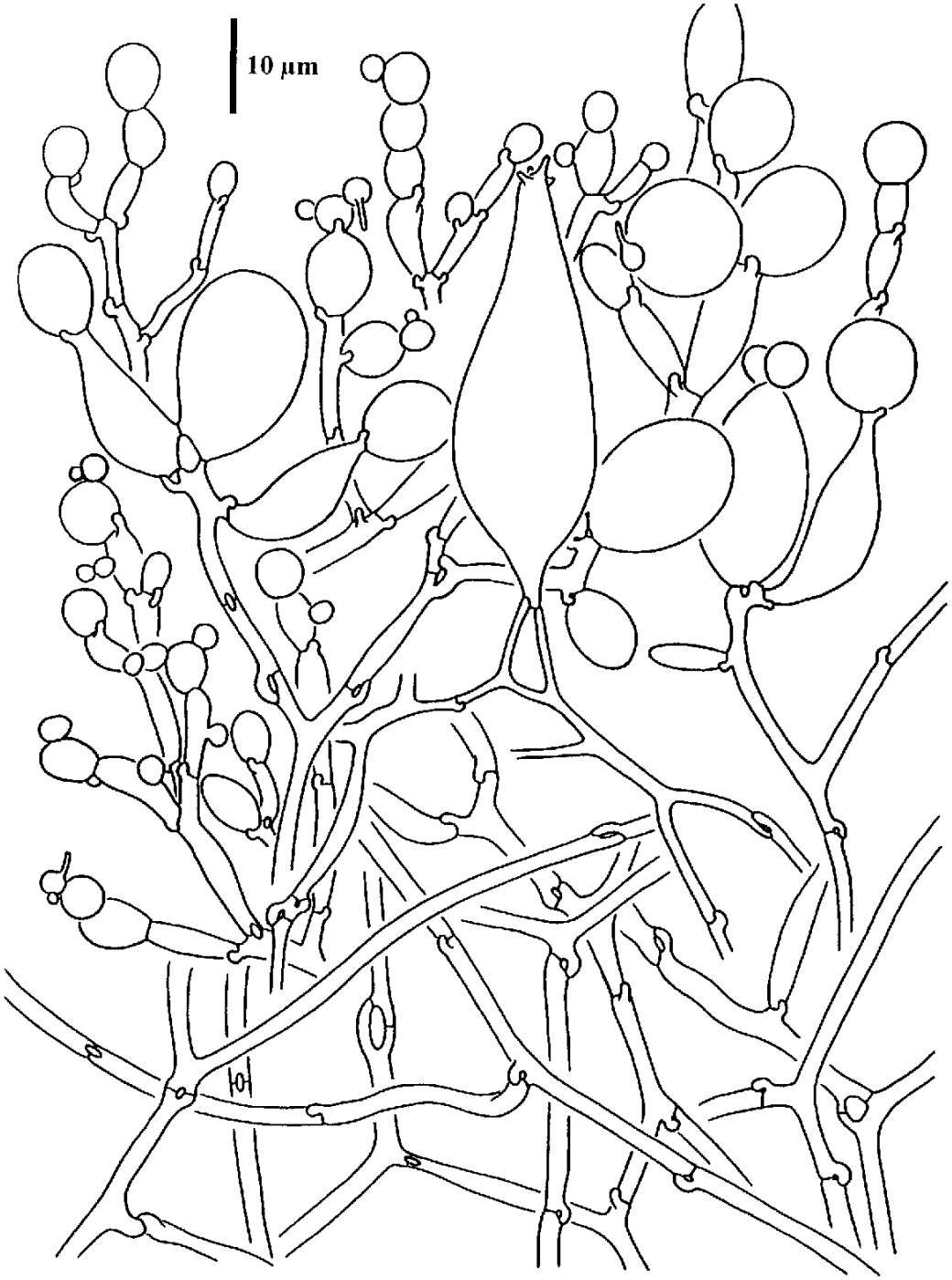
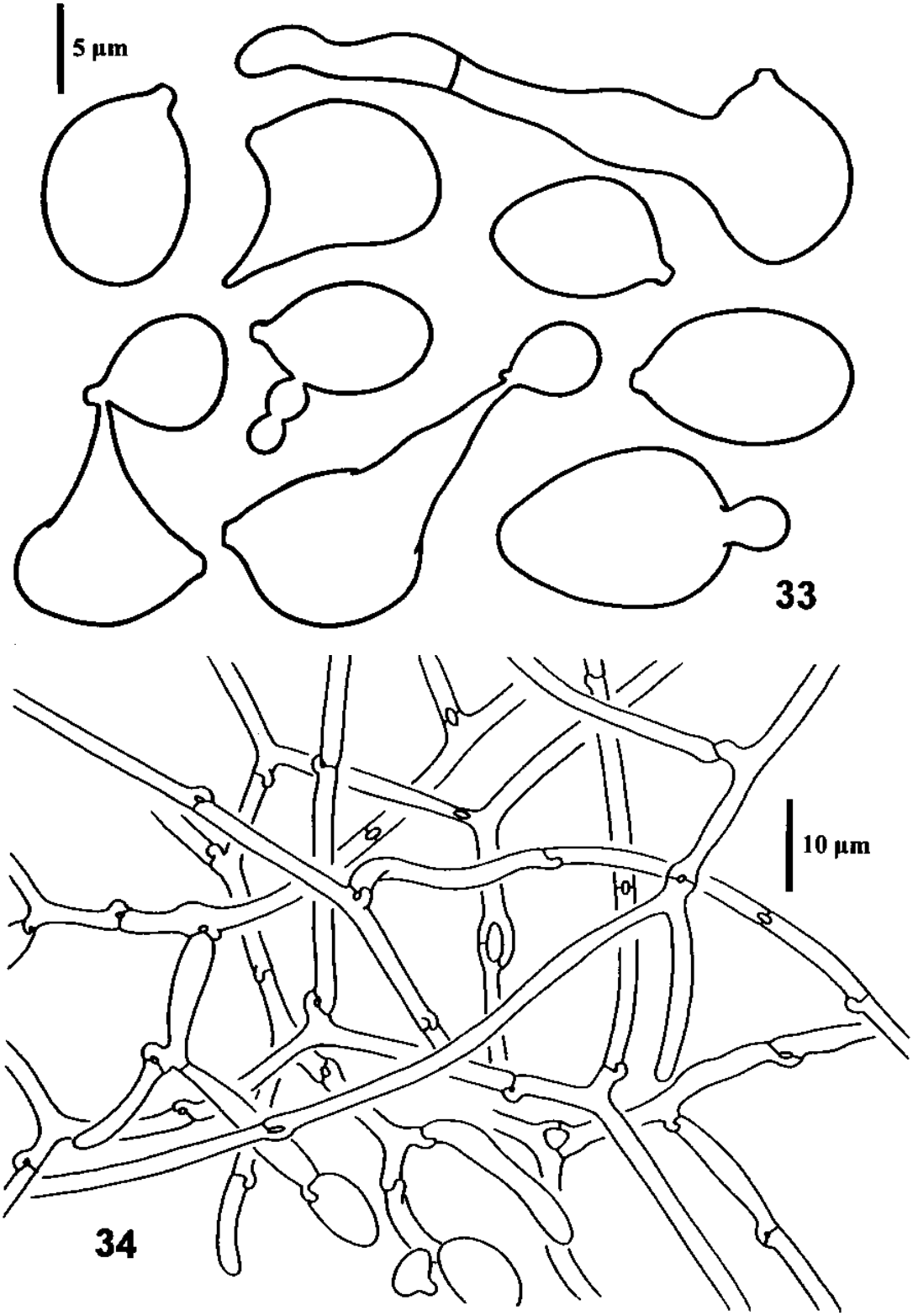


Fig. 32. *Tremella tropica* CCJ 1355. Basal part of a mature basidiocarp close to the substrate with conidiogenous cells and clampless conidia in chains.



Figs. 33-34. *Tremella tropica* CCJ 1355. 33. Basidiospores, one of them germinating by hypha, three producing sterigmata with two secondary spores, and two budding off yeasts. 34. Structure in the inner part of basidiocarp.

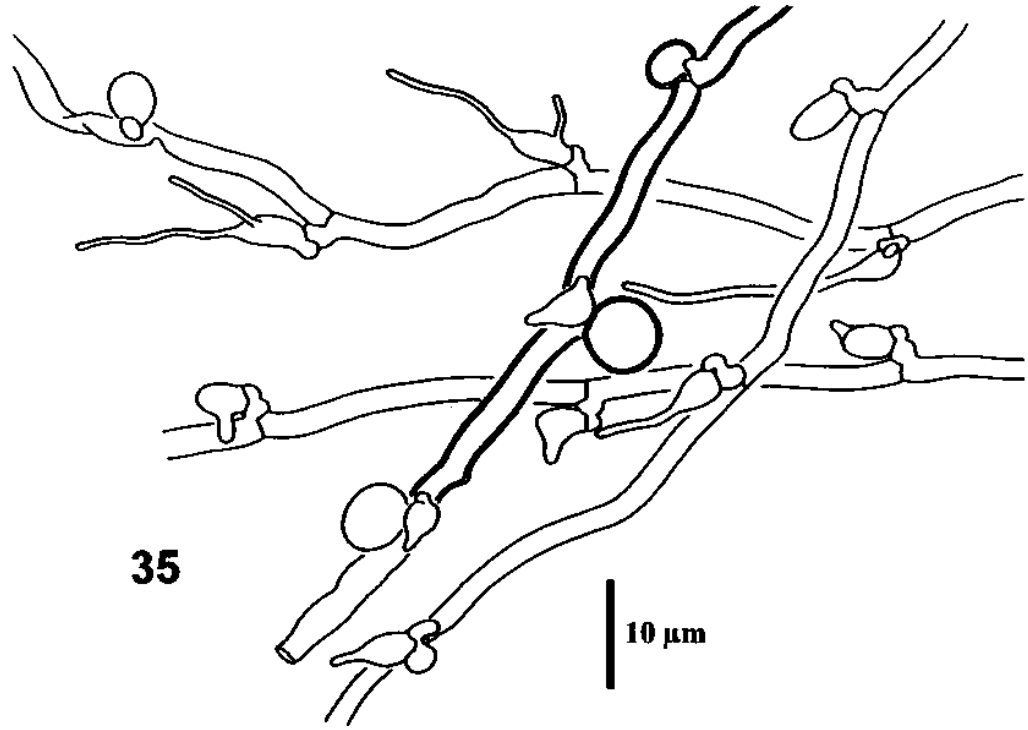


Fig. 35. *Tremella tropica* CCJ 1355. Mycelial stage in the pure culture.

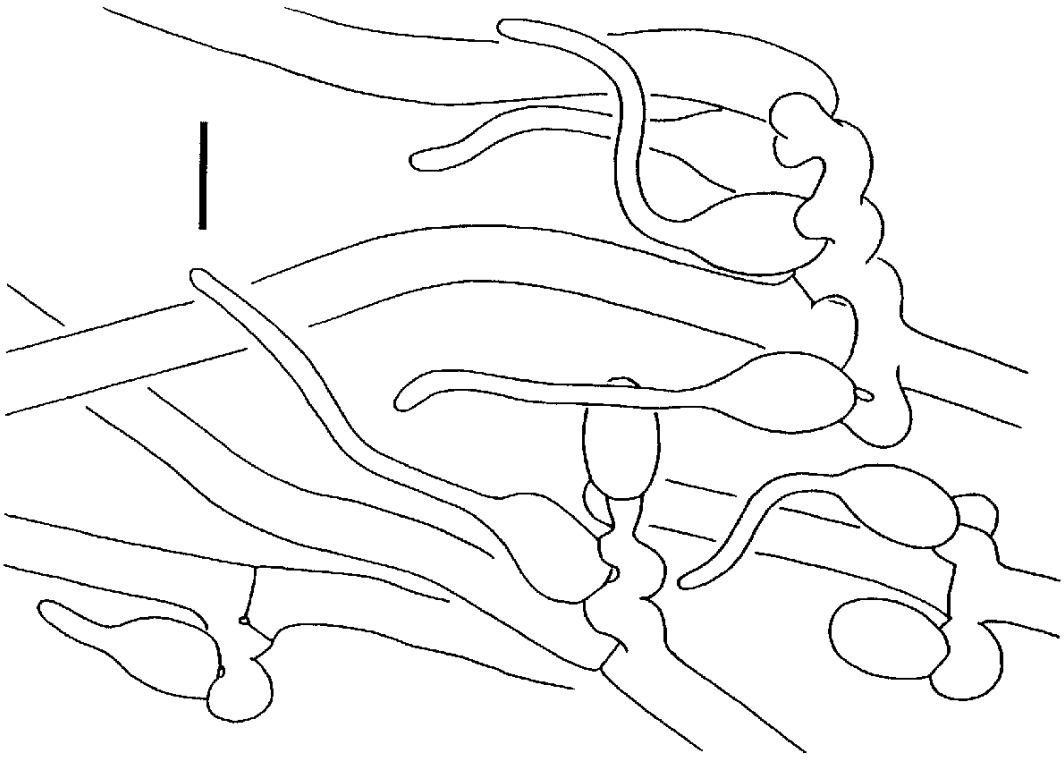


Fig. 36. *Tremella tropica* . CCJ 1355. Magnification of haustoria produced from clamped hyphae in the pure culture. Note that haustoria are always growing from clamps of hyphae. Bar=5µm.