Rev. Biol. Trop. 44 (Suppl. 4): 15-24, 1996

Four new species of *Tremella* (Tremellales: Basidiomycotina) from Costa Rica

R. Bandoni [1] J. Carranza [2] and A.-A. Bandoni [1]

1 Department of Botany, University of British Columbia, Vancouver, British Columbia, Canada

2 Escuela de Biología, Universidad de Costa Rica, San José, Costa Rica, Centro América

Abstract: Very few studies have been carried out on tropical Tremellales. Four new taxa are described, as follows: *Tremella armeniaca* R. Bandoni & Carranza: basidiomata superficial, lobes single or of small clusters, surfaces smooth, glossy to waxy Warm Orange to Ripe Apricot (R); nodose septate hyphae 2-5 µm ; basidiospores 6-9(-10) x 3-6 (-7) µm, ovoid, apiculate; conidia 3-5 x 1.5-2.5 µm, obovoid, ellipsoid to subcylindric. *T. lilacea* R. Bandoni & Carranza: basidiomata aggregated, tuberculate, anastomosing and distinctly moriform, gelatinous, pale amethyst to Pansy Purple (R); hyphae with few septa 1.5-4 µm; basidiospores mostly bullate 8.5-10 x 7-8 µm. *T. nigrifacta* R. Bandoni & Carranza: basidiomata erumpens, gelatinous, tuberculate, first hyaline then reddish-brown, becoming smoky and drying black; hyphae 2-5 µm with short lateral finger-like branches; gemmae present 6-8 x 5-6 µm, globose to ovoid ; basidiospores 10-14 x 9-12 µm, bullate or globose and *T. roseolutescens* R. Bandoni & Carranza: basidiomata pulvinate to cerebriform, soft gelatinous, Rose Pink to near Flesh Color or Salmon Color (R) changing to orange; nodose-septate hyphae 2-5 µm; scattered vesicles intermixed with basidia; basidiospores 11-15 x 9-11.5 µm. bullate to globose or ovoid. These new species were collected in La Selva Sarapiquí, Heredia; in San José; Cachí and Turrialba, Cartago; La Garita, Alajuela, Costa Rica.

Key words: Tremellaceae, *Tremella* , Tremellales, Costa Rican fungi, taxonomy, tropical fungi.

Compared with those of tropical regions, the temperate Tremellales *s. str.* are relatively well-known, especially taxa with macroscopic basidiomes, *e.g.* many spp. of *Tremella* and *Sirobasidium*. The monograph by Lowy (1971,1982), covering the Tremellales *s.lat.* includes most of the described neotropical *Tremella spp.* but there are some omissions and many taxa remain to be described. Few neotropical areas have been intensively collected for species of *Tremella.* During October and November of 1992, we collected numerous, unusual heterobasidiomycetes in San José and La Selva (Puerto Viejo de Sarapiquí) , Costa Rica. This account covers four new species of *Tremella.*

MATERIALS AND METHODS

Specimens were preserved by drying and were deposited in the Herbarium, Escuela de Biología, Universidad de Costa Rica (USJ). A few exceptions, deposited in the Herbarium of the University of British Columbia, are indicated with (UBC) following the collection number.

Specimens were sectioned using the method of F. Oberwinkler (pers. comm.) in which a razor blade is used to cut thin slices of the dry material while observing under low power of a dissecting microscope. The sections are then mounted directly in KOH-Phloxine (Martin 1934), or in this stain with a drop of 1% Congo Red in distilled water (Bandoni 1958). Color names that are capitalized and followed by (R) are from Ridgway (1912).

Species descriptions

Tremella armeniaca R. Bandoni & Carranza, sp. nov. (Figs. 1-11)

Fructificationes praecipue superficiales non erumpentes, 3.5-2.3 x 0.9 cm, solitariae vel aggregattae, lobulatae, lobis 1.2 x 1.1 x 0.8 cm altis, laevi, politi vel ceracei. Basidiomata armeniaca in sicco corneae et brunnescentes. Hyphae 2-5 µm frequentiter septatae et ramificatae. Sporae ovoideae 6-9 (-10) x 3-6 (-7) µm, apiculatae, 1-guttulatae interdum pluri-minutissime-guttulatae. Conidia 3-5 x 1.5-2.5 µm, ovoideae sed anguste ellipticae, subcylindricae.

Habitat: Supra ramos *Theobroma cacao* cum ascomata Xylariae. Costa Rica: Heredia Province, Puerto Viejo, Sarapiquí, La Selva Biological Station, Sendero Las Vegas.

Typus: A.-A. & R. Bandoni 9672, 12 Nov. 1992.

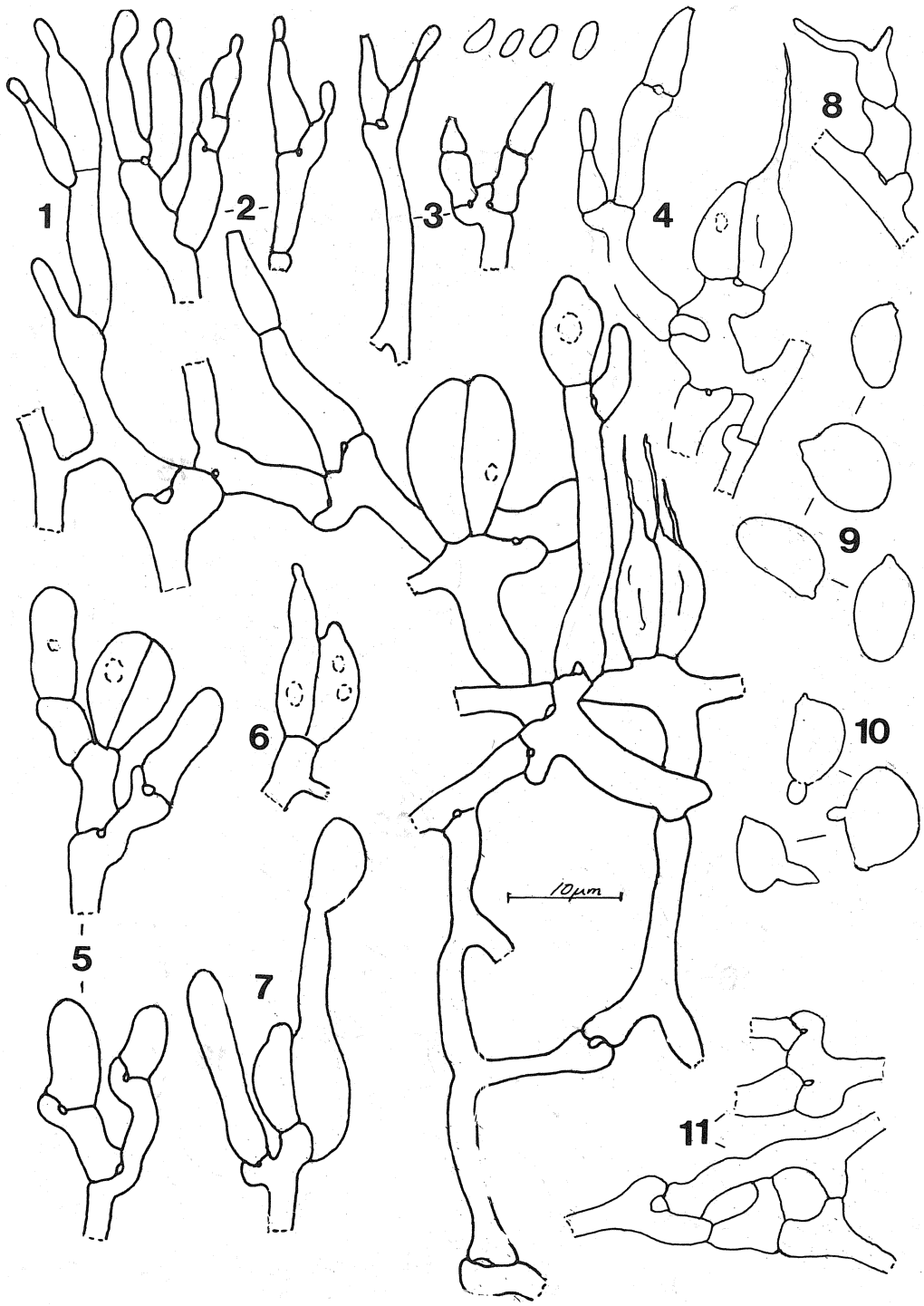
Basidiomata essentially superficial, developing beneath a thin outer layer of bark, the lobes single (up to 1.2 x 1.1 x 0.8 cm) or of small clusters (3.5 x 2.3 x 0.9 cm) most lobes hollow or partially so, the surfaces smooth, glossy to waxy, Warm Orange to Ripe Apricot (R), the color mostly retained on drying, dried basidiomes Kaiser Brown, Ferruginous, Apricot Buff (R),or pale yellow, remaining conspicuous, horny, when dry. In section, small sporocarps predominantly conidial, the conidiophores and conidiogenous cells forming a compact amphigenous pallisade-like layer 20-40 µm thick with conidial mass; basidia first appearing in the layer of conidiophores, then displacing the emptied anamorphic structures. Hyphae of context 2-5 µm in diam. septate and branched, relatively compactly arranged and with numerous anastomoses; clamp connections abundant, often open, some very large medallions, also forming complexes of 2 to 3 or an equal number closely arranged on a hypha, branches frequently arising from clamps; haustorial branches present but not abundant, found once in outer hymenial zone. Probasidial initials broadly clavate or elliptical, maturing ellipsoid, but ranging from globose through ellipsoid to obovoid, pyriform or clavate, (2-)4-celled when mature, 10-15(-17) x 6-10 µm; epibasidia to 26 x 1.5-2.5 µm, only slightly expanded apically to 2.5-3 µm. Basidiospores 6-9 (-10) x 3-6 (-7) µm, ovoid, prominently apiculate, with one large oil guttule or several small ones; germination by repetition or by budding; budding seen only from a single posterior or adaxial locus. Conidiophores compactly arranged, with few branches, most often bifurcate, but with numerous anatomoses with adjacent conidiophores; conidiogenous cells phialide-like, producing conidia apically; conidia 3-5 x 1.5-2.5 µm, obovoid to narrowly ellipsoid to subcylindric.

Habitat: Growing on a large fallen branch of *Theobroma cacao* in an abandoned plantation; associated with ascomata of a *Xylaria sp.* Heredia Province, La Selva (OTS Station), Sendero Las Vegas, 850 µm marker, 9672 (TYPE), 12 Nov. 1992; same data but collected 15 Nov. 1992, 9696 (portion in UBC, remainder in USJ).

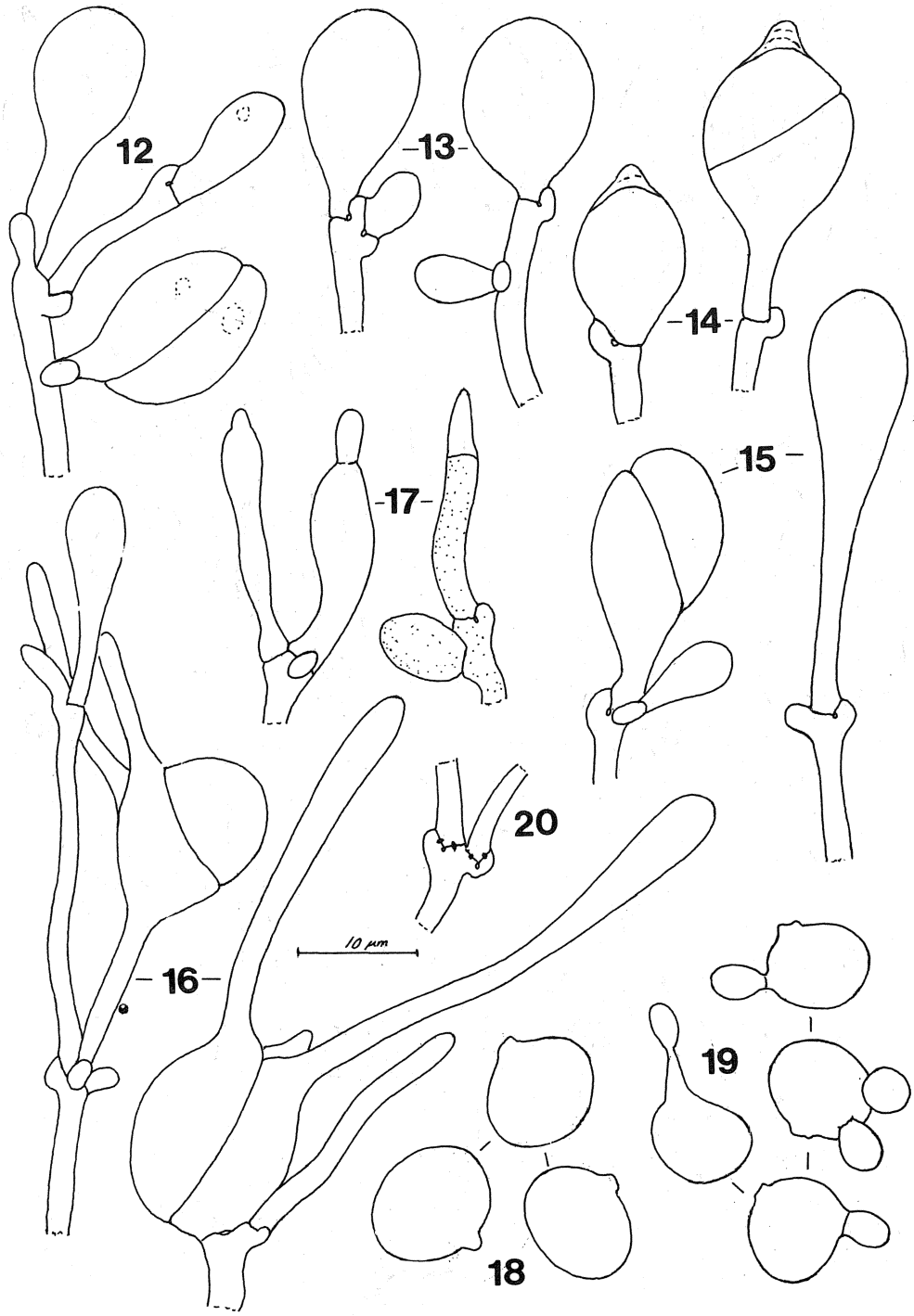
The specific epithet was selected on the basis of the ripe apricot color of the mature basidiomes; much of the color remains one and one half years after drying. Some small, pale yellow basidiomes were situated in a wooly layer of dark hyphae probably belonging to an associated *Xylaria sp.* but it is unclear whether this is the host fungus of the *Tremella.* The species is distinguished from others of similar basidiocarp shape by the color, small basidia and spores, and phialide-like conidiogenous cells (Figs. 2,3,6,7,9,10). The fact that the basidiomes arise superficially, rather than under the bark, is also unusual. Although most basidia examined were 4-celled, 2-celled basidia (Figs. 6-7) were not rare, and their size was somewhat smaller than the 4-celled ones. Conidiogenous cells similar to those in *T. armeniaca* occur in *T. mycophaga var. simplex* Olive (1946), a species producing its basidia and conidia in the hymenia of Dacrymycetaceous fungi.

Tremella lilacea R. Bandoni & Carranza, sp. nov. (Figs. 12-20).

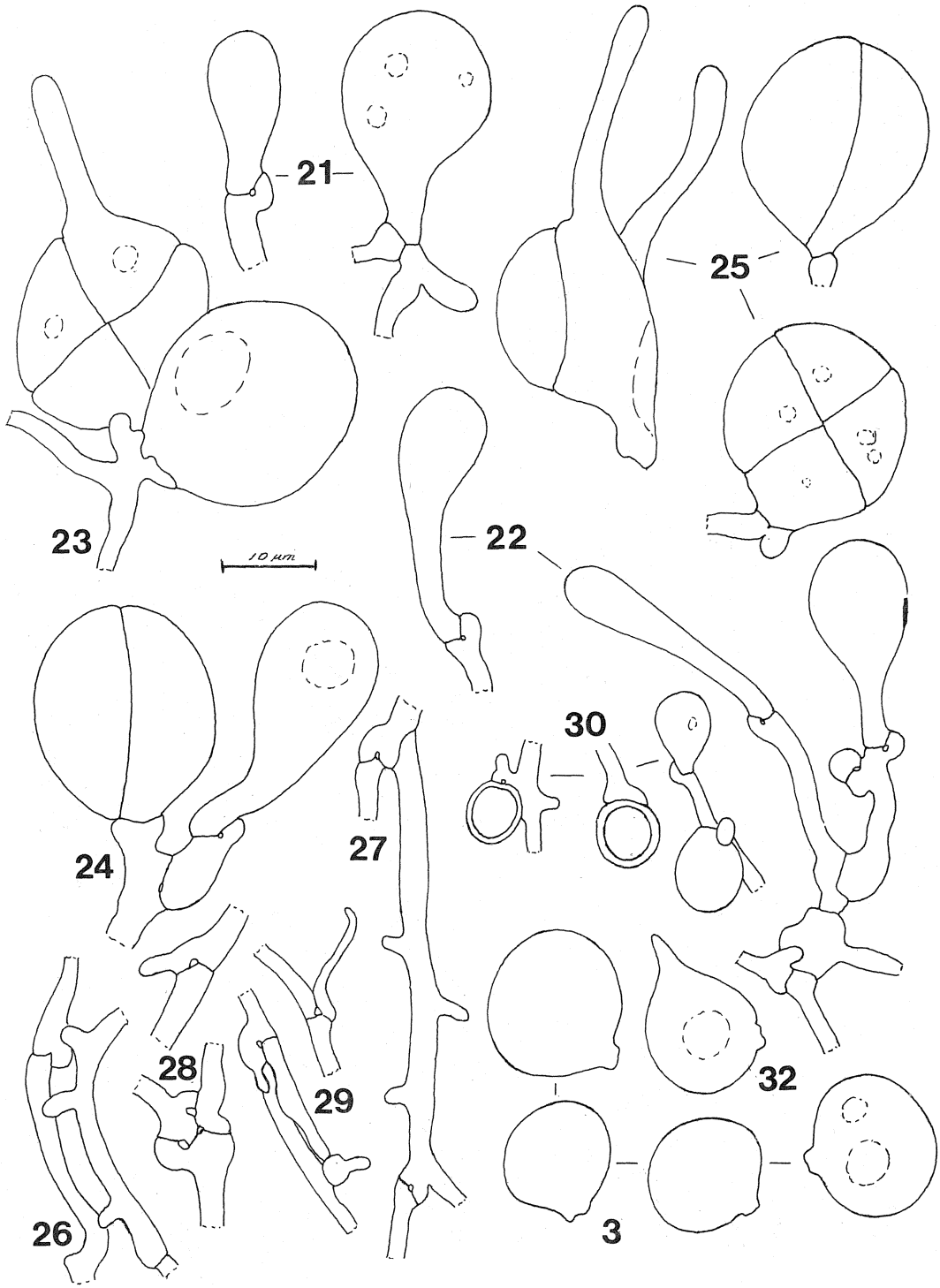
Fructificatio gregaria, tuberculatae, moriformis, hemisphaerica producta 6 x 3 x 2 mm, gelatinosa, pallide amethystina sed violaceae-pallide vinacea sicco atropurpurea vel nigrescentes cornea. Hyphae 1.5 x 4 µm, raro septate paucissime ramificatae. Basidia 13-30 x (8-) 11-16 µm, subglobosa pyriforme vel capitata,



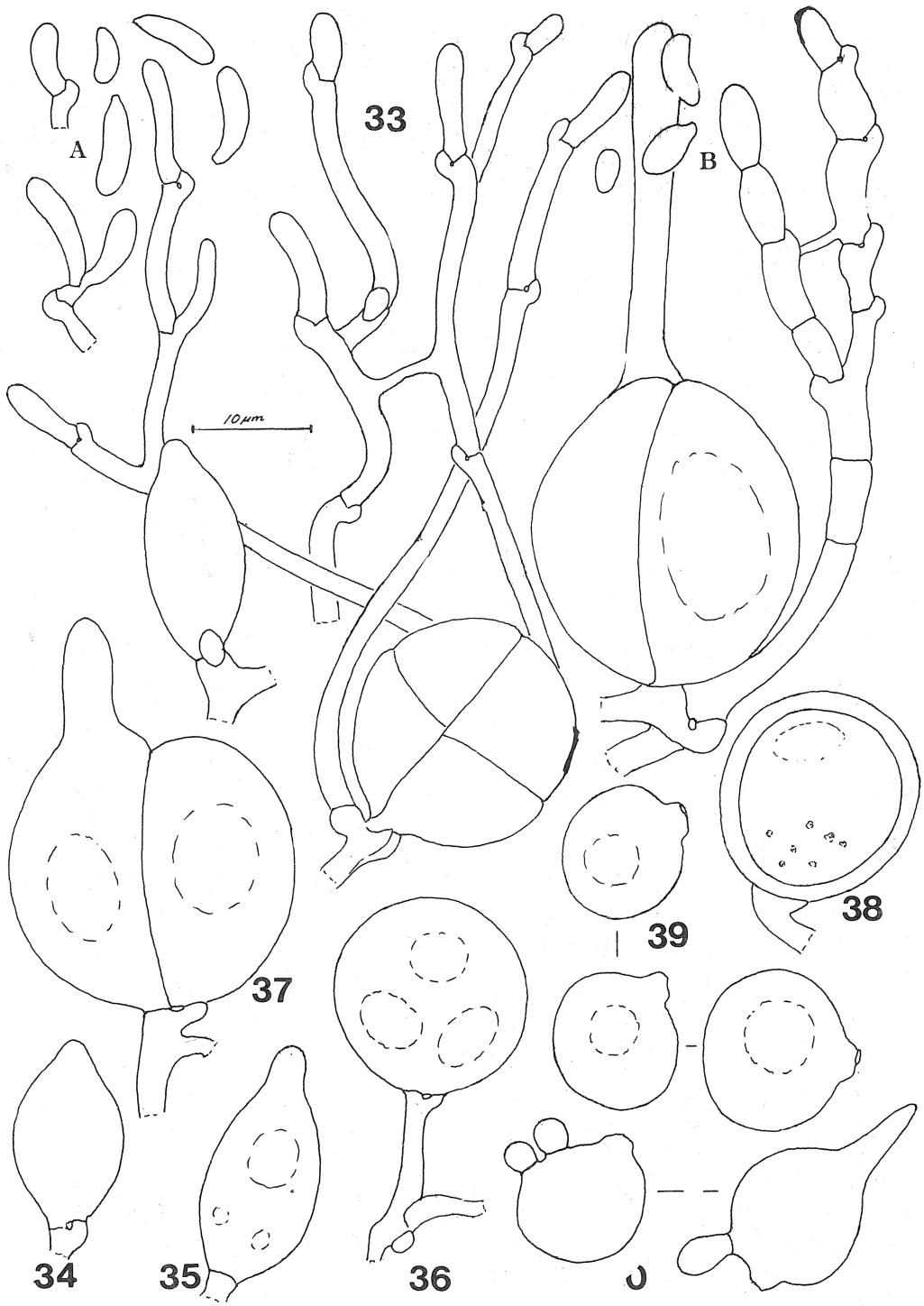
Figs. 1-11. *Tremella armeniaca*, from the Type collection. 1. portion of hymenium extending from the surface to the context and showing arrangement of and form of conidiophores and basidia. 2-3. branches of conidiophores showing phialide-like conidiogenous cells and condia. 4-5. fertile hyphae showing branching and basidia. 6-7. 2-celled basidia. 8. haustorial branch. 9. basidiospores. 10. basidiospores germinating. 11. simple paired clamps and a complex of medallion clamps (all figures from 9672).



Figs. 12-20. *Tremella lilacea.* 12-13. fertile hyphae, three young probasidia and one septate probasidium. 14. immature and mature probasidia with thick-walled umbos. 15-17. probasidia of different ages showing typical forms and proliferation of fertile hyphae. 18. basidiospores. 19. basidiospores germinating by budding. 20. pair of closely-situated clamps in context, the dolipores conspicuous (all figures from 9503).



Figs. 21-32. *Tremella nigrifacta*. 21-22. young probasidia before septal development. 23-25. probasidia and mature basidia showing variation in form. 26-27. context hyphae with short, finger-like lateral branches. 28. clamp connections from context. 29. haustorium like branches from context. 30. gemmae. 31. basidiospores. 32. basidiospore germinating by repetition (Figs. 24-25 from 9614; all others from 9632).



Figs. 33-40. *Tremella roseolutescens*. 33. composite drawing of hymenium showing probasidia, basidia and conidiophores (note allantoid, mostly solitary conidia, upper left, and catenate ellipsoid conidia, upper right). 34-36. immature probasidia and 37. basidium with developing epibasidium. 38. thick-walled vesicular element from hymenium. 39. basidiospores. 40. two basidiospores germinating by budding (that on the right also with sterigma) (figs. 35-36, 38-40, 9543, 9532; fig. 34 composite of camera lucida drawings from numbers 9532, 9543, 9547).

radicata (17 x 2-3 µm), epibasidia 60 x 2-3.5 µm and apicem inflatae 4-5 µm. Sporae bullatae 8.5-10 x 7-8 µm per repetitionen germinates sed gemmans.

Habitat: Citro ramunculo allia fungorum (*Diaporthe, Diatrype, Rhytidhysterium*, ignotus discomycete). Costa Rica, Cartago Province, Orosi Valley, Cachí.

Typus: A.-A. & R. Bandoni 9503, 12 Oct. 1992.

Basidiomata aggregated, tuberculate, later anastomosing and distinctly moriform, hemispheric-elongate, up to 6 x 3 mm, 2 mm high, gelatinous, pale amethyst to Pansy Purple or Pallid Vinaceous (R), drying dark purple to black, horny, the vinaceous color retained upon rewetting. In section, hymenium relatively diffuse, forming a surface layer that extends inward 100-350 µm, the context striking in its evenly spaced hyphae that radiate upwards and only slightly outwards, giving an initial impression of many parallel, rarely branched hyphae; base of the basidiome incorporating dark ascomycetous structures (?host). Context hyphae 1.5-4 µm, mostly straight, even, thin-walled, infrequently branched and with few septa, the branching often dichotomous, branches often originating from clamps, opposite clamps, or immediately adjacent to clamps; clamps closed or open, single or in closely situated pairs, unusual in that the dolipores are plainly visible as refractile spots in KOH-Phloxine-Congo Red preparations (Fig. 20); haustorial branches absent from the context, but structures possibly representing these scattered at the basidiome base. Basidia 13-30 x (8-)11-16 µm, subglobose to pyriform or capitate, predominantly with a distinct basal stalk (to 17 x 2-3 µm), 4-celled rarely globose and up to 15 µm in diam.; epibasidia to 60 x 2-3.5 µm, swollen above to 4-5 µm. Basidiospores mostly bullate, 8.5-10 x 7-8 µm, germinating by repetition or by budding, the latter restricted to one or two loci.

Habitat: Growing on pruned branches of cultivated *Citrus spp.* on the ground; associated with numerous fungi including spp. of *Diaporthe*, *Rhytidhysterium*, *Diatrype*, a pseudothecial fungus, and others; probably parasitizing the *Diaporthe sp.* and perhaps also the *Rhytidhysterium sp.* Cartago Province, Orosi Valley, Cachí, Oct. 12, 1992; 9496, 9501, 9502, 9503 (TYPE), 9504 (UBC), 9507, 9508.

Apothecia of the *Rhytidhysterium* are often overgrown by the *Tremella*; the former has a red hymenium, the color of which changes and approaches that of the *Tremella* in 3% KOH solution. A similar pigment also occurs in heavy deposits within some hyphae and basidia of the *Tremella,* suggesting possible origin with the discomycete. However, the species is closely related to *T. exigua* Desm. and its close relatives, a group apparently parasitizing *Diaporthe spp.* (R.J.B. unpubl. observations). Partially developed stromata of the host typically are present in the bases of the *Tremella* basidiomes, and such structures are present in our collections of *T. lilacea.* However, the deposits of pigments in hyphae of the *Tremella* resemble those in the hymenium of the *Rhytidhysterium. T. lilacea* differs from *T. exigua* in basidiome color, the moriform basidiomes, and in basidial form and dimensions. *T. exigua* has hyaline to greenish basidiomata that are black when dried. The abundant fungi characteristic of substrates of both species make determination of host difficult, and it is entirely possible that haustoria of the *Tremella spp.* can become attached to hyphae of more than one associate, as occurs in the type species, *T. mesenterica* Retz.: Fr. (R.J.B. unpubl. observations). Occasional clampless hyphae present in *T. lilacea* basidiome bases may belong to the associated ascomycetes.

Tremella nigrifacta R. Bandoni & Carranza, sp. nov. (Figs. 21-32).

Fructificatio 2 x 1.5 x 0.6 cm erumpens, gelatinosus, tuberculatus, anastomosans, humido perimetro orbiculatus discretus sicco tene crustosus, juventute hyalinus inde rufescentis fumagineus sicco nigrus, opacus vel nitidus aliquando sporis albis farinosus.

Hymenium 80-100 µm crassum. Hyphae 2-5 µm raro 7 µm, parietis senectutem nigrescentis, nonnullis sectionis virgulis digitiformis lateralibus. Gemmae 6-8 x 5-6 µm globosae vel ovoideae, incrassatae. Fibulae numerosae. Probasidia 4-cellulata 16-22(-30) x (12-)14-19 µm, 1-plure-guttata, globosa ellipsoidea, obovoidea pyriformis vel capitata. Epibasidia 45-90 x 2-3 µm cylindrica sed apicem inflata 3-6 µm. Sporae 10-14 x 9-12 µm, bullatae sed globosae, 1-guttatae, per repetitionem germinantes.

Habitat: Ad ramos. Costa Rica, San José Province, San Pedro, University of Costa Rica Campus.

Typus: A.-A. & R. Bandoni 9632, 6 Nov. 1992.

Basidiomata to 2 x 1.5 x 0.6 cm, erumpent, rubbery gelatinous, tuberculate, anastomosing, the margins typically abrupt and rounded when moist but thin and appressed when dry, at first hyaline, then reddish-brown or this color and partly white, becoming smoky and drying black, the surface dull or shiny, sometimes frosted with a white spore deposit when dry and often marked by reticulations suggesting anastomosis patterns. In section, with an amphigenous hymenial zone ca. 80-100 µm thick, the basidia exceeded only by a gelatinous matrix through which epibasidia extend; with age, a conspicuous black surface layer develops; scattered hyphae in the interior also become dark, their contents black and sections apparently dead. Hyphae mostly 2-5 µm in diam. infrequently up to 7 µm, the walls mostly darkening with age, many segments with several short lateral "finger"-like branches (Figs. 26-27), that clasp adjacent hyphae or sometimes anastomose with branches of such hyphae; some short branches basally clamped (Figs.. 28-29) and possibly representing primitive haustorial structures; gemmae present, infrequent to common, 6-8 x 5-6 µm, globose to ovoid, the wall thickened; clamp connections abundant, sometimes paired at a single septum, most closed, occasionally with a spur-like branch similar to those originating on internodes. Probasidia 16-22 (-30) x (12-)14-19 µm, 4-celled, with one or more conspicuous oil guttules, globose to ellipsoid, obovoid, pyriform or capitate, the latter with a stalk-like base to 16 x 2-3 µm; epibasidia 45-90 x 2-3 µm, cylindric or inflated to 3-6 µm apically. Basidiospores 10-14 x 9-12 µm, bullate or globose (the latter possibly secondary spores) each with a large oil guttule; germination by repetition.

Habitat: Associated with stromata of a *Diatrypella sp.* on windblown branches of *Ficus sp.* and other trees and on dead attached branches of *Citrus spp.* Cartago Province, Turrialba, Centro Agronómico Tropical para la Investigación y Enseñanza (CATIE), on windblown branch with *Diatrypella sp.* 31 Oct. 1992, 9596; UCR Campus, on fallen branch, probably of *Ficus sp.* 3 Nov. 1992, 9611 (UBC), 9612, 9614, 9615, same data as preceding, but substrate unkown; UCR Campus, San José, 6 Nov. 1992, 9632 (TYPE); Fabio Baudrit Experimental Station, La Garita, Alajuela, 20 Nov. 1992, 9710, 9712, 9721; UCR Campus, 24 Nov. 1992, on fallen branch (overgrown by a *Fusarium sp.*, in poor condition) 9724.

The related *T. indecorata* Sommerf.: Fr. differs in basidia and basidiospore dimensions (10-18 x 8-12 µm and 5-8 x 6-7 µm, respectively). Dried specimens of *T. nigrifacta* resemble those of *T. moriformis* (Fr.) Smith ex. Berk. but they are smoky to black rather than purple or vinaceous as in that species. *T. moriformis* basidiomes typically are moriform, and each basidiocarp has a hard, carbonaceous core (?ascomycetous host). Color changes that occur when sections of *T. moriformis* are placed in alkaline or acid solutions (Bandoni 1958) are lacking in *T. nigrifacta.* Basidia of *T. moriformis* are (13-)15-17(-26) x 11-16 µm, and the basidiospores (7.5-11 x 7-10 µm) are smaller than those of *T. nigrifacta. T. nigrifacta* basidiocarps are spread over the substrate and often over the stromata of the associated *Diatrypella*, but these stromata are infrequently central and then not core-like. Gemmae, common in the context of *T. moriformis* (6-12 x 5-7.5 µm) are similar to those in *T. nigrifacta.*

Tremella roseolutescens Bandoni & Carranza, sp. nov. (Figs. 33-40)

Fructificatio 2-3 x 2 mm, pulvinatus cerebriformis solidus, rugosus asper, gelatinosus, carneus vel salmonicolor sicco aurantiacus. Hyphae 2-5 µm, ramosae, fibulatae. Probasidia inmaturitatis umbonata, ellipsoidea vel subglobosa, 20-27 (-36) x 18-27 µm dein globosa ellipsoidea vel subglobosa, multiguttata, 4-locularis. Epibasidia 110 x 3.4 µm, apicem abrupte expansa (5-8 µm). Hymenium interbasidia vesiculosum. Sporae 11-15 x 9-11.5 µm bullatae, globosae, oleaginosae, per repetitionem germinantes sed gemmae. Conidia 4-9 x 2-3.5 µm ovoideo-subcylindrica, allantoideae.

Habitat: Ad ramos Ingae. Costa Rica, Heredia Province, Puerto Viejo, Sarapiquí, La Selva Biological Station.

Typus: A.-A. & R. Bandoni 9543, 17 Oct. 1992

Basidiomata mostly 2-3 mm in diam. and up to 2 mm high but sometimes reaching 5-10 mm in diam., at first pulvinate to cerebriform, spreading, the margin remaining abrupt, solid, wrinkled or not, minutely and evenly roughened, soft gelatinous, rose pink to near Flesh Color or Salmon Color (R) when fresh, changing to distinctly orange and the color more intense when dry, white when rehydrated. In section, young basidiomes with basidia mostly submerged 50-100 µm beneath a layer of dendritically branched conidiophores, not forming a compact layer. Hyphae 2-5 µm in diam. frequently branched, irregularly arranged, anastomoses common; clamps abundant, single, mostly closed; haustorial branches not seen. Young probasidia often umbonate, less frequently ellipsoid or subglobose, expanding, 20-27 (-36) x 18-27 µm, then globose to ellipsoid or obovoid, 4-celled, each compartment with one or more large oil guttules; epibasidia to 110 x 3-4 µm, expanded gradually or abruptly apically and there 5-8 µm. Scattered vesicles intermixed with basidia, 21-32 x (10-)17-29 µm, terminal or intercalary, often with thickened walls, these probably aborted basidia, sometimes septate and some compartments functional. Basidiospores 11-15 x 9-11.5 µm, bullate to globose or ovoid, mostly with one large oil guttule; germination by repetition or budding, the buds from one or two loci only. Conidiophores much branched, the final branches often with numerous short segments, each clamped; conidia 4-9 x 2-3.5 µm, ovoid to subcylindric or allantoid, thin-walled, most tapering slightly to the truncate attachment point.

Habitat: On dead attached lower branches of a Guava tree adjacent to dining hall, La Selva Biological Station (OTS), Heredia Province, Puerto Viejo, Sarapiquí, 9520 (UBC), 9532, 9536 (UBC), and 9543 (TYPE), 9546, 9547, 17 Oct. 1992.

Conidia in some basidiomes are predominantly curved cylindric, as illustrated in Figure 33a. In some basidiocarps, shorter and broader conidia (Figure 33b) are present. As can be seen in the figures, conidiogeny differs in the two. In spite of the difference in basidiome size and color, the internal structure suggests a close relationship to *T. mesenterica* and *T. brasiliensis* . Similar conidiophores and conidiogenous cells are characteristic of those taxa, but they often fail to produce conidia (esp. in the latter species) or are themselves obscured by conidial development (in the former). In *T. roseolutescens,* either single conidia develop and secede, or short chains are produced. In *T. mesenterica*, budding of primary conidial cells generally occurs and masses of conidia present in many fructifications obscure the original conidiogenous cells. Conidia of *T. roseolutescens* were regularly present in our collections, but they did not form a thick surface layer such as is present in many *T. mesenterica* basidiomes.

The small basidiomes are readily found when wet, but dry rapidly and are then obscure. In drying, there is a distinct color change from rosy to orange, and the color also becomes more intense. Almost all color is lost soon after drying.

RESUMEN

Pocos estudios se han llévado a cabo con hongos Tremellales en regiones tropicales. En el presente trabajo se describen cuatro especies nuevas de *Tremella*: *T. armeniaca* R. Bandoni & Carranza: basidiocarpos superficiales, lóbulos solitarios o en grupos pequeños, superficie lisa, brillante, cerosa, anaranjada; hifas fibuladas 2-5 µm; basidiósporas 6-9(-10) x 3-6 (-7) µm, ovoides, apiculadas; conidios 3-5 x 1.5-2.5 µm, obovoides, elipsoidales o subcilíndricos. *T. lilacea* R. Bandoni & Carranza: basidiocarpos agrupados, tuberculosos, anastomosados y moriformes, gelatinosos, moraduzcos; hifas con pocos septos 1.5-4 µm; basidiósporas buladas 8.5-10 x 7-8 µm. *T. nigrifacta* R. Bandoni & Carranza: basidiocarpos gelatinosos, tuberculosos, primero hialinos luego rojo-cafezuscos, y negros cuando secos; hifas 2-5 µm con ramifiicaciones cortas; yemas presentes 6-8 x 5-6 µm, globosas u ovoides; basidiósporas 10-14 x 9-12 µm buladas o globosas y *T. roseolutescens* R. Bandoni & Carranza: basidiocarpos pulvinados a cerebriformes, gelatinosos, rosados o color carne, o cambian a naranja; hifas fibuladas 2-5 µm; vesículas escasas, distribuídas entre los basidios; basidiósporas 11-15 x 9-11.5 µm buladas , globosas u ovoides. Los especímenes fueron recolectados en La Selva, Puerto Viejo de Sarapiquí, Heredia y en San José, Costa Rica.

ACKNOWLEDGMENTS

The authors thank Luis Diego Gómez for his help on the latin descriptions. Portions of this study were supported by a grant from the Natural

Sciences and Engineering Council of Canada (NSERGA 801).

REFERENCES

Bandoni, R.J. 1958. Some Tremellaceous fungi in the C.G. Lloyd collection. Lloydia 21: 137-151.

Lowy, B. 1971. Tremellales. Flora Neotropica, Monograph No. 6. Organization for Flora Neotropica. Hafner, New York. 153 p.

Lowy, B. 1980. Tremellales. Flora Neotropica, Monograph No. 6. Supplement. The New York Botanical Garden, Bronx, New York.

Martin, G. W. 1934. Three new Heterobasidiomycetes. Mycologia 26: 261.

Olive, L.S. 1946. Some taxonomic notes on higher fungi. Mycologia 38: 534-547.

Ridgway, R. 1912. Color Standards and Color Nomenclature. Washington, D.C. (published by the author).