

THE SUBSECTION LACTARIOIDEAE OF RUSSULA ¹

ROBERT L. SHAFFER

(WITH 20 FIGURES)

The section *Compactae* of *Russula* (Agaricales) contains species having a firm, compact flesh and numerous lamellulae. One group of these species has basidiocarps which blacken in age or when bruised and constitutes the subsection *Compactae* (Shaffer, 1962). The present paper is concerned with the subsection *Lactarioideae*, a group of non-blackening species typified by *R. delicata* and whose basidiocarps resemble those of certain species of *Lactarius*.

The two greatest problems in agaric taxonomy came out more forcibly than ever in the work with the *Russulas* of subsection *Lactarioideae*. One of these is the absence of type collections, often of supposedly well known species. *Russula delicata* is a species that everybody knows, so to speak, but the evidence indicates that *R. delicata* sensu Fries (1838) is not *R. delicata* sensu Singer (1938), which in turn is not *R. delicata* sensu Kühner & Romagnesi (1953). In such a case, where the original description could fit a number of things and where there is no type, the preferable solution is to designate a lectotype or neotype (Article 7 of the *International Code of Botanical Nomenclature*), which for those who follow the *Code* is binding and will stabilize the application of the name. I believe this should be done by European agaricologists for the species originally described from Europe, which are usually the problem species in this regard.

The second problem involves collections, type or otherwise, of agarics deposited in herbaria. Most of them are nearly worthless as bases for work in modern agaric taxonomy. They usually lack adequate notes on macroscopic and chemical characters of the fresh basidiocarps, and these are as important as microscopic characters. The taxonomist who uses the collections has to make assumptions which may be erroneous and obscure significant similarities or differences. Furthermore,

¹ Papers from the University of Michigan Herbarium and Department of Botany, No. 1147.

the basidiocarps often have not been dried properly so that the microscopic structures can be revived.

I have used the methods of studying and describing collections outlined previously (Shaffer, 1962) except that spore measurements do not include the height of the ornamentation. Drawings were made with the aid of a camera lucida. All collections are deposited in the University of Michigan Herbarium (MICH) unless indicated otherwise.

RUSSULA Pers. ex S. F. Gray sect. COMPACTAE (Fr.) Maire subsect.

LACTARIOIDEAE Maire, Bull. Soc. Mycol. Fr. 26: 120. 1910.

Russula sect. *Leucosporae* (Quél.) Bat. A *Lactarioides* Bat. b *Plorantes* Bat., Mém. Soc. Émul. Doubs VIII. 2: 50 (reprint pagination). 1908.

Russula sect. *Compactae* B *Constantes* J. Lange, Dansk Bot. Ark. 4(12): 21. 1926.

Russula sect. *Compactae* subsect. *Plorantes* (Bat.) Sing., Hedwigia 66: 180. 1926.

Russula Lactarioides 1 *Delicinae* Melzer & Zvara, Arch. Přírodov. Výzk. Čech. 17(4): 53. 1927.

Russula sect. *Compactae* subsect. *Delicinae* (Melzer & Zvara) Sing., Beih. Bot. Centr., Abt. 2, 49: 369. 1932.

Russula I *Compactae* Fr. sect. *Lactarioides* (Bat.) Konrad & Maubl., Les Agaricales 2: 33. 1952.

Type species: *Russula delica* Fr.

Basidiocarps, except perhaps for the lamellae, white to buffy white or pale yellowish when young, often becoming stained or spotted with sordid yellow, cinnamon-buff, tawny, or umber; trama compact and hard in young and mature basidiocarps; lamellulae abundant; clamp connections absent.

The species of subsection *Lactarioideae* fall rather naturally into two groups. One, containing *R. fuegiana*, *R. sp.*, *R. inopina*, *R. vesicatoria*, and *R. cascadiensis*, is characterized by its low (up to 0.7 μ high), usually completely amyloid spore ornamentation; some of these species have a taste which has a bitter component, at times in addition to an acrid component. The second group consists of *R. delicula*, *R. romagnesiana*, *R. delica*, *R. brevipes*, and *R. pseudo-delica*. These have spore ornamentation up to 1.7 μ high. The warts sometimes are non-amyloid or have a nonamyloid core, tip, or base. None of these species has a bitter taste.

Spore ornamentation 0.2–0.7 μ high.

Pileus viscid, the cuticle having a gelatinous matrix at least when young; spore deposit white.....1. *R. fuegiana*

Pileus dry, the cuticle lacking a gelatinous matrix; spore deposit not white.

Taste (pileus trama) not acrid, but perhaps becoming bitter.

Taste becoming bitter; spore deposit light yellow-orange (\pm "warm buff").....2. *R. sp.*

Taste not becoming bitter; spore deposit pale cream color.....3. *R. inopina*

Taste (pileus trama) becoming intensely acrid.

Odor strong and pleasant (somewhat like that of fresh *Lactarius camphoratus*); taste astringent to bitter at first....4. *R. vesicatoria*

Odor none or slight and not distinctive; taste not astringent to bitter.....5. *R. cascadenis*

Spore ornamentation, on at least some spores, 1 μ high or higher.

Spore deposit pale yellow ("cartridge buff" to "cream color") or lighter, i.e., Crawshay A, B, or C.

Pileus 3.5–6.5 cm broad; spore deposit \pm "cream color"; taste (pileus trama) mild.....6. *R. delicula*

Pileus 6.5–20 cm broad; spore deposit white to "cartridge buff"; taste (pileus trama) mild or acrid.

Spores 6.4–8.0 \times 6.1–6.8 μ excluding ornamentation.....7. *R. romagnesiana*

Spores larger than 8.0 \times 6.8 μ excluding ornamentation.

Spores 8.0–10.8 \times 6.7–8.6 (–9.8) μ , usually broadly elliptic.

Lamellae distant; spore ornamentation 0.4–1.0 μ high.....8. *R. delica*

Lamellae close to crowded; spore ornamentation 0.7–1.7 μ high.

Taste (pileus trama and lamellae) mild to slightly acrid; lamellae and stipe apex not bluish green.....9a. *R. brevipes* var. *brevipes*

Taste (pileus trama and lamellae) slightly to strongly acrid; lamellae or stipe apex or both often bluish green.....9b. *R. brevipes* var. *acrior*

Spores 9.3–14.1 \times 8.0–12.0 μ , usually subglobose to globose.....9c. *R. brevipes* var. *megaspora*

Spore deposit deep yellow, i.e., Crawshay D or darker....10. *R. pseudo-delica*

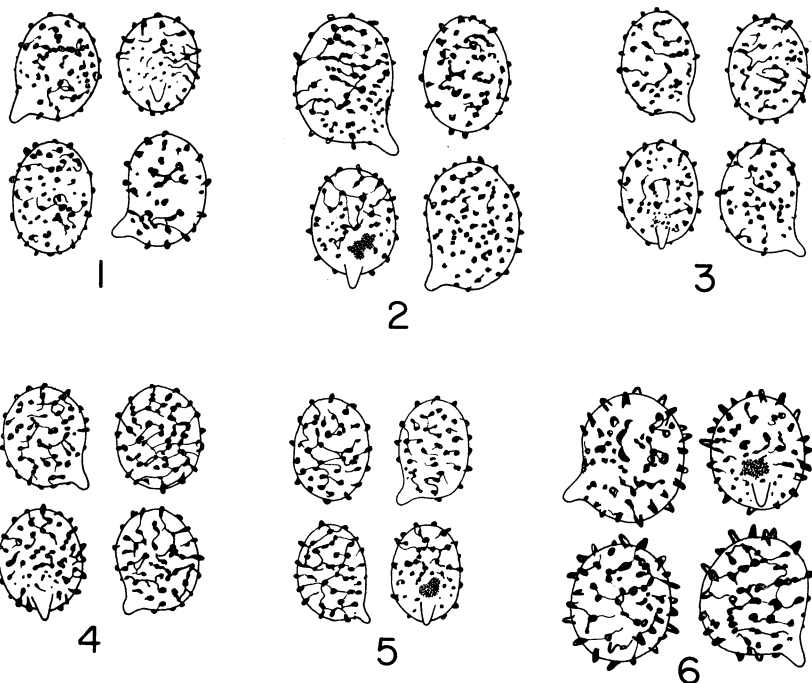
1. *RUSSULA FUEGIANA* Sing., Rev. Mycol. Paris 15: 125. 1950.

FIGS. 1, 9

Pileus 3–7 cm broad; with the margin incurved when young, convex and umbilicate, finally concave; subviscid to viscid when moist; glabrous or finely tomentose (especially at the margin of young pilei in dry weather); smooth; with the cuticle adnate or separable up to $\frac{1}{2}$ the distance to the center; white, rarely stained ochraceous brown, but not strongly browning. Trama hard except near the pileus margin where it is subelastastic; often \pm succulent; white, unchanging; with a slight odor

of apple sauce or *R. maculata* and an acrid, though not burning-acrid taste which has a slight bitter component.

Lamellae narrow, 3–5 mm broad; forming an acute angle with the pileus margin; slightly arcuate, horizontal, or slightly ventricose; almost free, becoming subdecurrent in age; crowded; often forked and strongly anastomosing; whitish, unchanging. Lamellulae almost regularly intermixed with the lamellae.



Figs. 1-6. Spores of *Russula* spp. with ornamentation as it appears in Melzer's reagent, $\times 1875$. 1. *R. fuegiana* (Singer M265, Co-type). 2. *R. sp.* (*Romagnesi* 55.50). 3. *R. inopina* (Smith 63889, Holotype). 4. *R. vesicatoria* (21 Oct. 1943, Lectotype). 5. *R. cascadiensis* (Smith 23695, Holotype). 6. *R. delicula* (*Romagnesi*, Holotype).

Stipe 1.6–4.7 cm long, 9–20 mm thick; subequal, ventricose, or attenuate toward the apex or the base which may be short-acuminate in the soil; glabrous; subrugose; solid; pure white.

Color reaction (stipe trama): $\text{FeSO}_4 + (2)$.

Spores white in deposit; $6.8\text{--}8.5 \times 5.3\text{--}7.3 \mu$ excluding ornamentation; usually elliptic to obovate, occasionally broadly elliptic or subglobose. Ornamentation $0.3\text{--}0.7 \mu$ high; of irregularly sized and shaped, completely amyloid warts which may be isolated, connected by lines, or

aligned; on most spores not forming even a partial reticulum, but rarely forming a partial to broken reticulum. Suprahilar disc usually more finely and faintly ornamented than the remainder of the spore, occasionally almost devoid of ornamentation.

Basidia $45-57 \times 6.7-10.6 \mu$; clavate, occasionally abruptly narrowed near the apex; 4-spored. Pleuropseudocystidia $53-90 \times 6.7-8.6 \mu$; subcylindric to narrowly clavate or narrowly fusiform; capitate or with the apex rounded, acute, or subacuminate; often sharply bent or flexuous toward the base; filled at least partially with granular to linear, yellowish, refractive crystals; arising in the subhymenium or trama; projecting to 33μ beyond the basidioles; abundant. Cheilopseudocystidia $48-74 \times 5.3-7.3 \mu$; like the pleuropseudocystidia, but more often with rounded apices; abundant, but the lamella edges homomorphous.

Subhymenium $13-27 \mu$ thick; prosenchymatous. Trama with occasional oleiferous hyphae.

Pileus cuticle $120-173 \mu$ thick; with a gelatinous matrix at least when young; in young basidiocarps composed of a subcutis and epicutis, the subcutis thin ($13-25 \mu$ thick), of horizontally arranged, nongelatinous, septate, branched, hyaline hyphae $1.0-2.6 \mu$ broad and occasional oleiferous hyphae up to 4.3μ broad, the epicutis $110-150 \mu$ thick, a somewhat tangled trichodermium of nongelatinous, septate, branched, hyaline hyphae $1.0-5.3 \mu$ broad and numerous subcylindric to narrowly clavate pseudocystidia $2.7-6.7 \mu$ broad; in mature basidiocarps for the most part lacking both the differentiation into two layers and the trichodermioid arrangement of the hyphae, which are then mostly loosely interwoven.

Stipe cuticle $13-67 \mu$ thick; scarcely differentiated from the trama; of interwoven, nongelatinous, septate, branched, hyaline hyphae $1.0-2.5 \mu$ broad and occasional to common oleiferous hyphae up to 5.3μ broad, the ends of both types sometimes forming ascendant to erect, undifferentiated hairs at the cuticle surface.

Collection examined: ARGENTINA: Tierra del Fuego: In silvis nothofagineis (*N. pumilio*), Estancia Nueva Argentina, Rio Grande, 14 Feb. 1950, *Singer M265* (LIL, labeled co-type).

The description of macroscopic characters is from the original description of *R. fuegiana*. The species resembles *R. vesicatoria* in having a bitter-acrid taste, narrow and crowded lamellae, and low spore ornamentation, but lacks the strong odor and colored spore deposit. It is apparently the only species in the subsection *Lactarioideae* having a truly viscid pileus.

2. *RUSSULA* SP.

FIG. 2

Pileus 9-13 cm broad; umbilicate and with the margin incurved at first, becoming infundibuliform; dry; mat; finely floccose-downy near

the margin, otherwise glabrous; becoming areolately cracked; with the cuticle separable no more than $\frac{1}{3}$ the distance to the center and the margin not striate; white at the margin, otherwise light buff to ochraceous-tawny. Trama 7–15 mm thick; hard; whitish, scarcely changing when cut; with the odor at first fruity, but becoming fishy in age, and the taste not acrid, but after a few moments becoming bitter.

Lamellae 5–6 mm broad; not thick; acute in front; \pm decurrent; moderately close; seldom forked; strongly intervenose; naples yellow except for the ochraceous-salmon to rufous edges. Lamellulae numerous.

Stipe 2.5–4 cm long, 2.5–3 cm thick; downy like the pileus margin; rugulose; white, becoming stained ochraceous to amber.

Color reactions (trama): Phenol +, FeSO_4 + (2), SV –.

Spores light yellow-orange (\pm “warm buff”) in deposit; 7.7–9.0 (–9.7) \times 6.3–7.0 μ excluding ornamentation; usually elliptic, occasionally broadly elliptic or broadly obovate. Ornamentation 0.2–0.6 μ high; of hemispheric to bluntly conic, occasionally partially nonamyloid warts, which are usually isolated, occasionally aligned, united in ridges or clusters, or connected by fine lines; usually not forming a reticulum, occasionally forming a broken, rarely a nearly complete reticulum. Suprahilar disc with an irregularly shaped, weakly amyloid, diffuse patch, or ornamentation much like that on the remainder of the spore, but finer, or both.

Basidia 43–53 \times 8.6–10.6 μ ; clavate; 4-spored. Pleuropseudocystidia 48–88 \times 5.7–10.6 μ ; lanceolate or fusiform to clavate-fusiform; at times capitate or submoniliform near the apex, otherwise rounded to subacute apically; filled with granular to linear, refractive, yellowish contents or almost empty; arising usually in the trama, occasionally in the subhymenium; projecting to 13 μ beyond the basidioles except near the lamella edges where they may project to 40 μ ; abundant near the lamella edges, common elsewhere. Cheilopseudocystidia 40–80 \times 4.7–10.6 μ ; like the pleuropseudocystidia; abundant.

Subhymenium approximately 33 μ thick; pseudoparenchymatous. Trama with occasional oleiferous hyphae.

Pileus cuticle 120–146 μ thick; lacking a gelatinous matrix; of interwoven, nongelatinous, septate, branched, hyaline to yellowish brown hyphae 1.3–2.7 μ broad, a few of which give rise to scattered, undifferentiated hairs; also with occasional oleiferous hyphae up to 6.7 μ broad.

Collection examined: FRANCE: Oise: In silva frondosa et arenosa, Apremont, 17 Aug. 1955, *Romagnesi 55.50* (PC).

The description of macroscopic characters is from Schaeffer's (1952) description of *R. pseudo-delica*. Kühner & Romagnesi (1953) indicated that Schaeffer's fungus is not *R. pseudo-delica*, and Romagnesi plans to name the species in his forthcoming monograph of European Russulas. The evidence supports this conclusion. Schaeffer had ex-

amined a specimen of *R. pseudo-delica* from the Lange herbarium and noted that the spores of his own specimens had smaller warts which were usually aligned and connected by fine lines to form a partial reticulum. I have not seen Schaeffer's material, but Hesler's (1961) notes on a 1937 collection made in Potsdam, Germany, and determined as *R. pseudo-delica* by Schaeffer confirm that the identification was erroneous.



FIG. 7. *Russula inopina* (Smith 63889, Holotype), $\times \frac{3}{4}$. Photograph by A. H. Smith.

3. *Russula inopina* Shaffer, sp. nov.

FIGS. 3, 7

Pileus siccus, impolitus, margine tenuiter coactus, cremeo-albus, umbrino-maculatus; trama rigida, cremeo-alba, sapore miti; lamellae angustae, adnatae vel subdecurrentes, confertae, pallido-luteae; lamellulae numerosae; stipes impolitus, albus, umbrino-maculatus; sporae pallido-luteae in cumulo, $6.8-9.3 \times 5.3-7.2 \mu$ (ornamentatione exclusa), ornamentatione $0.2-0.7 \mu$ altitudine, plerumque non reticulata; cuticula pilei ex hyphis intertextis $1.0-4.0 \mu$ latitudine etiam hyphis oleiferis $2.7-8.0 \mu$ latitudine constans. Holotypus: Colonial Point, Burt Lake, Cheboygan Co., Mich.; 11 Aug. 1961; *Smith 63889* (MICH).

Pileus 4–11 cm broad; convex-depressed when young, becoming subinfundibuliform with the margin sometimes decurved or raised and irregularly undulate; dry; unpolished; finely felted on the margin; at times becoming areolately cracked; with the cuticle not separable and the margin not striate; basically creamy white, but stained brown ("clay color" to "saccardo's umber") over most of the surface. Trama mod-

erately thick, 5–10 mm thick in the disc; hard-brittle; creamy white, stained brown (“clay color” to “sepia”) around the larva channels; with a somewhat pungent odor and a slight, nondescript taste.

Lamellae narrow, 3–6 mm broad; broadest near the middle; adnate to subdecurrent; crowded when young, then close; rarely forked near the stipe; intervenose; with entire edges; whitish when young, becoming pale yellow (“ivory yellow”) or more creamy, stained brown (\pm “tawny-olive”) on the edges. Lamellulae in 3–4 indistinct tiers; abundant, 2–5 between each pair of lamellae.

Stipe 1.5–6 cm long, 1.7–3 cm thick; tapering to the base; straight; terete; unpolished; even; hard-brittle; hollowed by larvae; basically white, but stained like the pileus surface.

Color reactions (stipe surface): Formalin $-$, phenol $+$, FeSO_4 $+$ (2).

Spores pale cream color in deposit; $6.8\text{--}9.3 \times 5.3\text{--}7.2 \mu$ excluding ornamentation; usually broadly elliptic to elliptic, occasionally obovate or subglobose. Ornamentation $0.2\text{--}0.7 \mu$ high; of short-cylindric to hemispheric, blunt-tipped, usually completely amyloid warts which may be isolated, but are often aligned, united in ridges or clusters, or connected by fine lines; occasionally forming a broken reticulum, but usually forming no reticulum. Suprahilar disc with an irregularly shaped, weakly amyloid patch or having ornamentation like the remainder of the spore only finer.

Basidia $54\text{--}66 \times 7.2\text{--}10.0 \mu$; narrowly clavate; 4-spored. Pleuro-pseudocystidia $47\text{--}136 \times 5.7\text{--}8.6 \mu$; narrowly subcylindric, elongate-clavate, or fusoid-clavate; sometimes capitate, bearing a finger-like projection, or moniliform near the apex, otherwise rounded to subacute apically; usually curved or flexuous toward the base; filled with colorless refractive contents; arising in the subhymenium or more usually in the trama; embedded or projecting to 20μ beyond the basidioles; abundant. Cheilopseudocystidia $46\text{--}100 \times 5.7\text{--}9.3 \mu$; like the pleuropseudocystidia, but often projecting more prominently; abundant.

Subhymenium $20\text{--}27 \mu$ thick; pseudoparenchymatous. Trama with numerous oleiferous hyphae.

Pileus cuticle $120\text{--}200 \mu$ thick; lacking a gelatinous matrix; of interwoven, nongelatinous, septate, branched, hyaline to brownish hyphae $1.0\text{--}4.0 \mu$ broad, these giving rise to scattered, \pm erect, septate, hyaline hairs $2.0\text{--}3.0 \mu$ broad and up to 80μ long which are capitate or taper to blunt apices; also with rare to abundant oleiferous hyphae $2.7\text{--}8.0 \mu$ broad.

Stipe cuticle not distinctly differentiated from the trama, the stipe surface consisting of interwoven connective hyphae $1.0\text{--}2.6 \mu$ broad and occasional oleiferous hyphae up to 4.2μ broad, both types in places giving rise to dense, tangled masses of undifferentiated hairs.

Collections examined: UNITED STATES: Michigan: Cheboygan Co.: Solitary in white cedar swamp, Carp Creek, UMBS, 5 Aug. 1957, *Shaffer 1748*; gregarious under conifers, Colonial Pt., Burt L., 11 Aug. 1961, *Smith 63889* (Holotype).

The most conspicuous difference between *R. inopina* and *R. vesicatoria* is in the taste of the pileus trama, that of the former having a slight taste, that of the latter a strongly bitter-acrid one. However, there are other relative differences: The odor of *R. inopina* does not



FIG. 8. *Russula cascadenis* (*Smith 23695*, Holotype), $\times \frac{3}{4}$. Photograph by A. H. Smith.

resemble that of *Lactarius camphoratus*; the spore ornamentation of *R. inopina* is less commonly and less completely reticulate than that of *R. vesicatoria*; and the pileus and stipe cuticles of *R. inopina* are less developed than those of *R. vesicatoria*.

4. *RUSSULA VESICATORIA* Burl., *Mycologia* 36: 118, fig. 1-t, 2. 1944.
FIGS. 4, 10

Pileus to 11 cm broad; umbilicate with an inrolled margin, finally spreading with a depressed disc, but the extreme edge remaining inrolled; slightly viscid on the margin when wet, but soon dry; dull; pruinose-downy on the margin; often finely areolate on the disc; with the cuticle separable only on the margin and the margin not striate; pale

yellowish buff (maize yellow tone 1)² to deep cinnamon-buff (chamois tone 4) centrally, otherwise white. Trama thick; firm; white, unchanging; with a strong pleasant odor (somewhat like that of fresh *Lactarius camphoratus*) and an astringent to bitter taste which slowly becomes extremely and persistently acrid.

Lamellae narrowed behind, rounded in front; close; sometimes forking near the stipe or outward; fleshy white. Lamellulae present.

Stipe 2.2 cm long, 2.2 cm thick apically, 1.5 cm thick basally; tapering to the base; somewhat pruinose-downy apically; solid; white.

Spores cartridge buff (fleshy white tone 4) to pale pinkish buff (flesh color tone 1) in thick deposit; (6.4–)6.8–9.3 × (5.3–)5.6–7.3 μ excluding ornamentation; usually broadly elliptic, occasionally elliptic, obovate, or subglobose. Ornamentation 0.2–0.7 μ high; of completely amyloid, rounded warts often connected by fine to moderately heavy lines; forming on most spores a broken to nearly complete reticulum. Suprahilar disc with lower, fine, weakly amyloid warts and lines or at times almost devoid of ornamentation.

Basidia 37–59 × 7.9–10.7 μ ; clavate; usually 4-spored, rarely 2-spored. Pleuropseudocystidia 47–93 × 5.0–10.7 μ ; subcylindric to clavate or fusiform; sometimes capitate, submoniliform near the apex, or bearing a short finger-like projection, otherwise rounded to subacute or acuminate apically; often curved or flexuous basally; filled or partially filled with refractive contents; arising in the subhymenium or trama; embedded or projecting to 15 μ beyond the basidioles except near the lamella edges where they may project to 30 μ ; abundant. Pleurocystidia 43–51 × 10.0–17.2 μ ; clavate, the apical portion inflated; apparently empty or containing scattered oil globules or refractive particles or both; with walls 0.7–1.5 μ thick; arising from connective hyphae in the subhymenium; when present rare to common, but usually absent. Cheilopseudocystidia 36–72 × 5.7–10.0 μ ; like the pleuropseudocystidia; projecting to 30 μ beyond the basidioles; abundant.

Subhymenium 20–30 μ thick; pseudoparenchymatous. Trama with numerous oleiferous hyphae.

Pileus cuticle 200–450 μ thick; passing imperceptibly into the trama and except for the absence of sphaerocysts not distinct from it; lacking a gelatinous matrix; of interwoven, nongelatinous, septate, branched, hyaline hyphae 1.3–6.7 μ broad which at the surface may give rise to ascendant to erect, usually nonseptate [if septate, sometimes having the subapical cell(s) inflated], usually unbranched, hyaline hairs to 93 μ long which may be \pm cylindrical or taper to a rounded or subacute apex and which are occasionally appendiculate at the apex or subcapitate, these hairs when present scattered, clustered, or in places even forming a \pm tangled

² Color designations in parentheses in this description are from the *Répertoire de Couleurs* of the Société Française des Chrysanthémistes, which was used by Burlingham.

epicuticular trichodermium; also with common oleiferous hyphae 3.0–9.3 μ broad usually ending abruptly in the cuticle, but occasionally giving rise to subcylindric to clavate pseudocystidia.

Stipe cuticle 190–260 μ thick; with a thin basal layer of loosely interwoven, nongelatinous, septate, branched, hyaline hyphae 1.7–4.0 μ broad which gives rise to a loose, \pm tangled trichodermium of nongelatinous, sometimes septate and branched, hyaline hairs 2.0–5.3 μ broad which may be \pm cylindrical or taper to a rounded or subacute apex, the trichodermium sometimes becoming matted or even disappearing in age; also with numerous, subcylindric to clavate, sometimes flexuous pseudocystidia 5.0–10.6 μ broad which may either be the ends of tramal oleiferous hyphae or arise from connective hyphae in the lower portion of the cuticle.

Collections examined: UNITED STATES: Florida: Seminole Co.: In black humus under pine, Lake Wildmere, Longwood, 1 Nov. 1939 (NY); Lake Wildmere, Longwood, 21 & 27 Oct. 1941 (NY); under long-leaf pines in lawn, Lake Wildmere, Longwood, 21 Oct. 1943 (NY, labeled Co-type, here designated Lectotype); under pines in lawn, Lake Wildmere, Longwood, 18 Oct. 1943 & 24 May 1944 (NY); Lake Wildmere, Longwood, 17 Nov. 1946 (NY); and collections (all at NY) probably from the Lake Wildmere locality but bearing only the following dates: 21 Oct. 1941, 21 Oct. 1941, 27 Oct. 1941, 27 Oct. 1941 & 13 May & 23 Oct. 1944, 1 Nov. 1941, 9 Nov. 1941.

Burlingham's original description was used for the macroscopic characters. The inflated-clavate pleurocystidia were found in only two collections: 1 Nov. 1941, in which they were rare, and 18 Oct. 1943 & 24 May 1944, in which they were common. Perhaps these cystidia were abnormal. I have not seen them in other *Russulas* studied.

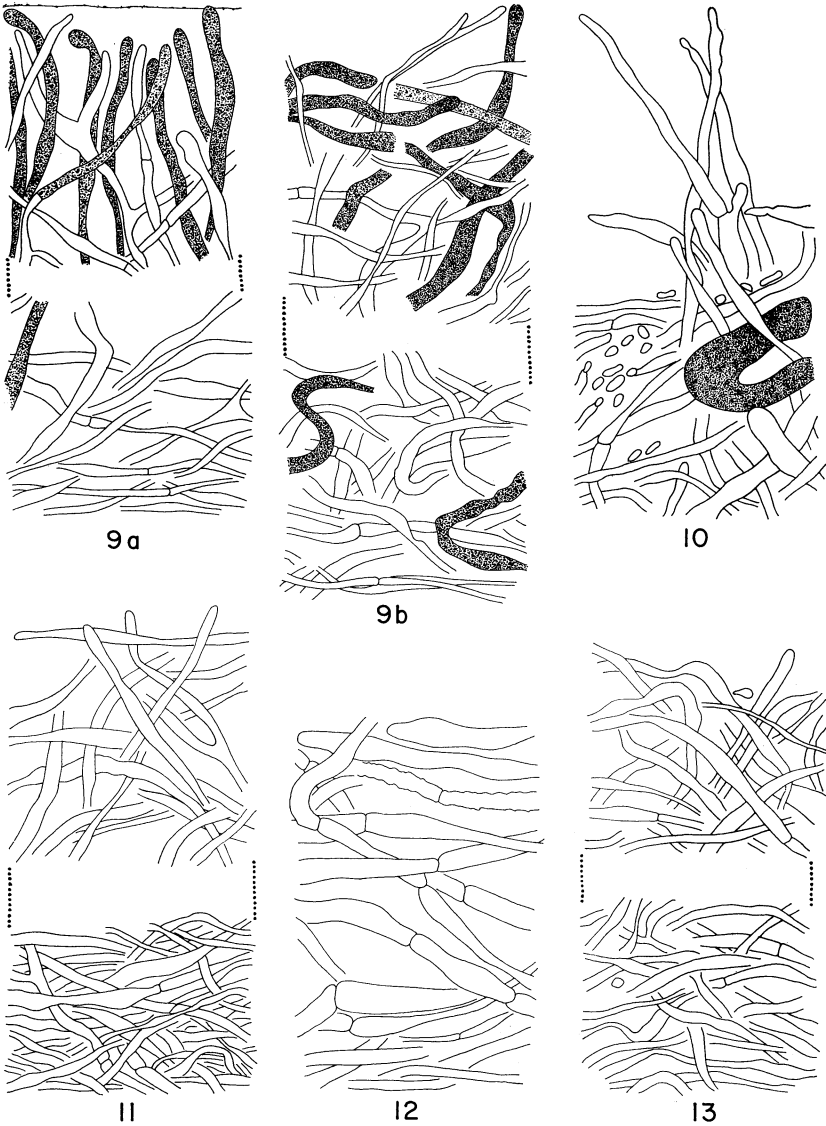
Burlingham designated a collection dated 23 Oct. 1941 as the type of *R. vesicatoria*. No collection at NY bears this date, and Dr. Clark T. Rogerson suggests that it may be an error. I am designating the 21 Oct. 1943 collection, which was labeled "co-type" by Burlingham, as the lectotype.

For a comparison of *R. vesicatoria* with *R. fuegiana*, *R. inopina*, and *R. cascadenis* see the latter species.

5. *Russula cascadenis* Shaffer, sp. nov.

FIGS. 5, 8, 11

Pileus siccus, tenuiter coactus, primo albus, deinde isabellino-maculatus; trama crassa, rigida, alba, odore nullo, sapore fortiter acris; lamellae angustae, adnatae vel subdecurrentes, confertae, primo albae, deinde pallido-glaucae ("pale olive-buff"); lamellulae numerosae; stipes impolitus, albus; sporae pallido-luteae ("cartridge buff") in cumulo, 6.7–8.2 \times 4.8–6.7 μ (ornamentatione exclusa), ornamenta-



FIGS. 9-13. Pileus cuticles of *Russula* spp. in tangential section, $\times 540$. 9. *R. fuegiana* (Singer M265, Co-type; upper and lower thirds of cuticle only): a. young basidiocarp, b. mature basidiocarp. 10. *R. vesicatoria* (21 & 27 Oct. 1941; upper portion of cuticle only). 11. *R. cascadenis* (Smith 23695, Holotype; upper fourth of epicutis and lower fourth of subcutis only). 12. *R. romagnesiana* (Romagnesi 58.269). 13. *R. brevipes* var. *brevipes* (Peck, Holotype; upper and lower fourths of cuticle only).

tion 0.2–0.7 μ altitudine, plerumque verrucoso-reticulata; epicutis pilei ex hyphis intertextis constans vel trichodermium implicatum formans. Holotypus: Prope Wapinitia Summit, Cascade Mts., Clackamas Co., Ore.; 24 Sep. 1946; *Smith 23695* (MICH).

Pileus 4–9 cm broad; when young broadly depressed on the disc and with the margin arched and incurved, expanding to broadly infundibuliform; dry; matted fibrillose (under a lens); white when fresh, but soon staining cinnamon-buff where injured or in contact with debris; frequently pale alutaceous overall in age. Trama thick; firm and brittle; white, discoloring slowly when broken; with the odor slight or none and the taste intensely acid.

Lamellae narrow, 3–4 mm broad; adnate to subdecurrent; close to crowded; often forked near the stipe; white at first, finally "pale olive-buff," staining sordid yellow to cinnamon-buff where injured. Lamellulae in many tiers.

Stipe short, 3–4 cm long, 2–2.5 cm thick; unpolished; solid; white, not staining readily where bruised.

Spores pale cream-yellow ("cartridge buff") in deposit; 6.7–8.2 \times 4.8–6.7 μ excluding ornamentation; usually elliptic, occasionally obovate. Ornamentation 0.2–0.7 μ high; of completely amyloid warts which may be almost entirely isolated or more often connected by fine to heavy lines, the ornamentation then forming a broken to nearly complete reticulum. Suprahilar disc with weakly amyloid ornamentation of minute, isolated to aligned warts or almost devoid of ornamentation.

Basidia 40–52 \times 8.0–10.6 μ ; clavate; 4-spored. Pleuropseudocystidia 47–86 \times 5.3–8.0 μ ; irregularly cylindrical to narrowly clavate or fusiform; at times subcapitate or submoniliform near the apex, otherwise rounded, subacute, or attenuate apically; sometimes flexuous; at least partially filled with refractive contents or more or less homogeneously glassy (especially if near the lamella edges); arising in the subhymenium or trama; projecting not at all or to 17 μ beyond the basidioles; abundant. Cheilopseudocystidia 33–53 \times 5.3–8.0 μ ; like the pleuropseudocystidia; common.

Subhymenium 27–43 μ thick; pseudoparenchymatous. Trama with rare oleiferous hyphae, or these apparently absent.

Pileus subcutis 133–160 μ thick; of interwoven to generally horizontally arranged, compacted, nongelatinous or subgelatinous, septate, branched, hyaline hyphae mostly 1.3–5.3 μ broad, but with some cells inflated and up to 12.0 μ broad; apparently lacking oleiferous hyphae, or these rare. Pileus epicutis 93–173(–400) μ thick; lacking a gelatinous matrix; of loosely interwoven, nongelatinous, septate, branched, hyaline hyphae 2.0–4.0 μ broad, or with these hyphae arranged in a tangled trichodermium; apparently lacking oleiferous hyphae, or these rare.

Stipe cuticle scarcely differentiated from the trama; 13–67 μ thick;

of interwoven, nongelatinous, septate, branched, hyaline hyphae 2.0–4.0 μ broad which in places give rise to scattered or tangled-clustered undifferentiated hairs; also with common oleiferous hyphae 2.7–8.0 μ broad.

Collections examined: UNITED STATES: Michigan: Jackson Co.: Clear L., Waterloo Recreation Area, 7 Oct. 1947, *Smith* 27896. Idaho: Bonner Co.: Under hemlock, Priest L., 2 Oct. 1956, *Smith* 53850; under hemlock and pine, Priest L., 17 Oct. 1956, *Smith* 54918. Idaho Co.: Seven Devils Station Rd., 30 Jul. 1954, *Smith* 45511. Washington: Clallam Co.: Lake Angeles, 19 Sep. 1941, *Smith* 17018. Pierce Co.: Lower Tahoma Creek, Mt. Rainier Natl. Pk., 22 Aug. 1948, *Smith* 30472 and 23 Aug. 1948, *Smith* 30529; Carbon R., Mt. Rainier Natl. Pk., 16 Sep. 1952, *Smith* 39966; Longmire, Mt. Rainier Natl. Pk., 15 Sep. 1948, *Smith* 31278, 11 Oct. 1954, *Smith* 48839, and 20 Oct. 1954, *Smith* 49353; Eatonville, 21 Sep. 1954, *Smith* 47792. Oregon: Clackamas Co.: Bruin Run Creek, 24 Sep. 1944, *Smith* 19052; scattered under pine, east fork of Salmon R., Mt. Hood, 30 Sep. 1944, *Smith* 19292 and 12 Oct. 1944, *Smith* 19643; middle fork of Salmon R., Mt. Hood, 29 Sep. 1946, *Smith* 23884; gregarious under pine and Douglas fir, below Wapinitia Summit, Cascade Mts., 24 Sep. 1946, *Smith* 23695 (Holotype); Little Crater L., Mt. Hood Natl. For., 25 Sep. 1946, *Smith* 23777.

This is another species closely related to *R. vesicatoria*. It differs in having a slight nondescript odor and a taste lacking a bitter component.

6. *RUSSULA DELICULA* Romag., Bull. Soc. Mycol. Fr. 61: 30. 1946.

FIG. 6

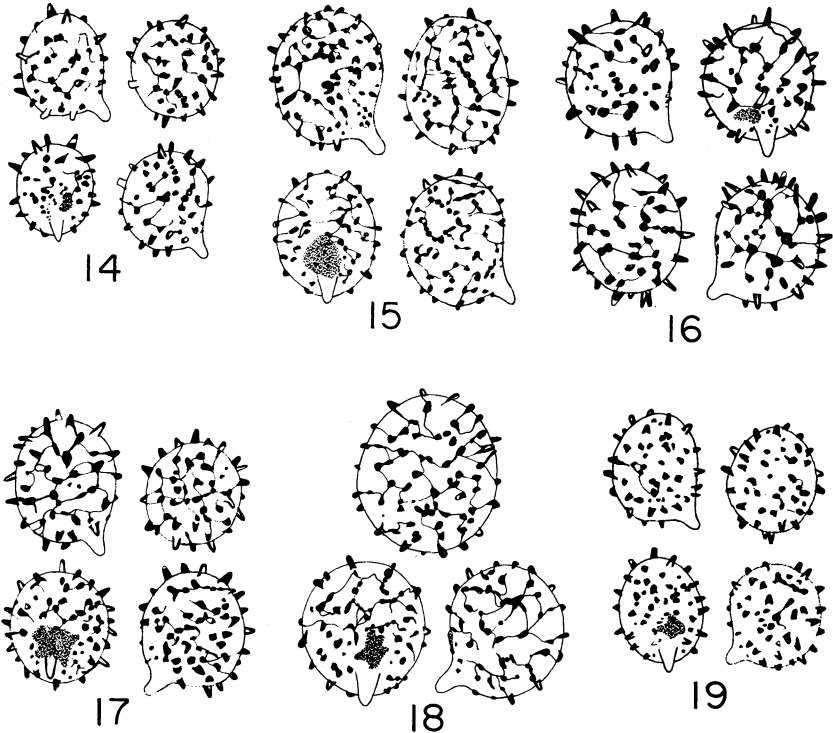
Pileus 3.5–6.5 cm broad; convex with a slightly depressed disc when young, expanding to infundibuliform; dry; mat; glabrous to finely velutinous; with the cuticle separable only on the margin and the margin not striate; white to light buff, often tinged yellowish in places. Trama thick, 6 mm or more thick in the disc; hard-brittle; white, at times becoming brownish in age; with a faintly fruity odor and a mild taste.

Lamellae narrow, 2–4 mm broad; thick; acute in front; decurrent; often forked at or near the stipe; intervenose; with entire edges; pale olive-buff. Lamellulae in 3–4 tiers; 1–3 between each pair of lamellae.

Stipe 1.5–3.5 cm long, 0.8–2 cm thick; subequal, or enlarged apically; straight or slightly curved; terete; glabrous; unpolished; solid; hard; white, staining brown ("saccardo's umber").

Spores pale yellow (\pm "cream color") in deposit; 8.1–10.6 \times 7.0–9.4 μ excluding ornamentation; usually broadly elliptic, occasionally sub-

globose or broadly obovate. Ornamentation $0.5\text{--}1.6\ \mu$ high; of cylindrical to conic, blunt-tipped, at times partially nonamyloid warts usually aligned or connected by fine lines, rarely isolated; often forming a nearly complete reticulum. Suprahilar disc with a weakly amyloid, irregularly shaped patch, or low warts and lines, or both.



FIGS. 14-19. Spores of *Russula* spp. with ornamentation as it appears in Melzer's reagent, $\times 1875$. 14. *R. romagnesiana* (Shaffer 242L, Holotype). 15. *R. delica* (Romagnesi 62.45). 16. *R. brevipes* var. *brevipes* (Peck, Holotype). 17. *R. brevipes* var. *acrior* (Shaffer 1068, Holotype). 18. *R. brevipes* var. *megasporea* (Collet, Holotype). 19. *R. pseudo-delica* (Lange).

Basidia $47\text{--}64 \times 8.0\text{--}13.3\ \mu$; clavate; 4-spored. Pleuropseudocystidia $51\text{--}97 \times 6.7\text{--}12.0\ \mu$; rarely subcylindric, usually clavate-fusiform or fusiform, the neck then sometimes long-attenuate; rounded to acute or often bearing a small bulb or stub apically; often curved or flexuous basally; filled with granular to linear, refractive, yellowish contents or at times partially empty; arising in the subhymenium or trama; projecting to $27\ \mu$ beyond the basidioles or sometimes to $50\ \mu$; abundant.

Cheilopseudocystidia $53-86 \times 5.3-10.0 \mu$; like the pleuropseudocystidia; rare to common.

Subhymenium $13-20 \mu$ thick; pseudoparenchymatous. Trama with occasional oleiferous hyphae, or these sometimes abundant in the pileus trama.

Pileus cuticle absent in some places, sphaerocysts then appearing at the pileus surface, otherwise up to 130μ thick; lacking a gelatinous matrix; of interwoven to generally horizontally arranged, nongelatinous, septate, branched, hyaline to yellowish brown hyphae $1.0-5.3 \mu$ broad which may give rise to scattered or tangled-clustered, undifferentiated hairs; with oleiferous hyphae rare or apparently absent.

Stipe cuticle $13-20 \mu$ thick; scarcely differentiated from the trama; of interwoven, nongelatinous, septate, branched, hyaline to brownish hyphae $1.0-3.5 \mu$ broad; also with occasional oleiferous hyphae to 5.3μ broad.

Collections examined: FRANCE: Seine-et-Oise: Saint-Cloud, 19 Sep. 1944, *Romagnesi* (PC, Holotype). UNITED STATES: Michigan: Chippewa Co.: Solitary on humus in beech-maple woods, Emerson, 13 Aug. 1959, *Shaffer 2328*.

Blum (1962) recognized *delicula* as a variety of *R. delica*, but did not make a valid new combination.

7. *Russula romagnesiana* Shaffer, sp. nov.

FIGS. 12, 14

Pileus siccus, glaber, cremeo-albus, isabellino-maculatus; trama rigida, odore parvo, sapore nullo; lamellae angustae, subdecurrentes, confertae, pallido-glaucae; lamellulae numerosae; stipes glaber, cremeo-albus; sporae $6.4-8.0 \times 6.1-6.8 \mu$ (ornamentatione exclusa), ornamentatione $(0.5-0.8-1.6 \mu$ altitudine, plerumque non reticulata; cuticula pilei circa 150μ crassitudine, ex hyphis intertextis, nonnunquam aspero-tunicatis $3.3-8.0 \mu$ latitudine constans. Holotypus: Pinckney Recreation Area, Washtenaw Co., Mich.; 19 Jul. 1960; *Shaffer 2421* (MICH).

Pileus 7.5 cm broad; subinfundibuliform with incurved margin; dry; glabrous; with the cuticle separable $\frac{1}{4}$ the distance to the center and the margin not striate; creamy white, streaked or spotted with dull yellow or brown ("honey yellow" to "clay color"). Trama 8 mm thick in the disc; hard-brittle; with a slight, nondescript odor and no taste.

Lamellae 5 mm broad; acute in front; arcuate-subdecurrent; close; not forked; intervenose; with entire edges; pale olive-buff. Lamellulae in 2-3 tiers; abundant.

Stipe 3.5 cm long, 15-16 mm thick; equal; straight; terete; stuffed; rugulose; glabrous; creamy white, slowly (overnight) becoming brown ("snuff brown") where bruised.

Spores white in a thin deposit; $6.4-8.0 \times 6.1-6.8 \mu$ excluding ornamentation; usually broadly elliptic to subglobose, occasionally globose, rarely broadly obovate. Ornamentation $(0.5-0.8-1.6 \mu$ high; of cylin-

dric to conic, blunt- to acute-tipped, often partially or completely non-amyloid warts which are often isolated, occasionally united in ridges or clusters or connected by lines; usually not forming a reticulum, but occasionally forming a broken or partial reticulum; occasionally with 1-few, large (\pm the size of the apiculus or larger), stubby, completely nonamyloid warts. Suprahilar disc with a diffuse, irregularly shaped, weakly amyloid patch or small warts and fine lines, or both.

Basidia $37-53 \times 7.3-9.3 \mu$; clavate; 4-spored. Pleuropseudocystidia $43-70 \times 4.7-8.0 \mu$; subcylindric to clavate or fusiform; often appendiculate, capitate, or submoniliform near the apex, otherwise rounded to subacute apically; often curved or flexuous basally; partially or completely filled with granular to linear, usually refractive, yellowish contents; arising in the subhymenium or trama; projecting to 27μ beyond the basidioles; abundant. Cheilopseudocystidia $29-57 \times 4.0-8.0 \mu$; like the pleuropseudocystidia; abundant.

Subhymenium 27μ thick; pseudoparenchymatous. Trama with rare to occasional oleiferous hyphae.

Pileus cuticle $90-150 \mu$ thick; not clearly delimited from the trama; lacking a gelatinous matrix; of tangled-interwoven, nongelatinous, septate, branched, hyaline hyphae ($1.0-$) $3.3-8.0 \mu$ broad and sometimes encrusted with irregularly shaped plates and granules of hyaline to yellowish material; apparently lacking oleiferous hyphae and pseudocystidia, or with a few hyphae containing scattered, linear, refractive crystals.

Stipe cuticle a loosely tangled mass of nongelatinous, septate, branched, hyaline hyphae $1.3-4.0 \mu$ broad; also with common oleiferous hyphae $2.7-8.0 \mu$ broad.

Collections examined: FRANCE: Oise: Sub arboribus frondosis in colle calcarea, Lamorlaze (?), *Romagnesi* 58.269 (PC). UNITED STATES: Michigan: Washtenaw Co.: Solitary in oak-hickory woods, Pinckney Recreation Area, 19 Jul. 1960, *Shaffer* 2421 (Holotype).

The *Romagnesi* collection was labeled *R. chloroides* var. *parvispora* Romag. (Bull. Soc. Linn. Lyon 31: 173. 1962), a name not validly published, for no nomenclatural type was indicated. Other than the smaller spores, this taxon differs from *R. delica* and *R. brevipes* in that the spores sometimes have large, blunt, completely nonamyloid warts and tend not to be reticulate and that the pileus cuticle has encrusted hyphae. These differences make the taxon specifically distinct. It is named in honor of Henri Romagnesi, who first collected it.

8. *RUSSULA DELICA* Fr., *Epicr.*, p. 350. 1838.

FIG. 15

Pileus 6-12 cm broad; dry; mat; somewhat roughened by fine innate fibrils; whitish at first, soon stained sordid reddish.

Lamellae thick and distant; frequently anastomosing in their anterior portion; intervenose.

Stipe 1.2–2.5 cm thick.

Spores $8.2\text{--}10.8 \times 6.9\text{--}8.1 \mu$ excluding ornamentation; usually elliptic to broadly elliptic or broadly obovate, rarely subglobose. Ornamentation $0.4\text{--}1.0 \mu$ high; of hemispheric to cylindric or conic, blunt-tipped, sometimes partially nonamyloid warts which are isolated, united in ridges or clusters, or connected by fine lines; usually forming a broken to nearly complete reticulum. Suprahilar disc with fine, weakly amyloid ornamentation or a diffuse, irregularly shaped, weakly amyloid patch, or both.

Basidia $56\text{--}64 \times 10.0\text{--}12.0 \mu$; clavate; 4-spored. Pleuropseudocystidia $53\text{--}93 \times 6.7\text{--}12.0 \mu$; occasionally clavate, usually clavate-fusiform; sometimes capitate or submoniliform near the apex, otherwise rounded to subacute apically; often curved basally; at least partially filled with usually linear, \pm refractive, yellowish contents; arising in the subhymenium or trama; projecting to 27μ beyond the basidioles; abundant. Cheilopseudocystidia $56\text{--}82 \times 8.0\text{--}9.3 \mu$; like the pleuropseudocystidia; abundant.

Subhymenium approximately 27μ thick; pseudoparenchymatous. Trama with rare oleiferous hyphae.

Pileus cuticle $133\text{--}200 \mu$ thick; lacking a gelatinous matrix; of interwoven, nongelatinous, septate, branched, hyaline to yellowish hyphae $1.5\text{--}6.7 \mu$ broad which give rise to scattered or clustered, ascendant to erect, undifferentiated hairs; also with rare oleiferous hyphae to 4.7μ broad.

Collections examined: FRANCE: Oise: Sub *Quercus sessiliflora* in colle calcarea, Coye-la-forêt, *Romagnesi* 50.220 (PC). Seine-et-Oise: Sub *Quericibus* et *Pinis silvestribus* in colle calcarea, Bellefontaine, 1 Aug. 1962, *Romagnesi* 62.45 (PC).

Fries (1838, 1874) described the basidiocarps of *R. delica* as white and unchanging and as having a smooth shining pileus and thin distant lamellae. This description does not fit any fungus which has been called *R. delica* in North America, neither does it resemble in all details the descriptions of *R. delica* published by post-Friesian Europeans.

Some have ignored, if not overlooked, the difficulties presented by Fries' description. Kauffman (1918) considered it erroneous in part, and others, e.g., Schaeffer (1952), have at least implied that the differences are the result of variation within a species.

In view of the original description and the variation which is present in what the older authors would probably call *R. delica* (i.e., in subsection *Lactarioideae*), but which modern authors consider great enough to justify the recognition of several species, I think a good case could

be made for rejecting the name *R. delica* because of its ambiguity. However, I accept *R. delica* in the sense of Kühner & Romagnesi (1953) as a species with thick distant lamellae lacking a bluish green coloration and with spores having obtuse warts which are lower than those of *R. brevipes* [and *R. chloroides*].

See also the discussions under *R. brevipes* var. *brevipes* and *R. chloroides*.



FIG. 20. *Russula brevipes* var. *brevipes* (Smith 23696), $\times \frac{1}{3}$. Photograph by A. H. Smith.

9a. *RUSSULA BREVIPES* Pk., 43rd Rep. N. Y. St. Mus., p. 20 (reprint pagination), pl. 2, figs. 5-8. 1890. var. *brevipes*

FIGS. 13, 16, 20

Pileus 9-20 cm broad; when young depressed on the disc and with inrolled margin, expanding to broadly infundibuliform; dry; mat; minutely felted; at times radially rugulose; not striate at the margin; white to buffy white, but soon stained with dull yellow or brown ("chamois" or "cinnamon-buff" to "clay color") and at times becoming brownish overall in age. Trama thick, 7-20 mm thick in the disc; hard-brittle; white, often stained with brown ("clay color") around larva channels; with a slight, sometimes faintly disagreeable odor and a mild to slightly acrid taste.

Lamellae narrow, 3-9 mm broad; thin; acute in front; decurrent; usually close, occasionally crowded; sometimes forked near the stipe; intervenose; with entire edges; nearly white when young, becoming pale

yellow ("cartridge buff," "ivory yellow"), at times "pale olive-buff" in age, becoming spotted-stained with cinnamon to clay color; with a mild to slightly acrid taste. Lamellulae of varying lengths; abundant.

Stipe 3–8 cm long, 2.5–4 cm thick; equal or tapering slightly basally; straight; terete; unpolished; rugulose; solid, or becoming hollowed by larvae; white, sometimes becoming stained with brown ("clay color" to "tawny olive").

Color reactions (stipe surface): Formalin –, phenol +, FeSO_4 + (2), SV –.

Spores white to light cream color (lighter than both "cream color" and Crawshay B) in deposit (even when colored, almost white in thin deposits); $8.0\text{--}10.6 \times 6.7\text{--}8.6(-9.8) \mu$ excluding ornamentation; usually broadly elliptic, occasionally broadly ovate, broadly obovate, or subglobose, rarely globose. Ornamentation $0.7\text{--}1.7 \mu$ high; of cylindrical to conic, blunt- to acute-tipped, occasionally partially nonamyloid warts which may be almost completely isolated, but which on most spores are usually aligned or connected by fine to moderately heavy lines, the ornamentation then forming a broken to nearly complete reticulum. Suprahilar disc with a diffuse, irregularly shaped, weakly amyloid patch or with ornamentation like that on the remainder of the spore only finer, or both.

Basidia $49\text{--}67 \times 8.6\text{--}13.3 \mu$; usually clavate, rarely fusiform; 4-spored. Pleuropseudocystidia $43\text{--}94 \times 6.7\text{--}13.3 \mu$; clavate to fusiform; sometimes capitate, submoniliform near the apex, or bearing a stub, otherwise rounded to subacute apically; straight, curved, or flexuous basally; filled partially to completely with granular to linear, refractive, yellowish contents; arising in the subhymenium or trama; projecting to 27μ beyond the basidioles; abundant. Cheilopseudocystidia $33\text{--}81 \times 6.0\text{--}12.0 \mu$; like the pleuropseudocystidia; common to abundant.

Subhymenium $13\text{--}40 \mu$ thick; pseudoparenchymatous. Trama with oleiferous hyphae occasional, rare, or apparently absent.

Pileus cuticle $67\text{--}186 \mu$ thick; lacking a gelatinous matrix; of interwoven to generally horizontally oriented, nongelatinous, septate, branched, hyaline to yellowish brown hyphae $1.3\text{--}6.7 \mu$ broad which may give rise to scattered or tangled-clustered, ascendant to erect, undifferentiated hairs to 140μ long; with oleiferous hyphae absent to fairly common.

Stipe cuticle scarcely differentiated from the trama; to 106μ thick; of interwoven, nongelatinous, septate, branched, hyaline hyphae $1.3\text{--}5.3 \mu$ broad which may give rise to scattered, ascendant to erect, undifferentiated hairs; also with rare to common oleiferous hyphae $2.0\text{--}8.0 \mu$ broad.

Collections examined: UNITED STATES: New Hampshire: Cheshire Co.: In road through mixed woods, Wantastiquet Mt., 15 Aug.

1961, *Shaffer* 3325. Vermont: Windham Co.: Solitary in beech-maple-hemlock woods, Williamsville-Newfane Rd., 15 Jul. 1961, *Shaffer* 2910 and *Shaffer* 2913. New York: Suffolk Co.: Quogue, *Peck* (NYS, Holotype). Michigan: Luce Co.: Pike L., 7 Aug. 1959, *Shaffer* 2269; Tahquamenon Falls St. Pk., 5 Oct. 1955, *Smith* 50770. Cheboygan Co.: Solitary on humus in white cedar swamp, Hermit's Bog, 9 Aug. 1957, *Shaffer* 1767. Emmet Co.: Wilderness St. Pk., 11 Jul. 1959, *Shaffer* 2157. Colorado: San Miguel Co.: Under spruce, Trout Lake, 16 Aug. 1956, *Smith* 52305 and 29 Aug. 1956, *Smith* 59932. Wyoming: Albany Co.: Pole Mt., 22 Jul. 1940, *Smith* 35037. Idaho: Custer Co.: Cape Horn Summit, 25 Aug. 1954, *Smith* 46689; Red Fish L., 16 Aug. 1954, *Smith* 46180. Oregon: Clackamas Co.: East fork of Salmon R., Mt. Hood, 21 Sep. 1946, *Smith* 23630; gregarious under conifers, below Wapinitia Summit, Cascade Mts., 24 Sep. 1946, *Smith* 23696. Josephine Co.: In mixed woods, Grants Pass, 10 Nov. 1956, *Smith* 55418.

In addition to the collections cited both above and under *R. b.* var. *acrior*, approximately 30 collections belonging to one or the other of these two varieties were examined. Because of inadequate notes, they could not be identified as to variety, but the following are cited for the information they add to the range of *R. brevipes*:

CANADA: Nova Scotia: Colchester Co.: Under fir, Upper Brookside, 6 Jul. 1931, *Smith* 576. Ontario: On ground under conifers, Petawawa For. Exp. Station, 18 July 1938, *Lewis* (ex *DAOM* F8595); Magnetawan, 12 Sep. 1921, *Kelly* 1300. UNITED STATES: Maine: Aroostook Co.: South of Sinclair, 31 July 1956, *Bigelow* 3680. New York: Essex Co.: Under spruce and balsam, Lake Placid, 4 Sep. 1914, *Kauffman*. Tennessee: Indian Camp Creek, Gt. Smoky Mts. Natl. Pk., 30 Aug. 1938, *Smith* 10666. Michigan: Crawford Co.: Solitary in humus under white pine, Hartwick Pines St. Pk., 20 Jul. 1956, *Thiers* 3399. Gratiot Co.: Gregarious on leaf-matted ground, Allen's Woods, Ithaca, 19 Sep. 1947, *Potter* 3930. Oakland Co.: Bass L., 21 Sep. 1937, *Smith* 7637. Indiana: Marshall Co.: Donaldson, Oct. 1947, *S. Aloysia*. Texas: Grimes Co.: Solitary in humus under loblolly pine, near Richards, 3 Apr. 1953, *Thiers* 1794. Idaho: Bonner Co.: Priest L., 2 Oct. 1956, *Smith* 53849. Idaho Co.: Papoose Creek, Seven Devils Mts., 23 Aug. 1954, *Smith* 46551. Washington: Pierce Co.: Lower Tahoma Creek, Mt. Rainier Natl. Pk., 22 Jul. 1948, *Smith* 29277. California: Humboldt Co.: Under redwood, Prairie Creek St. Pk., 9 Dec. 1956, *Smith* 56539.

As far as I am aware, no author except *Peck* previously has considered *R. brevipes* to be other than a synonym of *R. delica* or *R. chlo-*

roides. It is best to use *R. brevipes* for the North American collections which most authors, but not Kühner & Romagnesi (1953), call *R. delica*. The name, *R. brevipes*, is attached to a type collection, has a reasonably explicit original description, and provides a stable point about which a species concept can be formed.

Within the subsection *Lactarioideae* the diagnostic characteristics of *R. brevipes* are the relatively large size of the basidiocarps, the narrow to moderately broad, usually close lamellae, the whitish to cartridge buff or light cream color spore deposit, and the large spores with high warts usually aligned or connected by lines to form a reticulum. There is variation, even within a single collection of several basidiocarps, in taste and in the presence or absence of a bluish green coloration in the lamellae, or the stipe apex, or both. The correlations are not absolute but generally those collections which are mild to slightly acrid lack the bluish green coloration, and strongly acrid collections have it. The latter are the basis for *R. b.* var. *acrior* described below.

Spore size of *R. brevipes* also varies considerably. Most collections have spores falling in the range $8.0-10.6 \times 6.7-9.8 \mu$ excluding ornamentation. But a California collection having larger ($9.3-14.1 \times 8.0-12.0 \mu$) spores which are usually globose to subglobose is described below as the type of *R. b.* var. *megaspora*. The height of the spore ornamentation of this collection also is variable. On some spores the warts may be 1.5μ high but on others they may be only 0.3μ . A spore deposit was not available, and I am not certain how much of the variation in spore size and height of ornamentation can be attributed to the immaturity of some of the spores.

9b. *RUSSULA BREVIPES* Pk. var. **acrior** Shaffer, var. nov.

FIG. 17

A varietate *brevipe* sapore acriore et lamellis et stipite caeruleo-viridi tinctis distat. Holotypus: Big Payette L., McCall, Valley Co., Ida.; 10 Sep. 1956; *Shaffer 1068* (MICH).

Pileus 6.5–20 cm broad; when young convex with a depressed disc and inrolled margin, expanding to plano-convex with a depressed disc and finally to broadly infundibuliform; dry; when young sometimes cottony-tomentose on the margin, otherwise minutely felted; at times becoming areolately cracked in age; with the cuticle only slightly separable at the margin and the margin not striate; when young nearly white to “light buff” or “cartridge buff,” becoming irregularly stained with brown (“cinnamon-buff,” “clay color,” “tawny-olive,” or “isabella color”). Trama thick, 6–18 mm thick in the disc; hard-brittle; white,

stained with brown ("isabella color" or "tawny-olive") around the larva channels and elsewhere; with the odor not distinctive and the taste mild or slowly becoming slightly to strongly acrid.

Lamellae narrow to moderately broad, 4–9 mm broad; acute in front; adnate, appearing decurrent after the pileus becomes infundibuliform; close; usually forked at or near the stipe and occasionally outward toward the pileus margin; with entire edges; pale yellow ("ivory yellow," "sea foam yellow," or "marguerite yellow"), often colored bluish green ("light sulphate green," "microcline green," or "deep greenish glaucous") on the edges, or near the stipe, or near the pileus margin, often spotted-stained brown ("snuff brown" to "saccardo's umber"); with a strongly acrid taste.

Stipe 2.5–8 cm long, 1.5–5.5 cm thick; equal or enlarging slightly to the base or to the apex; straight; terete; glabrous to minutely felted; solid; white, at times with a narrow band of bluish green at the apex; \pm prominently staining brown ("isabella color" to "tawny olive") where bruised.

Color reactions (stipe surface): Formalin $-$, phenol $+$, $\text{FeSO}_4 + (2)$, SV $-$.

Spores white to "cartridge buff" in deposit (even when colored, often white in thin deposits); $8.0\text{--}10.6 \times 6.7\text{--}8.6(-9.6) \mu$ excluding ornamentation; broadly elliptic, broadly obovate, or subglobose. Ornamentation $(0.5\text{--})0.7\text{--}1.7 \mu$ high; of cylindric to conic, blunt- to acute-tipped, at times partially nonamyloid warts which are usually connected by fine to heavy lines; rarely forming no reticulum, usually forming a broken to complete reticulum. Suprahilar disc with a diffuse, irregular, weakly amyloid patch with or without small warts and fine lines.

Basidia $49\text{--}74 \times 8.0\text{--}14.3 \mu$; clavate; 4-spored. Pleuropseudocystidia $53\text{--}99 \times 4.0\text{--}13.3 \mu$; rarely subcylindric, usually clavate to fusiform; sometimes capitate or bearing a finger-like projection, but usually rounded, acute, or mucronate apically; often curved or flexuous basally; at least partially filled with granular to linear, refractive, colorless to yellowish contents; arising in the subhymenium or trama; projecting to 30μ beyond the basidioles; abundant. Cheilopseudocystidia $32\text{--}86 \times 6.7\text{--}10.0 \mu$; like the pleuropseudocystidia; common to abundant.

Subhymenium $20\text{--}47 \mu$ thick; usually pseudoparenchymatous, at times almost prosenchymatous. Trama with occasional oleiferous hyphae, or these apparently absent.

Pileus cuticle $130\text{--}240 \mu$ thick; not sharply delimited from the trama; lacking a gelatinous matrix; of nongelatinous, septate, branched, rarely encrusted, hyaline to yellowish hyphae $2.7\text{--}5.7(-11.5) \mu$ broad, these hyphae more compacted and horizontally oriented in the lower portion of the cuticle than in the upper portion where they sometimes end in

scattered or clustered, ascendant to erect, undifferentiated hairs; apparently lacking conspicuous oleiferous hyphae, but some cuticular hyphae or their cells having scattered refractive particles.

Stipe cuticle 53–67 μ thick; scarcely differentiated from the trama; of interwoven, nongelatinous, septate, branched, hyaline hyphae 1.0–2.7 μ broad, these sometimes ending in undifferentiated hairs which may be scattered or dense enough to form a tangled trichodermium; also with scattered oleiferous hyphae up to 5.3 μ broad.

Collections examined: UNITED STATES: Vermont: Windham Co.: Gregarious on soil in mixed woods, Grafton St. For., 6 Jul. 1961, *Shaffer 2863* and 19 Jul. 1961, *Shaffer 2972*; in mixed woods, Newfane Hill, 12 Aug. 1961, *Shaffer 3300*; gregarious in mixed woods, south of Williamsville, 18 Jul. 1961, *Shaffer 2950* and 29 Jul. 1961, *Shaffer 3138*. Massachusetts: Franklin Co.: Solitary on soil in beech-maple-hemlock woods, Cricket Hill, south of Conway, 27 Jul. 1961, *Shaffer 3101* and *3106*. Michigan: Luce Co.: Gregarious on humus in mixed woods, Pike L., 10 Aug. 1957, *Shaffer 1782*; Pike L., 15 Aug. 1959, *Smith 61401*; gregarious on very rotten wood and humus in beech-maple-hemlock woods, Tahquamenon Falls St. Pk., 24 Jul. 1957, *Shaffer 1671*. Schoolcraft Co.: Garden Peninsula, 6 Aug. 1959, *Shaffer 2252*. Ontonagon Co.: Solitary on humus in hemlock-hardwoods forest, Porcupine Mts. St. Pk., 3 Sep. 1962, *Shaffer 3896*. Mackinac Co.; Bois Blanc I., 27 Jul. 1947, *Smith 26041*. Cheboygan Co.: Reese's Bog, 20 Aug. 1946, *Smith 22168*; gregarious on soil in oak-aspen woods, Topinabee, 13 Jul. 1957, *Shaffer 1498* and 19 Jul. 1957, *Shaffer 1598*; solitary in deciduous woods, Douglas L., 27 Jul. 1957, *Shaffer 1717*. Emmet Co.: In beech-maple woods, west of Mackinaw City, 25 Jul. 1949, *Smith 32685*; Wilderness St. Pk., 15 Oct. 1960, *Shaffer 2835*; scattered on humus in white cedar woods, west branch of Maple R., 23 Jul. 1957, *Shaffer 1651*. Crawford Co.: Hartwick Pines St. Pk., 31 Jul. 1959, *Shaffer 2217*. Washtenaw Co.: Ann Arbor, 20 Jul. 1960, *Shaffer 2441*; solitary on soil in oak-hickory woods, Pinckney Recreation Area, 25 Jul. 1960, *Shaffer 2470*. New Mexico: Santa Fe Co.: In aspen-conifer forest, near Santa Fe, Sep., *Barrows 284*. Idaho: Idaho Co.: Papoose Creek, Seven Devils Mts., 12 Sep. 1956, *Smith 53428*. Valley Co.: Lake Fork Creek, near McCall, 27 Jul. 1954, *Smith 45398*; gregarious under conifers, Big Payette L., 8 Sep. 1956, *Smith 53223* and 10 Sep. 1956, *Shaffer 1068* (Holotype). Oregon: Clackamas Co.: Middle fork of Salmon R., Mt. Hood, 29 Sep. 1946, *Smith 23890*.

See the discussion under *R. b.* var. *brevipes*.

9c. *RUSSULA BREVIPES* var. **megaspora** Shaffer, var. nov. FIG. 18

A varietate *brevipe* sporis maioribus et plerumque subglobosis vel globosis distat. Holotypus: Paradise, Butte Co., Calif.; 13 Dec. 1947; *Collett* (MICH).

Pileus 20.3 cm broad; convex-umbilicate; dry; not polished; glabrous; with the cuticle not separable and the margin not striate; dull white, stained rust-brown. Trama firm; compact; white, unchanging when cut; odorless and with the taste acrid.

Lamellae subdecurrent; subdistant. Lamellulae present.

Stipe 8.9 cm long; thick; glabrous; solid.

Spores 9.3–14.1 \times 8.0–12.0 μ excluding ornamentation; usually subglobose to globose, occasionally broadly elliptic or broadly obovate. Ornamentation 0.3–1.5 μ high; of short-cylindric to conic, blunt-tipped, usually completely amyloid warts which are rarely isolated, sometimes aligned, usually connected by fine to moderately heavy lines; forming a nearly complete to complete reticulum. Suprahilar disc usually with an amyloid patch, granular or not, of varying size and shape, sometimes with a deeply amyloid cushion.

Basidia 53–73 \times 9.3–16.0 μ ; clavate; usually 4-spored, occasionally 2- or 3-spored. Pleuropseudocystidia 69–133 \times 5.3–10.0 μ ; narrowly fusiform; sometimes submoniliform near the apex, otherwise rounded or with an extruded mass of contents; straight or slightly curved basally; \pm glassy or at least partially filled with granular to linear refractive contents; arising in the subhymenium or trama; projecting to 35 μ beyond the basidioles; abundant. Cheilopseudocystidia 47–93 \times 5.3–8.6 μ ; like the pleuropseudocystidia but more usually subcylindric to narrowly clavate; common.

Subhymenium 47–53 μ thick; pseudoparenchymatous at the top of the lamellae, prosenchymatous at the edge, intermediate in between. Lamella trama mostly composed of sphaerocysts, scattered ones even occurring down to the lamella edges; with common oleiferous hyphae. Pileus trama with rare to common oleiferous hyphae.

Pileus cuticle 80–130 μ thick; not sharply delimited from the trama; lacking a gelatinous matrix; of tangled-interwoven, nongelatinous, septate, branched, hyaline hyphae 1.0–6.7 μ broad and arising from a layer of horizontally arranged hyphae which merges imperceptibly into the trama; apparently lacking oleiferous hyphae and pseudocystidia.

Stipe cuticle scarcely differentiated from the trama; 20–53 μ thick; of interwoven, nongelatinous, septate, branched, hyaline hyphae 1.3–3.0 μ broad which give rise to scattered, ascendant to erect, undifferentiated hairs; also with occasional oleiferous hyphae 2.7–5.3 μ broad.

Collection examined: UNITED STATES: California: Butte Co.: Solitary on soil under a mass of moist pine needles, 2100' elev., in transi-

tion region between coniferous forest and mixed woods, Oliver Rd., Paradise, 13 Dec. 1947, *Collett* (Holotype).

The macroscopic characters are taken from Mr. Collett's notes which accompany the specimen. Following is a description of the dried basidiocarp:

Pileus 17.5–18.5 broad; convex with a broadly and deeply depressed disc, the margin on one side raised and unevenly undulate; mat; glabrous; with the margin not striate; pale buff with irregularly shaped areas of "cinnamon-buff" to "clay color" and in some places tinged with "saccardo's umber." Lamellae 2.5–4 mm broad; decurrent; subdistant; not forked (?); not intervenose; with entire edges; "warm buff" to "avellaneous." Stipe 7 cm long, 3.7–5.6 cm thick; subequal; slightly flattened; glabrous; rugulose; buffy white, tinged sordid brown in places.

See also the discussion under *R. b.* var. *brevipes*.

10. RUSSULA PSEUDO-DELICA J. Lange, Dansk Bot. Ark. 4(12): 27. 1926. FIG. 19

"Very large: Cap about 10–11 cm, deeply depressed and soon infundibuliform, slightly viscid when young, glabrous, whitish, with a flush of dingy yellowish (e5-k2) in the centre. Gills descending, slightly rounded behind, rather crowded, whitish at first, but soon ochraceous-custard-yellowish (e5-b7), not furcate. Stem stout (2–3 cm), rather short (4–5 cm), white, firm and solid. Flesh everywhere white except in base of stem where it is slightly sordid; taste pungent (not very strong). Spore-powder custard-ochraceous." (Lange, l.c.; the color symbols refer to an accompanying color chart.)

Spores $6.9\text{--}9.3 \times 6.3\text{--}7.0 \mu$ excluding ornamentation; usually broadly elliptic, occasionally elliptic, broadly obovate, or subglobose. Ornamentation $0.5\text{--}1.3 \mu$ high; of cylindrical to conic, blunt-tipped, occasionally partially nonamyloid warts which are usually isolated, occasionally united or aligned in 2–4's or connected by fine lines; never forming a reticulum. Suprahilar disc ornamented like the remainder of the spore, but the ornamentation lower and often weakly amyloid; often also with a diffuse, weakly amyloid patch of varying size and shape.

Pleurospseudocystidia $48\text{--}82 \times 5.3\text{--}9.3 \mu$; cylindrical to narrowly fusiform; at times appendiculate, capitate, or submoniliform near the apex; otherwise rounded to subacute or mucronate apically; often curved or flexuous basally; filled with granular to linear, refractive, yellowish contents; arising usually in the trama; projecting $0\text{--}20 \mu$ beyond the basidiales; abundant. Cheilospseudocystidia present.

Pileus cuticle $133\text{--}146 \mu$ thick; lacking a gelatinous matrix; of non-gelatinous, septate, branched, hyaline hyphae $1.0\text{--}2.6 \mu$ broad and com-

mon oleiferous hyphae 2.0–5.3 μ broad, both types of hyphae more horizontally oriented next to the trama, elsewhere more ascending-interwoven.

Collections examined: DENMARK: I bøgskov, Fjellebro, 1 Sep. 194–, *Lange* (C). FRANCE: Seine-et-Oise: In silva frondosa et arenosa, inter *Leucobrya*, 15 Aug. 1952, *Romagnesi* 52.77 (PC).

Lange's collection consisted of a spore deposit. The basidia, cheilopseudocystidia, subhymenium, and trama of the *Romagnesi* collection did not revive well; the pileus probably had a trichodermioid epicutis when young.

See also the discussion under *R. sp.*

IMPERFECTLY KNOWN SPECIES AND VARIETIES

RUSSULA CHLOROIDES (Kromb.) Bres., *Fung. Trid.* 2: 89; pl. 202. 1900.

Agaricus chloroides Kromb., *Abbild. Beschreib. Schwämme* 8: 7; pl. 56, figs. 8–9. 1843.

Russula delica f. *chloroides* (Kromb.) Imai, *J. Fac. Agric. Hokkaido Univ.* 43: 353. 1938.

Krombholz described *Agaricus chloroides* not as a "Täubling" (*Russula*), but as a "Milchblätterschwamm" (*Lactarius*). He said, however, that it was "almost sapless with very spare, white, watery milk." The pileus was described as sometimes zonate, the lamellae narrow, subdistant, and greenish white, the odor strong and pleasing, but peculiar, and the taste at first mild, but becoming somewhat acrid. Fayod (1889) also called the species a *Lactarius*, but most other authors have considered it to be a synonym of *R. delica*.

Kühner & Romagnesi (1953) used the name *R. chloroides* for a species differing from *R. delica* in typically having the lamellae and stipe apex bluish green, the lamellae thin, narrow, and crowded, and the spores ornamented with long conic spines united in a \pm complete reticulum. Data on microscopic characters from two French collections determined by their collectors as *R. chloroides* follow:

Spores 8.4–10.6(–12.2) \times 7.4–8.5(–9.4) μ excluding ornamentation; usually broadly elliptic, occasionally broadly obovate or subglobose. Ornamentation 0.7–1.5 μ high; of cylindrical to conic, usually blunt-tipped, sometimes partially nonamyloid warts which are usually aligned or connected by fine lines; forming a broken to complete reticulum. Suprahilar disc with a diffuse, irregularly shaped, weakly amyloid patch or ornamented like the remainder of the spore only the ornamentation finer, or both.

Basidia 44–56 × 9.3–12.0 μ ; clavate, at times abruptly narrowed apically; 4-spored. Pleuropseudocystidia 47–80 × 6.0–10.6 μ ; usually clavate-fusiform, occasionally cylindrical to clavate; often bearing a small bulb or stub at the apex, otherwise rounded to subacute apically; straight or curved basally; with scattered, granular to linear, scarcely refractive, yellowish contents, or at times empty; arising in the subhymenium or outer trama; projecting 0–17 μ beyond the basidioles; abundant. Cheilopseudocystidia 33–63 × 6.0–8.6 μ ; like the pleuropseudocystidia; common to abundant, but the lamella edges homomorphous.

Subhymenium 20–27 μ thick; pseudoparenchymatous. Trama with occasional oleiferous hyphae.

Pileus cuticle usually 90–133 μ thick, but at times compacted to a thickness as small as 20 μ ; lacking a gelatinous matrix; of interwoven to generally ascending, nongelatinous, septate, branched, hyaline to yellowish brown hyphae 1.3–4.7 μ broad which in places give rise to scattered or clustered, ascendant to erect, undifferentiated hairs; also with rare oleiferous hyphae up to 6.7 μ broad or these apparently absent.

Collections examined: FRANCE: Environs de Paris, Oct. 1962, Heim (PC). Seine-et-Oise: Sub arboribus frondosis, Luzarches, 31 Aug. 1962, Romagnesi 62.115 (PC).

In this sense *R. chloroides* and *R. brevipes* are synonymous, but I think it legitimate to reject *R. chloroides* as a name used in different senses and hence a source of error.

Blum (1962) recognized *chloroides* as a variety of *R. delica*, but did not make a valid new combination.

See also the discussions under *R. brevipes* var. *brevipes* and *R. delica*.

RUSSULA DELICA var. BRESADOLAE Sing., Bull. Soc. Mycol. Fr. 54: 132. 1938.

This variety was described by Singer as the typical variety of *R. delica* in the sense of Bresadola, Quélet, and Singer, but the description fits Fries' description no better than most.

The name is probably synonymous with *R. brevipes* var. *brevipes*. Blum (1960) recognized *bresadolae* as a species, but did not make a valid new combination.

RUSSULA DELICA var. GLAUCOPHYLLA Quél., C. R. Ass. Franç. Av. Sci. 30, part 2: 495; pl. 3, fig. 7. 1902.

I have seen no authentic specimens and doubt that any exist. Quélet considered this to be the same as *Agaricus chloroides* Kromb. and de-

scribed it has having a bluish green hymenium and an acrid-peppery taste which is often pronounced. The resemblance to *R. brevipes* var. *acrior* is inescapable. Blum (1960) recognized *glaucophylla* as a species, but did not make a valid new combination.

RUSSULA DELICA var. GLUTINOSA Blum, Les Russules, p. 207. 1962.

The name is not validly published, and I have seen no specimens. The fungus itself is different, as described, from anything in the subsection *Lactarioideae*.

RUSSULA DELICIOSA Schroet. in Cohn, Krypt.-Fl. Schles. 3(1): 549. 1889.

Schroeter used *deliciosa* as a supposedly earlier (1727) specific epithet for *delica*, and his description matches Fries' description of *R. delica* more closely than any other. No authentic specimens have been available.

RUSSULA PSEUDO-DELICA var. FLAVISPORA Blum, Les Russules, p. 208. 1962.

The name is not validly published, but the fungus is different, as described. I have seen no specimens.

RUSSULA PSEUDO-DELICA var. PALLIDISPORA Blum, Les Russules, p. 208. 1962.

The name was published, although not validly, for *R. pseudo-delica* in the sense of Schaeffer. As such it is a synonym of the fungus designated *Russula* sp. in this paper.

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SUMMARY

Russula sect. *Compactae* subsect. *Lactarioideae* contains ten accepted species which may be distinguished on the basis of size of the pileus, taste and odor of the trama, spacing of the lamellae, and color, size, and ornamentation of the spores. Taxa described for the first time are *R. inopina*, *R. cascadenis*, *R. romagnesiana*, *R. brevipes* var. *acrior*, and *R. b.* var. *megaspora*.

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