

NORTH AMERICAN RUSSULAS OF THE SUBSECTION FOETENTINAE

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SUMMARY

Species of *Russula* sect. *Ingratae* subsect. *Foetentinae* (Agaricales) now reasonably well known from North America are *R. amoenolens*, *R. cerolens* sp. nov., *R. fragrantissima*, *R. granulata*, *R. laurocerasi*, *R. lilacipes*, *R. pectinatoides*, *R. pulverulenta*, *R. subfoetens*, and *R. ventricosipes*. They are separated primarily on height and pattern of spore ornamentation, spore size, pileus color and ornamentation, taste, odor, and the presence or absence of well-differentiated pseudocystidia in the pileus epicutis. The paper presents a key and descriptions for the ten species.

For several years I have been studying *Russula* sect. *Ingratae* subsect. *Foetentinae* (Agaricales), which includes *R. foetens* [Pers.] Fr. and its allies. Peck (1907), Burlingham (1915), and Kauffman (1918) have presented keys and descriptions for five or six species of the group, and Singer (e.g. 1958) has made modern studies of several of its members. Romagnesi's (1967) monumental treatment of European and North African *Russulas*, which recognizes 11 species in the *Foetentinae*, now makes possible a better evaluation of the North American species. I have found his work sound taxonomically. Although some of its nomenclatural conclusions may be disputed, which is not to say they are wrong, I have usually adopted them as a basis for my own work on North American *Russulas*.

One surprising conclusion that comes from the present study of the *Foetentinae* is that *Russula foetens*, a mushroom "everybody knows," is uncommon, if present, in North America. According to both Romagnesi and Schaeffer (1952), *R. foetens* has large basidiocarps with stout hollow stipes, very viscid pilei, and a strong disagreeable odor and taste. Its spores are large [Romagnesi: 7.5–8.5–10.25–(11.5) × 6.7–8.7 μ], subglobose, and ornamented with mostly isolated warts up to 1.5 μ high; they have few or no connectives and ridges and are not even partially reticulate. [FIG. 1 illustrates spores of a French collection (Bois du Tremblay, near Luzarches, Seine-et-Oise, 15 Jul., 1965, Shaffer 4174) determined as *R. foetens* by Romagnesi.] Basidiocarps

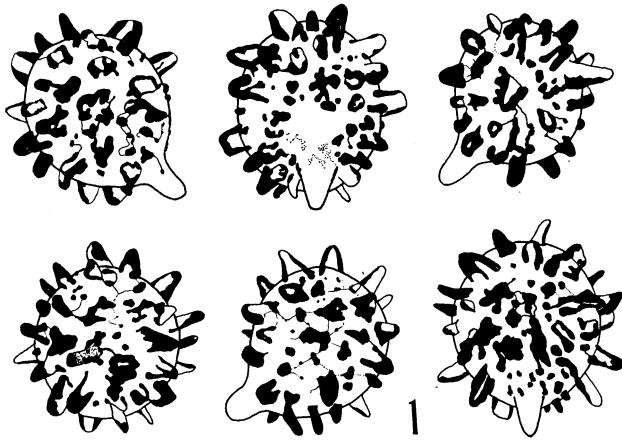


FIG. 1. *Russula foetens* (Shaffer 4174). Spores.

that fit this description best in southeastern Michigan and match some of Kauffman's herbarium material labeled *R. foetens* have a more fragrant, benzaldehyde- or maraschino cherry-like odor when young and spores like those of FIG. 38. Four New York collections identified by Peck as *R. foetens* have medium-sized basidiocarps with spores like those of FIG. 34—as do some of my own collections made on Burlingham's Newfane Hill in Vermont. Furthermore, I have yet to see North American specimens fitting *R. pectinata* Fr. in Romagnesi's sense. This species is commented on further in the discussions under *R. amoenolens* Romag. and *R. pectinatoides* Pk.

This paper undoubtedly does not cover all the North American species of the *Foetentinae* or all the variation in the included species. One has only to scan herbarium material to realize that many questions regarding the taxonomy of the group in North America remain unanswered here. Unfortunately most herbarium specimens lack detailed, precise notes on characters when fresh and are, therefore, unreliable for monographic studies. The paper does, I hope, set a solid foundation for further work on this continent. It may help also to dispel the notion that a member of the *Foetentinae* is *Russula foetens* if it has an unpleasant odor, *R. laurocerasi* Melzer if it has a fragrant one, and *R. pectinata* or *R. pectinatoides* if neither of the first two names seems right.

General color names in the following descriptions are those of the ISCC-NBS system (Kelly and Judd, 1955). Usually also the names of the closest matches from Ridgway (1912, capitalized color names)

or Maerz and Paul (1950, designations beginning "M&P") are given in parentheses. Masses of spores for color matching were prepared by Romagnesi's (1967) method, and I have usually recorded also the closest matches from his spore-color code.

Spore size and shape are given as seen in side view; the recorded size excludes ornamentation. Spore ornamentation is described and illustrated as it appears in Melzer's reagent; its height is given as the range within which the highest ornamentation unit on any one spore falls. Other microscopic structures were studied either from tangential sections of a pileus (with lamellae attached) cut from the approximate mid-point of a pileus radius or from radial sections cut from the uppermost centimeter of the stipe. Basidium length as given excludes sterigma length. Subhymenium thickness was measured approximately halfway between the top and edge of the lamellae.

Drawings were made with the aid of a camera lucida or drawing tube. As reproduced here, the drawings of spores are $\times 2,300$ natural size, of hymenial pseudocystidia $\times 570$, and of hyphae of the pileus cuticle and stipe surface $\times 850$. Stippling indicates the contents of hymenial pseudocystidia and vascular elements of the pileus and stipe.

All collections studied are deposited in the University of Michigan Herbarium (MICH) unless the appropriate *Index Herbariorum* symbol in parentheses following the collection citation indicates otherwise.

RUSSULA [Pers.] S. F. Gray sect. INGRATAE (Quél.) Maire, Bull. Soc. Mycol. France 26: 120. 1910.

Type species: *Russula foetens* [Pers.] Fr.

KEY TO SUBSECTIONS

1. Pileus cuticle pale orange yellow or pale yellow to white (but soon stained with brown, yellowish brown, olive brown, or brownish orange); trama and stipe surface becoming olive to grayish olive green in 10% FeSO₄; odor none, *Lycoperdon*-like, coconut-like, or fishy
 Subsect. *Crassotunicatinae* [see Shaffer (1970)]
1. Pileus more darkly colored (except in *R. lilacipes*); trama and stipe surface becoming pale gray to yellowish pink, moderate orange, or light reddish brown in 10% FeSO₄; odor none or, if present, not as above 2
2. Lamellae rounded in front; mature pilei with a continuous trichodermial epicutis; odor none or apple-like
 Subsect. *Felleinae* [see Shaffer (1970)]
2. Lamellae acute to subacute in front; mature pilei lacking a distinct trichoderm, the epicutal elements having become separated and often repent so that a trichodermial structure is evident at most in only small areas; odor spermatic, waxy, fetid, or benzaldehyde-like
 Subsect. *Foetentinae* [see below]

Subsect. FOETENTINAE (Melzer & Zvára) Sing. Beih. Bot. Zbl.,
Abt. 2, 49: 239. 1932.

Russula VII *Pectinatae* Burl. N. Amer. Fl. 9: 202, 213. 1915.

Russula Eurussulae C *Rutilantes* b *Ingratae* α *Mucrophyllae* 2
Foetentinae Melzer & Zvára, Arch. Přírodov. Výck. Čech.
17(4): 98. 1927.

Russula sect. *Constantes* subsect. *Foetentinae* (Melzer & Zvára)
Sing. Beih. Bot. Zbl., Abt. 2, 49: 239. 1932.

Russula II *Genuinae* b *Ingratae* sect. *Foetentinae* (Melzer & Zvára)
J. Schaeff. Bull. Soc. Mycol. France 51: 275. 1935.

Russula II *Genuinae* sect. *Ingratae* 1 *Foetentes* Konrad & Josserand,
Bull. Soc. Mycol. France 50: 265. 1935.

Russula sect. *Ingratae* subsect. *Obtectae* Sing. Sydowia 2: 40. 1948.

Type species: *Russula foetens* [Pers.] Fr.

Pileus tuberculate-striate marginally (except in *Russula lilacipes*); pileus cuticle brown, olive brown, reddish brown, yellowish brown, orange yellow, or yellow, these hues varying in shade and intensity; pileus trama hard- to soft-brittle, acrid or not, the taste sometimes with other components as well, with a spermatic, waxy, fetid, or benzaldehyde-like odor (except in *R. lilacipes*), becoming yellowish pink or grayish yellowish pink to moderate orange or light reddish brown in 10% FeSO₄; lamellae equal or unequal, but then the lamellulae not alternating with the lamellae, acute to subacute in front, usually slightly to strongly acrid (except in *R. lilacipes*), the taste sometimes also spermatic, waxy, oily, bitter, etc.; spores white (in *R. lilacipes* only) or pale orange yellow in mass; hymenopodium absent (except in *R. lilacipes*); pileus cuticle with or without conspicuous pseudocystidia which, if present, are SV+ or not, the trichodermial structure of the epicutis scarcely, if at all, evident in mature basidiocarps.

KEY TO SPECIES

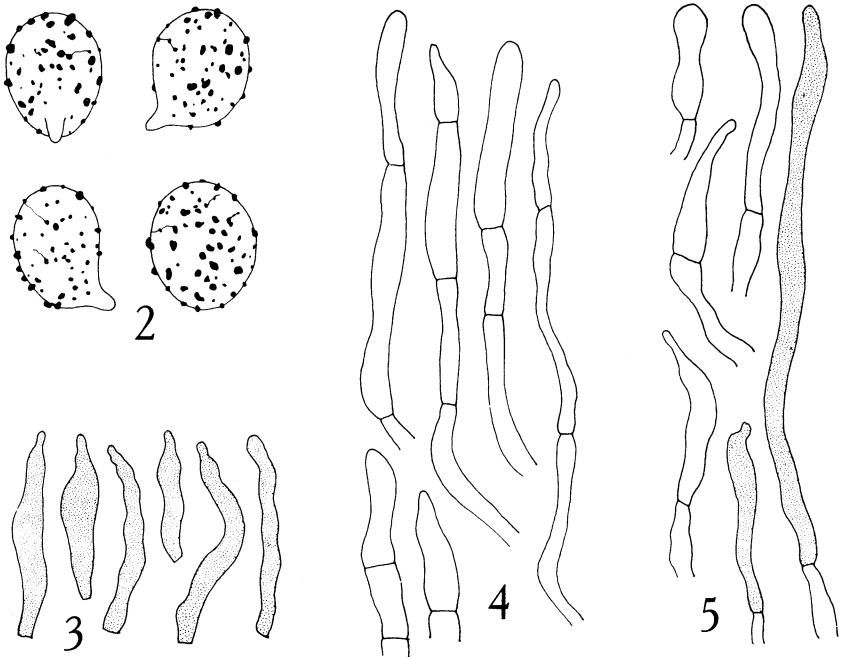
1. Spore ornamentation up to 0.1-0.3 μ high, the spores sometimes appearing almost smooth in optical section at $\times 900$ magnification 2
2. Pileus cuticle pale yellow or pale grayish yellow; stipe pale yellow spotted with moderate purple, moderate reddish purple, or deep purplish red, or pale yellow apically and purple to purplish red basally; pileus not striate; spores 5.7-7.6(-8.6) μ long (1) *R. lilacipes*
2. Pileus cuticle either dark grayish yellowish brown overall or partly colored also light to strong yellowish brown, light olive brown, light yellowish pink, or moderate yellow; stipe yellowish white at first, soon stained strong reddish orange to grayish reddish brown; pileus becoming tuberculate-striate up to 12 mm from the edge inward; spores 7.0-10.2(-13.6) μ long (2) *R. ventricosipes*

1. Spore ornamentation up to 0.3–2.6 μ high, the spores obviously ornamented in optical section at $\times 900$ magnification 3
3. Pileus cuticle scurfy or floccose, the pileus ornamentation sometimes inconspicuous and often gone from the margin in mature basidiocarps; lamellae not acrid or only slightly to moderately so 4
4. Pileus cuticle scurfy, the scurf reddish brown, brown, yellowish brown, or light yellowish pink to pale orange yellow and composed of hyphae with smooth, colorless to yellowish brown walls; stipe puberulent apically, the hairs with smooth, colorless or pale yellow walls (3) *R. granulata*
4. Pileus cuticle floccose, the floccules light orange yellow or moderate to pale yellow and composed of hyphae having warted, strong yellow walls; stipe fibrillose or scurfy apically or overall, the fibrils or scurf composed of hyphae whose walls are usually both warted and moderate to strong yellow (4) *R. pulverulenta*
3. Pileus cuticle neither scurfy nor floccose (but occasionally obscurely areolately cracked on the pileus margin); lamellae slightly to strongly acrid 5
5. Pileus epicutis lacking pseudocystidia filled with oily or granular contents, the apical epicutal cells sometimes cystidioid in shape, but containing scattered granules that at most are weakly SV+ 6
6. Pileus cuticle pale orange yellow, moderate yellow, or light yellowish brown overall or darker (dark to moderate yellowish brown, grayish brown, or dark to light grayish yellowish brown) centrally; lamellae slightly to moderately acrid; odor slightly to moderately spermatic, waxy, or fetid; spores M&P 9C3 or 9D2 to 10C2 (5) *R. pectinatoides*
6. Pileus dark yellowish brown or dark grayish yellowish brown to grayish yellowish brown centrally, light grayish yellowish brown, moderate yellowish brown, or dark grayish yellow to grayish yellow marginally; lamellae moderately to strongly acrid; odor strongly spermatic, waxy, or both; spores paler, M&P 9B2 or nearby 7
7. Spores with mostly isolated warts and sometimes a few connectives, the ornamentation only rarely forming a partial reticulum (6) *R. amoenolens*
7. Spores with warts, which are sometimes catenulate, short to long ridges, and connectives, the ornamentation occasionally forming a partial reticulum, rarely a complete one (7) *R. cerolens*
5. Pileus epicutis with well-differentiated pseudocystidia whose contents may be moderately to strongly SV+ 8
8. Spores (at least some of them) with long ridges which may be alternately amyloid and nonamyloid along their lengths and often form with the warts and connectives a partial or complete reticulum 9
9. Spores (6.8–)7.7–10.7 \times (6.8–)7.5–9.0 μ , with ornamentation up to 1.0–2.6 μ high; odor strongly fragrant (benzaldehyde-like) and often also with a slight fetid component; contents of pileus epicutal pseudocystidia strongly SV+ (8) *R. laurocerasi*
9. Spores 6.3–9.0 \times 5.7–7.7 μ , with ornamentation up to 0.3–1.0 (–1.4) μ high; odor of young basidiocarps fragrant (benzaldehyde-like)

- and sometimes also slightly fetid, becoming more strongly fetid as the basidiocarps age; contents of pileus epicutal pseudocystidia SV- or weakly SV+ (9) *R. fragrantissima*
8. Spores with warts, short ridges, and usually connectives, all of which occasionally form a partial reticulum, never a complete one 10
10. Pileus cuticle in dried basidiocarps strong brown to brownish orange centrally, strong yellowish brown to dark orange yellow marginally (10) *R. subfoetens*
10. Pileus cuticle in dried basidiocarps dark grayish reddish brown centrally, moderate to strong brown marginally [see discussion under (10) *R. subfoetens*]

1. *RUSSULA LILACIPES* Shear, *Mycologia* 31: 325 f. 1. 1939. FIGS. 2-5

PILEUS 7-15 cm broad; with the margin incurved when young, becoming broadly convex to nearly plane, then umbilicate or infundibuliform; not striate. CUTICLE viscid when wet (often with much soil adhering); glabrous; not separable; pale yellow or pale grayish yellow.



FIGS. 2-5. *Russula lilacipes*. 2. Spores. (Shear 4058). 3. Hymenial pseudocystidia (Shear, 7 Aug., 1938). 4. Hyphal ends from pileus cuticle (Shear 4058). 5. Hyphal ends from stipe surface (Shear, 7 Aug., 1938).

TRAMA firm and compact; with a mild, pleasant taste and slight odor; not or only slightly changing color when injured.

LAMELLAE broad; unequal, but the lamellulae few; arcuate in front; adnate; subdistant; sometimes forked; entire, the edges beaded with moisture in young basidiocarps; pale greenish yellow to pale yellow, sometimes becoming pale purple where injured or where the moisture beads dry, spotted and discolored in age.

STIPE stout; occasionally eccentric; equal; glabrous or pruinose; somewhat pitted or ridged; solid; hard; pale yellow spotted with moderate purple (Pleroma Violet), moderate reddish purple (Bishop's Purple), or deep purplish red (Auricula Purple), or pale yellow apically and purple to purplish red basally.

SPORES white in mass; $5.7-7.6(-8.6) \times 4.1-6.0(-7.3) \mu$; usually elliptic, obovate, or ovate, at times broadly so, rarely subglobose or suballantoid, sometimes flattened or concave in the suprahilar area. ORNAMENTATION of convex to conic warts up to $0.1-0.3 \mu$ high and a few connectives; rarely forming a partial reticulum, never a complete one. SUPRAHILAR AREA a plate or with sparse, minute warts.

BASIDIA $40-49 \times 7.2-8.6 \mu$; clavate; usually 4-, rarely 2-spored.

HYMENIAL PSEUDOCYSTIDIA $43-103 \times 4.3-8.6 \mu$; subcylindric, narrowly clavate, fusiform, or fusoid-ventricose; sometimes capitate, moniliform, appendiculate, or narrowed to a short, broad neck, otherwise rounded to acute apically; arising in the subhymenium, hymenopodium, or trama; sometimes embedded, usually projecting up to 40μ beyond the basidioles; common to abundant.

CHEILOLEPTOCYSTIDIA $19-40 \times 2.1-6.4 \mu$; filamentous, short-cylindric, clavate, ventricose, or fusiform; hyaline; common to abundant and usually extending up the lamellar faces for a short distance.

SUBHYMENIUM-HYMENOPIDIUM $45-130 \mu$ thick; pseudoparenchymatous or almost so just beneath the hymenium, elsewhere composed of loosely interwoven (though the basic orientation is horizontal), non-gelatinous or subgelatinous, hyaline connective hyphae $1.5-5.5 \mu$ broad; traversed by numerous, prominent granular vascular hyphae $3.6-6.4 \mu$ broad.

TRAMA with rare granular vascular hyphae, or these absent.

PILEUS CUTICLE $160-850 \mu$ thick; with a gelatinous matrix which may extend considerably above the cuticular hyphae; of nongelatinous or gelatinous connective hyphae $1.0-7.2 \mu$ broad whose apical cells are cylindrical, clavate, lanceolate, or fusoid-ventricose and may have yellowish, homogeneous contents; with the hyphae in the lower part of the cuticle yellowish and compactly interwoven, those in the upper part hyaline and usually loosely horizontally arranged, but in some places having ascendant to erect ends; lacking granular vascular hyphae, or these rare and inconspicuous.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline to yellowish brown connective hyphae 1.4–6.3 μ broad, those hyphae at the stipe surface giving rise to projecting, scattered or clustered, little differentiated hairs which may be rough-walled or incrustated with colorless granules, may have moderately thick walls (the walls up to 0.6 μ thick), and may have narrowly clavate, lanceolate, or fusiform apical cells; with rare granular vascular hyphae and rare to common pseudocystidia which are 36–116 \times 3.6–7.2 μ , filamentous, clavate, or fusiform, and capitate or rounded to acute apically.

Solitary, gregarious, or rarely almost cespitose on clay cellar bottoms, clay banks, and road cuts through woods.

Collections studied:

VIRGINIA: Arlington Co.: Radnor Heights, 19 Aug., 1922, *Dodge* (*Shear 4058*) (holotype of *R. lilacipes*, BPI); Arlington, 14 Sep., 1940, *Shear* (BPI); nine additional collections (all isotypes or paratypes of *R. lilacipes*, all BPI).

The description of macroscopic structures was modified from *Shear's* original description which is accompanied by a photograph of basidiocarps. He reported that the purple to purplish red color on the stipe mostly disappears as the basidiocarp dries; none was evident in any specimens I examined.

The ascendant to erect hyphal ends at the pileus surface are not dense or differentiated enough to form a distinct epicutis. In the dried material studied, the vascular elements (hyphae and pseudocystidia) did not react with sulfovanillin.

The contrast in color between the hymenopodium (hyaline to pale yellow) and the lamellar trama (dark grayish yellow) is marked. In no sense do the hymenopodial hyphae run parallel with those of the lamellar trama as *Singer* (1958) reported.

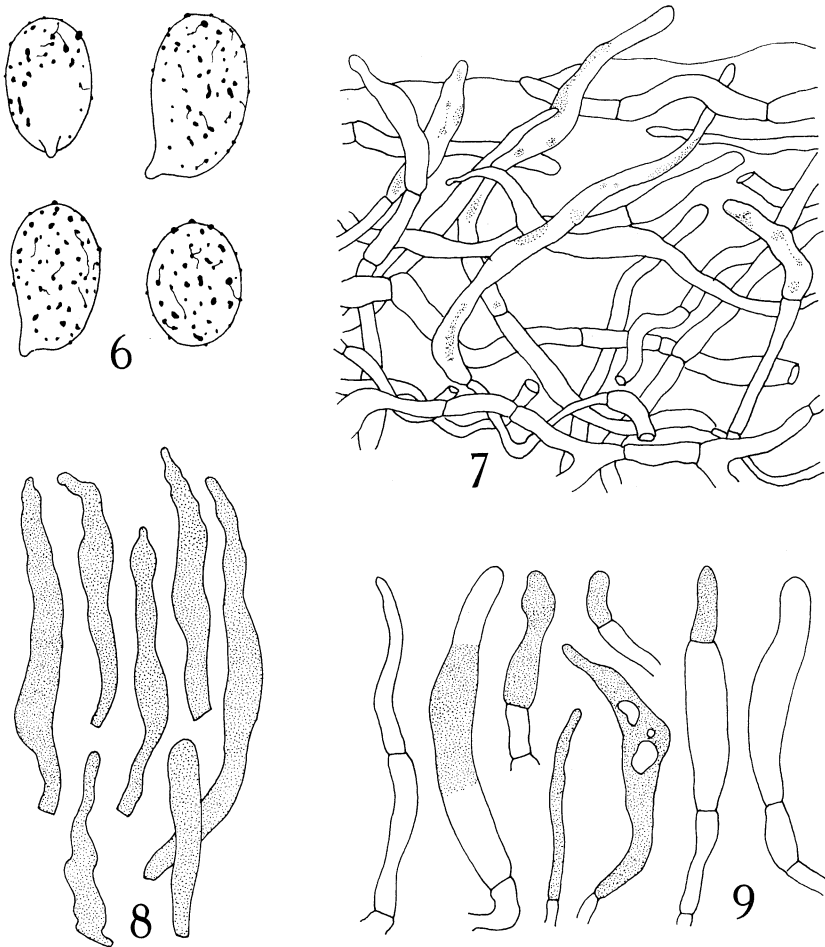
Singer (1958) thought *Russula lilacipes* to have some of the characters of the *R. delica* group (= sect. *Compactae* subsect. *Lactarioideae*), but placed it in the *Ingratae*, "probably relatively closest to *R. ventricosipes*," a relationship suggested earlier by *Beardslee* (*Shear, 1939*). Similarity in spore ornamentation supports this supposed relationship between *R. ventricosipes* and *R. lilacipes*; however, the latter is enough of a misfit in the *Foetentinae* that I would expect a modern study of fresh specimens to result in a major revision of some of the species' characteristics, or a change in its position in the infrageneric classification of *Russula*, or both.

2. *RUSSULA VENTRICOSIPES* Pk. Bull. Torrey Bot. Club 29: 70. 1902.
FIGS. 6-9

PILEUS 4.5-13 cm broad; when young deeply pulvinate and umbilicate, later convex to plane with an umbilicate-depressed disc, eventually concave or subinfundibuliform; becoming tuberculate-striate (sometimes obscurely so) up to 12 mm from the edge inward. CUTICLE thin; tough and rubbery; viscid and shiny when moist (often with much sand adhering); when young covered by an inconspicuous, thin, pale brownish pink, moderate reddish brown to dark reddish orange, or moderate brown to moderate yellowish brown, felt-like layer which, as the pileus expands, is obliterated or leaves only sparse remnants; finely radially streaked outward from the disc; sometimes areolately cracked on the margin; separable up to $\frac{3}{4}$ the pileus radius; tasteless; when young light to moderate yellowish brown and sometimes with a yellowish white to pale yellow disc, when mature sometimes dark grayish yellowish brown (Bister) overall, but usually variously colored also with light, moderate, or strong yellowish brown (Pinkish Cinnamon, Tawny-Olive, Clay Color), light olive brown (Light Brownish Olive), light yellowish pink (Pinkish Buff), or pale to moderate yellow (Light Buff to Chamois), often blotched with strong to deep reddish orange when young, especially on the margin, but these colors often fading and disappearing by maturity. TRAMA thick (up to 15 mm thick in the disc); firm-brittle; with the taste like *Agaricus bisporus* or slowly becoming oily-acrid; with a nondescript to fetid odor; yellowish white, becoming pale yellow to light yellowish brown when cut or in age.

LAMELLAE narrow to broad (up to 15 mm broad); brittle; equal, or unequal with the lamellulae few and mostly approaching the stipe closely; acute in front; adnate, adnexed, or sinuate, sometimes seceding; close; often forked at or near the stipe; intervenose or not; entire, the edges sometimes beaded with moisture in young basidiocarps; slowly becoming strongly acrid or oily-acrid and sometimes leaving a spermatic aftertaste; yellowish white to pale yellow at first, later light yellow to pale orange yellow, often with moderate red to strong reddish orange or moderate brown areas on the edges, soon stained dark yellow to moderate yellowish brown.

STIPE 2-10 cm long, 1.5-5 cm thick; ventricose to fusiform or tapered to the base which may be pinched; dry; dull; (perhaps originally covered by a felt-like layer like that of the pileus, then becoming) minutely scurfy, the scurf moderate reddish brown to dark reddish orange or moderate brown to moderate yellowish brown, sparse or nearly absent on the upper two-thirds or so of the stipe, dense near the base; longitudinally rugulose; hard and solid at first, later stuffed and at times cavernous; yellowish white, often stained strong reddish orange (Coral Red) to grayish reddish brown (Burnt Umber), becoming pale yellow to light yellowish brown in the cortex when cut.



FIGS. 6-9. *Russula ventricosipes* (Smith 38422). 6. Spores. 7. Pileus cuticle (upper third). 8. Hymenial pseudocystidia. 9. Hyphal ends from stipe surface.

COLOR REACTIONS (pileus cuticle): 10% KOH no change; (pileus trama): 10% FeSO_4 moderate yellowish pink; 2% phenol dark grayish red; formalin colorless; (stipe surface): SV dark reddish purple; 2% phenol dark grayish red; formalin colorless.

SPORES pale orange yellow (M&P 9D2 to 9E3, Romagnesi IIc-d) in mass; $7.0-10.2 (-13.6) \times 4.5-5.7 (-7.9) \mu$; usually elliptic, oblong, or obovate, occasionally ovate, pip-shaped, or reniform. ORNAMENTATION of warts and short ridges, both up to $0.1(-0.3) \mu$ high [the spores usually appear almost smooth in optical section at $\times 900$ magnification], and a few connectives which may be attached to only one wart; never

forming even a partial reticulum. SUPRAHILAR AREA a plage or with ornamentation in the same pattern as on the rest of the spore wall, but lower.

BASIDIA 36–62 × 5.7–9.6 μ ; elongate-clavate; 4-spored.

HYMENIAL PSEUDOCYSTIDIA 49–114 × 3.4–9.0 μ ; filamentous, fusiform, clavate, or lanceolate; often capitate, short-appendiculate, or moniliform apically, sometimes simply acute or broadly rounded; glassy or granular; SV+; arising in the subhymenium or outer part of the trama; embedded or projecting up to 28 μ beyond the basidioles; abundant.

SUBHYMENIUM 34–51 μ thick; pseudoparenchymatous.

TRAMA with common, SV+, glassy vascular hyphae.

PILEUS SUBCUTIS 215–500 μ thick; embedded in a gelatinous matrix; of horizontal-interwoven connective hyphae 1.0–5.0 μ broad which gelatinize progressively from the top to the bottom of the subcutis as the pileus ages; also with common, SV+ granular vascular hyphae 1.7–5.7 μ broad.

PILEUS EPICUTIS forming the macroscopic felt-like layer of the pileus; 50–70 μ thick; a trichoderm of connective hyphal ends 2.3–4.5 μ broad; also with common cystidia which are 40–64 × 3.4–5.8 μ , narrowly subcylindric, lanceolate, clavate, or fusiform, and sometimes capitate or short-appendiculate and may contain scattered, SV– or weakly SV+, refractive granules; with the elements becoming spread apart, sometimes in clumps, and frequently tangled or repent so that a mature pileus lacks a conspicuous epicutis.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline to yellowish brown (from a diffuse pigment) connective hyphae 1.0–5.7 μ broad whose ends may project from the surface as single or clustered, filamentous or tapered hairs and whose apical cells may be filamentous to clavate, fusiform, or fusoid-ventricose, SV+ pseudocystidia; also with embedded, longitudinal, SV+ vascular hyphae 1.0–5.7 μ broad.

Solitary or gregarious in sandy soil, e.g., of forested dunes, frequently under or near pines. Often the basidiocarps scarcely emerge from the sand; only the central part of the pileus is then exposed.

Collections studied:

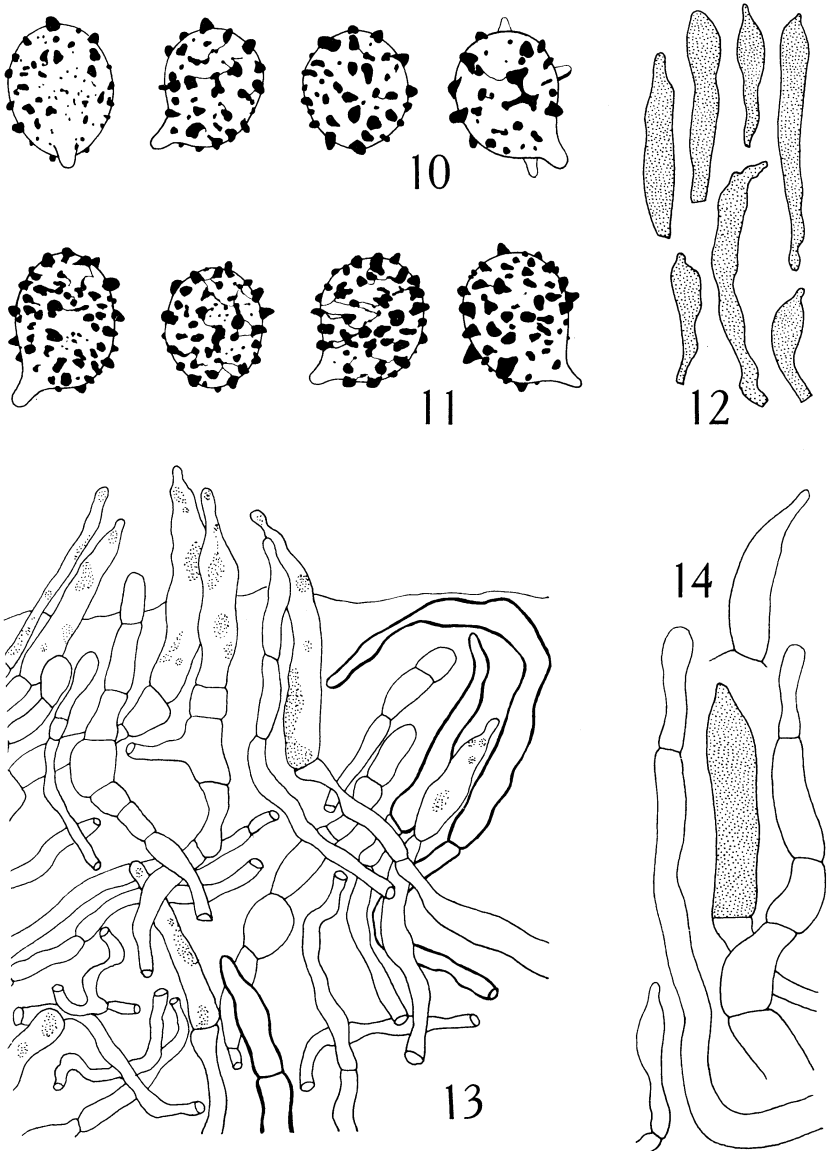
MICHIGAN: Marquette Co.: Howe Lake, Huron Mountain Club, 21 Aug., 1968, *Ammirati 2376*. Chippewa Co.: Whitefish Point, 7 Sep., 1951, *Smith 38422* and 16 Sep., 1957, *Shaffer 1951*; two additional collections. NEW YORK: Suffolk Co.: Napeague, 21 Oct., 1971, *Rogerson et al.* MASSACHUSETTS: Barnstable Co.: South Yarmouth, Oct., *Davis* (holotype of *R. ventricosipes*, NYS; isotype, MICH).

Singer (1942) reported that the reddish orange color of the lamellar edges and stipe results from a pigment incrusting the cheilocystidia and fasciculate hyphal ends of the stipe surface, respectively. I have been unable to find such a pigment, but have looked for it only on dried basidiocarps.

Smith (1953) has published a photograph of basidiocarps of *Russula ventricosipes*.

3. *RUSSULA GRANULATA* (Pk.) Pk. 53rd Rep. N. Y. St. Mus. 1: 843.
pl. C, f. 1-5. 1901. FIGS. 10-14
Russula foetens var. *granulata* Pk. 39th Rep. N. Y. St. Mus. 57.
 1886.
Russula obtecta Sing. Bull. Soc. Mycol. France 55: 233. 1940.

PILEUS 4-7(-10.5) cm broad; subglobose at first, then deeply pulvinate with the margin curved in to the stipe and the disc flattened or slightly depressed, expanding to convex or plano-convex with a depressed center, eventually irregularly concave or subinfundibuliform; prominently tuberculate-striate 6-14(-20) mm from the edge inward. CUTICLE at first slightly gelatinous-thickened (up to 0.5 mm thick) near the pileus edge, becoming thin throughout; slightly elastic; viscid and shiny when wet, less so when dry; radially streaked outward from the disc; scurfy, the small crustlike patches usually more concentrated on the central part of the pileus, sometimes disappearing completely on the margin, occasionally dark reddish brown at first on the central part, otherwise concolorous with or lighter than (e.g., light yellowish pink to pale orange yellow) the part of the surface on which they lie; easily separable $\frac{1}{3}$ - $\frac{2}{3}$ the pileus radius; with a spermatic- or raphanoid-acrid taste; when young moderate brown (Russet, Verona Brown), grayish brown (Warm Sepia), dark grayish yellowish brown (Bister), moderate yellowish brown (Sayal Brown, Snuff Brown, Tawny-Olive), dark yellowish brown (Saccardo's Umber), or strong to deep yellowish brown (Clay Color) centrally and strong yellowish brown, light yellowish brown, or dark yellow (M&P 12J-L5-7) to moderate yellow (Chamois, Honey Yellow) or rarely even light yellow (Cream-Buff) marginally, when mature retaining these colors or becoming lighter centrally, sometimes blotched with dark grayish red (Warm Blackish Brown), when moribund dark grayish brown. TRAMA 2-3 mm thick at mid-radius; hard- to firm-brittle; with a slight, spermatic or acrid taste which soon fades; with the odor slightly fetid and also having a cocoa-like component; tinged the cuticular color just beneath the cuticle, otherwise yellowish white to pale yellow, becoming grayish in age, moderate yellowish brown around the larval channels.



FIGS. 10-14. *Russula granulata*. 10. Spores (Shaffer 5547). 11. Spores (Shaffer 1676a). 12. Hymenial pseudocystidia (Shaffer 5547). 13. Pileus epicutis and upper part of subcutis (Shaffer 2270). 14. Hyphal ends from stipe surface (Shaffer 5547).

LAMELLAE 4-5(-9) mm broad, fragile-brittle; equal, or unequal with the lamellulae rare to occasional and of various lengths; acute to subacute in front; adnexed, adnate, or subdecurrent; close to subdistant; often forked at or near the stipe and occasionally outward; intervenose; entire; when young with a moderately oily-acrid taste which may soon fade, the taste sometimes nondescript in mature basidiocarps; yellowish white when young, becoming pale yellow or pale orange yellow, sometimes tinged gray, at times spotted-stained grayish yellow or moderate to dark yellowish brown, when moribund dark grayish brown.

STIPE 3-6(-8.5) cm long, 10-18(-26) mm thick; equal, subfusiform, or tapered or enlarging to the base; dry; dull; longitudinally rugulose; puberulent apically, elsewhere glabrous; stuffed at first, soon cavernous or hollow with a rough inner surface; yellowish white to pale orange yellow, sometimes with moderate reddish brown basal areas, becoming stained, especially basally, dark grayish yellow, light grayish brown, moderate to dark yellowish brown, or light to dark brown.

COLOR REACTIONS (pileus trama): SV bluish gray to light purplish gray; 10% FeSO_4 grayish yellowish pink to light reddish brown; 2% phenol grayish brown to grayish reddish brown; formalin colorless or pale pink; guaiac quickly moderate green to dark grayish green; (stipe cortex): 30% KOH pale yellow; (all brown parts of basidiocarp, e.g., pileus cuticle, stained areas of the pileus trama, lamellae, and stipe): 30% KOH dark reddish orange (Dragon's-blood Red), moderate red (Pompeian Red), or grayish red (Madder Brown); 30% NH_4OH moderate reddish orange (Ferruginous) to strong brown (Hazel, Kaiser Brown).

SPORES pale orange yellow (M&P 9B-C2, slightly lighter than Romagnesi IIc) in mass; $5.7-8.0 \times 4.4-6.3 \mu$; usually broadly elliptic or broadly obovate, rarely subglobose, or in some basidiocarps occasionally pip-shaped to subreniform. ORNAMENTATION of cylindric to bluntly conic warts up to $0.3-1.0 \mu$ high, on some spores the warts all isolated or at most partly clustered or aligned, on others with a variable number of connectives which may be attached to only one wart; occasionally forming a partial reticulum in some basidiocarps, but never a complete one. SUPRAHILAR AREA usually with a few tiny warts (i.e., almost a plage), but at times with a low, diffuse patch.

BASIDIA $32-57 \times 5.0-11.3 \mu$; clavate to clavate-fusiform; 4-spored.

HYMENIAL PSEUDOCYSTIDIA $32-85 \times 5.0-12.4 \mu$; subcylindric, clavate, or fusiform; broadly rounded, subacute, capitate, short-appendiculate, or submoniliform apically; SV+; arising in the subhymenium or at the outer edge of the trama; projecting up to 20μ beyond the basidiales, or on the lamellar edges and at the tops and between the lamellae projecting up to 40μ ; abundant.

SUBHYMENIUM $24-34 \mu$ thick; pseudoparenchymatous.

TRAMA with occasional, SV+, yellowish brown, usually glassy vascular hyphae.

PILEUS SUBCUTIS 170–400 μ thick; embedded in a gelatinous matrix; of horizontal- to ascending-interwoven, nongelatinous connective hyphae mostly 1.0–3.4 μ broad, most of these hyphae hyaline or yellowish brown from a diffuse pigment, but some with a yellowish brown wall or incrusting pigment and then either no different except for pigmentation from the other hyphae or, more usually, broader (up to 8.0 μ broad), tortuous, and slightly thicker walled; also with SV+, sometimes capitate or acute, granular vascular elements 1.7–7.8 μ broad which may be little-differentiated endopseudocystidia or elongate filaments, and which are often restricted to or more common in the lower part of the subcutis, but may occur also in the upper part and even extend into the epicutis.

PILEUS EPICUTIS discontinuous (except perhaps in very young basidiocarps); 40–110 μ thick; of nongelatinous, hyaline or yellowish brown (from a wall or incrusting pigment) connective hyphal ends 2.3–5.7 μ broad whose cells are often short (7–17 μ long), but whose apical cells may be cystidia which are up to 45 μ long, fusiform or lanceolate, often capitellate or short-appendiculate, and sometimes with SV– to weakly SV+, refractive contents; with the hyphal ends decumbent to erect, embedded in or projecting through the gelatinous matrix, and scattered or aggregated in trichodermial patches which are the macroscopically visible scurf of the pileus.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline or pale yellow connective hyphae 2.3–7.5 μ broad some of whose ends project as hairs, or have a cystidioid apical cell, or both; also with numerous, yellowish, SV+, glassy vascular elements 3.4–6.8 μ broad which vary from projecting, clavate to fusiform or cylindric pseudocystidia to appressed or embedded, filamentous apical cells of hyphae otherwise connective in nature.

Solitary to gregarious on humus in deciduous and deciduous-coniferous forests.

Collections studied:

QUEBEC: Portneuf Co.: Duchesnay, 26 Jul., 1967, *Shaffer 5547*; two additional collections.

MICHIGAN: Luce Co.: Pike Lake, 7 Aug., 1959, *Shaffer 2270*; Betsy Lake area, 23 Jul., 1959, *Shaffer 2185*; Tahquamenon Falls State Park (upper falls area), 12 Sep., 1969, *Shaffer 6147*; six additional collections. Chippewa Co.: Emerson, 13 Aug., 1959, *Shaffer 2329*. Mackinac Co.: Cut River Park, near Epoufette, 24 Jul., 1957, *Shaffer 1676a*; Castle Rock, north of St. Ignace, 7 Aug., 1953, *Smith 42424*;

two additional collections. Emmet Co.: West branch of the Maple River, 22 Jul., 1957, *Shaffer 1642*, and 14 Sep., 1953, *Smith 42674*; Bay View, 31 Jul., 1905, *Kauffman*; one additional collection. Cheboygan Co.: Maple River, 6 Aug., 1952, *Smith 39402*. TENNESSEE: Sevier Co.: Grassy Patch, Great Smoky Mountains Natl. Park, 6 Aug., 1938, *Smith 9830*; Mt. LeConte (5,000 ft elevation), Great Smoky Mountains Natl. Park, 23 Aug., 1938, *Smith 10477*. NEW YORK: Lewis Co.: Constableville, 21 Sep., 1911, *Peck* (NYS). Essex Co.: Forge, North Elba, Aug., *Peck* (NYS). Ulster Co.: Denning, Aug., *Peck* (holotype of *Russula granulata*, NYS). One additional collection.

The subcutal hyphal cells with yellowish brown wall or incrusting pigment should not be confused with vascular hyphae, they do not react with SV. In water and 2% KOH the vascular hyphae are colorless to light grayish yellow.

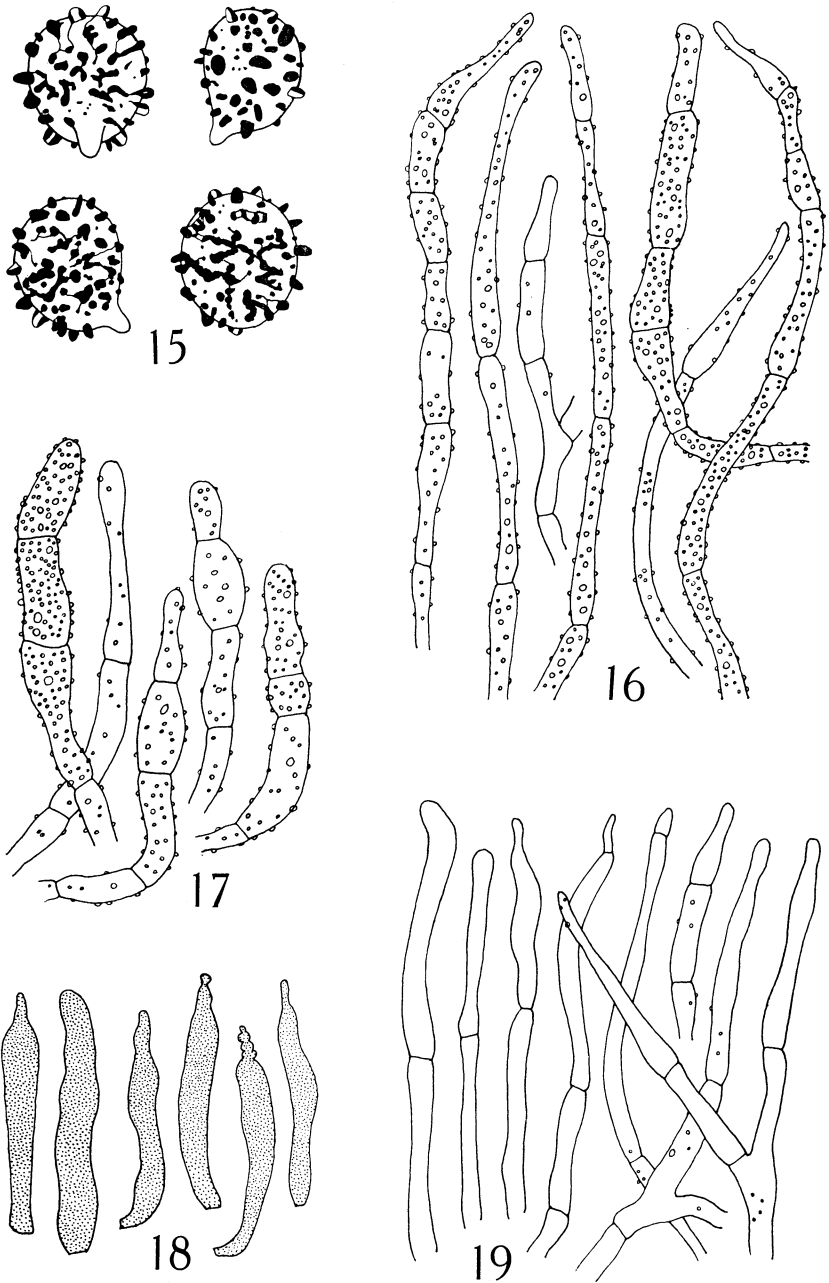
Singer (e.g., 1962) considered the pileus scurf to be velar in origin. I believe it is the epicutis whose growth fails to keep pace with other pileus regions. The hyphal ends composing the scurf arise from a subcutal region in a manner typical for the origin of epicutal elements in *Russula*. Other things, mainly size, being equal, the most conspicuous patches of scurf are those whose hyphal ends protrude through the gelatinous matrix. As a basidiocarp matures, the patches become less conspicuous, evidently because of the further separation of the epicutal elements resulting from expansion of the lower pileus regions and because of the matting down of the elements and their engulfment by the gelatinous matrix.

The relatively short, broad cells of the pileus epicutal hyphae seem distinctive. The frequency of epicutal cystidia varies considerably; they are rare to abundant, depending on the basidiocarp or on the part of the pileus sectioned.

There is no type material of *Russula obtecta* (Indian Gap, Great Smoky Mountains Natl. Park, Swain Co., N. C., 5 Aug., 1938, *Smith 9762*) at MICH as indicated by Singer (1958), and I have not seen that supposedly at LE. However, judging from the original description, I agree with Singer's (1943) conclusion that the name is a synonym of *R. granulata* Pk. According to their accompanying notes, *Smith 9830* and *10477* (see Collections studied) are the same as *9762*.

4. *RUSSULA PULVERULENTA* Pk. Bull. Torrey Bot. Club 29: 70. 1902.
FIGS. 15-19

PILEUS 3.5-8 cm broad; subglobose when young, then deeply pulvinate with an incurved margin, later pulvinate to convex to plano-



FIGS. 15-19. *Russula pulverulenta* (Shaffer 6120). 15. Spores. 16. Hyphal ends from pileus floccules. 17. Hyphal ends from stipe surface. 18. Hymenial pseudocystidia. 19. Hyphal ends from pileus cuticle.

convex with a depressed disc, in age irregularly concave or subinfundibuliform; prominently tuberculate-striate 3–12 mm from the edge inward. CUTICLE thin throughout even in young basidiocarps; somewhat elastic; dry or slightly viscid; dull or shiny; covered at first by a light orange yellow or moderate to pale yellow flocculent layer which later breaks into small, separate floccules except perhaps on the pileus center, the floccules sometimes inconspicuous in mature basidiocarps or even disappearing from the pileus margin; finely radially streaked outward from the disc; sometimes cracking areolately in age or dry weather; easily separable $\frac{2}{3}$ – $\frac{3}{4}$ the pileus radius; with a slight, fleetingly acrid or nondescript taste; when young dark grayish yellowish brown, grayish yellowish brown, or moderate yellowish brown overall, retaining these colors when mature or becoming lighter (pale grayish yellowish brown, pale yellowish brown, grayish yellow) marginally. TRAMA 1.5–3.5 mm thick at mid-radius; brittle; with a slight, waxy taste and odor; sometimes tinged the cuticular color in the disc, otherwise yellowish white, light to dark olive brown around the larval channels, unchanging when cut.

LAMELLAE 4–7 mm broad; elastic at first, brittle in age; equal, or unequal with the lamellulae approaching the stipe closely; subacute in front; adnate; close or subdistant; occasionally forked at or near the stipe; intervenose; entire; tasteless or with a slight nondescript or fleetingly acrid taste; nearly white when young, then yellowish white, sometimes stained dark orange yellow to moderate brown on the edges.

STIPE 3–5.5 cm long, 8–20 mm thick; flared slightly at the apex or not, otherwise equal or enlarging to the base; dry; subshiny; minutely fibrillose or scurfy apically or, more commonly, overall, the fibrils or scurf yellowish white to light yellow or light orange yellow in fresh basidiocarps, but brownish orange to deep brown when dried; stuffed at first, the pith becoming mealy-granular and the stipe eventually cavernous or hollow with a rough inner surface; yellowish white apically, yellowish white to light yellow basally, often discolored grayish yellow to yellowish brown in age.

COLOR REACTIONS (pileus trama and stipe cortex): SV light purplish gray; 10% FeSO_4 grayish pink; 2% phenol grayish reddish brown; formalin colorless; guaiac quickly dark yellowish green; (pileus cuticle): 30% KOH and 30% NH_4OH colorless; (pileus and stipe fibrils, floccules, and scurf): 30% KOH and 30% NH_4OH deep reddish orange to strong reddish brown.

SPORES pale orange yellow (M&P 9B2, Romagnesi IIc) in mass; 6.1 – 8.1 (– 9.6) \times 5.1 – 6.8 (– 7.3) μ ; usually broadly elliptic to broadly obovate, occasionally subglobose or pip-shaped. ORNAMENTATION of convex, cylindrical, or conic warts and short to long ridges which may be alternately amyloid and nonamyloid along their lengths, the warts and ridges up to 0.4 – 1.2 μ high; sometimes also with a few connectives; only rarely forming a partial reticulum, never a complete one.

SUPRAHILAR AREA usually a plage or with minute warts and connectives, rarely with a low, amyloid patch.

BASIDIA 28–51 × 6.8–11.3 μ; clavate; 4-spored.

HYMENIAL PSEUDOCYSTIDIA 45–99 × 6.8–11.3 μ; subcylindric, clavate, fusoid-clavate, or fusiform; sometimes broadly rounded apically, but more often acute, capitate to appendiculate, or abruptly narrowed to a short, conic neck; SV+; arising in the inner part of the subhymenium or in the trama; projecting up to 34 μ beyond the basidioles; abundant.

SUBHYMENIUM 22–40 μ thick; pseudoparenchymatous or subprosenchymatous.

TRAMA with rare, SV–, granular vascular hyphae.

PILEUS CUTICLE 280–500 μ thick; embedded in a gelatinous matrix; of horizontal- to ascending-interwoven, nongelatinous connective hyphae 2.3–6.8 μ broad some of which have grayish yellow to yellowish brown granules in the cytoplasm; with the hyphal ends near the cuticular surface (not those of the flocculent layer!) having colorless, occasionally sparsely warty walls, undifferentiated or at most with a tapered or subfusiform apical cell, and in some places oriented in an obscure, loose trichoderm; lacking vascular elements or with rare, intercalary, glassy vascular cells. FLOCCULENT LAYER of nongelatinous, branched or unbranched hyphae 2.0–5.7 μ broad whose walls are mostly both strong yellow and warty, sometimes densely so, these hyphae arising from the regular cuticular hyphae; lacking vascular elements.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline connective hyphae 1.7–4.5 μ broad whose scattered or clustered, projecting ends are 2.8–9.0 μ broad and unbranched and have walls that are usually both yellow and warty, the cells of these hyphal ends generally broader and more inflated than the cells of the similar hyphal ends on the pileus; also with rare, SV–, granular vascular hyphae.

Solitary to gregarious on soil in lawns and forests under both deciduous and coniferous trees.

Collections studied:

MINNESOTA: Rice Co.: Near Nerstrand Woods State Park, 26 Aug., 1962, *Weaver 8-26-62-N-9*; two additional collections. MICHIGAN. 30 Jul., 1900 (MSC 111009). Alger Co.: Rock River, 22 Sep., 1929, *Smith*. Berrien Co.: Warren Woods, 1 Oct., 1955, *Shaffer 636*. Oakland Co.: Kent Lake, 23 Aug., 1937, *Smith 7299*; Labadie Lake, 17 Sep., 1940, *Smith*. Washtenaw Co.: Chelsea, 20 Jul., 1942, *Smith 18485*; Sharon Hollow, 4 Aug., 1970, *Shaffer 6333*; Silver Lake area, Pinckney Recreation Area, 29 Jul., 1969, *Shaffer 6120*; Ann Arbor, 4 Aug., 1969, *Shaffer 6139*; five additional collections. TENNESSEE. Knox Co.: Knoxville, 13 Jul., 1943, *Hesler 15798*. NORTH CAROLINA. Buncombe Co.: Asheville, *Beardslee*.

This species is easily separable from the other North American species of the *Foetentinae* by the macroscopic and microscopic features of the floccules, fibrils and scurf of the basidiocarp surface. Singer (1945) said the flocculent layer of the pileus, which he called a veil, consists of “. . . smooth hyphae . . .with . . . hyaline to ochraceous (in NH_4OH) cell-sap. . .” These hyphae are actually warty, and their pigment is in the wall. However, strong bases dissolve the wall ornamentation and make the hyphae appear diffusely pigmented. It is these yellow-walled hyphae, on both the pileus and the stipe, that give the pronounced color macroreaction with bases.

I do not consider the flocculent layer a veil, for it evidently does not cover the hymenial surface of the basidiocarp at any stage of development. Rather, on the pileus, it seems to originate from or be an elaboration of the epicutis. The hyphal ends projecting from the stipe surface have differentiated so as to be similar to the pileus epicutal elements, a common condition in *Russulas*, even those having nothing remotely resembling a veil.

Peck's original description of *Russula pulverulenta* describes the pileus as “even on the margin.” However, the one basidiocarp of the collection MSC 111009, which is probably an isotype of *R. pulverulenta*, has a striate pileus margin. Evidently NYS no longer has any type material.

Russula pulverulenta is similar to a European species called by Romagnesi (1967) *Russula livescens* (Batsch) Quélet ss. Bres., which also has a flocculent layer on the pileus. (Since this distinctive feature is neither described nor illustrated by any of the three authors associated with the name *R. livescens*, the use of the name for the European fungus seems questionable.) To judge from Romagnesi's description and my own collections identified in the field by him (*Shaffer* 4246, 4442, 4534, and 4623, all from France), *R. livescens* differs from *R. pulverulenta* in the following ways:

(1) Its pileus cuticle is generally darker—brownish black to dark yellowish brown to dark grayish yellowish brown centrally and moderate to light yellowish brown marginally.

(2) The superficial pileus layer, which varies from light yellowish brown to light grayish yellow to dark orange yellow, is absent from mature basidiocarps except for a few floccules on the pileus margin. In *R. pulverulenta* the layer of floccules seems to be more tenacious, especially on the pileus center.

(3) Its stipe base has some projecting hyphal ends with strong yellow, warty walls, but the hyphae of the pruinae or scurf on the upper part of the stipe lack this feature. Macroscopically, the stipe of

R. livescens thus lacks the conspicuous, colored scurf present in *R. pulverulenta*. The difference is especially noticeable in dried specimens, for then the stipe ornamentation in *R. pulverulenta* is much darker than the stipe ground color.

(4) Its spores have more connectives and so are more commonly partially reticulate.

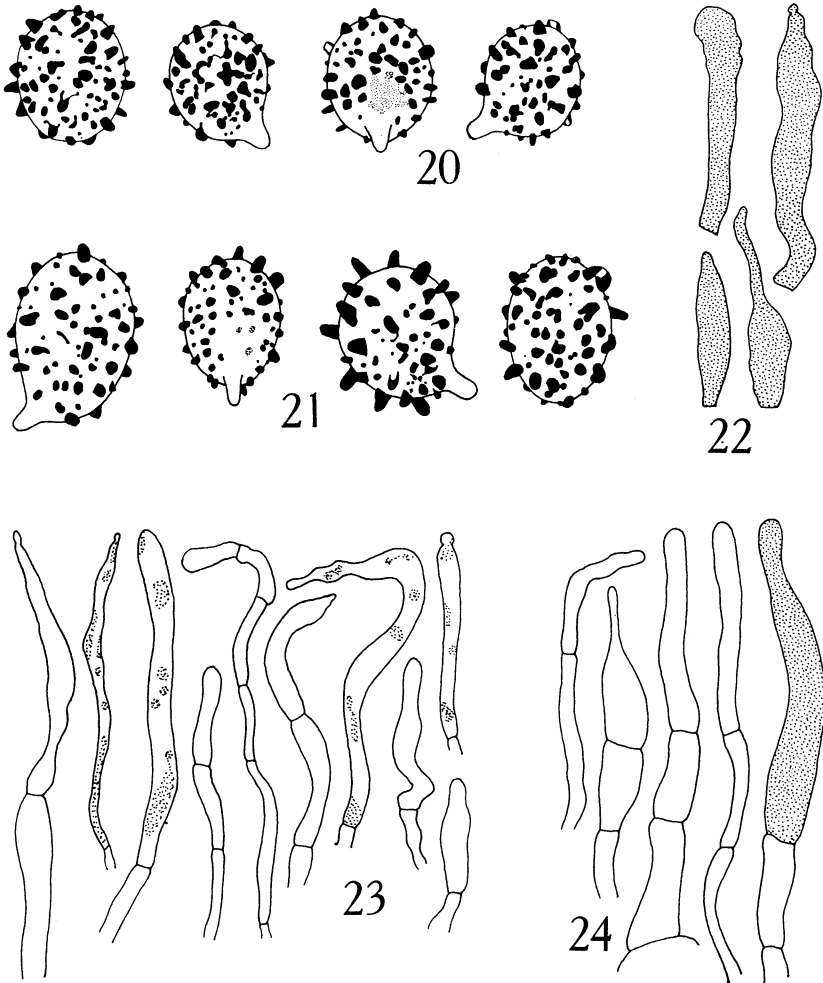
(5) The small, fusiform to subulate, often capitellate pseudocystidia present in the pileus cuticle of *R. livescens* have not yet been found in *R. pulverulenta*.

5. RUSSULA PECTINATOIDES Pk. N. Y. St. Mus. Bull. 116: 43. *pl.* 105, f. 6-10. 1907. FIGS. 20-24

Russula consobrina var. *pectinatoides* (Pk.) Sing. Hedwigia 66: 205. 1926.

Russula pectinata subsp. *pectinatoides* (Pk.) Bohus & Babos, Ann. Hist.-Nat. Mus. Hung. 52: 140. 1960. [Citation from Index of Fungi 3: 93. 1962, which indicates that the name is not validly published since no basonym was given.]

PILEUS 2.5-8 cm broad; flattened-globose when young, expanding through pulvinate to convex to plane, all the while umbilicate to depressed centrally, in age infundibuliform or almost so; at times split marginally; finely, but prominently tuberculate-striate 4-17 mm from the edge inward. CUTICLE slightly gelatinous-thickened (less than 1 mm thick) marginally in young basidiocarps, soon thin throughout; elastic; viscid and shiny in rainy weather, but usually scarcely so when found; glabrous; sometimes finely radially streaked centrally or around the disc; sometimes obscurely areolately cracked; easily separable $\frac{1}{3}$ - $\frac{2}{3}$ the pileus radius; faintly spermatic or spermatic-acrid in taste; when young light grayish yellowish brown overall or darker (grayish brown to dark grayish brown) centrally, when mature pale orange yellow (M&P 10-11D2), moderate yellow (Chamois, M&P 11H6), or light yellowish brown (M&P 11-12C-F5-7) overall, or darker [light grayish yellowish brown to grayish yellowish brown (Drab) or dark grayish yellowish brown, grayish brown (Benzo Brown), moderate yellowish brown (Snuff Brown, Sayal Brown, Buffy Brown), or dark yellowish brown (Saccardo's Umber)] centrally, sometimes with a narrow zone or small, irregularly shaped areas of moderate yellowish pink (Vinaceous-Fawn, Vinaceous-Cinnamon) to light reddish brown at the inner ends of the striae. TRAMA 0.2-2.5 mm thick at mid-radius; fragile; slightly spermatic or waxy and sometimes also faintly acrid in taste; with a slight to moderate, spermatic, waxy, or fetid odor; occasionally tinged the cuticular color just beneath the cuticle in the disc, otherwise yellowish white, unchanging when cut.



FIGS. 20-24. *Russula pectinatoides*. 20. Spores (Shaffer 3611). 21. Spores (Peck, Aug., 1906). 22. Hymenial pseudocystidia (Shaffer 3611). 23. Hyphal ends from pileus cuticle (Shaffer 3611). 24. Hyphal ends from stipe surface (Shaffer 3611).

LAMELLAE 2-7 mm broad; fragile; equal, or unequal with the lamellulae rare and of various lengths; acute or subacute in front; adnate or less commonly adnexed, sometimes seceding in age; close to subdistant; often forked at or near the stipe; intervenose; entire; with a slight to moderate taste having both spermatic to waxy and acrid components; yellowish white at first, then pale yellow, sometimes stained light to deep yellowish brown.

STIPE 1.5–7 cm long, 5–20 mm thick; flared slightly at the apex or not, otherwise subequal, subfusiform, or enlarging or tapering to the base; dry; dull; usually puberulent to minutely scurfy apically or overall, otherwise glabrous; scarcely longitudinally rugulose; stuffed at first, becoming cavernous and eventually hollow, the inner surface then uneven and yellowish white to light orange yellow; yellowish white, usually stained light olive brown to strong yellowish brown, or dark orange yellow to deep reddish orange, grayish red, or moderate to strong reddish brown basally, occasionally flushed yellowish gray basally or almost overall, unchanging when bruised or at most becoming light brown.

COLOR REACTIONS (pileus trama and stipe surface): SV purplish white to purplish gray; 10% FeSO_4 grayish yellowish pink, moderate yellowish pink, or light reddish brown; 2% phenol dark grayish reddish brown; formalin colorless; guaiac quickly dark bluish green; (dark orange yellow to deep reddish orange areas of stipe base): 15% NH_4OH strong reddish brown.

SPORES pale orange yellow (M&P 9C3 or 9D2 to 10C2, Romagnesi IIc to II d) in mass; $5.4\text{--}8.4\text{--}(10.9) \times 4.6\text{--}6.3\text{--}(7.7) \mu$; usually broadly elliptic to broadly obovate, rarely subglobose. ORNAMENTATION of convex to cylindric or bluntly conic warts up to $0.3\text{--}1.0\text{--}(1.4) \mu$ high and occasionally also a few connectives or short to long ridges; rarely forming a partial reticulum, never a complete one. SUPRAHILAR AREA usually a plaque or minutely warted, but occasionally with a low, diffuse, amyloid patch.

BASIDIA $34\text{--}51 \times 6.2\text{--}11.3 \mu$; clavate; 4-spored.

HYMENIAL PSEUDOCYSTIDIA in some basidiocarps of two types: (1) $40\text{--}79 \times 5.7\text{--}10.0 \mu$; subcylindric to clavate; rounded apically; often curved to tortuous basally; with grayish yellow, SV+ contents; arising in the trama; embedded or projecting only a short distance beyond the basidioles; abundant; and (2) $39\text{--}90 \times 7.2\text{--}13.6 \mu$; clavate, fusoid-clavate, fusiform, or fusoid-ventricose; often capitellate, appendiculate, or constricted 1–few times apically; almost hyaline and devoid of SV+ contents; arising in the subhymenium; projecting up to 36μ beyond the basidioles; abundant; in other basidiocarps with characteristics of the above two types in various combinations, and then cystidial dimorphism not evident.

CHEILOLEPTOCYSTIDIA $11\text{--}29 \times 2.9\text{--}9.3 \mu$; subcylindric, clavate, or fusiform; hyaline; common in some basidiocarps, absent in others.

SUBHYMENIUM $28\text{--}40 \mu$ thick; pseudoparenchymatous.

TRAMA with SV+, granular vascular hyphae, these rare to common depending on the basidiocarp, but usually more common just beneath the pileus cuticle than elsewhere.

PILEUS SUBCUTIS $150\text{--}190 \mu$ thick; with a gelatinous matrix; of horizontal- to ascending-interwoven, nongelatinous or gelatinous, hyaline to

yellowish brown (from a diffuse pigment) connective hyphae mostly 1.0–3.4 μ broad; also with SV+, glassy to granular vascular hyphae 2.3–5.7 μ broad which are common in the lower part of the subcutis, rare in the upper.

PILEUS EPICUTIS \pm 60 μ thick; with a gelatinous matrix; probably at first a continuous trichoderm, but soon discontinuous, the epicutal elements then scattered and repent to ascending at the pileus surface or in places remaining in trichodermial patches; of connective hyphal ends whose apical cells are 1.8–4.0 μ broad basally, often are subfusiform or taper to a capitellate or short-appendiculate apex, and occasionally have sparse, weakly SV+ granules.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline to yellow connective hyphae mostly 1.0–6.8 μ broad whose ends may project as filamentous or tapered hairs, or have cystidioid apical cells up to 15.0 μ broad (these may be of the same type as those of the pileus cuticle), the basal cells of the hairs sometimes short and inflated (up to 11.3 μ broad) and the hairs themselves frequently clustered; also with numerous, SV– to SV+, granular vascular elements 2.3–9.0 μ broad which may be straight or tortuous and embedded in or appressed to the surface layer, or may project as short- to long-filamentous cystidia.

Solitary, scattered, or gregarious on soil or rarely on rotten wood in deciduous and deciduous-coniferous forests, e.g., beech-maple, oak-hickory, and hemlock-hardwoods forests, and pine plantations with much hardwood undergrowth.

Collections studied:

WISCONSIN: Walworth Co.: Wychwood, Lake Geneva, 21 Jul., 1956, *Shaffer 938*; one additional collection. ILLINOIS: Cook Co.: Tinley Creek Woods Forest Preserve, 5 Aug., 1958, *Shaffer 2058*. MICHIGAN: Cheboygan Co.: Colonial Point, Burt Lake, 12 Aug., 1964, *Shaffer 4026*. Ostego Co.: Near Hardwood Lake, 27 Jul., 1971, *Shaffer 6793*. Berrien Co.: Warren Woods, 12 Aug., 1958, *Shaffer 2062*. Washtenaw Co.: Waterloo Recreation Area, 18 Sep., 1969, *Shaffer 6151*; Sharon Hollow, 22 Sep., 1961, *Shaffer 3611*; Stinchfield Woods, south of Pinckney, 31 Jul., 1969, *Shaffer 6138*; Silver Lake area, Pinckney Recreation Area, 14 Jul., 1960, *Shaffer 2387*; one additional collection. INDIANA: Owen Co.: Green Bluffs, near Spencer, 22 Aug., 1970, *Shaffer 6365*. NORTH CAROLINA: Swain Co.: Indian Creek, Great Smoky Mountains Natl. Park, north of Bryson City, 21 Jul., 1970, *Shaffer 6271*. NEW YORK: Albany Co.: Menands, Aug., 1906, *Peck* (lectotype of *Russula pectinatoides*, NYS). Rensselaer Co.:

North Greenbush, 22 Jul., *Peck* (NYS); Sandlake, 25 Jul., 1907, *Peck* (NYS). VERMONT. Windham Co.: Newfane Hill, 3 Aug., 1961, *Shaffer 3201*; one additional collection. MASSACHUSETTS: Franklin Co.: Mt. Toby, 6 Sep., 1961, *Shaffer 3587*.

Since a type for *Russula pectinatoides* seems never to have been formally designated, I choose as lectotype the NYS collection marked "TYPE," which was gathered by Peck at Menands, Albany Co., N. Y., in August, 1906. It consists of some 20 basidiocarps, one of which differs significantly from the rest and seems to be, in fact, a small specimen of *R. laurocerasi*. The rest of the basidiocarps are similar to one another and constitute a satisfactory type.

Peck's (1907) description and illustrations indicate unusually widely spaced pileus striations for *Russula pectinatoides*; however, the pilei of the three New York collections determined by Peck and cited above are finely striate as in my own collections. [Another NYS collection determined by Peck as *R. pectinatoides* (Houghton, Houghton Co., Mich., 3 Aug., 1906, *Kauffman 501*) is not this species and probably not even a member of Subsection *Foetentinae*.] Also, Peck emphasized the nonacid or slightly acid taste of the species, as have others (Singer, 1958; Romagnesi, 1967). In my collections this holds for the pileus (cuticle and trama), but the lamellae are always at least slightly acid and may be more strongly so. *Russula pectinatoides* should not be considered a mild species even though it is never as acid as most other members of the subsection.

Some basidiocarps of *Russula pectinatoides* have spores which range to a larger size (up to $10.9 \times 7.7 \mu$ and with ornamentation up to 1.4μ high) than most. This is true of the type collection, for example, in which about one-third of the basidiocarps have spores ranging larger than usual.

The European fungus called *Russula pectinatoides* by Romagnesi (1967) is certainly close enough to the North American one to bear the same name. It seems to be even less acid and to have a different odor ("nauséuse de caoutchouc, recouvrant un fond fruité plus ou moins distinct"), however. *Russula pectinata* in Romagnesi's (1967) sense has somewhat larger, stouter, more rigid basidiocarps with yellower pilei and more strongly acid taste ("brûlante dans les lames jeunes"). I have not yet found American collections answering this description well.

Russula pectinatoides in the sense of Singer (1958) also seems the same except he indicated that the spore ornamentation is never composed

predominantly of isolated warts, but rather has common connectives and often forms an incomplete reticulum. The collections I studied have isolated warts as the usual situation.

See under *Russula amoenolens* for a comparison of *R. pectinatoides* with that species.

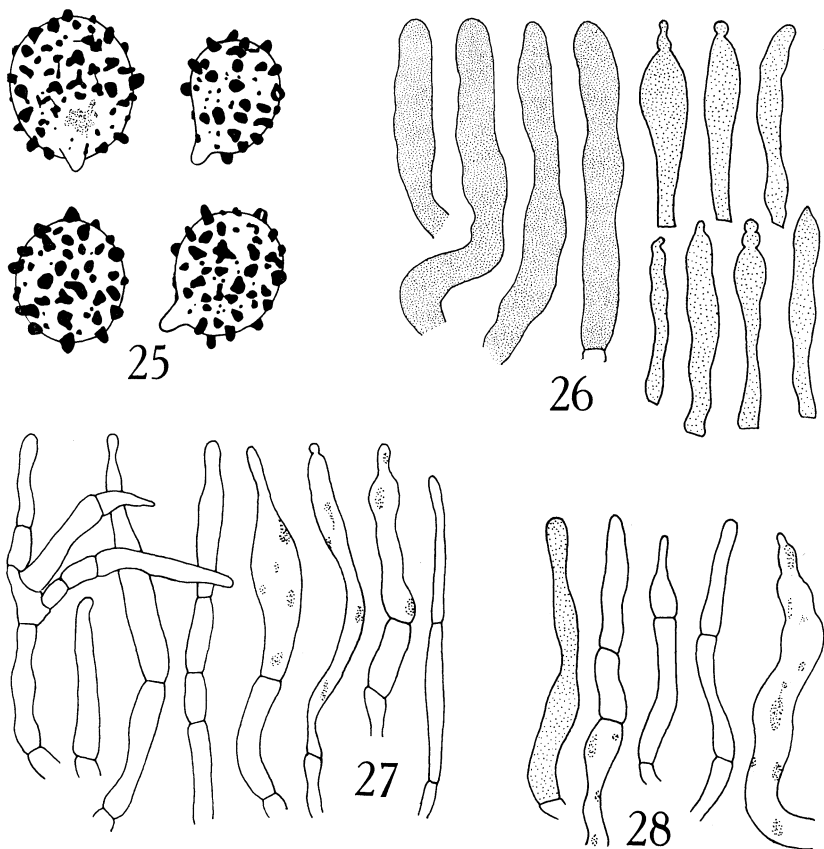
6. *RUSSULA AMOENOLENS* Romag. Bull. Soc. Linn. Lyon 21: 111. 1952.
FIGS. 25-28

PILEUS (2.5-)4-10 cm broad; when young deeply pulvinate with a slightly depressed disc and an incurved margin, expanding through pulvinate to convex to plane, all the while with a depressed disc, finally irregularly concave or subinfundibuliform; sometimes irregularly lobed marginally; tuberculate-striate (3-)6-20 mm from the edge inward. CUTICLE thin throughout, not gelatinous-thickened on the pileus margin when young; viscid and shiny when wet, less so during nonrainy weather and then at times dry and dull; glabrous; finely radially streaked centrally; separable $\frac{1}{3}$ - $\frac{3}{4}$ the pileus radius; spermatic-waxy in taste; when young brownish black (Fuscous-Black), dark grayish yellowish brown (Clove Brown, Bister, Sepia, M&P 16A-C9-10), dark yellowish brown (Saccardo's UMBER), dark olive brown (M&P 16C-J10), or moderate yellowish brown (Snuff Brown, Buffy Brown, M&P 13-15E-I7-8) centrally and dark yellowish brown to light grayish yellowish brown (M&P 12B-D3-5) marginally, or less commonly, moderate yellowish brown or grayish yellowish brown (M&P 15E7) overall, when mature dark grayish yellowish brown to grayish yellowish brown centrally and light grayish yellowish brown, dark grayish yellow (M&P 13E5), or grayish yellow (M&P 11-12C-D2) marginally, or, less commonly, moderate yellowish brown or light grayish yellowish brown overall, sometimes spotted or blotched with dark grayish reddish brown or strong brown to strong yellowish brown. TRAMA 1.5-3 mm thick at mid-radius; firm-brittle; spermatic-waxy in taste and sometimes also slightly acrid; with a spermatic-waxy odor; sometimes tinged the cuticular color just beneath the cuticle, otherwise yellowish white, unchanging when cut.

LAMELLAE (2.5-)5-10 mm broad; brittle; equal, or unequal with the lamellulae rare and of various lengths; acute or subacute in front; adnate to adnexed, at times almost free; close to subdistant; occasionally forked at or near the stipe and rarely outward; intervenose; entire; with a taste that is spermatic-waxy at first, then becomes moderately to strongly acrid; yellowish white to pale orange yellow, sometimes tinged gray or stained with moderate yellowish brown, but unchanging when injured.

STIPE (2.5-)3.5-7 cm long, (7-)10-27 mm thick; flared apically or

not, otherwise subequal, subfusiform, or tapered or enlarging to the base; dry; dull; puberulent apically, elsewhere glabrous; longitudinally rugulose, sometimes scarcely so; stuffed at first, becoming cavernous and eventually hollow; yellowish white, sometimes stained moderate to strong yellowish brown basally, at times flushed yellowish gray basally or almost overall and becoming the same color when bruised.



FIGS. 25–28. *Russula amoenolens* (Shaffer 2436). 25. Spores. 26. Hymenial pseudocystidia, the four on the left of type 1 of the description, the rest of type 2. 27. Hyphal ends from pileus cuticle. 28. Hyphal ends from stipe surface.

COLOR REACTIONS (pileus surface): 30% KOH no change; (pileus trama and stipe surface): SV pale gray to light purplish gray; 10% FeSO_4 light reddish brown; 2% phenol dark grayish reddish brown; formalin colorless; guaiac quickly dark grayish green.

SPORES pale orange yellow (M&P 9B2 or nearby, Romagnesi slightly lighter than IIa to slightly lighter than IIc) in mass; $5.7-8.8 \times 4.5-7.0 \mu$; usually broadly elliptic to broadly obovate or broadly ovate, in some basidiocarps occasionally elliptic, obovate, pip-shaped, or subglobose. ORNAMENTATION of cylindric to bluntly conic warts up to $0.3-1.0 \mu$ high, these usually isolated, but on some spores partially clustered or with a few connectives; rarely forming a partial reticulum, never a complete one. SUPRAHILAR AREA usually with tiny warts (at times almost a plage), occasionally with a small, uneven, diffuse patch, sometimes with both.

BASIDIA $23-44 \times 5.7-11.4 \mu$; clavate; 4-spored.

HYMENIAL PSEUDOCYSTIDIA in some basidiocarps of two types: (1) $44-103 \times 6.1-11.3 \mu$; subcylindric, clavate, or fusiform; usually rounded apically, occasionally capitate or appendiculate; sometimes sinuous or tortuous basally; with grayish yellow, SV+ contents; arising in the trama; ending at various levels in the hymenium (i.e., embedded); abundant; and (2) $34-58 \times 5.2-10.5 \mu$; filamentous, subcylindric, or clavate; often capitellate, appendiculate, or moniliform, occasionally acute or rounded apically; subhyaline; arising in the subhymenium; projecting up to 30μ beyond the basidioles; abundant; in other basidiocarps with the characters of the above two types in various combinations and then cystidial dimorphism not evident.

SUBHYMENIUM $20-34 \mu$ thick; pseudoparenchymatous.

TRAMA with common, SV- to SV+, granular vascular hyphae.

PILEUS SUBCUTIS $80-280 \mu$ thick: with a gelatinous matrix; of horizontal- to ascending-interwoven, nongelatinous or gelatinous connective hyphae $1.0-4.5 \mu$ broad some of which have a grayish brown vacuolar pigment; also with straight or tortuous, SV+, granular vascular hyphae $2.3-7.9 \mu$ broad, these most common in the lower part of the subcutis.

PILEUS EPICUTIS of connective hyphal ends $1.7-6.0(-7.8) \mu$ broad which may be scattered and repent to erect at the pileus surface or grouped in trichodermial patches $40-68 \mu$ high, the apical cells of these hyphal ends cylindric, tapered, narrowly clavate or fusiform, or rarely fusoid-ventricose, sometimes capitellate, and sometimes containing weakly SV+ granules which may be present also in subapical cells of the epicutis.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline connective hyphae $1.0-5.7 \mu$ broad some of whose ends project as filamentous to tapered, sometimes clustered hairs and may have cystidioid apical cells containing SV+ granules; also with common, straight or tortuous, SV+ granular vascular hyphae $2.3-5.7 \mu$ broad.

Solitary, scattered, or gregarious on soil; in southeastern Michigan often found under pines, but occurring in deciduous forests as well.

Collections studied:

ILLINOIS: Cook Co.: Paddock Woods Forest Preserve, 10 Jul., 1956, *Shaffer 834*. MICHIGAN: Livingston Co.: Fralick's Tree Farm, near Hell, 24 Sep., 1968, *Shaffer 6115*; two additional collections. Washtenaw Co.: Crooked Lake, Waterloo Recreation Area, 20 Jul., 1960, *Shaffer 2436*; Stinchfield Woods, south of Pinckney, 25 Sep., 1961, *Shaffer 3614*; Silver Lake area, Pinckney Recreation Area, 29 Jul., 1969, *Shaffer 6122*; eight additional collections. MASSACHUSETTS: Franklin Co.: Cricket Hill, south of Conway, 27 Jul., 1961, *Shaffer 3098*.

As Romagnesi (1967) stated, *Russula amoenolens* is *R. sororia* in the sense of Schaeffer (1952) and *R. pectinata* in the sense of Singer (1958) et al. However, Singer included western U. S. material such as *Smith 8572* that belongs in *R. cerolens*. The collections cited agree well with both Romagnesi's description of *R. amoenolens* and my French collections so identified in the field by him (e.g., *Shaffer 4357, 4477, 4492, and 4622*).

North American material of this species seems to have often passed under the names *Russula pectinata* and *R. pectinatoides*. *Russula amoenolens* differs from the latter in having larger, firm basidiocarps; darker, grayer pilei; more strongly acrid lamellae; a stronger spermatic-waxy odor; and paler spores.

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

FIGS. 29-33

Cuticula pilei sepiacea in centro, in margine pallidior; *trama pilei* cum lamellis sapore fortiter acri, *cerolens* in sicco; *sporae* pallide luteae in cumulo, 5.4-8.5(-9.0) \times 4.5-6.8 μ (ornamentatione exclusa), verrucis et cristis usque ad 0.3-0.5(-0.8) μ altis et connectivis, verrucis nonnunquam in catenis, ornamentatione reticulum inchoatum interdum formanti; *pseudocystidia hymenii* ope sulfovanilliniae atrantia; *subcutis pilei* ex hyphis conjunctivis intertextis et hyphis vascularibus constans; *epicutis pilei* primo trichodermium formans, mox inconspicua, pseudocystidia conspicua destituta. Holotypus: Sub Piceis, Lake Tahkenitch, Douglas Co., Ore., 12 Nov., 1935, *A. H. Smith 3447* (MICH).

PILEUS 4-8 cm broad; convex to plane with a slightly depressed disc, in age broadly depressed and with the margin upturned; sometimes split marginally; closely tuberculate-striate from the edge $\frac{1}{3}$ - $\frac{2}{3}$ the pileus radius. CUTICLE viscid when wet; glabrous; scarcely separable near the pileus edge; dark yellowish brown (Saccardo's Umber) to dark grayish yellowish brown (Sepia, Bister) centrally, moderate yellowish brown (Tawny-Olive) to light grayish brown marginally. TRAMA thick in the disc; strongly acrid (cuticle and lamellae included in piece tasted); disagreeable in odor, the dried specimens with a strong waxy

smell noticeable even above the odor of naphthalene; tinged the cuticular color just beneath the cuticle, otherwise white.

LAMELLAE unequal, the lamellulae few; adnate to nearly free; crowded or close; often forked at or near the stipe; white at first, then light yellow, stained yellowish brown.

STIPE 4–5 cm long, 1–2 cm thick; equal; dull; longitudinally rugulose; stuffed; white, often stained strong reddish brown or strong to dark yellowish brown basally.

COLOR REACTIONS (stipe surface): 10% FeSO₄ light reddish brown.

SPORES pale orange yellow (Light Buff) in mass; 5.4–8.5(–9.0) × 4.5–6.8 μ; usually elliptic to obovate, sometimes broadly so, or pip-shaped, rarely reniform. ORNAMENTATION of warts and short to long ridges, both up to 0.3–0.5(–0.8) μ high, the warts sometimes catenulate, and also a variable number of connectives; unusually variable in overall pattern, but occasionally forming a partial reticulum, rarely a complete one. SUPRAHILAR AREA usually a plage or with minute warts and lines, occasionally with a low, diffuse, amyloid patch, rarely ornamented like the rest of the spore wall.

BASIDIA 38–67 × 5.1–11.3 μ; clavate, in some basidiocarps elongate-clavate; 4-spored.

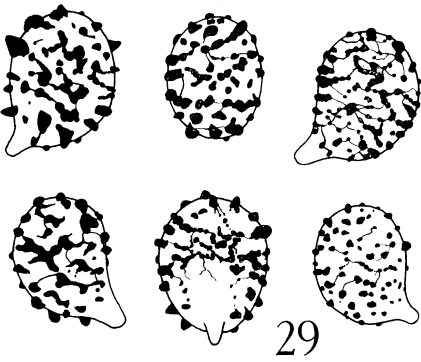
HYMENIAL PSEUDOCYSTIDIA 37–97 × 5.3–10.2 μ; subcylindric to clavate or fusoid-clavate, fusiform, or fusoid-ventricose; often papillate, capitate, or moniliform apically, sometimes simply rounded or subacute; in some basidiocarps often abnormally inflated or extruded-inflated (up to 17.0 μ broad) apically; with strongly SV+ contents; arising in the subhymenium or, more usually, in the outer part of the trama; embedded or projecting up to 40 μ beyond the basidioles; abundant.

SUBHYMENIUM 24–40 μ thick; pseudoparenchymatous.

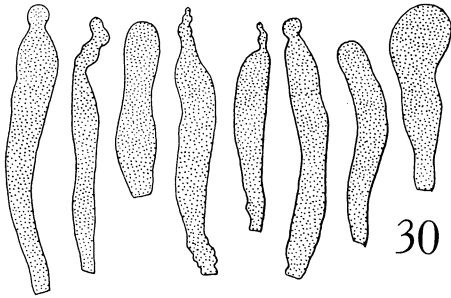
TRAMA with occasional, SV– to weakly SV+, granular vascular hyphae.

PILEUS SUBCUTIS 160–380 μ thick, evidently relatively thin at first, then thickening as the gelatinous matrix increases in volume; of horizontal- to ascending-interwoven, nongelatinous, hyaline to moderate or dark orange yellow connective hyphae 0.7–3.4(–6.8) μ broad; also with straight to tortuous, strongly SV+, glassy to granular vascular hyphae 2.8–10.2 μ broad, these often (if not always) the terminal cells of hyphae otherwise connective in nature and abundant in the lower part of the subcutis, less common or absent in the upper; also with rare to common, straight or curved, elongate-subcylindric or -fusiform, capitate or short-appendiculate pseudocystidia 70–170 × 2.3–5.2 μ which may extend into the epicutis.

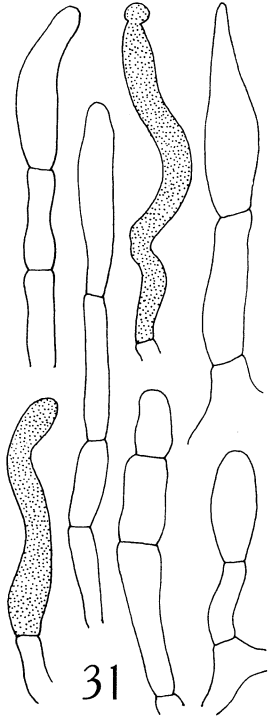
PILEUS EPICUTIS 40–50 μ thick; with a gelatinous matrix; at first a well-formed trichoderm of nongelatinous, sometimes branched, usually 3–6-celled, hyaline connective hyphal ends mostly 1.7–5.7 μ broad whose subapical cells may be slightly or rarely strongly inflated (up to 10.2 μ



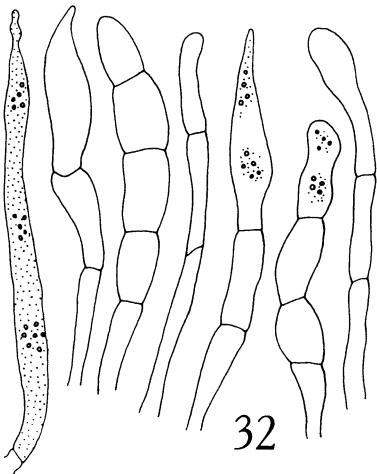
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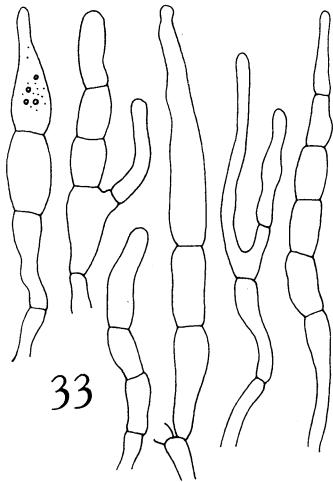
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33

broad) and whose apical cells are clavate, fusiform, or lanceolate and sometimes capitellate and may contain scattered, SV- to weakly SV+ contents; becoming discontinuous and inconspicuous, the epicutal hyphal ends then repent to erect and scattered or in small trichodermial patches.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous connective hyphae 1.2–4.5 μ broad which give rise to (1) hairs with \pm inflated cells up to 11.3 μ broad, (2) oval to fusiform cystidioid cells 10–17 \times 4.5–9.0 μ , and (3) pseudocystidia which are 34–62 \times 4.5–7.9 μ , subcylindric, lanceolate, clavate, or fusiform, sometimes capitate or short-appendiculate, and SV+; also with embedded, SV+ granular vascular hyphae 2.3–5.7 μ broad.

Gregarious on soil under conifers (pine, spruce), sometimes on dunes.

Collections studied:

OREGON: Tillamook Co.: Pacific City, 10 Nov., 1970, *Smith* 79794; Nestucca River at Fan Creek, 2 Nov., 1970, *Smith* 79477. Lane Co.: Blue River, 16 Nov., 1937, *Smith* 7839. Douglas Co.: Lake Tahkenitch, 11 and 12 Nov., 1935, *Smith* 3422 and 3447 (holotype of *Russula cerolens*). CALIFORNIA: Del Norte Co.: Crescent City, 9 Nov., 1937, *Smith* 8572.

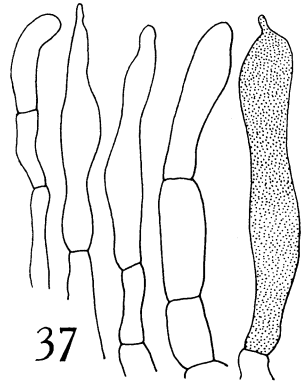
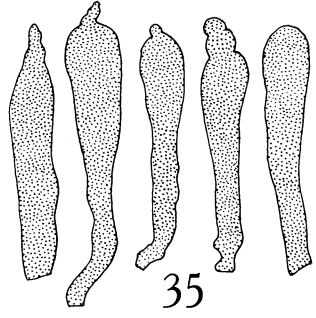
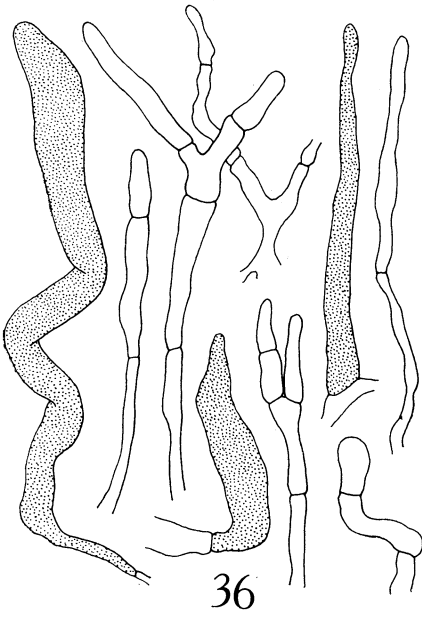
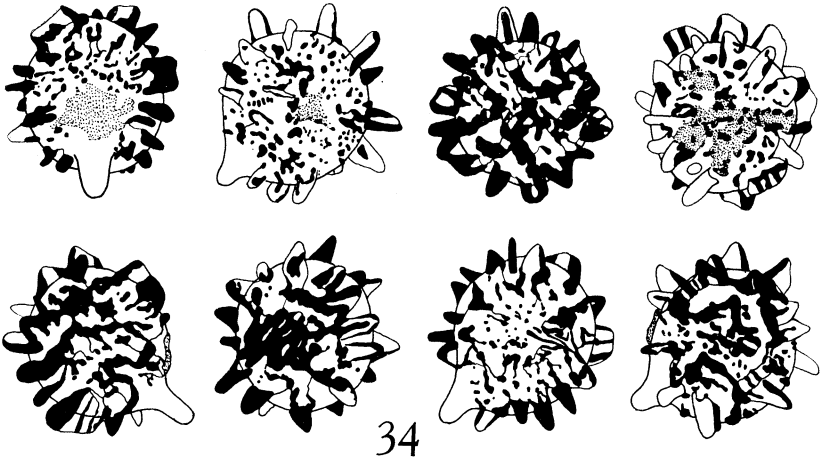
Notes accompanying *Smith* 3447 and 79477 were adapted for the description of macroscopic structures of *Russula cerolens* whose basidiocarps I have seen only dried. Study of fresh specimens may reveal more clearly differences between this species and *R. amoenolens*; the most significant distinction now seems to be in spore ornamentation pattern (see the key to species and compare FIGS. 25 and 29).

8. *RUSSULA LAUROCERASI* Melzer, Činopsis Českoslov. Houby 243. 1920.
[citation from Petrak (1939)] FIGS. 34–37

Russula foetens var. *laurocerasi* (Melzer) Sing. Ann. Mycol., Berl. 40: 73. 1942.

PILEUS 3.5–13 cm broad; when young deeply pulvinate with an incurved margin, expanding through convex to plane with a depressed disc, in age concave or shallowly infundibuliform; prominently tuberculate-striate 4–20 mm from the edge inward. CUTICLE gelatinous-

FIGS. 29–33. *Russula cerolens*. 29. Spores (*Smith* 3422). 30. Hymenial pseudocystidia (*Smith* 3422). 31. Hyphal ends from stipe surface (*Smith* 3422). 32. Hyphal ends from pileus cuticle (*Smith* 79477). 33. Hyphal ends from pileus cuticle (*Smith* 3422).



thickened (1.5–2 mm thick) marginally in young basidiocarps, thin throughout and somewhat rubbery in mature ones; slimy and shiny during rainy weather, otherwise viscid to almost dry and dull; glabrous; slightly rugulose centrally or not; sometimes radially streaked around the disc; easily separable $\frac{1}{3}$ – $\frac{3}{4}$ the pileus radius; slightly to strongly acrid, the taste rarely also bitter; when young variously colored with moderate yellowish brown (Sayal Brown, Tawny-Olive), dark grayish yellow (Isabella Color), light yellow (Cream-Buff), and pale orange yellow (Light Buff, Warm Buff), when mature moderate yellow (Chamois, Honey Yellow), pale yellowish brown, light to pale orange yellow, light to pale yellow (Cartridge Buff), or almost yellowish white overall, or, usually, darker [strong yellowish brown (Clay Color), moderate to dark yellowish brown, or moderate to light brown] centrally, sometimes tinged gray in age. TRAMA 1.5–9 mm thick at mid-radius; firm- to soft-brittle; slightly to strongly nauseating-acrid in taste; fragrant, the odor benzaldehyde-like with a slight fetid component; at times tinged brown just beneath the cuticle in the disc, otherwise white to pale yellow, stained moderate brown or moderate to strong yellowish brown around the larval channels, but unchanging when cut.

LAMELLAE 3–10 mm broad; fragile-brittle; equal, or unequal with the lamellulae rare to fairly common and of various lengths; subacute to broadly rounded in front; sometimes ventricose; adnexed to adnate; close to subdistant; often forked at or near the stipe; intervenose; entire; moderately to strongly acrid, the taste also having a slightly to strongly oily-nauseating component and rarely a bitter one; yellowish white to pale orange yellow, sometimes tinged gray, often spotted-stained light brown, moderate to strong yellowish brown, or dark grayish yellowish brown, but unchanging when bruised or only very slowly becoming light brown to moderate yellowish brown on the edges.

STIPE 2.5–11 cm long, 9–30 mm thick; sometimes flared apically, elsewhere equal or tapering or enlarging to the base; dry; dull; usually puberulent to minutely furfuraceous apically, elsewhere glabrous; scarcely longitudinally rugulose; stuffed at first, becoming hollow with a rough, yellowish white or moderate brown to strong yellowish brown inner surface; yellowish white to pale orange yellow, often discolored basally or rarely overall with pale grayish yellow, moderate brown or light grayish reddish brown, moderate to strong yellowish brown, or dark grayish yellowish brown, not staining appreciably when bruised or only slowly becoming dark grayish yellow to moderate yellowish brown, the cortex becoming pale yellow when cut.

FIGS. 34–37. *Russula laurocerasi* (Shaffer 5737). 34. Spores. 35. Hymenial pseudocystidia. 36. Hyphal ends from pileus cuticle. 37. Hyphal ends from stipe surface.

COLOR REACTIONS (pileus cuticle): 30% KOH pale yellowish pink to brownish orange; (stipe surface): SV brownish pink to purplish gray; 10% FeSO₄ moderate orange; 2% phenol moderate brown to dark grayish reddish brown; formalin colorless; guaiac quickly light green; 30% KOH light yellow on the whitish areas, grayish reddish orange (Vinaceous-Tawny) to dark reddish orange (Vinaceous-Rufous) or moderate reddish brown (Brick Red) on the brownish; (stipe cortex): 30% KOH pale yellow.

SPORES pale orange yellow (M&P 9B-D2 or paler than 9B2, Romagnesi IIa-c) in mass; (6.8-)7.7-10.7 × (6.8-)7.5-9.0 μ; broadly elliptic, broadly obovate, subglobose, or globose. ORNAMENTATION of blunt, cylindric to conic spines and ridges up to 1.0-2.6 μ high and also low warts and sometimes connectives among the high units of ornamentation; with the ridges sometimes forming a coarse, partial or complete reticulum; often conspicuously nonamyloid in part, the ridges then alternately amyloid and nonamyloid. SUPRAHILAR AREA with low, uneven, diffuse ornamentation which may be thicker near the area margin and form there a circular, oval, or horseshoe-shaped figure.

BASIDIA 40-64 × 9.0-15.3 μ; clavate; 4-spored.

HYMENIAL PSEUDOCYSTIDIA 42-107 × 5.7-14.7 μ; subcylindric, clavate, fusoid-clavate, fusiform, or fusoid-ventricose; broadly rounded apically or more commonly capitate, appendiculate, or moniliform-appendiculate; sometimes "extruded-inflated" apically or just beneath the head or appendix; often tortuous basally; SV+; arising in the subhymenium or trama; projecting up to 60 μ beyond the basidioles; abundant.

SUBHYMENIUM 34-45 μ thick; pseudoparenchymatous.

TRAMA with numerous, SV+, glassy to granular vascular hyphae.

PILEUS SUBCUTIS 130-400 μ thick; embedded in a gelatinous matrix; of horizontal-interwoven, nongelatinous, connective hyphae mostly 1.0-5.7 μ broad, but at times with scattered inflated cells up to 18.0 μ broad, those hyphae near the trama moderate orange yellow (from a diffuse pigment), those above hyaline; also with occasional to common, SV+, granular vascular hyphae 3.4-9.0 μ broad.

PILEUS EPICUTIS 57-73 μ thick; embedded in a gelatinous matrix; a trichoderm of nongelatinous or gelatinous, hyaline or moderate orange yellow connective hyphal ends 1.7-5.2 μ broad; also with occasional to common, sometimes capitellate or short-appendiculate, SV+, granular vascular elements 2.8-7.9 μ broad which vary in form from cylindric, clavate, or fusiform cystidia as short as 20 μ long to filaments more than 100 μ long arising deep in the subcutis, these elements always the apical cell of a hypha otherwise connective in nature; sometimes moribund in mature basidiocarps.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline connective hyphae 1.0-6.8 μ broad which give rise to short to

long hairs which may be filamentous or have inflated (up to 12.0 μ broad) subapical cells and/or a cystidioid (e.g., fusoid-ventricose) apical cell; also with common to abundant, SV+, granular vascular elements 2.8–9.0 μ broad which vary from longitudinal, appressed or embedded filaments to projecting, clavate to fusiform, sometimes capitate or short-appendiculate cystidia \pm 45 μ broad, these elements always the apical cell of a hypha otherwise connective in nature.

Solitary, scattered, or gregarious on humus in deciduous and deciduous-coniferous woods (e.g., beech-maple-hemlock woods).

Collections studied:

QUEBEC. Quebec Co.: Cap-Rouge, 2 Aug., 1967, *Shaffer 5634a*; two additional collections. Montmorency Co.: St.-François-d'Orleans, 7 Aug., 1967, *Shaffer 5737*; two additional collections.

MICHIGAN. Chippewa Co.: Emerson, 5 Aug., 1959, *Shaffer 2239*. Emmet Co.: West of Brutus, 10 Aug., 1968, *Shaffer 6099*. Cheboygan Co.: Colonial Point, Burt Lake, 19 Sep., 1957, *Shaffer 2024*. Jackson Co.: Clear Lake, Waterloo Recreation Area, 1 Aug., 1960, *Shaffer 2495*. Washtenaw Co.: Pinckney Recreation Area, 3 Aug., 1970, *Shaffer 6332*. NORTH CAROLINA: Swain Co.: Kephart Prong Trail, Great Smoky Mountains Natl. Park, 9 Jul., 1970, *Shaffer 6162*; Deep Creek, Great Smoky Mountains Natl. Park, north of Bryson City, 10 Jul., 1970, *Shaffer 6189*; Indian Creek, Great Smoky Mountains Natl. Park, north of Bryson City, 11 Jul., 1970, *Shaffer 6211*; three additional collections. NEW HAMPSHIRE. Hillsboro Co.: Fox State Forest, 24 Jul., 1961, *Shaffer 3049*. VERMONT. Windham Co.: Newfane Hill, 3 Aug., 1961, *Shaffer 3192*; Townshend State Forest, 7 Aug., 1961, *Shaffer 3233*. MASSACHUSETTS. Franklin Co.: Mt. Toby Forest, 25 Aug., 1963, *Shaffer 3943*.

Compared with *Russula fragrantissima*, *R. laurocerasi* is a species having basidiocarps that retain a cleaner aspect as they mature and have yellower pilei, more slender stipes (in general, stipe three or more times longer than broad), a stronger, more fragrant odor, and larger spores with higher ornamentation. Intermediates between these species exist, however. Two collections (*Shaffer 1723* and *1727*) made in aspen-jack pine woods near Black Lake, Cheboygan Co., Mich., during late July, 1957, have spores typical of *laurocerasi*, but the basidiocarp stature, coloration and odor of *fragrantissima*.

A few of my collections of *Russula laurocerasi* from the Great Smoky Mountains Natl. Park (e.g., *Shaffer 6189*) have spores whose size range is unusually extended in its lower part (down to 6.8 μ long

and broad). The small spores have the high ornamentation typical of the species, but their ornamentation units are, in general, more slender than those of large spores.

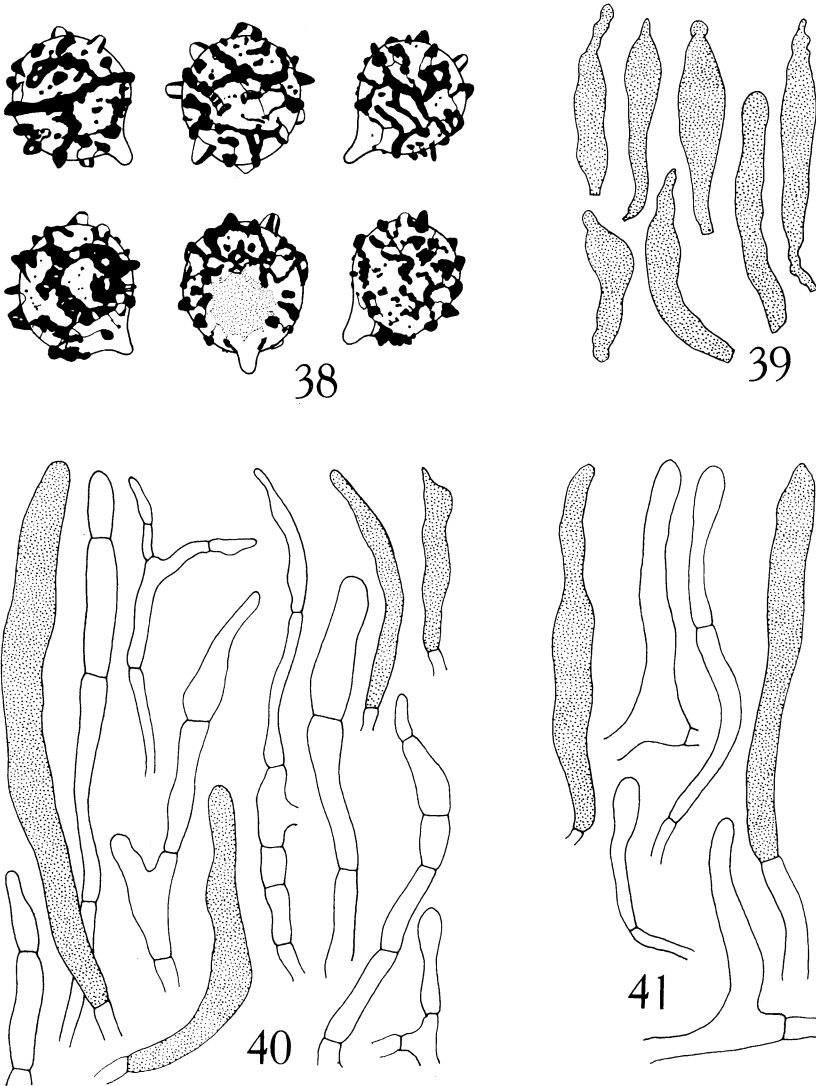
Four collections in NYS identified by Peck as a pale form of *Russula foetens* seem to be *R. laurocerasi* instead. These collections are Delmar, Albany Co., Sep., 1898, *Peck*; Sandlake/Selkirk, Rensselaer Co./Albany Co., Aug., *Peck*; Greenbush, Rensselaer Co., Jul., *Peck*; and Port Jefferson, Suffolk Co., Aug., *Peck*.

Romagnesi (1967) recognized both a type variety of *Russula laurocerasi* and var. *fragrans*, whose name is not validly published. Eastern North American material of the species has the acrid taste of the type variety in his sense, but the size, stature, and odor of the basidiocarps and the characteristics of the spores and pileus epicutal hyphae are more like those of var. *fragrans*.

9. *RUSSULA FRAGRANTISSIMA* Romag. Les Russules 348. f. 256-259.
1967. FIGS. 38-41

PILEUS 7.5-20 cm broad; subglobose to oval when young, then pulvinate with an incurved margin, later pulvinate to convex to plane with or without a depressed disc, in age irregularly concave or subinfundibuliform; at times split or lobed marginally; becoming prominently tuberculate-striate 6-30 mm from the edge inward. CUTICLE thick (up to 2.5 mm thick) and gelatinous marginally when young, becoming thin throughout; somewhat elastic; strongly viscid and shiny during rainy weather, moderately to scarcely so during dry; glabrous; often minutely radially streaked outward from the disc; separable $\frac{1}{3}$ - $\frac{3}{4}$ the pileus radius; moderately spermatic- or oily-acrid to almost tasteless; when young pale yellow (M&P 9-10G-F2), light yellow (Cream-Buffer), moderate yellow (Chamois, Honey Yellow), grayish yellow (M&P 11C3, 11G4), or light orange yellow to light yellowish brown (M&P 11-12E-G7), moderate yellowish brown (Dresden Brown, Snuff Brown, Tawny-Olive), strong yellowish brown (Clay Color), or dark yellowish brown (Saccardo's Umber), often becoming, at least partly, darker in age, sometimes even grayish brown (Warm Sepia), dark grayish brown (Blackish Brown (3)), dark grayish reddish brown (Chestnut-Brown), or dark grayish yellowish brown (Sepia, Bister). TRAMA 2-7 mm thick at mid-radius; hard at first, later firm-brittle; tasteless or slightly acrid or oily-acrid; smelling of benzaldehyde and sometimes also somewhat fetid when young, often becoming more strongly fetid and the benzaldehyde odor decreasing or disappearing as the basidiocarp ages or dries; yellowish white to pale yellowish brown, often stained moderate brown or strong or moderate to dark yellowish brown around the larval channels, unchanging when cut.

LAMELLAE 6–17 mm broad; brittle; equal, or unequal with the lamellulae varying in frequency and length, but mostly reaching halfway or more to the stipe; acute to subacute in front; adnexed to adnate; close to subdistant; occasionally forked at or near the stipe and some-



FIGS. 38–41. *Russula fragrantissima* (Shaffer 6121). 38. Spores. 39. Hyphal pseudocystidia. 40. Hyphal ends from pileus cuticle. 41. Hyphal ends from stipe surface.

times also outward; intervenose; entire, the edges sometimes beaded with moisture in young basidiocarps; moderately to strongly oily-acrid, the acidity not always developing immediately; yellowish white when young, remaining so or becoming pale yellow to pale orange yellow, sometimes assuming a gray tinge, often stained moderate brown or moderate to deep yellowish brown, unchanging when injured.

STIPE 7–15 cm long, 1.5–6 cm thick; flared apically or not, otherwise subequal, subfusiform, tapered to the base which may appear pinched, or enlarging to a broadly rounded base; dry; dull; puberulent to minutely scurfy apically when young, otherwise glabrous; scarcely longitudinally rugulose; solid and hard throughout at first, becoming stuffed and cavernous and eventually hollow with a rough, moderate to dark or deep yellowish brown inner surface; yellowish white, often stained strong brown or moderate to dark yellowish brown basally, or becoming light grayish brown, light grayish yellowish brown, or moderate yellowish brown almost overall.

COLOR REACTIONS (pileus cuticle): 30% NH_4OH no change; (pileus trama): SV light purplish gray or bluish gray; 10% FeSO_4 grayish yellowish pink to light reddish brown; 2% phenol dark brown or dark grayish reddish brown; formalin colorless; guaiac quickly grayish green or deep bluish green; 30% KOH pale to light yellow or moderate yellowish pink; (stipe cortex): 30% KOH pale to light yellow or light yellowish pink.

SPORES pale orange yellow (M&P 9B-C2, Romagnesi IIb or slightly lighter) in mass; $6.3\text{--}9.0 \times 5.7\text{--}7.7 \mu$; broadly elliptic, broadly obovate, broadly ovate, or subglobose. ORNAMENTATION of conic to cylindric warts and short to long ridges, both up to $0.3\text{--}1.0\text{--}(1.4) \mu$ high, and connectives; varying from mostly isolated warts and short ridges to a partial or nearly complete reticulum of ridges, warts, and connectives with interspersed isolated warts and short ridges, the ridges often alternately amyloid and nonamyloid. SUPRAHILAR AREA a plaque or with minute, inconspicuous warts and connectives.

BASIDIA $36\text{--}66 \times 8.5\text{--}11.9 \mu$; clavate; usually 4-, rarely fewer-spored.

HYMENIAL PSEUDOCYSTIDIA (40-) $51\text{--}100 \times (5.4\text{--})6.2\text{--}13.6 \mu$; subcylindric, clavate, fusiform, or fusoid-clavate; often capitate, papillate, or (moniliform-) appendiculate, otherwise simply rounded apically; often "extruded-inflated" apically; straight, curved, sharply bent, or even tortuous basally; SV+; arising in the inner part of the subhymenium or in the trama; embedded or more usually projecting up to 45μ beyond the basidioles; abundant.

SUBHYMENIUM $28\text{--}34 \mu$ thick; pseudoparenchymatous.

TRAMA with common, SV+, granular vascular hyphae.

FILEUS SUBCUTIS $200\text{--}520 \mu$ thick; with a gelatinous matrix; of horizontal- to ascending-interwoven, nongelatinous, connective hyphae 1.0--

4.5 μ broad a few of which have brown incrustations; also with numerous, SV+, glassy to granular vascular hyphae 2.3–7.3 μ broad.

PILEUS EPICUTIS 50–60 μ thick; with a gelatinous matrix; a trichoderm of nongelatinous, branched, hyaline connective hyphal ends 1.7–4.5 μ broad whose apical cells are subcylindric, narrowly clavate, narrowly fusiform, or subulate; also with common pseudocystidia which are 32–90 \times 4.5–9.0 μ , subcylindric, clavate, or fusiform, and sometimes capitate, have SV– or weakly SV+ granular contents, and arise in the epicutis or subcutis as the apical cells of hyphae otherwise connective in nature; often moribund and inconspicuous in mature basidiocarps, the hyphal ends then scattered and repent to ascending at the pileus surface.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline connective hyphae 1.7–4.5 μ broad whose ends may project as hairs or whose apical cells may be subcylindric, subclavate, or subfusiform, weakly to strongly SV+ pseudocystidia; also with numerous, SV+ vascular hyphae 2.8–7.9 μ broad whose ends may also project from the surface.

Solitary, scattered, or gregarious on humus in deciduous (oak-hickory, beech-maple, etc.), coniferous (e.g., white cedar, white pine, red pine), and deciduous-coniferous (e.g., hemlock-hardwoods) forests.

Collections studied:

WISCONSIN: Walworth Co.: Wychwood, Lake Geneva, 20 Jul., 1956, *Shaffer 911*. MICHIGAN: Marquette Co.: Ives Lake road, Huron Mountain Club, 8 Aug., 1968, *Gilliam 389*. Luce Co.: Tahquamenon Falls State Park (upper falls area), 22 Jul., 1971, *Shaffer 6791*. Chippewa Co.: Emerson, 5 Aug., 1959, *Shaffer 2242*. Emmet Co.: West branch of the Maple River, 5 Aug., 1971, *Shaffer 6820*. Crawford Co.: Hartwick Pines State Park, 31 Jul., 1959, *Shaffer 2215*; two additional collections. Livingston Co.: George Reserve, 29 Jul., 1969, *Shaffer 6136a*; one additional collection. Washtenaw Co.: Crooked Lake, Waterloo Recreation Area, 20 Jul., 1960, *Shaffer 2426*; Island Lake, Pinckney Recreation Area, 26 Sep., 1961, *Shaffer 3627*; Silver Lake area, Pinckney Recreation Area, 29 Jul., 1969, *Shaffer 6121*; Morgan Woods, south of Ann Arbor, 11 Aug., 1969, *Shaffer 6141*; two additional collections. NORTH CAROLINA: Swain Co.: Indian Creek, Great Smoky Mountains Natl. Park, north of Bryson City, 18 Jul., 1970, *Shaffer 6249*. VERMONT: Windham Co.: Southeast extension of Newfane Hill, 25 Jul., 1961, *Shaffer 3055*.

The collections cited differ slightly from Romagnesi's (1967) description of *Russula fragrantissima*. He described the pileus cuticle as

separable only at the very margin and, more significant perhaps, the spores as $7.5\text{--}10 \times 7\text{--}9.2 \mu$ and with ornamentation up to 1.6μ high.

This species is the common mushroom with large basidiocarps and strong odor usually called *Russula foetens* in the United States. It differs from *R. foetens* in the sense of Schaeffer (1952) and Romagnesi (1967) in its distinct benzaldehyde odor, which is present at least during the early stages of basidiocarp development, and its spore ornamentation, which resembles that of *R. laurocerasi* in pattern but is lower.

See also the discussion under *Russula laurocerasi*.

10. RUSSULA SUBFOETENS W. G. Sm. Journ. Bot., London 11: 337. 1873. FIGS. 42-46

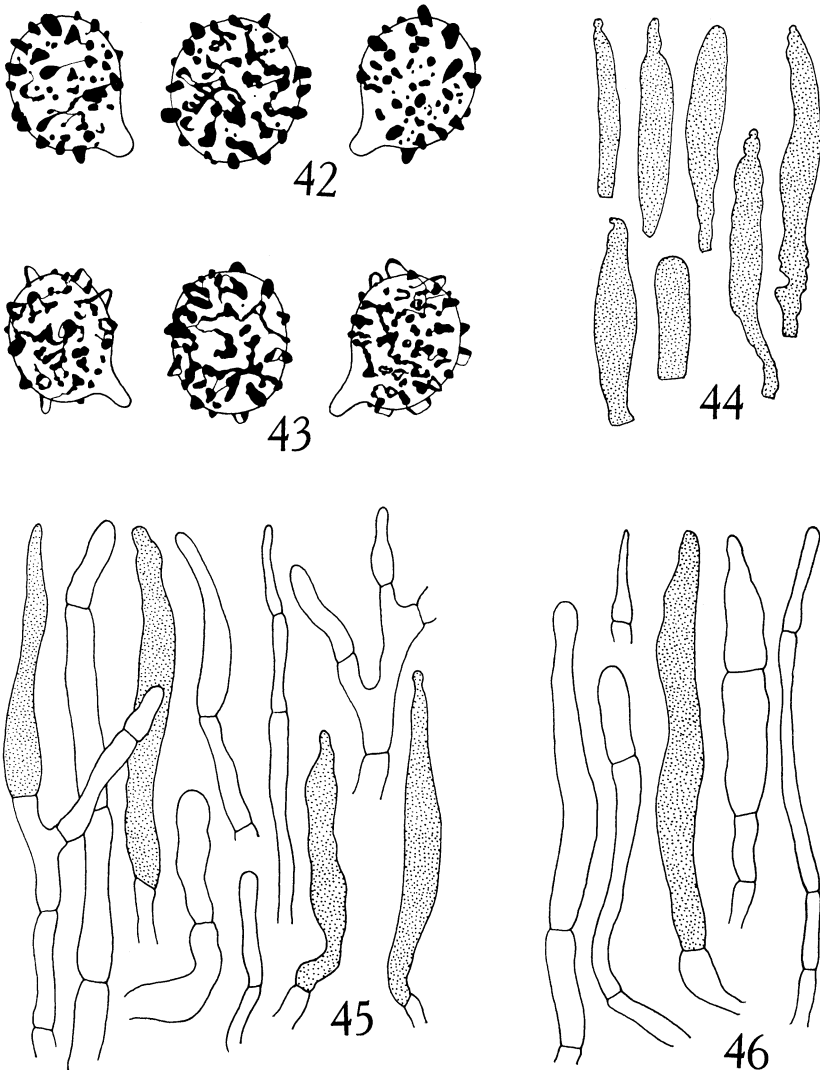
Russula foetens var. *subfoetens* (W. G. Sm.) Mass. Brit. Fung.-Fl. 3: 70. 1893.

Russula foetentula Pk. N. Y. St. Mus. Bull. 116: 85. 1907.

PILEUS (4-)7-12.5 cm broad; when young flattened-globose or deeply pulvinate with the margin curved in to the stipe, passing through pulvinate to convex to plane and all the while usually with a depressed disc, in age concave to infundibuliform; prominently tuberculate-striate (6-)10-25 mm from the edge inward. CUTICLE thick (± 1.5 mm thick) and gelatinous marginally when young, becoming thin throughout; tough and slightly elastic; viscid at first, but soon dry or almost so except during rainy weather; glabrous; often finely radially streaked centrally or around the disc; separable $\frac{1}{4}$ - $\frac{3}{4}$ the pileus radius; tasteless or faintly acrid; strong yellowish brown or dark orange yellow to light yellowish brown, pale orange yellow, or pale yellow overall, or, usually, darker (deep to moderate brown, strong brown, dark yellowish brown) in part—either centrally or marginally. TRAMA (1-)2-6 mm thick at mid-radius; hard at first, becoming firm-brittle; slightly to strongly acrid, the taste sometimes also with a spermatic or oily component; with a weak to moderate, fetid odor which may have also a benzaldehyde component; sometimes tinged the cuticular color just beneath the cuticle, otherwise yellowish white to pale yellow, stained deep brown to strong yellowish brown around the larval channels, unchanging when cut.

LAMELLAE (3-)5-10 mm broad; somewhat elastic at first, then fragile-brittle; equal, or unequal with the lamellulae rare and approaching the stipe closely; acute to subrounded in front; adnate, adnexed, or free; close to subdistant; often forked at or near the stipe; intervenose; entire; strongly acrid, the taste often also with a spermatic or oily component; yellowish white to pale yellow or pale orange yellow, sometimes tinged gray, often stained moderate or deep yellowish brown or deep brown.

STIPE (3.5-)5-11.5 cm long, (8-)15-35 mm thick; sometimes flared apically, otherwise subequal, subfusiform, or tapering or enlarging to the base; dry; subshiny or dull; puberulent to minutely scurfy apically,



FIGS. 42-46. *Russula subfoetens*. 42. Spores (Shaffer 6047). 43. Spores (Shaffer 5634b). 44. Hymenial pseudocystidia (Shaffer 6047). 45. Hyphal ends from pileus cuticle (Shaffer 6047). 46. Hyphal ends from stipe surface (Shaffer 6047).

elsewhere glabrous; longitudinally rugulose, sometimes scarcely so; solid at first, soon stuffed and cavernous and eventually hollow with a rough, deep brown to deep yellowish brown inner surface; white to yellowish white, in age stained basally with grayish yellow to dark orange yellow, light grayish brown to light yellowish brown, moderate yellowish brown to deep brown, or strong reddish brown, or rarely becoming pale grayish pink to light yellowish brown overall.

COLOR REACTIONS (pileus trama and stipe surface): SV pinkish gray or purplish gray; 10% FeSO_4 pale yellowish pink to grayish yellowish pink; 2% phenol grayish reddish brown to dark grayish reddish brown; formalin colorless or pale pink; guaiac quickly moderate to dark green; 3% and 30% KOH colorless to pinkish white, pale orange yellow, or pale yellowish gray (or, on stained areas of the stipe, light to moderate reddish brown); (stipe cortex): 3% and 30% KOH colorless, pale orange yellow, pale yellowish gray, or moderate orange.

SPORES pale orange yellow (slightly less pink than M&P 9B2 to nearly as dark as 9C2, slightly darker than Romagnesi Ib to as dark as Iic) in mass; $5.9-9.0(-9.5) \times 5.4-7.9(-8.5) \mu$ (rare giant spores are up to $\pm 14 \times 11 \mu$); usually broadly elliptic, broadly obovate, or subglobose, occasionally ovate or pip-shaped. **ORNAMENTATION** of convex to cylindric or bluntly conic warts and sometimes also short ridges, both up to $0.3-1.0(-1.3) \mu$ high, these units isolated, aligned, or clustered or with only a few connectives which may be attached to only one wart; occasionally forming a partial reticulum, never a complete one. **SUPRAHILAR AREA** with low, uneven, diffuse ornamentation or minute warts and ridges or both, or occasionally almost a plate.

BASIDIA $32-63 \times 6.8-14.7 \mu$; clavate; 4-spored.

HYMENIAL PSEUDOCYSTIDIA $45-102 \times 4.5-13.6 \mu$; subcylindric, clavate, fusoid-clavate, fusiform, or fusoid-ventricose; at times capitellate, appendiculate, or "extruded-inflated" apically, otherwise rounded to subacute; strongly SV+; arising in the subhymenium or outer part of the trama; embedded or projecting up to $40(-62) \mu$ beyond the basidioles; abundant.

SUBHYMENIUM $28-45 \mu$ thick; pseudoparenchymatous or almost so.

TRAMA with occasional, SV+, glassy to granular vascular hyphae, these more abundant just beneath the pileus cuticle than elsewhere.

PILEUS SUBCUTIS $120-580 \mu$ thick; with a gelatinous matrix; of horizontal- to ascending-interwoven, nongelatinous to gelatinous, hyaline to dark orange yellow or light yellowish brown (from a diffuse pigment) connective hyphae $1.0-5.7 \mu$ broad; also with common, SV+, dark orange yellow, glassy to granular vascular hyphae $2.3-7.9 \mu$ broad which are more common in the lower part of the subcutis than in the upper, the ends of these hyphae sometimes extending into the epicutis.

PILEUS EPICUTIS $40-62 \mu$ thick; with a gelatinous matrix; a trichoderm of nongelatinous to gelatinous, hyaline to dark orange yellow con-

nective hyphal ends 1.7–4.5(–6.8) μ broad which are filamentous (and usually subcylindric) or less commonly have inflated subapical cells, or end in pseudocystidia which are $11\text{--}70 \times 3.4\text{--}6.2 \mu$, subcylindric, clavate to fusiform, or lanceolate, often capitellate, and weakly to strongly SV+; distinct in young basidiocarps, but often scarcely visible in mature ones, the elements then scattered or in small clusters or trichodermial patches and often repent on the pileus surface.

STIPE SURFACE LAYER of longitudinal-interwoven, nongelatinous, hyaline connective hyphae 1.5–5.7 μ broad which give rise to projecting, scattered or clustered hairs up to 115 μ long, the hairs filamentous or with inflated subapical cells up to 25 μ broad and an apical cell which is often lanceolate, fusiform, or clavate and sometimes capitate, and may have SV+ contents; also with straight or tortuous, septate, strongly SV+ vascular hyphae 2.3–11.3 μ broad whose cylindric to clavate, sometimes capitate ends may project from the stipe surface.

Solitary, scattered, or gregarious on humus in deciduous (e.g., beech-maple, oak) or deciduous-coniferous (e.g., hemlock-hardwoods) forests.

Collections studied:

QUEBEC: Quebec Co.: Cap-Rouge, 2 Aug., 1967, *Shaffer 5634b*, Charlevoix Co.: Baie-St.-Paul, 17 Aug., 1967, *Shaffer 5904*.

WISCONSIN: Walworth Co.: Wychwood, Lake Geneva, 20 Jul., 1956, *Shaffer 906*. MICHIGAN: Emmet Co.: Pellston Hills, 8 Aug., 1968, *Shaffer 6097*. Cheboygan Co.: Grapevine Point, Douglas Lake, 15 Jul., 1968, *Shaffer 6047*. Alpena Co.: Sink Holes, north of Long Rapids, 7 Aug., 1971, *Shaffer 6819*. NORTH CAROLINA: Swain Co.: Kephart Prong Trail, Great Smoky Mountains Natl. Park, 9 Jul., 1970, *Shaffer 6166*; Deep Creek area, Great Smoky Mountains Natl. Park, north of Bryson City, 10 Jul., 1970, *Shaffer 6190*; Indian Creek, Great Smoky Mountains Natl. Park, north of Bryson City, 11 Jul., 1970, *Shaffer 6212*; Straight Fork, Great Smoky Mountains Natl. Park, 17 Jul., 1970, *Shaffer 6242*; two additional collections. NEW YORK. Suffolk Co.: Wading River, Aug., 1906, *Peck* (holotype of *Russula foetentula*, NYS).

The North American collections from which the above description was drawn resemble *Russula subfoetens* in the sense of Schaeffer (1952, as *R. foetens* var. *subfoetens*) and Romagnesi (1967) in their slender basidiocarp stature, clear pileus color, and less strong odor and taste when compared with *R. foetens*. The pileus cuticular elements are similar, as are the spores—in color, size, shape, and ornamentation pattern. However, in some collections the spore ornamentation may be up

to 1.3 μ high, in contrast to the upper limit of 0.75 μ given by Romagnesi. For *R. subfoetens*, Romagnesi emphasized the yellowing of the stipe cortex and other tramal regions upon exposure to air or alkali. None of my collections had trama that became yellow upon cutting. Those tested with KOH (*Shaffer 5904, 6047, 6097, and 6819*) were variable in their reaction, but none became distinctly yellow.

Peck's (1907) description and collection of *Russula foetentula* agree with the species here called *R. subfoetens*. He considered *R. foetentula* to resemble *R. foetens*, which in his sense is *R. laurocerasi* or perhaps a conglomerate of several species, in its almond-like odor and to differ in having closer lamellae and, usually, reddish brown or burnt sienna stains near the stipe base. Such stains are sometimes present also in other species of the subsection and do not seem significant taxonomically.

I have four collections (Tahquamenon Falls State Park, Luce Co., Mich., 3 Aug., 1964, *Shaffer 4012*; Rifle River, Ogemaw Co., Mich., 28 Sep., 1961, *Shaffer 3635*; Newfane Hill, Windham Co., Vt., 25 Jul., 1961, *Shaffer 3057*; and Newfane-Wardsboro Rd., Windham Co., Vt., 21 Aug., 1961, *Shaffer 3362*) that are now questionably assigned to *Russula subfoetens*, but may eventually be considered a different species. They differ from *R. subfoetens* in their generally smaller basidiocarps with darker, redder (not red!) pilei. The color difference is obvious even in properly dried pilei, which in these collections are dark grayish reddish brown (Light Seal Brown) centrally and moderate to strong brown marginally. Those of typical basidiocarps of *R. subfoetens* are strong brown to brownish orange centrally and strong yellowish brown to dark orange yellow marginally. The stipes of the four collections often have grayish red to dark reddish orange stains near the base, and because Peck (1907) emphasized reddish brown or burnt sienna areas at the stipe base for *R. foetentula*, I first used this name for the collections in question. However, the type of the latter name seems to be typical *R. subfoetens*.

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Alexander H. Smith, Director of the University of Michigan Herbarium, provided the collections and notes on which the description of the new species *R. cerolens* is based. Mrs. David Gilliam made the original drawings of microscopic structures and helped also with the manuscript of this paper.

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