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The Boletoidae of Florida

The Boletineae of Florida with Notes on Extralimital Species III.¹

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The Boletoidae are the central group of the Boletaceae, the most typical representatives of what we commonly call boletes. In general appearance, they resemble most closely *Boletus edulis* Bull. ex. Fr., the type of the genus *Boletus* which in its turn is the nomenclatorial type of the family Boletaceae and the subfamily Boletoidae. The preceding papers on the Boletineae of Florida dealt with the less typical "boletes," i.e., forms that are aberrant in important characters either of the spores and hymenium (Strobilomycetaceae), or in having clamped hyphal septa (Gyrodontoideae), or forms belonging to that characteristic type of obligatory symbionts of conifers (Suilloideae), or to a group with atypical tramal structure.

The Boletoidae are, as far as the number of species is concerned, by far the largest subfamily of the Boletaceae in Florida. This is in striking contrast with such boreal regions as most of Canada, the northern part of the Rocky Mountains, or Siberia where the Suilloideae undoubtedly maintain the first place in abundance and in importance. On the other hand, the genus *Boletus* and allied genera are supposed to be rare in tropical regions. Actually there seems to be a belt reaching from New Jersey south to North Florida where the number of boletoid species is unusually high, only to diminish both southward and northward without, however, disappearing wholly in either the tropical or in the boreal zone. The number of species is much higher in this continent than in Europe. Florida alone has 39 species of Boletoidae, not counting the species which are imperfectly known, and omitting the subspecies and varieties.

As for the determination of the genera (*Phlebopus*, *Pulveroboletus*, *Boletus*, *Xanthoconium*, *Tylopilus*, *Leccinum*) the reader is referred to the keys in part II² of *Boletineae of Florida* (Farlowia 2:225-230. 1945).

Subfamily Boletoidae, subfam. nov.

Fungi familiae Boletacearum, characteres subfamiliae Suilloidearum (Farlowia 2:250. 1945) haud reunientibus, tramate typice laterali-divergente;

¹ The first two monographs on Florida Boletineae, treating the Strobilomycetaceae and the Boletaceae subfamilies Gyrodontoideae, Suilloideae, and Xerocomoideae have appeared in Farlowia 2(1):97-141. 1945 and Farlowia 2(2):223-303. 1945. A fourth monograph, on the lamellate Boletineae, has appeared in Farlowia 2(4):527-567. 1946.

² The numbers in parentheses preceding the genera are those of the keys.

hyphis haud fibuligeris; sporis haud flavis in cumulo atque ellipsoideis submicroscopio; hymenophoris nunquam lamellosis.

Characters of the subfamily: see key, Farlowia, *l. c.* and the above Latin diagnosis. The type genus is *Boletus* Dill. ex Fr. em.

1(10). PHLEBOPUS (Heim) Sing., Ann. Mycol. 34:326. 1936.

Boletus subgenus *Phlebopus* Heim, Rev. de Mycol. 1:6. 1936.

Characters of the genus: The genus *Phlebopus* is represented by two species in Africa and at least two more in Asia, Europe and America where, however, the most striking characters of the stipe on which the genus was founded are almost completely lost. They thus become very similar to the species of *Pulveroboletus* from which they differ in the shape of the hymenophore which consists of relatively short to medium long tubes with a concave-arcuate lower surface at least in young specimens. The tubes are distinctly decurrent or at least show a decurrent tooth; they are never depressed around the stipe. The mycelium is very abundantly developed around the base and quite frequently forms some kind of pseudosclerotium. The context frequently changes to blue when injured. There is no veil. The African species, in addition to these characters have a conspicuously furrowed stipe. The spores of most of the species are ovoid-ellipsoid but in some forms of *P. sulphureus* they are more elongate, often cylindrical. The type species of the genus *Phlebopus* is *Boletus (Phlebopus) colossus* Heim.

KEY TO THE SECTIONS

- A. Stipe furrowed below. On the earth and on the base of *Coffea*-trunks. African speciesSect. *Colossi*
 A. Stipe scarcely or not furrowed on the base. On trunks and stumps of trees, also on sawdust (conifers, *Acacia*). Not occurring in Africa, at least not in tropical AfricaSect. *Sulphurei*

Section *Colossi*, sect. nov.

Stipite basin versus canaliculato. Species Africanae.

Characters of the section: see key and Latin diagnosis. The type species is *P. colossus* (Heim) Sing. The disposition of this latter species has been made by this writer on the assumption that the shape of the spores (Heim, *l. c.*, p. 11, fig. 2, 2), the hymenophore (*l. c.* pl. 1), and the absence of clamp connections (*l. c.* fig. 2, 1) as drawn in Heim's original figures correctly depict the subject. A fungus of much the same type but smaller and thinner, is *P. capensis* (Sacc.) Sing. The long, fusoid spores of the latter may be attributed to a parasite rather than to a bolete. Type material is not available at present.

Section *Sulphurei*, sect. nov.

Stipite ad basin vix vel haud canaliculato. Ad sarmenta et ad truncos.

Characters of the section: see key and Latin diagnosis. The type species is *P. sulphureus* (Fr.) Sing. (*Boletus sulphureus* Fr.)

KEY TO THE SPECIES

- A. Pileus dark brown to olive brown with a slight green shimmer; said to grow on wood of *Acacia* *P. viperinus*
 A. Pileus yellow; on pine, and coniferous sawdust 1. *P. sulphureus*

Description of the Species Occurring in Florida

1. *Phlebopus sulphureus* (Fr.) Sing. comb. nov.

Boletus sulphureus Fr., *Epicrisis*, p. 413. 1838.

Boletus hemichrysus Berk. & Curt., *Ann. Mag. Nat. Hist.* II. 12:429. 1853.

Boletus sphaerocephalus Barla, *Champ. Nice*, p. 72. 1859.

Versipellis sulfurea QuéL., *Enchir.*, p. 157. 1886.

Viscipellis sphaerocephala QuéL., *Enchir.*, p. 155. 1886.

Xerocomus sulfureus QuéL., *Flore Mycol.*, p. 419. 1888.

Ixocomus sphaerocephalus QuéL., *Flore Mycol.*, p. 415. 1888.

Boletus hemichrysus var. *mutabilis* Peck, *Bull. N. Y. State Mus.* 8:104. 1889.

Suillus sulphureus Kuntze, *Rev. Gen. Pl.* 3:536. 1898.

Ceromyces hemichrysus Murr., *Mycologia* 1:148. 1909.

Boletus sulphureus f. *sphaerocephalus* Konr. & Maubl., *Icon. Sel.* 6:469. 1937.

?*Boletus sulphureus* f. *silvestris* Kallenbach, *Ann. Mycol.* 22:410. 1924.

?*Boletus lignicola* Kallenbach, *Pilze Mitteleur.* 1:57. 1929.

?*Xerocomus lignicola* Sing., *Ann. Mycol.* 40:43. 1942.

Pileus almost "primulin yellow" when young, becoming "straw yellow," with the margin mostly "picric yellow" to "pale lemon yellow," faintly appressedly fibrillose-subvelutinous with velutinous margin but more or less glabrescent, slightly shining when properly dried, slightly viscid when wet but drying quickly, the outermost layer very soft and detersible when dried, and then the color "pinard yellow" at the margin, more "baryta yellow" with a tinge of "pale orange yellow" toward the center which in age becomes "antimony yellow," hemispheric, then pulvinate with umbo, or obtuse, with incurved, later lobed margin, 30-200 mm. broad.—*Hymenophore* yellow, initially arcuate-concave and adnate with a decurrent tooth or plainly decurrent; tubes up to 9 mm. long and of rather equal length from near the stipe to near the margin; pores about 3 per mm., their diameter individually very variable, from 0.5-0.75 mm. near the margin to up to 1 mm. near the stipe; spore print with a distinct olive shade.—*Stipe* as bright a yellow as the pileus, subglabrous or somewhat fibrillose when fresh, the fibrillosity appearing like pulverulence when dried, detersible, ventricose or with the basal portion tapering downwards, or in age tapering from the apex downwards, smooth but with the upper half often coarsely fibrillose-ribbed or venose, the apex often brown spotted in old specimens, solid, up to 100 x 35 mm.; mycelium bright yellow.—*Context* colored almost as the surface, bluing when injured, but the change is variable in promptness and intensity, absent in old and dry material; odor none; taste mild.

Spores 5.5-11 x 2.7-4.8 μ , ovoid-ellipsoid to cylindrical-oblong or cylindrical-subclavate, rarely tilda-shaped, thin-walled, brownish melleous to melleous-pallid, the more elongate the paler; *basidia* 12-28 x 6.8-7.5 μ , 4-spored, very few 2-spored (in the short-spored form only); *cystidia* 17-36 x 6-8.2 μ , very numerous on the pores, hyaline to deep melleous, naked or incrustated, fusoid-ampullaceous or fusoid-mucronate, or plainly fusiform; *trama* subhyaline, to

yellowish, the mediostratum deeper melleous, denser than the lateral stratum, the outer hyphae of the mediostratum somewhat diverging as are the hyphae of the loosely arranged lateral stratum, the mediostratum comparatively thick for a boletoid species, and progressively thickening while maturing and then not distinguishable from a trama of the *Phylloporus*-type; *cuticular velvet* deep canary yellow when seen in a thick layer but single hyphae almost hyaline, thin-walled, smooth, cylindric, equal, $3.5-7\mu$ in diameter; all hyphae without clamp connections.

Chemical reactions.—KOH on surface of pileus, brownish; on tubes and pores, deep castaneous; on context ochraceous brown. —NH₃ and NH₄OH on surface of pileus hardly reacting at all; on context provoking more bluing. —FeSO₄ on surfaces and on context negative. —H₂SO₄ on surface of pileus, very deep castaneous; on tubes and pores, orange-ochraceous; on context little reaction. —Formol little reaction.

Habitat.—On stumps of *Pinus palustris* (in Florida) and of other pines e.g. *P. strobus*, *P. silvestris*, etc., and also (in Europe) on sawdust from conifers even in sheltered places, fruiting practically the whole year but a given mycelium fruiting only at long intervals, rather rare everywhere.

Distribution.—In North America (known only from the eastern states) south to Florida, and also in Europe. In Florida it has been observed only in the northern part.

Material studied.—FLORIDA, CLAY Co. Green Cove Springs, Nov. 1925, *W. A. Murrill* (*Boletus hemichrysus*) (FLAS, FH);³ ALACHUA Co. Sugarfoot Hammock, June 1938, *Murrill* (*B. hemichrysus*) (FLAS);⁴ Flatwood 1 mi. east of Kelley's Hammock, July 1943, *R. Singer*, *F 2421* (FH);⁵ MASSACHUSETTS, Ellis, Sept. 1913, *E. B. Blackford* (FH).⁶ NEW YORK, Menando, *Peck* (NYS). SOUTH CAROLINA, Santee Canal, July 1849, *Ravenel*, 985 TYPE, (FH). ALABAMA, *Atkinson* (NYS). ENGLAND. A good colored picture of *Boletus sulphureus* Fr. by *Massee* (NY).

I am very doubtful whether or not the changing or unchanging character of the context or the relative length of the spores has any taxonomic significance. The bluing is not too strong, and may remain unnoticed. The collection from Green Cove Springs has elongate-cylindric as well as ellipsoid-ovoid spores in one single carpophore. The question as to whether or not *Boletus lignicola* Kallenbach is specifically, or maybe generically, different from *P. sulphureus* is much more difficult to answer, and has no immediate bearing on our Florida bolete. The bolete described by Corbière as *Boletus sphaerocephalus* from Cherbourg, France, is the same species as ours but as far as Barla's original *B. sphaerocephalus* goes, we can only assume that it is identical with Corbière's species. French authors will no doubt elucidate this situation later. As for the identity of *B. hemichrysus* and *B. sulphureus*, we can only state that the above description when compared with Fries' diagnosis and with more recent descriptions and figures (*Neuhoff apud Kallenbach*, *Corbière*, *Massee*) shows complete agreement.

³ This is a form with mixed (ovoid and elongate in the same hymenium) spores.

⁴ This is the elongate-spored form.

⁵ The short-spored form.

⁶ This, as all the collections from outside of Florida known to me, belongs to the form with elongate spores; so does the type.

Extralimital Species

Phlebopus viperinus, spec. nov.

Pileo obscure brunneo vel olivaceo-brunneo, leniter viridi-tincto viscidulo, cuticula in vetustis saepe fracta, semigloboso, sein convexo, dein plano, levi, admarginem tenui, 100-200 mm lato; hyphis terminalibus cuticulae cylindraceis, apice rotundatis, tenui-tunicatis; hymenophoro sulphureo, plus minusve concavo; poris minutulis, tubulis breviusculis (3.5 mm. longis in siccis), decurrentibus; sporis ellipsoideis, brunneolis, levibus, guttula magna instructis, 5-6.5 x 3.5-4.2 μ ; stipite pileo concolori, substriatulo, haud sulcato, cylindraceo, farcto, 70-120 x 7-13 mm., evelato; carne cremoricolori, laesa caeruleascente; hyphis haud fibuligeris. Ad folia putrida et ligna et sarmenta sub *Acacia*, Junio-Septembri.

This species is called *Boletus badius* Fr. by Mendoza (Philippine Mushrooms, Phil. Journ. Sc. 65:91. 1938) and kabuteng ahas, meaning snake mushroom in Tagalog (Filipino dialect). It is illustrated in pl. 54, fig. 1 by Mendoza, l.c., and the type is at the Farlow Herbarium. It is remarkable that in the Philippines the mushroom is thought to be poisonous, exactly as *P. colossus* is thought to be poisonous on Madagascar. It also occurs in Hongkong, U. S. N. Pac. Expl. Exp. C. *Wright* 212, det. Singer, CO-TYPE (FH).

Species Imperfectly Known

BOLETUS OVALISPORUS Clel., Toadst. Mushr., 2:191. 1935.

This may well be a *Phlebopus* but it is necessary to learn more about the shape of the hymenophore, the structure of the trama and the presence or absence of clamp connections before a transfer of this Australian species can be proposed.

BOLETUS FRAGICOLOR Berk., Hook. Journ. Bot. 4:137. 1852.

The well executed colored figure in Hooker's unpublished sketch book of Himalayan fungi suggests either a *Phlebopus* of this section or a *Gyrodon*.

2(11). PULVEROBOLETUS Murr., Mycologia 1:9. 1909. em.

Characters of the genus: Pileus viscid when wet, dry when observed in dry weather, cuticle usually (where studied) consisting of a cutis, more rarely of a trichodermium, often covered with the slender appressed hyphae of a veil that has a bright yellow (rarely inclining to greenish or orange) color and a pulverulent consistency, or else it is hyaline and glutinous; if there is no veil, there are nevertheless traces of a veil (the viscosity or some pulverulence on the stipe); the stipe is either entirely smooth or sometimes reticulate, usually subcylindric or somewhat thickened at the base but not typically bulbous-ventricose as in *Boletus*; tubes not or scarcely arcuate and usually more or less depressed around the stipe, usually rather long, and the longest tubes in the middle between stipe and margin, often very bright golden yellow to orange as never found in *Boletus*, and this color often very persistent after drying, the pores small to large, the trama truly bilateral-divergent though the difference

between lateral stratum and mediostratum not always strongly expressed in ammoniacal medium because of the solubility of the pigment; clamp connections none; spores typically elongate and either fusoid or ellipsoid-fusoid to subcylindric; cystidia usually rather large with the upper portion broadly inflated, or rather thin and ampullaceous; spore print olivaceous brown, e.g. "Isabella color," "orange citrine," "medal bronze;" context bluing only if a veil is present. Habitat: With coniferous and frondose trees.

This genus is easily distinguished from *Suillus* by the characters of the veil or its remnants, and the absence of glandular dots on the surface of the stipe; if a species has none of these characters, the incrustation of the cystidia and the chemical characters in combination with the presence of exclusive conifer-mycorrhiza point to *Suillus* while non-incrusted cystidia, and less active reactions of the usual reagents, in combination with an association with frondose trees points to *Pulveroboletus*. Some species in both genera have bright colored tubes. The dull red to pink color of the hymenophore is characteristic for *Suillus* while a vivid golden yellow to scarlet orange is more characteristic for *Pulveroboletus*.

The distinction between *Pulveroboletus* and *Boletus* is somewhat less easily achieved. Here again, the veil, if such is present, or its remnants, will help safely distinguish these genera. In case that there is no veil whatever, it is the sum of characters indicated in the key that decides to which genus a species belongs. One species of *Pulveroboletus* may also be looked for in *Boletus*, in fact, *P. retipes*, does not show, in a majority of cases, the yellow pulverulence of the pileus, and the cuticle is somewhat intermediate between a cutis and a trichodermium. Care should be taken not to confuse the pulverulent yellow basal mycelium of some species of *Boletus*, or the hymenial structure of the margin of the pileus which is yellow in one species of *Boletus* (*B. subsolitaris*), with the velar rudiments or remnants of a veil as found in *Pulveroboletus*. In general, the stipe of the Pulveroboleti is more slender than that of the Boleti.

The viscid and pulverulent species of the ancient genus *Boletus* have been united, in this paper, under one generic name for one positive and one negative reason. The latter consisted in the fact that the viscid species of what Gilbert called *Xerocomus*, i.e. sect. *Auripori* Sing., were found to have a truly bilateral trama, not one of the *Phylloporus*-type which, however, is similar in pigmentation when material in ammoniumhydroxide is compared, especially if the carpophores examined are not quite young enough. Since this group, consequently, is not closely related with *Xerocomus*, and also not with *Boletus* because of their habit (the very character on the basis of which Gilbert combined them with *Xerocomus*), it was natural to look for affinities in a group that is equally *Xerocomus*-like in habit but *Boletus*-like in structure, i.e. *Pulveroboletus Ravenelii* and closely allied species. It is obvious that the veil, still well developed in *P. Ravenelii*, gradually disappears in the other species allied to it, only to be found again as a more or less conspicuous viscosity on the surfaces of the pileus and stipe. A very strong similarity in important characters leads further to a few species where the viscosity of the stipe and the yellow pulverulence are no more constant characters though they can be noted in some specimens. Thus, we arrive at a definition of the genus *Pulveroboletus*

which may not be quite satisfactory to those who in the first place want a clear-cut definition in the Friesian style. But, on the other hand, our delimitation of *Pulveroboletus* will bring together a number of actually related species that cannot be placed satisfactorily in other genera. I trust that the taxonomists accepting this emendation of the genus *Pulveroboletus* will find it very convenient and natural after a considerate trial.

KEY TO THE SECTIONS

- A. Veil present, dry, sulphureus; context and tubes bluing or becoming green on injury or pressureSection *Flavovelati*
- A. Veil none, or not as described above; context neither bluing nor greening under any circumstances.
 - B. Veil none; stipe not glutinous, not viscid, nor markedly cartilaginous, and never hollow.
 - C. Stipe smooth(see under "D")
 - C. Stipe strongly reticulateSection *Reticulati*
 - B. Veil either present (glutinous), or absent, and then the stipe viscid to glutinous.
 - D. Glutinous veil presentSection *Glutinovelati*
 - D. Stipe glutinous or viscid in wet weather, but veil not developed.
 - E. Hymenophore bright yellow, or bright golden-olive yellow, remaining so in dried conditionSection *Auripori*
 - E. Hymenophore leather color to brownishSection *Cartilaginei*

Section *Flavovelati*, sect. nov.

Velo subpulverulento, sulphureo vel sulphureo-viridello, haud glutinoso, distincto.

Characters of the section: see key and Latin diagnosis. Type species: *P. Ravenelii* (B. & C.) Murr.

Description of the Species Occurring in Florida

2. *PULVEROBOLETUS RAVENELII* (Berk. & Curt.) Murr.

Boletus Ravenelii Berk. & Curt., Ann. Mag. Nat. Hist. II. 12:429. 1853.

Boletopsis icterinus Pat. & Baker, Journ. Straits Branch R. A. Soc. 78:68.1918.

Suillus Ravenelii Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Pileus testaceous or lateritious more rufous brown in the center but covered (especially on the margin, and in dry weather completely) by a sulphur yellow to lemon yellow ("strontian yellow" according to Coker & Beers) pulverulent, dry veil, viscid or subviscid beneath on the cuticle proper, glabrous or subglabrous aside from the veil, subpulvinate, then convex to nearly plane, 25-100 mm. broad.—*Hymenophore* lemon yellow, becoming alutaceous or sordid olive brown when older, and usually a beautiful cinnamon in dried specimens, bluing when injured, adnate but depressed around the stipe, occasionally arcuate when very young but soon becoming at least flat or convex; tubes 3-7 mm. long; pores small to medium sized (0.5-1.0 mm. in diameter), round or somewhat elongate, not dentate; spore print between "tawny olive" and "Saccardo's umber" in older prints, fresh prints not seen, but probably more olivaceous.—*Stipe* concolorous with the pileus and covered with the same yellow pulverulence which near the apex forms annular belts in some specimens while in others it adheres to the margin of the pileus, dry, occasion-

ally becoming minutely brownish, pustulate, solid, cylindrical or tapering downward, or ventricose in the middle, 30-100 (-145 according to Cokers & Beers) x 4-13 mm.; veil arachnoid-pulverulent, sulphur yellow to lemon yellow; mycelium whitish to yellow. — *Context* whitish to yellow in the pileus, yellowish, rarely whitish in the stipe, bluing slowly when wounded, in dry weather sometimes not bluing at all; taste slightly acid; odor none or peculiar "like hickory leaves" (Coker & Beers).

Spores 7.5-13.5 x 4-6 μ , most frequently 10-11 x 5-5.3 μ when quite mature, ovoid-ellipsoid, ellipsoid-oblong, or ellipsoid-cylindric, melleous, with supra-hilar depression; *basidia* 25-32 x 11 μ , 4-spored; *cystidia* 36-47 x 7-10.5 μ , hyaline or brown, fusoid, or subclavate, with a short and thin mucro; *trama* soon becoming indistinctly bilateral as in *Xerocomus* but in still closed specimens very distinctly truly bilateral of the *Boletus*-type, the lateral stratum strongly divergent and hyaline, the mediostratum honey yellow, of parallel-subinterwoven hyphae which are much denser than in the lateral stratum; veil consisting of loosely interwoven, long, filamentous hyphae of 3.5-6.5 μ in diameter, with thin hyaline walls, and hyaline cell-sap, the yellow color due to a sulphur yellow crystalline incrustation which is soluble in alkali; all hyphae without clamp connections.

Chemical reactions unknown.

Habitat.—On the earth or on rotten wood in frondose, mixed and coniferous woods, often in deep shade, fruiting from June till November.

Distribution.—From Maine to North Florida and Alabama, and from Hongkong to Singapore.

Material studied.—FLORIDA, GILCHRIST Co., Jennings Lake., Sept. 1938, *Murrill* (FLAS). MAINE, Kittery Point, edge of swamp, Sept. 1893, *Thaxter* (FH). VERMONT, Brattleboro, *Frost*, (under a herbarium name, unpublished), later collections as *B. Ravenelii* (FH). NEW HAMPSHIRE, Chocorua, Aug. 1910, *W. G. Farlow* (FH); Aug. 1907 (FH); Intervale, Sept. 1901, *Thaxter* (FH). MASSACHUSETTS, Randolph, Aug. 1897, *H. Webster* (FH); Williamstown, Sept. 1901, *Farlow* (FH). CONNECTICUT, Norwich, Sept. 1888, *W. A. Setchell* (FH). GEORGIA, Tallulah Falls, Aug. 1901, *A. B. Seymour* (FH); Rock Mountain, Sept. 1901, *A. B. Seymour* (FH). SOUTH CAROLINA, Santee Canal, *Ravenel*, 810, TYPE (FH). ARKANSAS, Oct. 1865, *J. M. Peters*, 17 (det. Curtis AUTH.) (FH). ALABAMA, *Earle* (comm. *Murrill*) (NY). HONGKONG, June 1854, *C. Wright*, 209 (det. Berkeley, AUTH.) (FH). SINGAPORE, Botanic Garden, *Baker* (TYPE of *Boletopsis icterinus*) (FH).

Since fresh Floridan material of this species could not be studied, our description is based on extralimital collections. The occurrence of this species in Eastern Asia is another example of one species having two seemingly or actually discontinued areas, one in eastern Asia and another in eastern North America. The veil of *P. Ravenelii* is surprisingly analogous to that of *Russula pulverulenta*.

Species Imperfectly Known

BOLETUS SUBGLOBOSUS *Clel. & Cheer*, *Trans. R. Soc. South Austr.* 47:63. 1923.

Without having seen the types, I would not transfer this species to *Pulveroboletus* though, judging from the description, it appears to be closely related to *P. Ravenelii*. It was described from South Australia.

BOLETUS FLAVIPES Berk., Hook. Journ. Bot. 6:135. 1854.

Said to have a mealy stipe like *P. Ravenelii*, this Himalayan species needs further study.

Section *Reticulati*, sect. nov.

Pileo stipiteve saepe flavo- vel aurantiaco-pulverulento, sed pulverulentia inconstante velumque haud efformante; stipite haud viscoso, fortiter reticulato.

Characters of the section: see key, p. 7, and Latin diagnosis. The type species is *P. auriflammeus* (B. & C.) Sing. (*Boletus auriflammeus* Berk. & Curt.).

KEY TO THE SPECIES

- A. Pores becoming deep orange *P. auriflammeus*
 A. Pores not becoming deep orange 3. *P. retipes*

Description of the Species Occurring in Florida

3. *Pulveroboletus retipes* (Berk. & Curt.) Sing. comb. nov.

Boletus retipes Berk. & Curt., Grevillea 1:36. 1872.

Boletus ornatipes Peck, Ann. Rep. N. Y. State Mus. 29:67. 1878.

Suillus retipes Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Suillus ornatipes Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Ceriumyces retipes Murr., Mycologia 1:151. 1909.

Pileus "cartridge buff," then deeper yellow, gradually approaching a tone near "light brownish olive" or "buffy brown," or bicolorous from the beginning, in dry condition "smoke gray" and "straw yellow," often with intermediate colors such as "yellow ochre," "Dresden brown," etc., often with a dry yellow pulverulence or pruina, especially on the margin, this pulverulence being more often seen on southern than on northern specimens, and showing an "apricot yellow" color, the cuticle proper viscid when wet, pileus pulvinate, with or without a narrow sterile margin, 40-180 mm. broad. — *Hymenophore* "baryta yellow" to "pinard yellow," the pores "aniline yellow," the tubes finally becoming "orange citrine," adnate or slightly depressed, pores staining "empire yellow" when injured, not closed at first, 0.3-1.0 mm. wide, in large specimens sometimes reaching 1.5 mm. in diameter, of irregular size and shape, tubes up to 12 mm. long, rarely longer; spore print "Isabella color," deeper and more rusty in thick, old prints. — *Stipe* with a strong and sometimes strongly raised (as in *Boletus Frostii*) network of "pinard yellow" color on "baryta yellow" ground, sometimes with the same superficial pulverulence that is observed on some caps, later becoming more sordid, solid, flexuous in many specimens, subequal or ventricose in the middle, more rarely tapering upward, 50-120 x 10-30 mm.; mycelium yellow, inconspicuous. — *Context* pale yellow, more deeply yellow when bruised (between "light cadmium" and "lemon chrome"), and eventually becoming "smoky gray," not bluing at any time; odor none; taste slightly to rather distinctly bitter.

Spores 9.8-13 x 3.7-4.8 μ , subcylindric-subfusoid, or fusoid with attenuate upper half, melleous; *basidia* 26-30 x 8.8-11 μ , 4-spored, rarely some 2-spored;

cystidia 33-45 x 5.5-7.5 μ , moderately numerous, little projecting, hyaline to melleous, frequently incrustated at the apex; *trama* truly bilateral of the *Boletus*-type, with a denser, fulvous brown (from dried material in NH_4OH), not very broad mediostratum and a strongly contrasting, strongly divergent, loosely arranged, subhyaline lateral stratum; *cuticle* consisting of repent, (2) - 7 - 7.7 - (9) μ thick cinnamon-melleous hyphae with cylindric-fusoid or clavate, sometimes rather short terminal hyphae, and at places where the tomentum is well preserved, the hyphae ascendant and the terminal members characteristically fusoid with mucro or appendage and dermatocystidioid; in neither case are the preterminal hyphae or chains of hyphae modified in any way, all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus beautifully yellow (about "strontian yellow"); on context solid gray.— NH_4OH on context negative where it had been stained yellow by autoxydation before; where not stained (freshly broken surface) deep yellow by action of the NH_4OH .— FeSO_4 negative.

Habitat.—In mixed frondose woods, especially under *Betula populifolia*, *Fagus grandifolia*, and various species of *Quercus*, gregarious in small, often cespitosely connate; fruiting from June till September.

Distribution.—From the Maritime Provinces in Canada south to North Florida and Alabama, and according to Murrill west to Wisconsin. In Florida rare.

Material studied.—FLORIDA, ALACHUA Co., Aligator Sink, Murrill, *F* 15691 (FLAS). NEW HAMPSHIRE, Shelburne, Farlow (FH); Lower Bartlett Thaxter (FH); Pequaket on Piper Trail, Mt. Chocorua, Linder & Singer (FH). VERMONT, Frost (under a herbarium name, later changed to *B. retipes*); another specimen from Brattleboro, Vt., with the determination *B. ornatipes* Peck and a note saying "This we once supposed to be *B. retipes*. B. & C." (FH). MASSACHUSETTS, Stony Brook Reservation, Linder (FH); Canton, Linder (several collections), (FH); Harvard, Singer (FH); Wakefield, Singer (FH). NEW YORK, Six Mile Creek, Kauffman (FH); C. H. Peck, TYPE of *B. ornatipes* (NYS). NEW JERSEY, Ellis (under a herbarium name), (FH). VIRGINIA Phifer, AUTHENTIC specimen of *B. ornatipes* (NYS). NORTH CAROLINA, Hillsborough, Curtis, 6414, TYPE (FH); Highlands, Alma Holland (Beers) & C. S. Mangum & W. C. Coşker, 9730 (FH). TENNESSEE, Crow Hollow, A. H. Smith, 9871 (FH); other Tennessee material at FLAS etc. ALABAMA, C. F. Baker (det. Singer), (NYS).

This species tends toward the genus *Boletus* because of the inconstant occurrence of the yellow pulverulence and the characters of the cuticle. It reminds one of *B. auripes* Peck in some peculiarities. Murrill has specimens under this name from two more points in Florida (Clay Co. and Gainesville), but the writer has seen no one in the season of 1943.

Extralimital Species

Pulveroboletus auriflammeus (B. & C.) Sing. comb. nov.

Boletus auriflammeus Berk. & Curt., *Grevillea* 1:36. 1872.

Boletus laeticolor Berk. & Curt., *apud* Curt., *Bot. N. Carol.*, p. 96. 1867 (*nom. nud.*).
Ceromyces auriflammeus Murr., *Mycologia* 1:147. 1909.

This striking species which is fairly common in most of our southeastern states, does not reach Florida in the south, or, at least, has never been collected

there. The trama of young specimens is very strongly truly bilateral with a hyaline, loosely arranged and strongly diverging lateral stratum, and a melleous, denser, axillar mediostratum. The cuticle is a modification of a cutis consisting of long, filamentous, interwoven hyphae which never form a palisade. As for the structure of the stipe see Yates, Univ. Calif. Publ. 6:248. 1916.

Section *Glutinovelati*, sect. nov.

Velo glutinoso.

Characters of the section obvious from the key, p. 7, and the above Latin characterization. Type species: *P. corrugatus* (Pat. & Baker) Sing. (*Boletopsis corrugata* Pat. & Baker).

Pulveroboletus corrugatus (Pat. & Baker) Sing. comb. nov.

Boletopsis corrugata Pat. & Baker, Journ. Straits Branch R. A. 78:68. 1918.

Young plants of the type (FH) show a persistent or evanescent annulus which is due to an entirely glutinous veil; the mycelium is white; the habit is much like that of *P. Curtisii*. The cuticle is formed by filamentous, 5.5-7 μ thick repent hyphae but beset with pyramidal, fasciculate strands of hyphae which are connivent with their upper ends, distantly septate, deep melleous, rather loose, parallel, the terminal members not differentiated and merely rounded at their apices and 6.5-7.8 μ thick; the pores are medium wide, the tubes rather long and convex beneath, depressed around the stipe; the spores have the color of these of *P. auriporus*, and are ellipsoid-fusoid with supra-hilar depression, 9-13.7 x 4.8-5.8 μ ; the trama is truly bilateral in young specimens, the mediostratum with denser, subparallel-subinterwoven, melleous hyphae, the lateral stratum with subhyaline looser and distinctly divergent hyphae, septa more numerous in the mediostratum; all hyphae without clamp connections. This has been described from Singapore.

Section *AURIPORI* Sing. (ut sectio generis *Xerocomi*), Ann. Mycol. 40:43. 1942.

Poris aureis vel laetissime olivaceo-aureis et in statu sicco; velo nullo vel haud abundante, luteo-pulverulento, haud glutinoso; pileo aut stipite aut ambobus viscidis; elementis hymenophori frequenter succo luteo-citrino repletis (in solutione ammoniac), cito diffundente.

Characters of the section: these are obvious from the key, p. 7, and the above Latin diagnosis. Type species: *P. auriporus* (Peck) Sing. (*Boletus auripes* Peck).

KEY TO THE SPECIES

- A. All cystidia narrowly and elongately fusoid with the thickest portion around the middle and the apical third usually more or less ampullaceous; either spores small (8.2-11 x 3.5-5 μ , rarely a few reaching 14 x 5.2 μ), or veil (though moderately distinct and rather fugacious) always present in young, fresh material.
- B. Veil present on the stipe; spores large: (13.5) -14.8- 18.5 - (20.5) x 4.5-6.5 μ ; pileus viscid and glabrous; mycelium white4. *P. subacidus*

- b. Veil absolutely none; spores smaller; pileus not or indistinctly viscid and then drying very fast, somewhat subflocculose-subtomentose when dry; mycelium yellowish *P. caespitosus*
 or if fusoid, rather short and with the thickest portion in the upper third; spores
- A. Not all cystidia as described above, either many of them or all of them clavate, medium to large: (9.2-18.5 x 4-6.8 μ); veil absolutely none.
- c. European plant with the pileus mostly pinkish ("onion skin pink" to "Japan rose," darker places reaching "ocher red" or almost "Indian red," more rarely colored about "vinaceous rufous" or "vinaceous pink"); stipe dry or, more rarely, viscid *P. gentilis*
- C. American and Asiatic plant with the fresh pileus not pinkish as above; stipe mostly distinctly viscid unless the gluten has been washed off by rain.
- D. Western plant with large pileus (60-90 mm.) and stout stipe (60-90 x 18 mm.); apex reticulate and beset with viscid granules *P. flaviporus*
- D. Eastern plant (a similar form also in China) with usually smaller pileus and slenderer stipe; apex often with decurrent lines but rarely reticulate, without viscid granules though sometimes faintly yellowish flocculose
5. *P. auriporus*

Description of the Species Occurring in Florida

4. *Pulveroboletus subacidus* (Murr.) Sing. comb. nov.

Ceratomyces subacidus Murr. Mim. Contr. Herb. Univ. Fla. Agr. Exp. Sta., Florida Boletes, p. 3. 1942. *nomen nudum*.

Pileo alutaceo-carneo vel ferrugineo-rubido, glabro, viscido, convexo vel plano, 60-105 mm. lato; hymenophoro laete flavo, adnato vel depresso, convexo, poris usque ad 2 mm. amplis; sporis in cumulo aeneo-olivaceis, circa 14.8-18.5 x 4.5-6.5 μ ; cystidiis 34-50 x 8-13.7 μ , fusoides vel ampullaceis; stipite albo vel pallide flavido, roseolo-zonato vel -striato apicem versus, plus minusve flavo-tincto vedi sparsi haud annuliformis gratia, sicco vel subviscidulo, levi, 50-65 x 12-18 mm.; mycelio albo; carne pilei flava, stipitis alba, immutabili, inodora, subacidula; hyphis non fibuligeris. Prope quercus in silvis siccioribus.

Pileus "pale cinnamon pink" with "buff pink" and "Japan rose" to "onion skin pink," more "pale cinnamon pink" toward the margin, at places "testaceous" to "cao brown," other caps "Hay's russett," partly "ferruginous" or "burnt sienna," and center often paler than this, viscid, glabrous, always scrobiculate or rugulose, at least on the margin, convex to flat, 60-105 mm. broad. — *Hymenophore* between "citrine" and "sulphine yellow" ("orange citrine" with more yellow pores when dried) becoming nearly "olive lake" when old, often surrounded by the white projecting sterile margin, adnate or depressed around the stipe, convex elsewhere; pores 0.5-2 mm. wide, darker and more sordid on pressure; spore print between "orange citrine" and "medal bronze." — *Stipe* white to pale yellow with "pale Congo pink" to "Congo pink" stripes or zone near apex, aside from this tinted yellow when fresh because of the veil, glabrous except for the veil, nearly or quite smooth, dry or very slightly viscid in damp weather, solid or almost so, tapering upward or subequal, 50-65 x 12-18 mm., apex 9-12 mm., base often acuminate; veil (thick layer) "lemon chrome" but forming no more than a sparse floccosity on the surface of the stipe, the floccosity being fugacious and mostly diluted in color because of the color of the stipe showing through, denser and more conspicuous at an almost annular zone or belt at the apex of the stipe, or below a consistently glabrous

zone of at least 5 mm. breadth, sheathing the lower portion of the stipe, or present at the apex as well as below, but often rather obsolete both above and below, and more like a superficial floccosity than an actual veil; mycelium white.—*Context* of pileus between “naphthalene yellow” and “barium yellow,” or partly paler, of stipe white, both unchanging, somewhat concolorous with the pileus immediately below the cuticle of the pileus; odor none, or slight, agreeable; taste somewhat acid, especially in the pellicle.

Spores (13.5) -14.8- 18.5 - (20.5) x 4.5-6.5 μ , well colored, brownish melleous, with thin to moderately thickened walls, subfusoid or ellipsoid-fusoid, either with out or with a suprahilar depression; *basidia* 22-23 x 10.5-13.7 μ , 4-spored; *cystidia* on pores 34-50 x 8.2-13.7 μ , hyaline, fusoid with the apex attenuate to an obtuse tip, more rarely more distinctly ampullaceous above; hyphae hyaline, forming a bilateral *trama*; veil of the stipe consisting of agglutinated, subparallel hyphae of 2.7-8.2 μ diameter, smooth, thin walled, filamentous, not always equal, dense, hyaline; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus little reaction, viz. a dull “cinnamon buff”; on the tubes “Prout’s brown,” then “mummy brown”; on the context negative, or weakly reacting to a dull “cinnamon buff.” —NH₄OH on surface of pileus “vinaceous gray,” later becoming a dull “cinnamon buff”; on tubegs merely becoming darker and sordid; on context of pileus greenish, on context of stipe negative.—HCl on surface of pileus “orange cinnamon,” same color obtained on tubes; on veil of stipe deeper yellow.—FeSO₄ on the context of the stipe little reaction.—Phenol on the context of the stipe little reaction.

Habitat.—On the earth and on trunks (e.g. *Sabal spec.*), near oaks (e.g. *Quercus virginiana*) in comparatively dry woods, solitary to subcespitate, fruiting from July to October. Rare.

Distribution.—Florida.

Material studied.—FLORIDA. PUTNAM Co., Lake Swann. August 1935, W. A. Murrill (FLAS); DADE Co., just outside Fairchild Tropical Garden near Miami, in a somewhat open stand of pines and oaks (no pines closer than 12 ft.), October 1942, R. Singer, TYPE (FH); ALACHUA Co., Payne’s Prairie, R. Singer, F 2952 (FH).

5. *Pulveroboletus auriporus* (Peck) Sing. comb. nov.

Boletus auriporus Peck, Rep. N. Y. State Cab. 23:133. 1873.

Suillus auriporus Kuntze, Rev. Gen. Pl. 3(2):595. 1898.

Ceratomyces auriporus Murrill, Mycologia 1:147. 1909.

Xerocomus auriporus Sing., Rev. de Mycol. 5:6. 1940.

Boletus viridiflavus Coker & Beers, Bol. N. Carol., p. 53. 1943.

Pileus “orange cinnamon,” “Mikado brown,” “hazel,” “Kaiser brown,” often marked with “pale pinkish cinnamon,” often (in dry as well as in very wet weather) with an olive tinge over part of the pileus in living condition but usually assuming the greenish or olive tones in dried condition, the dried pileus “spruce Y” with some “chipmonk” and a shade of “chutney,” margin more “hazel” (M. & P), or a mixture of “antique gold,” “hazel,” “cigarette,” “Oak briar,” reaching “Malay,” “cowboy,” occasionally near “Rembrandt” (M. & P.), the olive portions “banana,” “brass,” “rattan,” “burnished gold,” “samo-

var," "tinsel," "deep stone," "buckthorn brown," "gold," viscid to glutinous when fresh, shining and remaining shiny, or becoming subopaque in dried condition, glabrous or subglabrous, smooth, with even, slightly incurved, then more or less widely projecting sterile margin which is white beneath, pulvinate, somewhat expanding in age, 22-90 mm. broad. — *Hymenophore* "strontian yellow," "lemon yellow," or even richer and more brilliantly yellow, becoming more golden greenish in age, unchanging, scarcely changing its color in dried material, somewhat convex beneath, adnate but somewhat depressed or deeply depressed around the stipe in most specimens; tubes 8-20 mm. long, *i.e.* comparatively long; pores still brighter yellow than the tubes in dried condition, otherwise concolorous, irregular and some compound, 0.5-1.2 mm. wide, or 5 to 5 mm. radially, and 8 to 5 mm. transversely, of unequal level; spore print melleous-olive to brownish olive. — *Stipe* whitish and partly slightly tinged with cinnamon, in some specimens at length yellowish, the apex becoming nearly the color of the hymenophore, and the remainder pale yellow and still stained with pallid cinnamon, the base often deeper colored (like the pileus) but the very base again white, usually viscid to glutinous, the gluten drying out in very dry weather, and washed off in heavy lasting rains, more rarely only subviscid to practically dry in specimens with greenish or olive colors on the pileus, very rarely in others, glabrous or with a very faint floccosity (use lens) which is interrupted at places and usually light yellow, mostly solid until age, fusoid or tapering upward and with acuminate base, 25-78 x 5-15 - (25) mm.; veil absolutely none; mycelium white. — Context whitish but more or less concolorous with the cuticle in the upper part of the pileus, and eventually often yellow above the tubes and at the apex of the stipe, otherwise pure white in the stipe, everywhere unchanging (but "bruised places becoming brick red" in the stipe according to Coker and Beers for *B. viridiflavus*); odor none; taste somewhat acid.

Spores 9.2-17.7 x 4-6.5 - (8.8) μ , most frequently 11.5-14.2 x 4.5-5 μ , strikingly variable in shape and size in different collections as well as in a single preparation, pale golden melleous to deep brownish melleous, well colored when mature, subfusoid, to fusoid to elongate-ellipsoid with a slight or more often very sudden and distinct suprahilar depression, with thin or in old specimens very often somewhat (moderately) thickened walls; *basidia* 21-38 x (6) - 7.8-10.5 μ , 4-spored; *cystidia* of two types, (a) 27-56 x (6.5) - 9.5-15.5 μ , clavate, or clavate with a mucronate tip but not ampullaceous, often bright yellow because a minority of cystidia holds the lemon yellow fugacious pigment-solution in some cases longer than other hyaminal and tramal elements, (b) more fusoid, like these of *P. caespitosus*; the latter (b) type frequently absent, and mostly in the minority; if present, there may transitional forms between (a) and (b) be observed in some specimens; *trama* truly bilateral of the *Boletus*-type, the lateral stratum, loosely arranged and strongly bilateral and strongly divergent, the axillar mediostatum denser; the *pigment* of the trama unstable, bright lemon yellow, disappearing an ammonical solution in the course of a few seconds or minutes and being replaced by a pallid grayish cream coloring matter which is stable; the *pellicle* is a cutis consisting of interwoven, long-filamentous, irregularly arranged, cinnamon hyphae of 2.5-7.5 - (19) μ diameter, strongly reminiscent of the structure of *Leccinum rubro-*

punctum; some *dermatocystidia* present on the apex of the stipe; all *hyphae* without clamp connections.

Chemical characters not known but probably little different from those of *P. gentilis* where most reactions are not distinctive and weak.

Habitat.—On the earth on naked humus or sandy soil, rocks, etc., in northern woods under oaks and on shaded lawns, in the south in fragments of high hammock vegetation; solitary or in small groups, or rarely subcespitosae, moderately frequent in the north, fruiting from May until October, probably usually accompanying *Quercus spec.*

Distribution.—From New England to North Florida, west to Michigan and Alabama; also in China.

Material studied.—FLORIDA, ALACHUA Co. In and around Gainesville, *Weber* (det. Murrill) *F 15934* (“*B. auriporus?*”) (FLAS); *Murrill F 19319* (FLAS); *F 17974* (FLAS); *F 9870* (FLAS); *R. Singer F 2091* (FH); *F 2527* (FH); July 25, 1943 (no number) *G. Weber* (det. Murrill, as *Boletus flavimarginatus*, technically AUTHENTIC for *B. flavimarginatus* but mixed collection (FH); CLAY Co., Doctor’s Inlet *Murrill, F 19297* (FLAS); PUTNAM Co., Lake Swan, *L. & A. S. Rhoads, F 18197*, (det. Murrill) (FLAS). VERMONT, Brattleboro, *Frost* (as *B. glutinipes* *Frost*, later changed to *B. auriporus*) (FH); also as *Boletus auri[s]porus* *Peck* (NYS, FH). MASSACHUSETTS, Newton, *Farlow* (FH). RHODE ISLAND, East Providence, *Farlow* (FH). NEW YORK, New Baltimore, *Peck* CO-TYPE (NYS). NORTH CAROLINA, Chapel Hill, *W. C. Coker, 10661*, AUTHENTIC material of *B. viridiflavus*, (FH). GEORGIA, Tallulah Falls, *A. B. Seymour* (det. Singer) (FH); Tannery Brook, *A. B. Seymour* (det. Snell) (FH); also specimens from Connecticut, Washington D. C., Maryland, Michigan, Alabama, etc. in less well preserved condition but probably correct. CHINA, Hunan Prov., Ma-Ling-Tung, *Sinning Hsien, T. L. Liu* (“brownish above, deep yellow beneath, under bamboo forest”), *496* (FH).

The type from North Elba is not preserved as far as I could ascertain. The New Baltimore type is externally not too convincing but with the microscopical characters and the description at hand, it is satisfactory, inasmuch so, if the fact is considered that *Peck* consistently determined all later collections in the sense in which this species is described here. *Boletus caespitosus* was correctly distinguished from *P. auriporus* by *Peck* himself though described rather poorly with the emphasis put on the cespitose way of growth which is of small importance. *Boletus innixus* *Frost*, thought, by some, to be a synonym of *P. auriporus*, is hardly this species. The authentic specimens preserved here would rather suggest a species close to *Boletus* (or whatever the final generic disposition of it may be) *Roxanae* *Peck*, or *Xerocomus Boudieri* *Sing.* *Boletus glutinipes* *Frost* has evidently never been published after *Peck* advised *Frost* that he had already described this species under the name of *B. auriporus*. *P. flaviporus* (*Earle*) *Sing.* which *Kallenbach* placed in his list of synonyms of *Boletus auriporus sensu Kallenbach* (= *P. gentilis*), seems to be different from *P. auriporus* as well as from *P. gentilis* (see p. 17). *Boletus viridiflavus* *Coker & Beers*, according to authentic material received from the University of North Carolina, cannot be anything but the greenish form or stage of *P. auriporus*. This becomes understandable when we consider the fact that *Boletus auriporus sensu Coker & Beers* is at least partially based on specimens belonging to *P. caespitosus*. I have for a long time tried to distinguish *B. viridiflavus* from the typical *P. auriporus*, or from small-spored forms of the latter, or from specimens with more glutinous stipe, or from specimens with less olive

colored hymenophore. But no two of these characters were consistently correlated, and all kinds of combinations and intergradations made the distinction of forms impossible. The colors are products of weather conditions and age, the spores vary in younger and older, smaller and larger, diseased and healthy carpophores, and the viscosity of the stipe does not show a constant correlation with the size of the spores or the color of the carpophores. I have not seen the change of the flesh to brick red, indicated by Coker and Beers, but I do not think that this alone will prove to be a sound basis for distinction between the two species. *Boletus flavimarginatus* Murr. of which, according to Murrill (*Mycologia* 36:122. 1944), *B. viridiflavus* is a synonym is only partly identical with *P. auriporus*. Nomenclatorially, Murrill's change of mind on his own species does not mean that his type specimen which is different from *P. auriporus* (including *B. viridiflavus*) can be discarded. In a recent authentic collection, determined *B. flavimarginatus* by Murrill, and now preserved at the Farlow Herbarium, we found two species, *Xerocomus illudens* ssp. *xanthomycelinus* Sing. and *P. auriporus*. The unimportant character of a brighter yellow ring in the hymenophore has misled Murrill to combine two species which have nothing to do with each other.

Extralimital Species

Pulveroboletus caespitosus (Peck) Sing. comb. nov.

Boletus caespitosus Peck, Bull. Torr. Bot. Cl. 27:17. 1900.

This is generally considered to be a synonym of the preceding species though it is well distinguishable by several characters as pointed out in our key. It thus happens that *P. caespitosus* is sometimes determined as *Boletus auriporus* as, for example, by Coker & Beers. This also explains why, by these authors, *Boletus viridiflavus* (*P. auriporus*) is said to have larger spores than what is described as *Boletus auriporus*. Since so much confusion has been caused by the erroneous identification of *B. auriporus* and *B. caespitosus*, and no good description of *P. caespitosus* has been published thus far, we shall give a full description of it notwithstanding the fact that it does not occur (or has not been found) in Florida.

Pileus when young as well as in age about "Sudan brown," somewhat tomentose, not or not much viscid, smooth, sometimes slightly areolated, convex or becoming almost flat, 12-80 mm. broad. — *Hymenophore* "lemon chrome" and remaining so, or becoming still deeper golden to about "aniline yellow" when dried, adnate and slightly depressed around the stipe when mature; tubes 5-10 mm. long; pores unequal, small to medium (up to 1 mm. wide, rarely wider), concolorous; spore print "old gold." — *Stipe* concolorous with the pores above, gradually more brownish toward the base, brownish longitudinally striped, equal or slightly to strongly tapering upward but frequently the base again attenuate, viscid to glutinose on the surface, somewhat furfuraceous at the apex in some specimens 20-65 x 5-15 mm.; mycelium yellow; veil none. — *Context* yellowish white or with a purplish tinge near the surface of the pileus, and pale brownish in the lower part of the stipe, everywhere unchanging on exposure; odor none; taste mild or slightly subacid.

Spores 9.3-10.8 x 3.7-4.5 μ from print, otherwise 8.2-11-(14) x 3.5-5

(5.2) μ , pale melleous to melleous, ellipsoid-oblong to subfusoid; *basidia* 20-31 x 7.5-10 μ , 4-spored; *cystidia* 28-60-(80) x 6.8-12 μ , hyaline, fusoid with the upper part ampullaceous or more rarely tapering to a blunted cone, the apex (if cylindrical) about 3-5 μ thick, numerous at the pores, or sometimes rather scattered in mature plants; *trama* truly bilateral of the *Boletus*-type, a yellow solution leaving the elements of the hymenium when they are put in ammoniacal medium, this solution being destroyed in a few seconds or minutes.

Habitat.—On the ground, in mixed woods, probably always near frondose trees, caespitose but also often singly, fruiting during wet weather in summer and fall.

Distribution.—From Virginia south to North Carolina.

Material studied.—VIRGINIA, TYPE (NYS); also at Richmond, *Linder & Smart* (det. Singer) (FH). NORTH CAROLINA, Highlands, *Coker* (*Boletus auriporus*), 13414 (FH).

***Pulveroboletus gentilis* (Quél.) Sing. comb. nov.**

Boletus sanguineus var. *gentilis* Quél., Assoc. fr. avanc. sc. (1883):504. 1883.

Viscipellis sanguinea var. *gentilis* Quél., Enchir., p. 156. 1886.

Ixocomus sanguineus var. *gentilis* Quél., Flore Mycol. p. 413. 1888.

Boletus gentilis Kallenbach, Adna 4/5:18. 1925.

Xerocomus gentilis Sing., Rev. de Mycol. 5:6. 1940.

A rather complete description of this species and a good colored plate have been published by Kallenbach in *Pilze Mitteleuropas* 1:96, pl. 36, 1935 where it is called *Boletus auriporus* Peck. The American plant, however, differs in the characters outlined in the key, p. 12. Gilbert (*Bolets*, p. 137. 1931) proposed the name *Xerocomus cramesinus* (Secr.) Gilbert for the European species, but this as well as Gilbert's statement "*Boletus auriporus* Peck is close but different" was violently opposed by Kallenbach. Gilbert's statement on *B. auriporus* has meanwhile been verified by this writer. On the other hand, the identity of *B. cramesinus* Secr., *Mycogr. Suisse*, 3:39. 1833 is somewhat doubtful and at least impossible to prove. Thus the name cannot be used. It may be argued that the European species is merely a geographic race of *P. auriporus sensu lato* Kallenbach. This may be so. Yet, it seems to me that it is too early to combine the American and the European species under a single specific name so long as the distribution of these is not known better than at present. It is particularly important to find out about the status of the Chinese form mentioned here under *P. auriporus*. Good dried material of *P. gentilis* is preserved in the Höhnel Herbarium, (FH) under the name "*Boletus gentilis*." The trama has a very fugacious lemon yellow pigment which, in this young specimen, is not replaced by a more uniform and stable pigment; there is only one type of cystidia (type *a*) and the spores are the same as in *P. auriporus*.

***Pulveroboletus flaviporus* (Earle) Sing. comb. nov.**

Boletus flaviporus Earle, Bull. N. Y. Bot. Garg., 3:297. 1905.

Ceromyces flaviporus Murr., Mycologia 1:147. 1909.

This, in our opinion, is not identical with *P. auriporus* though it certainly appears to be very closely related. The dried pileus is like *Suillus luteus* in

color, and also corresponds in color to some forms of *S. auriporus*, without, however, a trace of green or olive in any of the numerous specimens distributed by Baker that I have seen. The same is true for the tubes which are between "light cadmium" and "aniline yellow" in well dried material. The carpophores are decidedly stouter than those of *P. auriporus* or *P. gentilis*. The stipe, at its apex, still shows the reticulation very clearly. The spores of the types are elongate-ellipsoid to more often fusoid with attenuate ends and suprahilar depression, with rather thick, well colored walls, 13-18.5 x 5.8-6.8 μ , i.e. with a larger average than in most specimens of *P. auriporus* and *P. gentilis*; the cystidia are broad and voluminous, hyaline in NH₄OH, 30-50 x 10.5-15.5 μ , the apex either broadly rounded or short-ampullaceous or tapering to a sub-acute cone, always broadest in the upper third; basidia about 32 x 10.5-14 μ . These specimens were collected under oaks in Santa Clara Co., California, C. F. Baker (Pacific Slope Fungi, 131).

Section Cartilaginei, sect. nov.

Velo nullo; hymenophoro haud persistenter aureo-luteo neque aurantiaco neque aureo-olivascense; stipite haud vel vix reticulato, raro subreticulato pro parte, plus minusve carnosocartilagineo, saepius cavo; carne plerumque aut constanter immutabili; fungi tropici vel zonam temperatam inhabitantes australiorem.

Characters of the section: see key p. 7, and the above Latin diagnosis. Type species: *P. Curtisii* (Berk.) Sing. (*Boletus Curtisii* Berk.). This and the other representatives of this section have not yet been found in Florida.

Pulveroboletus Curtisii (Berk.) Sing. comb. nov.

Boletus Curtisii Berk. apud Berk. & Curt., Ann. Mag. Nat. Hist. II. 12:429. 1853.

Boletus inflexus Peck, Bull. Torr. Bot. Cl. 22:207. 1895.

Boletus fistulosus Peck, Bull. Torr. Bot. Cl. 24:144. 1897.

Suillus Curtisii Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Suillus inflexus Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Ceratomyces Curtisii Murr., Mycologia 1:150. 1909.

Boletus carolinensis Beardslee, Journ. Elisha Mitch. Scient. Soc. 31:147. 1915.

The habit of this species is typical of *Pulveroboletus*, for it shows rather slender stipe, comparatively high, strongly convex pileus and small to medium sized carpophores. The mycelium is whitish. The stipe is not only viscid but of cartilaginous consistency and becomes hollow (a character also observed in some specimens of *P. gentilis*). The spores are (10.5)-11.2-15-(19) x 4.3-6.5 μ , mostly around 13 x 5 μ , sometimes as short as 13 x 7 μ , melleous to dull-golden-melleous, ellipsoid-oblong to subfusoid-ellipsoid, almost as variable in shape and size as in *P. auriporus*, the walls comparatively thick, suprahilar depression slight to distinct, mostly present; basidia 25-32 x 6-10.8 μ , 4-spored; cystidia inside the tubes somewhat seta-like in appearance because of the deep ferruginous brown color either in their lower part or in all parts, or becoming so, fusoid, with ampullaceous upper third, some not ampullaceous and these often with one to two septa and a small appendage, also clavate, 43-86 x 6.5-11 μ , mostly 57-70 x 70-8.7 μ if not non-septate; cheilocystidia are and remain hyaline, fusoid-ampullaceous, or filamentous-capitate, or fusoid-capitate, or of

the type of the septate bodies that are found in the tubes, about $1.5-7\mu$ thick if not septate, and originating in the trama; trama truly bilateral, of the *Boletus*-type with a very loose and pale lateral stratum and a colored mediostratum, but in the available material (which is rather close to fully mature), the mediostratum much broader than the lateral stratum. The cuticle consists of the same kind of hyphae as in *P. auriporus*, but these hyphae are hyaline and melleous only in thick layers (a cutis with gelatinous enclosures); surface of the stipe very similar to that of the pileus but forming a very thin layer, beneath which there is the cartilaginous cortex consisting of suddenly very strictly parallel hyphae which do not gelatinize and soon become thick-walled, long, filamentous, pale melleous, some with a brownish-ochraceous pigment; all hyphae without clamp connections. This species is found in pine woods in Pennsylvania, Virginia, the Carolinas, Kentucky and Alabama, and may eventually be discovered in adjacent regions, possibly even in North Florida.

Boletus inflexus Peck is certainly the same. I have examined the type (NYS). *B. fistulosus* Peck (NYS) does not differ from the type of *B. Curtisii* (FH). *Boletus rubropunctus* Peck put in synonymy with *B. inflexus* Peck by Murrill is quite different and belongs in *Leccinum*.

***Pulveroboletus rufobadius* (Bres.) Sing. comb. nov.**

Boletus rufobadius Bres., Bull. Soc. Myc. Fr. 6:XXXVII. 1890.

Suillus rufobadius Kuntze, Gen. Pl. 3(2):535. 1898.

This species was originally described from the Camerouns; we have (FH) material from Nengbe and from Ganta, Liberia, *G. W. Harley*, 58, 77. The pileus is golden brown to olive brown when fresh, 30-50 mm. broad, with the surface feeling like suede, convex, becoming flat; pores whitish brown, darker when mature, 15 per 10 mm., 5-6.5 mm. long; stipe concolorous with the pileus, brown on handling, solid or stuffed, darker furfuraceous, 60-100 x 5-6 mm.; context spongy, in the stipe rigid, pinkish tan color or light tan; spores 11-13 x 4.5-5.5 μ (up to 15 μ according to Bresadola); print the usual color of this group; basidia 30-36 x 8.5-9.5 μ , 4-spored; cystidia 38-41 x 4-7.5 μ , clavate-elongate to fusoid; cuticle of thin walled, hyaline, clampless interwoven 5-8 μ broad hyphae surface of the stipe consisting of thin-walled, hyaline, filamentous, long, parallel, 1.5-4 μ thick hyphae; these characters when added to the diagnosis given by Bresadola for the type seem to indicate that this species belongs to *Pulveroboletus* unless the tramal structure should unexpectedly be different from the truly bilateral type characterizing *Pulveroboletus*. The structure of the trama was not apparent in the material available. The external appearance is much the same as in the preceding species (see Bresadola, *Iconographia* 19, pl. 937. 1931.

***Pulveroboletus viscidulus* (Pat. & Baker) Sing. comb. nov.**

Boletus viscidulus Pat. & Baker, Journ. Straits Branch R. A. Soc. 78:72. 1918.

This species, described from Singapore, has the same habit as the two preceding species. The stipe is said to be somewhat shallowly reticulate-fibrillose. I do not think that this makes it comparable with the species of the section *Reticulati*. We find the spores of the type specimens (FH) to be 7.7-9.5 x 4-

5.3 μ , pale brownish melleous, ovoid-ellipsoid with a small central oil-drop, about twice as long as broad with a slight suprilar depression or with none at all; trama not investigable; cuticle not showing any particular structure in these specimens: all hyphae without clamp connections. *P. viscidulus* belongs in the neighborhood of the preceding species which it resembles a great deal. It differs from most species of *Pulveroboletus* in shorter spores.

***Pulveroboletus phaeocephalus* (Pat. & Bak.) Sing. comb. nov.**

Boletus phaeocephalus Par. & Baker, Journ. Straits Branch R. A. Soc. 78:70. 1918.

Described from Singapore, this belongs in *Pulveroboletus*. The data that can be gathered from the type specimens (FH), are conclusive enough to justify a transfer to this genus. The pileus is now a beautiful rusty brown color, the cuticle consisting of loosely arranged chains of equal, cylindrical, clampless, thin-walled hyphae with cylindrical broadly rounded terminal members of 14-38 x 5-7 μ , forming a trichodermium; spores melleous, thin-walled, smooth, ellipsoid to cylindrical, 9.7-14 x 5-5.5 μ (sometimes as short as 10.5 x 5.5 μ , or as elongate as 14 x 5 μ); cystidia on pores clavate, e.g. 20 x 5 μ ; hyphae of the trama hyaline; general appearance as in other *Pulveroboletus*; pores rather small; mycelium white.

3(12). *BOLETUS* Dill. ex Fr., Syst. Mycol. 1:385. 1821, *sensu stricto* Gilbert, Bolets, p. 96, 1931, *non* S. F. Gray, Nat. Arr. Brit. Pl. 1:640. 1821 (= *Polyporus sensu lato*), *nec Boletus sensu* Murr., Mycologia 1:10. 1909, R. Maire, Publ. Instit. Botàn. Barcelona 3:41. 1937 (= *Suillus sensu nostro*).

Tubiporus Paulet ex Karst., Rev. Mycol. 3:16. 1881. (Type *T. edulis*).

Dictyopus, Quél., Enchir., p. 159. 1886 (Lecto-type *D. edulis*).

Oedipus Bat., Bolets, p. 13. 1908 (Lecto-type *B. edulis*).

Boletus subgen. *Tubiporus* (Karst.) Konr. & Maubl., Icon. Sel. 6:452. 1924-1937.

Suillillus Murr., Mycologia 1:16. 1909 (Type *B. luridus* Schaeff.).

Cerionomyces Murr., Mycologia 1:144. 1909. (Type *B. crassus* Battara).

Xerocomus sensu Reichert, Pal. Journ. Bot. 3:292. 1940 (Type *B. impolitus* Fr.7.).

Characters of the genus: Spore print olive or at least brown with an olive hue ("olive brown," "dark olive buff," "brownish olive," between "buffy olive" and "yellowish olive," "light brownish olive," between "citrine drab" and "deep olive"); context white or yellow, sometimes partly red, bluing, rare-

7 Reichert's interpretation of the genus *Xerocomus* is contrary to the conception of all modern authors as well as of Quélet himself. It is a mere coincidence that *Boletus impolitus* is the first species mentioned. Reichert (*l.c.*) says: "But Singer (13) names as type species of the same genus the species *B. subtomentosus* which according to the rules of nomenclature cannot occupy this position because it was mentioned by Quélet only after *B. impolitus*." Which rules?, is all the comment I can make on this. As for the value of the genus *Xerocomus sensu* Reichert, it is impossible to find any character distinguishing it from *Boletus sensu stricto* unless the lack of reticulation on the stipe is seriously considered to be a generic character in the Boletaceae. The hesitancy of some authors regarding the generic position of *Boletus impolitus* was entirely due to the fact that the structure of the trama had not been used, then, for the distinction of boletaceous genera. This latter character has first been used by this author (1939) in order to separate *Xerocomus* from *Boletus*.

ly reddening or unchanging; stipe usually thick and fleshy, reticulate or flocculose punctate to flocculate-squamulose, rarely smooth and glabrous (use a lens), neither scabrous nor glandulose, dry and naked, in no stage and under no circumstances ever viscid or veiled; mycorrhiza with trees possibly not obligatory in some species, in others not very specialized as to the taxonomic position of the trees involved, or else with frondose trees; trama of the tube-walls truly bilateral, the lateral stratum broad, loosely arranged, strongly divergent, hyaline or nearly so, the mediostratum narrow, axillary arranged and denser than the lateral stratum, also more distinctly colored, the hyphae subparallel-subinterwoven, usually more frequently septate than those of the lateral stratum (septa about as close or nearly as close as those of the subhymenium); all hyphae constantly without clamp connections.

Murrill and R. Maire, applying the "first-species-rule," chose *Boletus luteus* L. ex Fr. as type species of *Boletus*. This rule, however, is not obligatory and should not be followed in this case since the first author who divided the Boletaceae (Suillidae, as he called them) into smaller genera, S. F. Gray, separated the genus *Suillus* with the type species *S. luteus* from the rest of the boletes, and Snell accepted this name. Thus, we have to come back to Gilbert's proposal to choose the type species of *Boletus* from those species not belonging to *Suillus* in the modern sense. This alternative lecto-type is *Boletus edulis* Bull. ex Fr. which we have accepted in 1936, and which is most satisfactory from a nomenclatorial as well as historical point of view.

KEY TO THE SECTIONS

- A. Fungi with white and unchanging context (or at least not bluing except for very rare cases in which a slight bluing is observed near the tubes), mild taste, distinctly reticulate or quite smooth stipe; elongate spores, and a cuticle not consisting of an epithelium.
 - B. Tubes white, later yellowish, eventually mostly greenish, pores occasionally slightly brownish; cystidia not strongly coloredSect. *Edules*
 - B. Tubes white, later grayish; cystidia strongly colored (melleous and brown) Sect. *Grisei*
- A. Fungi not combining all the above characters.
 - C. Stipe either reticulate or (rarely) entirely glabrous and smooth; pores never red; context mild or bitter though not containing poisonous matter; pileus never viscid.
 - D. Context whitish, or pale yellowish, usually more or less bitterish to strongly bitter, context, or at least tube-trama bluing when woundedSect. *Calopodes*
 - D. Context more or less yellow, mild, bluing or unchangingSect. *Appendiculati*
 - C. Stipe either reticulate and then pores red, or minutely to distinctly flocculose-punctate or flocculose-squamulose, never glabrous (except in very rare exceptional forms); context mild but sometimes containing poisonous matter; pileus viscid or dry.
 - E. Small to medium, rarely large species with the general appearance of *Xerocomus*, (i.e. stipe moderately broad and subequal to moderately thickened); pores in mature, medium sized specimens around 1 mm. wide, either distinctly open or daedaleoid-meandering when quite young, as seen under a lensSect. *Subpruinosi*
 - E. Medium to large, rarely small species with the habit of a typical *Boletus*, i.e. with comparatively thick or/and strongly ventricose stipe that is thickened either at the base, or at the apex, or in the middle; pores small, often stuffed when quite young, usually punctiform and not or little elongate, in medium sized, mature specimens rarely reaching an average diameter of 1 mm.Sect. *Luridi*

(E*. If the pores are small (less than 1 mm. in diameter) and yellow, the stipe finely furfuraceous, and the cuticle with a distinct epithelium, see
Genus *Leccinum*, sect. *Luteoscabra*)

Section EDULES Fr., Epicr., p. 420. 1838.

Genus *Oedipus* subgen. *Homosarcus* Bat., Bolets, p. 13. 1908.

Characters of the section: these are obvious from the key, p. 21. Type species: *B. edulis* Bull. ex Fr.

KEY TO THE SPECIES

- A. Stipe smooth, or at least not reticulate; pileus viscid*B. Athinsonianus*
 A. Stipe more or less reticulate; pileus somewhat viscid, or dry.
 B. Apices of the terminal members of the cuticular hyphae-chains clavate and broadly rounded, not forming a definite palisade.
 C. Terminal members of the cuticular hyphae-chains erect but more or less connivent at least at places where the cuticle breaks; pileus "cinnamon brown" or "Prout's brown," "sepia," "mummy brown," "Dresden brown" or more olive than these, becoming paler and more yellowish at least near the margin, with a coarse, densely granular-subtomentose to fibrillose-squarrose cuticle (like *Boletellus mirabilis*), fibrils of this covering often agglutinate because of a fugacious visciditv. Western species*B. olivaceobrunneus*
 C. All cuticular hyphae strongly interwoven, the terminal claviculae often oblique but not connivent; pileus not deep brown (in Florida specimens), never tending to olive, glabrous or evenly subtomentose, often distinctly and persistently viscid*B. edulis*
 D. Pileus reddish brown or yellowish brown with more ochraceous margin; stipe tapering from a very thick base; in coniferous woods
(2) *B. edulis* ssp. *clavipes*
 D. Pileus purplish or uniformly deep red-brown; stipe usually ventricose, also often tapering upward*B. edulis* (various subspecies).
 B. If the cuticular layer is completely developed, the epicutis consisting of an often disrupted but distinct trichodermium-palisade which forms a tomentum that is easily scratched off or washed off; terminal members of the palisade not or only exceptionally clavate*B. aereus*

Description of the Species Occurring in Florida

6. *BOLETUS AEREUS* Bull. ex Fr., Syst. Mycol. 1:393. 1821, *pro parte* (*sensu* Bat.)

Plate 1, Fig. 2

Boletus aeneus Rostk. in Sturm, Deutschl. Flora, 3:109. 1844.

Boletus vaccinus Fr., Epicr., p. 420. 1838 *sensu* Velenovsky, Cesk. H. p. 703. 1922.

Boletus reticulatus Boud., Bull. Soc. Mycol. Fr. 23:321. 1876, *an* Schaeffer; *non* Hook. in Kunth, Syn. Pl. 1:(9). 1822, *nec* Secr., Myc. Suis. 3:39. 1833.

Dictyopus aereus Quél., Enchir., p. 159. 1886.

Boletus variipes Peck, Ann. Rep. N. Y. State Mus. 41:76. 1888.

Boletus Athinsoni Peck, Bull. N. Y. State Mus. 94:20. 1905.

Boletus nobilis Peck, Bull. N. Y. State Mus. 150:48. 1905.

Boletus edulis var. *reticulatus* Bat., Bolets, p. 14. 1908.

Boletus Gertrudiae Peck, Bull. N. Y. State Mus. 64:50. 1911.

Tubiporus aereus Ricken, Vademecum, p. 206. 1918 (*descriptione exclusa*).

Boletus edulis ssp. *aereus* Konr. & Maubl., Icon. Sel. 6:454. 1924-1937.

Boletus edulis ssp. *reticulatus* Konr. & Maubl., Icon. Sel. 6:453. 1924-1937.

Tubiporus edulis ssp. *aereus* R. Maire, Publ. Institut. Botàn. 3:45. 1935.

Tubiporus edulis ssp. *reticulata* R. Maire, Publ. Institut. Botàn. 3:45. 1935.

Pileus "buckthorn brown" and often with a much deeper, "chukker" (M. & P.), shade at least at places, often purplish or vinaceous at places, sometimes producing the effect of "sayal brown," finely velutinous to tomentose when young, then glabrescent in many specimens and eventually usually cracking in large, irregular, areolate fragments, or minutely rivulose, never viscid, pulvinate, then less convex and eventually often flattened, 50-192 mm. broad.—*Hymenophore* white, at length greenish yellow, depressed around the stipe; tubes rather long, about 6-33 mm.; pores very small, initially punctiform and "stuffed," up to 0.5 mm. in diameter when mature, concolorous; spore print "olive."—*Stipe* "cinnamon buff" with a flush of "light pinkish cinnamon," or concolorous with the pileus but paler than "buckthorn" or "sayal brown," reticulate in the upper two thirds or more, more rarely only at the apex and even there occasionally so slightly that it may be overlooked (*B. vaccinus* Fr. ?), glabrous, solid, fleshy, tapering from a swollen, bulbous base or ventricose-fusoid with the thickest part near the middle, more rarely thick-cylindric, spongy and soft in the interior in old specimens, up to 95 x 40 mm.—*Context* white, sometimes somewhat brownish pink under the cuticle, unchanging in all parts or rarely very slightly and indistinctly becoming pinkish where cut; odor none in fresh material, but strongly cumarinous in dried material (more so than in *B. edulis*); taste mild.

Spores 11.5- 17 x 4.5-6 μ , bright melleous to brownish melleous, usually broadest in the lower third and gradually tapering toward the apex, more rarely more exactly fusoid, with or without suprahilar depression or applanation; *basidia* 24-40 x 8.8-12 μ , 4-spored; *cystidia* 24-42 x 7.5-14.3 μ , ventricose-mucronate or fusoid-ampullaceous, few to fairly numerous on the pores, very scattered in the tubes, hyaline; *trama* truly bilateral, of the *Boletus*-type, not different from that of *B. edulis* (see next following species); *cuticle* of interwoven hyphae which are brown when seen in dense strands, superposed by a deterrent and often interrupted but, in young undamaged specimens, very distinct trichodermium-palisade, the latter consisting of hyaline or slightly colored, erect hyphae-chains, the hyphae cylindric or subulate with rounded to rarely acute tip on the terminal members which measure between 11-55 μ in length and 5.8-10.2 μ in diameter, the subsequant, lower member 13.5-20.5 (50) x 6.5-10.2 μ ; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—Lawns and open woods, in Florida under *Quercus virginiana*, *Q. laurifolia*, *Q. laevis* and under other species of *Quercus* farther north and in Europe, possible also under other frondose trees, such as *Castanea*, *Betula*, *Fagus*, always on the ground, frequent in North Florida from May till October.

Distribution.—In New England and south to North Florida, west to Michigan and possibly to the Pacific Coast and Mexico, also in Europe (excepting northern Europe) and North Africa, and East Asia.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, R. Singer, F 1886 (FH); F 2206 (FH); Newnan's Lake, R. Singer F 2176/1 (FH); MASSACHUSETTS, Canton, D. H. Linder (det. W. H. Snell as *B. Atkinsonii* aff.), 1276 (FH). NEW YORK, Menands, TYPE of *B. varipes* Peck (NYS); Port Jefferson, types of *B. Atkinsonii* Peck and *B. nobilis* Peck, (NYS). CONNECTICUT, Old Lynn, TYPE of *B. Gertrudiae* Peck (NYS). Also several collections of fresh material from SPAIN, Catalonia etc.

This is the "cèpe d'été" of the French market (hence Paulet's name *B. aestivalis*, pre-Friesian, and misunderstood in later years), and, if colored dark enough, it becomes the "cèpe noir," the *B. aereus* Bull. *p.p.* Since Fries accepted Bulliard's species in 1821, distinguishing like Bulliard himself two forms or varieties (a) with snow white, and (b) with pale sulphureous flesh, we may well choose as the type the form (a) which is the *B. aereus* in the above description. In Fries' index, p. 515, we find, for the first time, the spelling *B. aeneus*, but it seems to me that the spelling in the main text should be accepted. Kallenbach gives a rather good picture of the dark form as found in Central Europe (cèpe noir), but the best illustration of our Florida plant which is more often ochre brown than blackish brown, may be found in Kawamura, Illustr. Japan. Fungi, pl. 140. 1930. This is the common species of the section *Edules* in Florida, and could be used for food to a great extent since it is easy to recognize and grows in the back yards of many homes in large numbers. It is as delicious an edible fungus as *B. edulis*.

Velenovsky calls this *B. vaccinus* but it is not certain that it is Fries's *B. vaccinus*. *B. reticulatus* in the sense of Boudier and many other French authors is the lighter colored form of this species, but this name cannot be used since it was validated by Boudier as late as 1876, 55 years after *B. aereus* had been validated by Fries. Besides, doubts have been expressed as to the identity of Schaeffer's plate which in a later edition is described as bluing. *B. Gertrudiae* Peck is described in a manner that would suggest a much more yellow species, but the specimens are indistinguishable from other pale forms of *B. aereus*. Peck did not see it in fresh condition, and the notes available may have been insufficient or misleading. In *Sturm's Flora*, Rostkovius called this *B. edulis*, and *B. edulis sensu* Secr. is also partly this species. It is likewise listed as *B. edulis* in Murrill's Florida Boletes (1942), and is considered to be a subspecies of *B. edulis* by Konrad & Maublanc and other French writers. However, once the anatomical differences of the cuticle are understood, it becomes perfectly clear that *B. edulis* and *B. aereus* are two different species. Peck subdivides his *B. varipes* which is the same as *B. aereus*, into three varieties, according to the characters of the reticulation of the stipe, but I am unable to state whether this is of any taxonomical importance at all. Lohwag and Peringer studied what they called *B. edulis* ssp. *reticulatus*, their indications on its anatomy, however, make it possible to think that they had either specimens of *B. aereus* that had lost their tricholermium-palisade, or *B. edulis* ssp. *euedulis* that had strongly cracked surface because of a sudden decrease in humidity.

7. BOLETUS EDULIS Bull. ex Fr., Syst. Mycol. 1:392. 1821, non Rostkov.

Plate 1, Fig. 1

Leccinum edule S. F. Gray, Nat. Arr. Brit. Pl. 1:647. 1821.

Boletus esculentus (Caesalp.) Persoon ex Persoon, Mycol. Eur. 2:131. 1825.

Boletus limatulus Frost, Bull. Buff. Soc. Nat. Sci. 2:104. 1874.

Tubiporus edulis Karst., Rev. Mycol. 3:16. 1881.

Boletus filiae Gill., Tab. anal. Hym. p. 143. 1884.

Dictyopus edulis Quél., Enchir., p. 159. 1886.

Boletus bulbosus Schaeff. ex Cehroet. in Cohn, Krypt. Fl. Schles. 3:499. 1888.

Cyrodon filiae Sacc. & Cub., Syll. Fung. 6:53. 1888.

Suillus bulbosus Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

- Ceriumyces crassus* Batt. ex Murr., *Mycologia* 1:149. 1909.
Boletus crassus (Batt. ex) Jacz., *Opred. Grib.* 1:594. 1913.
 ?*Boletus frustulosus* Peck, *Bull. Torr. Bot. Cl.* 24:146. 1897.
 ?*Ceriumyces frustulosus* Murr., *Mycologia* 1:145. 1909.

Subspecies EUEDULIS R. Maire, *Publ. Inst. Bot.* 3:44. 1935 *ut Tubiporus*.

This has not been observed in Florida but I have seen specimens from Oregon which probably belong here (comm. A. H. Smith, 19130, 20001, MICH).

Subspecies CLAVIPES Peck, *Rep. N. Y. State Mus.* 51:309. 1899 *ut var.*

Pileus "ochraceous tawny," or between "pecan brown" and "Kaiser brown," sometimes with a slight tinge of "cameo brown," also "hazel" or "auburn," the margin discolorous, paler and nearly always with a yellow tinge that may be more or less apparent according to age and weather ("yellow ocher," "mustard yellow," or even "ochraceous orange" at first), occasionally the pileus more yellow than brown, glabrous or subglabrous, slightly and not persistently viscid to distinctly viscid when wet, smooth, pulvinate, finally convex-applanate, 65-120 mm. — *Hymenophore* white, then near "yellow ocher" and eventually sordid green, the pores often becoming "chestnut brown," adnate but soon strongly depressed around the stipe; tubes long; pores small; spore print "olive brown." — *Stipe* pale brownish, pale reddish brown, smooth, except for a fine but distinct reticulation running down the stipe (from reticulate in the upper third to four-fifths approximately), glabrous, thick-cylindric and sometimes slightly to decidedly tapering upwards, never subfusoid-ventricose as in the European type, solid, fleshy, up to 130 x 35 mm. — *Context* white, sometimes slightly pinkish after a while in some parts, usually with a narrow bron?ish zone under the brownish portion of the cuticle; odor none, somewhat cumarinous when dried; taste mild.

Spores 13-17-(21) x 3.5-5.8 μ , melleous, fusoid, with suprahilar depression; *basidia* 30-40 x 6.8-11 μ , 4-spored; *cystidia* 36-48 x 4.5-12 μ , variable in shape and size, the thickest portion either near the middle or in the upper third, with an apiculus or mucro at the tip, or ampullaceous above, usually more or less subfusoid to fusoid, the thickest and most conspicuous cystidia crowded on the pores; *trama* truly bilateral of the *Boletus*-type, sometimes entirely hyaline, sometimes with a slightly colored (pale melleous) mediostatum which is formed by parallel-subinterwoven axillar hyphae, and an always hyaline, much looser lateral stratum made up of strongly divergent hyphae; *cuticle* made up of thin hyphae which are not consistently erect and usually strongly interwoven in all layers of the cuticle, or at least combined in interwoven strands of hyphae, the terminal members of which are inflated at the apex to form distinct clavicularae or capitate bodies which to the inexperienced may resemble a cellular structure; *trichodermium-palisade* not observed in any stage; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus darkening; on context "ochraceous tawny" or paler than this; on tubes brown. — NH₄OH on context pale yellowish. — FeSO₄ on context of stipe negative. — Methylparamidophenol negative everywhere.

Habitat.—In coniferous woods usually with some frondose trees (oaks, poplars, birches) scattered around, more rarely in pure stands of conifers, possibly also under birches alone; usually gregarious, sometimes solitary, on sandy, rocky, and humose ground, fruiting from May till October. Frequent in most of the eastern states but rare in Florida.

Distribution.—From Canada and New England south to North Florida and west at least to Utah.

Material studied.—FLORIDA, ALACHUA Co., near Newnan's Lake under *Pinus taeda* and *P. palustris*, the nearest oak 18 ft. away, May 30, 1943, R. Singer, F 2716/III (FH). NEW YORK, TYPE of *B. edulis* var. *clavipes* Peck (NYS); Newcomb, under *Abies balsamea* and *Picea rubra*, with some *Populus tremuloides* intermixed, September 17, 1941, R. Singer 254 (FH). MAINE, Bar Harbor, Oct. 1935, E. E. Morse, (FH). NEW HAMPSHIRE, Alton Bay, under *Pinus*, *Tsuga*, *Betula*, July 24, 1944, D. H. Linder (det. Singer) (FH). MASSACHUSETTS, Arnold Arboretum, Oct. 1944, R. Singer with Boston Mycological Club (not preserved). UTAH, SALT LAKE Co., Big Cottonwood Canyon, under *Abies lasiocarpa* and *Picea Engelmannii*, in 9600 ft. elevation, August 3, 1936, G. D. Darßer, (det. W. H. Snell), 6065 (FH).

This subspecies differs from the usual European type in its color and the shape of the stipe which, however, is not as good a character, in itself, as Peck may have thought. The clavicate hyphae-ends in the cuticle make it easy to distinguish this from *B. aereus* in Florida. The Florida collection is scanty and represents the only specimen I have seen thus far as far south as this. It grew in the neighborhood of *B. aereus* in spring but did not reappear, at least in the following summer, with the latter species. Peck (Boleti of the United States, p. 133) says that this "variety scarcely differs from var. *pachypus* R. & R. except in being reticulate to the base." Since our specimens were not all reticulate to the base, especially not the northern collections, it may seem to be logical to refer our plants to this variety of Richon & Roze. However, the pictures are different and do not look like the American subspecies. They lack the yellowish tinge on the margin.

B. frustulosus Peck is preserved at Albany. I think it is *B. edulis*, or possibly an old *B. aereus* that has lost its trichodermium-palisade, a pale and frustose (i.e. deeply rimose) form, the latter character being a strictly meteorological one. The specimens collected by Earle and referred to this species by Murrill (NY as "type 1") may be an undescribed species, possibly of the Strobilomycetaceae, and certainly quite different from the actual type (NYS, part of it in NY).

B. edulis and its subspecies are excellent edible mushrooms. They were imported, up to the present war, to this country from Eastern Europe in dried as well as pickled form notwithstanding the fact that they are equally frequent in American woods.

Extralimital Forms and Species

Boletus edulis Bull. ex Fr. ssp. *separans* (Peck) Sing. comb. nov.

Boletus separans Peck, Bull. Buff. Soc. Nat. Sci. 1:59. 1873.

The cuticle of young, well preserved specimens is sometimes somewhat tomentose but even then the tomentum consists not of a trichodermium-palisade but of hyphae that are interwoven and interlaced in all directions, and

the terminal hyphae reaching the surface of the pileus, are strongly thickened, clavate or capitate, exactly as in ssp. *clavipes* Peck. The main difference between this and the other subspecies of *B. edulis* consists in the color of the pileus and stipe which is purplish; also, the hymenophore tends to separate from the apex of the stipe, and Coker & Beers think that the spore print is somewhat less olive. I have seen no fresh spore prints of this subspecies, but if there should be a constant difference between the color of the prints in these forms, as there seems to be between *B. edulis* ssp. *clavipes* and *B. aereus*, this would serve as a reason for specific distinction. However, Coker & Beers also say that they find intergrading forms which would suggest that none of these characters is completely constant. *B. edulis* ssp. *separans* occurs from New York to North Carolina.

BOLETUS EDULIS Bull. ex Fr. ssp. PINICOLA Vitt., Funghi Mang., p. 168. 1835 (*ut* var.)

Boletus pinicola Vent., Mic. Agro Bresc., p. 39. 1863.

Dictyopus edulis var. *fuscuber* Forqu. apud Quéll., Assoc. fr. av. sc. (1889):511. 1889.

Boletus edulis var. *fuscuber* Bat., Bolets, p. 14. 1908.

Tubiporus edulis ssp. *pinicola* R. Maire, Publ. Inst. Bot. 3:45. 1935.

This subspecies of *B. edulis* has not been studied anatomically by the writer but if I understand Lohwag & Peringer's analysis correctly, they find the same swollen claviculate hyphae-ends of the interwoven trichodermium that I observed in ssp. *clavipes* and ssp. *separans*. This and the macroscopical characters seen by the writer in numerous collections of fresh material in Germany, Italy, Finland, and the U.S.S.R. seem to indicate that Vittadini's plant belongs to *B. edulis* as an autonomous subspecies, more precisely, the European conifer race. It has never been found in America, I believe.

BOLETUS OLIVACEOBRUNNEUS Zeller, Mycologia 27:457. 1935.

This seems to be distinct from *B. edulis* as well as from *B. aereus*. Good specimens that were referred to this species by A. H. Smith after comparison with specimens so determined by Snell, and also by this writer, have a characteristic appearance that does not recall *B. edulis*. But it evidently belongs in this section, and is even closely related with *B. edulis* itself. For more detailed indications on this species see the key, p. 22.

BOLETUS ATKINSONIANUS (Murr.) Sacc. & Trott., Syll. 21:236. 1912.

Ceromyces Atkinsonianus Murr., N. Am. Flora 9:144. 1910.

A specimen that obviously belongs to this species was collected by W. C. Coker and Alma Holland (Beers) at Highlands, N. C. The spores of this are fusoid with a slight suprahilar depression, melleous, smooth, 12.6-13.6 x 4.4-8 μ ; basidia 4-spored, 20-31 x 8.2-10.2 μ ; cystidia very scattered even on the pores, hyaline, fusoid with the ventricose portion in the middle and the apex ampullaceous, up to 45 x 7 μ ; hyphae without clamp connections.

Macroscopically, this reminds one of *B. edulis* to which it is no doubt related, differing in "cartilaginous" and longitudinally striate instead of fleshy and reticulate stipe. It has been observed thus far only in North Carolina and Georgia, and may also occur in North Florida. Coker & Beers and Murrill agree that *B. obsonium* (Paul.) Fr. *sensu* Atk. *non al.* is the same species.

Phylogenetically, this species links the section *Edules* of the genus *Boletus* to the section *Cartilaginei* of *Pulveroboletus*, thus offering an analogous case with *B. retipes* which links the section *Appendiculati* of the genus *Boletus* to the section *Reticulati* of *Pulveroboletus*, and with *B. subsolarius* which links the section *Subpruinosi* of the genus *Boletus* to the section *Auripori*, particularly *P. caespitosus*, of the genus *Pulveroboletus*. It seems that *Boletus*, as a whole, has derived from *Pulveroboletus*.

Species Imperfectly Known

GYROPORUS BIPORUS Murr., *Lloydia* 7:325. 1944.—Described from Florida, this would, schematically, key out in this section but probably does not belong here. From the tiny fragments I have, I cannot say where it really belongs, and whether or not it is distinct. It may belong in sect. *Macropori*, or to *Xerocomus*.

GYROPORUS ALBISULPHUREUS Murr., *l.c.*—Likewise described from Florida, this would key out here, provided the description of Murrill is correct. It is characterized by milk white pileus, and a yellow reticulum on the apex of the white stipe, sulphureous hymenophore, and occurrence in turkey oak woods.

CERIOMYCES PALLIDIFORMIS Murr., *l.c.* p. 324.—Another Florida species, described very recently. I have seen only tiny fragments of the last two species, and cannot say to which genus it belongs and whether or not it is an autonomous species. As a mere guess, one may think of forms of *B. aereus* Bull. *ex Fr.*

Section *GRISEI* (Sing.).

Xerocomus sect. *Grisei* Sing., *Ann. Mycol.* 40:44. 1942.

Characters of the section obvious from the key, p. 21. The type species is *B. griseus* Frost. This section has conditionally been inserted in *Xerocomus* by the author but since the trama of the type specimens of the type species and of other collections of *B. griseus*, and also the trama of *B. fumosiceps*, a species with much more typically boletoid habit, has turned out to be truly bilateral, of the *Boletus-type*, it became necessary to transfer this section to *Boletus*.

KEY TO THE SPECIES

- A. Reticulation of the stipe fine; stipe obconic and short; spores 3.2-4 μ broad 9. *B. fumosiceps*
 B. Reticulation of the stipe rather strongly raised, the reticulating veins projecting almost as much as in *B. Frostii*; stipe not obconic and not short; spores 3.5-5.5 μ broad 8. *B. griseus*

Description of the Species Occurring in Florida

8. BOLETUS GRISEUS Frost *apud* Peck, Rep. N. Y. State Mus. 29:45. 1878.

Suillus griseus Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Cerionomyces griseus Murr., Mycologia 1:145. 1909.

Xerocomus griseus Sing., Ann. Mycol. 40:44. 1942.

?*Boletus flexuosipes* Peck, Bull. N. Y. State Mus. 8:130. 1889.

Subspecies TYPICUS.

Pileus gray to brownish gray, not viscid, very finely subtomentose when young, glabrescent, with a narrowly projecting sterile margin, convex, 50-100 mm. broad, rarely broader. — *Hymenophore* white when young, becoming argillaceous when mature, staining brownish in injury, adnate or slightly depressed around the stipe; tubes 6-12 mm. long; pores about 0.5 mm. in diameter, or 10 per 5 mm. transversely, concolorous with the tubes; spore print about "dark olive buff" when thick and fresh. — *Stipe* pale gray to gray reticulate on grayish pallid or yellowish pallid ground, the reticulation strongly raised and always very distinctly visible without a lens, raised not quite as much as in *B. Frostii*, glabrous, dry, subequal, often flexuous, or at least curved at the mostly acuminate base, solid or stuffed, rarely becoming somewhat hollow when old, 50-100 x 10-17 mm. — *Context* white, grayish pallid, or yellowish pallid at places, becoming sordid cinnamon pallid on prolonged exposure but practically unchanging when bruised; taste perfectly mild; odor fruity or none.

Spores 8-13.5 x 3.5-8 μ , mostly 10.5-12.5 x 4.4-5 μ , rather pale brownish melleous, cylindric or cylindric-fusoid; *basidia* 8.5 μ broad; *cystidia* 31-58 x 6.3-10.3 μ , strikingly colored brown (melleous brown to dark fuscous) by a resinous incrustation, ampullaceous to fusoid with the thickest part in the middle or in the upper third, and with a small apiculus or mucro, numerous near pores; *trama* truly bilateral of the *Boletus*-type, the lateral stratum very loose and distinctly divergent, hyaline, the mediostratum slightly colored, denser, consisting of axillary arranged, subparallel-subinterwoven hyphae; all *hyphae* without clamp connections.

Chemical reactions.—Not studied separately but hardly different from these of *B. griseus* ssp. *pini-caribaeae* (see there).

Habitat.—In oak woods on the ground, fruiting from June until October.

Distribution.—From New England to North Florida where it is rare.

Material studied.—There is only one collection in the Herbarium in Gainesville (FLAS) which I have not examined closely. This, as far as I know, is all that has ever been collected under the name of *B. griseus* in Florida. Extralimital collections: VERMONT, Brattleboro, Frost, TYPE (FH). MASSACHUSETTS, Canton, D. H. Linder (det. W. H. Snell with "?"), (FH). TENNESSEE, Cosby, L. R. Hesler & A. J. Sharp, (det. Hesler as *B. indecisus*), 9062 (FH).

Subspecies PINI-CARIBAEAE Sing. Mycologia 37:797. 1945.

Pileus in color like *Leccinum scabrum*, i.e. about "Saccardo's umber," tomentose at places, the cuticle tending to become rimose forming small squamulae, non-viscid, convex, becoming flattish, about 120 mm. broad. — *Hymen-*

ophore gray, unchanging, not much ventricose beneath, adnate and sinuate around the stipe, with the attingent tube-walls stretched lamellosely, otherwise the pores rather equal in shape, varying from 0.7-1.5 mm. in diameter; spore print "dark olive buff." — *Stipe* white at the apex, otherwise a very pale drab, with a well elevated medium-wide network almost all over the stipe, tapering downward, solid and fleshy, about 100 x 25 mm. (but tapering to about 16 mm. at the base); mycelium white. — *Context* white, unchanging, soft at least in the pileus, mild, inodorous.

Spores.—12-15.3 x 4.5.5 μ (characteristic individual measurements: 13 x 4.8 μ , 13.7 x 4 μ), very variable in size and shape, the shortest ones also often being the broadest ones, rather pale brownish melleous; *cystidia* e.g. 37.5 x 10.2 μ , fusoid with the broadest part usually in the upper third, or clavate-apiculate, more rarely subampullaceous, brown from an incrustation or granular contents; *trama* as in the type subspecies; *clamp connections* none.

Chemical reactions.—KOH on surface of pileus becoming deeper colored; on context, sordid drab. — NH₃ on surface of pileus, almost slate gray. — NH₄OH on surface of pileus, somewhat more intensely colored. — FeSO₄ on context, pale greenish. — Methylparamidophenol slowly positive, rather distinctly lilac. — Formol, very pale salmon pink after a long exposure.

Habitat.—On shallow needle beds over lime rock in pure stands of *Pinus caribaea*, solitary. October and November.

Distribution.—Known only from South Florida.

Material studied.—FLORIDA, DADE Co., Coral Gables, Coral Way, R. Singer F 1397 (FH).

Subspecies *pini-caribaeae* differs in the larger spores, the carpophores themselves being near the upper limit of the size of the type subspecies. The habitat is unusual for this section and very characteristic.

9. BOLETUS FUMOSICEPS (Murr.) Murr., Lloydia 6:228. 1943.

Gyroporus fumosiceps Murr., Lloydia 6:225. 1943.

Pileus "Isabella color," "buffy brown," later somewhat "hair brown" at places, finely but distinctly tomentose, smooth, non-viscid, convex, becoming flat, with entirely fertile margin, 80-130 mm. broad. — *Hymenophore* sordid white, then sordid gray, almost unchanging or becoming somewhat fuscous on injury, slightly to decidedly depressed around the stipe; tubes 10-11 mm. long; pores concolorous, small (6-10 to 5 mm. transversely); spores print olive brown. — *Stipe* sordid-pallid, whitish, reticulate all over or over its larger upper part, but the reticulation often incomplete and very fine and shallow, rather more so than in *B. edula*, glabrous, dry, strongly tapering downward, obconic, 30-60 x 25-50 mm, tapering to about 9 mm. at the base. — *Context* white, at some places (irregularly) light yellow, unchanging immediately after injury but becoming concolorous with the pileus after hours of exposure to the air; odor none, or faint and fruity; taste mild.

Spores 11-12.5 x 3.2-4 μ , ellipsoid-fusoid, elongate, rather pale brownish-melleous; *basidia* 10.5 μ broad, 4-spored; *cystidia* 23-53 x 6.3-10 μ , fusoid, or fusoid with ampullaceous apex, characteristically deep melleous or fuscous, granulose, thin-walled, numerous; *trama* truly bilateral of the *Boletus*-type,

lateral stratum hyaline, loose, divergent, mediostatrum subhyaline, axillar, of subparallel-interwoven hyphae; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus, more brownish; on context, melleous or ochraceous melleous (a strong distinct reaction).—NH₄OH on pileus, more brownish; on context reacting as with KOH but paler.—FeSO₄ on context, grayish olivaceous.

Habitat.—On the ground, under or near oaks, solitary, fruiting in July.

Distribution.—North Florida.

Material studied.—FLORIDA, ALACHUA Co., TYPE (FLAS); also material from Gainesville, July 15, 1943, *W. A. Murrill* (det. Murrill & Sing.), AUTHENTIC (FLAS); Newnan's Lake, *R. Singer*, *F 2910* (FH).

The author was at first inclined to consider Murrill's species as a mere form or variety of *B. griseus*. However, the entirely different habit appears to be constantly correlated with the narrower spores and the much finer reticulation. It therefore deserves specific rank.

Section CALOPODES Fr., *Epicr.*, p. 416. 1838 *sensu stricto*.

Sect. *Pachypodes* Konr. & Maubl., *Icon. Sel.* 6:457. 1924-1937.

Characters of the section see key, p. 21. Type species: *Boletus calopus* Fr.

KEY TO THE SPECIES

- A. Stipe yellow or red, strongly reticulate or slightly reticulate at apex.
 - B. Pileus usually cracking into large frustulae, or rimulose; stipe reticulate almost its entire length. Western species, growing in coniferous woods *B. frustosus*
 - B. Not combining the above characters. Eastern American or European species.
 - C. Pileus not pink.
 - D. Stipe with a yellow network and without any red colors except for an occasional reddish or dull brownish red color ring-zone *B. radicans*
 - D. Stipe either with pallid network on red ground (at least over a certain zone in the middle of the stipe or deeper), or with red network on yellow ground.
 - E. Stipe with red network on yellow ground 11. *B. inedulis*
 - E. Stipe with pallid network on red ground *B. calopus*
 - C. Pileus pink, eventually, and on drying, bleached *B. Peckii*
- A. Stipe white, not reticulate, or very faintly so 10. *B. pallidus*

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10. *BOLETUS PALLIDUS* Frost, *Bull. Buff. Soc. Nat. Sci.* 2:105. 1874.

Suillus pallidus Kuntze, *Rev. Gen. Pl.* 3(2):536. 1898.

Ceromyces pallidus Murr., *Mycologia* 1:152. 1909.

Pileus "avellaneous," "cinnamon buff," with a hue of "chamois," "pale pinkish buff," "pinkish buff," "pale cinnamon buff," mixed with "pinkish buff," or "champaigne" (M. & P.) with "Cuban sand" (M. & P.), or "sea side, tea time" (M. & P.), "fallow" (M. & P.), "putty seed" (M. & P.), "sombbrero" (M. & P.), sometimes with "avellaneous" warts, sometimes with "light vinaceous cinnamon" margin, usually slightly darker when wet, paler when dry, minutely tomentose when dry, or distinctly tomentose all the time, becoming rimulose, or rimulose-tessellate, non-viscid, pulvinate, becoming flat, up to 140 mm. broad.—*Hymenophore* whitish becoming pale greenish or

"citine drab," bluing when young and fresh on pressure or injury, adnate or more often depressed around the stipe; tubes 8-14 mm. long; pores concolorous, 0.3-0.7-(1) mm. wide, bluing when touched at least when young and fresh, becoming "olive buff" in old specimens; spore print between "Saccardo's olive" and "brownish olive" ("light brownish olive" in thin dry layer).—*Stipe* white or whitish, or more rarely partially concolorous with the pileus, indistinctly and very faintly reticulate, or with a crude and incomplete network at the very apex, or most frequently perfectly smooth to merely subrugulose, glabrous, subequal to subventricose, solid, 60-80 x 10-35 mm.—*Context* of the pileus white, sordid, or eventually with stripes of pale yellow or "light vinaceous fawn," becoming yellowish near the tubes after prolonged exposure in some specimens, interior of the stipe white but more or less marbled with "fawn color," at least near the base, unchanging after bruising, *i.e.* not bluing in any part; odor almost none; taste mild to bitterish.

Spores 8.5-12.5 x 3.5-5 μ , fusoid to subclavate, with a slight suprahilar applanation, melleous; *basidia* 29-39 x 7-10 μ , 4-spored; *cystidia* scarcely projecting, 6-9 μ thick, fusoid-cylindric to fusoid-ampullaceous, hyaline or pale melleous; *trama* truly bilateral, of the *Boletus*-type, with very loosely arranged hyphae in the mediostratum, in dried material often secreting a bright yellow pigment-solution when examined in NH₄OH; *cuticle* of long, cylindrical-filamentous, equal, thin (3.5-5 μ in diameter), hyaline (NH₄OH) hyphae without clamp connections.

Chemical reactions.—KOH on surface of pileus little reaction; on context and on pores mostly somewhat brownish.—NH₃ and NH₄OH little reaction in all parts, but turning the context red or blue where previously treated with FeSO₄.—H₂SO₄ and HNO₃ on surface of pileus little reaction.—FeSO₄ on context of pileus pale greenish with dirty ring; on context of stipe, caesious to pale bluish.

Habitat.—Under various species of oak in open dry woods, mixed pine and oak woods, mesophytic and high hammocks, solitary to very gregarious, and at places dominant, fruiting from May to November.

Distribution.—From New England to North Florida, and west to Michigan and Tennessee.

Material studied.—FLORIDA, ALACUHA Co., Gainesville, R. Singer, *F* 2495 b (FH); Newnan's Lake, *F* 2921 (FH); W. A. Murrill (det. R. Singer), *F* 2069 (FH); Erdman West & W. A. Murrill, *F* 17714 (FLAS); Dayville, R. Singer, *F* 2495 (FH); *F* 2495 a (FH); Kelley's Hammock, W. A. Murrill, *F* 17962 (FLAS); COLUMBIA Co., Camp O'Leno, W. A. Murrill, *F* 21693 (FLAS); NW of High Spring, W. A. Murrill, *F* 8515 (FLAS). VERMONT. Probably part of TYPE (FH). MASSACHUSETTS, Numerous collections (very common in this state), (FH). NORTH CAROLINA, Highlands, W. C. Coker & Alma Holland, 9514 (FH). GEORGIA, Vicinity of Tallulah Falls, A. B. Seymour (det. Snell) (FH). MICHIGAN, Ann Arbor, A. H. Smith (FH). TENNESSEE, Elkmont, Great Smoky Mts. Nat. Park, L. R. Hesler 11589 (FH).

This is somewhat intermediate between the *Edules* and this section because of the whitish stipe, the inconstant bitterness, and the whiter than usual context. However, it differs from the former section in bluing pores and tubes and the frequent presence of a bitter taste. I think this species is best placed with the *Calopodes*.

Ceromyces subpallidus Murr., North Am. Fl. 9:145. 1910. is apparently a mixture of *B. edulis* and *B. pallidus*, and has to be rejected. I have seen the type (NY).

11. BOLETUS INEDULIS (Murr.) Murr., Mycologia 30:525. 1938.

Ceromyces inedulis Murr., Mycologia 30:523. 1938.

Pileus "sombbrero," "maple," center more "mastic," "cracker," "Arizona," "prairie" (M. & P.), sometimes somewhat "buffy brown," also sometimes reaching "Saccardo's umber" or "tawny olive" in the middle, subtomentose or finely tomentose, more rarely with faint appressed tomentose squamulae, not viscid, the extreme margin at times narrowly "light cadmium," pulvinate, becoming more expanded, 50-100 mm. broad. — *Hymenophore* "pyrite yellow," or pl. 20, F 1 (M. & P.), becoming blue when touched, more or less depressed around the stipe; tubes about 5-10 mm. long when mature, rarely longer; pores concolorous with the tubes and likewise bluing, the bluish stains eventually becoming sordid brownish, very small to small; spore print brownish olive. — *Stipe* "lemon chrome" and "light cadmium," on the apex or three quarters down the stipe marked with a "pomegrenade purple" or "acajou red" or "clove pink" (the latter M. & P.) reticulation on yellow or rarely almost concolorous (red) ground in the middle and below and even often at the very apex, the base becoming somewhat olive, or otherwise discolored to sordid yellow or some kind of brown, very rarely indistinctly reticulated and then the reticulation partly replaced by minute floccose-furfuraceous scurf, solid, tapering downward from a slight ventricose thickening in the upper third of the stipe, or tapering from the very apex, more rarely equal but very thick, 50-110 x (11)-15-25 mm.; mycelium pale yellow. — *Context* yellow, light yellow, becoming blue on the slightest injury, the base somewhat discolored (olive, brown, similar to the color of the surface); taste bitter; odor not remarkable, weak.

Spores 10-15.3 x 3.5-5.3 μ , ellipsoid-fusoid, in some carpophores some of the spores with attenuate apical half, with suprahilar depression, well colored, melleous; *basidia* 21-30 x 6.5-9 μ , 4-spored; *cystidia* 34-47 x 6.3-7.5 μ , fusoid or fusoid subampullaceous, numerous on pores; *trama* truly bilateral of the *Boletus*-type; *clamp connections* none.

Chemical reactions.—KOH on surface of pileus little reaction; on the context of the pileus yellowish brown. — NH₃ and NH₄OH negative everywhere. — Methylparamidophenol on context negative, on cuticle black.

Habitat.—Under various species of oak, solitary or gregarious on the ground, especially in well watered gardens, fruiting from May till September.

Distribution.—North Florida and South Carolina (see also observations).

Material studied.—FLORIDA, ALACHUA CO., TYPE and AUTHENTIC material (FLAS, FH); also numerous collections by Singer (F 2035/1, F 2136, F 2498, etc., all FH). SOUTH CAROLINA, Santee Canal, Ravenel, 736 (*B. pachypus*) (FH).

The fine, red reticulation on the yellow stipe distinguishes this species from *B. calopus* Fr. as well as from *B. radicans* Pers. *sensu* Kallenbach. The latter is supposed to have little red on the stipe while in *B. calopus* the network is

more pallid than the deep red ground, and besides, it usually though not always is more projecting and striking. Schematically, *B. inedulius* Murr. would fit in the characterization of *B. albidus* ssp. *eupachypus* Konrad whatever that it, but I have not seen any form of either European species that would exactly match the Florida species.

Curtis, in his Herbarium (FH), considered this as *B. pachypus* Fr. I am almost sure that *B. subclavatosporus* Snell, Mycologia 28:474. 1936. from North Carolina is the same thing but a form with less conspicuous reticulation than the type of *B. inedulius*. I have seen such forms frequently myself. On the other hand, I do not overlook certain discrepancies in the descriptions such as the elongate cylindrical stipe, the apparently more constantly clavulate spores, and the slightly aberrant colors of the pileus and the context. However, these colors are entirely within the range of variation possible or expected in *B. inedulius*, and so are the spores, and probably the stipe. Confirmation of this determination of *B. subclavatosporus* will be needed from fresh specimens from the type locality (Hot Springs). I have not examined the type. Murrill's name would, in case of identity with *B. subclavatosporus* fall into synonymy.

Extralimital Species and Species Incompletely Known

BOLETUS FRUSTOSUS Snell & Dick, Mycologia 33:33. 1941.

This has been more accurately described in Lloydia 7:56. 1944. However, the spore print is indicated as ochraceous brown. It may be assumed, under the circumstances, that this indication is based on preparations a year or more old. If the fresh spore print were of this color, *B. frustus* could not be referred to this section. The non-frustose specimens I have from Idaho (Selway National Forest, *Roszbach*, det. Singer, FH) are hard to distinguish from good specimens of *B. radicans* in dried condition. *B. frustus* is a western species.

BOLETUS RADICANS Pers. ex Fr. Syst. Myc. 1:390. 1821 *sensu* Kallenbach, Pilze Mitteleur. 1:88. 1934.

This has also been called *B. amarus*, *B. candicans*, *B. albidus*, *B. vitellinus*, etc., and one may be inclined, in view of the various and controversial interpretation of *B. radicans* in the European and American literature, to prefer one of the above names, but when the problem is studied from all the historic angles involved, it seems necessary to accept Kallenbach's emendation of Persoon's species. *B. radicans* has been collected by the writer in Maine, U. S. A., but has never been found in the southern states. It is uncommon but widely distributed in Europe.

BOLETUS FRAGRANS Vitt. *sensu* Slipp & Snell, Lloydia 7:53. 1944.

This western species is quite different from what is considered to be the rare Italian species described by Vittadini who says that the taste of his species is agreeable. Snell's species is closely related to *B. frustus* and *B. radicans*, and also to *B. inedulius* and *B. subclavatosporus*. If autonomous, it will have to be renamed.

BOLETUS CALOPUS Fr., Syst. Mycol. 1:390. 1821.

A very common European species, by some authors called *Boletus pachypus* Fr. Compare also our observations on *Boletus inedulius* (Murr.) Murr. (no. 11).

BOLETUS SUBCLAVATOSPORUS Snell, Mycologia 28:474. 1936.

See observations on *B. inedulius* Murr.

BOLETUS PECKII Frost *apud* Peck, Rep. N. Y. State Mus. 29:45. 1878.

Ceromyces Peckii Murr., Mycologia 1:151. 1909.

?*Boletus roseotinctus* Peck, Bull. Torr. Bot. Cl. 27:612. 1900.

This species reminds one of the group of *B. speciosus*-*B. regius* of the *Appendiculati*, and the group *B. miniatoolivaceus* of the *Luridi* but it certainly belongs here, and the similarity is mostly due to the color. We have seen specimens from various places from New England south to Georgia. Coker & Beers think that *B. roseotinctus* is the same; Snell thinks it is different. We have no definite opinion on the subject.

Section APPENDICULATI Konr. & Maubl., Icon. Sel. 6:458. 1924-1937.

Characters of the section: see key, p. 21. Type species: *Boletus appendiculatus* Schaeff. ex Fr.

KEY TO THE SPECIES

- A. Context and tubes constantly unchanging, never turning blue in any part of the carpophore.
 - B. Stipe 10-30 mm. thick, rather elongate; KOH on surface of pileus beautifully "strontian yellow" (2. *Pulveroboletus retipes*)
 - B. Stipe 28-45 mm. thick, rather bulbous at first; KOH on surface of pileus either negative, or yellow ochre 7. *B. auripes*
- A. Context and tubes or either of them bluing when fresh and young.
 - c. Pileus vivid yellow or ochre brown to deep brown.
 - D. Pileus vivid yellow. Floridan species (for a European species with this color see "F," *B. regius*) (19. *B. flavissimus*)
 - D. Pileus not yellow. European species (for a Florida species with this color see sect. *Luridi*, *B. luridellus*) *B. appendiculatus*
 - c. Pileus pink or pallid.
 - E. Pileus pallid (grayish cream to whitish) *B. pallescens*
 - E. Pileus purplish pink or pinkish red to testaceous.
 - F. Pileus "Corinthian red," or varying to "vinaceous russet" (according to Cokers & Beers), or "vinaceous tawny" to "Dahlia carmine" (according to Burt); context bluing strongly to a deep, bright blue; spores 2.8-4 μ broad, mostly 3-3.5 μ broad *B. speciosus*
 - F. Pileus much purer and brighter pink or purplish pink, rarely more yellow; context slightly bluing; spores broader than 3.5 μ , rarely narrower than 4 μ and up to 5 μ broad *B. regius*

Description of the Species Occurring in Florida

12. BOLETUS AURIPES Peck, Rep. N. Y. State Mus. 50:107. 1897.

Boletus crassipes Peck, Bull. Torr. Bot. Cl. 27:19. 1900 (=var. *typicus*).

Ceromyces aureissimus Murr., Mycologia 30:522. 1938 (=var. *aureissimus*).

Boletus aureissimus var. *castaneus* Murr., Mycologia 30:522. 1938 (=var. *typicus*).

Var. TYPICUS.

Pileus "snuff brown," "Dresden brown," "raw sienna," center often discolored, reaching "clay color," sometimes discolored also near the margin, sometimes with an olivaceous hue, center glabrescent, dry, not shining except for the glabrate portions, pulvinate, eventually flattened or even somewhat depressed in the center, 77-108 mm. broad, sometimes even larger and occasionally reaching 200 mm. — *Hymenophore* "light cadmium" to "cadmium yellow," depressed around the stipe when mature; tubes medium long to long, usually about 12-22 mm. long; pores initially "stuffed" and "Naples yellow," later concolorous with the tubes and 0.5-0.8 mm. wide, unchanging; spore print between "buffy olive" and "yellowish olive" when quite fresh but soon becoming gradually less olive, e.g. between "Saccardo's umber" and "light brownish olive," adding a darker shade to the very old tubes. — *Stipe* "light cadmium" to "lemon yellow" with paler apex when young, then "light cadmium" with "cadmium yellow" or "lemon chrome" shades in the middle, and often with "massicot yellow" mixed in below, on the upper third or half distinctly concolorously reticulate, the reticulation raised somewhat less than in *Pulveroboletus retipes*, smooth and glabrous on the lower half, dry, very bulbous when young more elongate but still very thick or ventricose when old, solid, 80-100 x 28-45 mm. — *Context* "light cadmium" in pileus, concolorous with surface in stipe, completely unchanging under all circumstances in all parts; taste mild; odor very agreeable, of plum pudding dough, not very strong, retaining a strong fruity odor in dried material for at least a year if well prepared.

Spores (9.5)-12-13.7 x (3)-3.7-4.8 μ , melleous, smooth, versiform, usually ellipsoid-cylindric with slightly narrowed apical half, also subfusoid, or tilda-shaped; *basidia* 27.5-34 x 9.8-11.7 μ , 4-spored; *cystidia* 20-42 x 8.8-11 μ , hyaline, versiform, usually ampullaceous or irregularly cylindric, rarely vesiculose, very scattered; *trama* of the *Boletus*-type; *cuticle* consisting of irregularly interwoven filamentous hyphae, the preterminal members filamentous and not parallel to each other, the terminal hyphae occasionally clavate or short-cylindric but mostly cylindric with rounded tip, some of the hyphae incrustated by fine granules, some walls somewhat thickened, clamps absent.

Chemical reactions.—KOH on surface of pileus, "yellow ocher"; otherwise little reaction.

Habitat.—In mixed and oak woods, and under oaks in gardens, mostly with *Quercus laurifolia* in Florida, on humus, sand and on grassy earth, gregarious, more rarely solitary, starting in May and fruiting through the summer.

Distribution.—From New York to Florida, in Florida rare and confined to the northern part of the state.

MATERIAL studied.—FLORIDA, ALACHUA Co., Gainesville, *W. A. Murrill*, *F 9278*, TYPE of *B. aureissimus* var. *castaneus* (FLAS); *R. Singer*, *F 2025 a* (FH); *G. Weber* (det. Singer), *F 2025* (FH). NEW YORK, TYPE of *B. auripes* (NYS). NORTH CAROLINA, Chapel Hill, *Alma Holland Beers*, *11615* (FH); Highlands, *Helen Sherwin* (det. Coker), *13295 a* (FH).

The type form is unusual in Florida. The common bolete of this section in North Florida has been described by Murrill as *B. aureissimus* which is with-

out any question conspecific with *B. auripes*. Murrill himself did not really intend to separate these forms specifically as is proved by the fact that he described the type variety under the varietal name *B. aureissimus* var. *castaneus* Murr. This arrangement finds an obvious explanation in the fact that Murrill still worked under the assumption that *B. auripes* Peck was a mere synonym of *B. edulis*.

Var. AUREISSIMUS (Murr.) Sing., *Mycologia* 37:797. 1945.

Ceratomyces aureissimus Murr., l.c.
Boletus aureissimus Murr., l.c., p. 525.

Differing mainly in the characters of the surface of the pileus which is "chamois," "yellow ocher," "primuline yellow," "mustard yellow," "Naples yellow" or "cream color" with "amber yellow" portions, the extreme margin usually "light cadmium," often nearly "honey yellow" when young, more glabrescent than the type. Otherwise as the type variety.

Microscopical characters as in the type variety, only the whole cuticular layer characteristically light lemon color in NH_4OH with the pigment rather stable and unchanging.

Chemical reactions.—KOH in all parts (negative). — NH_3 and NH_4OH negative. — H_2SO_4 and HNO_3 negative. — Formol negative.

Habitat.—In high hammocks and gardens under *Quercus laurifolia*, *Q. virginiana*, and also in open turkey oak woods (*Q. laevis*), on humus, sandy soil, and grassy earth, usually in large groups, from May till October.

Material studied.—FLORIDA, ALACHUA CO., Gainesville, *W. A. Murrill*, TYPE of *B. aureissimus* (FLAS, FH); AUTHENTIC material of *B. aureissimus* (FH); *R. Singer*, F 2505 (FH); F 2037/1 (FH); F 2078 (FH); Sugarfoot Hammock, *R. Singer*, F 2573 (FH).

"Often collected here for food, sometimes by the peck, and much esteemed by the few who know it," says Murrill. The author has also eaten it and found it delicious.

Extralimital Species

BOLETUS APPENDICULATUS Schaeff. ex Fr., *Epict.*, p. 416. 1838.

A European species; for more detailed data see any modern European description.

BOLETUS PALLESCENS (Konrad) Sing., *Ann. Mycol.* 34:424. 1937.

Boletus appendiculatus ssp. *pallescens* Konr., *Bull. Soc. Myc. Fr.* 45:73. 1929.

This European species has been well illustrated by Konrad & Maublanc (as *B. appendiculatus* ssp. *pallescens*), and by Kallenbach (under the name of *B. aestivalis*). Fries' *B. aestivalis* is decidedly different from this. In 1931, Kallenbach started to add an alternative name, *B. Romellii* Kallenbach. He did this on two occasions but he gave his name second place after *B. aestivalis* Fr. which he still thought to be the same (why then the new name?), using the latter in some other articles that have appeared after 1931 without men-

tioning the alternative name which cannot, consequently, be used, according to the International Rules, art. 40.

BOLETUS SPECIOSUS Frost, Bull. Buff. Soc. Nat. Scienc. 2:101. 1874.

This species is moderately frequent from Maine to North Carolina, and authentic material as well as numerous other collections (FH) prove it to be different from the two preceding as well as the following species, mainly because of the narrower spores.

BOLETUS REGIUS Krombh., Naturg. Abb. Schw. 2:3. 1832.

Dictyopus appendiculatus var. *regius* Quél., Fl. Mycol., p. 424. 1888.

This is an autonomous European species, not a variety or subspecies of *B. appendiculatus* as some authors think. I have collected it in Austria, and think it is sufficiently distinguishable from *B. speciosus*.

Section *SUBPRUINOSI* Fr., Hymen. Europ., p. 504. 1874.

Characters of the section: see key, p. 21. Type species: *B. Barlae* Fr. (= *B. rubellus* Krombh.).

This section has formerly been incorporated in *Xerocomus sensu lato* by the Quéletian-Gilbertian schools but has very apparent affinities with species of the following section of *Boletus sensu str.* These affinities are not quite obvious when only European material is considered, but if American, more specifically Floridan, material is taken into consideration, this becomes quite evident. Some pairs with striking similarities, one from the *Subpruinosi* the other from the *Luridi*, are the following: *B. rubellus* Krombh. and *B. rubricitrinus* Murr.; *B. pulverulentus* Opat. and *B. oliveisporus* Murr.; *B. Weberi* Sing. and *B. Queletii* Schulz.

There are a few tropical species which key out here but which may eventually be found worthy of separation within another section. Some of them are striking because of the small size of the carpophores, others because of the yellow color of the mycelial tomentum. At present, we can see no reason why they should not be treated together with the northern species, with one possible exception, *viz.* the species with epithelium (group of *B. pernanus*); this latter species has been kept with the section *Subpruinosi* on a tentative basis.

KEY TO THE SPECIES

- A. Cuticle with a distinct epithelium; diameter of the pileus 12-14 mm.; spores longer than twice as long as broad (Q larger than 2). Tropical species *B. pernanus*
- A. Cuticle occasionally, especially in *B. rubellus*, with some intermingled spherocysts, or with a trichodermium-palisade the preterminal members of which are made up by very short to isodiametric hyphae; there is, however, no definite epithelium present (of the kind observed in *Leccinum albillum*); but if there is an epithelium, and the shape of the spores or the size of the pileus are not as indicated for *B. pernanus* above, see this alternative.

- B. Spores comparatively very broad ($Q=2$, or smaller) without suprahilar depression; cuticle either a cutis, or an unorganized (not palisadiform) trichodermium (at least in the specimens available); mycelium yellow. East-Asiatic species (as for American species see genus *Xerocomus*, sect. *Pseudophyllopori*).
- C. Pileus red *P. Patouillardii*
- C. Pileus not red.
- D. Pileus olive umber, subsquamulose; context bluing; mycelium inconspicuous *B. nanus*
- D. Pileus alutaceous; context said to be unchanging; mycelium conspicuous, golden yellow *B. aureomycelinus*
- B. Spores narrow (Q larger than 2, or at least many spores with Q larger than 2 present in a print or in fully mature specimens); cuticle a trichodermium-palisade which, however, soon breaks down, and then the superficial layer made up of irregularly interwoven hyphae or strands of hyphae, not visibly organized, or the palisade at least partially discontinued and becoming fragmentary, usually entirely disappearing in fully mature specimens except in well sheltered caps; mycelium either white or yellow. Temperate species, and tropical species of the Western Hemisphere.
- E. Pores red; pileus and stipe somewhat squamulose 13. *B. Weberi*
- E. Pores concolorous with the tubes and never red (unless after having been discolored by autoxydation); pileus and stipe not squamulose (the latter may be minutely furfuraceous, or flocculose-squamulose as commonly observed in many species of *Boletus*).
- F. Pileus brownish or olive, chestnut brown or alutaceous.
- C. Surface of pileus bluing with ammonia (see *Xerocomus*, sect. *Pseudophyllopori*).
- G. Surface of pileus not bluing with ammonia.
- H. Mycelium white or sordid, or if slightly yellowish, not conspicuous; marginal zone of the cuticle of the pileus not hymeniform.
- I. Context unusually strongly and deeply bluing in less than one second after bruising provided the corphore is not over mature and reasonably fresh; pores about "wax yellow." In frondose woods of the temperate zone of Europe and North America where it reaches North Florida in the south 14. *B. pulverulentus*
- I. Context slightly to moderately bluing; pores yellow but only exceptionally "wax yellow" (for species that do not change to blue at all, even when very fresh and young, see *Xerocomus*).
- J. Pores "reed yellow," medium sized; spores 12.5-16.5 x 4.5-5.7 μ . Temperate species in coniferous woods (*Xerocomus badius*)
- J. Pores not "reed yellow," wide; spores 8.8-13 x 4.5-5.5 μ . Tropical American species (for species from other regions compare also genus *Xerocomus*) 15. *B. granuloseps*
- H. Mycelium yellow, conspicuous; margin of the pileus covered by a hymenium 16. *B. subsolitarii*
- F. Pileus pink, vinaceous, carmine, or purplish, rarely olive (but then portions of the pileus or stipe red) 17. *B. rubellus*

Description of the Species Occurring in Florida

13. BOLETUS WEBERI Sing. Mycologia 37:797. 1945.

Pileus "tennis" with some "alamo" (M. & P.), areolate-squamulose, dry, convex, 65 mm. broad. — *Hymenophore* "aureolin P" (M. & P.), slightly convex beneath, depressed around the stipe, the radial tube-wall running down the apex of the stipe in fine lines, unchanged when wounded; tubes 6 mm. long; pores discolorous, "tapestry red" (M. & P.), unchanging on pressure, medium wide (0.5-1.0 mm. in diameter, 5-6 pores per 5 mm.); spore print olive brown. — *Stipe* "tapestry red" (M. & P.) at the apex, pl. 22, F 1 (M.

& P.) below, fibrillose-subpunctulate, squamulose below, dry, subequal in its upper two thirds, the lower third acuminate toward the base, without any network, solid, 53 x 17 mm. — *Context* light yellow, deeper yellow (about "pyrethrum yellow" M. & P.) in the base and toward the hymenophore, pale yellow where showing through the cracks of the surface of the pileus; odor very slight, agreeable.

Spores 9-15.3 x 4-5.5-(6.3) μ , melleous, thin-walled, from the base upwards attenuate or cylindric-subfusoid, often with an oblong oil-drop; *basidia* 44 x 10 μ ; *cystidia* 14-60 x 4-6.5 μ , sometimes, especially on pores, melleous and somewhat thick-walled above, cylindric to cylindric-fusoid, numerous; *trama* truly bilateral of the *Boletus*-type, the thin mediostratum melleous, and denser than the definitely hyaline and distinctly though moderately divergent lateral stratum; all *hyphae* without clamp connections.

Chemical reactions.— NH_4OH on surface of pileus, negative; on context, blue. — H_2SO_4 where red becoming deeper red, and on surface of pileus also deeper colored. — FeSO_4 negative.

Habitat.—Under pines (*Pinus australis*) on the earth, solitary, fruiting in July.

Distribution.—Known only from the type locality.

Material studied.—FLORIDA, ALACHUA CO., Gainesville, Campus, G. Weber, F 3036. TYPE (FH).

This species is remarkable because it combines the characters of the red-pored *Luridi* with comparatively wide pores. It has no close relatives in *Xerocomus*, and the trama though with only moderately divergent lateral stratum and moderately loose arrangement of the hyphae, is still more typically boletoid than that of *X. badius*. The chemical reactions are remarkable for their comparative inactivity. It has been collected but once, but has features characteristic enough to be recognized immediately. We have, in the American literature, only one species with large, red pores, *B. parvus* Peck which differs in having reddish pileus and no squamulae.

14. *BOLETUS PULVERULENTUS* Opat., Wiegmann's Archiv Naturgesch. 2:27. 1836.

Boletus mutabilis Morg., Journ. Cincinnati Soc. Nat. Hist. 7:6. 1881.

Uloporus Mougeotii Quél., Assoc. fr. avanc. sc. (1886):487. 1886.

Uloporus sistotrema var. *Mougeotii* Quél., Fl. Mycol., p. 411. 1888.

Suillus mutabilis Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Boletus hortensis Smotlacha, Mon. Česk. Hub Gribov., p. 40. 1910.

Tubiporus nigricans Hermann, Pflz- und Kräuterfr. 4:124. 1921.

Boletus Richenii Gramberg, Pflz- und Kräuterfr. 4:226. 1921.

Boletus subtomentosus var. *nigricans* Hermann, Pflz- und Kräuterfr. 5:175. 1922.

Xerocomus pulverulentus Gilbert, Bolets, p. 116. 1931.

Ceromyces cyaneitinctus Murr., Lloydia 6:225. 1943.

Boletus cyaneitinctus Murr., Lloydia 6:228. 1943.

Pileus from between "bister" and "sepia" to "raw umber" but as deep as "mummy brown," margin either concolorous or rather "auburn" to "bister," a combination of colors that often gives the pileus a deep copper brown appearance, tomentose, especially on the disc, more rarely subglabrous but frequently

glabrescent and then slightly sticky in rainy weather, sometimes rivulose, rimulose, subsquamulose, the cracks subconcolorous but somewhat paler, not becoming reddish, pulvinate, then convex, with frequently flattened center or becoming irregular, 42-81 mm. broad, rarely larger (occasionally reaching 145 mm.). — *Hymenophore* about “wax yellow” and darkening to approximately “old gold” when quite mature, very strongly and rapidly bluing on injury, adnate or depressed around the stipe and then the radial walls of the tubes stretched forming a sublamellate ring around the stipe; tubes (5)-8-12-(20) mm. long; pores concolorous, immediately bluing where touched, up to medium wide and meandering when very young, then subangular, irregular in shape and size, more or less compound, 0.5-1.0 mm. in diameter, in average about 0.85 mm. wide or 5-6-(9) to 5 mm.; spore print olive. — *Stipe* a bright yellow at the apex, or pale cream color all over, often bluing on pressure, and eventually tending to reddish where it had been wounded, initially subvelutinous, then very minutely velutinous-flocculose-punctate, or with appressed fibrils with minute transverse fissures, more so below, frequently deep red or reddish brown below, finally a sordid or pale yellow brown in the middle, equal or subequal, more rarely ventricose at first, the basal portion very frequently acuminate, solid, 40-50 x 6-15-(27) mm., rarely up to 100 mm. long; mycelium white or yellowish white. — *Context* deep yellow, in the base usually but not constantly deep red, strongly and rapidly becoming deep blue in all parts when injured, the blue disappearing after a while as in all bluing boletes, and becoming sordid yellow, soft; taste mild; odor none.

Spores 11-14.7 x 4-6 μ , fusoid, smooth, melleous, with or without suprahilar depression; *basidia* 28-40 x 8.8-9.3 μ , 4-spored; *cystidia* 34.5-41-(65) x about 9 μ , fusoid-ampullaceous, entirely incrustated by a resinous, melleous-fulvous incrustation (if less incrustated, they are melleous-granular); on pores, they are usually more numerous than in the tubes, and narrower, (5.2)-6.8-7.5 μ broad, often subcylindric or with a short mucro, mostly hyaline; trama truly bilateral, of the *Boletus*-type, the broad mediostratum dense and deep melleous, the lateral stratum subhyaline, of broader and more loosely arranged, divergent hyphae; cuticular layer consisting of strands of parallel hyphae, these strands arising from different levels, reaching almost erect position, or more or less oblique, or even repent, the terminal members forming an often interrupted palisade of dermatocystidioid, clavate or sometimes fusoid, in ammonia more or less castaneous-fulvous (the pigment rapidly dissolving in the fluid) elements; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus deeper, darker; on context becoming reddish-ochraceous, then ochraceous brown. — NH₄OH on surface of pileus, little reaction; not bluing. — HNO₃ on surface of pileus, “Brazil red” to “oxblood red” (for other reactions see also Maire and Konrad, Schweizer Zeitschr. Pilzk. 5:4. 1927, and Kallenbach, Pilze Mitteleur. 1:14. 1927).

Habitat.—In high and mesophytic hammocks and in gardens, on lawns, farther north and in the mountains usually in mixed frondose woods or under shrubs, usually near Fagales (in Florida *Quercus laurifolia*, and possibly other species of oak, maybe also hickory) on grassy, mostly sandy or argillaceous soil, in small groups, fruiting from May till October.

Distribution.—Through Europe to the Caucasus Mts., and in North America from Ohio to Florida.

Material studied.—FLORIDA, ALACHUA Co., Kelley's Hammock, TYPE of *C. cyanitinctus* (FLAS); Gainesville, R. Singer, F 2711 (FH); Newnan's Lake, R. Singer, F 2937 (FH). OHIO, under the name of *B. mutabilis* (AUTHENTIC?) (NYS). ITALY, Vahrn near Brixen (Bressanone), F. v. Hoehnel, and Jenbach (*id.*), B 1146 (both as *B. radicans*) (FH). CAUCASUS MTS., Genswich (Genswitsch), Abkhazia, R. Singer (W); Khä, Swanetia, R. Singer (W.) Besides, many collections of fresh material in Europe (not preserved).

Our plant fits perfectly Opatowsky's description and colored picture published on pl. 1 of his paper, and also Kallenbach's picture, *l.c.*, pl. 6. The latter author has seen authentic material in Berlin. This makes *B. pulverulentus*, an up to very recently rather neglected though not infrequent species, one of the best documented species among the older ones. *B. mutabilis* Morg. belongs no doubt to this same species as has been suspected by Snell (*Mycologia* 26:348-349. 1934), at least that is what the specimens preserved at Albany are. This species is edible but not plentiful enough in Florida to be of much use.

15. *BOLETUS GRANULOSICEPS* Sing., *Mycologia* 37:797. 1945.

Plate 1, Fig. 4

Pileus "Dresden brown," "Prout's brown," "mummy brown," often partly or rarely entirely "clove brown," or more rarely an undescribable purplish-brown-black (not in Ridgway), finely velutinous-granular or more rarely evenly velvety all over or with the margin rimulose or subtomentose, dry, convex to flat, 30-65 mm. broad. — *Hymenophore* ochraceous-citrinous, much less golden yellow than in *P. auriporus* and less greenish and somewhat less pale than in *X. chryserteron*, with a more ochraceous tinge than both of these, adnate to subdepressed; pores concolorous, bluing when pressed, wide. — *Stipe* with brown or sepia granulae or furfuraceous excrescences on paler ground, smooth or coarsely and indistinctly rugose-subreticulate or ribbed, equal or subequal, dry, solid, 30-50 x 6-8 mm.; mycelium sordid-pallid to whitish or white. — *Context* of the stipe brownish to pallid, bluing or unchanging, in the *pileus* pale yellow to orange-pallid, becoming slate blue to blue on exposure (slow reaction), deep yellow on very prolonged exposure (where eaten by animals); odor and taste not remarkable.

Spores (7.5)-8.8-13 x (3.5)-4.5-5.5 μ , most frequently 10-12 x 4.8-5.2 μ , variable in shape and size, especially when young, the mature spores usually ellipsoid-fusoid to fusoid, with or without suprahilar depression, smooth, well colored, melleous; *basidia* 27-41 x 9.5-11.5 μ , most frequently 33-35 x 10-11 μ , 4-spored; *cystidia* 23-56 x 6.8-11 μ , most frequently subulate because of a high septum, or fusoid with a conical but rounded apiculus or mucro or a subcylindric ampullaceous neck (not broad above as in *P. auriporus*), hyaline, smooth, or a few slightly roughened at the apex, very crowded at the pores, not so numerous in the tubes; *trama* of the hymenophore truly bilateral of the *Boletus*-type, the mediostratum light melleous, its hyphae subparallel-interwoven; the hyphae of the lateral stratum much more loosely arranged than in the mediostratum, and with fewer septa, the *hymenophore*, when placed into ammonia, bright yellow all over but the bright yellow pigment soon disappearing

(as in some *Pulveroboleti*); *cuticle* consisting of a brownish castaneous or castaneous-fulvous layer of erect hyphae which form a trichodermium-palisade whose terminal members assume the shape of dermatocystidia which are subulate, only few of them cylindrical, $17-34 \times (4)-5.5-12-(14) \mu$, the next-following (downwards) hyphae up to the preterminal hypha are somewhat contracted at the septa, sometimes as broad as long, $8.2-15 \times 6.8-10.2 \mu$; *dermatocystidia* and *dermatopseudoparaphyses* none on the pileus; *basal tomentum* of long-filamentous, strictly cylindrical hyphae, strands of which are parallel but interlaced with other strands or single separated hyphae, very similar to those of *B. subsolitarii*, $2.7-6.5-(8.3) \mu$ in diameter; all *hyphae* without clamp connectives.

Chemical reactions not recorded.

Habitat.—Among ironwood trees (*Krugiodendron*), *Nectandra coriacea*, *Bursera simaruba*, etc., more than 38 ft. from the nearest oak tree (*Quercus virginiana*), along the roots and on the ground on lime soil in tropical hammock vegetation, solitary or in twos or threes, fruiting in September (and possibly all summer).

Distribution.—Tropical South Florida.

Material studied.—FLORIDA, DADE CO., Simpson Park, Miami, R. Singer, F 696 (FH); F 697 (FH) (CO-TYPES); Matheson Hammock, R. Singer, F 760, TYPE (FH).

This differs from *B. subsolitarii* which is the species most likely to be confused with *B. granuloseps*, in fruiting earlier, having broader cystidia, more ochraceous tubes and pores, in the lack of the yellow tomentum at the base, in showing brown instead of yellowish granulae on the stipe, changing to blue if quite fresh and young, and in having a slightly different color of the pileus as well as of the stipe in dried and in fresh condition though these colors may occasionally come very close. It differs from *Pulveroboletus caespitosus* in never having viscid stipe and besides in many of the above cited differences between this and *B. subsolitarii*. According to its habit, this species would be considered as either *Xerocomus* or *Pulveroboletus* in the north but both belong in *Boletus* proper, together with several other tropical species of a similar general appearance. The total lack of veil and pulverulence, and also of gluten and viscosity, the structure of the cuticle and the bluing are entirely in favor of *Boletus sensu stricto*, and so is its natural affinity.

16. BOLETUS SUBSOLITARIUS Sing., Mycologia 37:798. 1945.

Plate I, Fig. 5

Pileus with a pale yellow, tender, detersible tomentum or velvet on either granular or entire, brown ground (the brown ground perhaps sometimes a color mixture of the color of the cuticle proper and the yellowish covering on the margin) between "Sudan brown" and "raw sienna," with the margin between "Argus brown" and "mummy brown," or everywhere "cinnamon brown," "Mars brown," "hazel," later, when the external tomentum has almost completely disappeared becoming "Dresden brown" or "light brownish olive" on the margin, rarely on center, where it becomes "Brussels brown" in most instances partly "antique brown" or "amber brown," sometimes the yellowish tomentum macroscopically not evident, even in fresh specimens, and then the pileus merely brown tomentose, dry, smooth or somewhat rugulose, pulvinate,

soon becoming convex with more or less flattened or depressed center, 32-38 mm. broad. — *Hymenophore* “lemon chrome” and soon assuming a slight greenish shade, unchanging on pressure, adnate or slightly depressed around the stipe and usually the tube-walls which touch the stipe stretched and forming a lamellate ring around the stipe on which they run down a few millimeters; tubes up to 6 mm. long; pores concolorous, unchanging, medium wide to wide; spore print olive brown. — *Stipe* white to “massicot yellow,” the apex usually concolorous with the pores or with such furfuraceous granulation, also the lower part of the stipe usually though not always with yellow furfurations or minute flocculose particles, base yellow (“picric yellow,” “pale lemon yellow,” “lemon yellow”) tomentose from the mycelium which appears pale yellow in thin, rich yellow in thick layer, solid, strongly tapering downwards in all specimens, 33-38 x 11-12 mm. — *Context* whitish or “maize yellow” and “baryta yellow,” unchanging on injury or becoming more yellow after prolonged exposure; odor none; taste mild.

Spores 8-13.5 x 4.7-5.5 μ , usually 10-11 x 4.8-5.5 μ , exceptionally some giant spores present (up to 20 x 6 μ), very inconstant in size and shape, usually more or less oblong-ellipsoid and with suprahilar depression, smooth, melleous (well colored) to pale melleous, with moderately thin walls; *basidia* 27-38 x 8-10.5 μ , 4-spored; *cystidia* 40-55 x 6.8-8.8 μ , strictly fusoid, with narrowed but obtuse tip or neck, with normally thin wall above and often extremely thin wall below, rather numerous; *trama* of the hymenophore colored as in *Pulveroboletus auriporus*, i.e. bright yellow for a moment but then the pigment (in ammonia) moving out of the tissue and disappearing, being replaced by a more uniform and stable pale grayish melleous color, truly bilateral and of the *Boletus*-type, the mediostratum axillar, of subparallel-subinterwoven, multi-septate hyphae, the lateral stratum looser, entirely distinctly divergent and hyaline or becoming subhyaline but distinctly less colored than the mediostratum; *velutinous covering* of the margin of the pileus very peculiar, consisting of a hymenium of dermatopseudoparaphyses, dermatobasidia and some sort of hairs which, however, seem to be a mere modification of the dermatopseudoparaphyses; the latter 12-30 x 4.5-7.5 μ ; the dermatocystidia 23-31 x 10.5 μ , scattered among the dermatopseudoparaphyses, in shape and size recalling the hymenial basidia, fertile; *cuticle* (except for the hymenial structure just described) consisting of a tissue of very interlaced hyphae, running in all directions, and the ones reaching the very surface are either repent or erect but do not form a palisade, the terminal members of these flexuous or crooked hyphae chains either cylindrical and obtuse at the tip or broadly clavate and rounded, 4.8-9.8 μ in diameter; *granulae* of the stipe originating with a bunch of parallel, longitudinally arranged hyphae which after a certain distance tend to be deflexed and curved outwards, terminating in a small palisade of dermatocystidia among which there are very few dermatopseudoparaphyses (e.g. 30 x 6 μ) and perhaps dermatobasidia, the dermatocystidia-bearing hyphae hyaline, with crowded septa, smooth, thin-walled, parallel, 2.7-5-(6.8) μ ; dermatocystidia hyaline, about 40 x 7.5 μ , almost subulate but mostly narrower at the basal septum, often ampullaceous at apex; *mycelial tomentum* consisting of irregular strands of parallel hyphae with rather thin to very thin walls, their diameter 3-7 μ their pigment yellow but very rapidly destroyed in ammonium

hydroxide and then the hyphae hyaline, always smooth; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus, black; on pores, brown; on context, brown. —NH₃ on pileus, lilaceous black, otherwise negative. —NH₄OH on pores, green; on context, green or negative.

Habitat.—In tropical hammock, under *Coccolobis laurifolia*, *Ficus aurea* etc. on shaded lime rock soil or along the roots, solitary or in small groups, not conrescent at the bases, in fall (September and October).

Distribution.—Tropical South Florida.

Material studied.—FLORIDA, DADE CO., Matheson Hammock, R. Singer, F 894, TYPE (FH); F 1065, F 1233, F 1336 (CO-TYPES), (FH).

This species reminds one of *Pulveroboletus*, especially of *P. caespitosus*. However, it does not grow cespitosely and has a consistently dry stipe. The yellow pulverulence that can be observed at the base of the stipe, is of mycelial origin, not a veil, and the yellow external velvet of the margin of the pileus is of such fundamentally different structure from similar pulverulent coverings in *Pulveroboletus* (*P. Ravenelii* and *P. subacidus*) that we prefer to consider *B. subsolitarius* as an actual *Boletus* rather than a *Pulveroboletus*.

17. BOLETUS RUBELLUS Krombh., Naturgetr. Abb. Schw. 5:12. 1836.

Boletus subtomentosus var. *b* Fr., Syst. Mycol. 1:390. 1821.

Boletus versicolor Rostkov. in Sturm, Deutschl. Flora 3:55. 1844, non Gray (1821).

Boletus sanguineus With. (non L.) ex Lev. in Paulet, Iconogr. Champ. 2nd ed., p. 97. 1855, non Secr. (1833).

Boletus rubripruinus Barla, Champ. Nice, p. 64. 1859.

Boletus bicolor Peck, Rep. N. Y. State Mus. 24:78. 1872 (=ssp. *bicolor*), non Massee (1909), non Raddi ex Sacc. (1925).

Boletus Barlae Fr., Hymen. Eur., p. 504. 1874.

Boletus rubeus Frost, Bull. Buff. Soc. Nat. Sc. 2:102. 1874. (=ssp. *bicolor*).

Versipellis pruinata var. *Barlae* Quél. Enchir., p. 158. 1886.

Versipellis pruinata var. *versicolor* Quél., Enchir., p. 158. 1886.

Xerocomus chrysenteron var. *versicolor* Quél., Fl. Mycol., p. 418. 1888.

Xerocomus pruinatus Quél., Fl. Mycol., p. 420. 1888.

Xerocomus pruinatus var. *Barlae* Quél., Fl. Mycol., p. 420. 1888.

Boletus chrysenteron var. *versicolor* Mass., Brit. Fung. Flora, p. 264. 1892.

Xerocomus rubellus Quél., Assoc. fr. av. sc. (1895):620. 1895 (1896?).

Boletus fraternus Peck, Bull. Torr. Bot. Cl. 24:145. 1897. (=ssp. *fraternus*).

Suillus bicolor Kuntze, Rev. Gen. Pl. 3(2):535. 1898. (=ssp. *bicolor*).

Suillus Barlae Kuntze, l.c.

Suillus rubellus Kuntze, l.c., p. 536.

Suillus versicolor Kuntze, l.c.

Suillus rubens Kuntze, l.c. (=ssp. *bicolor*).

Ceromyces bicolor Murr., Mycologia 1:152. 1909. (=ssp. *bicolor*).

Ceromyces communis Murr., Mycologia 1:155. 1909, p.p.

Boletus communis Coker & Beers, Bolet. N. Carol., p. 62. 1943.

Boletus parvulus Coker & Beers, Bol. N. Carol., p. 69. 1943, non Mass. (1909).

Boletus Coşkeri House, Mycologia 35:593. 1943.

?*Boletus pruinatus* Fr. & Hök., Bol., p. 9. 1835.

?*Boletus Preauxii* Mont., Phytogr. Canar., p. 75. 1840.

?*Boletus purpurascens* Rostkov. in Sturm, Deutschl. Fl. 3:51. 1844.

?*Boletus armeniacus* Quél., Assoc. fr. av. sc. (1884):5. 1884.

?*Versipellis armeniaca* Quél., Enchir., p. 157. 1886.

?*Boletus bullatus* Britz., Hym. Südb. 4:159. 1885.

?*Versipellis pruinata* var. *purpurascens* Quél., Enchir., p. 158. 1886.

?*Xerocomus armeniacus* Quél., Fl. Mycol., p. 419. 1888.

?*Suillus Preauxii* Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

?*Suillus pruinatus* Kuntze, l.c.

?*Suillus purpurascens* Kuntze, l.c.

?*Suillus armeniacus* Kuntze, l.c., p. 535.

?*Suillus bullatus* Kuntze, l.c.

This species is divided in several forms some of which we consider as subspecies. They are geographic races in some cases, in others mycoecotypes; some are merely remarkable forms, probably mutations. The subspecies known to the writer can be determined with the help of the following key.

- A. European-African-Asiatic-Pacific *grex*: Mycelium whitish, sordid, or yellow; stipe yellow and often with red or carmine red tones, flocculose-squamulose at least in the middle; context bluingssp. *typicus*
- A. Eastern American *greges* not combining *all* the above characters.
- B. *Grex* characterized by yellow (light yellow, lemon yellow, bright yellow, sulphureus) mycelium.
- C. Stipe appressedly fibrillose, not flocculose or scarcely so even when seen under a lens; context bluing.
- D. South-temperate race, not occurring in the tropical zone: Pileus pinkish-brick red to carmine-purple, fading to yellow or brownish yellow; spores mostly 12.5-13.5 μ long [(8.5)-10-14-(15) μ]; usually growing on lawns, in flower beds, moist places in and near frondose or mixed woods, mesophytic and low hammocksssp. *fraternus*
- D. Tropical race: Pileus carmine-purple to olive, often the outer half sepia, becoming more deep purplish red when dried; spores short and broad (9.2-11 x 4.7-5.4 μ); growing in tropical hammock; odor often disagreeablessp. *consobrinus*
- C. Stipe flocculose-squamulose or almost furfuraceous, or velvety-scurfy; context only rarely bluing but the yellow surfaces, especially the pores not infrequently turning blue when touched; growing in the tropical hammock (if in low hammock compare carefully ssp. *consobrinus* f. *subdumetorum*)ssp. *dumetorum*
- B. *Grex* characterized by sordid white, sordid creamy pallid, occasionally salmonaceous-ocher mycelium.
- E. Races associated with frondose trees, not occurring in tropical Florida. scurfy, not deep red colored nor bright red; habit almost of *B. rubricitri-nus* rather than of the slender forms of this species, i.e. with rather voluminous stipessp. *caribaeus*
- E. Race associated with frondose trees, not occurring in tropical Florida.
- F. Prevalently southern race: Habit usually *Xerocomus*-like; stipe 28-64 x 5-12 mm.; pileus 24-52 mm. broad; spores 10.2-14.5 x 4-6 μ , mostly 10.5-14 x 4.5-5.5 μ ssp. *bicoloroides*
- F. Prevalently northern race: Habit usually *Boletus*-like; stipe 40-95 x 8-23 mm.; pileus 50-140 mm. broad; spores 9-12.2-(13.5) x 3.5-5 μ , mostly about 11 x 4 μ ssp. *bicolor*

Subspecies TYPICUS

Boletus rubellus Krombh. l.c. and other combinations with this epithet.

Boletus versicolor Rostkov. l.c. and other combinations with this epithet.

Boletus sanguineus With. ex Lév. in Paul., l.c.

Boletus rubropruinosis Barla, l.c.

Boletus Barlae Fr., l.c., and other combinations with this epithet.

As for this subspecies, we refer to Kallenbach, Pilze Mitteleur. 1:123, pl. 41; pl. 22, fig. 29; pl. 47, fig. 76. We cannot be sure that all these figures

belong here rather than to any of the other subspecies whose distribution and characters have not been studied in Europe, or to other forms not now known but distinguishable as subspecies within the European grex. However, judging from my own notes and from the description given by European mycologists, as well as by carefully comparing dried material from Europe, one arrives at the conclusion that none of the defined forms in Europe is actually identical with any of the forms belonging in the Eastern American grex. We have seen only one collection from the United States (*Richards, Morse, Landis et al.*, Mount Rainier, Wash., June 19, 1936, as *B. mirabilis*, FH) which we think is either identical with the larger forms of ssp. *typicus* (corresponding Kallenbach, *l.c.*, pl. 41, fig. 17, 18, 23), or represents an undescribed western race intermediate between this and ssp. *bicolor*. Since the floccosity of the stipe usually does not show well in dried material, the question has to wait for a solution until more data on the fresh fungus are available. We found the spores in these carpophores 11.8-15.7-(18.5) x 4.2-5.2 μ , i.e., definitely larger than in *B. rubellus* ssp. *bicolor*, and very close to my European measurements.

If on the other hand, the ssp. *typicus* should consist of several (here neglected) forms or subspecies, it will probably not be difficult to find corresponding names for them among the synonyms and questionable synonyms indicated above for *B. rubellus* as a whole. We have no means of segregating them at present, and the problem of doing so (if necessary) remains to be solved by the European mycologists. Whatever future dispositions will be made, the type form must always be the form described and painted by Krombholz.

Some authors have accepted the name *B. sanguineus* for this species or rather for its ssp. *typicus*. This pre-Friesian binomial, a homonym even at the time of Withering, has to be disregarded, since the first post-Friesian author to take up this binomial, Secretan in 1833, used it in a different sense; in the sense of Withering, *B. sanguineus* was used by L evill e many years later. The name *B. versicolor* is illegal for two reasons: It is a later homonym of *B. versicolor* L. ex S. F. Gray (*Coriolus versicolor*), and at the same time a synonym of *B. rubellus* Krombh. which was published eight years earlier. Fries' *B. pruinatus* is a *nomen dubium* because of the ambiguity of the description and the lack of any material to be checked upon. Not even a picture exists. It could have been accepted in the sense of Qu elet (1886) who obviously interpreted it as *B. rubellus* but this latter species had been described meanwhile and its interpretation is unequivocal.

Bresadola was the first to link the American species (*B. bicolor*) with this and, as for specific identity, he was right.

Subspecies *fraternus* (Peck) Sing. comb. nov.

Plate 1, Fig. 3

Boletus fraternus Peck, *l.c.*

Boletus parvulus Coker & Beers, *l.c.*

Boletus Cokeri House, *l.c.*

Pileus "Pompein red" to "madder brown," "hydrangea red," "deep Corinthian red," "ocher red," "brick red," "terra cotta," rarely "coral red" to

“dragon’s blood red,” or even “jasper red” toward the margin, or “Hessian red” all over, soon cracking and showing the above colors on a yellow ground which is seen in numerous crevices, rarely the pileus remaining entire, sometimes the extreme margin pale red mixed with yellow without the cuticle cracking, often olive in dried condition, especially in young specimens, usually non-viscid but becoming slightly viscid occasionally in rainy weather, tomentose or tomentose-flocculose-subgranulose, or velutinous-punctulate, or fibrillose-subsquamous-flocculose (usually very minutely so under a lens), pulvinate to convex or irregularly flattened with steeper margin, usually becoming appanate, 13-47 mm., rarely up to 95 mm. broad. — *Hymenophore* yellow, e.g. “pinard yellow” or “aniline yellow,” then becoming more olive or greenish (e.g. with “citron green” or “aniline yellow” shades) adnate or somewhat depressed around the stipe, and then usually lamellately stretched in a narrow zone around the stipe on which the tube-walls often run down for a distance of 1-2 mm.; tubes 4-14 mm. long; pores comparatively rather wide, initially somewhat meandering, either equally wide or wider near the stipe (there 0.8-2.0 mm. wide if deeper secondary pores are disregarded), angular and more or less compound when mature, concolorous, bluing or greening when touched if quite fresh and not too old; spore print olive brown. — *Stipe* more or less concolorous with the pileus but with the yellow of the ground color showing to a varying degree between the appressed, innate red fibrils, sometimes the red color concentrated near the base, sometimes the apex yellow or the entire stipe almost without a trace of red, not flocculose-squamulose, not furfuraceous, only longitudinally appressedly fibrillose, dry, solid, equal or tapering toward the base which is often acuminate, (15)-30-70 x 2-11 mm.; mycelium forming a more or less distinct intensely yellow tomentum at the base, the mycelial strands in the substratum, however, are whitish yellow or yellowish white. — *Context* pale yellow to rich yellow in the pileus (e.g. “baryta yellow”), deeper yellow in the stipe than in the pileus, on bruising slightly greening or bluing to strongly bluing at once; odor none; taste mild.

Spores (8.5)-10-14.5-(15) x 4-5.5-(6) μ , most frequently 12.5-13.5 x 4.5-5.5 μ , brownish melleous, with thin or moderately thickened walls, smooth, ellipsoid-subfusoid with a slight, more rarely with a strong suprahilar depression; *basidia* 26-38 x 9.5-11 μ , 4-spored, hyaline, or a few melleous; *cystidia* 41-68 x 6.7-12.5 μ on pores, hyaline or melleous from a thin resinous incrustation, often partly incrustated, fusoid, frequently with ampullaceous apex with rounded tip, numerous, more scattered in the tubes; *trama* truly bilateral of the *Boletus*-type; cuticle formed by a palisade of dermatocystidium-like erect hairs (a trichodermium-palisade) which are occasionally rather broad and short, vesiculose, others elongate and capitate or ampullaceous, or subcylindric, sometimes with a septum in the middle, occasionally with isolated spherocysts intermingled in the trichodermium, especially in the layer formed by the basal cells of the palisade which as a rule are shorter than the terminal hyphae; though this structure may be mistaken for a cellular structure, there actually is no epithelium present; all *hyphae* without clamp connections.

Chemical reactions.—KOH usually reacting weakly, not causing strong color changes on the surface of the pileus. - NH₃ on surface of pileus, little reaction. - NH₄OH on surface of pileus in very fresh material that is not too

dry and not too watersoaked, usually provoking a brownish, fulvous, or olive stain around which a lilac or slate blue marginal ring develops.

Habitat.—On lawns, in flower beds, on moist places and banks in and near frondose woods and in low and mesophytic hammocks, on the earth, or sometimes growing along stones or roots or trunks, occasionally climbing up to 3 feet on standing trunks, solitary, gregarious, or even cespitose, fruiting from May till September or October.

Distribution.—Common in the southern states but reaching Massachusetts in the north, not reaching the tropical zone in the south, west to Missouri.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, R. Singer, *F 2065* (FH); *F 2065 a* (FH); *F 2149* (FH); *F 2168 a* (FH); *F 2758* (FH); Sugarfoot Hammock, R. Singer *F 2669* (FH); HIGHLANDS Co., Highlands Hammock State Park, R. Singer, *F 648 B* (FH), *F 181* (FH). MASSACHUSETTS, Canton, July 23, 1927, D. H. Linder (FH). DISTRICT OF COLUMBIA, Washington, S. E. Wilcox (det. Peck as *B. sanguineus*), (NYS). NORTH CAROLINA, Pearson's Falls gorge, W. C. Coker & party, 11928, CO-TYPE of *B. parvulus* Coker & Beers (FH). ALABAMA, Auburn, L. M. Underwood, TYPE of *B. fraternus* Peck (NYS). MISSOURI, Valley Park, D. H. Linder, Aug. 29, 1928 (FH).

Forma *subdumetorum*, f.n.

Recedit stipite flavo, brunneo-punctato. In dumetis tropicis humidissimis.

This differs from the type only in having the character of the surfaces of the stipe exactly as sp. *dumetorum* from which it differs in "madder brown" color of the rimose pileus and much stronger bluing of the context, and also in the habitat in grassy openings in the low hammock instead of the thicket of the tropical hammock. It is known only from the type locality, Highlands Hammock State Park, Highlands Co., Fla., R. Singer, Sept. 8, 1942, *F 648 A* (FH).

Coker & Beers have described a new species which they consider as closely related to *B. fraternus* Peck, i.e. *B. rubellus* ssp. *fraternus* (Peck) Sing., calling it *B. subfraternus* Coker & Beers, Bol. N. Carol., p. 61 1943. The material kindly sent us by these authors is, in the writer's opinion related with *Boletellus turbinatus* (Snell) Sing. rather than with *Boletus rubellus* and its group. The spores are very characteristically mucronate at the apex, and differ in size from those of the known smooth-spored species of *Boletellus* to which genus it has to be transferred.

Subspecies *CONSOBRINUS* Sing., Mycologia 37:798. 1945.

Pileus more or less "madder brown" in the center, or in part "Pompeian red" or "diamine brown," margin "sepia" or "sepia" mixed with pallid, more rarely entirely olive brown, velutinous or very finely subtomentose-subgranulose, convex to applanate or flat to depressed in the center with steeper margin, 17-34 mm. broad. — *Hymenophore* yellow then greenish yellow, adnate-subdecurrent to adnate-subsinuate; pores concolorous, slowly bluing on pressure when fresh, or unchanging, comparatively rather wide. — *Stipe* "pinnard yellow" above, "madder brown" in the middle, and with a striking "pale greenish yellow" mycelial tomentum at the base, neither granulose nor floccose-squamu-

lose but smooth and glabrous or very minutely (use lens) subpruinose, solid, subequal or tapering downward, 32-37 x 3.5-6.5 mm.; mycelium yellow. — *Context* yellow, either unchanging or slightly and slowly bluing; odor disagreeable, reminding one of old, dirty clothing; taste mild.

Spores 9.2-11 x 4.7-5.4 μ , comparatively broader and shorter than in other subspecies of this grex, melleous, with a slight suprahilar depression or without depression, smooth; *basidia* 25-38 x 10.2-10.5 μ , 4-spored; *cystidia* 41-64 x 7.5-10.5 μ , ventricose in the middle with ampullaceous apex, hyaline to pale melleous, not visibly incrustated, rather numerous at pores, scattered in the tubes; *trama* and *cuticle* as in the preceding subspecies.

Chemical reactions not studied.

Habitat.—In tropical hammock on lime rock soil, solitary or in small groups, fruiting from October till November.

Distribution.—Tropical Florida.

Material studied.—FLORIDA, DADE Co., Matheson Hammock, R. Singer, F 1251, TYPE (FH); F 1454 (FH).

Subspecies DUMETORUM Sing., Mycologia 37:798. 1945.

Pileus "vinaceous rufous" or between "madder brown" and "brick red," or "brick red," or colored in the latter shade on the granulae which stand out upon a paler ground (thus making the general impression "vinaceous russet" to "cameo brown"), often pale yellow or "sulphur yellow" on the extreme margin, velutinous, especially on the young margin, or granular, especially on adult, larger specimens, non-viscid, usually unchanging when touched but sometimes bluing on the margin when touched, convex, the center often nearly flattened or depressed, 16-55 mm. broad. — *Hymenophore* yellow, becoming more greenish or olivaceous, in some specimens becoming stained with reddish brown when old, usually bluing or greening when touched, adnate or slightly to deeply depressed around the stipe, very often showing a narrow lamellate zone around the stipe; pores concolorous with the tubes, rather wide, angular; spore print "olive brown." — *Stipe* variable in color, the lower larger part yellow or "onion skin pink," or reddish brown granular or yellowish brown granular on yellowish ground, the apex always and the base usually yellow (concolorous with the young pores) and there also reddish brown or yellowish brown granular, or glabrous both above and below the granular zone, or either above or below, the granulation often rather in form of a minute flocculose punctation (use lens) rather than of conspicuous granulae, but always present in all specimens, dry, equal, mostly pointed-acuminate at the base, straight or curved or sometimes flexuous, solid, 22-83 x 5-10 mm.; mycelium usually forming a more or less conspicuous tomentum at the base, yellow or sulphur yellow. — *Context* yellow, in most cases not bluing when injured, rather firm, fleshy and rather thick; odor none; taste mild.

Spores 9.5-13.7 x 4.3-5.5 μ , brownish or melleous, ellipsoid-fusoid, with suprahilar depression; *basidia* 31-34 x 10-13.5 μ , 4-spored; *cystidia* 45-70 x 7-14 μ , fusoid, often with an ampullaceous neck (10-29 x (4)-55 μ), numerous at the pores, hyaline or melleous, more scattered in the tubes; *trama* truly

bilateral of the *Boletus*-type, with bright yellow pigment which disappears readily in ammonia, with a looser lateral stratum or distinctly and entirely divergent hyaline hyphae, and a melleous, denser, axillar mediostratum with parallel-subinterwoven, more frequently septate, thinner hyphae; *cuticle* with erect hyphae forming a palisade, the terminal members dermatocystidium-like, cylindrical to subulate, rarely subcapitate, 14-40 x 6-11 μ , the pre-terminal hyphae short, often as broad as long, short-cylindric or vesiculose, with rather thin to very moderately thickened walls; *tomentum* of the stipe yellow, not entirely losing its pigment in NH₄OH, consisting of very irregularly interwoven hyphae of varying diameter but mostly 0.7-2.5-(6.8) μ thick; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—In tropical hammocks in the deep shadow of mixed frondose, mostly evergreen trees on lime rock soil or on very decayed wood, frequently but probably not always near *Quercus virginiana*, solitary to gregarious, fruiting from September (or possibly earlier in the rainy season) till October.

Distribution.—Dade County, Florida.

Material studied.—FLORIDA, DADE Co., Miami, Simpson Park, R. Singer, F 695, TYPE (FH); Matheson Hammock, R. Singer, F 695 a (FH); F 1384 (FH); Royal Palm State Park, R. Singer F 1256 a (FH); all CO-TYPES.

Forma *crassotunicatus* f. n.

Pileo olivaceo, trichodermio ex hyphis erectis, crassotunicatis efformato recedit. In dumetis tropicalibus.

This differs from the type of this subspecies in the members of the trichodermium of the pileus being thick-walled (diameter of the walls 0.5-2.0 μ , mostly around 1.3 μ); macroscopically, for some reason or other, this seems to show in color. The cuticle which has been red in fresh condition is now a pure olive color; no yellow pigment-solution did come out of the hymenophoral hyphae in NH₄OH; cystidia mostly hyaline, fusoid-ampullaceous; not otherwise different from the type form. On earth in tropical hammock. Known only from the type locality; Matheson Hammock near Miami, Dade Co., Fla., October 8, 1942, R. Singer, F 976, TYPE (FH).

Subspecies *CARIBAEUS* Sing., *Mycologia* 37:798. 1945.

Pileus "brick red," "Japan rose," "terra cotta," or some similar color, not carmine-purple, often discolored to olive brownish or olive gray ("dark olive drab," "ecru olive"), distinctly tomentose and non-viscid, especially strongly so on the margin, more subtomentose in the center after a while and generally glabrescent with age and at the same time cracking into areolae, becoming rimose with yellow crevices, rather pale and very opaque in dried condition (much more so than *B. rubricitrinus*), pulvinate with the center sooner or later appanate or depressed, 40-70 mm. broad. — *Hymenophore* yellow, becoming more olivaceous when old, bluing where touched, adnate and often somewhat depressed around the stipe; tubes 6 mm. long, or somewhat longer; pores rather wide (0.7-1.5 mm. in diameter, towards the stipe frequently wider, 1-2 mm.), concolorous; spore print "olive brown." — *Stipe* sordid pale yellow-

ish or sometimes partly sordid pale pinkish, the base some shade of yellow, rarely a deep Corinthian red (not "madder brown" as in *B. rubricitrinus*) at the base, covered with flocculose squamulae or furfureous floccons of any of the above named colors but usually not prominently red or pink but predominantly yellowish, dry, subequal or often tapering downward, the base often pseudorhiza-like, solid, 58-67 x 10-25 mm.; mycelium sordid, not yellow, forming a basal tomentum, or inconspicuous. — *Context* yellow in the pileus and the upper portion of the stipe, bluing when bruised, in the base of the stipe yellow mixed with reddish pink, in the very root-like base beneath, yellow again inside and outside; odor none; taste mild.

Spores (9.5)-10-14.2-(14.5) x 4.2-6.5 μ mostly 11-11.7 x 5 μ , broadly fusoid, rather thin-walled to quite thin-walled, with suprahilar depression, brownish melleous, well colored, smooth; *basidia* 29.42 x 10.5-12.5 μ , (1)-4-spored with about 5.5 μ long, half sickle-shaped sterigmata which are connected with the spores at a hilar point distinctly outside the longitudinal axis of the spore (spores asymmetric⁸); *cystidia* 23-70 x 7.5-11 μ , fusoid to fusoid-subampullaceous, hyaline, some (either a majority or a minority) covered with a strongly appressed resinous, melleous incrustation, moderately numerous to numerous on the pores, more scattered in the tubes; *trama* of the hymenophore truly bilateral, of the *Boletus*-type, the mediostratum slightly colored melleous, and denser than the lateral stratum which consists of rather loosely arranged, hyaline and decidedly divergent hyphae; all *hyphae* without clamp connections.

Chemical reactions.—KOH everywhere brown. NH₃ and NH₄OH reactingly indistinctly, making the pileus more dirty olive. HCl on surface of pileus, negative. — FeSO₄ olive grayish.

Gastroid conditions.—These are similar to those formed by *Boletinus decipiens* though differing in being comparatively much larger; they have the color of the pileus of a normally developed carpophore, and all truly gastroid stages were found to be sterile and remaining sterile. They are met with together with the normal form.

Habitat.—In dry pine land (*Pinus caribaea*) of the tropical zone of South Florida, on poor, rocky lime soil, also on lawns along pine lands, often in the shade of leguminous trees or *Ficus* but evidently associated with pine, in groups, fruiting from September till November.

Distribution.—Dade Co., Fla.

Material studied.—FLORIDA, DADE CO., Fairchild Tropical Garden, along the stone wall, often hidden in dense shrubbery, *R. Singer, F 1370*, TYPE (FH); Coral Gables, lawn under *Pithecolobium* near pines, *R. Singer, F 1119*, (FH); Coral Gables, *Dr. Buswell* (det. *R. Singer*), *F 1093* (FH); Woodlawn Park Cemetery, just outside the cultivated lot in dry pine land, *R. Singer, F 1288* (FH), all CO-TYPES.

⁸ This is the type generally found in Agaricales. Like the spore attachment in *Boletinus decipiens*, it differs from what we find in those Gastromycetes with a structure comparable to that of the gastroid forms of both *B. rubellus* ssp. *caribaeus* and *Boletinus decipiens*. Otherwise one would rather be inclined to consider the boletes as boletoid stages of certain Gasteromycetes, while, actually, they are atavistic forms re-establishing an angiocarpous development but retaining the advanced way of spore-formation acquired by pseudoangiocarpous and gymnocarpous development.

Forma *serotinus*, f. n.

Sporis majoribus praesentibus (usque ad 16.3μ) differt. In hortis in Coral Gables *serotinus*.

This differs from the typical form of the subspecies, so common in Dade Co. in fall, in having a higher maximum spore length. The spores are $10-16.3 \times 4.5-6.8\mu$, most frequently $12.5 \times 5.5\mu$. These rare late specimens, collected by the writer in mid-November during a dry but cooler spell, do not otherwise differ from ssp. *caribaeus* and are here considered as a seasonally aberrant form. The same mycelium also produced a sterile, gastroid condition which was, naturally, indistinguishable from the gastroid stage of the type form.

Subspecies *BICOLOROIDES* Sing., *Mycologia* 37:798. 1945.

Pileus "Pompeian red" to "dragon's blood red," discoloring to "Dresden brown" or "Isabella color," very minutely areolate-subgranular to rimulose-subtessellate, never viscid, convex to flat, 24-52 mm. broad. — *Hymenophore* yellow, soon inclining to become greenish and eventually reaching almost "citron green," slightly depressed around the stipe, with short decurrent ribs on the very apex of the stipe; pores rather wide and irregular, mouths of irregular depth, concolorous and changing to green or blue when touched, at least when young and fresh; spore print "olive brown." — *Stipe* more or less yellow at the apex, farther downward's concolorous with the pileus or "mineral red" near the base, subglabrous, but under a lens extremely minutely subfloculose, not reticulate but coarsely longitudinally ribbed by innate fibers, subequal, solid or stuffed, 28-64 \times 5-12 mm.; mycelium not very abundant, pallid cream white, or at places yellowish white. — *Context* yellow, bluing readily in all parts when exposed; odor slight, somewhat in between the odor of *B. edulis* and *B. auripes*; taste mild.

Spores $10.2-14.5 \times 4-6\mu$, mostly $11-13.7 \times 4.5-5.5\mu$; *cystidia* with ampullaceous apex; otherwise about as in *B. rubellus* ssp. *bicolor* (Peck) Sing.

Chemical reactions.— NH_4OH on surface of pileus a slate blue ring around a fulvous to olive stain.

Habitat.—In high hammocks under oaks and in deciduous woods or under frondose trees on lawns, fruiting from July till September in small groups, singly or cespitously.

Distribution.—North Florida, possibly north to Virginia along the Atlantic Coast.

Material studied.—FLORIDA, ALACHUA Co., Sugarfoot Hammock, *R. Singer*, F 2537, TYPE, (FH); Gainesville, *R. Singer*, F 2669, (FH). ?VIRGINIA, Richmond, *D. H. Linder & R. F. Smart* (FH).

Extralimital Subspecies of *B. rubellus* and Related Species

B. rubellus Krombh. ssp. *bicolor* (Peck) Sing. comb. nov.

Boletus bicolor Peck, l.c., and other combinations with this epithet.

Boletus rubeus Frost, l.c., and *Suillus rubeus* Kuntze l.c.

Though not recorded in Florida, this has been found as far south as Georgia and Tennessee. In order to prevent confusion with the other subspecies of *B. rubellus*, we shall describe ssp. *bicolor* in the same manner as the others.

Pileus "madder brown" to "ocher red," tomentose, dry or very slightly viscid in rainy weather, slightly rimulose with the flesh showing in the crevices being yellow, discoloring to "Dresden brown," or paler from the disc outward, pulvinate, then convex with appanate or less convex center, eventually often partly depressed, or irregular, 50-140 mm. broad.—*Hymenophore* "straw yellow," then more greenish and olivaceous, adnate or slightly depressed around the stipe; tubes 6-14 mm. long; pores concolorous with the tubes, moderately rapidly and moderately strongly bluing when touched, at least when quite fresh, scarcely 1 mm. wide in medium sized carpophores near the stipe, smaller (of the size of these of *B. miniatoolivaceus*) toward the margin, or more rarely all medium wide; spore print "olive brown."—*Stipe* deep yellow at the very apex or at a rather wide apical zone, "Pompeian red" to "madder brown" below, but tending to become as olive as the pileus, "Isabella color" at places, rugulose, subglabrous, *i.e.* extremely faintly flocculose-punctulate (but hardly visible to the unaided eye), variable in shape, solid, straight or curved, 40-95 x 8-23-(35) mm.; mycelium sordid white, reaching pale salmonaceous ochraceous, but never yellow, not even light yellow, usually inconspicuous, more rarely forming a strong basal tomentum.—*Context* light yellow, deeper yellow at places and when exposed for a long time, bluing but not immediately, and not very strongly so, occasionally almost unchanging; odor of radishes, or of *Leucocoprinus procerus*, or of garlic, especially some time after the carpophores have been picked, sometimes none; taste agreeable.

Spores 9-12.2-(13.5) x 3.5-5 μ , mostly 11 x 4 μ , pale melleous to melleous, cylindric-fusoid, with slight suprahilar depression and tapering apical portion, smooth; *basidia* 21-28 x 8.8-10.5 μ , (1)-4-spored; *cystidia* 21-48 x (3.5)-4-7.5 μ , subulate-fusoid or fusoid-ampullaceous, rather versiform, hyaline with moderately thin wall, rather numerous at the pores, somewhat more scattered in the tubes; *trama* truly bilateral, of the *Boletus*-type; *cuticle* consisting of a trichodermium whose hyphae are for the most part organized in a palisade, but with intermingled spherocysts of about 14 μ diameter which, however, do not form an epithelium; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—In frondose and mixed woods under Fagales on the ground, in small groups, singly or cespitose, fruiting from June till October.

Distribution.—From New England to Georgia and the Great Lakes region to Tennessee and Missouri.

Material studied.—VERMONT, TYPE of *B. rubeus* Frost (FH). MASSACHUSETTS, Woburn, *W. L. White* (det Singer, conf. Snell) (FH); Prospect Hill, *Farlow* (FH). NEW YORK, TYPE of *B. bicolor* Peck (NYS). NORTH CAROLINA, Chapel Hill, *Alma Holland (Beers)*, 11102 (as *B. communis*) (FH). TENNESSEE, Elkmond, *L. R. Hessler* (FH, similar material in FLAS); Laurel Falls, *A. H. Smith*, 10441 (FH). We have also material from Devil's Lahr, Wis., with smaller pores, determined as *B. bicolor* but possibly different.

BOLETUS PERNANUS Pat. & Baker, Journ. Straits Branch R. A. Soc. 78:72. 1918.

Plate 1, Fig. 9

The type (FH) shows slender, small fruit bodies with strikingly yellow mycelial tomentum; spores 9-12.6 x 3.7-5.3 μ , without suprahilar depression

or with a very slight one, the apex often attenuate, melleous brownish with a golden glimmer, now often with dark brown pigment-granulae, relatively rather thick-walled; cystidia hyaline, fusoid-ampullaceous or fusoid; the sulphur yellow mycelium of the base consisting of long filaments of (in NH_4OH) hyaline, 2-3.5 μ thick, thin-walled hyphae; the cuticle consisting of a trichodermium of ascendant, cylindric hyphae, with the last members erect, forming an epithelium of ovoid to globose bodies, only scattered clavate terminal hyphae or dermatocystidia interrupting this epithelium; all hyphae without clamp connections.

This Singapore species seems to be most closely related to the remaining species of this section, especially to the small tropical forms from the same general region. It is too early to decide whether or not the epithelium of the pileus is sufficient reason for a sectional separation.

***Boletus Patouillardii*, spec. nov.**

Pileo pulchre rubro, sicco, opaco, 4-10 mm. lato in siccis; hymenophoro flavo, circum stipitum depresso zonamque angustam sublamellosam formante, tubulis moderate longis; poris mediocriter amplis sed pro ratione amplis, concoloribus; sporis 7.5-9.5-(10) x 4.5-5.5 μ , brunneo-melleis, ellipsoideo-oblongis, (forma sua *Tylopilum Balloui* in mentem revocantibus), levibus; basidiis 28-30 x 7.5-10 μ ; cystidiis pororum 28-45 x 7.5-11.8 μ , hyalinis, fusoideo-ampullaceis vel fusoideis; tramate hymenophorali typi *Boletorum*; stipite ad apicem flavo, ceterum pileo concolori, subglabro, subaequali, sicco, solidi, fragili, 6-16 x 0.8-1 mm. in siccis; mycelio laete luteo sed tomentum basale haud formante, haud copioso; carnis colore haud observato; hyphis omnibus haud fibuligeris. Ad vias silvaticas, Reserve Forestière de Campong chhuong, Cambodge, Indo-China, Julio mense, *Petelot*, 222 (FH).

This species was collected and sent to Patouillard in 1921. Patouillard kept it in his herbarium under a herbarium name, but strangely enough not among the Boletaceae but—of all things—as a *Porolaschia*. If the writer had not by chance been interested in the *Laschia*-complex at the same time, this new *Boletus* would probably have escaped the attention of the specialists for a long time. This fungus and *B. pernanus* look very much alike in dried condition except for the mycelium which is much scantier in *B. Patouillardii*. The spores are definitely shorter than in *B. pernanus*, and the color of the fresh pileus and stipe should make the distinction of this plant easy. The cuticle is not in a condition that lends itself to anatomical analysis. It may belong to either the *Pernanus*-type or the *Nanus*-type, i.e. forming an epithelium, or forming a tomentum with elongate hyphae only.

BOLETUS NANUS Mass., Bull. Misc. Bot. Gard. Kew (1909):208. 1909.

I have not seen the type but I have seen two good collections in the Höhnel-Herbarium (FH) which undoubtedly belong here. The pileus is amber or olive umber, flocculose-tomentose or innately squamulose, dry, convex, about 28 mm. broad, deep brown in the herbarium; tubes and pores light yellow, or yellow, adnate or slightly depressed, rather short (about 4 mm.

long); pores rather small but in comparison with the diameter of the pileus rather wide; stipe light yellow, or somewhat reddish at the apex, yellowish brown in the middle and olive below, somewhat radicate at the base, smooth, longitudinally fibrillose, without distinct basal tomentum, cylindric, somewhat curved, about 26 x 5.5 mm.; mycelium yellow; context light yellow, bluing on exposure. Spores 8.2-10.2 x 4.5-5-(5.5) μ ; hyaline to strikingly golden yellow, small, without suprahilar depression, thin-walled, smooth; basidia 25-31 x 7-8.2 μ , 4-spored; cystidia 34-68 x 6.8-13.5 μ , very crowded at the pores, hyaline, fusoid, apiculate; trama bilateral with a bright yellow denser axillar mediostratum of somewhat interwoven-parallel hyphae, and reaching a point near the pores (not the pores themselves), the lateral stratum hyaline, of distinctly divergent, more loosely arranged hyphae; cuticle of interwoven hyphae, the terminal members often ascendant, with distant septa, fulvous-melleous, often with the pigment concentrated in guttulae; all hyphae without clamp connections. The colors and measurements of the carpophores are given according to Höhnel's notes and sketch *in sched.*

This was originally described from Singapore but the above description refers to specimens from Tjibodas, Java.

BOLETUS AUREOMYCELINUS Pat. & Baker, Journ. Straits Branch R. A. Soc. 78:69. 1918.⁹

The type from Singapore (FH) has wide pores; spores about 7 x 5 μ , pale melleous; hyphae of the bright yellow, abundant mycelial tomentum of the base filamentous, 2-5.5 μ in diameter; the tomentum of the pileus consisting of melleous-citrinous strands of parallel or subparallel hyphae, or of single hyphal filaments, not forming a distinct palisade anywhere, the hyphae very variable in diameter, without clamp connections. This is obviously close to the preceding species. Though the exact color of the spore print is not known for either of them, the combination of the known characters strongly suggests this section rather than the genus *Tylopilus* where no related species exist.

Species Imperfectly Known

BOLETUS PARVUS Peck, Bull. Torr. Bot. Cl. 24:145. 1897.

The data on this plant may be found in Coker & Beers, *l.c.*, p. 39. Its generic position is not quite certain. It was described from Alabama, and Coker & Beers think they have re-collected it in North Carolina. Its main features are small (1-2 in.) reddish pileus, rather large, bright red pores.

Section *LURIDI* Fr., *Epicrasis*, p. 417. 1838.

Suillellus Murr., *Mycologia* 1:16. 1909, (*ut genus*).

Characters of the section: The difference between this and the section *Apendiculati* consists in the reddish or brown pores, or the non-reticulate stipe in the former section. The *Luridi* differ from the section *Subpruinosi* in

⁹ In the original paper, the name is spelled "aureomycetinus" but this is obviously a printing error since the specimens are correctly labeled as above.

smaller pores. Some species with definitely concolorous pores during their entire development are very close to the *Luridi* in the old sense *i.e.* to species with red pore mouths. This fact becomes still more evident if varieties with permanently concolorous pores of species with typically discolorous pores, or varieties with discolorous pores of species with typically concolorous pores are considered (see nos. 18 and 25). This shows that the section *Luridi* had to be emended to include certain species with concolorous pores. Though the color of the pores is a convenient character for determination, it has, in many cases, little bearing on questions of natural affinity between species.

The section *Luridi* of the genus *Boletus* contains the only known poisonous species of the Boletineae. Amateurs should be careful not to experiment with any of these species since even a small quantity of the poisonous carpophores may cause serious illness though none is believed to be as deadly as the Amanitae of the Phalloides group (*A. phalloides*, *A. brunnescens*, *A. verna*, *A. virosa*). *B. satanas*, *B. luridus* and *B. miniatoolivaceus* have notoriously caused ill effects on people who ate them though the amount of poisonous matter seems to vary either regionally, or perhaps according to climatic factors. The susceptibility of different persons also varies to a certain degree.

The type species of the section *Luridi* is *Boletus luridus* Schaeff. ex Fr.

KEY TO THE SPECIES

- A. Pores concolorous with the tubes (yellow).
 B. Pileus pink, red, testaceous, vinaceous-rufous, purplish, or yellow.
 C. Pileus pallid leather ocher; context usually little or not changing when exposed to the oxygen of the air (*B. impolitus*)
 C. Pileus not colored as above; context usually distinctly bluing in fresh material.
 D. Spores 5μ or broader.
 E. Pileus prevalently red or reddish; spores $12.5-18.8 \times (4.5)-4.8-7.7\mu$, mostly $(14)-15-(17) \times 5-5.5\mu$; stipe flocculose-squamulose.
 F. Pileus strongly viscid when wet *B. dichrous*
 F. Pileus not strongly viscid when wet 25. *B. rubricitrinus*
 E. Pileus not or not prevalently red (only with a superficial red covering in young specimens and possibly some red or pink areas alongside the prevalent bright yellow color of the adult specimen); spores distinctly shorter than indicated above: " $(10)-11-15-(17) \times 5-6.5\mu$ " according to Kallenbach in Europe
 *B. junquilleus* (cf. also *B. Queletii*, see p. 65-66 and p. 79)
 D. Spores up to 5μ broad.
 G. Pileus prevalently bright golden yellow when mature with somewhat shining cuticle in dry weather, the purplish carmine floccons or fibrils all disappearing in early youth; base of the stipe inside and out deep carmine, at least constantly so in mature specimens; odor slight, agreeable, or none, slightly cumarinous when dried 19. *B. flavissimus*
 G. Pileus usually prevalently red or pink though occasionally fading to olive or brownish, leaving large yellow areas in some specimens and rarely remaining yellow instead of some kind of red, always opaque; base of the stipe rarely with carmine colors; odor though weak yet characteristic, disagreeable, variable (of onion, garlic, spoiled meat, cumarine, etc., see description) when fresh and especially some time after collecting, cumarinous when dried 18. *B. miniatoolivaceus*
 B. Pileus without reddish, purplish, pinkish, etc. tones, and also not yellow.
 H. Pileus pallid leather color; context usually not changing on exposure
 *B. impolitus*

- H. Pileus differently colored (brown); context usually readily bluing.
1. Stipe not carmine but umber brown in the base, its apex without a network, merely finely flocculose23. *B. olivisporus*
 - I Stipe not umber brown but carmine in the base of mature specimens, its apex almost constantly with a narrow zone of fine reticulation which a few millimeters from the point of attachment of the tubes, is replaced by minute floccons24. *B. luridellus*
- A. Pores discolorous as compared with the tubes, i.e. tubes yellow, then olivaceous, and pores red from the beginning or with maturity, often dusky red, or in some cases rather brown.
- J. Stipe without distinct reticulation, or with an indistinct very fine one continuing from the line of attachment of the pores on the apex of the stipe for a distance of no more than one-fourth of the length of the stipe, but much more frequently no reticulation of any kind is observed on the stipe.
- K. Spores in average twice as long as broad ($Q=2$), 5-7 μ broad, rarely broader; basal tomentum indistinct. Old-world species*B. Queletii*
- K. Spores, if as broad as indicated above, at least in their majority somewhat longer than two times their breadth; or, if the spores do have a Q around 2, they are American species with a very well developed basal tomentum.
- L. Pileus "vinaceous brown" on the margin, "sorghum brown" on the disc, tomentum of the base between "Isabella color" and "buffy citrine" (i.e. olivaceous); dried pileus usually "sorghum brown" on the margin and "vinaceous buff" in the center (if prepared carefully); spores 9.5-12.2 x 4.2-5.5 μ . Tropical Florida20. *B. austrina*
- L. Not combining the above indicated characters.
- M. Basal tomentum very prominent, reaching high up the stipe; spores 9.2-13.8 x 5.5-6 μ . Western species*B. tomentipes*
- M. Not combining a strong basal tomentum with spores of the above size.
- N. Pileus pinkish red, vinaceous-testaceous; spores large (13.5-16.3 x 4.8-5.5 μ). Tropical Florida25. *B. rubricitrinus* var. *Fairchildianus*
- N. Not combining the above color with the above spore measurements, and not occurring in tropical Florida (but some occurring in extra-tropical Florida).
- O. Pileus brownish to deep brown, very rarely with red or yellow light spots or red or yellow portions.
- P. Pores and floccons of the stipe (if present) red, dusky red.
- Q. Stipe not glabrous, or if it is glabrous above, it shows a distinct lines on white ground, otherwise similar to *B. subvelutipes* except for the spores which are somewhat smaller (8.5-11.5 x 3.5-3.8 μ in the type)21. *B. hypocarycinus*
 - Q. Stipe not glabrous, or if it is glabrous above, it show a distinct velvety to strigose basal tomentum.
 - R. Context bluing; pores bluing; mycelium rarely bright yellow (*B. erythropus*) and22. *subvelutipes*)
 - R. Context reddening, not bluing; pores reddening, not bluing; mycelium bright yellow*B. Morrisii*
 - P. Pores and floccons of stipe brown*B. vermiculosus*
- O. Pileus red, sometimes mixed with yellow, frequently discolored, at least in part, to brownish or olive; stipe indistinctly and inconstantly minutely flocculose or subglabrous.
- S. Stipe subglobose-bulbous(*B. Eastwoodiae*)
- S. Stipe thick and ventricose to subequal, or tapering upwards or downwards, not subglobose-bulbous.
- T. Spores large (12-18 x 4-6 μ); odor weak and agreeable or none.
- U. Pileus viscid, bright red (about the color of the most usual form of *B. Frostii*); Mediterranean*B. Dupainii*
 - U. Pileus sometimes slightly sticky in rainy weather, but not distinctly viscid, drying rapidly; color not uniformly bright and deep red, only occasionally with some brown-red or

- or orange red mixed in, very rarely prevalently in these latter colors (*B. erythropus*)
- T. Spores smaller; odor more or less distinctly disagreeable, of onion, garlic, spoiled meat, cumarine, etc. (like that of *B. satanas*) 18. *B. miniatoolivaceus* var. *subluridus*
- J. Stipe with a distinct network, normally (i.e. in the majority of the carpophores of a group) covering one quarter or rather more of the length of the stipe.
- v. Pileus usually pale sordid white, or pale sordid grayish cream color, or with a greenish tinge, and becoming somewhat brownish only in old specimens; sometimes with a flush of light purplish pink but never carmine red, not orange, not deep yellow, not deep olivaceous, and never deep brown from the beginning; stipe bulbous and remaining so, or becoming stretched with age, with a very fine reticulation of little raised red lines which form meshes that are not or not much longer than broad, the base of the stipe usually not so strongly carmine red, vinaceous, olivaceous, etc. as in *B. luridus*; odor very weak, agreeable, or almost none, or, though slight, yet distinctly disagreeable as in *B. miniatoolivaceus*.
- w. Reticulation constantly confined to the very apex of the stipe; stipe subglobose-bulbous; pileus usually pink, or prevalently pink. Western species *B. Eastwoodiae*
- w. Not as above, or not combining the above characters.
- x. Odor weak, agreeable or none; stipe at maturity elongated; pileus often with a pinkish, never with a greenish tinge *B. rhodoxanthus*
- x. Odor weak to rather strong, disagreeable, like that of *B. miniatoolivaceus*; pileus often with a greenish, never with a pink hue *B. satanas*
- v. Pileus well colored at maturity, either brown, or with bright red orange, olive, yellow, or pink colors; stipe bulbous but soon elongated and eventually cylindrical with a rather strongly elevated reticulation, the meshes of which are strongly longitudinally elongated, the resulting network usually running down over one half or more of the length of the stipe, the inside of the base deep carmine red, deep vinaceous, deep olive, or orange red if the ground color of the stipe is not thoroughly yellow (aside from discolorations); odor agreeable and very weak, or none.
- Y. Raised lines of the reticulation of the stipe strongly projecting and, at least on a part of the stipe, red on red ground; pileus deep red, or entirely pink. American species 26. *B. Frostii*
- Y. Raised lines of the reticulation moderately strongly elevated, usually red on yellow ground but later often discolored. European species, probably not occurring in America *B. luridus*

SIMPLIFIED KEY TO THE FLORIDA SPECIES OF SECTION LURIDI

- A. Pores concolorous with the tubes, yellow.
- B. Pileus red, or some shade of reddish.
- c. Floccons of the stipe distinct; spores 12.5-18.8 x (4.5)-4.8-7.7 μ mostly (14)-15-(17) x 5-5.5 μ ; odor none or very slight and agreeable; base of the stipe usually deep red inside 25. *B. rubricitrinus*
- c. Floccons of the stipe indistinct or very small and forming a glabrous surface as seen with the unaided eye; spores smaller than indicated above; odor disagreeable a while after picking; base of stipe mostly not deep red inside. Rare. 18. *B. miniatoolivaceus*
- B. Pileus not red (or only somewhat reddish at places, especially where not exposed to light and water).
- D. Pileus bright yellow (or prevalently so at least in mature specimens) 19. *B. flavissimus*
- D. Pileus some shade of brown.
- E. Stipe not carmine but umber brown in the base, its apex without a network, merely finely flocculose 23. *B. oliveisporus*

- E. Stipe not umber brown but deep carmine in the base of mature specimens, its apex almost constantly with a narrow zone of fine reticulation which, farther downwards, changes into minute flocculosity24. *B. luridellus*
- A. Pores discolorous, red.
- F. Stipe without a distinct network (except perhaps a very narrow belt at the very apex of the stipe).
- G. Pileus about "sorghum brown" in dried caps; stipe with a strongly strigose olivaceous basal tomentum20. *B. austrinus*
- G. Pileus differently colored; if the stipe shows a strong basal tomentum, the latter's color is usually red or rusty-red.
- H. Pileus brown.
- I. Spores 8.5-11.5 x 3.5-3.8 μ in the type; stipe red punctate and red-lined on whitish ground; basal tomentum inconspicuous21. *B. hypocarycinus*
- I. Spores larger; stipe usually strongly red flocculose to red squamulose on yellow ground; basal tomentum strigose, red to rusty red22. *B. subvelutipes*
- H. Pileus red.
- J. Floccons of the stipe distinct. South Florida25. *B. rubricitrinus* var. *Fairchildianus*
- J. Floccons of the stipe indistinct. North Florida18. *B. miniatoolivaceus* var. *subluridus*
- F. Stipe very distinctly reticulate26. *B. Frostii* ssp. *floridanus*

Description of the Species Occurring in Florida

18. BOLETUS MINIATOOLIVACEUS Frost, Bull. Buff. Soc. Nat. Sc. 2:101. 1874.

Boletus sensibilis Peck, Rep. N. Y. State Mus. 32:33. 1879.

Boletus miniatoolivaceus var. *sensibilis* Peck, Bull. N. Y. State Mus. 2(8):107. 1889.

Boletus Underwoodii Peck, Bull. Torr. Bot. Cl. 24:145. 1897 (a variety).

Suillus miniatoolivaceus (sic) Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Ceratomyces miniatoolivaceus Murr. Mycologia 1:152. 1909.

Suillellus subluridus Murr., Mycologia 30:524. 1938. (a variety).

Boletus subluridus Murr., l.c., p. 525. (a variety).

Var. TYPICUS

Description of the Northern Form

Pileus "testaceous" to "Etruscan red" or almost "jasper red" or "orange vinaceous," but often deeper red in young specimens and paler pink) in old ones, usually partly, rarely entirely becoming discolored assuming an olivaceous to brownish alutaceous tinge (e.g. "old gold"), suede-like to distinctly tomentose, somewhat viscid in rainy weather but drying rapidly and usually found in dry condition, often becoming reticulately rimose with the deep yellow flesh showing through, convex then more or less applanate, 60-160 mm. broad.—*Hymenophore* "amber yellow" or "pinard yellow," subplane beneath, adnate, or adnate-subdecurrent, or slightly depressed around the stipe, often separating in age; tubes 6-11 mm. long; pores concolorous or more rarely the more projecting tube-walls red-tipped (with "orange rufous"), bluing when touched, small or somewhat wider up to (0.8 mm.) near the stipe, 8-14 pores to 5 mm.; spore print brownish olive.—*Stipe* "baryta yellow" with some pink or red stripes or dots (between "dragon's blood red" and "Etruscan red") also usually with "light cadmium" stains near the base, later becoming orange yellow in some cases, at last sometimes brown fibrillose, sometimes "Pompeian

red" at the base, glabrous or extremely faintly flocculose-punctulate (use a lens), solid, equal, or sometimes subfusoid, or tapering upwards, more rarely tapering downwards from the apex, solid, 70-125 x 18-28 mm.; mycelium sordid whitish to light yellow or pale alutaceous. — *Context* "baryta yellow" (or paler in the pileus), bluing either strongly to deep indigo or weakly to greenish blue, changing either rapidly or slowly when injured, long-exposed flesh becoming deep golden yellow ("light cadmium"); odor at first very faint, and mostly more or less agreeable, in old specimens, especially after lying in the laboratory for a few hours, decidedly disagreeable but hard to define, much like the odor of spoiled meat, or of onion or garlic, or of rancid fat, or cumarinous (probably varying), always more or less cumarinous when dried.

Spores (8.5)-10.14-(14.5) x (3.5)-4.5-(7) μ , melleous or pale melleous, ovoid-oblong or fusoid, smooth; *basidia* 20-25.5 x 7.5-10 μ , 4-spored; *cystidia* 30-50 x 6-12 μ , fusoid to fusoid-ampullaceous or subclavate hyaline; *trama* truly bilateral of the *Boletus*-type; *cuticle* filamentous, frequently with some spherocysts intermingled on the surface; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus, olive yellow and rapidly becoming olive green, then olive bronze, in the red portions usually with red marginal ring around the stain; on context of stipe, rusty ochraceous, then duller; NH₄OH on surface of pileus, orange yellow, often with a caesious marginal ring around the stain; on context of stipe often greening; HNO₃ on surface of pileus becoming deep red, or remaining red, reddening even the yellow portions; on context of stipe, rusty ochraceous, then avellaneous.

Habitat.—On the earth in frondose and mixed woods under *Fagus grandifolia*, *Betula* and *Quercus* (several species). Fruiting from July till September.

Distribution.—From Canada to the Carolinas and west to the Pacific Coast.

Material studied.—MAINE, near Camden, *Linder & Singer, ME 12* (FH). VERMONT, Brattleboro, probably TYPE, *Frost* (FH). MASSACHUSETTS, Canton, *Linder* (det. Snell) (FH); Wakefield, *Singer M 104* (FH). RHODE ISLAND, East Providence, *W. C. Farlow*, on sheets and in boxes, also unpublished color plate (FH). NEW YORK, TYPE of *B. sensibilis* Peck (NYS); *Murrill* (NY). VIRGINIA, Petersburg, *Linder & Smart* (det. Singer) (FH); Mountain Lake, *Linder* (det. Linder & Overholts) (FH); Danville, *R. S. Phifer* (det. Peck, as *B. roseotinctus* (NYS). OREGON, Mt. Shasta, *W. B. Cooke* (det. Snell) 14628 (FH).

Description of the Florida Form

Pileus "Corinthian red" or "deep Corinthian red," or between "orange vinaceous" and "Etruscan red," or "Etruscan red" to "ocher red," or "dragon's blood red," often the covered places or in the folds pallid to yellow, rarely entirely yellow with a slight fugacious pink hue, glabrous to subvelutinous, somewhat viscid-sticky when wetted by rains but rapidly drying out, opaque or more rarely partly shining when dry, smooth, pulvinate, then expanding, 70-154 mm. broad. — *Hymenophore* yellow, adnate to somewhat depressed around the stipe; tubes moderately long; pores concolorous or occasionally the projecting dentate tube-walls tipped with "orange rufous," slowly and moderately strongly bluing on pressure if quite fresh, otherwise practically unchanging, small, subequal; spore print as in the northern form. — *Stipe*

yellow, mixed with pink or reddish because of extremely minute (use a lens) reddish rarely partly brownish or yellowish floccons which are irregularly crowded or scattered, not distinctly flocculose-squamulose, but causing the stipe to be very faintly pruinose at places, the base sometimes deeper red, everywhere smooth except for the very apex which is mostly covered by a very narrow inconspicuous orange or yellow reticulation in continuation of the pores, this reticulation composed of non-elongated to slightly elongated meshes of very fine (use lens), very slightly raised lines, sometimes with a brownish zone between this reticulate belt and the main portion of the stipe, sometimes entirely subglabrous and the floccons not visible even with a lens, solid, variable in shape, 40-110 x 18-45 mm.; mycelium of mixed yellowish and whitish filaments.—*Context* yellow, bluing when injured but not very rapidly and moderately strongly, becoming deep golden yellow (about "light cadmium") on long exposure or when wounds are dried, firm, thick in the pileus, later very soft and spongy; odor slight but distinct, disagreeable, of spoiled meat or onions or garlic, or cumarine, always cumarinous when dried; taste mild.

Spores 11.5-13.5 x 3.5-4.2 μ , ellipsoid-oblong to subcylindric or subfusoid, smooth, melleous; *basidia* 20-25 x 7.9 μ , 4-spored; *cystidia* 34-48 x 6.7-11.2, melleous, fusoid with ampullaceous neck, rather numerous; *trama* as in the northern form.

Chemical reactions, as in the northern form.

Habitat.—On the ground in high and mesophytic hammocks, near oaks, especially *Quercus virginiana* and *Q. laurifolia*. Fruiting in summer (mostly from June to August).

Distribution.—North Florida, northern and western limits unknown.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, *Singer*, F 2610 a (FH); also additional material without number, July 1943 (FH); Newnan's Lake, *Murrill* (det. *Singer*), F. 2073 (FH).

Var. *SUBLURIDUS* (Murr.) Sing., *Mycologia* 37:798. 1945.

Suillellus subluridus Murr. and *Boletus subluridus* Murr., *l.c.*
Boletus Underwoodii Peck, *l.c.*

Pileus "coral pink" to almost "jasper red," "Etruscan red" or "ocher red," sometimes with deep yellow ("deep chrome") portions, then showing a mixture of "vinaceous tawny" and "jasper pink," or becoming "vinaceous rufous," "ferruginous," or "cinnamon rufous," or partly buff discolored, subvelutinous, glabrescent, rimulose in age, or with an entire cuticle, sometimes with deep cracks showing the deep golden yellow ("light cadmium" or deeper) flesh through the crevices, usually dry but subviscid to viscid-sticky when exposed to rains for some time, convex then expanding, 50-110 mm. broad or rarely broader.—*Hymenophore* "sulphur yellow" to "pale green yellow," becoming "light calcedony yellow," (except for the discolorous pores), bluing on injury, depressed around the stipe in adult specimens; tubes 6-11 mm. long; pores either partly concolorous with the tubes, the yellow superseded by a shallow red tinge, or "Etruscan red" to "ocher red," or "Pompeian red" to almost "carmine" all over, frequently bluing on pressure when very fresh; spore print between "syrup" and Pl. 15, L 9 (M. & P.) when approximately 5 years old,

possibly better preserving the olive color than other species, especially those of sect. *Calopodes*.—*Stipe* "Eugenia red" to "jasper red" or "Pompeian red" to almost "carmine" (but duller, especially when old), becoming yellow at the apex and there with a faint network of isodiametric meshes which are formed by decurrent tube-walls and are red, more rarely yellow, occupying a very narrow zone (1)-2-6 mm. from the hymenophore downwards, the remaining main portion of the stipe entirely smooth and macroscopically almost glabrous, but when seen under a lens, the surface usually appears to be formed by minute floccons which, if very dense, make the surface appear uniformly red, and if scattered (near apex), the yellow begins to show through, or the stipe is beset with transverse rows of very minute (though visible to the naked eye) flocculae on yellow ground, the base yellow or white, or with some chrome yellow or orange, rarely with a dark red spot, solid, tapering upwards from a rather thick base, or ventricose and tapering toward both sides, 50-80-(120) x 18-22-(35) mm.; mycelium pale yellow to light yellow.—*Context* yellowish white to "Martius yellow," deeper yellow in the stipe than in the pileus, or uniformly light yellow, unchanging or bluing (moderately rapidly and moderately deeply) on injury but constantly becoming "lemon chrome" or even deeper golden yellow when exposed for a long time, the blue portions becoming green after a while and then isabelline, and if dried deep golden yellow; odor distinctly fetid, of spoiled meat, but not very strong; taste mild.

Spores and other microscopical characters and also the chemical reactions exactly as in the Florida form of var. *typicus*.

Habitat.—In high hammocks on bare ground, on sandy soil, usually gregarious, fruiting from May till October.

Distribution.—From North Carolina to North Florida and west to Alabama.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, TYPE of *B. subluridus* which is also the type of *B. miniatoolivaceus* var. *subluridus*, Murrill, 15869 (FLAS); 15868 (CO-TYPE) (FLAS), F 18351 (FLAS); Singer, F 2157 and F 2157 a (FH); F 2746 (FH); Newnan's Lake, Singer, F 2635 (FH). NORTH CAROLINA, Hillsborough, Aug. 1864, Curtis (as *B. satanas*), (FH), (540) (FH); JACKSON Co., Whiteside Cove., Steward and Howell (det. Coker as *B. luridus*), 12136 (FH). ALABAMA, TYPE of *B. Underwoodii* Peck, most probably this (see observations) (NYS).

This has been called *B. luridus* by Coker & Beers, *B. satanas* by Curtis, but it is not even similar to either of these species. If there were not the Florida form of var. *typicus* which in all regards except the lesser abundance of red pigment (especially on the pores) agrees with var. *subluridus*, one might consider this as a distinct though most closely related species. Further observations are desirable in order to find out whether or not there is anything like a constant character distinguishing the Florida form from the Northern form of var. *typicus*. If so, there could not be any objection to raising var. *subluridus* to the status of a subspecies or an autonomous species, provided that these distinguishing characters are identical in the Florida form of var. *typicus* and in var. *subluridus*. However in this case, a difficult question might arise because of the necessity of making certain that *B. Underwoodii* is actually the same as *B. miniatoolivaceus* var. *subluridus* since as a species, the former has priority. If they would grow together, *B. rubricitrinus* var. *Fairchildianus* and

B. miniatoporus var. *subluridus* would be difficult to distinguish externally but fortunately they do not grow together, but if they did, they would still be distinguishable by the difference in spore size and the covering of the stipe.

19. *BOLETUS FLAVISSIMUS* (Murr.) Murr., *Mycologia* 30:525. 1938.

Ceromyces flavissimus (Murr.) Murr., *Mycologia* 30:522. 1938.

Pileus "yellow chrome" to "light cadmium," or between "light cadmium" and "cadmium yellow," with an occasional faint tinge or "raw sienna" at places, lighter toward the margin where it often reaches "pinard yellow" or "amber yellow," positively opaque when young, but not velutinous or only subvelutinous, later becoming shiny in dry weather but not actually viscid when wetted, usually covered with a very fugacious red floccosity which is rarely persistent beyond the earliest stages but has nothing to do with the "claret brown" (i.e. deep red) spots and dots that are often found on the surface of old caps, rarely retaining a "jasper rose" tinge on less exposed portions of the pileus (transition toward *B. miniatoolivaceus*, see observations), convex or sometimes convex-umbilicate, with slightly projecting margin, 50-150 mm. broad, most frequently 65-100 mm. — *Hymenophore* between "reed yellow" and "olive yellow," often bluing where wounded, eventually assuming the color of the spore print which is between "citrine drab" and "deep olive,"¹⁰ depressed around the stipe; tubes 10-20 mm. long; pores "citron yellow," "reed yellow," "deep colonial buff," occasionally with a small ring-zone of "light orange yellow" around the margin, sometimes distilling golden, transparent watery drops, usually gray to cinnamon in dried material, eventually reaching the color of old tubes when fresh but frequently bluing when touched, small and not markedly irregular. — *Stipe* "pinard yellow," "Empire yellow," "amber yellow," or an inhomogeneous mixture of several yellow shades, later with "madder brown," "claret brown," "mineral red" base and, higher up, dots and lines of the same color, glabrous or extremely faintly and minutely subflocculose-pruinose (use a lens), smooth or reticulate with a fine concolorous network to a variable extent, unchanging or bluing where touched, dry, solid, ventricose, or bulbous when young, 45-65 x 22-32 mm.; mycelium whitish, sordid white, yellowish white, or light yellow. — *Context* "pinard yellow," at places more whitish where it begins to dry out but turning "light cadmium" to "deep chrome" in old wounds, not so deep yellow in rapidly dried material, bluing moderately strongly and moderately rapidly in most fresh and not too dry or too old specimens immediately after bruising but even in these the bluing is not constant, if present, it reaches "deep Delft blue" or "deep slate blue" in intensity, in the base of the stipe, the context is usually though not constantly red ("dark Indian red," "Hessian brown," "madder brown," "mineral red," or a still deeper red); taste mild; odor agreeable, somewhat of lemon but becoming cumarinous in dried material.

Spores 10.13.5-(21) x 3.5-5-(5.5) μ cylindric, cylindric-fusoid, cylindric-ellipsoid, or inversely clavate (tapering toward the apex), smooth, honey

¹⁰ After two years it has become between "deep brownish olive" and "Saccardo's umber."

brown, thin-walled; *basidia* e.g. $32 \times 8\mu$, hyaline or colored, 4-spored, very few 2-spored; *cystidia* $28-43 \times 7-18\mu$, thin-walled but with thicker walls than the tramal hyphae, hyaline or yellowish to melleous, subulate to fusoid, most frequently with an ampullaceous neck; *trama* truly bilateral, of the *Boletus*-type, but its hyphae becoming parallel in old specimens, $3.5-7\mu$ thick.

Chemical reactions.—KOH on surface of pileus, between "mahogany red" and "chestnut" but darker than both of these in the shiny-capped specimens, dirty brown in opaque specimens; on pores, dirty brownish; on context of pileus, dirty pink; on context of stipe, brown; NH_4OH on surface of pileus, somewhat paler (almost negative); on pores, nil; on context, dirty vinaceous to almost negative; FeSO_4 on context, olive; formol negative but stimulating the bluing.

Habitat.—Under or near *Quercus virginiana*, *Q. laurifolia*, *Q. nigra*, *Q. laevis* and *Q. Chapmanii*, on grassy, sandy soil, or on the forest soil in high hammock, also in gardens and on lawns, fruiting from June until September.

Distribution.—Florida, gradually more frequent from the north toward the south but not observed in the tropical zone.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Singer, F 2507 (FH); Murrill, F 18660 (FLAS); Singer F 2610 (FH); Murrill, F 15858, TYPE (FLAS); Sugarfoot Hammock, Singer, F 2507 a (FH); HIGHLANDS Co., Highlands Hammock State Park, F. 408 a (FH); F 506 (FH); ? F 616 (FH); Sebring, Singer, F 408 (FH).

Krieger (The Mushroom Handbook, p. 268, 1936) thinks that *B. pseudosulphureus* Kallenbach (i.e. *B. junquilleus*) is a yellow form of *B. miniatoolivaceus*. In fact, he has seen what he calls a specimen of *B. miniatoolivaceus* with entirely yellow pileus at the Boston Mycological Club, and we have seen such forms in Florida. If we substitute the narrow-spored *B. flavissimus* as described above for the broad spored *B. junquilleus*, Krieger's statement certainly makes sense. It is remarkable that Quélet himself (l.c.) made a statement reminiscent of, or rather parallel with Krieger's saying that *Dictyopus junquilleus* Quél. "seems to be a form of *discolor* from which it does not differ except by the concolorous pores." Now, *B. discolor* Quél. is unknown to most mycologists and suspected by some to be a form of *B. Queletii* which differs mainly in the color of the pileus. Thus we would have to distinguish

1. A narrow-spored group, all American forms, containing
 - a. a species with yellow pileus: *B. flavissimus* Murr.
 - b. a species with red (discoloring olive or brown) pileus: *B. miniatoolivaceus*.
 - c. as "b" but with red pores: *B. miniatoolivaceus* var. *subluridus*.
2. A broad-spored group, all European forms, containing
 - a. a species with yellow pileus: *B. junquilleus*.
 - b. a species with yellow pileus but red pores: *B. discolor*.
 - c. a brown or red or orange species with reddish pores: *B. Queletii*.

It seems to me that the species under "1" are specifically different from those under "2" though I cannot deny a marked parallelism in variability. As for the yellow forms in each group (1a, 2a), they can hardly be mere color forms of the other forms (1b, 2b), since the color is not the only distinguishing character. In Europe, it would be surprising that Kallenbach who is rather a "combiner" than a needless splitter, would describe a new species (which he thought his *B. pseudosulphureus* was) without even mentioning *B. Queletii*

which he knew very well (as *B. erythropus*), if they were merely color forms. *B. Queletii* lacks the characteristic strigosity formed by the basal tomentum always noted in *B. junquilleus*, and, besides, does not change as strongly as the latter; all this aside from the differences in color of the pileus and the pores. As for the narrow-spored, American group, the forms with yellow and those with red pileus also appear to be different from each other. *B. miniatoolivaceus* with yellow pileus would not necessarily be *B. flavissimus*, and *B. flavissimus* with some red on the cap (such as my *F* 2507, *F* 2610, and Murrill's *F* 18660) would not necessarily be *B. miniatoolivaceus*. In fact, the best means of distinguishing these species is not the color of the pileus unless this color is so unmistakable as to make further investigation unnecessary. In dubious cases, the best character for those who perceive them, are the different odors of these species, the agreeable odor of *B. flavissimus* and the disagreeable one of *B. miniatoolivaceus*. In order to explain the odor of the latter to a European one may best compare it with that of *B. satanas*, and vice-versa, yet, the odor of the American species is perhaps more variable than that of *B. satanas*. Another distinguishing character between *B. flavissimus* and *B. miniatoolivaceus* is the context of the base of the stipe which is very rarely deep red in the latter species, and very rarely not so in the former. The chemical characters of these species do not seem to be identical, especially the KOH reaction on the surface of the pileus is quite different according to my notes. It may, however, be argued that the reactions of the cuticular layer are largely determined by the presence or absence of certain pigments, or their proportion, and this would, consequently reduce this chemical reaction to a character parallel to the abundance of the red in the pileus. Also, the geographic area of these two plants are too different to assume that they are color variants of the same species.

We therefore conclude that the yellow form of group 1 as well as group 2 are specifically different from the other forms of their respective group. But cannot the yellow species of each group be combined into one species, accounting for the difference in spore shape with the assumption of the existence of geographic races? I do not think they can. The weaker bluing, the occasionally reticulate stipe, the absence of a conspicuous basal tomentum, and the absence, in all my specimens, of the slightest reddish flush on the pores, are in my opinion enough characters to justify the distinction of two entirely autonomous species.

Murrill has recently (*Mycologia* 36:122. 1944) revised his opinion concerning *B. flavissimus*, stating that "*Ceratomyces flavissimus* = *Ceratomyces aureissimus*" I do not think that these two boletes are even very much related. All they have in common is the fact that they are the two bright yellow boletes of Florida. They do, however, appear to be very similar when first seen in the herbarium, or when separated according to the original descriptions or the key of Murrill's. The best distinction lies in the bluing of *B. flavissimus* (if noticeable), the purple-carmine base (if present) and the constantly and strongly different odor of the dried plants. For those who already know these species, the color of the pileus (not as deep yellow and tending towards chestnut rather than pinkish red in *B. auripes* var. *aureissimus*) is sufficient to separate them in the field.

20. BOLETUS AUSTRINUS Sing., Mycologia 37:798. 1945.

Pileus "vinaceous brown" on the margin, "sorghum brown" on the disc, when dried "sorghum brown" on the margin and paler on the disc, strongly tomentose, turning blue when handled, if young and fresh; dry, convex, 38-55 mm. broad. — *Hymenophore* yellow, greenish yellow, deeply depressed around the stipe; tubes moderately to fairly long; pores discolorous, "zinc orange," or some of the protruding tube-walls with "Etruscan red" or "Corinthian red" tips and the rest of the pores concolorous with the tubes, distinctly bluing when touched; spore print apparently olive, but not obtained in thick layer. — *Stipe* yellow at the apex and beset with very minute to rather small flocculose-furfuraceous particles which are purplish brown or "russett vinaceous," farther downwards, these particles are dense enough to completely or nearly cover up the yellow ground color, with a conspicuous, strigose, "Isabella color" or "buffy citrine" basal tomentum, equal or tapering downwards, slightly ventricose with narrowed apex when dried, 38-40 x 10-12 mm.; mycelium yellowish, sparse at the base. — *Context* yellow, turning blue immediately at the slightest injury in all parts; odor not remarkable; taste mild.

Spores 9.5-12.2 x 4.2-5.5 μ , mostly 11-12 x 4.8-5 μ , well colored, melleous or brownish melleous, smooth, ellipsoid-subfusoid, with suprahilar depression or without it (mostly with depression); *basidia* about 31 μ long and 9.8-12 μ broad, 4-spored; *cystidia* at pores 36-41 x 5.3-7.5 μ , hyaline or melleous, fusoid with acuminate mucro, or with ampullaceous neck; in tubes much more scattered, mostly basidiomorphous but versiform, strongly incrustated by a melleous incrustation, rarely without it, e.g. 29 x 15.5 μ ; *trama* truly bilateral, of the *Boletus*-type.

Chemical reactions not studied.

Habitat.—Under *Quercus virginiana* in comparatively open places, lawns, etc., on calcareous soil, fruiting in September and October, solitary.

Distribution.—Tropical Florida.

Material studied.—FLORIDA, DADE Co., Matheson Hammock, Singer, F 753 a, TYPE (FH); F 1012, CO-TYPE (FH).

This species is best determined by the color of the fresh and the dried carpophores. In dried condition it reminds one strongly of *B. tomentipes* Earle which has the basal tomentum still more strongly developed, and its color in fresh condition is described somewhat differently; its size is larger, and the spores are slightly broader than in our Florida species. Notwithstanding all these differences, *B. austrinus* is no doubt the closest relative of *B. tomentipes* among the *Luridi*.

21. BOLETUS HYPOCARYCINUS Sing., Mycologia 37:798. 1945.

Pileus "Saccardo's umber" to "bister," margin somewhat "cinnamon brown," in dried condition olive brown, distinctly tomentose, pulvinate, about 80 mm broad. — *Hymenophore* yellow, not or slightly depressed around the stipe; tubes moderately long; pores concolorous at the very margin, elsewhere discolorous, red ("hydrangea red" to "mineral red"), very minute. — *Stipe* minutely "carmine" to "acajou red" punctate and lined or striate but not

reticulate, on whitish ground, only the very apex is yellow at places but the base is entirely red ("carmine" to "acajou red"), not distinctly tomentose, very bulbous-diform, about 85 x 52 mm.; mycelium whitish. — *Context* yellowish in the pileus as well as in the stipe, bluing readily when wounded; odor none noticed; taste mild.

Spores 8.5-11.5 x 3.5-3.8 μ , subfusoid-subellipsoid, smooth, melleous; *basidia* about 30 x 8 μ , 4-spored; *cystidia* 28-38 x 4.5-7 μ , with a thin, melleous resinous incrustation, fusoid or almost so, moderately frequent at the pores, scattered elsewhere; *trama* of the hymenophore truly bilateral, of the *Boletus*-type, the mediostратum strongly colored melleous, of axillary arranged sub-parallel-subinterwoven, densely packed hyphae, the lateral stratum of completely hyaline, somewhat thicker, loosely arranged and strongly divergent hyphae; *cuticle* of the pileus consisting of strongly interwoven, irregularly interlaced brownish melleous to brown hyphae, the terminal members most frequently clavate, also cylindrical and broadly rounded or fusoid with obtuse tips, strongly incrustated by a melleous-brown resinous incrustation; the *red ornamentations* of the stipe consisting of fascicles of hymenially arranged clavulae each of which is deep melleous (in NH₄OH) and 22-30 x 5-8.5 μ , in the whitish areas there are corresponding club shaped elements which, however, are hyaline; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—Under *Quercus virginiana* on the ground. Fruiting in May, solitary.

Distribution.—Known with certainty only from the type locality.

Material studied.—FLORIDA, ALACHUA Co., near Newnan's Lake, May 23, 1943, Murrill, (as *B. luridus*), F 2071, TYPE, (FH).

Dr. Murrill was kind enough to forward to me for further study this collection of what turns out to be a rare plant in Alachua Co. It is part of the complex he calls *B. luridus*, and according to the herbarium, *B. subvelutipes* and *B. Frostii* ssp. *floridanus* represent the other constituents of this collective species. I would not be surprised if *B. luridus sensu* Coker & Beers which for the most part is *B. miniatoolivaceus* var. *subluridus* contained, as an additional element *B. hypocarycinus*. Though not entirely corresponding to my description, the fungus depicted in Coker & Beers, pl. 3, fig. 5, may yet turn out to be this species in a more advanced stage. My material is rather young.

B. hypocarycinus differs from *B. miniatoolivaceus* var. *subluridus* in the color of the pileus which is *never* red nor yellow, and the ground color of the stipe which is whitish at least in youth.

22. BOLETUS SUBVELUTIPES Peck, Rep. N. Y. State Mus. 2 (8):142. 1889.

Suillus subvelutipes Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Pileus "Dresden brown," "snuff brown," "raw umber," "Saccardo's umber," between "Verona brown" and "Argus brown," "Isabella color," between "ochraceous tawny" and "raw sienna," "Sudan brown," "Brussels brown," sometimes with some yellow lights in the dark brown surface ("yellow ocher" or even "light cadmium"), becoming "bister" or darker than the above browns

in age, especially in the center, or with an olivaceous hue ("tawny olive") on the margin, or merely paler towards the margin, subglabrous to somewhat tomentose-velutinous but glabrescent with age, dry but usually sticky-subviscid in rainy weather, pulvinate, becoming flattened and usually also irregular with age, 37-144 mm. broad, rarely up to 160 mm. — *Hymenophore* yellow (except for the discolorous pores), in age greenish yellow, rapidly and intensely bluing on injury, convex beneath, depressed around the stipe; tubes long (8-22 mm.); pores "vinaceous rufous" or "mahogany red," more rarely in youth or in age the yellow of the tubes showing through and the pore surface merely speckled with red, bluing when touched, small; spore print olive. — *Stipe* yellow (any shade between "maize yellow" and "light cadmium," or "baryta yellow" and "pinard yellow," much paler yellow below and also more sordid towards the base, or sometimes tinged with olivaceous, beset with fine reddish or ochraceous cinnamon flocculose specks or horizontally elongated striae which in youth are hardly visible except with a lens but becoming larger with age and then form a distinct flocculose-squamulose covering that in the lower part of the stipe often obscures the ground color, the very base "Etruscan red" or more frequently "haematite red," the color of the covering being the same as that of the pores in the upper part of the stipe, or more rarely between "Hay's russet" and "English red," dry, solid, the base with a mostly red strigose-velutinous basal tomentum in the color of the base ("Etruscan red," "haematite red," or with a more cinnamon tinge), this basal tomentum sometimes (in the south very rarely) wanting, stipe equal with attenuate base or bulbous-ventricose when young, later often more stretched-elongate but still very thick, 33-78 x 12-30 mm.; mycelium creamy pallid-sordid, or whitish. — *Context* entirely deep and rich yellow when young and fresh, less deep and rich and occasionally bleaching to yellowish white in the pileus when older and drier, bluing instantaneously to a deep indigo when bruised and even the surfaces bluing on pressure when young and fresh, concolorous or deep red ("haematite red") in the base, yellow on the plane of attachment of the tubes to the flesh of the pileus; odor faint, agreeable; taste mild.

Spores 11-16.5 x 4.5-6.2 μ , (northern specimens often with slightly larger spores, e.g. 13-17.8 x 4.5-6.5 μ , most frequently 13.5-16.8 x 4.8-5.8 μ ¹¹), from as narrow as 16 x 4.8 μ to as broad as 11 x 6 μ but the vast majority decidedly more than twice as long as broad ($Q=2.3$ or more in an average), definitely fusoid, with or without a suprahilar depression, smooth, with moderately thin walls and well colored when mature, rusty melleous; *basidia* 23-32 x 8.2-9.8 μ , 4-spored, hyaline, usually rather broad in their lower portion and not always clavate; *cystidia* 30-50 x (4.8)-6.8-8.5 μ , hyaline, definitely fusoid with narrowly conical mucro, very few of a different shape, rather numerous on the pores,

¹¹ It is not so much the specimens collected in the plains as the specimens from the White Mountains that show the larger spore-measurements. This does not mean that they are different since it corresponds to the rule first indicated by R. Heim on the basis of Alpine material compared with collections from the environs of Paris, and later corroborated by the writer on the basis of specimens from the Pyrenees, likewise compared with Paris specimens, asserting that montane forms tend to have larger spores than the form found in the plains without being otherwise different. Some species, however, do not seem to be capable of this kind of variation in spore volume.

more scattered in the tubes; *cheilocystidia* on the pores only, 17-32 x 4-5.5- (6) μ , cylindrical or fusoid or subulate, pale melleous or fulvous-castaneous incrusted, often wavy-flexuous and very crowded where the red of the pores is concentrated; *trama* of the hymenophore truly bilateral, of the *Boletus*-type, slightly colored and denser in the axillar mediostratum, with entirely divergent hyphae with less crowded septa in the lateral stratum; *floccons* of the stipe consisting of a hymenium (on a bilateral hyphal base) formed by basidioles which either remain indefinitely sterile (dermatopseudoparaphyses), or become fertile with two or more rarely four spores, often thinnest in the middle, or fusoid, often melleous, interrupted by dermatocystidia corresponding in character to the cystidia of the hymenophoral cystidia, or sometimes like the cheilocystidia; *basal tomentum* consisting of hyphae that are deep red even when taken from dried material in an ammoniacal medium, strongly interwoven and irregularly arranged but at places, where transition to the floccons of the stipe begins, it is covered by a palisade of versiform, mostly more or less clavate elements with many septa and (as in the other hyphae of this part of the fruit bodies) with moderately thick (0.3-0.5 μ) walls; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—Under laurel oak and live oak (*Quercus laurifolia* and *Q. virginiana*) in high hammocks, on shaded lawns and in well watered gardens, usually in large groups on the ground, fruiting from May until fall; in the north under or near *Quercus*, *Fagus*, *Betula*, and *Tsuga* in preferably mixed woods from July till September.

Distribution.—New England to Florida (not reaching the tropical zone), western limits unknown.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Singer, *F* 1895, *F* 1895 a, *F* 1895 b, and *F* 1895 c, also several unnumbered collections (FH); *F* 2081 (FH). MAINE, Georgetown, H. Webster (det. E. B. Blackford as *B. luridus*), (FH). NEW HAMPSHIRE, Shelburne, Farlow, Sept. 1891 and Sept. 1893 (FH); Chocorua, Linder & Singer (FH). MASSACHUSETTS, Newton, Darßer, 5635 (det. Linder as *B. luridus*), (FH); Woods Hall, Farlow (FH); Arnold Arboretum, Jamaica Plain, Darßer (det. Linder), 6155 (FH); Harvard, Singer & Harrie Dadmun (det. Singer), (FH); Wakefield, Singer, *M* 105 (FH).

Forma *glabripes* f.n.

Stipite glabro, flocculis destituto, flavello a typo differt. Cum typo.

This differs only by the lack of the flocculose-squamulose covering of the stipe which is completely glabrous and yellowish, except for the red velvety basal tomentum. The spores are paler and smaller, and also fewer than in the type form but the specimens are parasitized, and though apparently mature, not as fertile as normal specimens. It is not impossible that this is a partially sterile teratologic form since failure to form the hymenia of the stipe would cause the morphological result observed here. The forma was found together with the type at Gainesville, Fla., Singer *F* 2169 (FH).

B. subvelutipes Peck is, of all species treated here as occurring in Florida, most closely related to *B. hypocarycinus* Sing. The latter should be compared with *B. subvelutipes* f. *glabripes* Sing. which differs in the velvety basal tomen-

tum and the complete absence of any kind of marks on the yellowish, not whitish stipe. The spores are very similar in *B. subvelutipes* f. *glabripes* and *B. hypocarycinus*, at least in the specimens available.

It may be asked why this is not called *B. erythropus* as it has been called by Burt in *Icones Farlowianae* and as it is called by Snell and has often been determined by Peck. Since there is no doubt as to the identity of *B. subvelutipes* with our American collections, I gave preference to this name and shall continue to do so as long as more convincing and conclusive data on the identity of the American and European *B. erythropus* are not available. The European *B. erythropus* is well known to this writer. It is undoubtedly intimately related to the American species but the following differences (which, of course, may yet turn out to be of secondary importance, or not quite constant in all instances during future observations) have been noted by me: *B. subvelutipes* has the characteristic red basal tomentum which is strigose below and velvety above but which in several of our collections is either replaced by an olivaceous tomentum, or is entirely wanting. The latter two conditions are rarer in the north, and extremely rare in the south. This is exactly reversed in the European species where I have never seen red tomentum on the base, and I cannot find a citation in the literature where it is mentioned. The carpophores of the American form are often more slender, though large specimens are more frequent, but even there the stipe tends to be thinner as can easily be seen when two pictures are compared such as *Icones Farlowianae*, pl. 85 and Kallenbach, *Pilze Mitteleur.*, pl. 30. This comparison also shows a slight difference in the color of the pileus which is more deep reddish brown or deep rusty brown or yellowish-rusty-brown in the American plant with orange to red caps never occurring while in the European type of *B. erythropus* the surface of the pileus is usually a deep dusky brown, and frequently tends to be partly or entirely orange or red. It seems that while the cheilocystidia are the same in both forms, the real cystidia are somewhat different being more acute in the American species. The spores of our southern form are somewhat more variable in shape and smaller in size than those of *B. erythropus* in Europe though the specimens from the White Mts. usually have larger fusoid spores.

23. BOLETUS OLIVEISPORUS (Murr.) Murr., *Lloydia* 7:326. 1944.

Ceratomyces oliveisporus Murr., *Lloydia* 7:323. 1944.

Pileus either dark fulvous, tinged with bay (according to Murrill) and then between "cinnamon brown" and "Prout's brown" when dried carefully, or more irregularly colored with the margin in fresh condition "cinnamon buff" and the larger middle zone much darker (between "Prout's brown" and "mummy brown" when fresh) and in these specimens the center tending to become tessellate-areolate in the manner of *Russula virescens*, somewhat tomentose on the margin or entirely finely tomentose, not viscid or at least never strongly so, convex, then more or less appanate, with slightly projecting sterile margin, 60-185 mm. broad.—*Hymenophore* yellowish with a faint greenish tinge, soon about "olive lake," depressed around the stipe, or in smaller specimens not depressed; tubes long (5-20 mm., depending on the size of the carpophores); pores concolorous, bluing readily when touched or in-

jured, small but not "stuffed," 0.3-0.8 mm. wide or somewhat wider but, at least in average, not reaching 1 mm. in diameter; spore print olive. — *Stipe* at the base "Saccardo's umber" to "sepia" and subvelutinous to subglabrous, farther upwards in this same color minutely but distinctly flocculose-punctate on pallid ground and at the very apex more or less yellow and glabrous to subglabrous, in the middle often with a "Corinthian red" belt caused by minute but distinct floccons of this color, never reticulate anywhere, dry, solid, subequal to strongly tapering downwards and the base almost pointed, without red or olive basal felt, often slightly curved, 40-85 x 10-50 mm. (at the apex); mycelium white, inconspicuous. — *Context* yellowish white to yellow in the pileus, deeper yellow in the stipe, bluing instantaneously and strongly to slowly and weakly in the stipe and fairly rapidly and distinctly to not at all in the pileus, often with a dull reddish brownish zone beneath the cuticle of the pileus; odor slight and agreeable; taste mild.

Spores either 11-15 x 4.4-8 μ (mostly 12.7-13.7 x 4.3-4.5 μ as in the type specimens), or up to 11.5-17 x 4.5-6 μ , (mostly 14-15 x 5 μ) depending on the size of the carpophores, melleous to rather intensely brownish melleous, with thin to moderately thin smooth walls, fusoid; *basidia* 28-38 x 9.3-11 μ , hyaline, more rarely melleous, 4-spored, exceptionally 3- or 2-spored among the normal 4-spored ones; *cystidia* 34-62 x 6.5-10.3 μ , with a distinct, melleous granular incrustation, much more rarely without an incrustation, sometimes even fulvous castaneous, sometimes with an adpressed resinous hood, fusoid, mostly with a tapering (upwards), narrowly conical and usually rather long apex whose very tip is subacute or obtusate-rounded (thus recalling the *cystidia* of *B. subvelutipes*), moderately to very numerous on the pores even in age, rare in the tubes; *cuticle* made up of long, filamentous hyphae without any visible order in the specimens available (mature), deep fulvous brown, incrustated; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus (center), negative or on the margin ochraceous brown; on context, ochraceous brown. — NH₄OH and NH₃ on surface of pileus, negative; on context, keeping the bluing down (NH₄OH). — HNO₃ on surface of pileus (center), negative. — FeSO₄ on context, dirty greenish.

Habitat.—In flatwoods on stumps of or under *Pinus palustris* (not far from a patch of *Quercus minima* at least at one locality), solitary, in July and August.

Distribution.—North Florida.

Material studied.—FLORIDA, ALACHUA Co., 2 miles west of Gainesville, *Singer*, *F 2847* (FH); west of Rochelle, *Murrill*, *F 17961*, part of TYPE (FH)

This interesting species seems to be astoundingly variable in size and to a certain degree also in color and in shape. I had intended to publish on my collection (*F 2847*) as the type of a new species when in the last minute Murrill's description of *B. oliveisporus* appeared and the author received a specimen from the type collection (*F 17961*). This specimen is much smaller than my *F 2847*, and the pileus is more evenly colored, the stipe lacks the reddish belt in the middle, the spores are also somewhat smaller. Nevertheless, the remaining characters are so strikingly in accord (and the specimens still

show them well enough) that it became necessary to consider these collections as identical and describe them under the name proposed by Murrill.

This species may be briefly characterized as similar to *Boletus pulverulentus* from which it differs in several characters including the smaller pores, the somewhat different shape of the cystidia and somewhat broader basidia, the lesser degree and constancy of the bluing and the negative reaction with HNO_3 . There may also be a slight difference in the color of the hymenophore but this ought to be checked upon on more material than there is at our disposal. It also differs sharply in the habitat which is very peculiar though several hammock species, viz., *Porphyrellus subflavidus*, *Xerocomus pseudo-boletinus*, and *Leccinum chalybaeum* have been found under similar conditions. *B. olivisporus* differs from *B. subvelutipes* by the concolorous pores and the absence of basal tomentum, and also by the narrowness and inconstant occurrence of the reddish pustules on the stipe and the habitat. *B. luridellus* is distinguished by the characters indicated in the key.

24. BOLETUS LURIDELLUS (Murr.) Murr., Mycologia 30:525. 1938.

Ceriumyces luridellus Murr., Mycologia 30:523. 1938.

Ceriumyces subsensibilis Murr., Mycologia 31:111. 1939.

Boletus subsensibilis Murr., Mycologia 31:112. 1939.

Pileus "amber brown," "Brussels brown," often in virgate streaks, one color alongside with the other, or on yellow ground, becoming "ochraceous tawny" or "hazel," or "buckthorn brown," and unicolorous in age, also often "cinnamon" and "Mikado brown," and partly discoloring to "tawny olive," or even as dull as "snuff brown" to "Saccardo's umber," sometimes rather pl. 14. J 10 with "sombbrero" (M. & P.) giving the general impression of "yellow beige" (M. & P.), occasionally with some "ochraceous tawny," tomentose, or glabrous with subvelutinous margin, mostly glabrescent in age, sometimes minutely rimulose to innately punctate, pulvinate to subflat, often with up to 1 mm. projecting sterile margin, 40-120 mm. broad, rarely broader. — *Hymenophore* "pinard yellow" then "lemon yellow" or "pale lemon yellow," then "primuline yellow" and discolored, especially at the pores by autoxydation and spores, and usually more greenish in age (but not so much on the pores), depressed around the stipe, or adnate without depression; tubes long (10 mm. or longer); pores concolorous, bluing when touched, minute but not closed in fairly young specimens, eventually becoming wider and reaching 1 mm. in diameter which is rather wide for a *Boletus* of this section, but the majority of pores is smaller than 1 mm. (4 pores to 3 mm. in an average); spore print "olive brown." — *Stipe* yellow ("pinard yellow," "picric yellow" to "lemon yellow") at the apex and here almost always showing a narrow reticulate belt in continuation of the pores, or with a "buckthorn brown" reticulation reaching somewhat farther downwards (but not more than about one fourth of the length of the stipe) on yellow ground, beset with "buckthorn brown" flocculose flecks on yellow, yellowish or rarely brownish ground below the reticulation, the base almost uniformly "Vandyke red" or "dark mineral red," or "Hay's russet," or dotted or speckled in these colors, bluing where

touched, dry, solid, equal or ventricose, or tapering downwards with pointed base, 45-95 x 9-30 mm.; mycelium inconspicuous, white or dirty whitish. — *Context* “Martius yellow” to “picric yellow,” or becoming paler yellow in the pileus, in the stipe “primuline yellow” marbled with paler yellow, concolorous with the outside in the base, bluing readily and strongly in all parts; odor none, or insignificant; taste mild.

Spores (11.5)-12.5-17.3 x 4.5-5.5 μ , fusoid, smooth, rather thin-walled, melleous, with hilar depression but some without it; *basidia* 22-34 x 8.3-12.3 μ , 4-spored, very rarely some with 2 or 3 sterigmata; *cystidia* 26-35 x 7.5-10 μ , hyaline, ampullaceous (with usually rounded tip), in the tubes and on the pores; *trama* truly bilateral of the *Boletus*-type, the hyphae of the lateral stratum distinctly divergent and looser than those of the slightly melleous and axillar mediostratum in which some melleous laticiferous vessels are usually found; *cuticle* of pileus composed of cylindrical, interwoven and interlaced hyphae with the terminal members not parallel but all at the very surface, clavate, brownish melleous; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus, much deeper brown; on context, ferruginous-ochraceous. — NH₄OH on margin of pileus, lilac; on context and on surface of stipe, olive; on pores, negative. — HNO₃ on surface of pileus, reddish brown becoming brown; on context, pale ochraceous or rusty ochraceous. — Formol on context, more blue, becoming bluish sordid after a while. — FeSO₄ almost negative but if KOH is added afterwards, a brown reaction is obtained.

Habitat.—On open and shaded lawns, in high and mesophytic hammocks, never very far from either *Pinus palustris* or *P. australis*, or more often *Quercus Chapmani*, *Q. geminata*, *Q. laurifolia*, *Q. virginiana*, etc. on the ground, usually in rather large to very large groups, sometimes even cespitose, fruiting from May until October.

Distribution.—Florida, from North Florida to South Florida but not in the tropical zone.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Murrill F 15863, TYPE of *B. luridellus* (FLAS); TYPE of *B. subsensibilis* (FLAS); AUTHENTIC material of *B. subsensibilis* (FH); Singer F 1999, F 1999 a, F 1999 b (FH); F 2152 (FH); F 2161 (FH); Dayville southwest of Gainesville, Singer, F 2476, F 2476 a (FH); also other collections from Alachua Co. by Murrill and Singer; HIGHLANDS Co., Highlands Hammock State Park, Singer, F 598 (FH); F 615 (FH); Singer & Altwater, F 546 (FH).

This species is somewhat similar to the European *B. appendiculatus* Schaeff. ex Fr. in some forms, especially the form depicted in Kallenbach, Pilze Mitteleuropas I, pl. 31. But, of course, these species are not closely related.

B. luridellus has been well described and is abundantly represented in the Herbarium at Gainesville under the name of *B. subsensibilis*. Murrill himself is not inclined to consider *B. luridellus* and *B. subsensibilis* as the same species. However, the type specimen of *B. luridellus* has been compared carefully by the writer, and the only conclusion one can arrive at is that they are identical. The spores of the type are slightly smaller than in the average specimen of *B. subsensibilis* but this alone would hardly be sufficient for a separation. Unfortunately, the species much less completely described by its own author

and found only once by him, *B. luridellus*, has the priority over *B. subsensibilis*, and we are thus forced to use the earlier name.

One may be tempted to consider *B. luridellus* as described above, as a brown variety of *B. rubricitrinus* Murr. However, after prolonged observation of several hundreds of specimens under varying conditions and in different counties, I have firmly convinced myself that they are different species. They are constant in their colors; never has the slightest transition been observed, and the reticulate apex, though not quite constant in *B. luridellus*, is *constantly* absent in *B. rubricitrinus*. The latter species is still rather frequent in the tropical lime soil zone of South Florida where *B. luridellus* is not represented.

25. *BOLETUS RUBRICITRINUS* (Murr.) Murr., Bull. Torr. Bot. Cl. 67:66. 1940.

Ceromyces rubricitrinus Murr., Bull. Torr. Bot. 67:66. 1940.

Var. TYPICUS

Pileus "ocher red," "Japan rose," also "terra cotta," "testaceous," "cacao brown," "buff pink," "Etruscan red," "orange cinnamon," or some of these colors mixed, under dry conditions remaining so or discoloring with age (see below), under wet weather conditions soon becoming deeper colored, rarely so from the beginning, *i.e.* "vinaceous rufous," "Pompeian red," or "madder brown" in dots, or entirely "madder brown" all over, or only the disc "madder brown," the extreme margin sometimes "light salmon orange," the color of the pileus often eventually fading to "tawny olive," "buckthorn brown," "clay color," or the red portion reduced to make space for some "baryta yellow," to "pinard yellow" intermixed spots, especially near the margin, bluing where touched if very fresh and young, soon becoming unchanging, glabrous to subtomentose, feels like kid, non-viscid, rarely partially tomentose to rimose, pulvinate, eventually almost flat, the center sometimes somewhat depressed, (30)-40-150 mm. broad.—*Hymenophore* between "pinard yellow" and "picric yellow," then becoming "wax yellow" and finally "pyrite yellow" or "citron green," bluing when touched, especially when young, depressed around the stipe, often deeply so; tubes rather long; pores concolorous, irregular in shape, level, and diameter, small and punctiform when young with some medium sized ones intermixed when mature, most of them decidedly below 1 mm. on diameter, but in large mature specimens there are always a few reaching 1 mm., angular when mature; spore print "olive brown."—*Stipe* "Martius yellow," "pinard yellow," "mustard yellow," "primuline yellow," later often more "Empire yellow" or "light cadmium," sometimes with an olive gray zone in the middle, lower half or the base only with many red spots or dots ("madder brown," "Hessian brown," "burnt lake"), coarsely and indistinctly fibrosely longitudinally striate or rugulose, not reticulate except for a very narrow (1-2 mm.) zone at the very apex of the stipe where occasionally a very faint reticulation continues the pores downward *i.e.* spuriously reticulated, the whole surface or most of it beset with "Pompeian red" to "madder brown" or concolorous (yellow), mostly the former, squamulose floccons comparable with those of *B. subvelutipes*, or with somewhat finer punctiform, furfuraceous particles of

the same colors which may sometimes be difficult to observe if no lens is used, but in most cases the covering clearly visible to the naked eye, solid, dry, tapering upwards or downwards, or ventricose, more rarely subventricose-subequal, or becoming so with age, (35)-50-120 x 15-37 mm., mostly 18-28 mm. thick; mycelium whitish to pale ochraceous or salmon ochraceous, often variegate in these colors. — *Context* yellow, in dry weather sometimes pale yellow, bluing when bruised, with much deep red (“madder brown,” “Hessian brown,” “burnt lake”) in the base, soft except for the base; odor none; taste mild.

Spores 12.5-18.8-(19.7) x (4.5)-4.8-7.7 μ , mostly (14)-15-(17) x 5-5.5 μ , melleous or brownish melolous, smooth, subfusoid-ellipsoid or subcylindric to fusoid, with distinct or indistinct suprahilar depression, occasionally with a depression on the external long side, with thin to medium walls; *basidia* 26-39 x 9-12 μ , 4-spored; *cystidia* 37-53 x 5-7.7 μ , fusoid and subacute or fusoid with ampullaceous neck, hyaline, numerous at the pores, but scattered in the tubes; *trama* truly bilateral of the *Boletus*-type; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus, deep maroon, or between “raw sienna” and “orange citrine,” or “Sudan brown”; on surface of stipe, “amber brown”; on context from negative over light brown to rich brownish yellow (depending on the degree of autoxydation that has been allowed to take place before application of the reagent); on pores and tubes, usually brown. — NH₄OH on surface of pileus, from olive or dirty olive (near “buffy citrine”) to almost negative; on surface of stipe, brown; on context, usually more bluing when moist enough, or only somewhat sordid otherwise. — HNO₃ on surface of pileus negative. — HCl on surface of pileus negative; on surface of stipe the floccons brigher red.

Habitat.—Under pines (*Pinus australis*, *P. caribaea*, rarely *P. palustris*) and under oaks (*Quercus laurifolia*, *Q. virginiana*) on the ground, preferring roadsides, especially where both pines and oaks are present, solitary or more often gregarious. Fruiting from May till November.

Distribution.—Apparently in all counties, at least in all zones of Florida.

Material studied.—FLORIDA, ALACHUA Co., TYPE (FLAS), and AUTHENTIC material (FLAS); also *F 19593* (as *B. subsensibilis*) (FLAS); Gainesville, *Singer, F 2123* and *F 2123 a* (FH) and other collection from in and around Gainesville; HIGHLANDS Co., Highlands Hammock State Park, *Singer, F 181 a* (FH); DADE Co., Fairchild Tropical Garden and Matheson Hammock (not in the densest growth), *Singer, F 753* (FH); *F 917* (FH); *F 1369* (FH); Coral Gables, *Singer, F 1396* (FH).

Var. FAIRCHILDIANUS Sing., *Mycologia* 37:798. 1945.

Differs in having “Pompeian red” pore mouths on “primuline yellow” ground; the pileus of this collection was between “vinaceous rufous” and “dragon’s blood red”; the stipe all the way from “wax yellow” to “massicot yellow” with “Pompeian red” floccons; context yellow, strongly bluing. Chemical and anatomical characters as in the type variety. Under *Quercus virginiana*, October 31, 1942, *Singer F 1368* (FH).

This beautiful species is common in Florida during the summer season and can easily be recognized in most cases. However, one may find it difficult, at

times, readily to distinguish this from *B. rubellus* ssp. *caribaeus* Sing. in Dade Co. since they often grow in neighboring localities. The present species is less tomentose, the red in the base is more striking and more constant, and the pores are slightly smaller in an average. In the laboratory, the distinction, in practically all cases, is easy because of the marked difference in spore size. This species is not closest to *B. rubellus* but to *B. dichrous* Ellis and *B. luridellus* Murr. The former, if it represents a separate species, would be distinguished by the viscose pileus, the latter is distinguished by the color of the pileus and the reticulation on top of the stipe.

26. *BOLETUS FROSTII* Russell *apud* Frost, Bull. Buff. Soc. Nat. Sc. 2:102. 1874.

Boletus alveolatus Berk. & Curt. *apud* Frost, Bull. Buff. Soc. Nat. Sc. 2:102. 1874.

Suillus Frostii Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Suillellus Frostii Murr., Mycologia 1:17. 1909.

Ssp. TYPICUS (not observed in Florida but described here for comparison).

Pileus "jasper red," "nopal red," "carmine" in fresh condition, if dried properly between "acajou red" and "Pompeian red" in the herbarium, with or without a tinge of "Morocco red," occasionally showing some yellow on the margin, strongly viscid when wet, subglabrous, rarely subtomentose, subpruinose at places when dry, strongly shining when dry if it has dried out after rains, convex to plane, 55-155 mm. broad. — *Hymenophore* yellowish, later more greenish yellow, bluing on injury, with the pore-mouths discolorous, depressed around the stipe; tubes (6)-7-9-(12) mm. long; pores "acajou red," bluing on pressure, minute, 12-14 to 5 mm.; spore print olive brown. — *Stipe* "acajou red," in dried condition between "Vandyke red" and "mineral red," occasionally with some yellow showing especially at the apex when old and on the base, strongly alveolate-reticulate over a considerable length, often almost to the base, the reticulate ridges "acajou red" on concolorous, rarely partly yellow ground, not viscid or with a waxy-subviscid touch, solid, straight or with curved base, variable in size and shape, usually tapering upwards, also subventricose, etc., 45-110 x 18-25 mm, at base; mycelium yellowish white to light yellow. — *Context* whitish yellow to yellow, somewhat marbled in the stipe, more or less bluing when injured, sometimes reaching a deep blue shade almost immediately, in other carpophores bluing weakly and slowly, old injuries reddened; odor almost none; taste mild.

Spores and other microscopical characters as in ssp. *floridanus*.

Chemical reactions.—KOH on surface of pileus, tan color; on pores, cin-namon; on context, tan color. — NH₃ on surface of pileus, negative; on pores, little reaction; on context, either augmenting the bluing or negative. — NH₄OH not much stronger reaction than with NH₃-vapors. — FeSO₄ with context almost negative, keeps deep yellow portions from bluing.

Habitat.—In oak woods, especially on somewhat hilly ground in moderately dense forests. Fruiting from June till October.

Distribution.—From Maine to Georgia and west to Michigan and Tennessee.

Material studied.—VERMONT, Brattleboro, AUTHENTIC material, probably part of TYPE, C. C. Frost (FH). MASSACHUSETTS, Newton, Farlow (FH); Chelmsford, Mrs. Isadore Albertini (det. Linder) (FH); Canton, three collections by D. H. Linder (FH); Arlington, Singer; Woburn, W. L. White (det. Singer) (FH). RHODE ISLAND, East Providence, three collections by W. G. Farlow (FH). NEW JERSEY, Ellis, July 30, 1875 (FH). NORTH CAROLINA, Hillsborough, Curtis (as *B. purpureus*) (FH). GEORGIA, Thompson, area of the Fall line Sandhills, Bartlett (det. Farlow), 1571 (FH). MICHIGAN, Ann Arbor, Aug. 18, 1932, A. H. Smith (FH, a similar collection in LE).

Subspecies FLORIDANUS Sing., Mycologia 37:799. 1945.

Pileus "Corinthian red," "light Corinthian red," with spots or larger areas of "mineral red" or even "dark mineral red," "madder brown," or prevalently a mixture of "orange vinaceous," "jasper red," "acajou red" with occasionally more orange or yellow on the margin, the dried pileus usually about "mineral red" with some "Etruscan red," or "hydrangea red" with some "light russet vinaceous," opaque or slightly shining when dried, distinctly viscid after prolonged rains but ordinarily not very strongly red and rapidly drying and becoming opaque in drier weather, consequently usually seen in dry condition, tomentose or velutinous, or partly tomentose and partly subtomentose (not merely subtomentose-subpruinete), somewhat rimulose at times, pulvinate, soon with applanate or even subdepressed center, or remaining convex everywhere, 50-100 mm. broad.—*Hymenophore* yellow, with discolored pores, soon more or less depressed around the stipe; tubes 6-9 mm. long; pores "Corinthian red" or a similar color or blotched or punctate in this color on yellow ground, rarely entirely yellow in young stages and reddening gradually while maturing, again becoming concolorous with the tubes (olive) in very old or in dried material, strongly to moderately strongly bluing when touched, about 0.5 mm. wide.—*Stipe* "deep vinaceous," "dark vinaceous," "Indian red," "Etruscan red," "vinaceous," "old rose," "acajou red," "neutral red," either unicolorously red, with the deeper red colors usually rather concentrated near the base, or with a strong (but not stronger than in *B. luridus*) venose (not lamellose) reticulation in the above-indicated colors on pinkish-pallid, light pink, or yellow ground but the yellow ground never extending from the apex to more than one third of the stipe's length, the meshes distinctly elongated longitudinally [(0.5)-1.5-3.5 x 0.5-1.0 mm.], covering more than the upper half of the stipe and often practically its entire length, dry or subviscid-slippery when wet, solid, subequal or tapering upwards, or fusoid-ventricose with the thickest portion usually just below the middle, 40-80 x 17-27 mm.; mycelium pale yellow.—*Context* pale yellow, or light bright yellow, or whitish, sordid olive or sometimes pale reddish in the base of the stipe but never deep red in any part, usually strongly bluing everywhere when wounded; odor slight, not disagreeable; taste mild or slightly acidulous.

Spores 13.2-16.7-(18) x (4)-4.5-5.3 μ , melleous to brown, ellipsoid-fusoid, smooth; *basidia* 26-35 x (6.5)-10.5-11.5 μ , 4-spored; *cystidia* 30-53 x 7.5-14 μ , fusoid or subampullaceous, hyaline, thin- or thick-walled, numerous, especially on the pores, the tip mostly rounded; *trama* bilateral of the *Boletus*-type though the difference between the density and the color of the two strata appears to be moderately striking, the hyphae of the lateral stratum strongly and entirely

divergent; *cuticle* consisting of interwoven hyphae and some laticiferous vessels, the terminal members of the chains of hyphae versiform and often assuming the shape of dermatocystidia but not arranged in a palisade nor constantly erect; all *hyphae* without clamp connections.

Chemical reactions similar to those of the typical subspecies.

Habitat.—In open stands of oak, mostly on shaded lawns or around scrub areas, under or near *Quercus Chapmanii*, *Q. laurifolia*, *Q. virginiana*, and probably also other species of *Quercus*, on grassy or naked sandy soil, usually in large groups, fruiting from May until October.

Distribution.—Florida (but not in the tropical zone).

Material studied.—FLORIDA, HIGHLANDS CO., Highlands Hammock State Park, Singer *F* 616 (FH); *F* 650 (FH), *F* 654 (FH); *F* 657A (FH); ALACHUA CO., Gainesville, Erdman West, July 1935 (det. Murrill as *B. luridus*), (FLAS); Singer, *F* 2204 (FH); *F* 2428 TYPE of the subspecies (FH); *F* 2503 (FH).

The Florida material differs from the typical plant in two characters, *viz.*, in the color of the pileus and in the degree of its feltiness, and also slightly in the venose, not lamellose reticulation of the stipe. In some very rare cases we have observed single carpophores in Florida that showed the strong alveolate-reticulate stipe of the type subspecies, but they had it only on one side, on the other side of the stipe the reticulation was exactly as in *B. luridus*. The degree of viscosity is rather hard to express more definitely, and the degree of tomentose covering also is hard to define but the color of the pileus can easily be checked against Ridgway. In very rare instances have we found pilei which show partly the colors characteristic for the opposite subspecies, and in these cases the sum of characters has to decide. For all practical purposes, however, excepting perhaps the determination of specimens collected along the borderline between the two subspecies, the distinction can be made automatically according to the area of origin. The external appearance of typical material in the north on the one hand and in Florida on the other hand, is sufficiently different to explain the fact that Dr. Murrill consistently and correctly determined all northern material as *B. Frostii* while he determined all Floridan material just as consistently as *B. luridus*.

Extralimital Species

BOLETUS IMPOLITUS Fr., Epicr., p. 421. 1838.

A good species but often misunderstood, not yet observed with sufficient certainty in North America but collected by the writer in Austria and in the Ukraine (U.S.S.R.), generally corresponding to the figures given by Kallenbach, Pilze Mitteleur. 1, pl. 4, *figs.* 1-11.

BOLETUS QUELETII Schulz., Hedwigia 24:143. 1885.

Boletus purpureus Secr., Mycogr. Suisse 3:29. 1833 (an Pers. 1825).

Boletus erythropus Pers. (1796) ex Kallenbach, Pilze Mitteleur. 1:21. 1927, non Pers. 1825.

Boletus lateritius Bres. & Schulz. apud Schulz., Hedwigia 24:143. 1885.

Boletus Bresadolae Schulz., Hedwigia 24:144. 1885, non Quélet.

Boletus slavonicus Sacc. & Cub., Syll. 6:17. 1888.

Boletus Queletii var. *rubicundus* R. Maire, Bull. Soc. Myc. Fr.; 26:195. 1910.

?*Boletus Schulzeri* Quélet. apud Schulz., Hedwigia 24:143. 1885.

The spores of this European species (probably also occurring in parts of Asia, and certainly in North Africa) are usually about 13-13.7 x 6.5-6.8 μ , some up to 16 x 8 μ , and a minority narrower (10-14 x 4.8-6.5 μ), ellipsoid in frontal view, subellipsoid in lateral view, without suprahilar depression but constantly with a suprahilar applanation, melleous, smooth. These spores are rather characteristic as pointed out by Kallenbach, *l.c.* but that author has not seen material of Buchholz called *B. erythropus*, "siniak" (Russian common name) or else he would have cited it as occurring in U.S.R.R. instead of citing Buchholtz's indication for *B. miniatoporus* Secr. (*i.e.* the real *B. erythropus*). Buchholtz's specimens from his Herbarium 499 (FH) belong to *B. Queletii*.

BOLETUS DUPAINII Boud., Bull. Soc. Myc. Fr. 18:139. 1902.

I have had excellent fresh material from the late Dr. Codina of La Sellera, Catalonia, Spain. The pileus is much more viscid and a much purer and deeper red or pinkish red than *B. Queletii* ever attains. I think that Kallenbach is mistaken considering it as a form of the latter. While studying our Florida species I was much more concerned about its possible identity with American species such as *B. miniatoolivaceus* var. *subluridus* (Murr.) Sing. which it resembles to a certain degree. But the much more viscid pileus and broader spores, and probably a slightly different range of colors, and the lack of odor distinguish the European species sufficiently. In Europe it has a definitely southern distribution and is known thus far from France, Spain, and Switzerland.

BOLETUS JUNQUILLEUS (Quél.) Boud., Icon. Mycol. 4:76. 1905-1910.

Dictyopus junquilleus Quél., Assoc. fr. avanc. sc. 1897:450. 1898.

Boletus pseudosulphureus Kallenbach, Zeitschr. Pilzk. 2:255. 1923.

We consider this European species as independent so long as it cannot be proved that *B. discolor* Quél. (which has priority) is actually a form of the same species. This is what Quélet seemed to think, but why, then did he describe the two species separately? This species is closest to but different from *B. Queletii* Schulz. among the European and *B. flavissimus* Murr. among the American species.

BOLETUS TOMENTIPES Earle, Bull. N. Y. Bot. Gard. 3:298. 1904.

Ceromyces tomentipes Murr., Mycologia 1:154. 1909.

If this species is correctly described macroscopically, it would be outstanding in having the hymenophore becoming brick red when wounded or on drying. However, the type specimens distributed by Earle and studied by us (FH, NY) are strikingly similar to *B. austrinus* Sing. and we think that they belong in the same "stirps." It would be worth while to try to re-collect this species at the type locality (Stanford University, among decaying oak leaves, Calif.) and see whether the hymenophore actually turns red on injury, or merely becomes red during its individual development as is the case in many species of the *Luridi*.

BOLETUS VERMICULOSUS Peck, Ann. Rep. N. Y. State Mus. 23:130. 1872.

This Eastern species (New England to North Carolina) is remarkable for its small, often rather slender carpophores and the color of its stipe and pores. Microscopically, we did not find anything extraordinary for this section in Peck's material (NYS) and specimens collected by Farlow (FH). The spores are rather small and not deeply colored, melleous, cylindric-subfusoid, or ellipsoid-oblong with or without suprahilar depression, sometimes the whole interior long side depressed, variable in shape and size, 8.7-13.3 x 3-4.2 μ . These spores distinguish *B. vermiculosus* from forms of *B. subvelutipes* in which the pores or the stipe are more brownish colored than usual, and also from all similar species occurring in Europe. *B. miniatoolivaceus* var. *subluridus* has constantly bright red, never brown pores and stipe and differs also in the color of the pileus. This species has been well described and illustrated by Coker & Beers, Bolet. N. Carol., p. 40. 1943. It has not been observed in Florida.

BOLETUS LURIDUS Schaeff. ex Fr., Syst. Mycol. 1:391. 1821.

Leccinum luridum S. F. Gray, Nat. Arr. Brit. Pl. 1:648. 1821.

The writer has studied this species which is not uncommon in most of Europe, North Africa and parts of Asia, but has never seen it in North America, notwithstanding the claims of practically all American authors. Even Kallenbach indicates North America as part of its geographic area, citing L. C. C. Krieger. Krieger, however, does not even give an original description of *B. luridus* in his latest book (The Mushroom Handbook, p. 265. 1936). Material received from the University of North Carolina proves that Coker and his school determine as *B. luridus* what actually appears to be *B. miniatoolivaceus* var. *subluridus* (possibly including various other species of section *Luridi*), while the *B. luridus* in the sense of Murrill (1942) is *B. Frostii* ssp. *floridanus* (also including other representatives of the section *Luridi*). The *B. luridus* of Curtis and probably also of Schweinitz is *B. Frostii* ssp. *typicus* (Sprague, 253, FH). *B. subvelutipes* also is seen to be called *B. luridus* by some authors.

The writer has been seriously poisoned by the true *B. luridus* in Austria and it may be supposed that the content of poisonous matter in the fruit bodies varies from negligible to considerable, or else we would have to assume that *B. luridus* consists of at least two physiological races. It is irresponsible and dangerous for the amateur stubbornly to insist on the harmlessness of the European *B. luridus*, and so long as it is not proved that all the American species confused with it are harmless and that the true *B. luridus* does not occur in any part of North America, it would be wise to caution people in this country not to experiment with any representative of the section *Luridi*.

BOLETUS RHODOXANTHUS (Krombh.) Kallenbach, Zeitschr. Pilzk. 5:31. 1925.

Boletus sanguineus var. *rhodoxanthus* Krombh., Naturg. Abbild. Schw. 5, pl. 37, fig. 12-15. 1836.

?*Boletus purpureus* Mich. ex Pers., Mycol. Europ. 2:143. 1825, non Secr, 1833, nec Fr. 1835.

Most authors have called this European species *B. purpureus* Fr., and so has the author (Ann. Mycol. 40:40. 1942). But for reasons not given by Kallenbach, this name cannot be maintained, and since Kallenbach's name is the only other one available, it must be applied to this species. *B. purpureus* is originally not Fries' species, but it represents *B. purpureus* Micheli ex Persoon. If an author in 1825, as does Persoon, says a species is little known, it has probably little chance of ever being recognized by a modern author unless validly emended by some author after 1825. However, the second time in post-Friesian times, Secretan uses *B. purpureus* in 1833 in an entirely different sense. What he describes is *B. Queletii*. Thus Secretan's *B. purpureus* becomes a homonym of Persoon's, and a synonym of *B. Queletii*. Fries, whose description of 1835 is in my opinion unrecognizable, describes *B. purpureus* again in 1838 and this description is, as pointed out by Kallenbach, a *mixtum compositum* of *B. Queletii*, *B. rhodoxanthus*, and *B. luridus*. However, this species of Fries's is of no nomenclatorial importance since Fries neglected to cite Micheli or Persoon, consequently considered his species as new. It is then a homonym and has to be discarded. There is only one way of reviving the familiar name *B. purpureus* so well introduced in French mycology. This could be done by studying the type locality which is indicated by Persoon as "In Boboli sylvulis circa piscinam Insulae." If it can be shown that the one purple bolete still growing there is none other than *B. rhodoxanthus*, the latter name would become a synonym of the thus validated *B. purpureus* Mich. ex Pers.

B. rhodoxanthus sensu Snell, is according to Snell *B. calopus*. The *B. purpureus* of Curtis is nothing but *B. Frostii*. Consequently, *B. rhodoxanthus* has not yet been observed in this hemisphere.

BOLETUS SATANAS Lenz, Schwämme, p. 67. 1831.

Boletus sanguineus Secr., Mycogr. Suisse 3:23. 1833; Krombh. 1836; non Sow. ex Kallenbach.

Boletus tuberosus Bull. ex aut. gall. nonn.

Boletus foetidus Trog, Flora 19(1):228. 1836.

?*Boletus marmoreus* Roques, Hist. Champ., p. 65, pl. 6. 1832.¹²

This species has been misunderstood by many, also by some American authors. It has thus far been observed with certainty only in Europe where it prefers lime soil. It is completely absent in sandy regions with a low percentage of Ca and is also absent in Northern Europe. What has been called *B. satanas* by the early American authors (Curtis and Schweinitz) was, probably always, *B. miniatoolivaceus* var. *subluridus* (Murr.) Sing. What Coker & Beers call *B. satanas* var. *americanus* is most probably not a variety of *B. satanas* but some other species of the section *Luridi*. Of all American collections, the Western *B. Eastwoodiae* seems to come closest to the true *B. satanas* (see the following notes).

BOLETUS EASTWOODIAE (Murr.) Sacc. & Trott., Syll. 21:237. 1912.

Suillellus Eastwoodiae Murr., North Am. Flora 9:152. 1910.

The spores of this species are, according to my own measurements, pale melleous, melleous, thin-walled, fusoid, smooth, (11.5)-13.3-15.7 x (3)-4-6 μ ,

¹² Possibly not belonging here but to *B. rhodoxanthus* (Krombh.) Kall.

that is relatively narrower than the spores of *B. satanas* Lenz. The color of the pileus, the lesser extent of the reticulation of the stipe and the lack of an odor (?) would be additional differences. The more permanently bulbous stipe with a much less extensive network and probably different colors distinguish this from *B. rhodoxanthus* (Krombh.) Kallenbach which is equally close. Briefly characterizing this species, we may sum it up in the following way: It has the color and the spores of *B. rhodoxanthus* and the shape of the stipe and general appearance of *B. satanas* but is different from both.

***Boletus luridus* Schaeff. ex Fr. var. *caucasicus* nom. nov.**

"*Boletus erythropus* Fr.—*luridus* (Schff.) Fr." Sing., Beih. Bot. Centralbl. **48**(II): 519. 1931.

This is intermediate between *B. erythropus* and *B. luridus* but seems to be closer to *B. luridus*. The varietal name *B. luridus* var. *caucasicus* is here proposed.

BOLETUS ERYTHROPUS (Fr. ex Fr.) Pers., Mycol. Europ. 2:133. 1825, *p.p.*, *em.* Fr., *non* Pers. (1801) ex Kallenbach.

Boletus luridus var. *erythropus* Fr., Syst. Mycol. 1:391. 1821.

Boletus miniatorporus Secr., Mycogr. Suisse 3:28. 1833.

Boletus luridiformis Rostkov. in Sturm, Deutschl. Fl. 3:105. 1844.

Dictyopus erythropus Quél., Enchir., p. 160, 1886.

Tubiporus erythropus Ricken, Vademecum, p. 205. 1918.

This species is frequent during summer and fall in fir woods of the Alps, for example near Neuhaus, Bavaria, where I have collected it frequently. It is also frequent in the montane woods of the Caucasus Mts. This form under firs has been well described by Konrad & Maublanc, Icon. Sel. 5, pl. 407. 1924-1938. Kallenbach seems to have it mostly from under *Fagus sylvatica* and says it grows on soils poor or devoid of lime which does not agree with our observation at the Alpine localities. It may be that there are two forms loosely adapted to frondose or coniferous woods.

Persoon in 1825 considered *B. erythropus* as a species (the asterisk does not make it a subspecies as the Greek letters do) with a tolerable description and the citation of Fries, Observ. 1:23 on the first place. This makes it impossible to choose the later synonym *B. miniatorporus* Secr. as the valid name of *B. erythropus* (Fr.) Pers.

Some chemical characters of this species are indicated by Kallenbach, *l.c.* p. 80. They are probably very similar to if not identical with those of *B. subvelutipes*.

BOLETUS MORRISII Peck, Bull. Torr. Bot. Cl. 36:154. 1909.

Suillellus Morrisii Murr., North Am. Flora 9:153. 1910.

I have seen one collection from deciduous woods in Corweeta Experiment Forest, N. C. (10910, NC)). This is different from all the other species I know, especially if it is true that this species constantly reddens only when injured. The hymenophore contains much soluble and slowly disappearing

rich yellow pigment like *Pulveroboletus auriporus* (Peck) Sing. The spores are 11.5-16.3-(18.5) x (4)-4.8-(6.8) μ ; cystidia about 45 x 10 μ , fusoid, often with a short ampullaceous neck or mucronate, hyaline; there are also balloon-shaped bodies on the pore mouths (pseudoparaphyses). The mycelium is distinctly yellow. The cuticle is made up by a trichodermium palisade of erect dermatocystidia which are versiform, rather long and slender in an average, fusoid, clavate, or filamentous, hyaline; all hyphae without clamp connections.

The rather strongly flocculose-pustulate stipe is reminiscent of *Leccinum*. However, the structure of the cuticle of the pileus does not support this suspicion, and it has to be assumed that *B. Morrisii* is an outstanding species of the section *Luridi*.

Species Imperfectly Known

BOLETUS FIRMUS Frost, Bull. Buff. Soc. Nat. Sc. 2:103. 1874.

Authentic material (FH) has few spores on the hymenium, and the ones present were winged like *Boletellus*-spores, and about 17 x 10 μ . They may have come from *Boletellus Russellii* Frost. Otherwise the specimens examined did not reveal anything about the affinities of this species except for the strong network at the apex of the stipe which could almost belong to *B. Frostii* ssp. *typicus*. However, the network tapers out just below the upper third or fourth of the length of the stipe. The pileus must have been rather light colored, gray—as Krieger says who has observed this species in Canada. Unfortunately, he does not give more details about this unusual species which, as far as our personal knowledge goes, cannot be considered as sufficiently studied. The type came from Vermont.

BOLETUS MAGNISPORUS Frost, Bull. Buff. Soc. Nat. Sc. 2:103. 1874.

Authentic material (FH) shows rather small spores, smaller than in *B. junquilleus* (Quél.) Boud. which the description otherwise recalls. The spores are not as short as those of *B. Queletii* Schulz. but they were few and possibly not quite mature in our material. These observations are not sufficient for any conclusions.

BOLETUS SULLIVANTII Berk. & Curt. *apud* Mont. Syll. Crypt., p. 152. 1856.

I have not seen the type which comes from Ohio. This species may belong in the section *Luridi*.

BOLETUS DICHROUS Ellis, Bull. Torr. Bot. Cl. 6:109. 1876.

Boletus squamulosus Ellis, Bull. Torr. Bot. Cl. 6:77. 1876, *non* Rostkov. in Sturm (1844).

Type material is found in several herbaria. We have studied material preserved at NY and FH and find the spores 14.5-17.5 x 5.2-6.3 μ , melleous, fusoid, with suprahilar depression, smooth; cystidia small, fusoid; hyphae of the cuticle of the pileus filamentous with some inflated terminal members, not strikingly mucilaginous, without clamp connections.

The spores are too large for *B. rubellus* ssp. *bicolor* (Peck) Sing, with which it is identical according to Murrill; they are also too large for *B. miniatoolivaceus* which is more similar than *B. rubellus* ssp. *bicolor*. It could be *B. rubricitrinus* Murr. as far as the spore measurements are concerned, but it appears somewhat unlikely that this Florida species should have been found so much farther north than its present northern limit. Aside from this, there is Ellis' remark about the viscosity of the cuticle of the pileus, a character irreconcilable to the characters of any of the above-mentioned species. Such a condition cannot be considered likely in *B. rubricitrinus* even after prolonged rains. It is possible that *B. dichrous* represents a now neglected or local species confined to a part of New Jersey. But it is also possible that Ellis' indication on the viscosity of the pileus is an error (the anatomy of the cuticle shows nothing to support his description), and that *B. dichrous* with the characters as given in the original diagnosis does not exist. The species has therefore been listed as "imperfectly known." There is, however, no doubt about its belonging in section *Luridi*, and it is obvious from the specimens that it has nothing at all to do with *Xerocomus badius*.

BOLETUS DISCOLOR (Quél.) Gilbert, Bolets, p. 172. 1931.

Dictyopus luridus var. *discolor* Quél., Flore Mycol. p. 422. 1888.

According to Quélet this is a form of *B. junquilleus* (or *vice versa*) while, according to Leclair it is a synonym of *B. Queletii*. Initially described as a variety of *B. luridus* from Central and Northern France, it is impossible to come to any conclusions without having seen authentic specimens. If no such specimens are in existence, it would be just as well to discard this species entirely.

Species Incertae Sedis and Species Excludendae

There are many species of *Boletus* which cannot be placed at present, as far as their section in *Boletus sensu stricto* is concerned, or even the genus to which they belong, either as autonomous species or as synonyms. They are, in fact so numerous that it will take type studies of the most extensive kind, including the reexamination of type localities to ascertain the correct position of at least some of them. In many cases there will be no way of making any conclusions even after all possibilities of rechecking are exhausted, and then these species will be entered in the list of *nomina dubia*.

There are also many species that have to be transferred from the genus *Boletus* in which they were described, to some of the recent segregates such as *Suillus* em., *Gyroporus*, *Pulveroboletus*, etc.

We do not include these lists of species because of the space they would occupy. This space would not be in proportion to the size of the paper which is not intended to be a monograph of the boletes of the world, inasmuch as the reader will find a complete index at the end of part IV of the present paper from which he can check back and easily find the proper place of all species mentioned and described as *Boletus* or transferred to this genus by others. This takes care of the *species excludendae* of Florida and those extra-

limital species that have been treated here. As for the *species incertae sedis*, we refer to the general literature on boletes (Saccardo, Sartory & Maire), adding some species that have been published in the period between 1925 and now mainly by Cleland, Snell, and Beeli. If they are not represented in our index, they belong in the category of *species incertae sedis*. We can see no possible advantage in reprinting all these names only to state that we know nothing about them.

4(13). XANTHOCONIUM Sing., Mycologia 36:361. 1944.

Characters of the genus: Pileus not scrobiculate; hymenophore of medium long tubes with fine pore-mouths, the latter concolorous or subconcolorous with the tubes, plainly adnate or adnexed, or more frequently depressed around the stipe; spores in print rusty yellow-brown to brownish yellow, without an olive hue even in the freshest preparation (except, perhaps, if the trama of the hymenophore has pressed on the support), about "antique brown," "raw sienna," "Sudan brown," "Argus brown," under the microscope bright golden, smooth, cylindrical or fusoid-cylindrical and rather narrow; basidia not voluminous; cystidia present; trama truly bilateral of the *Boletus*-type; stipe equal or ventricose, rather thick, glabrous or subglabrous, entirely smooth, solid; context white, unchanging; taste mild. On the ground in woods or in open places near conifers or frondose trees (not much specialized), in temperate and subtropical America. Type species: *Xanthoconium stramineum* (Murr.) Sing. (*Gyroporus stramineus* Murr.). The two known species both occur in Florida.

KEY TO THE SPECIES

- A. Pileus white, later sometimes stramineous27. *X. stramineum*
 A. Pileus distinctly colored from the beginning28. *X. affine*

27. XANTHOCONIUM STRAMINEUM (Murr.) Sing., Mycologia 36:362. 1944.

Plate 1, Fig. 8 and Plate 2

Gyroporus stramineus Murr., Bull. Torr. Bot. Cl. 67:62. 1940.

Leucogyroporus stramineus Snell, Mycologia 34:408. 1942.

Gyroporus Woodiae Murr., Lloydia 6:226. 1943.

Pileus white, later whitish or pale stramineous with white margin, eventually becoming stramineous or grayish or brownish on the areolae between the cracks when rimose in age, otherwise smooth and glabrous to very slightly pubescent on the margin when quite young, opaque, non-viscid, often more or less shining when dried, often with initially incurved and later projecting sterile margin, convex, eventually expanded, and eventually irregular when old, 45-85 mm. broad. — *Hymenophore* white, at maturity becoming dirty buffy cream or umbrinous-pallid and occasionally deeper brown at places from the spores, unchanging, adnate and with or without a slightly decurrent tooth (up to 1 mm.), or slightly depressed around the stipe; tubes 3-10 mm. long; pores minute, round and seemingly closed in young specimens, later angular and still small (10-15 to 5 mm.), often somewhat radially elongate next to the stipe, concolorous with the tubes or later either

paler or browner than the tubes, or remaining concolorous and very slightly staining brownish when touched; spore print "antique brown" or "raw umber," in thin layer often between "honey yellow" and "primuline yellow," or more "buckthorn brown," "Dresden brown" when caught in contact with the pores. — *Stipe* pure white, later whitish, unchanging when touched, glabrous, smooth, except for an extremely faint reticulation on the very apex of the stipe (a mere prolongation of the pores) in some of the very young specimens, practically constantly non-reticulate, non-viscid, equal or tapering downwards, or somewhat ventricose, sometimes with an unusual appendage at the base, solid, 30-60 x 10-35 mm.; mycelium white. — *Context* white, unchanging, thick, firm, eventually softer; odor none, or slight, fruity ("of anise" Murrill); taste mild.

Spores (9)-10.5-14.5 x 2.5-3.5 μ , most frequently around 11 μ long and 2.8-3.2 μ broad, hyaline but always a majority with a brilliantly golden yellow sap, thin-walled and smooth, rod shaped, cylindrical; *basidia* 24-35 x 8.5-11 μ , 4-spored, both basidia and sterigmata in all regards normal for the Boletineae; *cystidia* 28-35 x 4.5-6.8 μ , hyaline, fusoid or subulate, sometimes ampullaceous, very scattered and rare, soon disappearing, inconspicuous; *trama* truly bilateral of the *Boletus*-type, the mediostratum axillar, denser than the lateral stratum, with a few wavy-flexuous laticiferous vessels in some walls, the lateral stratum much more nearly hyaline, not very strongly divergent but loosely arranged; *cuticle* of the pileus apparently without any differentiated layer; hyphae without clamp connections.

Chemical reactions.—KOH on surface of pileus and context, negative; on pores, brown. — NH₃, NH₄OH, aniline and formol negative or almost negative in all parts. — HNO₃ on surface of pileus, yellow, otherwise negative. — FeSO₄ bluish slate gray. — Phenol on context, lilacinous-purple to chocolate brown.

Habitat.—In moderately dense mesophytic and low hammocks under oaks and in rather open places along flatwoods (*Pinus palustris*) or scrub (*Pinus palustris* and *Quercus Chapmanii*), also on lawns and in gradens under oaks (*Quercus virginiana* and probably other species) and under *Pinus taeda*, also in woods of *Quercus laevis* Walt.

Distribution.—Florida (except for the tropical zone).

Material studied.—FLORIDA, HIGHLANDS Co., Highlands Hammock State Park, Botanic Garden area and flatwoods, *Singer F 153, F 153 a, F 153 b* (FH); LAKE Co., sand shore of Lake Harris near Tavares, det. Murrill (as *Boletus* spec.) *F 15499* (FLAS); PUTNAM Co., near Lake Winn Ott (only label, *vide Murrill*); CLAY Co., Goldhead Park (only label, *vide Murrill*); Green Cove Springs (label only, *vide Murrill*); COLUMBIA Co., Camp O'Leno (label only, *vide Murrill*); ALACHUA Co., Melrose (label only, *vide Murrill*); Devil's Millhopper, *Miss Harriet Wood & Murrill*, TYPE of *G. Woodiae* (FLAS); Gainesville, *Murrill*, August 26, 1942; *Singer, F 2496 b* (FH); *Erdman West & Murrill* (det. Murrill as *B. roseialbus*, co-TYPE of the latter¹³), *F 9287* (FLAS); TYPE of *G. stramineus* (FLAS); Dayville, *Singer, F 2496, F 2496 a*, (FH); Flatwood between Gainesville and Newnan's Lake, *Singer, F 2808* (FH); Cary Memorial Forest, *Murrill, F 21797* (FLAS).

This is one of the most remarkable species of Florida, striking because of the uniformly white color which often resembles fallen flowers of *Magnolia*.

¹³ The type of *G. roseialbus* is identical with *Cyroporus subalbellus* Murr.

The lack of pigment may be mimicry as well as protection against the direct sun to which many specimens are exposed. Deer eat this bolete eagerly. It is also palatable to man. *X. stramineus* can be readily recognized not only macroscopically but microscopically by its characteristic rod-shaped, golden yellow spores. The mild taste, smooth stipe and brownish yellow to yellowish rusty brown spore print distinguish it from *Tylophilus Rhoadsiae* which may be found in similar places.

28. *Xanthoconium affine* (Peck) Sing. comb. nov.

Boletus affinis Peck, Rep. N. Y. State Mus. 25:81. 1873.

Suillus affinis Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Ceromyces affinis Murr. Mycologia 1:149. 1909.

?*Boletus leprosus* Peck, Bull. N. Y. State Mus. 2(8):135. 1889 (?=var. *maculosus*).

Var. TYPICUS

Pileus when young deep brown (from "Dresden brown" to "mummy brown"), then from "raw umber" to "Saccardo's umber," then "buckthorn brown" to "tawny olive" or "yellow ocher" to "raw sienna," or variegated with the following colors (of which one or several may be absent) "buckthorn brown," "honey yellow," "Dresden brown," "raw sienna," "bay," eventually often becoming "Isabella color," subtomentose-subglabrous to glabrous, non-viscid, becoming somewhat rimulose or rimose in age, otherwise smooth or somewhat roughened, pulvinate, then convex with applanate or somewhat depressed center, eventually often irregular, 40-110 mm. broad, rarely broader. — *Hymenophore* almost whitish when young, then "Isabella color" with or without some "cream buff," especially near the pores, becoming "honey yellow" when mature, unchanging, adnate or more frequently depressed around the stipe; tubes 7-15 mm. long; pores concolorous, unchanging or somewhat deeper yellowish or brownish when touched, round or subangular, small (2.4 to a mm.) to eventually medium-sized in very large specimens (but still relatively small); spore print between "raw sienna" and "antique brown," or between "Sudan brown" and "Argus brown." — *Stipe* white, later pallid or pale sordid and often partially "wood brown" or nearer the color of the hymenophore, remaining white or whitish at the base in most individuals, glabrous, smooth, or somewhat rough, never reticulate, versiform, either tapering upwards and downwards (ventricose), or tapering from the apex downwards, or thickened as well upwards as downwards (thinnest in the middle), or subequal to equal, solid, 40-52 x 10-25 mm.; mycelium inconspicuous, white. — *Context* white, unchanging; odor slight or distinct of *Leucocoprinus procerus*; taste mild.

Spores 11-13.7-(16) x 3-4 μ , slightly more fusoid, i.e. not quite as strictly rod-shaped as in *X. stramineum*, and slightly less intensely golden but less frequently completely hyaline than in that species, smooth, thin-walled; *basidia* 24-26 x 8-8.7 μ , 4-spored, often with golden-ferruginous contents in dried material; *cystidia* 30-62 x 8.7-11 μ , ventricose with ampullaceous apex, often with golden contents or with a ferruginous incrustation, rather numerous on the pores; *trama* truly bilateral, of the *Boletus*-type; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—Most frequently in open woods and in high and mesophytic hammocks, more rarely in low hammocks, near *Quercus virginiana* and other species of oak as well as near pines (*Pinus palustris* and *P. australis*), in the latter case some *Quercus minima*, *Q. nigra*, or at least *Cerothamnus cerifera* may be present but hardly in constant mycorrhizal connection with any of these species on sandy soil or on humus, more rarely on very decayed wood, solitary or in small to large groups. Fruiting from May until September.

Distribution.—From New England to South Florida and west to Indiana and Tennessee, not found in the tropical zone.

Material studied.—FLORIDA, HIGHLANDS Co., Highlands Hammock State Park, Singer, *F* 361 (FH); ALACHUA Co., Wend Prairie near Gainesville, Murrill *F*. 16504 (FLAS); Newnan's Lake, Murrill, *F* 17690 (FLAS); Singer, *F* 2178 a (FH); Gainesville, Singer, *F* 2158 (FH); *F* 2083 (FH); Sugarfoot Hammock, Singer, *F* 2569 (FH); CLAY Co., Gold Head Park, Murrill, *F* 19626 (FLAS); Doctor's Inlet, Murrill, *F* 20123 (FLAS). VERMONT, Brattleboro, C. C. Frost, one specimen under the correct name, another under an unpublished name, (FH). NEW HAMPSHIRE, Chocorua, Farlow, good spore prints (FH). MASSACHUSETTS, Dedham, Rusden & Darßer, 5369 (det. Snell), (FH); Arnold Arboretum, Hemlock Hill, Jamaica Plain, Darßer (det Linder) 6225 (FH); Canton, Linder, 1156 (FH). NEW YORK, Albany-TYPES (NYS). VIRGINIA, Mountain Lake, Linder (det. Snell), (FH).

Var. *maculosus* (Peck) Sing. comb. nov.

Boletus affinis var. *maculosus* Peck, Rep. N. Y. State Mus. 32:57. 1879.

This has not been found in Florida but since it occurs in the northern states together with the type and south to North Carolina [Mass., Wellfleet, Linder (det Singer), (FH). — New York TYPE (NYS) and others], it may yet be found in Florida, especially in North Florida where the type form is so common. It differs only in whitish to cream colored stains all over the pileus. I have never seen spore prints with olivaceous hue.

5(14). TYLOPILUS Karst., Rev. Mycol. 3:16. 1881.

Rhodoporus (Quél.) Bat., Bolets, p. 11. 1908 (type *B. felleus*).

Dictyopus (sect.) *Rhodoporus* Quél., Flore Mycol., p. 421. 1888 (type *D. felleus*).

Leucogyroporus Snell, Mycologia 34:408. 1942. (type *G. pisciodorus*).

?*Rhodobolites* G. Beck, Zeitschr. Pilzk. 2:146. 1923.

Characters of the genus: Pileus subglabrous to tomentose, sometimes scrobiculate, dry or viscid; cuticle of diverse structures, even sometimes cellular; hymenophore light colored or pallid, at least when young, usually depressed around the stipe, at least at maturity; pores small, not discolorous except by autoxydation when injured; spore print ranging all the way from a sordid pinkish flesh color to dull flesh ocher, or deep ferruginous-brown, wood brown, etc. ("light russet vinaceous," "russet vinaceous," "Rood's brown," "fawn color," "army brown," between "wood brown" and "fawn color," "pinkish cinnamon" with a shade of "fawn color," "vinaceous fawn," "cream buff," "Isabella color," "chamois," "amber brown"), often becoming paler after several months or years of preservation¹⁴), pale melleous to

¹⁴ This change is unusual because it is in contrast to what has been observed by the writer in the Russulaceae and Tricholomataceae where white or cream colored spore prints are likely to darken after prolonged preservation.

yellowish-subhyaline under the microscope, variable in shape, smooth, thin-walled; cystidia usually well developed, sometimes contrasting in color; trama truly bilateral of the *Boletus*-type; stipe either naked or covered with a palisade of hairs or dermatocystidia, often with a hymenium in the reticulate portions (when there are such); veil none; context whitish, never yellow, unchanging or changing but never bluing, mild (mild *and* unchanging only in *T. conicus* which has scrobiculate pileus), or very frequently bitter. Habitat in woods and hammocks, open pine lands, on lawns etc. on the soil. Type species: *T. felleus*. (Bull. ex Fr.) Karst. (*Boletus felleus* Bull.)

This well defined genus can easily be divided into three natural and convenient sections, only one of which is represented in Europe while all three are represented in Florida.

KEY TO THE SECTIONS

- A. Context constantly unchanging on injury, unchanging with KOH, or turning yellowish with KOH and then the pileus scrobiculate-pitted.
 - B. Pileus not scrobiculate-pitted; context rarely mild, not turning yellowish with KOHSect. *Fellei*
 - B. Pileus scrobiculate-pitted; context mild, turning more or less yellowish with KOHSect. *Scrobiculati*
- A. Context changing color when injured (sometimes rather slowly), becoming reddish or grayish violaceous, distinctly reacting with KOH in the spectra tested
..... Sect. *Oxydabiles*

Section *Fellei*, sect. nov.

Carne immutabili, plus minusve amara, raro miti vel submiti, KOH ope haud flavescente; pileo haud scrobiculato.

Characters of the section: see key and the above Latin diagnosis. The type species is *Tylopilus felleus* (Bull. ex Fr.) Karst.

KEY TO THE SPECIES

- A. Stipe reticulate; pileus not violaceous when young.
 - B. Pileus white to alutaceous white29. *T. Rhodasiae*
 - B. Pileus neither white nor alutaceous white.
 - c. Stipe 50-68 x 7-13 mm., pallid to between "cinnamon" and "clay color" in the middle with paler apex and base, equal or tapering downwards; spores (8)-10-15-(16.3) x 3.3-4 μ , the apex of the stipe finely concolorously reticulate; in frondose woods and in mesophytic and high hammocks ..30. *T. minor*
 - c. Stipe as slender as above, or more frequently larger, especially thicker, ventricose, or tapering upwards or, with more or less thickened base, more strongly colored than no. 30, with a more extended belt between "cinnamon" and "clay color" or a similar color, usually up to the very apex, or if not so, the very apex rather yellowish colored, with a strong and distinctly elevated network which is often darker than the ground color (e.g. "sayaal brown"); spores broader; in coniferous and mixed woods near conifers31. *T. felleus*
- A. Stipe non-reticulate.
 - D. Pileus initially violet; stipe at first bulbous, very thick27. *T. plumbeoviolaceus*
 - D. Pileus not initially violet; stipe subequal, or thin and tapering downwards (see 30. *T. minor*, forms with non-reticulate stipes).

Description of the Species Occurring in Florida

29. *TYLOPILUS RHOADSIAE* (Murr.) Murr., *Mycologia* 36:122. 1944.

Boletus felleus forma *albiceps* Kauffm. *apud* Snell, *Mycologia* 28:466. 1936.

Gyroporus Rhoadsiae Murr., *Bull. Torr. Bot. Cl.* 67:62. 1940.

Leucogyroporus Rhoadsiae Snell, *Mycologia* 34:408. 1942.

Pileus white except for occasional "avellaneous" or "pinkish buff" or "pale ochraceous salmon," or "light pinkish cinnamon" portions, especially near the margin, sometimes somewhat guttate, center exceptionally reaching "warm buff" in some specimens, subtomentose, non-viscid, or very slightly sticky in prolonged rains, opaque or somewhat shining when dried, with narrowly projecting sterile margin which is pubescent when young, pulvinate, then convex or with flattened disc, 60-90 mm. broad. — *Hymenophore* whitish, then pale pinkish white, deeply depressed; tubes 9-16 mm. long; pores small, about 2 to a mm. in an average, concolorous and unchanging; spore print "light russet vinaceous" to "russet vinaceous." — *Stipe* white, strongly reticulate with a somewhat projecting concolorous (white) network with wide meshes, covering the upper half or the upper two thirds, glabrous, solid, equal or subequal, or slightly tapering upwards, or ventricose, 55-95 x 16-27 mm.; mycelium white. — *Context* white, unchanging; odor none or "bitter"; taste bitter.

Spores 11-13.7 x 3.7-4.5 μ , fusoid, often more attenuate towards the apex (clavate), with a slight suprahilar depression, smooth, honey-yellow-hyaline; *basidia* 25-26 x 8-9 μ , 4-spored, often with yellow contents; *cystidia* 36-43- (62) x (6)-6.8-8.3 μ , fusoid, not ampullaceous and not rounded above but acutely attenuate or acuminate and subobtusate, yellowish guttulate or with a yellow central body, rather numerous in young specimens near the pores; *trama* truly bilateral of the *Boletus*-type; *cuticle* consisting exclusively of filamentous hyphae which are more nearly parallel and horizontally arranged towards the surface, the terminal members often in strands or in single hypha-ends which are erect or ascendant and have rounded tips, rarely cystidioid, capitate or ampullaceous, sometimes with yellow, guttulate contents, sometimes with an hyaline incrustation; all *hyphae* without clamp connections.

Chemical reactions.—KOH on context, negative or almost so. — Phenol and methylparamidophenol negative.

Habitat.—Near the margin of open pine lands and in flatwoods, also in mesophytic hammocks, connected with either pine or oak, not fully dependent on either of these trees, solitary or gregarious on sandy soil, from July till September.

Distribution.—Frequent in extratropical South Florida and becoming gradually less frequent towards the north, but reaching Michigan. The northern and western limits have not been established.

Material studied.—FLORIDA, Highlands Hammock. Numerous specimens in and around Highlands Hammock State Park, August and September 1942, *Singer, F 351* (FH); PUTNAM Co., at the margin of Lake Rosa, September 8, 1938, *L. & A. Rhoads*, TYPE of *G. Rhoadsiae* (FLAS); CLAY Co., Gold Head Park, *Watson*, July 9, 1939, AUTHENTIC, (FLAS); ALACHUA Co., Sugarfoot Hammock under *Pinus taeda* solitary, *Singer F 2594* (FH); Flatwoods between Gainesville and Newnan's Lake, *Singer, F 2844* (FH).

This is briefly defined as a white *T. felleus* although it certainly is not an albino form but an autonomous species. It occurs in groups of uniformly colored carpophores and no *T. felleus* has ever been seen in their neighborhood.

30. TYLOPILUS MINOR Sing., Mycologia 37:799. 1945.

Pileus between "Verona brown" and "fawn color" when young, becoming about "saya brown" or "cinnamon buff," or eventually "winter leaf" (M. & P.), sometimes with an avellaneous hue, or somewhat deeper colored than indicated above but in the same colors, decidedly non-viscid, opaque, subglabrous to slightly tomentose, pulvinate, becoming plane in age, 38-57 mm. broad. — *Hymenophore* whitish, then pale and sordid pink, slightly to decidedly depressed around the stipe, unchanging or almost so when wounded; tubes about 6 mm. long; pores concolorous, small, about 11-12 per 5 mm. or 0.2-0.3 (0.5) mm. in diameter; spore print as in the preceding species. — *Stipe* white, whitish, then often assuming a color between "clay color" and "cinnamon," especially in the middle but leaving large portions especially at the apex and the base pigmentless, entirely brownish in some specimens when very old, with a fine (finer than in *T. felleus*), wide-meshed, concolorous (*i.e.* mostly whitish) reticulation at the apex, leaving the lower, larger portion of the stipe smooth, more rarely entirely smooth, even at the apex, glabrous, solid, equal or subequal, but the base often acuminate, more rarely tapering downwards, appearing subradicate, 50-68 x 7-13 mm.; mycelium white. — *Context* white, unchanging; taste bitter, often becoming milder with age; odor none, or weak, agreeable.

Spores (8)-10-13.5 x 3.5-4 μ , or 10.2-15-(16.3) x 3.3-3.5-(4.8) μ , yellowish hyaline or hyaline, smooth, fusoid or clavate-fusoid, thin-walled; *basidia* 27 x 7 μ , 4-spored; *cystidia* 38-49 x 4.8-7 μ , fusoid, on the pores often strongly yellowish incrustated, besides with yellowish guttulate contents, the incrustation slowly dissolving in ammonia; the abundance of the colored cystidia on and near the pores is so great that the whole region is yellow under the microscope while the rest of the hymenium is hyaline or nearly so; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus, ochraceous brown; on context, negative, and not causing any remarkable change if applied after the reaction with FeSO₄ has taken place. — NH₄OH little reaction. — HNO₃ on surface of pileus, ochraceous brown. — FeSO₄ on context, immediately pale sordid caesious to glaucous.

Habitat.—In hammocks, mostly mesophytic hammocks with intermixed *Magnolia* or *Pinus palustris*, always in the neighborhood of *Quercus*, solitary or in small groups. Fruiting from May till August.

Distribution.—North Florida.

Material studied.—FLORIDA, ALACHUA Co., mesophytic hammock 2 miles south of Gainesville, Singer, F 2213 (FH); Kelley's Hammock, Singer, F 2717, TYPE (FH); F 2979, CO-TYPE (FH).

This species is closely related to *T. felleus* but, in my opinion neither a geographic race nor a mere *forma nana* but constant in its distinguishing characters, and with a geographical area more southern than that of *T. felleus*.

31. *Tylophilus plumbeoviolaceus* (Snell) Snell, Mycologia 33:33. 1941.

Boletus felleus forma *plumbeoviolaceus* Snell, Mycologia 28:463. 1936.

Boletus plumbeoviolaceus Snell, Mycologia 33:32. 1941.

Pileus "dull lavender," "dark heliotrope gray," "heliotrope slate," "dark vinaceous drab," some portions soon becoming "dusky brown" or "pale brownish drab," eventually mostly "drab," the discoloration starting mostly after exposure to the sun, dry and practically non-viscid in the center, viscid in the marginal half when exposed to rains for a prolonged period and remaining shining there after it has dried out while the disc is opaque, subglabrous, then glabrous, pulvinate, eventually frequently flattened, with somewhat projecting sterile margin and the latter sometimes separating from the pileus by a circular scission, 68-152 mm. broad. — *Hymenophore* white, then assuming a color between white and "sea shell pink," eventually "light russet vinaceous" with "sorghum brown" shades, depressed around the stipe; tubes 10-15 mm. long; pores concolorous, small, less than 1 mm. in diameter, usually 2-3 to 1 mm., subangular and not quite regular but not radiately elongate when old; spore print "light russet vinaceous." — *Stipe* "pale vinaceous drab" to "light vinaceous drab," mostly somewhat marbled with paler tints when young, becoming "light cinnamon drab," usually with a pallid, inconspicuous spurious network of continuing pores on the extreme apex of the stipe running down not more than 3 mm. at most, all the rest of the stipe decidedly smooth, glabrous, dry, solid, thick-ventricose, almost bulbous or bulbous when young, mostly becoming cylindric in older specimens, 40-90 x 32-56 mm. — *Context* white, unchanging, "light vinaceous drab" immediately under the cuticle, assuming the violet pigmentation also where wounded and exposed for a long time during the period of intensive growth, fleshy and thick, hard when young, especially in the stipe; taste very bitter; odor insignificant, not disagreeable.

Spores 9.5-14 x 3-3.8 μ , most frequently 10.2-12 x 3.3-3.5 μ , fusoid-cylindric, without suprahilar depression or with a very slight one, the broadest part in the middle or in the lower third, thin-walled and smooth, pale melleous or light golden melleous (not so golden and not so intensively colored as in *Xanthoconium*, — young spores entirely hyaline); *basidia* 21-24 x 7.5-8.5 μ , 4-spored; *cystidia* 32-56 x 6-15 μ , enormously numerous on the pores as well as in the tubes, with a striking golden yellow incrustation, and also pale golden yellow contents in many cases, the attenuate or thin, ampullaceous, often acuminate though at the very tip obtusate apices hyaline and free from incrustation, the main part fusoid; *trama* truly bilateral, of the *Boletus*-type,

the lateral stratum very loose, strongly and entirely divergent and quite hyaline; all *hyphae* without clamp connections.

Chemical reactions.—KOH on surface of pileus, bleaching to a pale isabelline; on pores pale isabelline; on context, negative or a very pale and sordid salmon color, at places almost bay. —NH₃ and NH₄OH negative everywhere. —H₂SO₄ on surface of pileus, bleaching to a pale isabelline; on pores brownish. —FeSO₄ on context, slowly and weakly reacting, becoming pale sordid gray; if KOH is added later, the reacting portion of the flesh becomes pale sordid salmon or pale sordid vinaceous, at places sordid bay (likewise slow reaction). —Methylparamidophenol everywhere negative.

Habitat.—On earth under oaks, either on bare sandy soil or among grasses, gregarious from May until fall.

Distribution.—From Massachusetts south to Florida and west to Tennessee and Mississippi.

Material studied.—FLORIDA, ALACHUA Co. Common in and around Gainesville, Singer F 1897, F 1897 a, 1897 aa (FH); F 2151, F 2151 a (FH), etc. RHODE ISLAND, East Providence, Farlow (det. Singer, conf. Snell), AUTHENTIC (FH, with excellent plate and notes); also paintings from Massachusetts material by Krieger. MISSISSIPPI, Tice (det. Curtis as "*B. subtomentosus* ?"), (FH).

Snell had this species from New York and Tennessee. The type is in the Walter H. Snell Herbarium (Providence, R. I.). This species is very different from *T. felleus* although it belongs to the same section. It has been silently accepted by American authors as a color form of *T. felleus*, without regard to the fact that the European form does not show such aberrant colors and has constantly reticulated stipe. It is incomprehensible that a strikingly beautiful, not too rare species like this has not been recognized long before it was described by Walter Snell. Specimens determined as *T. felleus* in America up to 1941 should be revised; indications in lists ought to be used with caution. The true *T. felleus* does occur in North America, but not in Florida.

Boletus violascens Martin from Switzerland is known to me only from the description in Saccardo. It seems to me that no one else has ever seen it in Europe. Assuming that *T. plumbeoviolaceus* exists in Europe though rarely, one may be led to believe that the diagnosis of *B. violascens* is just an awkward attempt to describe *T. plumbeoviolaceus* from insufficient material. In the case that there should be no type material worthy of examination, the only way to make sure whether this is the same as *T. plumbeoviolaceus* would be an intensive search at the type locality. It may be hoped that the otherwise very active members of the Swiss Mycological Clubs will cooperate.

The slow maturing of the spores indicated by Snell, *l.c.* finds its explanation in the fact that in young specimens the cystidia are so crowded and consequently the incrustations so dense that the formation of normal basidia is suppressed until sufficient space is provided in fully grown carpophores for the development of the even then inconspicuous basidia. The spores are indicated as 7-11 x 2.8-4 μ , mostly 8-9 x 3 μ , by Snell but I have checked

my findings on Florida material as well as on northern material, and I find the measurements given in my description reasonably constant.

Extralimital Species

TYLOPILUS FELLEUS (Bull. ex Fr.) Karst., Rev. Mycol. 3:16. 1881.

Boletus felleus Bull. ex Fr., Syst. Mycol. 1:394. 1821.

This is well represented in many European books, the best illustration and description is found in Kallenbach, Pilze Mitteleuropas 1:131-138, pl. 42, figs. 1-22, pl. 47, figs. 77-78. 1938. It also occurs in North America. The spores are 10.5-15.5-(18) x 4.2-4.5 μ ; the cystidia are fusoid-subventricose with ampullaceous apex, hyaline; the trama is truly bilateral of the *Boletus*-type; all hyphae are devoid of clamp connections. The color of the pileus is "cinnamon" with "snuff brown" center, or "cinnamon," "snuff brown," and "saya brown" mixed (much the same as in *T. ferrugineus*). NH₄OH does not react with any part of the carpophore nor does H₂SO₄ on the context; on the tubes however, it causes a ferruginous then brown-yellow reaction. FeSO₄ makes the context of the pileus gray-reddish. The context of the stipe and the plane of attachment of the hymenophore become more gray, the interior of the context more reddish. Guajacol does not cause any discoloration. The spore print is "fawn color" to "army brown" when fresh. The habitat is under various conifers.

My own collections from Middlesex and adjacent counties of Massachusetts are identical with the European type in all regards. However, Snell also mentions a form which I have not seen. He calls it *Boletus felleus* f. *rubrobrunneus* Snell, Mycologia 28:463. 1936.

Section Scrobiculati, sect. nov.

Pileo scrobiculato; carne immutabili, miti; reactione KOH flavida; stipite albo, levi.

Characters of the section: see the key of the sections, p. 90, and the above Latin diagnosis. The type and only species is *T. conicus* (Rav. apud B. & C.) Beardslee.

32. TYLOPILUS CONICUS (Rav. apud B. & C.) Beardslee, Mycologia 26:253. 1934.

Boletus conicus Rav. apud Berk. & Curt., Ann. Mag. Nat. Hist. II. 12:430. 1853.

Suillus conicus Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Ceromyces conicus Murr., Mycologia 9:146. 1909.

Pileus with uneven surface of elevated ridges around small depressions (scrobiculate) that give the pileus a characteristic pitted appearance, the most elevated ridges "Sudan brown," "raw sienna," "yellow ocher," the lower ones "mustard yellow," the depressions (since they are naked context) white, but the pileus giving the general impression of about "primuline yellow,"

more pitted near the margin, dry, pulvinate to convex, 25-95 mm. broad. *Hymenophore* "pale grayish vinaceous" to "pale vinaceous fawn" when mature, paler when immature, depressed around the stipe; tubes about 14 mm. long; pores small, equal, concolorous and unchanging, 8-10 per 5 mm. radially, 10-11 per 5 mm. transversely; spore print "Rood's brown." — *Stipe* white, at least at the apex and at the base, the middle portion usually with a flush of "light pinkish cinnamon" and "chamois," smooth to minutely rugulose at places, entirely glabrous, ventricose to subequal, 40-70 x 6-18 mm.; mycelium white. — *Context* pure white with a hyaline line above the tubes; odor agreeable, fruity; taste mild.

Spores 14.2-17.7-(21) x 4-6 μ , fusoid, the upper half attenuate, with thin, rarely in some exceptional spores with slightly thickened walls (0.8 μ), hyaline and becoming melleous or brownish melleous only at maturity, with distinct or indistinct suprahilar depression, with small oil-drops inside, smooth; *basidia* (17.5)-27.5-30 x 10-11.6 μ , 4-spored; *cystidia* 41-68 x 4.8-8.5 μ subfusoid, often with 1-2-(3) septa, hyaline but frequently with a melleous incrustation; *trama* truly bilateral of the *Boletus*-type; *cuticle* of strands of very slender, and others of medium thick (4.5-8 μ in diameter) hyphae; these *hyphae* are alternately hyaline and deep honey color with dissolved pigment, somewhat interwoven and repent but a few ascendant to erect, all without clamp connections.

Chemical reactions.—KOH on surface of pileus, deeper colored, eventually brown; on context of pileus, yellow, eventually brown. — NH₄OH on surface of pileus, deeper and richer colored, eventually brown; on context of pileus, negative except for the margin which usually assumes the color of the tubes. H₂SO₄ on pores, negative. — FeSO₄ on context of pileus, negative but if treated with KOH subsequently, the context becomes brownish; on tubes with FeSO₄, gray, eventually steel gray. — Formol on surface of pileus and on context, negative. — Methylparamidophenol on context and tubes, negative.

Habitat.—In flatwoods under *Pinus palustris*, often on soil that is at times partly inundated. Fruiting in July.

Distribution.—From South Carolina to Florida, but not in the tropical zone.

Material studied.—FLORIDA, ALACHUA Co., in a flatwood east of Gainesville, *Singer F 2780* (FH). SOUTH CAROLINA, Santee Canal, *Ravenel, 1024*, TYPE (FH).

This is, as has been pointed out by Beardslee, one of the most striking boletes of the south, and very few mycologists have ever seen it. It has been collected by Ravenel, Beardslee and this writer, that is three times in nearly a century. It grows in small number in places where ordinarily few Agaricales would be expected. Ravenel's type consists of small specimens. This plant, however, reaches considerable size if well developed. This obviously depends on the weather conditions, and well formed specimens may be found when continuous rainfall favors its growth until it has reached its maximum size. Unfortunately, Beardslee did not indicate the locality and county in which his Florida collections were made; we may assume it was in central

peninsular Florida. The specific epithet "conicus" is regrettable since it is misleading as far as normally developed specimens are concerned.

Section *Oxydabiles*, section. nov.

Pileo haud scrobiculato; carne violascente vel rubente vel grisente, amara vel miti; KOH ope discolorante.

Characters of the section: see key, p. 90, and the above Latin diagnosis. Type species: *Tylophilus tabacinus* (Peck) Sing. (*Boletus tabacinus* Peck).

Gilbert considered the species of this section as belonging in *Porphyrellus*. All he knew about them were not too good descriptions. None of the species of this group occurs in Europe.

KEY TO THE SPECIES

- A. Spores ellipsoid to ovoid, about twice as long as broad, or shorter ($Q=2$, or less).
 B. Cuticle of filamentous hyphae *T. Balloui*
 B. Cuticle of chains of short hyphae and spherocysts *T. veluticeps*
- A. Spores fusoid or cylindric or ellipsoid-oblong, or clavate-elongate with Q larger than 2.
 C. Pileus blackish umber, deep fuliginous, dark fuscous.
 D. Cuticle of the pileus with an epithelium *T. cellululosus*
 D. Cuticle of the pileus formed by a palisade of stiff hairs or dermatocystidioid terminal members of hyphae-chains.
 E. Cystidia with ampullaceous apex; spores cuneiform-clavate with a Q less than 3 (i.e. spores less than three times longer than broad) 33. *T. alboater*
 E. Cystidia not all ampullaceous; spores cylindric and three times as long as broad in an average *T. nigricans*
- C. Pileus purplish brown to chocolate brown, reddish brown, ochraceous brown, pale alutaceous, cinnamon, even whitish, sometimes with pinkish areas.
 F. Spore print "amber brown"; spores large, $13.5-23.5 \times 3.5-5.5\mu$ *T. eximius*
 F. Spore print not "amber brown" (not as rusty brown as this, rather dull yellowish, wood brown, or pinkish); individual spores smaller than indicated above, rarely some spores in a print larger than 14.5μ .
 G. Taste mild; odor none; context white before autoxydation takes place; spores broader than $2.3-3.5\mu$.
 H. Winter fruiting species in Florida (see *B. alachuanus*)
 H. Either not winter-fruiting, or not occurring in Florida..... *T. ferrugineus*, *T. indecisus*, *B. decorus*, *B. subpunctipes*, *B. subdecorus*, *B. pseudodecorus*
- C. Taste not mild or odor strong, or else the context partly brown before autoxydation starts, or spores only $2.3-3.5\mu$ broad.
 I. Pileus "snuff brown," "Argus brown," "buckthorn brown"; odor of guava, or fishy, or both these odors present at the same time; stipe reticulate at the apex; spores $11.8-14.5-(17) \times 3.5-5\mu$; spore print between "wood brown" and "fawn color," or "vinaceous fawn"
 34. *T. tabacinus*
- I. Pileus whitish, or "chamois" to "antimony yellow," or more umber, or with a salmon colored ("ochraceous salmon") zone, often stained with "cinnamon brown" or "Prout's brown" but not prevalently in these colors; odor slight, somewhat acid, or of chloride of lime, or of anise, not of guava and not of fish; stipe never reticulate in any part; spores $10.5-13.5 \times 2.3-3.5\mu$; spore print "cream buff," "chamois," "Isabella color," rarely "vinaceous fawn" in a very distinctly bitter variety
 35. *T. peralbidus*

Description of the Species Occurring in Florida

33. TYLOPILUS ALBOATER (Schwein.) Murr., Mycologia 1:16. 1909.

Boletus alboater Schweinitz, Schr. Naturf. Ges. Leipzig 1:95. 1822.

Boletus nigrellus Peck, Ann. Rep. N. Y. State Mus. 29:44. 1878.

Suillus alboater Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Suillus nigrellus Kuntze, Rev. Gen. Pl. 3(2):535. 1898.

Porphyrellus alboater Gilbert, Bolets, p. 99. 1931.

Porphyrellus nigrellus Gilbert, Bolets, p. 99. 1931.

Pileus very dark brown to nearly black with a grayish bloom, dark smoky drab with a fleshy tint to brownish gray, distinctly velutinous, dry, with projecting sterile margin which is incurved at first, convex to nearly flat or irregular, 60-110 (-280) mm. broad. — *Hymenophore* white or pale gray, later flesh colored, changing slowly to black, or reaching blackish through pink or purplish brown when wounded, adnate to depressed with decurrent lines; tubes 5-10-(12) mm. long; pores variable in shape and size, 1-3 per mm., not stuffed at first but crowded and folded together, later rounded-angular, concolorous and changing as tubes when touched; spore print deep rosy salmon or dull flesh colored. — *Stipe* concolorous with the pileus but paler at the apex at least when young, usually reticulated above, the longitudinal lines much stronger than the cross veins, more rarely practically non-reticulated even at the apex, pruinose to velvety, black when rubbed, usually heavy and irregular, or subequal, largest below or rarely above, solid, 50-105 x about 15-25 mm. — *Context* white to creamy gray, changing to pinkish gray, pinkish or purplish brown when bruised, then becoming blackish, firm in the stipe, thick in the middle of the pileus; taste mild, sometimes nutty; odor none.

Spores 9-13 x 4-4.8 μ , subclavate, broadest near the lower end, pale brownish melleous, thin-walled, or sometimes some moderately thick-walled, smooth; *basidia* (24)-38 x 7.3-8 μ , 4-spored; *cystidia* 60-65 x 11-12 μ , constantly ampullaceous as in *Leccinum scabrum*, brown, the neck 24-34 x 3.5-4.5-(6.5) μ ; *hyphae* of the trama brown, at least in the mediostratum of dried mature specimens, in young specimens truly bilateral of the *Boletus*-type with the mediostratum colored and dense and the lateral stratum hyaline and loosely arranged, divergent; *cuticle* made up of a palisade of hairs which are dark fuscous, slightly attenuate upwards but bluntly rounded at the very tip, very brittle, often thick-walled (walls 0.6-0.9 μ thick), very densely arranged, 4-7.5 μ broad, sometimes reaching 12 μ in breadth; palisade of the surface of the stipe with the same kind of hairs; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—In mixed woods and in low places near deciduous trees, often during dry weather in large quantity (Snell), on the soil. Fruiting from July till September.

Distribution.—From New York and New England to North Florida and west to Mississippi. In Florida rare.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Murrill, July 27 (FLAS); COLUMBIA Co., Camp O'Leno, Murrill, F 21801 (FLAS). NEW YORK, Sandlake, Peck, TYPE of *B. nigrellus* (NYS). NORTH CAROLINA, Great Smoky Mts., National Park, Swain Co., Hesler, August 1, 1937 (FH).

This species is remarkable for its color and it can therefore safely be assumed that Schweinitz's plant is what is now generally called *Tylopilus alboater*. We have, however, not seen authentic material. We have also not collected this species in fresh condition, and the above description is, as far as macroscopical characters are concerned, strongly inspired by published descriptions of authors who know it well in fresh condition, such as Peck, and especially Coker & Beers.

Paler specimens that may occasionally be confused with *T. ferrugineus* and allied forms, and also deeper colored forms of the latter that may be taken for *T. alboater*, can easily be distinguished in dried condition if it is remembered that the cystidia of *T. alboater* are brown while those of *T. ferrugineus* and allied forms are yellow.

34. TYLOPILUS TABACINUS (Peck) Sing., Mycologia 36:362. 1944.

Boletus tabacinus Peck, Bull. Torr. Bot. Cl. 23:418. 1898.

Ceriumyces tabacinus Murr., Mycologia 1:151. 1909.

Gyroporus pisciodorus Murr., Mycologia 31:111. 1939.

Boletus pisciodorus Murr., Mycologia 31:112. 1939.

Leucogyroporus pisciodorus Snell, Mycologia 34:408. 1942.

Var. TYPICUS

Pileus "Argus brown," at some places "buckthorn brown," velutinous, dry, smooth, margin often minutely wavy, pulvinate, becoming flatter, 45-175 mm. broad.—*Hymenophore* whitish to sordid white, later with Sanford's brown," patches and stains on the otherwise concolorous pores, or the pores brown almost from the beginning, adnate, becoming depressed around the stipe; tubes 10-14 mm. long; pores small, becoming medium wide in large, old specimens (1-2 to a mm.); spore print between "wood brown" and "fawn color," or "vinaceous fawn."—*Stipe* almost concolorous with the pileus, subvelutinous, smooth in the lower part, with a "hazel" network on paler ground in its upper portion (one tenth to one third), this reticulation with rather wide meshes, but often with strongly and permanently raised veins, solid, ventricose to subventricose, almost globose-bulbous when young, mostly elongate and subcylindric though very thick when old, mostly acuminate to the very base, 40-164 x 25-60 mm.—*Context* white becoming slate violet as in *T. peralbidus* when cut, the base of the stipe often from the beginning slate violet, or more often brown, always brown in old and in dried material; taste mild or very slightly bitterish; odor initially weak, fruity, later strong and compound, of guava paste, and at the same time of old, emptied fish cans, the latter odor sometimes wanting, both odors, especially the guava odor, rather persistent even in dried condition for a short while.

Spores (8.8)-11.8-14.5-(17) x (3.5)-4.5 μ , most frequently 11.8-13.8 x 4.2-4.5 μ , fusoid, fusoid-ellipsoid, fusoid-cylindric, often a high percentage fusoid-clavate with strongly attenuate upper half, hyaline to pale melleous, smooth, thin-walled, exceptionally a few spores abruptly ventricose in the middle and then up to 5.5 μ broad; *basidia* 28-30 x 7.5-8.5 μ , 4-spored; *cystidia* 18-45 x 4.5-8.5 μ , hyaline or yellowish-melleous, very versiform, most frequent-

ly fusoid-clavate or fusoid-ampullaceous, with rather thin walls, very crowded on the pores, scattered in the tubes, a few more distinctly incrustated by a thin castaneous crust; *trama* truly bilateral, of the *Boletus*-type, the mediostratum of axillar, denser hyphae, many of which are strongly colored, lateral stratum of strongly and entirely diverging, for the most part hyaline hyphae; *cuticle* with a distinct epicutis of erect and at places densely packed into a palisade, versiform hairs; these hairs either hyaline or pale melleous, some with, some without a fulvous-castaneous resinous incrustation that often forms a hood on the apex of the hair, with rather thin to very thin smooth walls, 27-39 x 5.5-10.5 μ ; covering of the stipe of similar elements; all *elements of the carpophore* are either naked or covered with incrustation, in every carpophore both types present, all septa without clamp connections.

Chemical reactions.—KOH on surface of pileus causing the color to become much deeper; on context, yellow.—NH₄OH on surface of pileus as with KOH; on context, dirty buff.—HNO₃ on context, somewhat yellow.—FeSO₄ on context, deep bluish slate gray; if stained with KOH afterwards, the stain becomes deep red.—Formol intensifying the autoxydation of the context.

Habitat.—Under *Quercus virginiana* and *Q. laurifolia*, rarely under other oaks, frequently in high hammocks and on shady lawns. Fruiting from June until August.

Distribution.—From South Carolina to North Florida and west to Alabama.

Material studied.—FLORIDA, ALACHUA Co., common in and around Gainesville, especially in July, many AUTHENTIC (for *B. Pisciodorus*) collections, Murrill, also Singer (conf. Murrill as, *B. pisciodorus*); TYPE of *G. pisciodorus*, etc. (FH, FLAS); MARION Co., Caroll's Cottage near East Lake, Tisdale (det. Murrill), *F. 19951*, (FLAS); PUTNAM Co., Lake Swan, A. S. Rhoads (det. Murrill), *F. 19938* (FLAS). SOUTH CAROLINA, Clemson College, July 1900, Rolfs (det. Peck), very good, AUTHENTIC material (NYS). ALABAMA, Underwood, TYPE; Earle (?), (NY).

This interesting species is related to but different from *T. ferrugineus* and its allies. It is this species which Snell studied and based upon the genus *Leucogyroporus*. Murrill says this species is edible and very tasty. One will, however, do well to avoid the following variety if use is made of the edible qualities of this species.

Var. AMARUS Sing., *Mycologia* 37:799. 1945.

Pileus "snuff brown" in the center, pale towards the margin, reaching "pinkish buff" near the margin but the very margin occasionally "amber brown" to "Argus brown" (as in the type variety), 80-100 mm. broad.—*Hymenophore* 5-6 mm. in diameter; pores small; spore print between "wood brown" and "fawn color."—*Stipe* "snuff brown" at the base and with very minute "snuff brown" floccons on "pinkish buff" or "pale pinkish buff" ground in the lower half of the stipe, apical third same color but with fine though distinct "snuff brown" network, solid, subequal with slightly widened apex, or tapering downwards, 40-70 x 22-35 mm.—*Context* pure white but "snuff brown" in the stipe and sometimes also under the cuticle, turning

"avellaneous" in the pileus when injured; odor same as in the type variety; taste moderately but very distinctly bitter; otherwise as var. *typicus*.

Spores and other microscopical characters as in var. *typicus*.

Chemical reactions as in var. *typicus*.

Habitat as in var. *typicus*.

Distribution.—Known only from the type locality.

This variety when first seen was thought to be a separate species differing not only in the taste but also in color. Later, however, the narrow, tobacco-colored marginal zone was discovered, and among our specimens of var. *typicus* we have one that is transitory insofar as it has the same color of the pileus as the bitter variety. After these facts had been taken into consideration, it seemed better to consider var. *amarus* the bitter form of *T. tabacinus*. The mild, lighter colored form which we may consider as a transient form would be closest to *T. ferrugineus*; yet in this form the yellow cystidia were least distinct and the spores larger than usual in *T. ferrugineus*; besides, there is still the brownish color of the context in the base of the stipe or the entire stipe in fresh specimens, and their odor of guava and fish in fresh condition, all characters that *T. ferrugineus* and allied forms are not supposed to show.

The yellow color of the cystidia in some specimens is nearly comparable to that of *T. ferrugineus* though not quite as striking, while in other specimens the cystidia are mostly hyaline, and some are merely incrustated with a melleous to fulvous or castaneous resinous cover, making them all shades of honey color.

Var. *DUBIUS* Sing., *Mycologia* 37:799. 1945.

Pileus "cinnamon" to "ochraceous tawny" on the margin and "pinkish buff" or a similar color in the center. — *Pores* "cinnamon," tubes paler. — *Stipe* at the apex with an indistinct, rather coarse incomplete network which is likely to be overlooked. — *Context* with large brown areas in the stipe; odor of guava; taste mild or submild.

Spores and other microscopical characters as in var. *typicus*.

Chemical reactions as in var. *typicus*.

Habitat.—Under live oaks (*Quercus virginiana*) in W. Gainesville, July 1943, Singer, F 2904 (FH).

Distribution.—Known only from the type locality.

This is evidently closer to *T. ferrugineus* than either var. *typicus* and var. *amarus*. However, the characters of the context, and the less yellow cystidia, cause me to retain it with *T. tacabinus* (Peck) Sing., as another variety.

35. *TYLOPILUS PERALBIDUS* (Snell & Beardslee) Murr., *Mycologia* 30:521. 1938.

Boletus peralbidus Snell & Beardslee *apud* Snell, *Mycologia* 28:471. 1936.

Var. *TYPICUS*

Pileus "chamois" to "antimony yellow," margin frequently white when young and fresh, occasionally white all over when young, sometimes with

salmoneous shades ("ochraceous salmon"), often stained with "cinnamon brown," or "Prout's brown," or becoming so on pressure when fresh, subglabrous to subtomentose, or tomentose, dry, pulvinate or plainly convex, then with flattened and finally depressed center or remaining convex on the disc, 45-130 mm. broad. — *Hymenophore* pallid to pinkish-avellaneous-white, slowly changing to "buff pink" or "vinaceous fawn," or "pale pinkish buff" when cut (not from the spores which are never this color), adnate, soon depressed around the stipe; tubes (3)-6-10 mm. long; pores concolorous with the tubes but staining "saya brown" where touched when young and fresh, very small when young but becoming medium wide and some of them even rather wide, at least old specimens (0.4-1.2 mm. in diameter); spore print from "cream buff¹⁵) to "chamois" or "Isabella color" depending on the thickness of the spore layer, neither pink nor olivaceous when fresh. — *Stipe* white or partly (below) or entirely concolorous with the pileus, frequently with a shade of "wood brown," glabrous and smooth, or, when seen under a lens, with "chamois" punctiform flocons, thick and equal, or tapering upwards, or downwards, or ventricose, solid, 45-110 x 13-40 mm. — *Context* white, usually marbled with hyaline, slowly changing to "buff pink" or "vinaceous fawn" or some color between these when injured; taste moderately but constantly bitter; odor either almost absent, or of chloride of lime.

Spores 7.5-9.5 x 2.3-3.5 μ , melleous-hyaline, cylindric or cylindric-subclavate, smooth, the inner profile subconcave or without any depression, strikingly small and narrow when compared with the spores of other species of this genus; *basidia* 27-34 x 7.5-9.3 μ , 4-spored; *cystidia* of two types, either yellow and of irregular occurrence, similar in shape and size to those of the genus *Suillus*, or, in the other type, occurring in the same hymenophores, hyaline, fusoid or clavate-fusoid with acuminate apex but with the very tip subobtuse, the upper attenuate portion shorter than in the average of the cystidia in related species, only in a few scattered cystidia the apex anything near ampullaceous, occurring mainly near the pore-mouths, numerous; *trama* truly bilateral, of the *Boletus*-type, the mediostratum axillar, colored, its hyphae parallel-interwoven and densely arranged, the lateral stratum strongly and entirely divergent, hyaline, and loosely arranged; structure of the *cuticle* very variable, sometimes a quite fragmentary palisade is present, and the uppermost layer of parts of the surface formed by irregular interlaced, melleous-yellow or yellow hyphae whose terminal members have rounded tips, while in other specimens the palisade is as uninterrupted and well developed as in *T. tabacinus* with the terminal members frequently assuming the character of dermatocystidia, often clavate or fusoid; all *hyphae* without clamp connections.

Chemical reactions.—KOH on context of pileus, yellow, eventually reaching "yellow ocher." — H₂SO₄ negative if applied before autoxydation takes place, bleaching the darkened portions if applied afterwards. — NH₄OH

¹⁵ In the type specimen of an unpublished species of Murrill's which he correctly identified as *T. peralbidus* in later notes, the spore print is "pale ochraceous buff." I do not believe that such pale tints occur in fresh spore prints; they are evidently the result of bleaching by drying out or while preserved.

negative, or intensifying or accelerating the autoxydation.— FeSO_4 on context, "dark Payne's gray" or "violet slate," or "light Varley's gray" (immediately and constantly so); if the gray spot is treated with KOH afterwards, it becomes red.—Formol on context, as with ammonia.—Methylparamidophenol positive (purplish lilac) but slowly and not very strongly.

Habitat.—In woods and gardens, in high hammocks and on shaded lawns, on the ground, usually near *Quercus laurifolia*, but also near other oaks, and occasionally also under pines (*Pinus australis*). Fruiting from May till October.

Distribution.—Florida, but not in South Florida.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Murrill, F 15871 (FLAS), also one collection at FH; Singer F 1991, F 1991 a (FH); F 1970, F 1970 a, F 1970 b (FH); F 2124, F 2124 a (FH); F 2685 (FH) and numerous other fresh collections of the author.

This has been described and labeled under a different name by Murrill but the name was never published because Murrill realized that this was identical with what Snell and Beardslee had described as *Boletus peralbidus*. We have not seen the types of *B. peralbidus*, but we have seen a letter from Snell to Murrill in which the former says he has compared his type with what Murrill had sent him (F 15871) and "they match the type perfectly." The name *T. peralbidus* is regrettable because this plant is not typically "all whitish."

The color of the spores and the color of the pileus are somewhat variable. We have described the most common form of this common fungus as var. *typicus*, and now we have to add two aberrant forms, one of which we consider as a remarkable color form while the other seems to be more than that and is here given as a variety.

Forma praeanisatus (Murr.) Sing. comb. nov.

Cyroporus praeanisatus Murr., Lloydia 6:225. 1943.

Boletus praeanisatus Murr., Lloydia 6:228. 1943.

Pileus partly or entirely umber or fuliginous; taste more decidedly bitter than in most individuals of the type form; odor "strong of anise" (Murrill), slight and fruity or none in our specimens; otherwise like the type.

Habitat.—Under oaks (*Quercus laurifolia*) on the ground. Fruiting from June until August. Rare.

Distribution.—North Florida.

Material studied.—FLORIDA, ALACHUA Co., TYPE of *C. praeanisatus* (FLAS) and AUTHENTIC material (FLAS); Singer, F 2708 (FH).

Var. RHODOCONIUS Sing., Mycologia 37:799. 1945.

Spores (9.7)-10.5-13.5-(17.3) x 3-3.5 μ , pale melleous, smooth, cylindrical to cylindrical-clavate (slightly thicker at the base or in the basal third), pinkish ("vinaceous fawn") in print; *basidia* 27.5-29.2 x 8 μ ; *cystidia* 36-45 x 6-8.5 μ , ventricose, the apex ampullaceous as in *Leccinum* with a neck of variable

length, hyaline, or a few of them with melleous-incrusted necks, scattered in the tubes, numerous on pores; otherwise like var. *typicus* f. *praeanisatus*.

This variety is rare in Florida, and differs from the type form not only in the more umber pileus but also in pinkish spore print and perhaps more ampullaceous cystidia. It is possible that this will ultimately be considered as a closely related but different species.

Extralimital Species

Tylopilus Balloui (Peck) Sing. comb. nov.

Boletus Balloui Peck, Bull. N. Y. State Mus. **157**:22. 1912.

Gyrodon Balloui Snell, Mycologia **33**:422. 1941.

Boletus subsanguineus Peck *sensu* (Murr.) Coker & Beers, Bol. N. Car., p. 23. 1943; an Peck (1900).

This species is obviously a *Tylopilus*. The short spores do, in fact, occur in almost all groups of boletes and are not characteristic for *Gyrodon* alone. I have examined the type (NYS) and material determined by Murrill as *C. subsanguineus* (Peck) Murr. (NY). I find the spores 7.5-11 x 3.7-4.8 μ , ellipsoid-ovoid to short-cylindric, the larger ones clavate with the basal portion thicker than the central one, in an average about twice as long as broad, hyaline with a slight yellowish sheen in most of them, thin-walled, smooth; basidia 27-27.5 x 8.3 μ , 4-spored; cystidia 34-78 x 6.5-16.5 μ , ventricose-fusoid, with or without a 1-11 μ long mucro, very few hyaline or subhyaline, the majority strikingly dark golden yellow incrusted and easily recognizable under low power as deep yellow spots on hyaline ground; trama of the hymenophore truly bilateral, of the *Boletus*-type, the lateral stratum consisting of much thicker hyphae (2.7-8.2 μ in diameter) than those of the mediostatum (2-4.5 μ) and almost hyaline, very slightly but undoubtedly and entirely divergent, loosely arranged; the mediostatum slightly more decidedly colored, denser, subinterwoven, axillar, thin in comparison with the lateral stratum; subhymenium very distinct, of intricately interwoven, very thin filamentous hyphae; cuticle of very irregular, partly erect, colored (golden-succineous) filamentous hyphae which are partly in strands, and have obtusely rounded tips at their free ends; hyphae of the context hyaline, all hyphae without clamp connections.

The naming of this well characterized species is one of the most intricate nomenclatorial problems I have ever encountered in so-called American species. Murrill has (before *B. Balloui* had been published) called this *Ceromyces subsanguineus*, and Coker & Beers follow his lead in 1943, while Snell and this writer prefer the later but unequivocal name *B. Balloui*. There is absolutely no doubt that this species is *B. Balloui*; the types are in excellent condition and well described. On the other hand, there is no type of *B. subsanguineus* preserved at Albany. This species was known to Peck from a picture only, or if there have been specimens they must have been lost. The description is somewhat vague and may well be interpreted as the same as *B. Balloui* if McIlvaine's picture which may be the original one sent to Peck, is compared. This picture may, however, also be something else, and besides there is no proof that it really represents the original picture which might

be regarded as a substitute for the type specimen. In favor of the name *B. subsanguineus* we may only say that Murrill has created something like a tradition of calling what certainly is *B. Balloui* by the dubious name *B. subsanguineus*. But this tradition, if we may call it so, is in my opinion, more than offset by the fact that there are, at Albany, authentic specimens—the only specimens preserved there under the name of *B. subsanguineus*—which most certainly are not *B. Balloui* and not even a *Tylopilus* at all but some *Boletus* of the section *Luridi*, probably close to *B. miniatoolivaceus*. This does not prove anything except the vagueness of Peck's own concept of *B. subsanguineus*.

My material shows that *T. Balloui* occupies an area from New York to North Carolina with the western limits unknown. *T. Balloui* is somewhat similar to certain specimens of *T. peralbidus*, even in color. Fortunately, they do not occur in the same territory together, and herbarium specimens can easily be distinguished by simple measurements of the breadth of the spores.

Tylopilus veluticeps (Pat. & Baker) Sing. comb. nov.

Boletus veluticeps Pat. & Baker, Journ. Straits Branch R. A. Soc. 78:71. 1918.

The habit of the Singapore type (FHI) is that of a slender form of *Tylopilus*; the spores are short ellipsoid with an indistinct suprahilar depression or applanation, the inner profile strongly convex otherwise, the upper half attenuate, very pale melleous, almost hyaline, thin-walled and smooth, 7.5-8.7 x 3.5-4.5 μ ; basidia 16-27 x 7-8.5 μ ; cystidia fusoid to vesiculose with subampullaceous apex or with a long filiform proliferation instead, 27-45 x 7-10.5 μ , with finely granulose contents in the type specimens; cuticle consisting of erect chains of thick-walled (walls 1-1.5 μ in diameter) short-ventricose hyphae or spherocysts, some of the chains terminating with a narrower appendage which is either cylindrical or subulate with rounded tip; the surface appearing velvety and unbroken. The margin of the pileus is sterile and projecting (but probably not always since this is not shown in the sketch accompanying the type specimens); the pores are unequal in size but rather small in average, depressed around the stipe. All these facts are no doubt enough evidence to necessitate a transfer to *Tylopilus*.

Tylopilus cellulusus, spec. nov.

Pileo atrofusco, lato, subtomentoso; cuticula ex epithelio consistente; tubulis rubido-fuscidulis, exiguis; sporis in cumulo cacaeoloribus, sub microscopio melleis et 10.5-12.5 x 4-5.5 μ ; cystidiis fuscis, clavato-acutatis, 40 x 7.5-10.5 μ ; stipite griseolo-brunneo, subtomentoso, torto, 150 x 12 mm.; carne dilute coriaceo-brunnea brunneoque marmorata; hyphis haud fibuligeris.

Pileus dark brown, suède (subtomentose), convex, about 110 mm. broad. — *Hymenophore* chocolate brown, watery, soft, depressed around the stipe; tubes 13-14 mm. long; pores subconcolorous, small 10 to 15 mm.; spore print "pinkish cinnamon" with a shade of "fawn color" (two years old). — *Stipe* gray brown, suède (subtomentose), tortuous, rather hard, solid, slightly tapering upwards, almost equal, about 150 mm. long and 12 mm. thick at the apex

to 20 mm. thick at the base. — *Context* light tan color (from the beginning ?), mottled or striped with brown, soft in the pileus; odor and taste not noted.

Spores 10.5-12.5 x 4-5.5 μ , pale melleous, smooth, subfusiform; *basidia* about 28 μ long and 7-9.5 μ broad; *cystidia* about 40 μ long and 7.5-10.5 μ broad, clavate to clavate-fusoid but always with acuminate tip, brown; *trama* of the hymenophore not clearly definable in this material (too mature); *cuticle* consisting of brown spherocysts (also some clavate bodies), e.g. 20 x 15 μ ; all *hyphae* without clamp connections.

Chemical reactions not studied.

Habitat.—In tropical woods on humus, solitary during the early rains (April).

Distribution.—Known only from the type locality, Nengbe, Liberia, Tropical West Africa, G. W. Harley, 60 (FH).

This appears to be very easily recognizable and distinct. Tropical species with similar colors are *B. ater* Henn. from Cameroun and *B. funerarius* Mass. from Singapore. Both have much wider pores.

Tylophilus nigricans (Pat & Baker) Sing. comb. nov.

Boletus nigricans Pat. & Baker, Journ. Straits Branch R. A. Soc. 78:70. 1918.

The type from Singapore (FH) is very close to *T. alboater* (Peck) Murr. We find the spores pale brown, 10.8-14 x 3.8-4.5 μ ; *cystidia* pallid to brownish, same shape as in *T. cellulosus* Sing., 28-42 x 7-14 μ ; *trama* probably truly bilateral of the *Boletus*-type, of e.g. 7 μ broad *hyphae*, some of which now show spiralling veins (mucose or resinous ?); the *cuticle* of the pileus and stipe consists of a palisade of clavate or more rarely ampullaceous-fusoid light to dark brown hairs with rather thick (0.7 μ), brittle walls, about 4 μ in diameter; all *hyphae* without clamp connections.

This analysis shows that this plant differs from *T. alboater* only in the shape of the *cystidia* and spores and probably in the smaller size of the *carpo-phores*.

Tylophilus ferrugineus (Frost) Sing. comb. nov.

Boletus ferrugineus Frost, Bull. Buff. Soc. Nat. Sc. 2:104. 1874. non Schaeff. ex Bres. (1931).

We have seen good material (FH, NY) and have compared it with the type material and authentic collections of Frost. As for our Florida species, this is no doubt closest to *T. tabacinus* (Peck) Sing., especially to *T. tabacinus* var. *dubius* Sing. Since in this group so many species have been described, all hardly distinguishable to me, and since it may be confused with Florida species, and possibly be found in Florida in the future, we shall add a complete description of this species.

Pileus "sayal brown," "Verona brown," "snuff brown," but somewhat variable within the limits of what may be called reddish brown, not much changing color in drying, non-viscid, sometimes with a yellowish bloom towards the margin which is due to fugacious accumulations of dermatocystidia, this bloom disappearing in age and on drying, subglabrous, or minutely tomentose,

pulvinate, then convex and often somewhat irregular with wavy or somewhat lobed margin, with slightly projecting sterile or entirely fertile margin, 45-100- (145) mm. broad. — *Hymenophore* whitish when quite young, light flesh color, becoming brown when bruised, adnate, soon depressed around the stipe; tubes 7-11 mm. long, rarely longer; pores concolorous, staining brown on pressure, small, rounded-angular, 6-14 to 5 mm.; spore print somewhere between "Isabella color" and "wood brown" (not quite fresh). — *Stipe* "cream buff" masked with "snuff brown," or subconcolorous with the pileus below and paler above, either smooth or with a reticulation of very irregular and inconstant extent and density, usually the upper third or quarter of the length of the stipe reticulated but in some specimens of the same collection the reticulation extending over one half to three quarters of the stipe's length, the meshes longitudinally elongate, usually smaller than in *T. tabacinus*, the surface outside the network subglabrous to minutely flocculose on paler ground, rather versiform, tapering upwards or downwards, or subequal, sometimes compressed longitudinally or otherwise irregular, even slightly eccentric, solid, 35-80 x 15-25-(33) mm. — *Context* white in fresh and young specimens first changing to pink when bruised, then becoming brown in the wounds, rather firm and thick in the pileus, but soon becoming soft; taste mild; odor none.

Spores 8.3-13 x (3)-3.5-5 μ , hyaline, soon becoming pale yellow on maturing and some with a brownish melleous shade, thin-walled, very few with slightly thickened walls, smooth, ellipsoid-subfusoid, some clavate and tapering upwards; *basidia* 22-29 x 7-10 μ , 4-spored; *cystidia* 30-50 x 5.5-12.5 μ , with golden yellow contents, yellow granulose, or yellow incrusted, strongly contrasting with the hyaline background, fusoid, clavate, or ampullaceous, the majority obtusate but many of them more or less acute at the tip; *trama* of the hymenophore truly bilateral of the *Boletus*-type;; cuticle of the pileus and the floccons of the stipe formed by short but not brittle, yellowish to castaneous-fulvous, more rarely hyaline, thick-walled hairs as in *T. alboater*; among them numerous dermatocystidia as in the hymenial layer of the hymenophore, these hairs and dermatocystidia together forming the palisade of the pileus respectively the fascicles of the floccons of the stipe; the dermatocystidia usually scarce on the pileus but numerous on the stipe; all *hyphae* without clamp connections.

Chemical reactions unknown.

Habitat.—In woods, usually under oaks, fruiting from July till September.

Distribution.—From New England to Georgia and westwards (western limits unknown), possibly entering North Florida.

Material studied.—VERMONT, TYPE (?) and AUTHENTIC material (FH). MASSACHUSETTS, Canton, several collections, *Linder* (as *T. indecisus*) (FH); Middlesex Falls and Cabot's Woods, *Farlow* (FH). VIRGINIA, Mountain Lake, *Linder & Snell* (det. Snell as *B. indecisus*) (FH). GEORGIA, Glenbrook Ravine, vicinity of Tallulah Falls, Aug. 12, 1901, *Seymour* (det. *Singer*), (FH), also probably two more collections (*Seymour*, 14. 15.)

Snell discards Frost's species with the implication that it is antedated by *Boletus ferrugineus* Schaeffer. The latter is, however, pre-Friesian and has not been validated, as far as I know, by any post-Friesian author until Bresadola

took it up in the sense of *Xerocomus spadiceus* (Fr. *sensu*) Quél. I can see no reason why Frost's name should be rejected unless an application of Schaeffer's name between 1821 and 1931 has escaped my attention.

Frost says that the flesh is unchanging but he probably overlooked the autoxydation which is slow and not very distinct in the first phase; it is lacking in not quite freshly collected material. His description covers the darker forms of this species, but some of his authentic specimens are as light colored as any of the above cited material. The following species may be mere synonyms of this:

Boletus decorus Frost, Bull. Buff. Soc. Nat. Sc. 2:103. 1874.

This has been considered as a form of *B. edulis* but since Snell says it rather belongs in this group, it may turn out to be identical with *T. ferrugineus*.

Tylopilus indecisis (Peck, Rep. N. Y. State Mus. 41:76. 1888) Murr., Mycologia 1:15. 1909.

This is said to have ochraceous brown pileus; besides, Peck thought that *T. ferrugineus* had no "pink" spores. Since it does have "pink" spores (obviously the same tinge that Peck calls brownish flesh color which is descriptive enough for *T. ferrugineus*), and the pileus varies from lighter to darker shades of reddish brown, we can see no reason why *T. indecisis* should be different from *T. ferrugineus*. In fact, the type (NYS) is indistinguishable from *T. ferrugineus* and shows the same variable extent (or absence in some specimens) of the reticulation of the stipe. There seems to be a tendency to determine mild or submild forms of *T. felleus* as *T. indecisis*. Peck's specimens as well as his description definitely exclude this possibility. Most of our material of *T. ferrugineus* had been determined *B. indecisis*.

Boletus subpunctipes Peck, Bull. N. Y. State Mus. 116:19. 1907.

The type (NY) is not, as Murrill thought, the same as *T. felleus*, but obviously a specimen of *T. ferrugineus* with entirely non-reticulated stipe. The color of the pileus is perhaps somewhat more cinnamon and the surface is less velutinous than in the types of *B. indecisis*.

Boletus subdecorus Snell, Mycologia 28:21. 1936.

Here, the spores are somewhat larger than usual in *T. ferrugineus*; yet, it is hard to believe that this should belong to the section *Edules* of *Boletus* rather than in the closest neighborhood of *T. ferrugineus*. I have seen no specimens.

Boletus pseudodecorus Snell, Mycologia 28:22. 1936.

Snell thinks now that this is *T. ferrugineus* (Frost) Sing. with which it coincides in every particular.

Tylophilus eximius (Peck) Sing. comb. nov.

Boletus eximius Peck, Journ. Mycology 3:54. 1887.

Boletus robustus Frost, Bull. Buff. Soc. Nat. Sc. 2:104. 1874, non Fr. (1851).

Boletus scabripes Peck, Bull. Torr. Bot. Cl. 29:555. 1902.

This northeastern species has been collected by the writer in fresh condition and has also been compared with the respective Peck types (NYS) and authentic material of *B. robustus* (FH). The spores are characteristically large and narrow, pale brown, smooth, $13.5\text{-}23.5 \times 3.5\text{-}5.5\mu$; basidia (23)-26-30 \times (5.2)-7.8-9 μ , 4-spored; cystidia hyaline, narrow, infrequent, ventricose or clavate-acuminate, 14-28 \times 6-10 μ ; trichodermium of the cuticle not in palisade, the terminal members of the filamentous hyphae cylindrical or clavate with broadly rounded tips, brown; cuticle of the stipe little differentiated except for the flocculae which consist of strands of parallel hyphae ending in fascicles of hymenium with about $25 \times 5\mu$ large dermatobasidia and versiform, often brown, 20-40 \times 6-10 μ large dermatocystidia. The spore print when fresh is deep ferruginous ("amber brown"). *T. eximius* reaches Georgia in the south but has not been observed in Florida.

Species Imperfectly Known and Species Incertae Sedis

TYLOPILUS JAVANICUS Henn. Monsunia 1:146. 1899.

I have not seen specimens. It may be close to the following species.

GYROPORUS JAMAICENSIS Murr., see part II, Farlowia 2:240. 1945

BOLETUS MODESTUS Peck, Ann. Rep. N. Y. State Mus. 25:81. 1873.

Though I have seen the type (NYS), I am not quite sure about the position of this species. I do not think, however, that it is a mere synonym of *T. felleus* as suggested by Murrill.

CERIOMYCES ALACHUANUS Murr., Mycologia 30:522. 1938.

Pileus uniformly bay-fulvous, slightly viscid when moist, glabrous, smooth, convex, 30 mm. broad. — *Hymenophore* pale yellowish, unchanged when cut; pores small, not stuffed when young. — *Stipe* subconcolorous but streaked, not reticulate, smooth, dry, solid, tapering downwards, 40 \times 10 mm. — *Context* white, becoming very slightly pinkish when cut, firm; taste mild; odor not recorded.

Spores $10\text{-}12.3 \times 3.5\text{-}4.5\mu$, clavate with the thickest portion near the base, nearly hyaline with a slight melleous shade; *hyphae* without clamp connections.

Chemical reactions unknown.

Habitat.—On the ground in a hammock, January.

Distribution.—Known only from a single specimen from the type locality.

Material studied.—FLORIDA, ALACHUA Co., south of Newnan's Lake, Murrill, F 15860 (FLAS).

This species is here described from the data published by Murrill and my microscopical examination of the type. The tubes appear now to be depressed around the stipe; the surface of the pileus is glabrous, subtomentose on the

margin, brownish with a slight olivaceous tinge. In the fresh condition the apex of the stipe is said to be pale yellowish. The trama is probably truly bilateral but I was not sure of it. It belongs most probably in *Tylopilus*, and possibly in the *T. ferrugineus*-group. More data from more numerous collections are needed to make a transfer safe.

BOLETUS INDECORUS Mass., Bull. Bot. Gard. Kew 1914:75. 1914.

A portion of the type (FH) shows the spores to be ellipsoid with distinct suprahilar depression, with rather thick walls, smooth, melleous; hyphae of both the cuticle of the pileus and stipe filamentous, without clamp connections. This may or may not be a *Tylopilus*, but the above additional data on Masee's material may help to identify this plant when re-collected on the Malay Peninsula for observation of the now lacking data.

Species Excludendae

TYLOPILUS GRACILIS (Peck) Henn. This is *Porphyrellus gracilis* (Peck) Sing.
TYLOPILUS SUBFLAVIDUS Murr. This is *Porphyrellus subflavidus* (Murr.) Sing.

6(15). LECCINUM S. F. Gray, Nat. Arr. Brit. Pl. 1:646. 1821. *em.* Snell, Mycologia 34:406. 1942.

Krombholzia Karst., Rev. Mycol. 3:17. 1881. (type *K. versipellis*) non Rupr. ex Galeotti, Bull. Acad. Bruxelles 9:247. 1844, *nec Krombholzia* Benth., Journ. Linn. Soc. 19:121. 1881.

Trachypus Bat., Bolets, p. 12. 1908. (lecto-type proposed: *B. rufus*).

Krombholziella R. Maire, Publ. Inst. Botàn. Barcelona 3(4):41. 1935 (type *K. aurantiaca*).

Characters of the genus: Pileus with a cuticle consisting of an epithelium or with only a few spherocysts, or with some chains of broad hyphae mixed in along with filamentous hyphae of the trichodermium, or the cuticle made up by a cutis consisting of filamentous, horizontally arranged hyphae only, viscid or dry, glabrous or tomentose, often rimulose, the margin often sterile and projecting and then sometimes looking like a spurious veil in young specimens; no true veil present in any species; hymenophore yellow or whitish, convex beneath, the tubes very long but drastically depressed around the stipe; pores always very small and far below 1 mm. in diameter, concolorous with the tubes; spores in print olivaceous-umber to umber, or, in one species (which does not occur in Florida) dirty vinaceous; trama truly bilateral of the *Boletus*-type, but forming a very thin layer and the lateral stratum soon stretched and parallel; cystidia fusoid-ventricose, very frequently with ampullaceous apex, hyaline, small to medium sized; stipe usually rather thin and fragile at the very apex in mature specimens, otherwise fibrous-hard and thickened downwards, beset with very prominent furfureous particles or dark squamules causing the stipe to appear and feel scabrous-rough, non-viscid, without glandulae and without reticulation except for occasional specimens in which the prominent dark scabrosities are connected with very fine lines forming a peculiar and usually not persistent network; scabrosities of the

stipe consisting of a strand of parallel hyphae which terminates in a fascicle of hymenium consisting of dermatobasidia, dermatopseudoparaphyses, and dermatocystidia; mycelium forming mycorrhiza with forest trees, almost constantly with species of the Salicales and Fagales (in Florida *Quercus*). The type species is *L. aurantiacum* (Bull. ex) S. F. Gray (*B. aurantiacus* Bull.).

The name *Leccinum* has been taken up by Snell though, in S. F. Gray's sense, it is a substitute for *Boletus* (which Gary reserves for *Polyporus*). However, the two first species in Gray's treatment happen to belong to *Leccinum sensu* Snell, and by choosing the first species as the type species, this genus can thus be emended and modernized, much to the advantage of bolete nomenclature. Though the word *Leccinum* is derived from the Italian *leccino*, a common name probably referring to *Suillus granulatus*, Snell's proposal is apt to ease a confused situation since *Krombolzia* has been spelled erroneously, I suppose, the same way as our fungus genus, by those who in 1844 introduced it for phanerogames, and the spelling *Krombholtzia* for this genus is not found until 1881. *Trachypus* and *Krombolziella* have not come into general use thus far. Since Snell established the type species of *Leccinum* in a comprehensive paper and as a competent specialist, I feel that Gray's genus has to be accepted in Snell's sense, which automatically makes all the other names later synonyms.

The diagnosis given above makes it possible to fix the limit between *Boletus* and *Leccinum* in such a way as to incorporate into *Leccinum* those species that have a transitory covering of the stipe (such as *L. subglabripes*), if because of natural affinity and other prominent characters they are obviously better taken care of within *Leccinum* than within *Boletus*. Species with an epithelium are taken into *Leccinum* if their characters otherwise fit into this genus.

Morphologically speaking, the scabrosities of *Leccinum* are homologous with the glands of *Suillus* and the minute floccons of the *Boletus* and *Xerocomus* and represent nothing but a modification of the ordinary reticulation of many species in *Pulveroboletus*, *Xerocomus*, *Boletus*, *Tylopilus* which in its turn is merely a continuation of the hymenophore in a reduced way over a normally sterile portion of the carpophore, the stipe. In certain young specimens of *Boletus inedulis*, *Suillus cembrae*, and *Leccinum aurantiacum* the homology between floccons, glands and scabrosities on one hand and the primordial reticulation is still well recognizable since in all these species the floccons, glandulae, or scabrosities are initially connected by lines, thus forming a reticulation; later the connecting lines disappear and the floccons, glandulae, scabrosities remain. In most species the reticulation cannot be demonstrated any more once it is replaced by isolated floccons, glandulae, or scabrosities. Naturally, this morphological affinity of the various ornamentations of the stipe does not make them any less useful as generic or specific characters in the Boletaceae.

KEY TO THE SECTIONS

- A. Hymenophore more or less yellowSection *Luteoscabra*
 A. Hymenophore initially white or whitish, then becoming more or less sordid but not yellow.

- B. Spores in print umber or olive-umber; stipe never deep chrome; pileus never pinkSection *Versipelles*
 B. Spores in print cinnamon or brownish with a vinaceous hue; stipe deep chrome at the base; pileus pinkSection *Roseoscabra*

Section *Luteoscabra* Sing. sect. nov.

Hymnophoro et plerumque stipite et parte carnis flavo-tincto.

Characters of the section: see key and Latin diagnosis. Type species: *L. nigrescens* (Rich. & Roze) Sing. (*Boletus nigrescens* Richon & Roze).

This section is, of the three known sections of *Leccinum*, the one nearest to *Boletus*, as has been emphasized previously by R. Maire (1935).

KEY TO THE SPECIES

- A. Outermost layer of the cuticle of the pileus (epicutis) formed by an epithelium or by erect chains of short, broad hyphae; pileus non-viscid.
 B. Context unchanging on injury except for a slight reddening that takes place with age and only in certain portions of the context, rarely turning blue either in the pileus or in the stipe36. *L. subglabripes*
 B. Context distinctly changing color immediately on injury (becoming dirty vinaceous violet or drab, pinkish gray or pinkish red, etc.) but not bluing.
 C. American species with the hymenophore dull yellow, never lemon yellow
37. *L. rugosiceps*
 C. European species with bright yellow, lemon yellow hymenophore*L. nigrescens*
 A. Outermost layer of the cuticle of the pileus formed by the cutis which consists of cinnamon-castaneous filamentous hyphae which are very flexuous and loosely arranged in a gelatinous mass; pileus viscid*L. rubropunctum*

Description of the Species Occurring in Florida

36. *LECCINUM SUBGLABRIPES* (Peck) Sing., *Mycologia* 37:799. 1945.

Boletus flavipes Peck, Rep. N. Y. State Mus. 39:42. 1886, non Berk. (1854).

Boletus subglabripes Peck, Bull. N. Y. State Mus. 8:112. 1889.

Suillus subglabripes Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Ceratomyces subglabripes Murr., *Mycologia* 1:153. 1909.

Krombholzia subscabripes Sing, Rev. de Mycol. 3:188. 1938.

?*Boletus unicolor* Frost apud Tuckerman & Frost (1875) *nom. nud.*; apud Peck, Bull. N. Y. State Mus. 8:100. 1889.

?*Suillus unicolor* Kuntze, Rev. Gen. Pl. 3(2):536. 1898.

Description of the Florida Collections

Pileus "auburn" with a tinge of "chestnut," or between "bay" and "chestnut," sometimes deeper colored than these, smooth or slightly rugulose, non-viscid, convex, 37-78 mm. broad. — *Hymenophore* a vivid rich golden yellow when young (between "citron yellow" and "strontian yellow") becoming as greenish as "yellowish citrine," tubes up to 10 mm. long, deeply depressed around the stipe; pores small, concolorous and usually unchanging but very rarely bluing on pressure; spore print "buffy olive." — *Stipe* "strontian yellow" at the apex and "mustard yellow" to "chamois" or concolorous with the apex farther downwards, later here and there with a tinge of "cacao brown," or with "onion skin pink" to "buff pink" in the middle, with concolorous or

slightly darker scabrosities consisting of furfuraceous, small squamulae, the base often curved, tapering from the base or from the middle upwards, in the latter case also tapering from the middle downwards, more rarely tapering from the apex downwards, 50-68 x 8-15 mm.—*Context* light yellow in the pileus and there sometimes bluing but mostly unchanging everywhere, concolorous with the surface in the stipe and there almost always unchanging, very rarely bluing, soft and fleshy in the pileus, becoming spongy and watery, hard and fibrous in the stipe, becoming fragile; odor none; taste mild.

Spores 13-18.5-(20.5) x 5-6 μ , melleous or pale melleous, fusoid or ellipsoid-fusoid with suprahilar depression; *basidia* 23-34 x 11-12.5 μ , 4-spored, rarely a few 2-3-spored; *cystidia* hyaline, ventricose in the middle, with an ampullaceous apex, rather numerous near the pores, 27-48 x 6.5-15 μ ; *trama* truly bilateral, of the *Boletus*-type; cuticle forming erect chains of spherocysts, the latter about 13.5-26.5 μ in diameter, forming an epithelium; scabrosities of the stipe formed by strands of parallel, cylindrical, hyaline hyphae, projecting above the surface of the stipe and forming with their terminal members a large fascicle of hymenium, consisting of bodies differentiated as dermatobasidia (28-29 x 9-12 μ , 4-sterigmatic), dermatopseudoparaphyses (hyaline, or yellowish, versiform, even sometimes 2-3-lobed, often with appendage, representing the most numerous element, 20-50 x 11-19 μ), and dermatocystidia (cylindrical, fusoid, vesiculose with ampullaceous apex, hyaline, 34-55 x 8-15 μ); all *hyphae* with calmp connections.

Chemical reactions not studied.

Habitat.—Under oaks in high and mesophytic hammocks, solitary or in small groups on the ground. Fruiting from June till August.

Distribution.—Florida and, if identical with the northern collections, north to Canada, if a separate form or race, at least to North Carolina.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Singer, F 2519, F 2519 c (FH); Sugarfoot Hammock, Singer, F 2519 a, F 2519 b (FH); Newnan's Lake, Singer, F 2636 (FH).

Description of the Northern Collections

Pileus "naphthalene yellow" and "antimony yellow" and "buckthorn brown" and "ochraceous tawny," all these colors varying in extent, sometimes with "Mikado brown" spots, sometimes one or two of the above colors lacking, opaque, non-viscid, even in rainy weather, with a very slightly projecting sterile margin, glabrous, smooth, or subsmooth, convex, up to 66 mm. broad.—*Hymenophore* between "citron yellow" and "strontian yellow," becoming as greenish as "sulphine yellow" when old, plane, becoming convex beneath, depressed around the stipe; tubes fairly long; pores very small; spore print "Saccardo's olive."—*Stipe* "naphthalene yellow" or lighter colored (to "citron yellow"), or with "wax yellow" stains, or with slight to strong "Pompeian red" or "madder brown" or "brick red" spots or stripes, straight or more often somewhat flexuous, equal or with tapering base, transversely furfuraceous-squamulose-scabrous, the scabrosities concolorous with the ground color, solid, 80-95 x 8-14 mm.—*Context* light yellow, mixed with some

deeper lemon yellow, or often with some red like that on the surface of the stipe, but the context of the pileus uniformly light yellow, rarely with reddish spots when old, and then distinctly bluing on injury (var. *caerulescens* Sing. in sched.), not otherwise changing color when bruised; odor almost none; taste mild.

Spores 10-20 x 3.5-5 μ , most frequently 13-14 x 3.7-4.2 μ , melleous to pale melleous, fusoid-ellipsoid to subfusoid with suprahilar depression; *basidia*, *cystidia*, *trama*, *cuticle* and *scabrosities* of the stipe as in the Florida specimens.

Chemical reactions.—KOH on the surface of the pileus, negative; on tubes, "chestnut."—NH₃ and NH₄OH everywhere negative or almost so.—FeSO₄ negative.

Habitat.—In mixed woods and in frondose woods under black or yellow birch and also under oak on the ground, usually gregarious. Fruiting from June until September.

Distribution.—From Eastern Canada through New England and New York, possibly also farther south and west.

Material studied.—NEW HAMPSHIRE, Jaffrey, *H. Webster* (det. Linder), (FH); Alstead, *Fernald* (FH). MASSACHUSETTS, Harvard, *Singer* and *Harrie Dadmun* (FH). ONTARIO, Bear Island, Lake Temagami, *Jackson*, 7676 (FH); *Cain*, 12009 (FH); Forest Belt, C.E.F., Ottawa, *Conners*, 5927 (det. Snell) (FH). NEW YORK, Silver Lake Assembly, *F. H. Ames*, (NYS); Port Jefferson, AUTHENTIC (NYS); AUTHENTIC material of *B. flavipes* Peck non *Berk.* (possibly type?), (NYS).

We have given the description of the Florida specimens separately from that of the northern plant which we have found identical with Peck's material. The differences are mainly in the color which is a different shade in the pinkish or reddish stains in the flesh and on the surface of the stipe. The color of the surface of the pileus also is a different shade of brown in the Florida plant when compared with the northern form. It may be that our experience in spite of the numerous carpophores examined is too limited to evaluate the constancy of these different shades. Peck, in his original description says that the pileus is red or chestnut which would rather fit the Florida form if any. Curiously enough, the plates which were published by Peck (Rep. N. Y. State Mus. 51, pl. 55, figs. 1-7. 1898, and Mem. N. Y. State Mus. 3(4), pl. 64, figs. 1-7. 1900) show the pileus much more yellow, about the color some of the specimens still show and rather agreeing with the specimens I collected in Massachusetts. It has to be kept in mind that part of Peck's illustrations refer to his var. *corrugis* which is nothing but *L. rugosiceps*.

Another curious matter is the occasional occurrence of bluing specimens in both the Florida and the northern collections. In the latter, the only bluing specimens I have ever seen, grew near the normal specimens and were distinguished by the stipe which became more definitely red and the pileus that was subviscid after strong rains; the cuticle however, had the same structure as the non-bluing specimens, i.e. an epithelium. I can not, at present, decide whether this is a mutant, or a physiological stage.

Coker & Beers' *B. subglabripes* seems to be the same as the Florida form.

Peck and others have stated that *L. subglabripes* is edible.

Var. CORRUGATOIDES Sing., *Mycologia* 37:799. 1945.

Pileus "light brownish olive," very rugose; spore print "light brownish olive." Microscopical and chemical characters as in the smooth type form from Florida.

Habitat.—In mesophytic hammocks with oak and *Magnolia grandiflora*.

Distribution.—From North Carolina to North Florida.

Material studied.—FLORIDA, ALACHUA Co., Kelley's Hammock, northwest of Gainesville, Singer, F 2727, TYPE (FH).

37. LECCINUM RUGOSICEPS (Peck) Sing., *Mycologia* 37:799. 1945.

Boletus rugosiceps Peck, Bull. N. Y. State Mus. 94:20. 1905.

Boletus subglabripes var. *corrugis* Peck, Bull. N. Y. State Mus. 2(8):112. 1889.

Krombholzia rugosiceps Sing., Ann. Mycol. 40:34. 1942.

Pileus "mustard yellow" near the margin and more ochraceous brown toward the disc, paler where cracked, non-viscid, subsmooth to rugulose or scrobiculate-pitted, then areolate-rimose, glabrous or subglabrous, pulvinate, then less convex and eventually often subplane, with projecting sterile margin, 62-150 mm. broad. — *Hymenophore* "pale green yellow" to "baryta yellow," deeply depressed around the stipe, convex beneath; tubes long to very long; pores small to very small, concolorous, somewhat sordid on pressure; spore print olive brown. — *Stipe* concolorous with the hymenophore, below "tawny"-scabrous on yellowish ground, the base and the mycelium "marguerite yellow," dry, solid, ventricose, 60-90 x 14-30 mm. — *Context* yellowish, slowly changing to dirty pinkish violaceous in fresh material (this may easily be overlooked on hasty observation), firm and fleshy, rather hard and fibrous in the stipe; odor nine; taste mild.

Spores 14-17 x 4.8-5.2 μ , boat-shaped with rounded ends or ellipsoid-fusoid, with thin, rarely somewhat thickened walls, melleous; *basidia* 23-38 x 8-11.7 μ , 4-spored; *cystidia* 33-40 x 4-10.5 μ , fusoid-ventricose with the thickest part above the middle, the apex always forming an ampullaceous neck of 6-11 μ length; *trama* with a bright yellow pigment easily diffusing in ammonia, truly bilateral of the *Boletus*-type, with somewhat colored, denser mediostratum and hyaline, divergent, loosely arranged lateral stratum, the trama as a whole comparatively thin; *cuticle* of the pileus with an epithelium consisting of many layers of spherocysts which are arranged in erect chains and ending with a spherocyst or more frequently with a thick, subulate appendage-like mucro that is smaller than the next-lower member of the chain and is divided from it by a septum, or not divided from it; a minority of chains consists of mere successions of short-cylindric hyphae of 5-8 μ diameter; the spherocysts are 9-33 μ in diameter; some members with a more elliptical outline, e.g. 25 x 13.5 μ ; scabrosities of the stipe consisting of strands of parallel hyphae terminating in small convex hymenia which in their turn consist of dermatobasidia (27.5-52 x 8.5-11 μ , 4-spored), dermatopseudoparaphyses versiform, often ventricose-subclavate, often with 1-4 sterigma-like appendages, hyaline or faintly yellowish, 27-70 x 9.5-21 μ , and dermatocystidia in shape like those of the hymenophore but often lower portion broader, hyaline or faintly yellowish, 39-68 x 6.8-15 μ ; the hyphae immediately beneath the hymeni-

al elements of the scabrosities of the stipe forming some kind of a subhy-menium, differentiated by being shorter than the other hyphae; all *hyphae* without clamp connections.

Chemical reactions.—KOH on context and tubes, intensely deep golden yellow to golden ferruginous.—NH₃ little reaction.—FeSO₄ on context and tubes, greenish gray or grayish olive.—Formol on context, slightly reddish to strikingly salmon red.

Habitat.—On the ground under oaks and possibly also other frondose trees of the order Fagales, in Florida preferring gardens and shaded lawns to dense hammocks, gregarious. Fruiting from May till August, or perhaps until fall.

Distribution.—From New York to North Florida and some distance west (exact limits not known); very common in North Florida, increasingly less common towards the north.

Material studied.—FLORIDA, ALACHUA Co. Many times in and around Gainesville in spring and summer 1943, Singer, *F 1972*, *F 1972 a* (FH). NEW YORK, TYPES of *B. rugosiceps* and *B. subglabripes* var. *corrugis* (NYS).

This species differs from the preceding one in somewhat different colors of the pileus and especially of the tubes and pores, in somewhat larger size, and in changing context. This latter, the decisive character, also finds its expression in a marked difference in the chemical reactions (see *L. subglabripes*, northern collections) which is parallel to those of the unchanging and changing species of section *Versipelles*.

Peck's *Boletus subglabripes* var. *corrugis*, and Murrill's *Ceriomyces subglabripes*, *Mycologia* 5, pl. 80, fig. 6, 1913 as well as in Florida *Boletes* (1942) is also this species. Murrill says he also collected it in Putnam, Columbia and Clay Counties, Fla. This is also *Boletus rimosellus* Peck in the sense of Coker & Beers. However, the original description of Peck's is all but convincing. The only specimen found at Albany was collected by S. E. Wilcox in Washington, D. C. It is a *Boletus*, not a *Leccinum*, and probably belongs to sect. *Edules*. The type has been lost. On the other hand, the type of *L. rugosiceps* has been preserved. The type as well as two authentic collections are undoubtedly the *Leccinum* described above. Only one authentic specimen of *L. rugosiceps* from Wading River, Suffolk Co., N. Y., Aug. 21, 1906, is *L. rubropunctum*. Peck seems to have distinguished *L. rugosiceps* and *L. subglabripes* mainly by the degree of scabrosity to be seen on the stipe. This, however, is a variable character in both species, and certainly of secondary importance, except perhaps for certain local populations. The less distinctly scaly specimens with rugose cap have been referred to *B. subglabripes* var. *corrugis* by Peck while the strongly scabrous specimens with rugose caps were referred to *B. rugosiceps*.

This species has been tested by several authors, including the writer, and found to be of good edible quality. Considering its abundance in summer in North Florida, one may strongly recommend it for use in the kitchen.

Extralimital Species

Leccinum nigrescens (Rich. & Roze) Sing. comb. nov.

Boletus tessellatus Gill., Champ. Fr., Hymen., p. 636. 1878, non Rostkov. in Sturm (1844).

Boletus nigrescens Richon & Roze, Atlas Champ., p. 191. 1888, non Pallas, Voyage Emp. Russ. 1:31. 1788.

Gyroporus scaber var. *flavescens* Quél., Assoc. fr. avanc. sc. 1889:512. 1889.

Boletus luteoporus Bouchinot apud Barb., Bull. Soc. Myc. Fr. 20:92. 1904.

Boletus Velenovskýi Smotlacha, Vestn. k. české spol. nauk, 2:60. 1911.

Krombholzia tessellata R. Maire, Publ. Junta Ciènc. Nat. Barcelona, Fungi Catalaunici, p. 42. 1933.

Krombholzia luteopora Sing., Rev. de Mycol. 3:153. 1938.

?*Boletus crokipodius* Let., Fig. Champ., pl. 666. 1838, nom. nud.

?*Boletus rimosus* Vent. Mic. Agr. Bresc., p. 48. 1863.

?*Boletus cruentus* Vent., Mic. Agr. Bresc., p. 37. 1863.

This European species has been well described and figured in Kallenbach's *Pilze Miteuropa* 1 (4):17, pl. 7. 1927. under the name of *Boletus rimosus*. We agree with the French mycologists who contend that Kallenbach's interpretation of *B. rimosus* and *B. cruentus* is impossible to prove and that these species are legitimately referred to as *nomina dubia*. While a certain kinship with *L. scabrum* cannot be denied, the white stipe in one and the blue stipe in the other species make it impossible to reject Richon & Roze's excellent account and figures in favor of Venturi's phantastic forms.

This is also the *Boletus radicans* of Rostkovius, but not that of Persoon. It is the *Boletus*, *Krombholzia*, *Trachypus* and *Krombholziella crokipodia* of some French authors. The writer preferred Bouchinot's name in 1938 but since *Boletus nigrescens* Pallas has apparently not been used in post-Friesian time, we feel justified in using the name of Richon & Roze.

We have collected this species at several occasions, and think it is sufficiently different from the three American species of this section. However, Romagnesi says that the cuticular hyphae are filamentous. In my specimens they were globulose-catenulate or at least very short as shown by Kallenbach. Romagnesi's observation suggests *L. rubropunctum* which thus far has not been indicated from Europe, or else he has examined specimens with the epithelium washed off.

Leccinum rubropunctum (Peck) Sing. comb. nov.

Boletus rubropunctus Peck, Rep. N. Y. State Maus. 50:109. 1897.

Boletus longicurvipes Snell & A. H. Smith, Journ. Elisha Mitch. Soc. 56:325. 1940.

I have seen good fresh and dried material from the following states: Massachusetts, New York, Virginia. There are also trustworthy reports from North Carolina and Georgia, and *B. longicurvipes* from Tennessee is apparently the same. It is therefore quite possible that this species occurs in North Florida though thus far it has not been collected.

The cuticle consists of repent but flexuous, loosely arranged, interwoven, filamentous hyphae with the terminal member clavate or equal at the end and slightly ascendant or more rarely horizontal but not forming anything like a palisade; very rarely these terminal members are ellipsoid or even subglobose, imbedded in a mucilaginous mass, in dried as well as in fresh material the section in NH_4OH is distinctly cinnamon; trama hyaline but lateral stratum appearing lighter under high power because of the loose arrangement of the divergent hyphae, the mediostatum scarcely pigmented but denser,

axillar, the hyphae subparallel-subinterwoven, trama as a whole very thin; all *hyphae* without clamp connections. The white context of our fresh collections becomes dark or pale gray with FeSO_4 , and green with this same reagent in the base of the stipe.

Species Imperfectly Known

BOLETUS CORSICUS Rolland, Bull. Soc. Myc. Fr. 12:1. 1896.

Boletus sardous Belli & Sacc., Bull. Soc. Bot. Ital. 1903:225. 1903.

Boletus ilemecenensis R. Maire, Bull. Soc. Bot. Fr. 7:CCXIV. 1907.

These are considered to be Mediterranean varieties of *Boletus impolitus* Fr. by R. Maire. The data about them strongly suggest varieties of *L. nigrescens* (Rich. & Roze) Sing., or rather a species closely related to this species. Maire later (1935) states that these boletes link the genus *Krombholziella* (= *Leccinum*) with *Tubiporus* (= *Boletus*). We do not need to rely on these forms alone to become convinced of the existence of a link between *Leccinum* and *Boletus*. The whole section *Lutescabra* in general and *L. subglabripes* in particular may be considered as intermediate between *Boletus* and *Leccinum*.

As far as *B. corsicus* is concerned, we have to wait for more data in order to make sure that it is an autonomous species of *Leccinum* before we can propose a transfer under a new combination.

Section *Versipelles* (Fr. *emend.* Konr. & Maubl.) Sing. comb. nov.

Boletus, subgen. *Krombholzia*, sect. *Scabri* Konrad & Maublanc, Icon. Sel. 6:459. 1926-1937.

Boletus, subgen. *Derminus*, sect. *Versipelles* Fr., Epicr., p. 423. 1838.

Boletus, subgen. *Krombholzia*, sect. *Versipelles* Konr. & Maubl., l.c.

This coincides with the limits of the genus *Leccinum sensu stricto* as initially understood by Snell. The characters are obvious from the key, p. 111-112. The type species is *Boletus versipellis* Fr. & Hök. (i.e. *L. aurantiacum*).

KEY TO THE SPECIES

- A. Cuticle with a distinct epithelium, consisting of several layers of spherocysts, arranged in erect chains, and only a few chains of rather cylindrical members, the spherocysts eventually isolated and no more catenulate but in this stage frequently washed or rubbed off.
 - B. Context unchanging, pileus whitish or somewhat fuliginous, American species 38. *L. albellum*
 - B. Context strongly changing to reddish-violet-gray. European species *L. duriusculum*
- A. Cuticle predominantly of filamentous hyphae even in the outermost layer but in some species arranged in chains with rather short members and even some spherocysts at places, but not prevalently cellular in a manner that could be characterized as epithelium-structure.
 - C. Cuticle with chains containing (at least some of the chains) shortened hyphae or even some spherocysts, not yellow and not orange, and hyphae devoid of bright orange pigment under the microscope; associated with various species of *Betula*; context reddening by autoxydation when exposed *L. oxydabile*
 - C. Cuticle not formed by chains consisting of shortened hyphae or spherocysts; occasionally, there are very rare and very scattered spherocysts among the filamentous hyphae forming the uppermost layer of the pileus which is a felty

- to mentum that easily becomes viscid in some species but then the color of the pileus is yellow or orange or rufous, and the context changes strongly when broken; if there are no spherocysts at all, not even isolated, scattered ones, the pileus may also be white, or avellaneous, or grayish brown, brown, fuscous, umber, blackish brown, etc., sometimes with some blue or green showing; the forms with unchanging context mostly under *Betula*, otherwise frequently with *Populus*, *Carpinus*, *Fagus*, or (in Florida always) with *Quercus*.
- D. Pileus brown to grayish brown or umber, often with steel blue or caesious shades; context becoming reddish-violet-gray on injury; none of the colored hyphae of the cuticle filled with orange pigment; associated with *Quercus* in Florida 39. *L. chalybacum*
- D. Pileus either not colored as indicated above (i.e. yellow, orange, reddish brown, or rufous, also white), or the colored hyphae of the cuticle (at least some of them) filled with a bright orange pigment, or the context unchanging. Rarely under *Quercus*, never found in Florida.
- E. Context white, becoming either blue or reddish to violet to deep gray or black when bruised, eventually usually at least partially blackened; pileus yellow, orange, reddish brown or rufous, rarely whitish or white and then sometimes with a pinkish tinge.
- F. Hyphae of the colored portions of the cuticle at least partly filled with bright and deep orange pigment; scales of the stipe whitish, then brownish and eventually blackish, often several of these colors present in different parts of the stipe; context rarely bluing; pileus rarely yellow and rarely orange red; mycelium associated with *Populus*, *Carpinus*, *Fagus*, or *Quercus* *L. aurantiacum*
- F. Hyphae of the cuticle never filled with bright, deep orange pigment; scales of the stipe black from the beginning; context rarely reddening, usually bluing on injury; pileus yellow or orange red; mycelium associated with various species of *Betula* *L. testaceo-scabrum*
- E. Context white, becoming very slightly pinkish (never violet nor eventually blackening), or slowly and slightly avellaneous-gray, or most frequently entirely unchanging on injury; pileus white, grayish brown, avellaneous, brown, fuscous, umber, etc. *L. scabrum*

Description of the Species Occurring in Florida

38. *LECCINUM ALBELLUM* (Peck) Sing., *Mycologia* 37:799. 1945.

Plate I, Figs. 6 and 7

Boletus albellus Peck, Rep. N. Y. State Mus. 41:77. 1888.

Ceratomyces albellus Murr., *Mycologia* 1:145. 1909.

Pileus white, grayish white, or avellaneous-white, non-viscid, subpruinately smooth, convex, the center becoming flat, 20-52 mm. broad. — *Hymenophore* white or very pale gray or grayish cream, depressed around the stipe; tubes 5-8 mm. long; pores regular and round or somewhat irregular, 0.4-0.8 mm. in diameter; spore print olive brown. — *Stipe* white to very pale gray, with the ground color always whitish but the scabrosities (which occasionally form a reticulate design) at times somewhat grayish, solid, slightly tapering upwards, very rarely slightly tapering towards the base, or subequal, 40-90 x 5-12 mm. — *Context* white, never yellow or blue anywhere in the carpophore, strictly unchanging, soft and fleshy in the pileus, harder and fibrous in the stipe; odor none; taste mild.

Spores 12.5-23 x 4.2-5.8-(6.5) μ , pale melleous-stramineous, thin-walled, a few with slightly thickened walls, smooth; *basidia* 24.5-30.8 x 10-13.5 μ , 4-spored; *cystidia* 38-55 x 6.5-9.5 μ , ventricose-fusoid with mucronate or ampul-

laceous apex, hyaline, numerous at least near the pores; *trama* thin but truly bilateral of the *Boletus*-type; *cuticle* with a well developed epithelium when young and fresh, the spherocysts organized in chains and some chains consisting of filamentous hyphae only, or with the terminal hyphae broadly clavate, but these filamentous hyphae only scattered and irregularly intermixed among the prevalently cellular epicuticular elements; the spherocysts hyaline, about 15-30 μ in diameter; all *hyphae* without clamp connections.

Chemical reactions.—FeSO₄ on context, "dark violet gray" (a blackish gray).—Formol negative.—Phenol negative.

Habitat.—Under various species of *Quercus*, in Florida in high hammock vegetation, usually solitary or in small groups. Fruiting from June till September.

Distribution.—New York to North Florida and west to Missouri.

Material studied.—FLORIDA, ALACHUA Co., Kelley's Hammock, Murrill (as *B. niveus*), F 20158 (FLAS); Sugarfoot Hammock, Singer, F 2542 (FH). NEW YORK, TYPE and AUTHENTIC material (NYS). MISSOURI, Winora, Routien, 4158 (W. H. Snell Herbarium, Providence, R. I., as *Leccinum niveum*).

Forma **epiphaeum**, f. nov.

A typo pileo fuliginello differt.

Pileus "buffy olive" or "citrine drab," or brownish gray to sordid gray, or areolate-punctate in these colors on white ground because of early disruption of the cuticle under normal weather conditions, rimose-tessellate in old specimens, otherwise as the type form, 40-70 mm. broad. — *Hymenophore* grayish cream or gray, otherwise as the type form. — *Stipe* with umbrinous scabrosities all over on white to palest grayish ground, or fuliginous-scabrous only below, and the scales of the apex white, up to 15 mm. broad, otherwise as the type. — *Context* white, in the base of the stipe often faintly yellowish, otherwise as the type.

Microscopical and chemical characters as in the type form.

Habitat.—In high hammocks on the ground in small groups. Fruiting mostly in July.

Distribution.—North Florida.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Murrill, F 19835 (as *B. niveus*) (FLAS); Singer, F 2201 (FH); F 2833 (FH).

Forma **reticulatum** Murr. f. nov.

A typo differt pileo reticulato.

Pileus white with a coarse reticulation almost all over its surface, the ridges colored grayish brown or rosy-isabelline, otherwise as the type. — *Stipe* white or pale gray, with white or pale gray scabrosities, otherwise as in the type. *Hymenophore* and *context* as in the type form.

Microscopical and chemical characters as in the type form.

Habitat.—In mesophytic and high hammocks, solitary or in small groups. Fruiting in June and July.

Distribution.—North Florida.

Material studied.—FLORIDA, ALACHUA Co., Gainesville, Murrill, TYPE (FLAS); Sugarfoot Hammock, Singer, F 2534 (FH).

Murrill was not the only one to mistake *L. albellum* and its forms for *L. scabrum* and *L. scabrum* ssp. *niveum*. However, the author has studied the anatomy of the type specimens of *Boletus albellus* Peck and found that these are quite different in structure from the true *L. scabrum* and *L. scabrum* ssp. *niveum*. It is interesting to note that the characters of the boletes of the *Scaber*-group in Florida are exactly opposite to the corresponding species in Europe: *L. albellum* has unchanging flesh and cellular cuticle while *chalybaeum* has changing context and filamentous cuticle; in Europe, *L. scabrum* has unchanging flesh and filamentous cuticle, and *L. duriusculum* has changing flesh and cellular cuticle. *L. oxydabile* is intermediate between these.

All these species are edible.

39. *LECCINUM CHALYBAEUM* Sing., *Mycologia* 37:799. 1945.

Pileus between "pinkish buff" and "cinnamon," but more sordid, or more frequently "bamboo" (M. & P.), with a shade of "sphinx" (M. & P.) when young, very frequently with a caesious tinge on the margin or shining through cracks of the surface, often partly "court gray," glabrous or subglabrous-subtomentose, more or less distinctly viscid in wet weather, slightly shining when dry, smooth or slightly uneven, pulvinate, eventually sometimes more appanate, 42-84 mm. broad. — *Hymenophore* whitish, soon "flax" (M. & P.) to "ecru-beige" (M. & P.), convex beneath, deeply depressed around the stipe; tubes up to 14 mm. long; pores concolorous but becoming dirty olive gray when handled, small to very small; spore print olive brown. — *Stipe* white, becoming sordid, beset with white scabrous squamules at the apex, white with pale brown, later darker brown squamules farther downwards, dry, subequal with very slightly attenuate apex, or ventricose, or tapering upwards almost from the base, solid, 40-65 x 13-21 mm. — *Context* white, becoming reddish-violet-gray or purplish lilac ("dark vinaceous gray") when bruised, and eventually becoming blackish, firm and fleshy then watery soft in the pileus and the apex of the stipe, fibrous and hard in the rest of the stipe; odor none; taste mild.

Spores 16.3-17.7 x 5.5-6.2 μ , melleous-brownish, well colored, fusoid, the walls thin or somewhat thickened; *basidia* 28-34 x 9.3-13.7 μ , 4-spored; *cystidia* 31-51 x 6-11 μ , hyaline, fusoid, more often non-ampullaceous than with an ampullaceous apex, thin-walled, rather numerous near the pores; *trama* truly bilateral, of the *Boletus*-type, comparatively thin; *cuticle* of the pileus consisting of strongly interwoven, irregularly arranged (not in erect chains), filamentous brownish or hyaline, smooth hyphae of 4-10 μ , usually between 6.5 and 8.5 μ diameter; scabrosities of the stipe consisting of strands of parallel hyaline, filamentous hyphae, at the end of each a subhymenial hypha which is shorter and usually broader than the others and bearing, in its turn, either a dermatobasidium (3-4-spored, e.g. 20-21 x 9-9.5 μ), or a dermatopseudo-paraphysis (basidiole-like, small, or irregularly lobed at the apex, mostly hyaline, or very faintly pigmented), or a dermatocystidium (hyaline or much more rarely melleous, fusoid or fusoid-ampullaceous, thin-walled or with a wall of up to 0.7 μ diameter, 38-82 x 6.2-16.2 μ), these three latter elements forming small fragments of hymenium.

Chemical reactions.—KOH and NH₄OH on pores, deep reddish brown. FeSO₄ on context, "pistachio green," "Russian green." — Formol on context, immediately salmon red. — Phenol on context, "dusky brown" or "chocolate."

Habitat.—In gardens, open woods and flatwoods with *Quercus minima*, associated with the latter, or with *Q. virginiana*, or *Q. laurifolia*, on sandy ground or on humus, in small groups or solitary. Fruiting mostly in July.

Distribution.—North Florida, probably also in adjacent states but overlooked and taken for *L. scabrum*.

Material studied.—FLORIDA, ALACHUA Co. Two miles east of Gainesville among *Quercus minima* in a *Pinus-palustris* flatwood during and after strong rains, July 20, 1943, Singer, F 2846, TYPE (FH); Gainesville, Singer, F 2761, CO-TYPE (FH); F 2756, CO-TYPE (FH).

This species differs from *L. duriusculum* in the structure of the cuticle, from *oxydabile* in stronger autoxydation and more equally filamentous-interwoven cuticular hyphae, also in the habitat; from *L. scabrum* and its subspecies in the strongly discoloring flesh and the chemical reactions, also in the mycorrhizal connection; from brown forms of *L. aurantiacum* in the absence of orange pigment in the hyphae of the cuticle and in the caesious or gray stains on the pilei of most specimens, also in the mycorrhizal connection.

Extralimital Species

Leccinum duriusculum (Schulz.) Sing. comb. nov.

- Boletus duriusculus* Schulz. *apud* Fr., Hymen. Europ. p. 515. 1874.
Gyroporus scaber (Fr. *sensu*) Quélet, *Enchir.*, p. 162. 1886.
Gyroporus griseus Quélet, *Assoc. fr. avanc. sc.* (1901):496. 1902.
Boletus griseus Sacc. & D. Sacc., *Syll.* 17:100. 1905, non Frost (1878).
Boletus rufus var. *duriusculus* Bat., *Bolets*, p. 12. 1908.
Boletus scaber var. *griseus* Bat., *Bolets*, p. 12. 1908.
Boletus duriusculus var. *carpini* R. Schulz in *Michael Führ. Pilzfr.* 1, pl. 95. 1924.
Krombholzella duriuscula Gilbert, *Bolets*, p. 185. 1931.
Boletus pseudoscaber Kallenbach, *Pilze Mitteleur.* 1:117. 1935, non Secr. (1833).
Boletus nigrescens Huber, *Zeitschr. Pilzk.* 19:75. 1935, non Rich. & Roze (1888).
Krombholzella scabra (Bull *ex Fr. sensu*) R. Maire, *Publ. Inst. Botàn. Barcelona*, 3(4):46. 1937.
Trachypus scaber "Fr., Quélet. (*nec* Bull.)" Romagnesi, *Rev. de Mycol.* 4:141. 1939.

It is improbable that Schulzer, not to mention those modern French mycologists who maintain *L. duriusculum* as a species different from what we call by this name, made so bad a mistake as to consider the brown form of *L. aurantiacum* as the "actual" *L. duriusculum* without discovering the fact that this form is at most a color form of the typical *L. aurantiacum*. The above list of synonyms shows clearly that in case these authors should have misinterpreted the brown form of *L. aurantiacum* as a "new species," — an assumption so odd it could plausibly be proved only if there are type specimens at Budapest that show the characters of *L. aurantiacum*, — the European species with epithelium, as common and well known as it may be, would remain without a name. The author still thinks, however, that *Boletus duriusculus* Schulzer is the same plant as ours.

The occurrence of this species in North America is not proved, in fact, it is improbable, at least as far as the east coast is concerned, since none of

the specimens seen by the writer belongs here. It occurs in Central and Southern Europe, also in the Caucasus Mts., in North Africa and England.

Leccinum oxydabile (Sing.) Sing. comb. nov.

Krombholzia oxydabilis Sing., Schweiz. Zeitschr. Pilzk. **16**:136. 1938.

This is the frequent species, usually determined as *Boletus scaber*, in the mixed woods of New England and New York, also occurring in Siberia, and probably in Europe (*B. duriusculus sensu* Huber —?).

LECCINUM AURANTIACUM (Bull. ex) S. F. Gray, Nat. Arr. Brit. Pl. **1**:646. 1821.

Boletus aurantiacus Bull. ex Pers., Mycologia Europ. **2**:147. 1825.

Boletus versipellis Fr. & Hök, Bol., p. 13. 1836.

Krombholzia aurantiaca Gilbert, Bolets, p. 182. 1931.

Krombholziella aurantiaca R. Maire, Publ. Inst. Botàn. Barcelona **3**:46. 1937.

Trachypus aurantiacus Romagnesi, Rev. de Mycol. **4**:141. 1939.

Leccinum versipelle Snell apud Slipp & Snell, Lloydia **7**:58. 1944.

Boletus rufus Schaeff. ex aut. plur.

This somewhat variable species is most frequent in America and Europe under or near *Populus tremula* and *P. tremuloides*. It is much more rarely found under other trees. Neither the hosts nor the fungus occurs in Florida.

LECCINUM TESTACEO-SCABRUM (Secr.) Sing. comb. nov.

Boletus testaceus scaber Secr., Mycogr. Suisse **3**:8.1833.

Boletus rufescens scaber Secr., Mycogr. Suisse **3**:11. 1833; *B. rufescens* Konrad, Bull. mens. Soc. Linn. Lyon, p. 10. 1932.

Krombholzia rufescens Sing., Rev. de Mycol. **3**:189. 1938.

This is a northern-Alpine species growing with various species of *Betula*, and being especially abundant in the tundras of Europe and Asia. I have seen specimens referable to this species in America. Most European (not French) authors confuse this and *L. aurantiacum* under an ambiguous name like *Boletus rufus* or *Boletus versipellis*.

LECCINUM SCABRUM (Bull. ex Fr.) S. F. Gray, Nat. Arr. Brit. Pl. **1**:647. 1821.

Boletus scaber Bull. ex Fr., Syst. Mycol. **1**:393. 1821.

Krombholzia scabra Karst., Rev. Mycol. **3**:17. 1881.

Ceratomyces viscidus (L. ex) Murr. North Amer. Fl. **9**:139. 1910, non *Boletus viscidus* L. ex Fr. (1838).

Krombholziella scabra R. Maire, Publ. Inst. Botàn. Barcelona **3**:46. 1937.

Trachypus scaber "Bull. non Fr.)" Romagnesi, Rev. de Mycol. **4**:141. 1939.

A very common European and American species which has rightly been divided into several subspecies (see Singer, Ann. Mycol. **40**:34. 1942), this has been confused with *L. duriusculum* by many European writers. Nomenclatorially this has also been mixed up unnecessarily. It is obvious for anyone who attempts to apply the International rules impartially that the one issue of importance is what Fries thought was the typical *B. scaber* among

the many forms he initially included. Neither Bulliard's and S. F. Gray's, nor Quélet's and Imler's views count in this regard. Fries has hardly seen much of *L. duriusculum* since he collected only in Sweden where the latter is rare. The last of the varieties indicated in Fries' *Systema* (1821) is our *L. scabrum*, the form common in Sweden and well known to every mycophagist and farmer there. This species is also most similar to Bulliard's picture, *pl.* 132, as confirmed by the Parisian author H. Romagnesi. As if this were not enough, Fries says generally about *B. scaber* that the *flesh is usually unchanging*, rarely blackening which cannot mean that the blackening species (*L. duriusculum*) is the type form. Since only two of the varieties indicated by Fries do not blacken, *viz.* *a* and *f*, only these can be considered as candidates for type variety. Both belong in *L. scabrum* in our sense. It is logical that all the other varieties have since been named and have to be excluded from *B. scaber*. The remaining form is our *L. scabrum*. The name *B. leucophaeus* Pers., frequently applied to this species, is incorrect since even the scanty characters given for this species do not fit *L. scabrum* especially the blackening attributed to *B. leucophaeus* by Persoon.

L. scabrum ssp. *niveum* is not infrequent in New England, especially in wet, low woods, with *Betula*; *L. scabrum* ssp. *rotundifoliae* has recently been found in this Hemisphere, in arctic Canada and Greenland. None of all these occurs in Florida. What is called so there, is either *L. albellum* f. *epiphæum* or *L. chalybaeum*.

Section *Roseoscabra* Sing. sect. nov.

Hymenophoro haud flavo-tincto, sed base stipitis chroemia (haud citrina); sporis in cumulo cinnamomeis vel roseo-fuscidulis; pileo roseo.

Characters of the section: see key and Latin diagnosis. Type species *L. chromapes* (Frost) Sing. comb. nov. (*Boletus chromapes* Fros).

This section is, of the three known sections of this genus, the one closest to *Tylopilus* because of the color of the spores. The type and only species of this section has filamentous cuticle, and the context does not react with methylparamidophenol; it reacts greenish in the "lemon chrome" part of the stipe, not at all in the pileus with formaline, the white part of the flesh becomes "sage green" and "Artemisia green" with FeSO_4 while the chrome yellow part becomes slowly more olive. The pileus and the scales of the stipe are about "pinkish vinaceous," the former becomes brownish with KOH and the latter with age. It grows with *Betula*, *Populus*, and *Salix*, and has not thus far been observed in Florida.

Species Excludendae

LECCINUM LACTIFLUUM (With. ex Fr.) S. F. Gray is *Suillus granulatus* (L. ex Fr.) Kuntze ssp. *typicus*.

LECCINUM SUBTOMENTOSUM (L. ex Fr.) S. F. Gray is *Xerocomus subtomentosus* (L. ex Fr.) Quélet.

LECCINUM PIPERATUM (Sow., Pers. ex Fr.) S. F. Gray is *Suillus piperatus* (Bull. ex Fr.) Kuntze.

- LECCINUM CONSTRICTUM (Pers. ex) S. F. Gray is *Gyroporus cyanescens* (Bull. ex Fr.) Quél.
 LECCINUM EDULE (Bull. ex Fr.) S. F. Gray is *Boletus edulis* Bull. ex Fr.
 LECCINUM ELEPHANTINUM (With. ex) S. F. Gray is a *nomen dubium*.
 LECCINUM LURIDUM (Sow. ex) S. F. Gray is *Boletus luridus* Schaeff. ex Fr.
 LECCINUM RUBEOLARIUM (Sow. ex) S. F. Gray is a *Boletus* of the section *Luridi*.

Genera Incertae Sedis

BOLETOCHAETE Sing., *Mycologia* 36:358. 1944.

Three tropical species (*B. spinifera* (Pat. & Baker) Sing., the type species, *B. brunneosetosa* Sing., and *B. spec.* = *Xerocomus* sp. Heim), none of them occurring in Florida. This is a characteristic, easily recognizable genus which can, however, not be placed in one of the subfamilies of the Boletaceae as long as the structure of the young hymenophoral trama is unknown (see Singer, *l.c.*)

IXECHINUS Heim, *Rev. de Mycologie* 4:20. 1939.

Two species from Madagascar, *I. majus* and *I. minus* Heim. The trama of these species as shown in *fig. 4* by Heim, *l.c.*, may represent a third type of tramal structure among the boletes, characterized by still more gelatinized lateral stratum than is observed in the *Boletus*-type. The *fig. 2* (*l.c.*) shows no clamps but this fact is not conclusive since it is not definitely stated in the text. The exact color of the spores in print and the chemical reactions are unknown. This is certainly a good and very interesting genus. Its final place in the classification of the Boletaceae is difficult to name at present. A special *tribus*, *Ixechineae*, has been proposed by Heim, for the genus *Ixechinus*.

GASTROBOLETUS Lohwag, *Beih. Bot. Centralbl.* 42(2):273. 1926.

This is based on one species, *G. Boedijnii* Lohwag (see also Lohwag in Handel-Mazzetti, *Symbolae Sinicae* 2:54. 1937) which, in spite of its unique half-angiocarpous character, is in need of a more thorough examination. It would be interesting to know the structure of the trama, the hyphae (whether there are clamp connections at the septa), the color of the spore print, the characters of the cystidia (if there are any), and many other things not mentioned in the diagnoses. It may well be that *Gastroboletus* is close to the gasteromyceteus genus *Truncocolumella*. It has been collected only in north-western Yunnan, China.

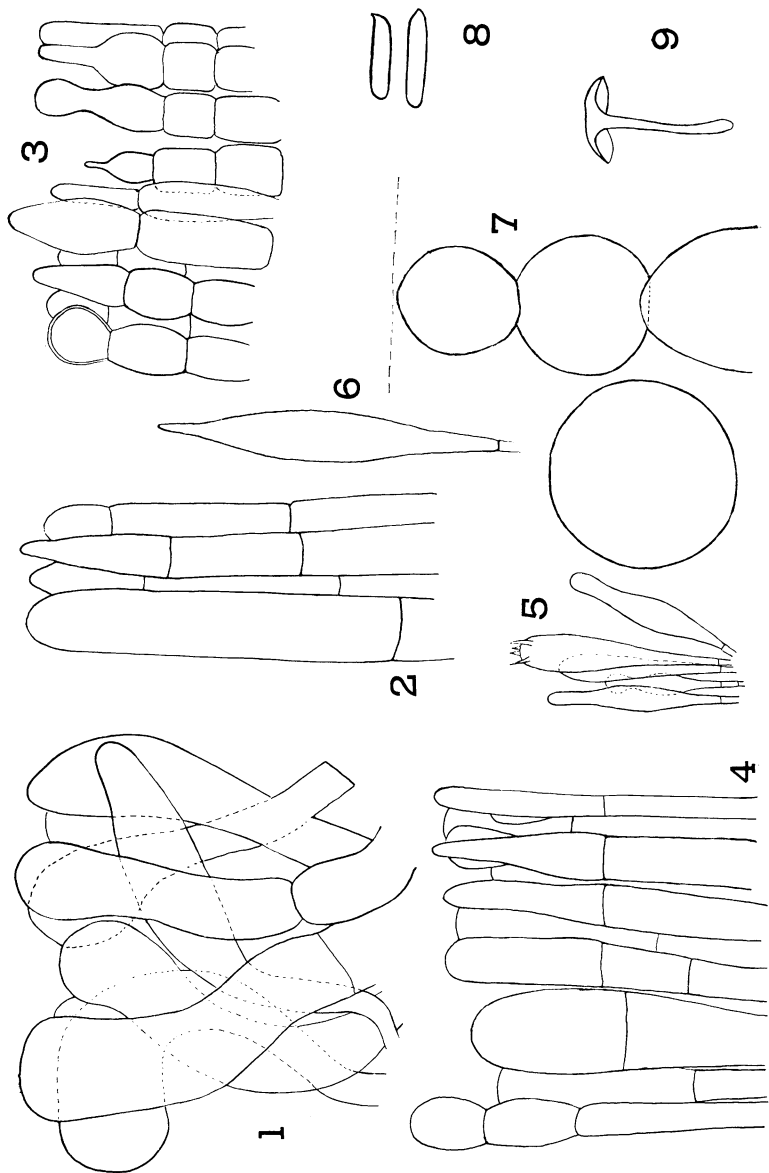


PLATE 1.—*Boletus edulis* Bull. ex Fr.—Structure of the epicutis, $\times 1000$.—2. *Boletus aereus* Bull. ex Fr.—Structure of the epicutis, $\times 1000$.—3. *Boletus rubellus* Krombh. ssp. *fraternus* (Peck) Sing. Structure of the epicutis, $\times 1000$.—4. *Boletus granuloseps* Sing.—Structure of the epicutis, $\times 1000$.—5. *Boletus subsolarius* Sing.—Fragment of the hymenial layer on the margin of the pileus, $\times 1000$.—6. *Leccinum albellum* (Peck) Sing.—Cystidium of the hymenophore, $\times 1000$.—7. *Leccinum albellum* (Peck) Sing.—Epithelium of the pileus. The broken line above indicate the surface of the pileus, $\times 1000$.—8. *Xanthoconium stramineum* (Murr.) Sing. Spores, $\times 1000$.—9. *Boletus pernanus* Pat. & Baker.—Section through the fresh carpophore in natural size. From a drawing accompanying the type specimens; del. C. F. Baker.

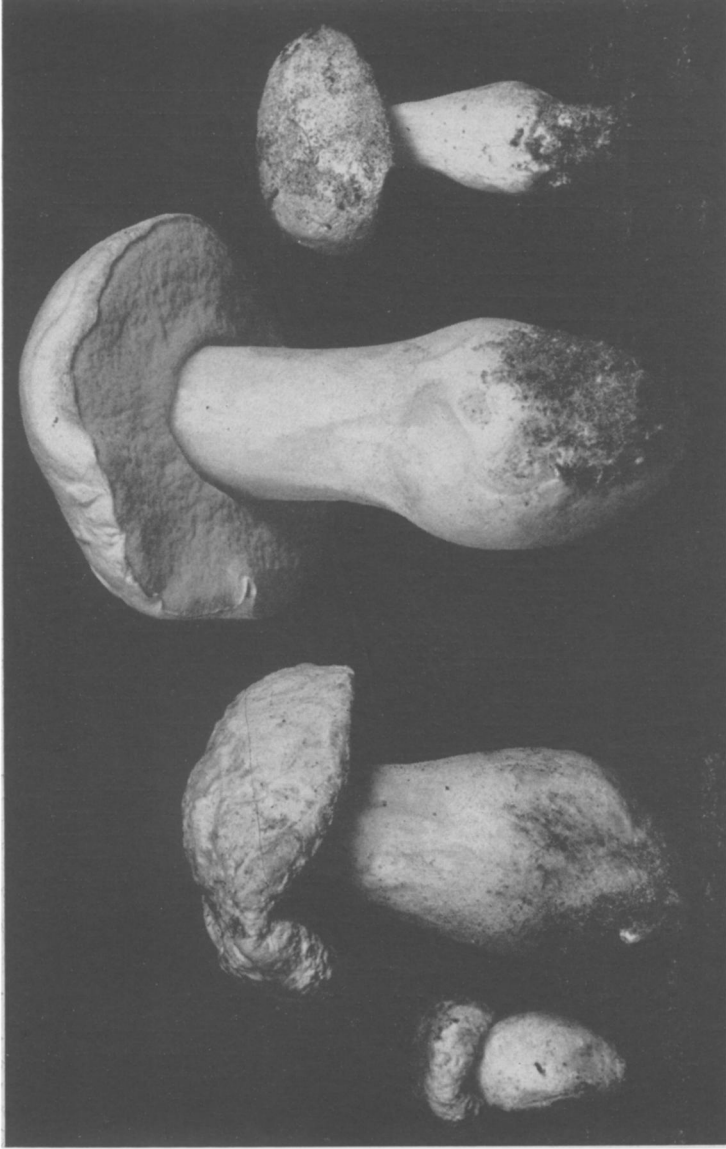


PLATE 2.—*Xanthoconium stramineum* (Murr.) Sing.—Carpophores in various stages of development, fresh material in natural size, from Highlands Hammock State Park, Fla.

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 ssp. jamaicensis IV: 531
 violascens, Bol. III: 94
 viperinus, Phleb. III: 5
 viridiflavus, Bol. III: 13

viscidulus, Pulv., Bol.	III: 19	viticola, Geopetalum	IV: 558
viscidus, Cer.	III: 123	viticolus, Pleurotus	IV: 558
viscidus, Gomph.	IV: 533	volvatus, Gyrodon	II: 250
f. columbiana	IV: 533	Weberi, Bol.	III: 39
viscosus, Bol.	II: 265	Woodiae, Gyroporus	III: 86
vitellinus, Bol.	III: 34	Zelleri, Xer., Cer.	II: 297

CORRIGENDA

- Part I, p. 98, line 28, read: *Suillus cothurnatus* instead of *Suillus australis*.
- Part I, p. 100, line 2, read: *Xerocomus pseudoboletinus* instead of *Xerocomus subilludens*.
- Part I, p. 104, line 20, read: *Porphyrellus subflavidus* instead of *Porphyrosporus subflavidus*.
- Part I, p. 105, line 31, read: *Porphyrellus pseudoscaber* instead of *Porphyrosporus pseudoscaber*.
- Part I, p. 111, line 39, read: HNO₃ instead of HNO₄.
- Part I, p. 121, line 14, read: *P. Cooķei* instead of *P. lacunosus*.
- Part II, p. 223, line 3, read: (except *Boletoideae*) instead of (*Gyroporoideae*).
- Part II, p. 240, line 32, read: *Gyroporus biporus* instead of *Gyroporus bisporus*.
- Part II, p. 243, line 32, read: *Gyrodon lividus* instead of *Gyroporus lividus*.
- Part II, p. 247, line 3, read: Linder, det. R. Singer) instead of . . . Linder (det. R. Singer).
- Part II, p. 260, lines 11-12, delete: *S. flavoluteus* (Snell) Sing. comb. nov. (*Boletinus flavoluteus* Snell).
- Part II, p. 280, line 27, read: *Ssp. foliiporus* (Murr. l.c.) Sing. comb. nov. instead of *Ssp. foliiporus* Murr. l.c.
- Part II, p. 282, line 15, read: *Gymnopilus* instead of *Gymnocybe*.
- Part II, p. 292, line 16, read: (FLAS) instead of (FLAS, FH).
- Part II, p. 298, line 16, read: altering instead of alternating.
- Part IV, p. 539, line 18, delete: (e.g. of *Nyssa silvatica*).
- Part IV, p. 543, line 33, delete sentence beginning with: We therefore. . .
- Part IV, p. 562, line 10, read: Christiansen instead of Lange.