THE BOLETES OF TAIWAN[1] (I)

KAI-WUN YEH[2] and ZUEI-CHING CHEN[3]

(Received for publication Apr. 1, 1980)

Abstract: Fifteen species of Boletaceae are described. Among them about twelve species are new record to Taiwan. They are: *Gastroboletus scabrosus* Mazzer & Smith., *Phylloporus rhodoxanthus* (Schw.) Bres., *Xerocomus chrysenteron* (Fr.) Quelet., *Boletinus pictus* (Peck) Peck., *Gyroporus castaneus* (Fr.) Quelet., *Boletus queletii* Schulzer., *Leccinum holopus* var. *holopus* (Rostkovius) Watling., *Leccinum rugosiceps* (Peck) Singer., *Suillus grevillei* (Klotzsch) Singer., *Suillus subaureus* (Peck) Snell, *Suillus subalutaceus* (Smith & Thiers) Smith & Thiers., *Suillus punctipes* (Peck) Singer. The other species, *Strobilomyces floccopus* (Vahl ex Fr.) Karst., *Xerocomus subtomentosus* (Fr.) Quelet., and *Suillus bovinus* (L. ex Fr.) O. Kuntze had been described before in Taiwan.

INTRODUCTION

In spite of an early recognition of mycorrhizal association of Boletaceae (*sensu lato*) with forest trees and a long history of forest management in Taiwan, only seven species of boletes fungi were reported by Japanese workers (Sawada, 1933, 1944; Kida, 1937.) before the world war II. The seven species are *Boletus badius* Fr. (Kida, 1937.), *B. edulis* Fr. (Sawadw, 1944.), *B. pachypus* Fr. (Sawada, 1944.), *B. pulverulentus* Opat. (Sawada, 1944.), *Suillus bovinus* (Fr.) Kuntz. (Sawada, 1933.), *Suillus granulatus* (Fr.) Kuntz. (Sawada, 1933.) and *Xeroconus subtomentosus* (Fr.) Qulet. (Sawada, 1944.). After world war II, Ho and Wu (1971) added one species of *Strobilomyces, S. floccopus* (Fr.) Karst to the flora of Taiwan. Since a pioneer work of mycorrhizal investigation of Taiwan red pine forest by Hu (1976), followed by Hung, L. L. *et al.* (1978), the economic importance of Boletaceae on native forest management has gradually been recognized in Taiwan. The need of a thorough floristic investigation of Boletaceae in Taiwan is thus recognized and an organized field survey around the island has been carried out since 1979. This report contains parts of the results obtained during the first year's survey. All specimens listed are deposited at Mycological herbarium, Department of Botany, National Taiwan University, Taipei, Taiwan, R. O. C. Color nomenclature used in description are followed Ridgeway (1912).

1. **Strobilomyces floccopus** (Vahl *ex* Fr.) Karst. Bidr. Finl. Nat. Folk. **37**: 16, 1882.

Fig. 1 & Plate 3

Boletus floccopus Fries. Syst Myc. **1**: 292, 1821.
Boletus strobilaceus Scopoli ex Fries. Elench. Fung. **1**: 127, 1828.

Pileus 4–9 cm dia, convex when young, becoming plano-convex at maturity, surface dry, natal brown or sepia to black, covered with large silky-woolly flocci arranged into thick

(1) This research program was supported by a grant (No. NSC-69B-0201-02(16)) from the National Science Council in Taipei, Taiwan, Republic of China.

(2) 葉開溫, Graduate student, Department of Botany, National Taiwan University, Taipei, Taiwan, Republic of China.

(3) 陳瑞青, Professor, Department of Botany, National Taiwan University, Taipei, Taiwan, Republic of China.

imbricate scales, scale tip protruding out from pileus, margin hung with the remains of the gray to pallid fibrillose membraneous veil, in age pileus turn to black. Context whitish, when cut or bruised turn reddish and becoming blackish. Tubes 8-15 mm long, whitish to gray at first, becoming blackish when aged or bruised, adnate, some depressed around stipe; pores large, angular. Stipe 5-7 cm long, about 10 mm thick, solid, cylindrical, taper downward, concolorous with pileus, near the apex having a constriction belt owing to a thick wooly sheath around the lower portion, (probably remains of partial veil). Spore print black, spores 9.5-12 × 7.5-8.5 μm, reticulate, some with a germ pore. Basidia clavate, 2- or 4-spored, 22-35 × 12-16 μm. Pleurocystidia rostrate or mucronate, 37-50 × 15-30 μm. Epicutis of the pileus composed of trichodermium structure, cell 22-88 × 7-13 μm, oblong or cylindrical, cell wall slightly thick, some cell with inner granular, slightly constricted septa. Clamp connection absent.

Habitats: solitary, scattered on ground of deciduous forest or mixed forest.
Distribution: Taiwan, Japan, North American, Europe. Australia.
Specimens Examined: TAI CHUNG: Li-Shan, alt. 2000 m, mixed forest. Sept. 12, 1979. TAI-YB-001.
Notes: The presence of this species in Taiwan was first reported by Hou and Wu (1971) who collected it from Wulai, Taipei prefecture on July, 1969.

2. **Gastroboletus scabrosus** Mazzer & Smith. Mich Bot. **6**: 60, 1967. Fig. 2 & Plate 4

Pileus 2.5-5 cm broad, convex when young, becoming plano-convex to strongly plano type at maturity; surface dry, glabrous, somewhat subtomentose, central region yellow-brown, yellowish vinaceous, margin slightly paler to clay color or mustard yellow, when cut becoming pale olive and slowly turning olive; context 10-15 mm thick. Tubes about 1.5 cm long, when young lemon yellow, depressed around stipe, becoming olivaceous yellow and tube oriented out from the stipe, becoming very irregular; tube trama bilateral, pores small, 2-3 mm large concolorous with tube, turning to brownish or blackish on bruising. Stipe 2-6 cm long, 4-9 mm wide, surface striate, reticulate, solid, equal, slightly taper upward, the upper portion near the hymenophore is brownish, the lower yellowish, base with yellowish mycelium. Spores 12.5-20 × 4.5-7 μm, most subfusiform, but variable, thin-walled, pale brown in KOH solution. Basidia about 25 μm long, 10 μm wide; pleurocystidia and cheilocystidia fusoid, ventricose, clavate, hyaline, thin-walled, 40-50 μm long, 10 μm wide. Pileus with trichodermium of loosely interwoven hyphae, some with swollen end cells. Clamp connection absent. Hymenophore gastroid. No spore print.

Habitats: gregarious on sandy soil of road side under mixed forest or Sasa bamboo forest.
Distribution: Taiwan, North America.
Specimens Examined: TAICHUNG: Shueshan, alt. 3000-3200 m, Sasa bamboo forest, Sept. 26, 1979. TAI-YB-002. NANTOU: Yu-Shan (Mt. Morrison), alt. 3200-3400 m, mixed forest, Nov. 28, 1979. TAI-YB-003.

3. **Phylloporus rhodoxanthus** (Schw.) Bres., Fungi Trid. **2**: 95, 1900. Fig. 3 & Plate 1, 2

Agaricus rhodoxanthus Schw. Naturf Ges. Leipzig. **1**: 83, 1822.
Gomphidius rhodoxanthus (Schw.) Sacc. Syll. **5**: 1139, 1822.
Paxillus rhodoxanthus (Schw.) Rick Blatterp. **1**: 95, 1911.

Pileus 4-6 cm broad, when young flat-convex, turning plano-convex, flattened or even, somewhat depressed, delicately pubscent at the center, velvety, mat, slightly hygrophaneous when moist; antimony yellow or brown-red color; margin of the pileus initially involute, straightening during development; context yellowish about 3 mm thick; hymenophore with gill, lamellae distant, large, thick, soft, waxy, connected with anastomoses, readily separable from the pileus,

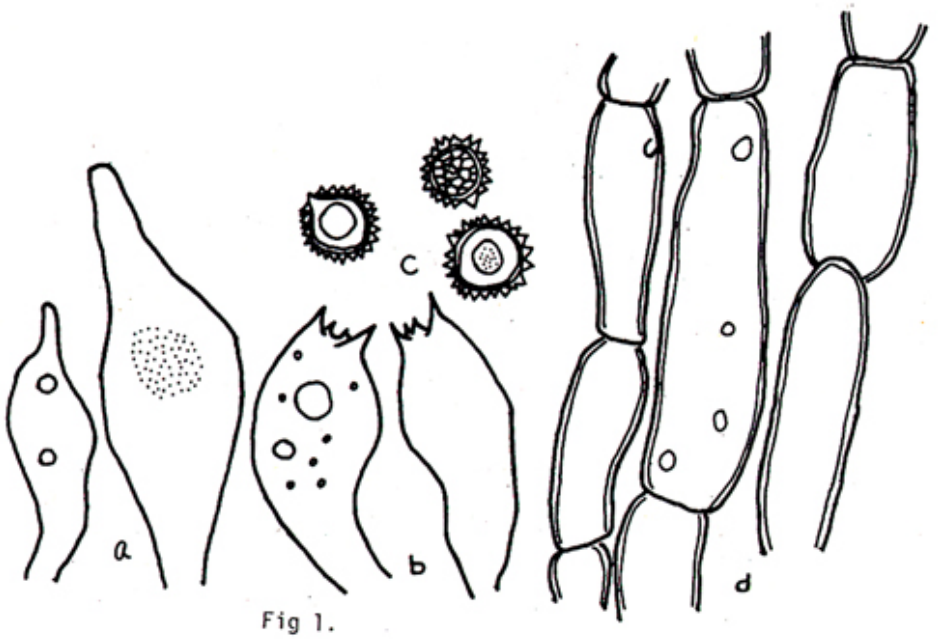

Fig 1.

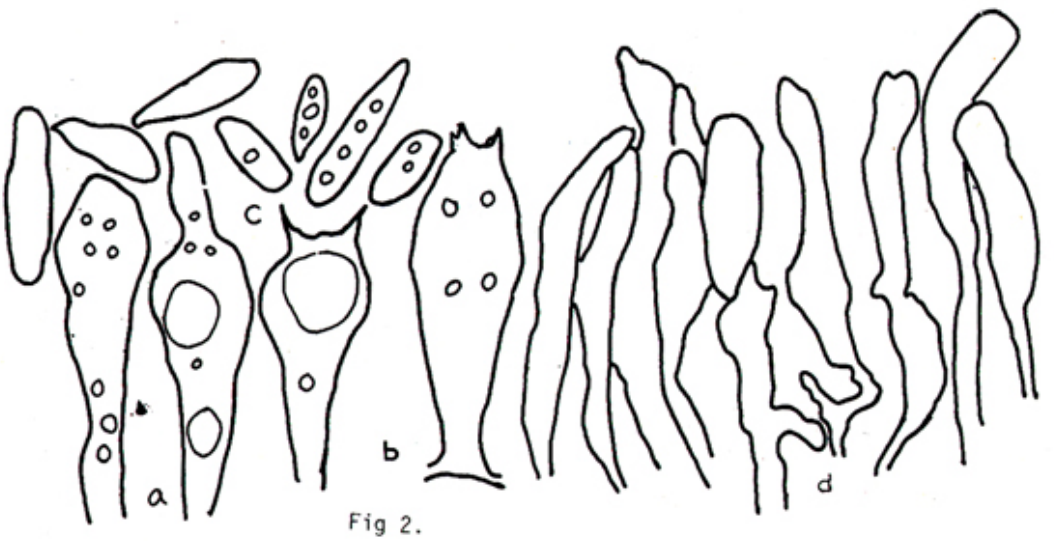

Fig 2.

Fig. 1. *Strobilomyces floccopus*: a. cystidia; b. basidia; c. basidiospores; d. surface cells of pileus; ×480.

Fig. 2. *Gastroboletus scabrosus*: a. cystidia; b. basidia; c. basidiospores; d. surface cells of pileus; ×480.

golden-yellow (light cadmium). Stipe 4–6 cm long, 5–7 mm wide, taper downward, solid, cylindrical, upper portion ribbed owing to decurrent lamellae. Spore print yellow-ochre to olive-ochre, spores ellipsoidal to fusiform with granular contents, smooth, 9.5–13 × 3.5–4.5 μm. Basidia 35–45 × 8–10 μm; cystidia cylindrical about 55–75 μm long, 7.5–15 μm wide.

Habitats: solitary or scattered, under mixed forest or road side.
Distribution: Taiwan, Japan, North America, Europe. China Mailand, Indo-China.
Specimens Exantined: NANTOU: Wu-She, alt. 1200 m, under deciduous forest, Sept. 2, 1979. TAI-YB-005; TAICHUNG: Li-Shan, alt. 2000 m, under mixed forest, Aug. 22, 1979. TAI-YB-004.

4. **Xerocomus chrysenteron** (Fries.) Quelet. Flor. Myc. Fr. p. 418, 1888. Fig. 4 & Plate 5

Boletus chrysenteron Fries. Epicr. Syst. Myc. p. 415, 1838.

Pileus 2–4 cm broad, convex to plano-convex, surface dry, evenly velutinous to subtomentose when young, in age appearing rimose-areolate and exposing context tissue, color saccardo's umber to olive brown, marginal zone is slightly redder. Context white to yellowish, slowly becoming blue when cut. Tubes 5–7 mm long, depressed around the stipe, bright yellow, becoming bluish when bruised; pores large, yellow when young becoming reddish when old, irregular, some pores splitted in age. Stipe 4–5 cm long, 3–5 mm thick, solid, slightly taper downward, upper portion slightly pink to yellowish, middle portion is purplish red, pruinose with longitudinal lines. Spores 10–12.5 × 4–5 μm, smooth, fusiform, oblong, narrowly inequilateral in profile. Basidia clavate, 24–30 × 10–12 μm; pleurocystidia fusoid or rostrate, smooth, 25–40 × 8–15 μm; caulocystidia 24–30 × 9–12.5 μm, clavate, rostrate. Epicutis of the pileus is trichodermium type, hyphae very wide, up to 30 μm wide.

Habitats: solitary, scattered, under mixed forest.
Distribution: Taiwan, Japan, North America, Europe, Africa, Australia, China Mainland.
Specimens Examined: HSINCHU: Mt. Ta-Ba-Chien, alt. 2200 m, mixed forest, Aug. 26, 1979. TAI-YB-006.

5. **Xerocomus subtomentosus** (Fr.) Quel. Flor. Myc. Fr. p. 418, 1888. Fig. 5

Leccinum subtomentosus (Fr.) S. F. Gray. Nat. Arr. Brit. Pls, **1**: 647, 1821
Rostkorites subtomentosus (Fr.) P. Karsten. Rev. Mycol. 3: 16, 1881.
Versipellis subtomentosa (Fr.) Quelet. Enchir. Fung. p. 158, 1886.
Ceriomyces subtomentosus (Fr.) Murill. Mycologia. 1: 153, 1909.
Boletus subtomentosus Fries. Syst. Mycol. p. 389. 1821.

Pileus about 2–5 cm broad, convex when young, in age becoming plano-convex, margin slightly incurved, surface dry, subtomentosus, velvety, even; color with acajou red, to carmin when young, getting paler to fawn, wood brown in development, in age surface becoming slightly rimose. Context thin, yellowish, slightly blue when cut. Tubes about 0.5 cm long, adnate, in age slightly depressed around stipe, pores large, angular, irregular, near the stipe slightly lamellate, pore and tube both primuline yellow to mustard yellow, and slightly bluish when cut or bruised. Stipe about 5 cm long, 0.5 cm thick, equal, solid, concolorous with pore, upper portion is paler than lower portion, surface of the stipe is pruinose. Spores 12–17.5 × 4.5–6 μm, subfusiform, smooth, narrowly inequilateral in profile, wall thick. Basidia clavate or sphaeropedunculate, 28–35 × 10–12.5 μm. Pleurocystidia lanceolate about 50 μm wide. Epicutis of the pileus is trichodermium type, thin wall, smooth, obtuse. Clamp connection absent.

Habitats: solitary, scattered, under mixed forest.
Specimen Examined: HSINCHU: Mt. Ta-Ba-Chien. alt. 2000 m, under mixed forest, Aug. 26, 1979, TAI-YB-007.

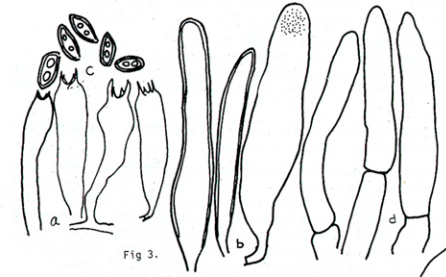

Fig 3.

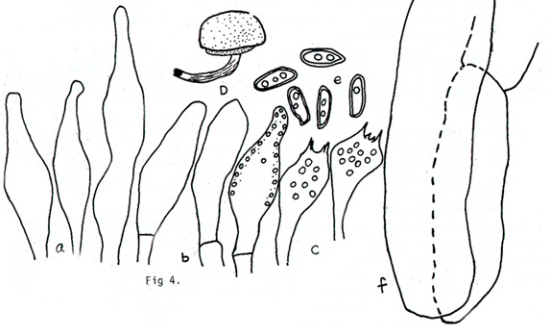

Fig 4.

Fig. 3. *Phylloporus rhodoxanthus*: a. basidia; b. cystidia; c. basidiospores; d. surface cells of pileus; ×480.

Fig. 4. *Xerocomus chrysenteron*: a. cystidia; b. caulocystidia; c. basidia; d. fruiting body ×¾; e. basidiospores; f. surface cells of pileus; ×480.

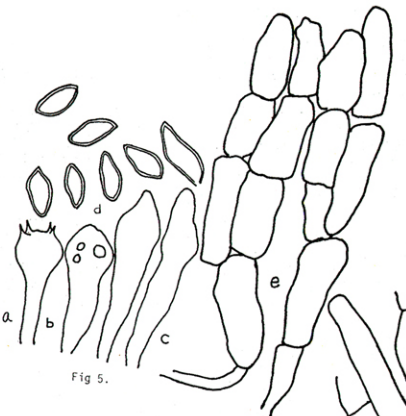

Fig 5.

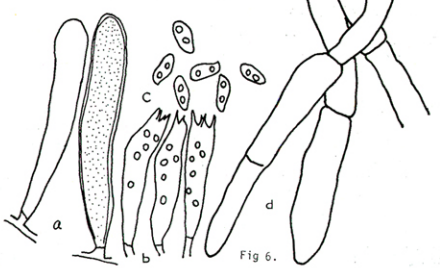

Fig 6.

Fig. 5. *Xerocomus subtomentosus*: a. basidia; b. basidiole; c. cystidia; d. basidiospores; e. surface cells of pileus-trichodremium tye. ×480.

Fig. 6. *Boletinus pictus*: a. cystidia, b. basidia; c. basidiospores; d. surface cells of pileus; ×480.

Note. this specimen has variable context and hymenophore and more or less close to *Xeroconus spacideus* var. *gracilis*. But differ in having rather larger spores.

6. **Boletinus pictus** (Peck) Peck; Bull. N. Y. State Mus. **8**: 77, 1889. Fig. 6 & Plate 14

Boletus pictus Peck. Ann. Rept. N. Y. State Cab. **23**: 128, 1872.
Suillus pictus (Peck) Smith & Thiers. Contrib. toward a monograph of N. Amer. sp. of Suillus p. 31. 1964.

Pileus 3–7 cm broad, plano-convex to plane, margin incurved, with remains of the veil, slightly undulate when developed, pompeian red when young, getting fading then changing into pink, tawny, hazel, ocher with development, surface dry smooth when young, in age becoming fibrillose-scale. Context about 10 mm thick, pale yellow orange, turning pinkish when cut. Tubes 0.5 cm long, adnate or slightly decurrent, primuline yellow. Pores concolorous with tube, large, angular, boletinoid, pores near the stipe is larger than outer region. Stipe 7–9 cm long, about 10 mm thick, solid, enlarge downward (bulbous), but base taper (ventricose), context yellow, but base context is brownish, becoming slightly bluish when cut, surface concolorous with cap, with membraneous sheath coating the lower stipe, the sheath is coarsely, fibrillose, striate, some break into patch. Spore print clay to brown, spores 9–10.5 × 3–4 μm, elliptical, olivaceous under microscope, smooth. Basidia 22–38 × 7–9 μm, clavate; pleurocystidia abundant, clavate, 42–75 × 7–12 μm, having two type in phloxin, one gray, the other hyaline. Epicutis of pileus composed of loosely, interwoven hyphae which have smooth, slightly inflated cell, but end cell is obtuse.

Habitats: scattered, under mixed forest.
Distribution: Taiwan, America, Europe, China Mainland.
Specimens Examined: HSINCHU: Mt. Ta-Ba-Chien, alt. 1800 m–2000 m, under mixed forest, Aug. 26, 1979. TAI-YB-007, TAI-YB-008.
Notes: Smith and Thiers (1971) noted the appearance of the species only in native white pine stand. Our specimens were collected in a different habitats more or less close to the description of *B. pictus*.

7. **Gyroporus castaneus** (Fries) Quelet. Enchir Fung p. 161, 1886. Fig. 7 & Plate 6

Boletus castaneus Fries. Syst. Myc. **1**: 392, 1821.
Boletus cyanescens fulvidus Fries. Epicr Syst Myc. p. 426, 1836.
Boletus fulvidus Fries. Epicr Syst Myc. p. 426, 1836.
Boletus testaceus Persoon. Mycol Eur. **2**: 137, 1825.
Suillus castaneus (Fries) Karsten Bidr Finl Nat Folk. **37**: 1, 1882.
Gyroporus castaneus var. *fulvidus* (Fries) Quelet. Enchir Fung p. 161, 1882.
Boletus rufocastaneus Ellis & Everhart. N. Amer. Fungi. 2d Ser. no. 2302. 1890.
Coelopus castaneus (Fries) Bat., Bolets p. 12. 1908.

Pileus 2.5–4 cm broad, obtuse to plano-convex, sometime shallowly depressed; surface dry, unpolish to pruinose; margin entire when young, becoming straight at maturity; color with russet, chestnut-brown to biscuit or tawny orange. Context white, unchanging when bruised, fragile. Tubes about 5 mm deep, depressed around the stipe, white in young, becoming yellowish in age. Pores white, small, irregular, round to angular. Stipe 3–5 cm long, 5–7 mm thick, equal or slightly taper downward, hollow, fragile, surface dry, unpolish, glabrous, color paler than pileus. Spores 7.5–9.5 × 3.8–5.5 μm, smooth, ellipsoidal, some ovoid. Basidia 30–35 × 8–12 μm, clavate. Pileus cuticle is trichodermium type, composed of inflated base hyphae, 35–100 × 8–18 μm, terminal cells of short hyphae like pilocystidia, smooth, thin wall, hyaline in KOH solution (2%). Clamp connection present in carpophore.

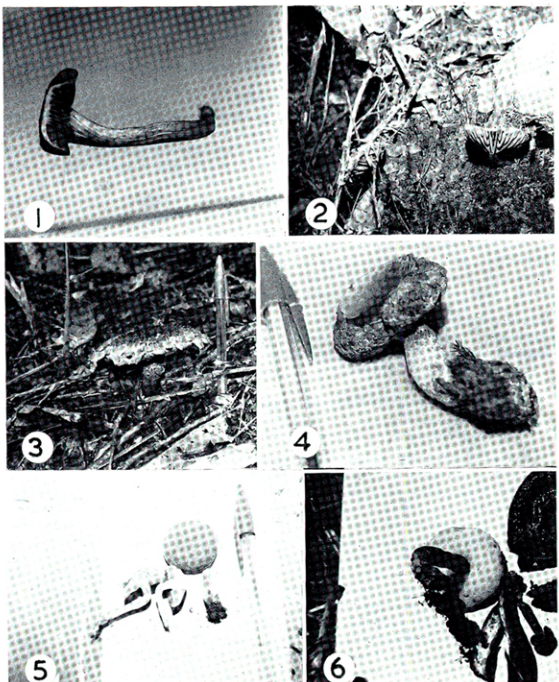

Plate 1. *Phylloporus rhodoxanthus* (Schw.) Bres.
Plate 2. *Phylloporus rhodoxanthus* (Schw.) Bres.
Plate 3. *Strobilomyces floccopus* (Vahl ex Fr.) Kart.
Plate 4. *Gastroboletus scabrosus* Mazzer & Smith.
Plate 5. *Xerocomus chrysenteron* (Fr.) Quelet.
Plate 6. *Gyroporus castaneus* (Fr.) Quelet.

Habitats: solitary, scattered, under mixed forest, or deciduous tree.
Distribution: Taiwan, Japan, North America, China Mainland, Europe, Australia.
Specimens Examined: NANTOU: Wu-She, alt. 1000 m, under deciduous trees. Aug. 30, 1979, TAI-YB-009.
Notes: We collected this specimen from the ground base of a fern (*Nephrolepis auriculate*).

8. **Boletus queletii** Schulzer. Hedwigia **24**: 143, 1885. Fig. 8 & Plate 9

Pileus 5-7 cm broad, convex, dry, glabrous, somewhat like velvety; margin incurved, sterile, undulate, some with small cracks, color shining, brick red, ox-blood red, victoria red, intermixed with small region of yellow. Context about 10 mm thick, yellow, turning strongly blue quickly when cut. Tubes about 6 mm long, free to stipe, yellow, changing to bluish when cut. Pores very minute, less than 0.5 mm diamter, morocco red tinged yellow, changing to bluish when bruised. Stipe about 6 cm long, 2-3 cm wide, solid, subequal or abrupt, base enlarge then contracted; context above base yellow, but in base sordid red, bluish all over when cut. Stipe surface orange to pinkish, with yellowish and pinkish vein, dry, look like slightly reticulate. Spores 12-16×4-6.5 μm, elliptical, smooth, thin wall, olivaceous under microscope. Basidia 30-55×10-13 μm, smooth, clavate, with vacuolar contents. Cystidia ventricose lanceolate, about 80 μm long, 12 μm wide, smooth, thin wall. Epicutis of pileus composed of fibrillose interwoven hyphae, not inflated, paler yellowish in KOH solution (2%). clamp absent. Taste mild.

Habitats: scattered under coniferous tree (Tsuga, Spruce, Abies), on humus with living mosses.
Distribution: Taiwan, Europe, China Mainland.
Specimens Examined: TAICHUNG: Mt. Shue-Shan, alt. 3000 *m*, under coniferous tree (Tsuga forest), Oct. 25, 1979, TAI-YB-012.

9. **Leccinum rugosiceps** (Peck) Singer. Mycologia. **37**: 799, 1945. Fig. 9 & Plate 8

Boletus rugosiceps Peck. Bull. N. Y. State Mus. **94**: 20, 1904.
Krombholzia rugosiceps (peck) Singer. Ann. Mycol. **40**: 34, 1942.

Pileus 15-20 cm broad, convex when young, becoming plano-convex in age; margin round, with small sterile region, some with slightly crenate, surface viscid, uneven, unpolish when dry, color light orange-yellow to sudan brown, becoming rimose-areolate, and showing the white context in the crack; surface is somewhat powdery when dry. Context 2-3 cm thick, white, becoming slightly cream buff when cut, except the tissue immediately above the tube became bluish (forming a bluish band.). Tubes 1-2 cm, yellow, deep depressed around the stipe, becoming dark greenish olive or brownish olive when cut; pores very small, round, concolorous with tube; when bruised changing color as tube. Stipe 6-11 cm long, 3-4 cm thick, solid, equal, flesh-fibrillose, orange yellow (paler than pore color), with many asperuli at surface. the asperulus turned brownish in age. Spores 10-16×4-5 μm, fusiform, elliptical, smooth. Basidia 25-30×8.5-11 μm, clavate. Cystidia 45-60×12-15 μm, rostrate, ventricose, smooth. Asperulus composed of hymenium, caulobasidia with 1, 2, 4, sterigma, caulocystidia lanceolate, ventricose, brachy, also with paraphyses. Caulobasidiospores 10-17×4-5 μm, subfusiform, elliptical-fusiform, ovoid. Epicutis of pileus hyphae like trichodermium type, but also like cellular type, end cell more or less inflated. Taste mild, odor fragrant.

Habitats: gregarious under deciduous tree.
Distribution: Taiwan, Japan, America, Europe.
Specimens Examined: TAICHUNG: Li-Shan. alt. 2000 m, under deciduous forest, Sept. 16, 1979. TAI-YB-011.
Notes: This specimens grows with roots of *Quercus variabilis*.

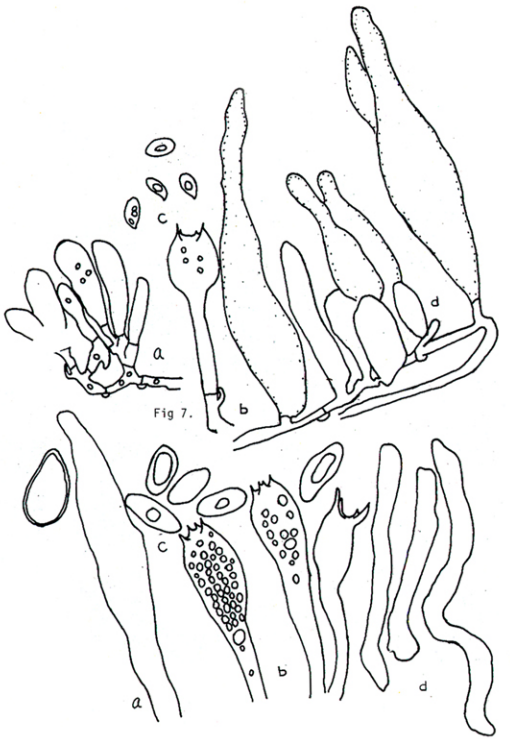

Fig. 7. *Gyroporus castaneus*: a. basidioles; b. basidia; c. basidiospores; d. surface cells of pileus; all hyphae with clamp connection; ×480.

Fig. 8. *Boletus queletii*: a. cystidia; b. basidia; c. basidiospores; d. surface cells of pileus; ×480.

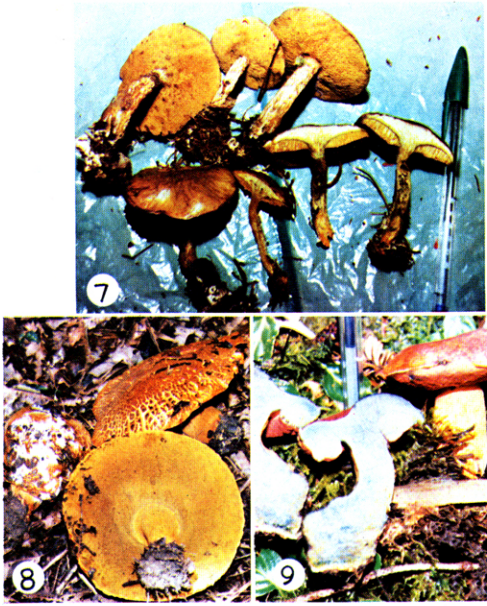

Plate 7. *Suillus subalutaceus* (Smith & Thiers) Smith & Thiers.
Plate 8. *Leccinum rugosiceps* (Peck) Singer.
Plate 9. *Boletus queletii* Schulzer.

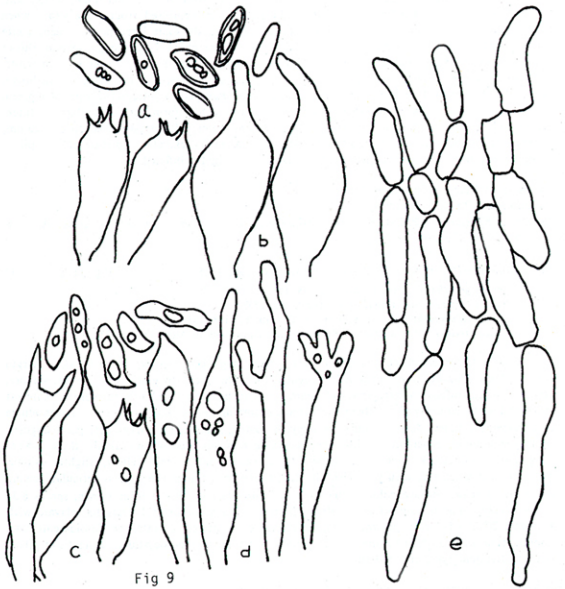

Fig. 9. *Leccinum rugosiceps*: a. basidia and basidiospores; b. cystidia; c. caulobasidia and spores; d. caulocystidia and streile hyphae; e. surface cells of pileus. ×480.

10. **Leccinum holopus** var. **holopus** (Rostkovius) Watling. Trans. Brit. Mycol. Soc. **43**: 692, 1960. Fig. 10 & Plate. 13

Pileus about 5 cm broad, strongly convex, margin sterile, surface smooth, slightly viscid, somewhat moist, soft to the touch, having unpolish, glabrous appearance, but with slightly appressed, fibrillose, pale flesh color to pink, disc paler to whitish. Context thick, white, soft, about 5 mm thick. Tubes about 6 mm deep, adnate, in age depressed around the stipe, when young color is pallid, in age pale vinaceous-fawn; pores small, some large pores spread, white when young, in age becoming pale vinaceous-fawn. Stipe about 7 cm long, 7–9 mm thick; context flesh-fibrillose, context of the upper portion white to yellowish, lower portion white, stipe solid, taper upward, apex ornamented with pink squamules, the rest with yellow-brown squamules, becoming brownish at maturity; base color wax yellow intermixed with blue-green. Spore print brown, spores 11–15 × 5–7.5 μm, elliptical, subfusiform, smooth, slightly thick. Basidia clavate, with contents in the cell, 27–35 × 8–12 μm; pleurocystidie 40–50 × 14–20 μm, ventricose; caulocystidia rostrate, sicyoid (with flexuous neck), clavate. Epicutis of the pileus composed of interwoven appressed hyphae, end cell is slightly inflated.

Habitats: solitary under mixed forest.
Distribution: Taiwan, America, Europe.
Specimens Examined: HSINCHU: Mt. Ta-Ba-Chien, alt. 2000 m, under mixed forest, Aug. 26, 1979, TAI-YB-010.

11. **Suillus grevillei** (Klotzsch) Singer. Farlowia **2**: 259, 1945. Fig. 11 & Plate 12

Boletus grevillei Klotzch. Linnaea **7**: 198, 1832.
Boletus elegans Fries. Epicr. Syst. Mycol. 409, 1838.
Boletus clintonianus Peck. Ann. Rept. N. Y. Cab. **23**: 128, 1872.
Suillus grevillei var. *clintonianus* (Peck.) Singer. Agaricales in Mod. Tax. p. 721, 1951.

Pileus 8–10 cm broad, convex when young, becoming plano-convex, plane in age, margin obtuse, slightly sterile, some incurved, irregular; surface viscid to glutinous, uneven, smooth, color vinaceous-rufous to ferruginous at central region, paler to hazel toward margin. Context straw-yellow to amber yellow, about 2 cm thick, becoming pinkish buff when cut. Tubes adnate to decurrent, 5–10 mm deep, ochraceous-tawny, becoming pompeian red when cut; pores angular, slightly boletinoid, concolorous with tube, becoming pompeian red when bruised. Stipe 6–8 cm long, about 5 mm thick, solid, equal to slightly clavate, context pale yellow, slightly sulphur green at base when cut, with yellowish annulus; above the annulus the stipe is reticulate owing to decurrent pore; Surface color of the stipe is pompeian red. Spore print brown, spores 8.5–12.5 × 4–5 μm, smooth, subfusiform, oblong-elliptical, fusiform-elliptical. Basidia clavate with 4-spored, 20–26 × 5–7 μm; pleurocystidia in cluster or scattered, clavate, or fusoid-ventricose, smooth, thin wall, 35–50 × 4–6 μm; cheilocystidia is similar to pleurocystidia. Epicutis of pileus is trichodermium type, end cell tubular.

Habitats: gregarious, cespitose, mycorrhizae with larch.
Distribution: Taiwan, Japan, America, Europe, Australia.
Specimens Examined: HSINCHU: Mt. Ta-Ba-Chien, alt, 2200 m, under coniferous tree (larix), Aug. 26, 1979, TAI-YB-013.

12. **Suillus bovinus** (L. *ex* Fr.) O. Kuntze. Rev. Gen. Plant. **3**(2): 535, 1898. Fig. 12

Boletus bovinus L. ex Fr. Syst. Mycol. **1**: 388, 1821.
Ixocomus bovinus (L. ex Fr) Quelet. Flor. Myc. Fr., p. 413, 1888.

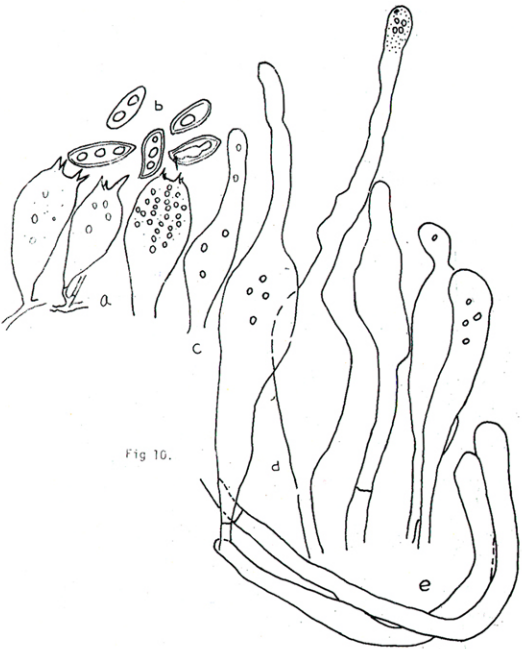

Fig 10.

Fig. 10. *Leccinum holopus*: var. *holopus*; a. basidia; b. basidiospores; c. cystidia; d. caulocystidia; e. surface cells of pileus. ×480.

Pileus 3–8 cm broad, strongly convex when young, in age becoming plano-convex or plane, margin straight, some sterile, incurved, irregular or undulate, viscid to glutinous, warm buff to yellow ocher; context thick, whitish to naple yellow, or cream color, slowly turning to brownish when cut. Tubes 5–7 mm deep, adnate to decurrent, sulfur yellow when young, in age turning to aniline yellow; pores large, angular, boletinoid, concolorous with tube, some olivaceous in age. Stipe 2–3.5 cm long, 6–9 mm thick, solid, equal to taper downward, antimony yellow, moist; apex with vein owing to decurrent pore; context also antimony yellow, appearing olivaceous in age, basal part tawny color, base with white mycelium. Spore print dark brown, spores 7–8 × 2.5–3.5 μm, ovoid, subfusiform. Basidia 15–25 × 4–5 μm, with vacuole contents; pleurocystidia in cluster, clavate, or fusoid-ventricose, thin wall, smooth, the former type appearing gold-yellow in phloxin, 22–46 × 4–7 μm. Epicutis of the pileus composed of appressed, interwoven hyphae mixed with jelly substance, hyphae cells 10–88 × 3–20 μm, cell wall papillated with irregular shape granules.

Habitats: gregarious under pinus.
Distribution: Taiwan, Japan, Europe, North America, Aferica, China Mainland, Siberia.
Specimens Examined: HSINCHU: Mt. Ta-Ba-Chien, alt. 2900 m, Aug. 26, 1979, TAI-YB-014; NANTOU: Wu-She, alt. 1000 m, Aug. 30, 1979, TAI-YB-015; CHIAYI: Mt. Yu-Shan, (Mt. Morrison), alt. 2600 m, Nov. 30, 1979, TAI-YB-016.

13. **Suillus subaureus** (Peck) Snell in Slipp & Snell; Lloydia **7**: 30, 1944. Fig. 13 & Plate 15

Boletus subaureus Peck. Ann. Rept. N. Y. State Mus. **39**: 42, 1886.
Rostkovites subaureus (Peck) Murril. Mycologia. **1**: 13, 1909.
Ixocomus subaureus (Peck) Singer. Rev. de. Mycol. **3**: 45, 1938.

Pileus 4–6 cm broad, convex with incurved margin, when old becoming plane, at times the margin strongly waved and flared, some parts involute; surface viscid when moist, slightly glutinous, color mars yellow, yellow ocher or antimony yellow, some spotted with appressed brownish tomentum. Context 10–15 mm thick, yellow, taste slightly acid. Tubes about 6 mm deep, aniline yellow to orange citrine, adnate, slightly decurrent; pores rectangular to irregular, medium in size, concolorous with tube, somewhat radiate. Stipe about 3 cm long, 5 mm thick, cylindrical, equal, solid, apex pale lemon yellow, basal part natal brown with glandular dots, the dots sparse, clay color, turning to darker or black in age, stipe base covered by mycelia; context turning reddish tawny when cut. Spores elliptical to subfusoid, 7–12 × 4–5 μm, smooth. Basidia 4- or 2-spored, 22–30 × 6–8 μm, smooth, clavate, thin wall. Pleurocystidia in cluster, 30–60 × 5–6.5 μm, clavate, some dark brown, some hyaline; cheilocystidia same as pleurocystidia. Epicutis of pileus composed of gelatinous, filamentous, interwoven hyphae, about 4 μm wide.

Habitats: solitary and scattered on the ground of peacock pine.
Distribution: Taiwan, America, Europe, Japan.
Specimens Examined: NANTOU: Wu-She, alt. 1000 m, under peacock pine, Aug. 30, 1979, TAI-YB-018.

14. **Suillus subalutaceus** (Smith & Thiers) Smith & Thiers. The Boletes of Michigan, p. 57, 1971. Fig. 14 & Plate 7

Suillus acidus var. subalutaceus Smith & Thiers. Contrib. toward a Monograph of N. Amer. Sp. of Suillus. p. 75. 1964.

Pileus 3–7 cm broad, obtuse to convex, in age always obtuse umbo, surface viscid, slightly glutinous, clay color, but somewhat yellowish, ochraceous, becoming cinnamon buff to tawny olive in age; margin thin, with remains of veil. Context about 10 mm thick, yellowish or lemon yellow, slowly turning brownish when cut. Tubes about 5 mm deep, adnate to somewhat subdecurrent, pale yellow, stain brownish when cut, pores medium size, round, yellow ocher,

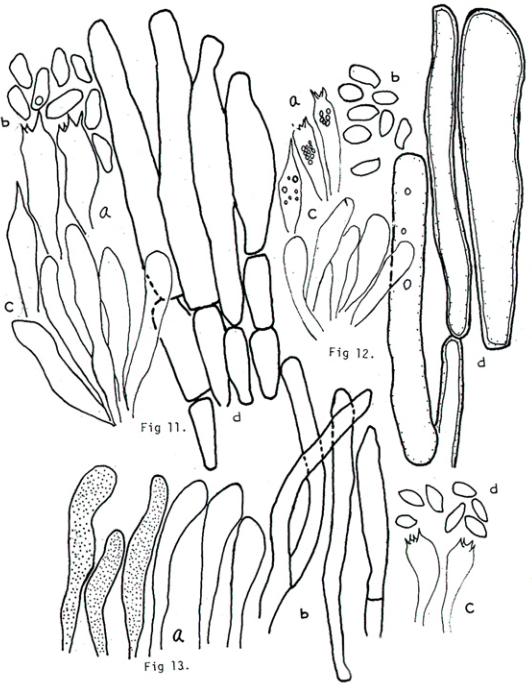

Fig. 11. *Suillus grevillei*: a. basidia; b. basidiospores; c. cystidia-ventricose and clavate type; d. surface cells of pileus; ×480.

Fig. 12. *Suillus bovinus*: a. basidia; b. basidiospores; c. cystidia-ventricose and clavate type; d. surface cells of pileus; ×480.

Fig. 13. *Suillus subaureus*: a. cystidia-hyaline and golden yellow type; b. surface cells of pileus; c. basidia; d. basidiospores; ×480.

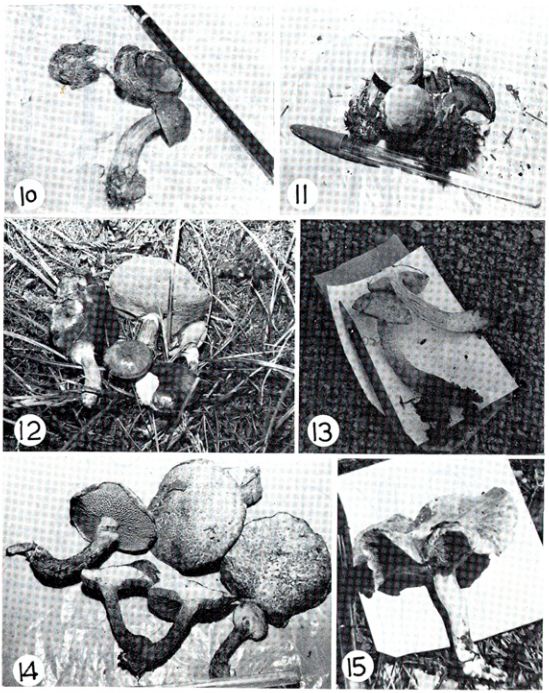

Plate 10. *Gastroboletus scabrosus* Mazzer & Smith.
Plate 11. *Suillus punctipes* (Peck) Singer.
Plate 12. *Suillus grevillei* (Klotzsch) Singer.
Plate 13. *Leccinum holopus* var. *holopus* (Rostkovius) Watling.
Plate 14. *Boletinus pictus* (Peck) Peck.
Plate 15. *Suillus subaureus* (Peck) Snell in Slipp & Snell.

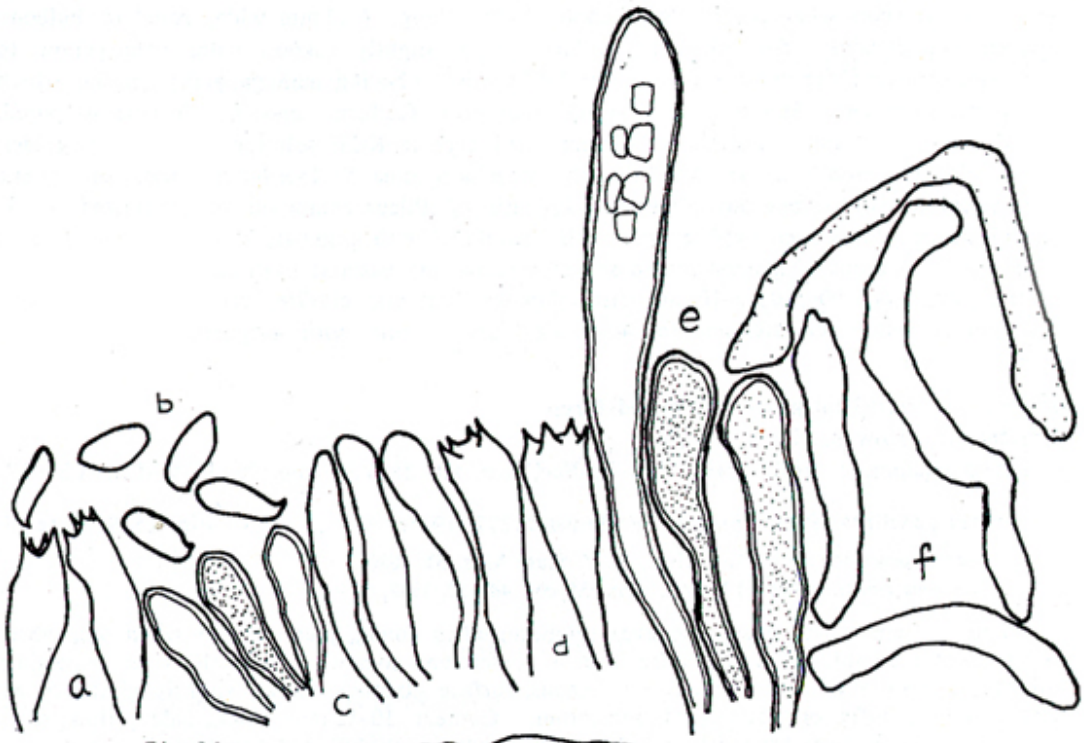

Fig 14.

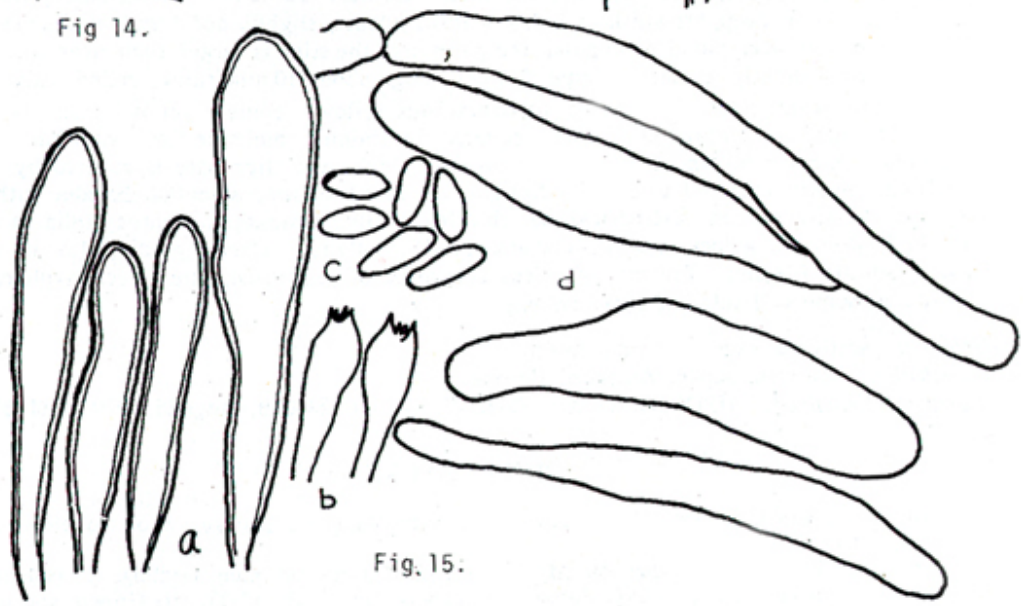

Fig. 15.

Fig. 14. *Suillus subalutaceus*: a. basidia; b. basidiospores; c. cystidia-hyaline and golden yellow type, d. caulobasidia; e. caulocystidia-hyaline and golden yellow type; f. surface cells of pileus; ×480.

Fig. 15. *Suillus punctipes*: a. cystidia; b. basidia; c. basidiospores; d. surface cells of pileus; ×480.

having tawny spots when touch. Stipe about 5-9 cm long, 7-12 mm wide, equal to bulbous, covered with glandular dots all over, surface rough, slightly rugous, color pale yellow to brownish, solid but somewhat tubular at middle portion; having mahogany red annulus which may diminish in age. Spores 8-10×3-4 μm, subfusoid, fusiform, smooth. Basidia 4-spored, clavate, 20-25×5-7 μm. Cystidia in cluster, two type in KOH solution (2%), one is golden yellow, clavate, smooth, 22-35×4.5-7 μm, the other is hyaline 30-45×4-6 μm, most smear, but some smeared with amphorous material. Epicutis of Pileus composed of gelatinized, semi-decumbent and interwoven hyphae, some cells papillated with granular, 25-68×3-6 μm. Glandular dots vinaceous cinnamon composed of cystidia and basidia; cystidia two type in KOH solution (2%); one 90-110×5-10 μm, with glanular contents, clavate, clavate, in cluster, the other golden yellow, clavate, smooth, 40-50×4-7 μm, basidia with 4-spored, 25-30×4-5 μm, clavate, smooth.

Habitats: scattered on ground of mixed forest.
Distribution: Taiwan, North America.
Specimens Examined: HSINCHU: Mt. Ta-Ba-Chien, alt. 2500 m, Aug. 26, 1979, TAI-YB-019.

15. **Suillus punctipes** (Peck.) Singer. Farlowia **2**:277, 1945. Fig. 15 & Plate 11

Boletus punctipes Peck. Ann. Rept. N. Y. State Mus. **32**, 1880.
Ixocomus punctipes (Peck) Singer, Ann. Mycol. **40**: 30, 1942.

Pileus 2-7 cm broad, strongly convex (globose) when young, plano-convex when old, when young covered by tufts of dull grayish brown tomentum, somewhat whitish, then becoming dull ochraceous-orange to pale dingy ochraceous, surface glabrous, viscid, slightly glutinous, at margin having tufts or patches of tomentum. Context 10-12 mm thick, pale yellow, soft. Tubes about 5 mm deep, brownish to honey yellow, adnate, slightly decurrent, or sinuate. Pores small to medium size, round to angular, the pores near the stipe is larger than near the margin, honey yellow, slightly radiate. Stipe 2-7 cm long, about 10 mm thick, cylindricaly slightly enlarged downward, solid, dull orange to ochraceous yellow; context yellowish slowly turning olivaceous when cut, surface all densely covered by minute punctate or somewhat scabrous dots, dots is grayish brown at first, then turning black; the stipe base is covered by whitish mycelium. Spores ellipsoid to fusoid-elliptical, 7.5-10×3-4.5 μm, smooth. Basidia with 2- or 4-spored, 12-15×4-5 μm, cylindrical to clavate, hyaline, smooth. Pleurocystidia in cluster, smooth, hyaline or golden yellow, clavate, 30-45×7-9 μm. Cheilocystidia also in cluster, clavate, 30-50×7-9 μm. Epicutis of pileus composed of gelatinzed, interwoven hyphae, 55-85×6-12 μm, some cell tubular, some oblong.

Habitats: scattered under red pine forest.
Distribution: Taiwan, Japan, America, Europe.
Specimens Examined: HSINCHU: Mt. Ta-Ba-Chien, alt. 2400 m, Aug. 26, 1979, TAI-YB-017.

REFERENCES

1. HOU, H. H., and L. L. WU. 1971. Survey of Fleshy Fungi in Taiwan. J. of the Horti. Soc. of China. **17**(1): 1.
2. HU, HUNG-TAO, 1976. Studies on Mycorrhizae of Taiwan red pine seedlings (I) Isolation, inoculation and morphology. Exp. Forest Nat. Taiwan Univ. **118**: 17-30; (II) Growth and nutrient uptake. ibid. **118**: 31-38.
3. HUNG, L. L., and C. Y. CHIEN. 1978. Physiological Studies on Two Ectomycorrhizal Fungi *Pisolithus tinctorius* and *Suillus bovinus*. Tran. Myc. Soc. Japan. **19**(2): 121-128.
4. KIDA, T. 1937. A Glimpse of Mushroom in Mt. Niitake and Its Vicinity. Trans. Taipei Agr. & Forestry J. Coll. **2**(3): 360-366.
5. RIDGWAY, R. 1912. Color Standards and Color Nomenclature. Published by the author.
6. SAWADA, K. 1933. Descriptive catalogue of the Formosan Fungi. VI, 56.
7. SAWADA, K. 1944. Ibid. XI, 116.