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THE GENUS *FISCHERULA* (TUBERALES)

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SUMMARY

Fischerula, hitherto known only from *F. macrospora,* the Italian type species, is expanded to include a new species, *F. subcaulis,* from Oregon and Washington. *Fischerula* has been regarded as a member of the Tuberaceae, but its affinities are closer to the genus *Hydnotrya* than to the genus *Tuber.*

In southwest Washington State in 1969, I collected a large number of specimens of an undescribed truffle unique in having a well-developed stipe-columella. By virtue of this character, it appeared to represent a new genus; however, none of the specimens had mature spores. Two years later, mature specimens of the same fungus were discovered in western Oregon. The stipe-columella varied from a simple basal pad to a large core surrounded by gleba and extending more than a centimeter beyond the glebal base. Despite this feature, novel to the Tuberales, the mature spores strikingly resembled those of *Fischerula macrospora* Matt., known only from central Italy (Mattirolo, **1928**, **1934**, **1935**). Detailed comparison of additional anatomical features of the Italian and northwest American specimens clearly indicated a generic relationship despite the stipe-columella of the latter.

Fischerula has been placed close to *Tuber* because of its ornamented spores and asci embedded in tramal veins (*venae internae*) which are separated by clearly differentiated, hypha-stuffed veins that emerge through the peridium (*venae externae*) (Fisher, **1938**). However, the mucilagenous spore ornamentation and the broad, often isodiametric cells of the peridium of *Fischerula* are unlike those of *Tuber.* Rather, they closely resemble those typical of the genus *Hydnotrya.*

Anatomical features in the following descriptions are from mounts in 5% KOH unless otherwise specified. Colors of the new American species were based on Ridgway (**1912**), but the terminology was converted to that of the ISCC-NBS near-synonyms (Kelly and Judd, **1965**). Specimens examined are deposited in the mycological herbaria of Botanisches Institut, Univ. Bern, Switzerland (BERN), Istituto

Botanico, Univ. Torino, Italy (TO), and Oregon State University, Corvallis (OSC).

FISCHERULA Matt., Nuovo Giorn. Bot. Ital., n. s. **34**: 1348. 1928.

Type species: Fischerula macrospora Matt.

Etymology: In honor of mycologist Eduard Fischer (1861–1939) of Bern, Switzerland.

Ascocarps hypogeous, subglobose to irregular, with or without stipe-columella. Peridium smooth to minutely scabrous-warty, often furrowed, grayish-pink to yellow-brown. **Gleba** solid, of brown to purplish-black fertile tissue marbled with narrow, white to grayish-yellow, palisade-lined, hypha-stuffed veins that occasionally emerge through the peridium. **Spores** ellipsoid, 49–87(–110) × 40–73 μm including epispore of dark brown, rounded to conic warts up to 15 μm tall. Asci 1–6(–8) spored, embedded in tramal tissue, ellipsoid to obovoid, subcylindric or reniform, short stipitate, with multilayered walls 1–3 μm thick, nonamyloid. **Peridium** (ectal excipulum) of large, elongate to isodiametric cells with yellow to brown walls 1–3 μm thick.

KEY TO SPECIES

Ascocarps sometimes with a basal pad but lacking a stipe-columella; spore ornamentation 3–8 μm tall at maturity.....1. *F. macrospora.*
Ascocarps with a slight to prominent stipe-columella; spore ornamentation 6–15 μm tall at maturity.....2. *F. subcaulis.*

1. FISCHREULA MACROSPORA Matt. Nuovo Giorn. Bot. Ital., n.s. **34**: 1348. 1928. FIG. 1

Etymology: Greek, "large spored."

Illustrations: Mattirolo (**1935**) Plate II, Figs. 1–7; Knapp (**1951**), Plate V, Fig. 1; Ceruti (**1960**), Plate XLVI, Fig. 2.

Ascocarps hypogeous, ±15 × 15–24 mm, subglobose to irregular, with basal indentation. **Peridium** (ectal excipulum) yellowish brown to dark brown, minutely scabrous. **Gleba** solid, of dark brown to nearly black fertile tissue marbled with narrow, pallid to grayish yellow veins that occasionally emerge through the peridium; basal pad lacking or present but inconspicuous.

Spores broadly to narrowly ellipsoid, 49–87(–110) × 40–62 μm including epispore, 44–77(–101) × 36–59 μm without epispore, the walls ±2 μm thick, yellow; in youth smooth, at maturity with epispore of rounded to conic warts or irregular, broad ridges 3–8 μm tall, dark brown, deep reddish brown in Melzer's reagent, weakly cyanophilic in cotton blue-lactic acid. **Asci** 1–5(–8) spored, embedded randomly in

tramal tissue, broadly ellipsoid to obovoid, 130–160 × 90–110 μm, tapered to abruptly attenuated to a short, uncroziered stipe ±10 μm in diam; walls hyaline to light brown, 3 or more layered and 2–5 μm thick, nonamyloid. **Peridium** (ectal excipulum) 100–150 μm thick, of elongate to inflated cells 6–30(–40) μm in diam; walls yellow to brown, 0.5–1 μm thick, some surface cells giving rise to emergent, smooth to somewhat surface-granulated, 1–3 celled, blunt-tipped hyphae 25–80 × 10–15 μm. **Glebal fertile tissue** gradually to abruptly differentiated from peridium as hyaline to brown-walled, interwoven hyphae 4–10 μm in diam at septa but cells often inflated (up to 25 μm). **Glebal veins** 50–200 μm broad, lined with a palisade of hyaline to yellow thin-walled cells 20–40 × 6–12 μm, many growing out to loosely stuff the veins with hyaline hyphae 5–12 μm in diam.

Central to southern Italy, November and December.

Collections examined.—HOLOTYPE: *ITALY. Toscana:* Vallombrosa (TO, isotypes at BERN, OSC).—PARATYPES: ITALY. *Campania:* Sora, leg. Carlo Campbell, 26 Nov. 1902, Dec. 1903, Nov. 1912, and 12 Nov. 1925 (all TO).

The description of macroscopic features was derived from Mattirolo's (**1935**) text and illustrations, since I have not seen fresh material. He illustrated spores with broad, rather flat patches of ornamentation, as are characteristic of immature spores. In my examination of his specimens, the spore ornamentation was verrucose on the most mature specimens (FIG. 1). I have listed the Carlo Campbell collections as paratypes; Mattirolo's original description referred to them collectively but did not list them individually.

2. **Fischerula subcaulis** Trappe, sp. nov. FIGS. 2–6

Ascocarpia hypogaea, 8–25 × 13–25 mm, subglobosa, basibus identatis et pulvino basali vel stipes-columella 2–12 × 2–5(–10) mm; peridium canaliculatum, minute scabrum, juventute incarnatum demum brunneum. Gleba solida, juventute incarnata, demum atropurpurea vel prope atra, venis externis albis marmorata. Asci tenus 230 × 80 μm, stipitati, juventute ellipsoidei, obovoidei vel clavati, demum elongati, parietibus crassis atque tristratis. Sporae (cum epispora) 60–77(–96) × 55–73 μm, spadiceae, grosse verrucosae. Holotypus: Oregon, Tillamook Co., Cascade Head, 13 Aug. 1971, Trappe 2866 (OSC).

Etymology: Latin, "somewhat stemmed."

Ascocarps hypogeous, 8–25 × 13–25 mm, subglobose to slightly lobed, the indented base giving rise to a dense basal tuft or pad frequently extended as a recurved stipe 2–12 × 2–5(–10) mm which ends

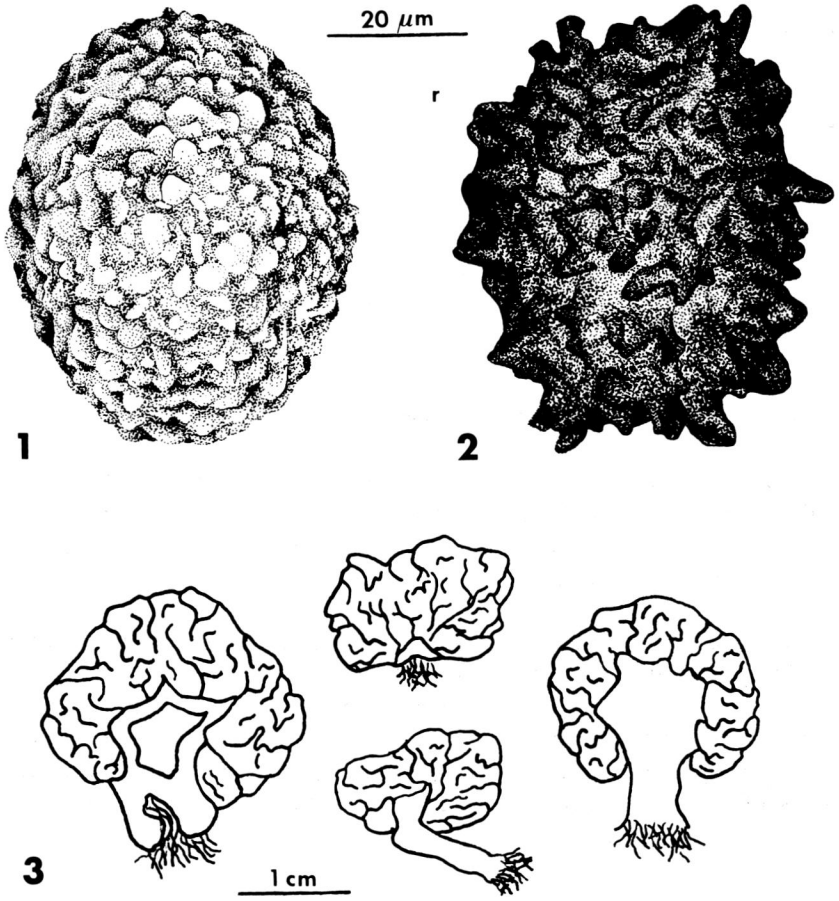


FIG. 1. *Fischerula macrospora*, spore. FIGS. 2–3. *Fischerula subcaulis*. 2. Spore. 3. Diagrammatic cross-sections of ascocarps, showing variation in development of stipe-columella.

in a dense mycelial tuft with much intermingled soil; surface minutely scabrous, furrowed where veins emerge from the gleba, pinkish gray to grayish yellowish pink in youth, soon becoming mottled with darker areas and at maturity moderate brown marbled with light brown where veins emerge; stipe-columella concolorous. Macrochemical reactions to KOH, $FeSO_4$ and ethanol, negative. **Gleba** very firm, the fertile tissue grayish pink in youth and becoming dark grayish purple to nearly black by maturity, marbled with narrow, white, hypha-stuffed veins that radiate obscurely from the columella and emerge through the

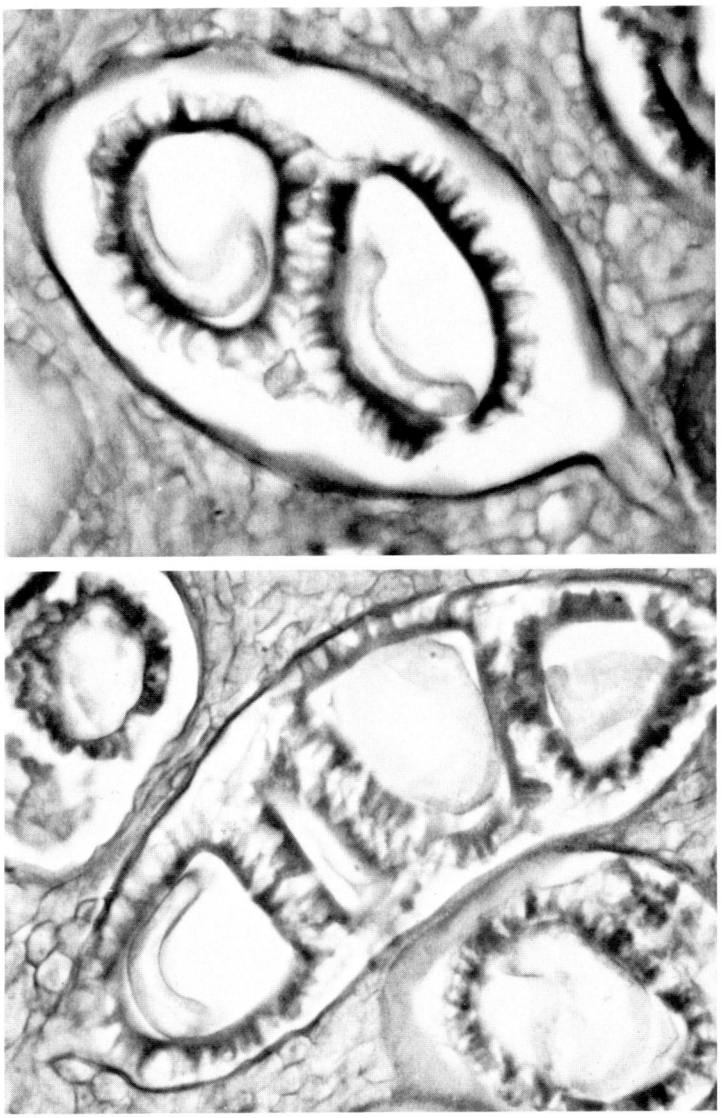
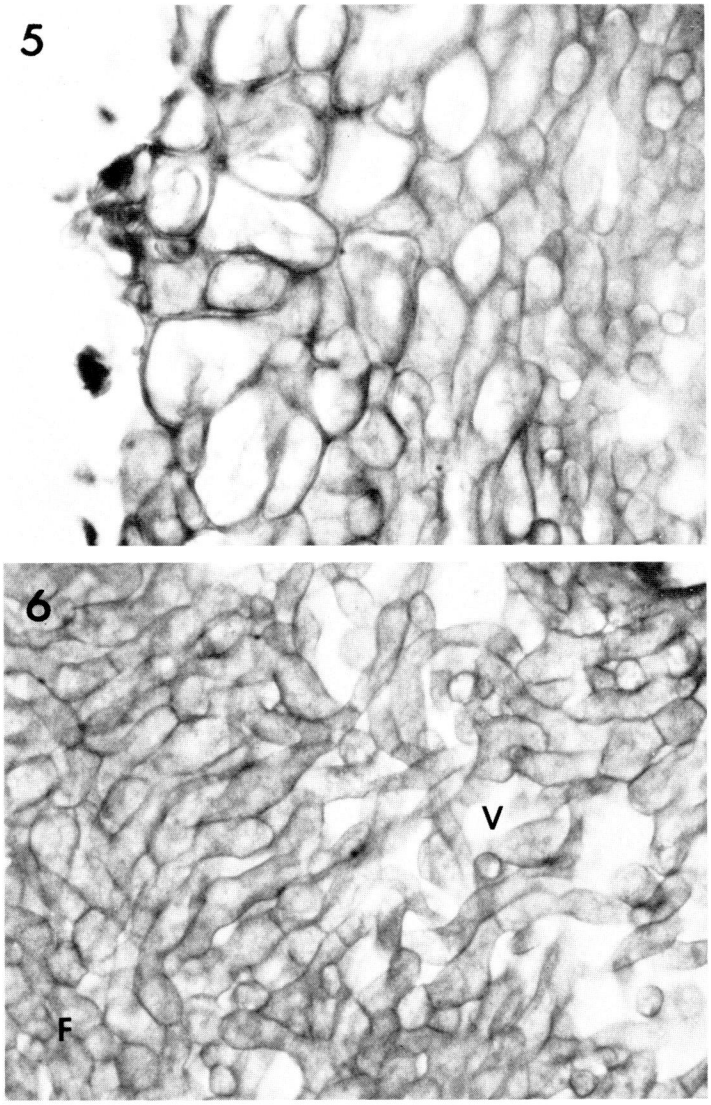


FIG. 4. *Fischerula subcaulis*. Variations in ascus shape × 400.

peridium. Stipe-columella context light grayish reddish brown, the upper portion sometimes becoming hollowed by maturity.

Spores ellipsoid, 60–77(–96) × 55–73 μm including epispore, 40–54(–70) × 25–46 μm without epispore; walls 1–2 μm thick, hyaline and smooth in youth but at maturity brown and ornamented with ob-



FIGS. 5–6. *Fischerula subcaulis.* Tissues in cross section. 5. Peridium (ectal excipulum). 6. Gleba, showing fertile tissue (F) and vein (V) loosely stuffed with hyphae. (All × 400.)

scure, dark brown, flexuous spines 6–15 × 1–2 μm agglutinated into conical to irregular warts and ridges; deep reddish brown in Melzer's reagent, weakly cyanophilic in cotton blue-lactic acid. **Asci** 1–6(–8)

spored, embedded randomly in tramal tissue, ellipsoid to obovoid, reniform or clavate, in youth 120–170 × 55–80 μm, at maturity 120–230 × 65–100 μm, tapered to abruptly attenuated to a short, uncroziered stipe 6–10 μm in diam; in youth walls hyaline and thin, at maturity 3 or more layered and 1–3 μm thick, nonamyloid. **Peridium** (ectal excipulum) 100–150 μm thick, of elongate to inflated cells 5–30(–40) μm in diam, with yellow to brown walls 1–2(–3) μm thick, the outer cells often emergent from the surface and larger in diam than those beneath. **Glebal fertile tissue** rather abruptly differentiated from peridium as hyaline to light brown walled, interwoven hyphae 3–10 μm in diam at septa but cells often inflated (up to 25 μm), the walls ±0.5 μm thick. **Glebal veins** 50–200 μm broad, in youth lined with a palisade of hyaline to yellow, thin-walled cells 30–50 × 7–12(–25) μm, many growing out to loosely stuff the veins with hyaline hyphae 5–10 μm in diam. **Stipe-columella** of subparallel hyphae 5–10 μm in diam with yellow to brown walls 0.5–1 μm thick, near the soil attachment the walls somewhat thicker and irregularly surface-granulated.

Oregon and Washington coasts and coastal mountains, in coniferous or mixed conifer-*Alnus rubra* Bong. forests; probably mycorrhizal with *Pseudotsuga menziesii* (Mirb.) Franco, *Abies procera* Rehd., and possibly other conifers; collected as early as May but not maturing until mid-July to October; sought as food by rodents.

Collections examined.—TYPE: OREGON. *Tillamook Co.:* Cascade Head Experimental Forest, T. 65N., R. 10W., NW 1/4 Sec. 16, hypogeous under moss in 35-yr-old stand of *Pseudotsuga menziesii* and *Alnus rubra,* 14 July 1971, Trappe 2866 (OSC).—PARATYPES: OREGON. *Benton Co.:* near summit of Mary's Peak, 11 Oct. 1973, Fogel 713 (OSC).—*Curry Co.:* Long Ridge Forest Camp, 24 Sept. 1970, leg. C. Maser, Trappe 3208 (OSC).—*Lincoln Co.:* Cascade Head Expt. Forest, 19 July 1966, Trappe 739 (OSC).—*Tillamook Co.:* Van Duzer State Park, 8 Oct. 1970, Trappe 3639 (OSC); Cascade Head Expt. Forest, leg. Elwin Stewart, 10 May 1971, Trappe 2660, and 14 July 1971, Trappe 2814, 2815 (all OSC).—WASHINGTON. *Grays Harbor Co.:* ca. 6 mi S of Elma, 10 June 1969, Trappe 1889, 1890 (both OSC).—*Lewis Co.:* 1 mi N of Vader, 10 June 1969, Trappe 1891 (OSC).

This species differs from *F. macrospora* in having a usually prominent stipe-columella and much taller spore ornamentation at maturity.

The collection from Curry County, Oregon (Trappe 3208), was found in the stomach of the Oregon meadow mouse, *Microtus oregoni*

(Bachman), collected by C. Maser (Maser 2612). An estimated 95% of the mouse's stomach content was comprised of masticated tissue of *F. subcaulis,* which was readily identifiable by its distinctive spores and asci.

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