

CHLOROSPENIUM AND ITS SEGREGATES. II.
THE GENERA CHLOROCIBORIA AND CHLORENCOELIA¹

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ABSTRACT

Four species of *Chlorociboria* are recognized in this monograph; one is divided into two geographically disjunct subspecies, both of which are associated with a phialoconidial state, *Dothiorina tulasnei*. A new species, *C. argentinensis*, and two new combinations, *C. aeruginascens* subsp. *brasiliensis* and *C. omnivirens*, are proposed. Six species and two varieties previously assigned to the genus are reassigned to other genera.

A new genus, *Chlorencoelia*, and the new combinations *C. versiformis* and *C. torta* are proposed for two species previously treated as members of *Chlorosplenium* and *Chlorociboria*.

Based on a thesis presented to the Graduate School of Cornell University in partial completion of the requirements for the degree of Doctor of Philosophy.
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THE GENUS *CHLOROCIBORIA* SEAVER emend. DIXON

When Seaver (1936) erected the genus *Chlorociboria* he did not specifically indicate a taxonomic position for the genus. In 1951, Seaver placed this genus in the family Helotiaceae, tribe Helotieae. Rehm (1893) placed the species now in *Chlorociboria* in the Helotiaceae ("Helotieae") subtribe Ciboriinae ("Ciborieae"). Nannfeldt (1932) placed these species in his family Helotiaceae subfamily Ombrophiloideae. White (1941) suggested that *Chlorociboria* might prove to belong to the Ciborioideae of Nannfeldt (1932), which Whetzel (1945) raised to family rank as the Sclerotiniaceae. Dennis (1956) placed the genus *Chlorociboria* in the Helotiaceae subfamily Phialeoideae. In 1968 Dennis, under the name of *Chlorosplenium*, treated this genus in the Helotiaceae tribe Helotieae (ut "Helotioideae"). Ramamurthi, Korf and Batra (1958) placed the genus in the Sclerotiniaceae and Korf (1958) wrote, "The discovery of at least three Japanese species in which the ascospores regularly germinate by spermatia (much as in some species of *Rutstroemia*) lends additional weight to my view that the genus is correctly a member of that [Sclerotiniaceae] family." Berthet (1964b), however, pointed out, "*Chlorosplenium aeruginosum*, comme nous le signalions dès 1961, possède un mycélium aux articles uninuclées; cette espèce doit donc être placée, comme nous l'avions fait alors, dans les HELOTIACEAE, et rien ne permet d'en faire une SCLEROTINIACEAE, comme l'ont fait Ramamurthi, Korf et Batra (1957), puis Korf (1958, 1959b)."

On the basis of my study, I find that this genus fits

very well in the Leotiaceae (= Helotiaceae) as most other authors have concluded. However, its gelatinous hyphae, its ability to stain wood, its production of microconidia from ascospores and its general morphological features recall several species of *Claussenomyces*. I conclude that *Chlorociboria* should be considered a member of the subfamily Leotioideae, tribe Leotieae. It should also be pointed out that the granularly roughened tomentum hyphae remind one of the granularly roughened hairs exhibited in the Hyaloscyphaceae, both in members of the Trichoscyphelloideae and Hyaloscyphoideae, and the genus *Chlorociboria* may prove to be a connecting link to this family as well.

The pigmentation exhibited by members of this genus has been studied in *Chlorociboria aeruginosa*. Recently Blackburn et al. (1962, 1965) have elucidated the structure of this pigmentation and have confirmed the conclusions of Rommier (1868), Lieberman (1874), Frenzel (1928), and Kogl et al. (1925, 1930a, 1930b) that Xylindein (a peri-hydroxyquinone compound) is responsible for the green coloration of this fungus. Xylindein is formed by the hyphae of the fungus, and even though not readily soluble in water, it does leach from the hyphae staining the substrate which in time displays the aeruginous coloration typical of the fungus. Berthet (1964b) wrote, "*Chlorosplenium aeruginosum* possède des hyphes dont les inclusions lipidiques sont colorées en bleu-vert intense," and in regards to the hyphae of the "stroma" produced in culture, "Ce pigment se trouve répandu dans le milieu en amas irréguliers, probablement à la mort des hyphes qui le renferment."

Berkeley (1860) wrote that the "spawn" of *Chlorosplenium aeruginosum* (most likely *C. aeruginascens* since *C. aeruginosum* does not appear to occur in England) is used by craftsmen in Tunbridge Wells. Evidently they allow the mycelia to develop in the wood and after the wood has been stained, it is manufactured into various objects, *i.e.*, boxes, toys, bowls, etc. According to the Encyclopaedia Britannica (Anon., 1964), "The industry known as Tunbridge Wells ware continued during 300 years, but the factory closed and the small existing supply comes from the spare work of old hands."

GENERIC DIAGNOSIS
OF THE GENUS *CHLOROCIBORIA* SEAVER emend.
(HELTOIALES, LEOTIACEAE)

CHLOROCIBORIA Seaver ex Ram., Korf & Bat., Mycologia 49: 857. 1958, emend. Dixon

≡ [*Chlorociboria* Seaver, Mycologia 28: 390. 1936, not validly published, no Latin diagnosis nor reference to a previously and validly published Latin diagnosis.]

NAME: from Greek, "Chloris," the green one, and *Ciboria*, genus of Inoperculate Discomycetes; referring to the color of the apothecia and the taxonomic affinity to the genus *Ciboria*.

HOLOTYPE: *Helvella aeruginosa* Oeder per Purton [= *Chlorociboria aeruginascens* (Nyl.) Kanouse ex Ram., Korf & Bat.], selected by Seaver (1936) and Ramamurthi, Korf and Batra (1958).

PHIALOCONIDIAL STATE: *Dothiorina* von Höhnel.

Apothecia: superficial, solitary to caespitose, centrally to excentrically stipitate, fleshy to coriaceous.

Disc: shallow cupulate to infundibuliform, orangish-yellow to aeruginous and concolorous with the receptacle.

Receptacle: glabrous or finely tomentose, or with dark aeruginous pustules.

Stipe: glabrous to finely tomentose to heavily pustulate with dark aeruginous pustules.

Asci: cylindrical-clavate with long tapering stalks, apex rounded to subconic and inoperculate, J+, arising from repeating croziers.

Ascospores: fusiform to fusiform-elliptic, in some species sub-allantoid, unicellular to occasionally 1-septate, hyaline or with green contents.

Paraphyses: filiform, blunt at the apex, hyaline, septate, branching near the base.

Subhymenium: not always distinctly delimited, composed of tightly compacted *textura intricata*.

Medullary Excipulum: of loose to tightly compacted, hyaline to aeruginous, gelatinized *textura intricata*.

Ectal Excipulum: of gelatinized, hyaline (in young specimens) to heavily pigmented (in more mature specimens) *textura intricata*, or *textura angularis* to *textura globulosa*. Substrate always stained aeruginous and usually stained in a

extended area.

Habitat: on decayed and decorticated wood.

NOMENCLATRURAL STATUS OF THE SPECIFIC EPITHETS
"AERUGINOSA" AND "AERUGINASCENS"

Confusion exists in the literature concerning the application of the specific epithets "aeruginascens" and "aeruginosa." It has become increasingly clear that (1) the names *Peziza aeruginosa* and *P. aeruginascens* are in desperate need of typification, (2) that every attempt should be utilized to follow the spirit of the International Code of Botanical Nomenclature's Recommendation 7b as adopted at the Seattle Congress (Stafleu and Voss, 1969) which states: "Whenever the elements on which the name of a taxon is based are heterogeneous, the lectotype should be so selected as to preserve current usage unless that element is discordant with the original description and (or) figure," and (3) that any means possible should be used to avoid burdening the literature with another name for a taxon which already has a valid name.

Let us examine the history of these two specific epithets. In 1770 Oeder in the *Flora Danica* [vol. 3 (Fasc. 9): 7, Tab. 534, fig. 2] described and illustrated under the polynomial "Elvela aeruginosa, minima pileo difformi viridissima" a specimen collected by J. G. König in Iceland. Twenty-five years later Persoon (1795) erected independently the species *Peziza aeruginosa*. Later, Persoon (1801) in his *Synopsis Methodica Fungorum* page 663 again described *Peziza aeruginosa* and on page 617 of the same work cited *Helvella ? aeruginosa* based on the description and illustration of Oeder.

Nylander (1869) erected *Peziza aeruginascens* for a species similar to *P. aeruginosa* Pers., but with smaller spores (6-8 × 1.5-2.5 μm). He wrote: "*P. aeruginosa* Raven. Fung. Carol. V, 40, et auctor omnium pr. p.; *Chlorosplenium aeruginosum* Tul. Sel. Fung. Carp. III, p. 187, t. 20, f. 15-19, cum spermogonis." Almost all later authors because of the similarity of the specific epithets have assumed that *Helvella aeruginosa* Oeder and *Peziza aeruginosa* Pers. were synonymous. This is in fact not the case. *Peziza aeruginosa* of Persoon is a large-spored fungus known to Nylander (1869), Schumacher (1803), Albertini and Schweinitz (1805), Schweinitz (1822), etc. It is *Helvella aeruginosa* Oeder (never placed in *Peziza*) which is the fungus named by Nylander (1869) as *Peziza aeruginascens*. Mistakenly, Persoon himself

(1822) synonymized the two species.

Which of the two identical species epithets did Fries 'sanction' when he treated *Peziza aeruginosa* in the *Systema Mycologicum* 2(1): 130. 1822? Both appear in his synonymy. The index to volume 2 is of no help in this instance, for no author is credited there. The index to the whole work, in volume 3, cites the author as "Fl. Dan." But Fries had cited two plates of the *Flora Danica*, one (534) being Oeder's species, the other (1260) being Persoon's. It is only in the *Systema Mycologicum* 2(1): 22. 1822 that the answer is to be found, for here Fries unequivocally states: "H[elvella]. aeruginosa Pers. syn. est *P. aeruginosae* varietas." Fries thus accepted Persoon's name as the basis of the species, not Oeder's. Even though Fries (1822) synonymized the two species, he clearly had Persoon's fungus in mind when he drew up the description of *Peziza aeruginosa*, because the excentrically stipitate fungus illustrated by Holmskjöld (1799) as *P. aeruginosa* was different enough for Fries to recognize it as a variety, *P. aeruginosa* var. *subgrisea*. Holmskjöld's illustration is undoubtedly the same fungus called *P. aeruginascens* by Nylander.

The small-spored fungus (*P. aeruginascens*) which occurs in Europe and Scandinavia became known by the misapplied name, *P. aeruginosa*. Since *P. aeruginascens* was the same fungus, it has been treated as a synonym of *P. aeruginosa* by various workers. In North America, where both species occur sympatrically, workers such as Kanouse (1947) and Ramamurthi, Korf and Batra (1958) recognized Nylander's *P. aeruginascens* as well as *P. aeruginosa* in the concept of Persoon, but attributed, in error, the latter specific epithet to Oeder instead of to Persoon.

Neither of these species has been lectotypified. An attempt to locate an authentic specimen from Oeder's herbarium and an authentic specimen from Persoon's herbarium was made. I have examined the only remaining specimen labelled *P. aeruginosa* in the Persoon herbarium and find it to be *P. aeruginascens* Nyl. I therefore avoided typifying *P. aeruginosa* by this specimen. Attempts to locate an Oeder specimen of *Helvella aeruginosa* were fruitless, and Dr. Skovsted of the Botanical Museum and Herbarium, Copenhagen, informed me (pers. comm.), "There are scarcely any fungi left of those used for the illustrations in *Flora Danica*, and I believe that König's material from Iceland has been lost." It is possible under the International Code of Botanical Nomenclature to typify the species by *Flora Danica* Tab. 534, but I felt that since this species is so poorly illustrated, having only a habit sketch, that this would not be suitable.

In hopes of conserving the current usage of these specific epithets, I am neotypifying *Peziza aeruginosa* by a specimen from the Fries herbarium at Uppsala which preserves Fries's concept of the species, preserves current usage, and which conforms with Persoon's original concept of the species. I am also lectotypifying *P. aeruginascens* by one of the syntype specimens from the Nylander herbarium now on deposit at Helsinki. I hereby designate this same Nylander collection as the neotype of *Helvella aeruginosa* Oeder per Purton. In so doing I am adopting a position that will conserve the usage of these specific epithets by such authors as Kanouse (1947), Ramamurthi, Korf and Batra (1958), Korf (1958, 1959a, b), Dennis (1960, 1968, 1970, 1972), Gamundí (1962), etc.

KEY TO THE SPECIES OF CHLOROCIBORIA

1. Ectal excipulum giving rise to tomentum hyphae..... 2
- 1'. Ectal excipulum not giving rise to tomentum hyphae, but instead at points along the ectal excipulum forming conical mounds of heavily pigmented and granulated *textura angularis* to *textura globulosa* which project almost perpendicularly from the flanks of the apothecium..... 4
- 2 (1). Ectal excipulum giving rise to few to numerous, coiled or sometimes straight, smooth-walled tomentum hyphae; often with several apothecia arising from each darkly pigmented, irregularly shaped fundament or "stromatic mass," excentrically stipitate to infrequently centrally stipitate..... 3
- 2' (1). Ectal excipulum giving rise to few to numerous, straight or coiled, strongly granularly roughened tomentum hyphae, apothecia arising singly from a scarcely differentiated, darkly pigmented, irregularly shaped fundament or "stromatic mass;" centrally stipitate to rarely excentrically stipitate, ascospores (8-) 9-14 (-15) × 2-4 μm..... 1. *C. aeruginosa*
- 3 (2). Ascospores 5-7 (-10) × 1.0-1.5 (-2.4) μm; asci (40-) 50-65 (-75) × 3-4 (-5) μm..... 2. *C. aeruginascens* subsp. *aeruginascens*
- 3' (2). Ascospores 3.0-5.5 (-6) × 1-1.5 μm; asci (35-) 41-49 × 3-4 μm..... 3. *C. aeruginascens* subsp. *brasiliensis*
- 4 (1'). Ascospores (7-) 9.0-10.2 (-11) × 1.7-2.0 μm; several apothecia arising from each darkly

- pigmented, irregularly shaped fundament or "stromatic mass;" centrally stipitate.....
 4. *C. argentinensis*
 4' (1'). Ascospores (11-) 14-18 (-20) × 3-4 μm; apothecia arising singly from a scarcely differentiated, darkly pigmented, irregularly shaped fundament or "stromatic mass;" centrally substipitate to stipitate.....
 5. *C. omnivirens*

THE PERFECT STATES OF CHLOROCIBORIA

1. CHLOROCIBORIA AERUGINOSA (Pers. per Pers. : Fr.) Seaver ex Ram., Korf & Bat. [ut "(Oed. ex Gray) Seaver"], Mycologia 49: 859. 1958.
 ≡ [*Peziza aeruginosa* Pers., [Neue] Ann. Bot. (Usteri) [Stuck] 9: 27. 1795.]
 ≡ *Peziza aeruginosa* Pers. per Pers., Myc. Eur. 1: 291. 1822 (pro parte typica) : Fr., Syst. Mycol. 2(1): 130. 1822 (pro parte typica). (!!)
 ≡ *Chlorosplenium aeruginosum* (Pers. per Pers. : Fr.) Auct., non *C. aeruginosum* (Oeder per Purton) de Not. 1864.
 ≡ [*Chlorociboria aeruginosa* (Pers. per Pers. : Fr.) Seaver [ut "(Oed.) Seaver"], Mycologia 28: 391. 1936, pro parte typica (genus not validly published).]
 = *Peziza aeruginea* Berk., Hooker's J. Bot. Kew Gard. Misc. 6: 210. 1854. (!!)
 ≡ *Chlorosplenium aerugineum* (Berk.) Sacc., Syll. Fung. 8: 318. 1889.
 = *Chlorosplenium discoideum* Masee, Brit. Fungus-Fl. 4: 286. 1895. (!!)

(Figs. 19-20, 28)

Apothecia: superficial, solitary to gregarious, never with several apothecia arising from the same fundament or "stromatic mass," centrally to slightly excentrically stipitate.

Disc: < 5 mm in diam, cupulate to rarely convex-plane, color varying even in the same collection from orange-yellow to almost concolorous with the receptacle to light pea-green (Capucine Yellow to Sorrento Green to Pale Cendre Green) when fresh, becoming slightly darker from that in the fresh state to greenish-black upon drying, edges of disc enrolling

to the point of often touching.

Receptacle: glabrous or finely tomentose, pustulate, aeruginous (Sorrento Green to Dark Viridian Green) when fresh, becoming bluish-aeruginous upon drying, often vertically ribbed or rugose, especially upon drying.

Stipe: $< 3 \times 0.5-1.0$ mm, concolorous with the receptacle, pustulate (often more so than the receptacle), on breaking showing an outer aeruginous cortex with an orange-yellow (Capucine Yellow) medullary tissue.

Hymenium: (55-) 75-90 (-106) μm high, hyaline to aeruginous, often with portions of the hymenium becoming more darkly pigmented.

Asci: cylindric-clavate, with a long tapering stalk, (57-) 68-80 (-95) \times (4.0-) 5-7 (-7.5) μm (mean of collections $79 \times 7 \mu\text{m}$), strongly J+, 8-spored, wall at apex 1.0-1.5 μm thick, 0.25-0.5 μm thick along the sides of the ascus, arising from repeating croziers.

Ascospores: irregularly biseriate, unicellular to submedian 1-septate, fusiform-elliptic, hyaline or with light green contents, prominently biguttulate and/or with several smaller guttules, (8-) 9-14 (-15) \times 2-4 μm (mean of collections $13 \times 3 \mu\text{m}$), spores often germinating in the ascus by unipolar or bipolar germ tubes, with occasional globose or subglobose microconidia 1.0-2.5 μm in diam being produced at the ends of the germ tube and floating free in the mounting media.

Paraphyses: filiform, blunt at the apex, hyaline, septate, branching near the base, (1.0-) 1.5 (-2.0) μm in diam, scarcely extending beyond the asci.

Subhymenium: (5-) 10-25 (-45) μm thick, of hyaline to aeruginous *textura intricata*, hyphae 1-3 μm in diam.

Medullary Excipulum: of gelatinized, thin-walled, loose to tightly compacted *textura intricata*, hyaline to light green (an occasional specimen dark green), hyphae sympodially branched, (2-) 3-4 (-5) μm in diam.

Ectal Excipulum: 15-85 μm thick, of green hyphae forming a single layer of gelatinized hyaline and/or green, granulated *textura intricata*, *textura epidermoidea* or *textura oblita*, dark aeruginous in fully mature apothecia, ectal excipular hyphae giving rise to straight or coiled, strongly granularly roughened tomentum hyphae, in old and in fully mature specimens the outer layer often becoming brown, especially in the lower portion of the stipe.

Habitat: on decayed and decorticated wood; collected on wood of *Abies*, *Acer*, *Akebia*, *Alnus*, *Betula*, *Carpinus*, *Corylus*, *Fagus*, *Fraxinus*, *Liriodendron*, *Nothofagus*, *Picea*, *Pinus*, *Populus*, *Prunus*, *Salix*, *Tsuga*, *Quercus* and unidentified wood.

Range and Seasons of Fructification: North, South and Central America, China, India, Japan, Philippines, Union of Soviet Socialist Republics; Spring, Summer and Autumn.

Name: from Latin, "aeruginosus," deep-green, with a mixture of blue, referring to the color of the apothecia.

Neotype Locality: unknown.

Neotype Specimen: *Helotium aeruginosum*, in lignis *Betula*, (locality unknown), Kalchbrenner, (no date), UPS-Fries No. 287 (= CUP 51738).

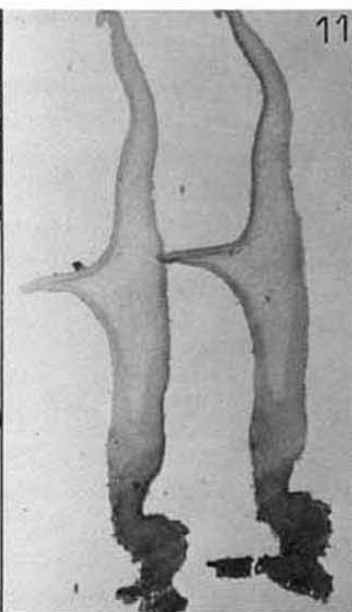
Illustrations: Vahl., Fl. Danica Tab. 1260. 1797 (ut *Peziza*); Weberbauer, Pilze Norddeuts. 1: Tab. 1, fig. 5a, b, & c. 1873 (ut *Peziza*)!; Saccardo, Fungi Italici, Tab. 1348. 1883 (ut *Helotium*); Boudier, Ic. Mycol. Tab. 485. 1908 (ut *Chlorosplenium*)!; Migula, Kryptog.-Flora in Thomé's Fl. Deuts. 3(3²): Pl. 166, figs. 4-6. 1913 (ut *Chlorosplenium*)!; Akai, Bot. & Zool. 2: 835, fig. 2. 1934 (ut *Chlorosplenium*); Le Gal, Prodr. Flore Mycol. Madagascar 4: 363, fig. 161. 1953 (ut *Chlorociboria*); Gamundí, Darwiniana 12: Pl. 5, figs. 1-7. 1962 (ut *Chlorosplenium*)!; Ramamurthi, Korf and Batra, Mycologia 49: 856, fig. 1. 1958 (ut *Chlorociboria*)!; Korf, Sci. Rep. Yokohama Natl. Univ. Sect. 2, Biol. Sci. 7: 25, figs. 7 & 10. 1959 (ut *Chlorociboria* et Tax. sp. 3)!

Exsiccati: Ellis, North American Fungi No. 987 (ut *Chlorosplenium*) CUP-A, CUP-D 11212 (76-26); Fuckel, Fungi Rhenani No. 1158 (ut *Helotium*) FH (= CUP 52690); Herbar Barbey-Boissier No. 1279 (ut *Chlorosplenium*) BPI; Libert,

FIGS. 10-23. Photographs of *Chlorociboria* spp. and of *Dothiorina tulasnei*. FIGS. 10-14. *C. aeruginascens*. 10. Rehydrated apothecia, CUP 51821, approx. $\times 2.5$. 11. Complete section of apothecia, BPI-Jaczewski-s.n., 1895, approx. $\times 7$. 12. Freshly collected apothecia, CUP 51685, approx. $\times 1.5$. 13. Several young apothecia being formed on a single fundamen-
 14. Rehydrated apothecia in side view, CUP 51685, approx. $\times 1.5$. FIGS. 15-18. *Dothiorina tulasnei*. 15. Gross view of young stromata, CUP 52701, $\times 10$. 16. Section of stromata, CUP 51855, $\times 133$. 17. Enlarged view of a pycnidium, CUP 51855, $\times 770$. 18. Side view of a stroma, CUP 52701, $\times 6$. FIGS. 19-20. *C. aeruginosa*. 19. Complete section of apothecium, CUP-VZ 4472, approx. $\times 12$. 20. Rehydrated apothecia, CUP-D 1349 (76-42), approx. $\times 2.5$. FIG. 21. *C. omni-
 22. Dried apothecia, BA 20262, approx. $\times 4$. 23. Dried apothecia, BA 21223, approx. $\times 2$.*



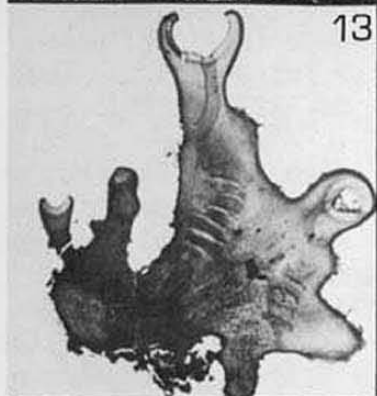
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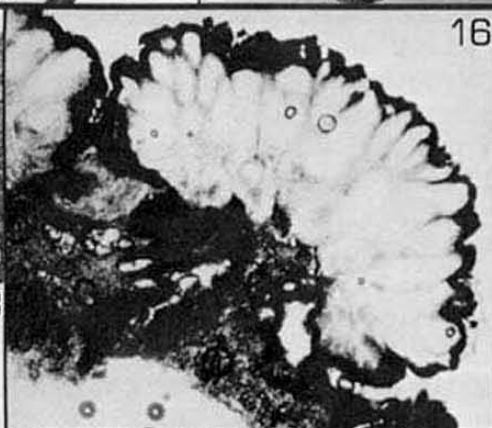
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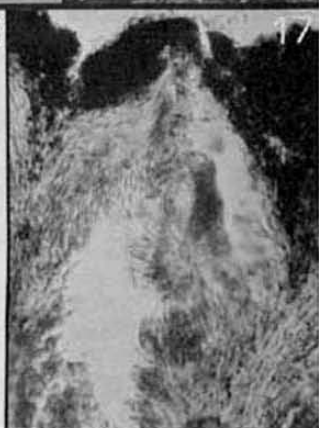
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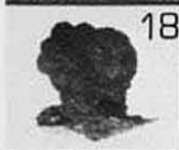
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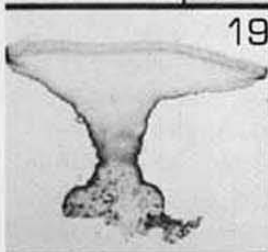
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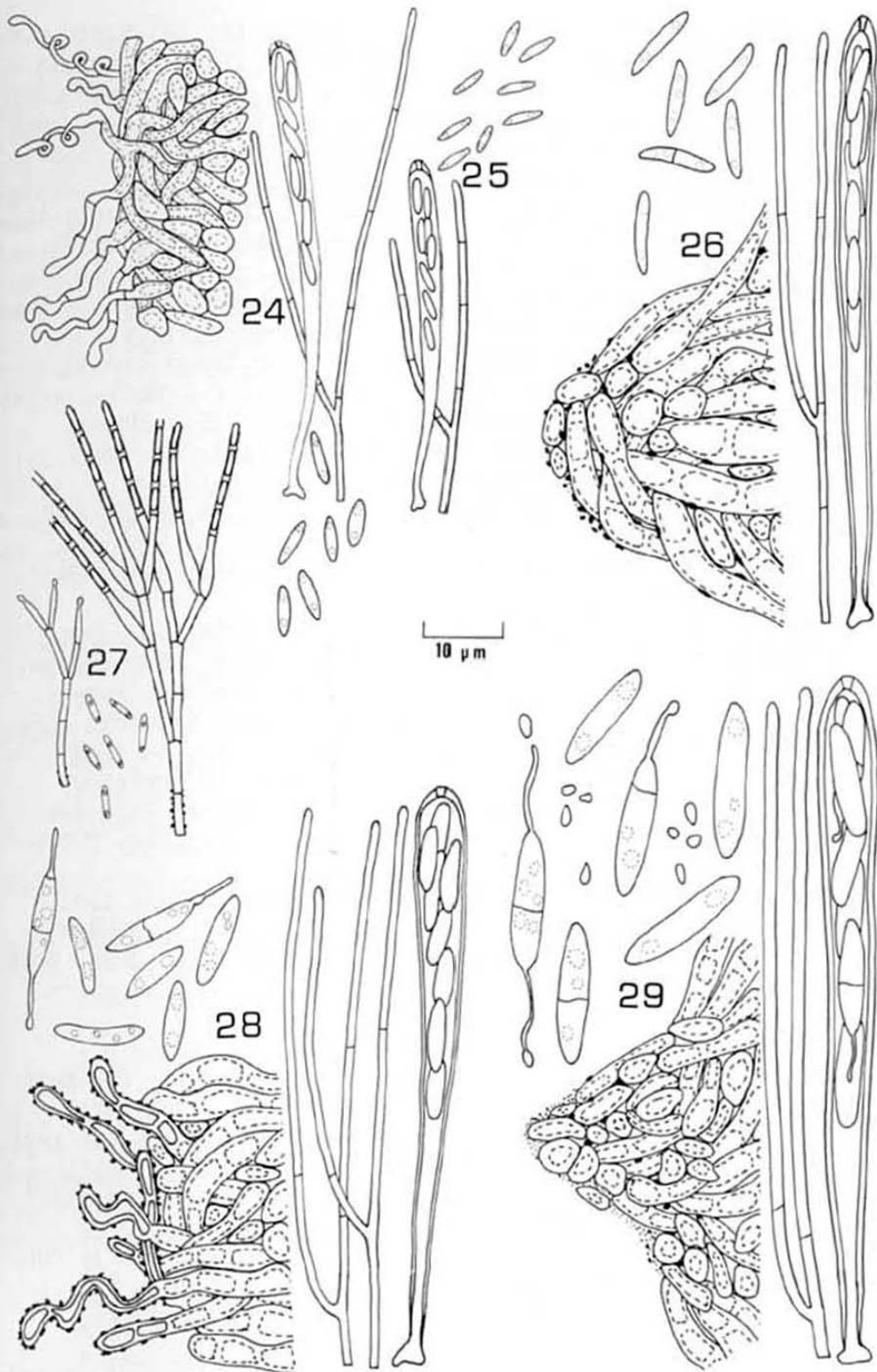


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Pl. Crypt. Arduennae No. 328 (ut *Peziza*) PAD-Saccardo (= CUP 51746); Ravenel, Fungi Caroliniana Exs. Fasc. V, No. 40 (ut *Peziza*) FH, CUP-D 6334 (76-68), 3667 (76-49); Rehm, Ascomyceten Exs. No. 409b (ut *Chlorosplenium*) CUP-D 4890 (76-57); Rick, Fungi Austro-Americani Exs. No. 6a (ut *Chlorosplenium aeruginascens*) BPI; Roumeguère, Fungi Sel. Exs. No. 5522 (ut *Chlorosplenium*) CUP-A, CUP-D 11610 (76-25); Roumeguère, Fungi Gallici Exs. No. 1858 (ut *Chlorosplenium*) CUP; Siemaszko, Fungi Bialowiezenses Exs. No. 19 (ut *Chlorosplenium*) BPI, P; Weese, Eumycetes Selecti Exs. No. 127 (ut *Chlorosplenium*) BPI.

Excluded Exsiccati: Berkeley, British Fungi Exs. No. 281 issued as *Peziza aeruginosa* is *Chlorociboria aeruginascens*; Karsten, Fungi Fennici No. 151 issued as *Chlorosplenium aeruginosum* is *Chlorociboria aeruginascens*; Petrak, Flora Bohemica et Moraviae Exs. No. 234 issued as *Chlorosplenium aeruginosum* is *Claussenomyces atrovirens*; Phillips, Elvellacei Britannici No. 86 issued as *Helotium aeruginosum* is *Chlorociboria aeruginascens*; Rabenhorst, Fungi Europaei No. 1310 issued as *Peziza aeruginosa* is *Chlorociboria aeruginascens*; Saccardo, Mycotheca Italica No. 333 issued as *Chlorosplenium aeruginosum* is *Chlorociboria aeruginascens*; Smarods, Fungi Latvici Exs. No. 771 issued as *Chlorosplenium aeruginosum* is *Chlorociboria aeruginascens*; Wilson & Seaver, Ascomycetes and Lower Fungi No. 78 issued as *Chlorosplenium aeruginosum* is *Chlorociboria aeruginascens*.

FIGS. 24-29. Camera-lucida drawings of *Chlorociboria* spp. and of *Dothiorina tulasnei*, $\times 1000$. FIG. 24. *C. aeruginascens* subsp. *aeruginascens*. Portion of ectal excipulum and tomentum hyphae, R.P.K. 3340; ascus, paraphysis, and six ascospores, CUP-D 1221 (76-10). FIG. 25. *C. aeruginascens* subsp. *brasiliensis*. Ascus, paraphysis, and eight ascospores, BPI-Rick, Fungi Austro-Americani No. 6. FIG. 26. *C. argentinensis*. Six ascospores, paraphysis, ascus, and conical mass of hyphae protruding from the ectal excipulum, BA 21223. FIG. 27. *D. tulasnei*. Young phialide, six microconidia, and more mature phialide producing spores, CUP 52701. FIG. 28. *C. aeruginosa*. Seven ascospores, two in process of germination, CUP-D 1349 (76-46); portion of ectal excipulum and tomentum hyphae, CUP-VZ 4522; two paraphyses, ascus, CUP-D 1349 (76-46). FIG. 29. *C. omnivirens*. Six ascospores, two in the process of germination, and scattered microconidia, ascus, paraphysis, and conical mass of hyphae protruding from the ectal excipulum, CUP-JA 52.



- Specimens Examined:* U.S.A. - CALIFORNIA: BPI-Parks s.n., April 7, 1925. IDAHO: BPI-Weir 8067; CUP 51853. INDIANA: CUP-D 10953 (76-71). MICHIGAN: CUP 51774, 51799. MINNESOTA: CUP-D 10668 (76-78). NEW HAMPSHIRE: CUP 19508, 51846. NEW YORK: BPI-Tapke s.n., Spring 1917; CUP 51707, 51837, 51847, 51849, 51852; CUP-A 12168, 14875; CUP-D 1349 (76-42), 2163 (76-43); CUP-LG 137; R.P.K. 2522. OHIO: CUP-D 2717 (76-44), 4940 (76-58). OREGON: BPI-Kienholz K55; OSC 6415, 29395. PENNSYLVANIA: CUP 131, 45629; PH-Schweinitz Syn. 899, 156 (substrate unknown), Schweinitz, (date unknown), Bethlehem, ut *Peziza aeruginosa*. WASHINGTON: BPI-Humphrey s.n., Oct. 12, 1909, '9-15-1910 on *Alnus*, 9-15-1910 on *Tsuga heterophylla*?; BPI-Weir s.n., Sept. 1915. WYOMING: CUP-D 9863 (76-75). ARGENTINA: BA-20361, 20557 (= R.P.K. 2985), 20873, 20875, 21001, 21127, 21785; BA-Singer 3371; R.P.K. 2955. BRASIL: BPI-Rick s.n., 1923. CANADA - QUEBEC: BPI-McKeen s.n., Nov. 26, 1950; CUP 52347. CHINA: BPI-Deng 5191, 7541, Shen 340, Shen s.n., Sept. 22, 1933, Tsiang 260. COSTA RICA: BPI-Quiros s.n., July 4, 1948. ENGLAND: Holotype of *Chlorosplenium discoideum* Masee, on green colored wood of *Robinia* sp., Kew Gardens, Masee, 9/1894, NY (= CUP 51727); Isotype: CUP-D 8050 (77-50). INDIA: Holotype of *Peziza aeruginea* Berk., on dead wood, Khasia, Hooker and Thomson, (no date), K-Berkeley (= R.P.K. 2939); Isotype NY-Masee, s.n.; CUP-IN 463, 464. JAMAICA: BPI-Orcutt 5716, Welden 571, 928, 950; CUP-D 8043 (76-73), 4980 (77-121). JAPAN - HOKKAIDO: CUP-JA 2631. HONSHU: CUP-JA 1602 (=TNS 201039), 1803, 3514; R.P.K.-JA 1682, 1686. KYUSHU: CUP-JA 401, 419, 1531. YAKU ISLAND: CUP-JA 2020, 2026, 2058. MEXICO: CUP-ME 159. PANAMA: BPI-Martin 2199, 2398, 2773. PHILIPPINES: CUP-SA 1538, 1586, 1624, 1629. UNION OF SOVIET SOCIALIST REPUBLICS - RUSSIA: TAA-Kullman and Raïtviir 61115, Raïtviir 42584, 43431. UKRANIA: BPI-V.P. et L.J. Savicz et A.J. Bjelajajeva s.n., 15-VII-1924. VENEZUELA: CUP 4472; NY-Dumont-VE 7 (= CUP-VZ 4516), 38 (= CUP-VZ 4529), 252 (=CUP-VZ 4528), 114 (= CUP-VZ 4525), 145 (= CUP-VZ 4533), 247 (= CUP-VZ 4517), 454 (= CUP-VZ 4521), 511 (= CUP-VZ 4532), 523 (= CUP-VZ 4534); 794 (= CUP-VZ 4524), 795 (= CUP-VZ 4518); 798 (= CUP-VZ 4526), 1330 (= CUP-VZ 4515), 1356 (= CUP-VZ 4522), 1427 (= CUP-VZ 4520), 2348 (= CUP-VZ 4523; NY-Wurdack 31431, 31518. LOCALITY UNKNOWN: Neotype specimen of *Peziza aeruginosa* Pers. per Pers. : Fr., UPS-Fries 287, in lignis *Betula*, (locality unknown), Kalchbrenner, (no date) (= CUP 51738).

Notes: This species is easily distinguished by the size of its ascospores and its granularly roughened tomentum hyphae. I have examined several specimens which on casual observation appear not to possess any such tomentum hyphae, but which have beyond question ascospores typical of this species. Careful examination especially at the margin of the apothecia always shows that tomentum hyphae are present; hence, if there is any question as to the presence of tomentum hyphae the observer is urged to examine the apothecial margin. This species appears to be somewhat more southern in its distribution (on the basis of numbers of specimens examined), but definitely overlaps the ranges of its closest relative, *Chlorociboria aeruginascens*.

Gamundí (1962) reports the presence of "pelos himeniales" for this species. I have examined the same specimens in which she indicated these hymenial hairs occur, but have been unable to locate any such structures either in squashed or sectioned material.

2. CHLOROCIBORIA AERUGINASCENS (Nyl.) Kan. ex Ram., Korf & Bat., Mycologia 49: 858. 1958, subsp. aeruginascens.

= [*Peziza viridissima*, *petiolata*, *scypho infundibuliformi* Hall., Hist. Stirp. Indig. Helvetiae Inch. 2: 131. 1768.]

≡ [*Peziza viridis stipitata*, *viridis*, *arborea* Wigg., Primit. Fl. Holsaticae p. 106. 1780.]

= [*Elvela aeruginosa*, *minima pileo difformi viridissima* Oed., Flora Danica 3(9): 7, Tab. 534, fig. 2. 1770.]

≡ [*Helvella aeruginosa* Oed. ex With., Arrangement Brit. Plants, ed. 3, p. 341. 1796.]

≡ *Helvella aeruginosa* Oeder per Purton, App. Midl. Fl. p. 258. 1821. (!!)

≡ *Helotium aeruginosum* (Oed. per Purton) Gray, Nat. Arrangement Brit. Plants p. 661. 1821.

≡ *Chlorosplenium aeruginosum* (Oed. per Purton) de Not., Comment. Soc. Critt. Ital. 1: 376. 1864.

= [*Merulius aeruginosa* Schum., Enum. Pl. Saell. p. 371. 1803.] (!!)

= *Peziza aeruginosa* Pers. per Pers. : Fr. [var.] b. *subgrisea* Fr., Syst. Mycol. 2(1): 130. 1822.

≡ *Peziza aeruginascens* Nyl., Not. Sällsk. Fauna Fl. Förh. 10: 42. 1869. (!!)

≡ *Chlorosplenium aeruginascens* (Nyl.) Karst., Not. Sällsk. Fauna Fl. Förh. 11: 233. 1870 (ut "aeruginescens," Seaver, Mycologia 28: 391. 1936, pro synonym. et lapsus calami).

- ≡ *Helotium aeruginascens* (Nyl.) Schroet., Krypt.-Fl. Schles. 3²(1): 83. 1893.
- ≡ *Chrysosplenium aeruginascens* (Nyl.) Karst. in Allescher, Ber. Bot. Vereines Landshut 15: 82. 1898 (lapsus calami).
- ≡ [*Chlorociboria aeruginascens* (Nyl.) Kanouse, Mycologia 39: 641. 1947 (generic name not validly published).]
- ≡ [*Chlorociboria aeruginosa* "(Oed. ex Gray) Seaver" var. *aeruginascens* (Nyl.) Bellemère, Bull. Soc. Mycol. France 83: 585. 1968 (basionym not cited).]
- = *Chlorosplenium indicum* Singh (ut errore "Dumont, Korf & Singh"), Trans. Brit. Mycol. Soc. 63: 293. 1974. (!)

MISAPPLIED NAMES:

- Peziza aeruginosa* Pers. per Pers., Myc. Eur. 1: 291. 1822 : Fr., Syst. Myc. 2(1): 130. 1822 (pro parte non typica).
- ≡ [*Chlorociboria aeruginosa* (Pers. per Pers. : Fr.) Seaver (ut "(Oed.) Seaver"), Mycologia 28: 391. 1936 (pro parte non typica; genus not validly published).]
- ≡ *Chlorociboria aeruginosa* (Pers. per Pers. : Fr.) Seaver ex Ram., Korf & Bat. (ut "(Oed. ex Gray) Seaver" Mycologia 49: 859. 1958 (pro parte non typica).

(Figs. 10-14, 24)

Apothecia: superficial, solitary to gregarious, eccentrically to infrequently centrally stipitate, frequently with several apothecia arising from a darkly pigmented and irregularly shaped fundament or "stromatic mass" which in section has a medulla of hyaline to light-green textura intricata and a cortex of tightly compacted and darkly aeruginous textura intricata, gymnocarpic in development.

Disc: < 7 mm in diam, cupulate to spathulate when young, becoming expanded-infundibuliform in fully mature specimens, color varying from light orange-yellow to concolorous with the receptacle to whitish-pale-green (Amber Yellow to Benzol Green to Pale Glaucous-Green), on drying becoming slightly darker than that in the fresh state.

Receptacle: glabrous or finely tomentose, bluish-aeruginous (Benzol Green to Sorrento Green), lower portion furrowed and rugose especially upon drying.

Stipe: < 6 × 1.0-1.5 mm, concolorous with the receptacle, on breaking showing a cortex and medulla both concolorous with the receptacle.

Hymenium: (45-) 60-85 (-100) μm high, hyaline to aeruginous, often with portions of the hymenium being more darkly pigmented.

Asci: cylindric-clavate, with a long tapering stalk, (40-) 50-65 (-75) \times 3-4 (-5) μm (mean of collections 54 \times 4 μm), strongly J+, 8-spored, wall at apex 1.0-1.5 μm thick, 0.25-0.5 μm thick along the sides of the ascus, arising from repeating croziers.

Ascospores: irregularly biseriate, unicellular, fusiform to elliptic-fusiform, hyaline or with light green contents with bipolar guttules, smooth-walled, 5-7 (-10) \times 1.0-1.5 (-2.4) μm (mean of collections 6 \times 1.5 μm).

Paraphyses: filiform, blunt at the apex, hyaline, septate, branching near the base, (1.0-) 1.5 (-2.0) μm in diam, scarcely extending beyond the asci.

Subhymenium: (5-) 10-25 (-40) μm thick, of gelatinized, hyaline to aeruginous *textura intricata*, hyphae 1-2 (-3) μm in diam.

Medullary Excipulum: of gelatinized, thin-walled, loose to tightly compacted *textura intricata*, with hyaline to light green contents (an occasional specimen dark green), hyphae sympodially branched, 1.5-3 (-4) μm in diam.

Ectal Excipulum: 30-75 μm thick, of hyaline to aeruginous hyphae forming a single layer of gelatinized *textura intricata* to *textura epidermoidea*, dark aeruginous in fully mature apothecia, ectal hyphae giving rise to few to numerous, coiled or sometimes straight, smooth-walled tomentum hyphae, often with tomentum hyphae so numerous that they appear to form an outer layer of the ectal excipulum, tomentum hyphae 1.0-1.5 (-2) μm in diam.

Cultural Characters: Very slow growing on agar (PDA), producing an aeruginous colony from which hyphae penetrate into the agar and ramify through it. No conidia produced. Agar appearing dark aeruginous due to leaching of aeruginous pigment into media. Hyphae 1.0-2.5 μm in diam, frequently branched, highly guttulate, thin-walled, with hyaline to light green contents. Two of my cultures are on deposit with the American Type Culture Collection as ATCC 24028 (= specimen CUP 51683) and ATCC 24029 (= specimen CUP 51676).

Habitat: on decorticated and decayed wood; collected on *Abies*, *Alnus*, *Betula*, *Carpinus*, *Cornus*, *Crataegus*, *Fagus*, *Fraxinus*, *Pasania*, *Picea*, *Pinus*, *Podocarpus*, *Populus*, *Salix*, *Sorbus*, *Tilia*, *Tsuga*, *Ulmus*, *Quercus* and unidentified wood.

Range and Seasons of Fructification: world-wide; collections from North & South America, Europe, Scandinavia, India, Japan, China, Philippines, Union of Soviet Socialist Republics; Spring, Summer, and Autumn.

Name: from Latin, "aeruginosus," deep-green, with a mixture of blue, + "-ascens," Latin suffix, becoming; perhaps referring to the fact the substrate becomes aeruginous.

Lectotype Locality: Ostrobothniae australis, Kuortane, northwest Finland.

Lectotype Specimen: (substrate unknown), Ostrobothniae australis, Kuortane, P. A. Karsten, 28. VII. 1859, det. W. Nylander, H-Karsten s.n. (= CUP 52630).

Illustrations: Oeder, Fl. Danica, Tab. 534, fig. 2. 1770 (ut *Elvela aeruginosa*); Holmskjöld, Beata ruris otia fung. dan. 2: Pl. 12. 1799 (ut *Peziza aeruginosa*); Greville, Scot. Crypt. Fl. 5: Pl. 241. 1827 (ut *Peziza aeruginosa*); Tulasne & Tulasne, Sel. Fung. Carp. 3: Pl. 20, figs. 15-19. 1865 (ut *Chlorosplenium aeruginosum*)!; Lindau, Naturl. Pflanzen-fam. I 1*: 196, fig. 155 H-J. 1897 (ut *Chlorosplenium aeruginosum*); Migula, Kryptog.-Flora in Thomé's Fl. Deutschl. 3(3²): Pl. 169, figs. 5-6. 1913 (ut *Chlorosplenium*); Akai, Bot. & Zool. 2: 835, fig. 2. 1934 (ut *Chlorosplenium*); Kobayasi in Asahina, Nippon inkwas yokubutu Dukan, Pl. 141, figs. 3-5, 1939 (ut *Chlorociboria aeruginosa*); Dennis, Mycol. Pap. 62, fig. 39. 1956 (ut *Chlorociboria aeruginosa*); Dennis, Brit. Cup Fungi Pl. 15, fig. F. 1960; Ramamurthi, Korf & Batra, Mycologia 49: 856, fig. 2. 1958; Korf, Sci. Rep. Yokohama Natl. Univ. Sect. 2, Biol. Sci. 7: 25, figs. 8-9, 1958 (ut *Chlorociboria* et ? Tax. sp. 2)!; Bellemère, Bull. Soc. Mycol. France 83: 584, fig. 68, A-H. 1967 (ut *Chlorociboria aeruginosa*)!; Dennis, Brit. Ascomycetes, Pl. 18, fig. F. 1968 (ut *Chlorosplenium*).

Exsiccati: Berkeley, British Fungi Exs. No. 281 (ut *Peziza aeruginosa*) FH; Jaczewski, Komarov & Tranzschel, Fungi Rossiae Exs. No. 194 (ut *Chlorosplenium*) BPI, CUP-D 4534 (76-16); Jaap, Fungi Selecti Exs. No. 457 (ut *Chlorosplenium*) BPI; Karsten, Fungi Fenniae No. 151 (ut *Chlorosplenium aeruginosum*) FH; Phillips, Elvellacei Britannici No. 86 (ut *Helotium aeruginosum*) FH, CUP-D 11088 (76-24); Rabenhorst, Fungi Europaei No. 1310 (ut *Peziza aeruginosa*) FH, CUP; Rehm, Ascomyceten Exs. No. 408 (ut *Chlorosplenium*) CUP-D 4885 (76-18); Saccardo, Mycotheca Italica No. 333 (ut *Chlorosplenium aeruginosum*) BPI; Smarods, Fungi Latvici Exs. No. 771 (ut *Chlorosplenium aeruginosum*) CUP 33049; Wilson & Seaver, Ascomycetes and Lower Fungi No. 78 (ut *Chlorosplenium aeruginosum*) CUP, CUP-D 10000 (76-76).

Excluded Exsiccati: Rick, Fungi Austro-Americani No. 6 issued as *Chlorosplenium aeruginascens* is *Chlorociboria aeruginascens* subsp. *brasiliensis*; Ibid., No. 6a, issued as *Chlorosplenium aeruginascens* is *Chlorociboria aeruginosa*.

Specimens Examined: U.S.A. - ALASKA: BPI-Baxter s.n., Aug. 24, 1936; NY-Cooke 42266. CALIFORNIA: BPI-McMurphy s. n., Jan. 14, 1924; Parks 2687, 5210, s.n., 31. Aug. 1960. COLORADO: CUP-D 6668 (76-70). GEORGIA: CUP 51773. IDAHO:

BPI-Slipp 1072; CUP 52636; OSC 25794. IOWA: CUP-D 470 (76-30). MAINE: CUP-D 8981 (77-123). MASSACHUSETTS: CUP 51845; CUP-D 4536 (76-52). MICHIGAN: C-Povah s.n., Aug. 20, 1930; CUP 51679, 51689, 51691, 51693, 51695, 51698, 51700, 51705, 51765, 51766, 51768, 51775, 51776, 51779, 51780, 51791, 51800-825. MINNESOTA: NY-Cooke 43493, 43623. NEW HAMPSHIRE: FH-no collector, s.n., Sept. 93. NEW JERSEY: CUP 51836; CUP-D 4537 (76-53). NEW YORK: BPI-Seaman s.n., Buffalo; CUP 11858, 43235, 51674, 51676-78, 51683-85, 51692, 51694, 51696, 51697, 51699, 51706, 51767, 51828-29, 51830-35, 51844, 51848, 51850; CUP-D 9549 (77-125), 9554 (77-126); CUP-LG 354; R.P.K. 782, 53-102. NORTH CAROLINA: BPI-Miller s.n., Aug. 18, 1933; CUP 37276, 51867, 51770, 51851. OHIO: CUP-D 1231 (76-4). OREGON: OSC 25793, 27978, 30119. TENNESSEE: CUP 51676, 51686, 51688, 51690. VERMONT: CUP-D 9008 (77-124). WASHINGTON: BPI-Maas 1778, Smith 2576; OSC 25797. WISCONSIN: CUP 51682, 51838, 51839, 51840-43.

BULGARIA: TAA-Parmasto 19299.

CANADA - BRITISH COLUMBIA: BPI-Mounce 7306; OSC 25795; V-collector unknown, s.n., Oct. 6, 1965. ONTARIO: BPI-Cain s.n., Sept. 6, 1933, Cain 41241, Elliott 89367, Jackson 1830, Senn 5340; C-Elliott 89367; CUP 51921, 52708; R.P.K. 3932. QUEBEC: BPI-Emmons s.n., Aug. 24-26, 1938.

CHINA: BPI-Deng 501, Teng 3371.

CUBA: FH-Wright, Fungi Cubenses Wrightiani No. 625 [= CUP-D 3561 (76-47)].

CZECHOSLOVAKIA: BPI-Pilat s.n., VII-1934.

DENMARK: C-Dissing s.n., 10-8-1963, F. et W. s.n., Oct. 1908, Hansen s.n., 30.8.1965, Kongr. s.n., 28.VIII.1969, Lind s.n., 12-9-1904, Milan s.n., 13.8.1965, Mortensen s.n., 19 Oct. 1884, Raunkjaer s.n., April 1912, Rostrup s.n., 17/79, 3/5 81, 12/ 81, 6/9 81, 21/10 95, 27-10. 1895, 4/ 03, Wieze s.n., Sjaellands; CP-Åmose s.n., 26.11.1961, Fussingø s.n., 3.10.1952, Hind s.n., 30/10 1911, NB[uchwald] s.n., 1955, NB[uchwald] s.n., 18.9.1961, Rostrup s.n., 29.9.89, 10. 1895, 20.5.91, Stenskov s.n., 8. 1905.

ENGLAND: BPI-Shear s.n., Sept. 18, 1930; CUP-D 146 (76-28), 147 (76-29).

FINLAND: *Ostrobottniae australis*, Kuortane, (substrate unknown), P. A. Karsten, 28. VII. 1859, det. W. Nylander ut *Peziza aeruginascens*, H-Karsten Herb., s.n. (= CUP 52630), lectotype specimen (designated here) of *Chlorociboria aeruginascens* subsp. *aeruginascens* and neotype specimen (also designated here) of *Helvella aeruginosa* Oeder per Purton).

GREENLAND: C-Lange s.n., 28/9 1946.

INDIA: CUP-IN 468 (= Singh 3492), paratype specimen of *Chlorosplenium indicum* Singh.

JAPAN - HOKKAIDO: CUP-JA 446, 2635, 2659. HONSHU: CUP-JA 1542, 1554, 1555, 1594; R.P.K.-JA 1686. KYUSHU: CUP-JA 331, 346, 357, 400.

NETHERLANDS: C-Schumacher No. 1919, (locality, collector and date unknown), [orig. descr.: in trunco subputrido (Charlottenlund) Octob.], holotype of *Merulius aeruginosa*.

PHILIPPINES: CUP-SA 1529.

SWEDEN: BPI-Haglund s.n., 30/8 1901, Nannfeldt s.n., 10.VIII-1928; C-Haglund s.n., 24/8 1910; CUP-D 28 (76-27), 2516 (76-3), 9915 (76-22); UPS-Fries, lignum Småland: Femsjö, 1856, ut *Helotium aeruginosum*, det. J.A. Nannfeldt (= CUP 51735).

UNION OF SOVIET SOCIALIST REPUBLICS - ARMENIA: TAA-Raitviir 43130 (= R.P.K. 3332). GEORGIA: TAA-Parmasto 16854, Raitviir 44858. KAMCHATKA: TAA-Parmasto 12493. KURIL ISLANDS: TAA-Parmasto 12186. RUSSIA: BPI-Jaczewski s.n., 1895; TAA-Maasik 19623, Parmasto 7231, 8092, 14381, 15359, 16005, 16191, Kullman & Raitviir 61197, 61252, 61255, Raitviir 42258, 42292, 42307, 42550, 42521, 42601, 42750, Remm 44362. UKRANIA: BPI-V.P. et L.J. Savicz et Z.J. Bjeljajeva s.n., 15-VII-1924; H-Karsten s.n., ad Salic., Rossia, Kola, P. A. Karsten, 27.VII.1861, det. W. Nylander (=CUP 52631), syntype (lectoparatype, designated here) specimen of *Peziza aeruginascens* Nylander.

VENEZUELA: NY-Dumont-VE 76 (= CUP-VZ 4527), 150 (= CUP-VZ 4519), 157 (= CUP-VZ 4531), 406 (= CUP-VZ 4530), Morillo 1520, Wurdack 34156.

LOCALITY UNKNOWN: L-Persoon, L-910,261-154, (locality, date and collector unknown) ut *Peziza aeruginosa* (= CUP 51759).

Notes: This species is distinguished by its small sized fusoid spores $5-7 (-10) \times 1.0-1.5 (-2.4) \mu\text{m}$, and by its tomentum hyphae which are smooth and usually coiled. I have examined several specimens which on casual examination seem to lack tomentum hyphae. Careful examination shows that tomentum hyphae typical of this species are present, but not as numerous as is the usual case. This species often produces several apothecia from the same fundament, a feature never found in *Chlorociboria aeruginosa*, with which it is often confused.

I have examined the specimen from Japan (CUP-JA 446) which Korf (1958: fig. 9) illustrated and which has ascospores $6-10 \times 1.5-2 \mu\text{m}$ and a mean size of $8 \times 1.5 \mu\text{m}$. While these ascospores are clearly within the range exhibited by *C. aeruginascens*, the mean size is somewhat larger than the $6 \times 1.5 \mu\text{m}$ exhibited by other collections I have observed.

This specimen is in all other respects *C. aeruginascens*, and until more information concerning the role of biological and environmental factors are at hand in regard to this species, I choose not to designate it a distinct taxon.

Schweinitz's species *Cantharellus viridis* Schw. [= *Chlorosplenium viride* (Schw.) Morgan] could provide an older epithet for *C. aeruginascens* if the type or an authentic specimen could be located (cfr. the discussion in Part I of this paper, MYCOTAXON 1(2): 103. 1974).

3. CHLOROCIBORIA AERUGINASCENS (Nyl.) Kan. ex Ram., Korf & Bat. subsp. *brasiliensis* (Berk. & Cooke) Dixon, *comb. et stat. nov.*
 = *Chlorosplenium brasiliense* Berk. & Cooke, J. Linn. Soc., Bot. 15: 363. 1876. (!!)
 = *Chlorosplenium puiggarii* Speg., Anales Soc. Ci. Argent. 12: 89. 1881. (!!)
 = ? *Chlorosplenium microspermum* Henn., Hedwigia 41: 26. 1902.

(Fig. 25)

In all respects similar to *Chlorociboria aeruginascens* subsp. *aeruginascens* except asci (35-) 41-49 × 3-4 μm (mean of collections 43.5 × 3.5 μm) and ascospores 3.0-5.5 (-6) × 1-1.5 μm (mean of collections 4.9 × 1.3 μm).

Habitat: on decayed wood.

Range and Seasons of Fructification: collected in Brazil, Jamaica, and Venezuela; Autumn and Winter.

Name: Brasil + -ensis; referring to the type locality.

Type Specimen: (substrate unknown), R. Tapajos, Brazil, Trail No. 29, (date unknown), K (= CUP 52720)

Illustrations: none.

Exsiccati: Rick, Fungi Austro-Americani No. 6 (ut *Chlorosplenium aeruginascens*) BPI.

Specimens Examined: BRASIL: (substrate unknown), R. Tapajos, Brazil, Trail No. 29, (date unknown), K (= CUP 52720), holotype of *Chlorosplenium brasiliense*; BPI-Noak s.n., 12. 1896 [= CUP-D 6834 (76-20)], Rick s.n., 1924, Rick 107; FH-Rick s.n. (date unknown); LPS 24436, (substrate unknown), Apiaty, Brazil, J. Puiggari No. 1490, 1556, V/1881, holotype specimen of *Chlorosplenium puiggarii*; isotypes of same, BA (= CUP 51749), BPI (= CUP 51714).

JAMAICA: K-Welden 420 (= BPI-Welden 420).

VENEZUELA: K-Dennis 1195, 1307A.

Notes: This subspecies has been recognized at least

twice in the literature at the specific rank and possibly a third time (by Hennings as *Chlorosplenium microspermum*). I have examined several specimens of this subspecies and feel that while they exhibit consistently smaller asci and ascospores, in all other respects they have the same gross and microanatomical features as does *C. aeruginascens* subsp. *aeruginascens*.

4. *Chlorociboria argentinensis* Dixon, *spec. nov.*

(Figs. 22-23, 26)

Apothecia superficialia, solitaria vel gregaria, saepe pluribus ab entis fundamento ("massa stromatica") obscure pigmentifero vel irregulariter formato. Discus usque ad 4 mm diametro, cupulatus in speciminibus juvenibus, planescens in speciminibus magis maturis, dilutae-aeruginosae ubi dulces, atro-aeruginosescens ubi aridae et non recepitum diluta coloratio qui humecto in aquam. Margines disci incurvus ubi aridae. Receptaculum glabrum, papulosum (pustulae atro-aeruginosae), portionis rugulosae imprimis ubi aridae. Stipes centralis vel leviter excentricus, usque ad 0.5-1.5 x 0.5-1 mm, concolor cum receptaculo, valde papulosus, ubi fractus aeruginosus cortex et albida medulla constitutum. Hymenium (70-) 75-90 (-95) μm altum, hyalinum vel aeruginosum frequenter cum portionis plurae obscure pigmentiferae. Asci octospori, cylindraneo-clavati, basaliter longe angustati, (61-) 70-82 (-95) x (3.5-) 4.0-5.0 (-5.5) μm (modorum collectionis 79.0 x 4.5 μm), ad apicem inoperculati, poro valde jodi ope azurescente, tunica in apice 1.0-1.5 μm crassa, secus latera 0.25-0.5 μm crassa. Ascosporae irregulariter biseriatae, unicellularis (aliquando cum uno submedio septo), fusioideo-ellipticae, hyalinae vel cum viride quod intus continetur, biguttulatae, tunica laevis, (7-) 9.0-10.2 (-11) x 1.7-2.0 μm (modorum collectionis 9.6 x 1.9 μm). Paraphyses septatae, filiformes, hyalinae, ramificans prope basem, (1.0-) 1.5 (-2.0) μm diametro. Subhymenium 10-30 (-40) μm crassum, ex textura intricata, septatae, gelatinosa, hyalina vel atro-aeruginosa formatum, hyphis 1-3 μm diametro. Excipulum medullare ex textura intricata crasse tunicata laxa vel stricta formatum, quod intus continetur diluta vel atro-aeruginosa, sympodialiter ramosis, hyphis 2.5-5 μm diametro. Excipulum ectale 45-90 μm crassum, ex textura intricata, gelatinosa, atro-aeruginosa formatum, in speciminibus perfecte maturis ex textura angularis vel textura epidermoidea formatum, non hyphis tomenti formati loco ad punctum secus ectale conicus tumulus ex textura angulari vel globulosa obscure pigmentifera et granulata fere sub angulo 90° ab superficie apotheciorum abeuntes edente. Habitat in ligno carioso, Tucumania, America Meridionali.

Apothecia: superficial, solitary to gregarious, frequently with several apothecia arising from a darkly pigmented and irregularly shaped fundament or "stromatic mass," which in section has a medulla of hyaline to light-green textura intricata and a cortex of tightly compacted and darkly aeruginous textura intricata, centrally stipitate to slightly excentrically stipitate.

Disc: < 4 mm in diam, cupulate in young specimens, becoming plane in more mature specimens, pale blue-green (Malchite Green to Deep Glaucus Green) when fresh (according to Gamundí, 1962), becoming aeruginous-black (Dusky Dull Green to Black) upon drying, and not recovering the lighter coloration when moistened with water, margins of disc enrolling to the point of touching when dry.

Receptacle: glabrous, aeruginous when fresh, drying to a darker aeruginous (Dusky Bluish Green), lower portion furrowed and rugose especially upon drying, with dark aeruginous pustules.

Stipe: 0.5-1.5 × 0.5-1.0 mm, concolorous with the receptacle, heavily pustulate, on breaking showing an outer aeruginous cortex with a whitish medulla.

Hymenium: (70-) 75-90 (-95) μ m high, hyaline to aeruginous, often with portions of the hymenium being more darkly pigmented.

Asci: cylindric-clavate, with a long tapering stalk, (61-) 70-82 (-95) × (3.5-) 4.0-5.0 (-5.5) μ m, (mean of collections 79.0 × 4.5 μ m), strongly J+, 8-spored, rounded to subconic at the apex, wall at the apex 1.0-1.5 μ m thick, 0.25-0.5 μ m thick along the sides.

Ascospores: irregularly biseriate, unicellular (an occasional spore sub-median 1-septate), fusiform to elliptic-fusiform, hyaline or with light green contents, with bipolar guttules, smooth-walled, (7-) 9.0-10.2 (-11) × 1.7-2.0 μ m (mean of collections 9.6 × 1.9 μ m).

Paraphyses: filiform, blunt at the apex, hyaline, septate, branching near the base, (1.0-) 1.5 (-2.0) μ m in diam, scarcely extending beyond the asci.

Subhymenium: 10-30 (-40) μ m thick, of gelatinized hyaline to dark aeruginous *textura intricata*, hyphae 1-3 μ m in diam.

Medullary Excipulum: of gelatinized, thick-walled, loose to tightly compacted *textura intricata*, contents light to dark aeruginous, hyphae sympodially branched, 2.5-5 μ m in diam.

Ectal Excipulum: 45-90 μ m thick, of dark aeruginous hyphae forming a layer of gelatinized *textura intricata* which in fully mature specimens becomes *textura angularis* to *textura epidermoidea*, no tomentum hyphae present, but at points conical mounds of heavily pigmented and granulated *textura angularis* to *textura globulosa* project almost perpendicularly from the flanks of the apothecia.

Habitat: on decorticated and decayed wood; collected on *Nothofagus dombeyi* and *Nothofagus* sp., and unidentified wood.

Range and Seasons of Fructification: collected only in Argentina; Spring, Summer and Autumn.

Name: Argentina + -ensis; referring to the type locality.

Type Specimen: (substrate unknown), ARG., R. Negro, P. N. N. Huapí, L. Frías, camino a Paso de las Nubes, C. Pujals - I. Gamundí, 24/IV/1958, BA (= CUP 52726).

Illustrations: Gamundí, Darwiniana 12: Pl. 5, figs. 8-13. 1962 (ut *Chlorosplenium aeruginum*).

Exsiccati: none.

Specimens Examined: ARGENTINA: BA-Dicke s.n., 24/XI/1966; BA-20042, 20359, 20400, 20620 (= R.P.K. 2896), 20929, 21090, 21099, 21113, 21152, 21179, 21201, 21223, 21265, 21354, 21375, 21396, 21400, 21585, 21636, Gamundí s.n., 31/III/1963.

Notes: This species is distinguished from other species of *Chlorociboria* by its dark aeruginous hymenium which becomes blackish aeruginous on drying and does not recover its lighter coloration even when rehydrated in water, its fusoid spores which are $9.0-10.2 \times 1.7-2.0 \mu\text{m}$ and by its ectal excipulum which forms conical mounds of hyphae which are heavily pigmented and granulated and project almost perpendicularly from the flanks of the apothecia.

Gamundí (1962) has an excellent description of this species (as *Chlorosplenium aeruginum*) and reports the presence of "pelos himeniales." In her discussion and illustration of these hymenial hairs, she indicates they are very similar to the type of tomentum hyphae arising from the ectal excipulum of *Chlorociboria aeruginosa*. I have examined these same specimens but have been unable to locate any such structures in either squashed or sectioned material.

5. *Chlorociboria omnivirens* (Berk.) Dixon, *comb. nov.*

≡ *Peziza omnivirens* Berk., in J. D. Hooker's Bot. Ant. Voy. H. M. Disc. Erebus & Terror, II: Flora Tasmaniae 2: 275. 1860. (!!)

≡ *Chlorosplenium omnivirens* (Berk.) Cooke, in Mueller's Fragmenta Phytog. Austr. 11 (Suppl. 6): 100. 1880.

(Figs. 21, 29)

Apothecia: superficial, solitary to gregarious, never with several apothecia arising from the same fundament or "stromatic mass," centrally to slightly excentrically substipitate to stipitate, gymnocarpic in development.

Disc: < 4 mm in diam, cupulate to convex-plane, color varying from orange-yellow (Capucine Yellow) in younger specimens, becoming greenish-black (Dusky Dull Green to Black) in older specimens, edges of the disc not enrolling on drying.

Receptacle: glabrous, pustulate, aeruginous to dark aeruginous (Sorrento Green to Dark Viridian Green) when rehydrated, becoming darker aeruginous green to black upon drying, often vertically ribbed or rugose, especially upon drying.

Stipe: 0.5-1.5 × 0.5-1.0 mm, concolorous with the receptacle, pustulate, often more pustulate than the receptacle, on breaking showing an outer aeruginous cortex and a whitish medulla.

Hymenium: (85-) 90-120 (-160) μm in height, hyaline to dark aeruginous, often with portions of the hymenium becoming more darkly pigmented.

Asci: cylindric-clavate, with a long tapering stalk, (65-) 76-90 (-95) × (6.5-) 7-8.5 (-9.0) μm (mean of collections 76.5 × 7.0 μm), strongly J+, 8-spored, wall at apex 2-3 μm thick, 0.5-1.0 μm thick along the sides of the ascus, arising from repeating croziers.

Ascospores: irregularly biseriate, unicellular to submedian 1-septate, fusiform-elliptic, hyaline or with light green contents, prominently biguttulate and/or with several smaller guttules, (11-) 14-18 (-20) × 3-4 μm (mean of collections 16 × 3.5 μm), spores frequently germinating in the ascus by unipolar or bipolar germ tubes, with globose to subglobose microconidia 1.0-2.5 μm in diam frequently being produced at the ends of the germ tube and floating free in the mounting media.

Paraphyses: filiform, blunt at the apex, hyaline, septate, branching near the base, 1.5-2.0 μm in diam, scarcely extending beyond the asci.

Subhymenium: 10-25 (-35) μm thick, of hyaline to aeruginous *textura intricata*, hyphae 1.5-3 μm in diam.

Medullary Excipulum: of gelatinized, thin-walled, loose to tightly compacted *textura intricata* (in the type specimen the hyphae are more highly gelatinized than in the Japanese material), hyphae sympodially branched, (2-) 3-4 (-5) μm in diam.

Ectal Excipulum: 45-60 μm thick, of gelatinized, heavily pigmented *textura intricata* to *textura angularis*, no tomentum hyphae present, but at points along the flanks conical mounds of heavily pigmented and granulated *textura angularis* to *textura globulosa* project almost perpendicularly.

Habitat: decayed and decorticated wood; collected on

Thuja standishii and unidentified wood.

Range and Season of Fructification: Japan and Tasmania; Autumn.

Name: from Latin, "omnino," adv., entirely, + "virens," green; referring to the coloration of the apothecia.

Type Locality: Tasmania.

Type Specimen: (substrate unknown), Tasmania, Archer s.n., (date unknown), K-Berkeley (= CUP 51757).

Illustrations: Korf, Sci. Rep. Yokohama Natl. Univ. Sect. 2, Biol. Sci. 7: 25, fig. 6 (ut Tax. sp. I) et 27, figs. 11-12 (ut Tax. spp. IV et V)!

Exsiccati: none.

Specimens Examined: JAPAN - HONSHU: CUP-JA 31, 52, 1603. KYUSHU: CUP-JA 347. YAKU ISLAND: CUP-JA 2079.

TASMANIA: K-Berkeley Archer s.n., holotype of *Peziza omnivirens* (= CUP 51757).

Notes: This species is redescribed here after 115 years. It is distinguished from *C. aeruginosa*, its closest relative, by its larger asci and ascospores and its conical mounds of hyphae which are heavily pigmented and granulated and project nearly perpendicularly from the flanks of the apothecium. It tends to be somewhat more substipitate than stipitate, but I have observed specimens which are definitely stipitate.

THE PHIALOCONIDIAL STATES OF CHLOROCIBORIA

Tulasne and Tulasne (1865) were the first workers to recognize the connection of *Dothiorina tulasnei* (as *Sphaeria moriformis* Tode var. [unnamed]) to a perfect state species of *Chlorociboria*. They discussed and illustrated very accurately the imperfect state and gave detailed measurements of ascospores and asci which agree with *Chlorociboria aeruginascens* subsp. *aeruginascens*. Saccardo (1884) transferred Tulasne and Tulasne's unnamed variety to the genus *Dothiorella* as *D. tulasnei* and stated, as had Tulasne and Tulasne, that it was a spermagonial state.

Von Höhnel (1911) erected a new genus, *Dothiorina*, to accommodate *Dothiorella tulasnei*, stating, "*Dothiorella* Sacc. 1880, ist im heutigen Umfange eine Mischgattung" and "Die Gattung wurde in Michelia, 1880, II Bd., p. 5, aufgestellt und hier als Typus *D. pyrenophora* (Berk.) Sacc. angeführt." Von Höhnel also goes on to say in regard to *D. pyrenophora* that, "Diese Art wird aber in Syll. Fung., III, p. 380, als *Botryodiplodia* bezeichnet, da die Sporen nach Cooke braun und

zweizellig sind."

I have seen several specimens of *Dothiorina tulasnei* collected separately and collections of this species collected with both *C. aeruginascens* subsp. *aeruginascens* and *C. a.* subsp. *brasiliensis*, but never have I observed the two fungi on the same substrate in such close proximity to each other that I could be convinced that they grew from the same mycelia and were in fact different states of the same fungus.

I am extremely indebted to Dr. André Bellemère, Laboratoires de Sciences Naturelles, St.-Cloud, who was kind enough to send me a microphotograph of a specimen collected on "bois de l'Hautil près de Triel-sur-Seine, non loin de Paris, où il a été trouvé le 17 avril 1960 (N° 276)," which clearly shows that there are mycelial connections between these two states.

Berthet (1964b) described the cultural characteristics he noted in cultures derived from germinated ascospores. It is not possible with any certainty to deduce whether the ascospores were from an apothecium of *C. aeruginascens* or *C. aeruginosa* from his description. His illustrations and discussion of the sporogenous hyphae he obtained in culture (Berthet, 1964a) and the spores they produce agree with observations I have made on phialides produced in the pycnidial chambers of *Dothiorina tulasnei*. I have been successful in obtaining cultures of *C. aeruginascens* from germinated ascospores which agree with Berthet's observations in all respects except unlike his cultures, my isolates do not produce phialoconidia at either 4° C or 20-25° C. Brefeld (1891) also illustrated mycelia and spores which he obtained in culture, but lack of sterile and pure culture techniques during the late eighteen hundreds and the poor quality of Brefeld's illustrations makes it uncertain if he was dealing with a pure culture. Berthet (1964a) observed that the phialoconidia produced in his cultures germinated easily. This fact would indicate that *Dothiorina tulasnei* is an imperfect state and not a spermatial state as indicated by Tulasne and Tulasne (1865) and Saccardo (1884). Today *D. tulasnei* would be placed in the Sphaeropsidales, Zythiaceae (= Nectrioidaceae).

The only other species that has been added to *Dothiorina* is *Psilonia discoidea* Berk. & Broome. Von Höhnelt (1925) evidently made this transfer on the basis of Rabenhorst, Fungi Europaei Exs. No. 1075. I have examined this collection and find that it is dissimilar to *D. tulasnei*. The stroma is very effuse, more carbonaceous, black with yellow pycnidia, and produces dark brown-walled, frequently septate hyphae which ramify throughout the substrate. The spores produced

are also phialoconidia, $3-4 \times 2 \mu\text{m}$, but the phialophores are not branched and do not produce flask-shaped phialides. Von Höhnel felt that *D. discoidea* was the imperfect state of a "*Helotium*, vielleicht *Helotium ferrugineum* (Schum.)". Hence, while I am not certain to which genus *D. discoidea* belongs, I believe it is not congeneric with *D. tulasnei*, and that von Höhnel was over-influenced by the parallel nature of the hyphae between the pycnidial chambers in making *D. discoidea* a member of his genus *Dothiorina*.

1. DOTHIORINA TULASNEI (Sacc.) v. Höhn., Akad. Wiss. Wien Sitzungsber., Math.-Naturwiss. Kl., Abt. 1, 120: 86. 1911.

≡ [*Sphaeria moriformis* Tode var. (unnamed), Tul. & Tul., Sel. Fung. Carp. 3: 187. 1865.]

≡ *Dothiorella tulasnei* Sacc., Syll. Fung. 3: 39. 1884.

(Figs. 15-18, 27)

Fructification: a subspherical to moriform stroma < 2 mm in diam, often with several stromata coalescing, superficial to erumpent through the bark, when rehydrated dark aeruginous and sub-fleshy, drying blackish aeruginous to almost black, and on drying becoming somewhat more carbonaceous, producing numerous oval to pyriform pycnidial chambers, $30-70 \mu\text{m}$ wide at their widest point, which are lined with numerous, short, cylindrical, inflated, frequently flask-shaped phialides $5-11 \times 1.5-2.5 \mu\text{m}$, produced singly or in groups of two, three or four on branching phialophores. Phialophores $1.5-3 \mu\text{m}$ in diam, with hyaline to light green contents and heavily granulated (with green granules) at the point of origin in the locule. Phialoconidia $3-5 \times 1 (-1.5) \mu\text{m}$, baciliform to oblong-elliptic with light green contents, occasionally hyaline. Stroma in section of strongly gelatinized hyphae forming a *textura intricata*, with green contents, becoming more parallel between pycnidial chambers, and brownish to black-walled at the surface of the stroma, $2-3.5 \mu\text{m}$ in diam.

Habitat: on decayed wood, staining the wood aeruginous. Occasionally found in association with its perfect states, *Chlorociboria aeruginascens* subsp. *aeruginascens* and *C. a.* subsp. *brasiliensis*.

Range and Seasons of Fructification: North and South America and Europe; collected in Summer and Autumn, apparently very rare.

Name: Latinized name of the Tulasne brothers.

Illustrations: Tulasne and Tulasne, Sel. Fung. Carp. 3: pl. 20, figs. 17-18. 1865 (ut *Sphaeria moriformis* var.); Bellemère, Bull. Soc. Mycol. France 83: 584, fig. 68 B, I, J. 1967 (ut *Chlorociboria aeruginosa*).

Exsiccati: Ellis and Everhart, North American Fungi No. 2047 (ut *Chlorosplenium aeruginosum*, Spermogonia) PAD-Saccardo (= CUP 51752), CUP-A; Fuckel, Fungi Rhenani No. 2479 (ut *Helotium aeruginosum*, fungus spermogonium) FH (= CUP 52697); Herbar Barbey-Boissier No. 1240 (ut *Chlorosplenium aeruginosum*, Fungus conidiophorus) BPI (= CUP 51855).

Specimens Examined: U.S.A. - CONNECTICUT: on alder, West Haven, R. Thaxter No. 194 (ut *Chlorosplenium aeruginosum*, conidial stage) FH (= CUP 52701).

AUSTRIA: Auf Holz, Sonntagsberg, Strasse s.n., Dec. 1910, FH-Höhnel No. 3329.

VENEZUELA: on green stained wood, cloud forest below (E. of) Hotel Humboldt, El Airla, Dto. Federal, Venezuela, R.W.G. Dennis No. 1195, 5.7.58 (ut *Chlorociboria* and imperfect stage) K.

EXCLUDED SPECIES AND SYNONYMS

1. CHLOROCIBORIA AERUGINELLA (Karst.) Dennis ex Ram., Korf & Bat. \equiv *Dasyscyphus aeruginellus* (Karst.) Korf & Dixon in Dixon; for complete synonymy see MYCOTAXON 1(2): 85. 1974.
2. [CHLOROCIBORIA AERUGINOSA var. AERUGINASCENS (Nyl.) Bellemère] \equiv *Chlorociboria aeruginascens* subsp. *aeruginascens*, q.v.
3. CHLOROCIBORIA BULGARIOIDES (Rabenh.) Ram., Korf & Bat. \equiv *Rutstroemia bulgarioides* (Rabenh.) Karst.; for complete synonymy see MYCOTAXON 1(2): 88-90. 1974.
4. CHLOROCIBORIA MUSAE Dennis, Kew Bull. 13: 460. 1958.

Notes: Examination of the type specimen of this species shows it to have an ectal excipulum of thin-walled, nearly hyaline, globose cells and ascospores $5-6 \times 1.5-2 \mu\text{m}$ as reported by Dennis (1958). I feel this species is surely a member of the genus *Ciboriopsis*. Since many species of *Ciboriopsis* seem to grade into *Ciboria*, I hesitate to make a new combination until monographic work has been done on the genus *Ciboriopsis*.

Specimens Examined: BOLIVIA: on banana, Rio Yariza, Prov. Nor-Yungas, Dpto. La Paz, R. Singer No. B-1377, 23. 2. 1956, K (= CUP 51754), holotype specimen.

5. CHLOROCIBORIA RUGIPES (Peck) Ram. & Korf in Ram., Korf & Bat. = *Chlorencoelia torta* (Schw.) Dixon, q.v.
6. CHLOROCIBORIA STROBILINA (Alb. & Schw. per Fr.) Seaver = *Rutstroemia bulgarioides* (Rabenh.) Karst.; for complete synonymy see MYCOTAXON 1(2): 88-90. 1974.
7. CHLOROCIBORIA VERSIFORMIS (Pers. per Pers. : Fr.) Seaver ex Ram., Korf & Bat. ≡ *Chlorencoelia versiformis* (Pers. per Pers. : Fr.) Dixon, q.v.
8. CHLOROCIBORIA VERSIFORMIS var. OLIVACEA (Rodway) Dennis = *Chlorencoelia torta* (Schw.) Dixon, q.v.

THE GENUS CHLORENCOELIA DIXON

For two species that have been treated both in *Chlorosplenium* and in *Chlorociboria*, I now propose a new genus. Seaver (1951) apparently was the first person to recognize the affinities of these species when he transferred *Peziza versiformis* to the genus *Midotis*. (His concept of *P. versiformis* included both species of the genus.) During the course of this study I have observed several specimens of *Chlorencoelia torta* in which the cells of the ectal excipulum (of brown-walled *textura angularis* to *textura globulosa*) are loose and encoelioid. *Chlorencoelia* should be considered as a member of the Leotiaceae (= Helotiaceae), subfamily Encoelioidae. The members of *Cordierites* show similarities with *Chlorencoelia* both in gross morphological characters and more especially in their microanatomical features. It should also be noted that the species of *Chlorencoelia* show affinities with *Encoelia* (Fr.) Karst. and to some lesser extent with *Velutarina* Korf.

GENERIC DIAGNOSIS
OF THE GENUS *CHLORENCOELIA* DIXON
(HELOTIALES, LEOTIACEAE)

CHLORENCOELIA Dixon, *gen. nov.*

NAME: from Greek, "Chloris," the green one, + the generic name *Encoelia*; referring to the color of the apothecia plus the generic name of a related genus.

HOLOTYPE: *Peziza versiformis* Pers. per Pers., Myc. Eur. 1: 243. 1822, : Fr., Syst. Mycol. 2(1): 130. 1822.

Apothecia superficialia, solitaria vel gregaria vel in fasciculo caespitose, stipitato conferta. Discus non profunde cupulatus vel infundibuliformis, convexoexpansus vel repandus in speciminibus magis maturis. Asci octospori, cylindraco-clavati, basaliter longe angustati, ad apicem inoperculati, poro valde jodi ope azurescente, apicibus rotundatis vel subconicus. Ascospores hyalinae, 0-1-septatae. Paraphyses septatae, filiformes, ad apices aliquando subclavatae, non ramificantes vel ramificantes prope basem. Subhymenium ex textura intricata hyaline et/vel dilute ferruginea formatum. Excipulum medullare ex textura intricata parietibus hyalina vel rufa, laxa vel stricta formatum, hyphis laevibus et/vel granulis rufis asperatis, sympodialiter ramosis. Excipulum ectale formatum ex textura angulari vel textura globulosa tenui vel crassa, hyalina vel parietibus rufa, et hyphas tomenti filamentosas vel subglobosas vel clare clavatus fere sub angulo 90° ab superficie apotheciorum abeuntes edente. Habitat in ligno carioso.

Apothecia: superficial, solitary to gregarious, occasionally in caespitose clusters from a common stipe.

Disc: shallow cupulate to infundibuliform, becoming convex-expanded to repand in mature specimens.

Asci: 8-spored, cylindric-clavate with long tapering stalks, apex inoperculate, strongly J+, apex rounded to subconic.

Ascospores: ellipsoid to cylindric-oblong to allantoid, unicellular to 1-septate, hyaline.

Paraphyses: filiform, septate, occasionally subclavate at the apex, unbranched or branching near the base.

Subhymenium: of hyaline and/or light brown textura intricata.

Medullary Excipulum: of hyaline to dark brown-walled, loose to tightly compacted textura intricata, hyphae smooth and/or roughened with dark brown granulations, sympodially branched.

Ectal Excipulum: of thin to thick walled, hyaline to dark-walled textura angularis to textura globulosa which give rise to filamentous or subglobose to definitely clavate tomentum hyphae oriented nearly perpendicularly to the flanks of the apothecia, tomentum hyphae frequently containing green pigmentation and/or green granules.

Habitat: on decorticated and decayed wood.

Notes: This genus is distinguished from *Cordierites* Mont., its closest relative, by its ascus apices which stain strongly blue in iodine, its apothecia being yellow-orange to olivaceous-green in color, its lack of an ionomidotic reaction in KOH, and its apothecia which do not branch and become irregularly lobed or lacerated as in *Cordierites*.

KEY TO THE SPECIES OF CHLORENCOELIA

1. Ascospores cylindrical to allantoid, (10-) 11-15 (-16) × 2.5-3.5 μm; medullary excipulum of hyaline to light brown-walled hyphae; ectal excipulum producing filamentous to slightly clavate tomentum hyphae..... 1. *C. versiformis*
- 1'. Ascospores irregularly ellipsoid, (5.6-) 9-11 (-12) × 2-4 μm; medullary excipulum of dark-walled hyphae; ectal excipulum of stalked, subglobose to definitely clavate tomentum hyphae..... 2. *C. torta*

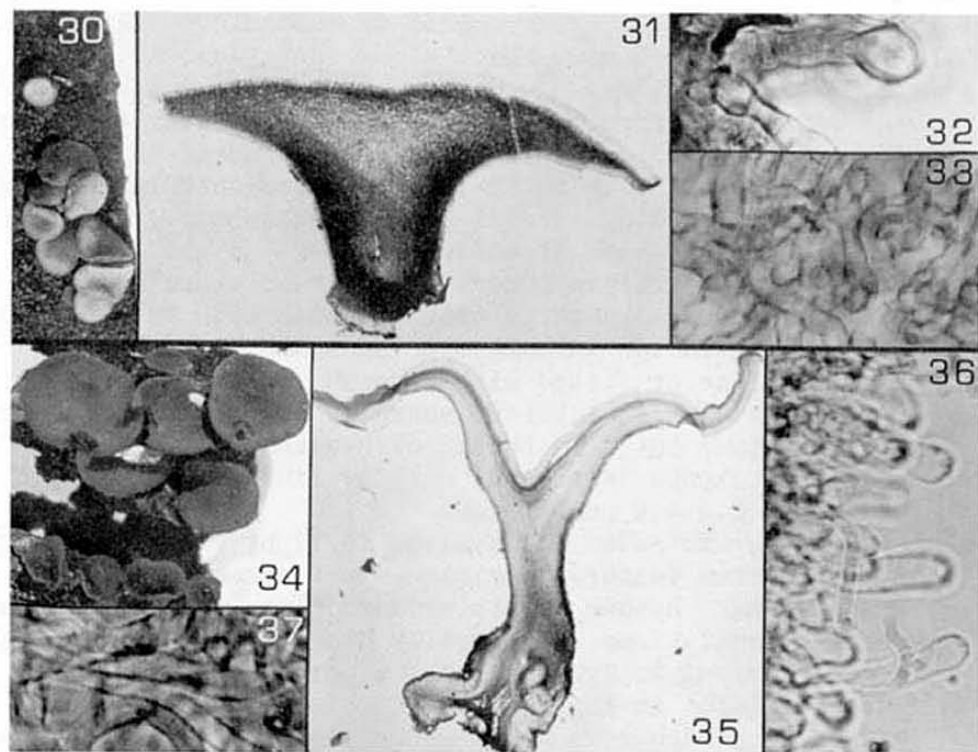
1. *Chloroencoelia versiformis* (Pers. per Pers. : Fr.) Dixon, *comb. nov.*
 ≡ [*Peziza versiformis* Pers., Ic. Descr. Fung. p. 25, 1800.] (!!)
 ≡ *Peziza versiformis* Pers. per Pers., Myc. Eur. 1: 243. 1822, : Fr., Syst. Mycol. 2(1): 130. 1822.
 ≡ *Helotium versiforme* (Pers. per Pers. : Fr.) Fr., Summa Veg. Scand. p. 356. 1849.
 ≡ *Chlorosplenium versiforme* (Pers. per Pers. : Fr.) de Not., Comment. Soc. Critt. Ital. 1: 376. 1864.
 ≡ *Coryne versiformis* (Pers. per Pers. : Fr.) Schroet., Krypt.-Fl. Schles. 3²(Lief. 1): 99. 1893.
 ≡ [*Chlorociboria versiformis* (Pers. per Pers. : Fr.) Seaver, Mycologia 28: 393. 1936 (genus not validly published).]
 ≡ *Midotis versiformis* (Pers. per Pers. : Fr.) Seaver, N. Amer. Cup Fungi (Inopercul.), p. 94. 1951.
 ≡ *Chlorociboria versiformis* (Pers. per Pers. : Fr.) Seaver ex Ram., Korf & Bat., Mycologia 49: 860. 1958.
 = *Craterellus caespitosus* Peck, Annual Rep. New York State Mus. 25: 82. 1873. (!!)
 = [*Coryne sarcoides* (Gray) Tul. (ut "(Jacq.) Tul.") var. *viridescens* Rehm in Voss, Verh. Zool.-bot. Ges., Wien 37: 224. 1887 (*nomen nudum*).]

= *Coryne sarcooides* (Gray) Tul. [ut "(Jacq.)"] var. *viridescens* Rehm in Rabenhorst's Krypt.Fl. II 1³(Lief. 35): 492. 1891. (!!)

(Figs. 34-37, 39)

Apothecia: superficial, solitary to gregarious, occasionally in caespitose clusters from a common stipe.

Disc: shallow cupulate to infundibuliform, becoming convex-expanded to repand in mature specimens, occasionally revolute, olive-yellow to olive-green in fresh specimens (Mars



FIGS. 30-36. Photographs of *Chlorencoelia* spp. FIGS. 30-33. *C. torta*. 30. Freshly collected apothecia, CUP 51796, approx. $\times 3.5$. 31. Complete section of an apothecium, CUP 51730, approx. $\times 14$. 32. A single tomentum hypha, CUP 51771, $\times 1400$. 33. Medullary hyphae, CUP 51671, $\times 1600$. FIGS. 34-37. *C. versiformis*. 34. Freshly collected apothecia, CUP 51710, approx. $\times 1.5$. 35. Complete section of an apothecium, CUP 52734, approx. $\times 8$. 36. Tomentum hyphae, CUP-D 4523 (77-47), $\times 2100$. 37. Medullary hyphae, CUP 51710, $\times 1900$.

Yellow to Olive Citrine) becoming chestnut brown to black (Mummy Brown to Black) upon drying, < 9 (-17) mm in diam, mostly 7-9 mm in diam.

Receptacle: dark olive-green to brownish-olive when fresh, drying to dark brown or greenish-black, with a pruinose greenish-yellow cast when dry, furrowed to rugose.

Stipe: < 7 × 0.5-1 mm, concolorous with the receptacle, glabrous, rugose especially upon drying.

Hymenium: (80-) 95-130 (-145) μm high, hyaline with occasional brown portions due to abundance of pigmented paraphyses.

Asci: cylindrical-clavate with long tapering stalks, (79-) 95-130 (-150) × (4-) 5-8 μm (mean of collections 106 × 6 μm), 8-spored, strongly J+, apex rounded to subconic, wall at apex 1.5-3 μm thick, 0.5-1.0 μm thick along the sides, arising from repeating croziers.

Ascospores: irregularly biseriata, unicellular to submedian 1-septate, hyaline, smooth-walled, cylindrical-oblong to allantoid, non-guttulate to bi-, tri-, tetra-guttulate, occasionally also including several smaller guttules, (10-) 11-15 (-16) × 2.5-3.5 μm (mean of collections 12 × 3 μm).

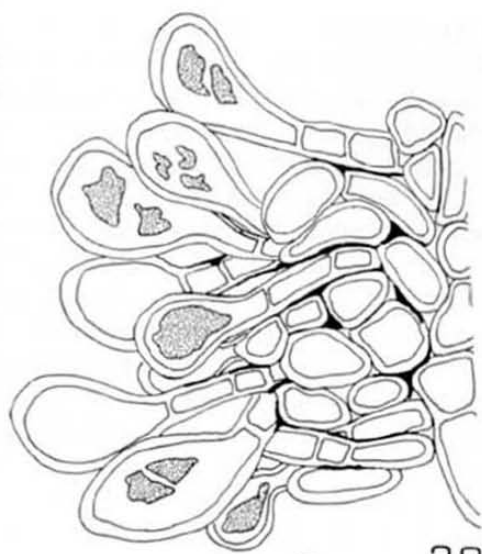
Paraphyses: filiform, occasionally subclavate at the apex, unbranched or branching near the base with the point of branching being so low in some specimens as to appear unbranched, hyaline or filled with numerous guttules and/or green granules, 2-3 μm in diam, scarcely longer than the asci.

Subhymenium: 20-35 μm thick, of hyaline and/or light brown-walled *textura intricata*, with hyaline or brown contents, hyphae 2.4-4.0 μm in diam.

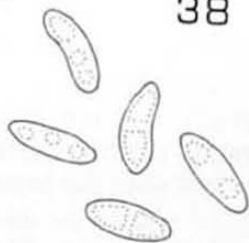
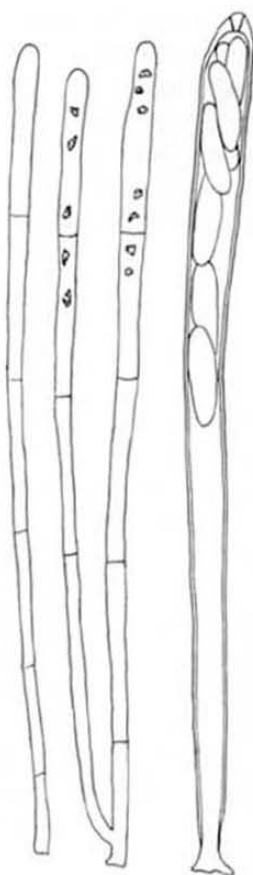
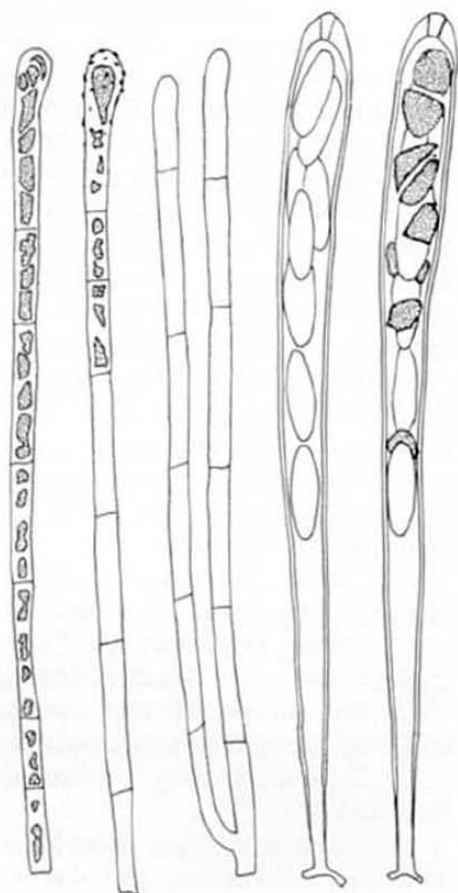
Medullary Excipulum: of hyaline to light-brown, loose to tightly compacted *textura intricata*, portions often with collapsed hyphae; hyphae smooth or more often roughened with dark brown granulations, sympodially branched, 3-5 μm in diam.

Ectal Excipulum: 25-100 μm thick, of hyaline to dark-walled (especially in fully mature specimens) *textura intricata* to *textura angularis* which gives rise to filamentous to slightly clavate tomentum hyphae oriented nearly perpendicularly to the flanks of the apothecium; hyphae at the base of

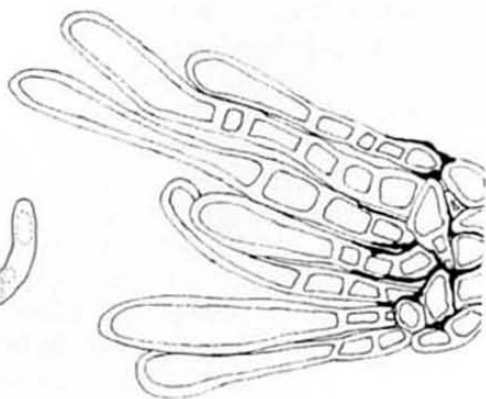
FIGS. 38-39. Camera lucida drawings of *Chlorencoelia* spp. Pigments in amorphous or granular form shown shaded, × 1000. FIG. 38. *C. torta*. Portion of ectal excipulum and tomentum hyphae, three paraphyses, two asci and five ascospores, CUP 51671. FIG. 39. *C. versiformis*. Two paraphyses, four ascospores, and portion of ectal excipulum and tomentum hyphae, CUP 51708.



38

10 μm

39



the tomentum hyphae often highly septate, forming cuboid cells of various sizes, tomentum hyphae 5-7 μm in diam with hyaline walls 0.25 (-1.5) μm thick, in occasional specimens tomentum hyphae containing green pigment and/or granules. In KOH (2% aqueous), Aerosol, and Acid-alcohol producing a yellowish-green coloration in the mounting solution.

Cultural Characters: Very slow growing on agar (PDA), producing greyish-brown, humped-up colonies. No conidia produced. Agar appearing brownish-black when viewed from the underside. Hyphae 1.5-5 μm in diam, frequently branched, highly guttulate, thin-walled with occasional hyphae with dark brown granulations, contents hyaline to light-brown. Culture on deposit with American Type Culture Collection as ATCC 24031 (= specimen CUP 51710).

Habitat: decayed wood of angiosperm and gymnosperm trees; collected on *Betula*, *Nothofagus*, *Quercus*, *Tsuga*, and unidentified wood.

Range and Seasons of Fructification: world-wide; Summer and Autumn, most frequently in Autumn.

Name: from Latin, "verso," to turn up, to turn hither and thither, + "formo," shape or form; referring to the fact that the shape of the apothecium may be spathuloid or otideoid and sometimes convoluted.

Type Locality: unknown (? Hercynia [Harz region, mid-Germany]).

Presumed Type Specimen: L-Persoon 910, 256-1329 (substrate, collector and date unknown) (= CUP 51760).

Illustrations: Persoon, Ic. Descr. Fung. Tab. 7, fig. 7, 1800 (ut *Peziza*)!; Berkeley, Outl. Brit. Fungol. Pl. 2, fig. 6, 1860 (ut *Helotium*, habit); Lagarde, Ann. Mycol. 4: figs. 43-45, 1906 (ut *Chlorosplenium*)!; Boudier, Ic. Mycol. Pl. 486, 1908 (ut *Chlorosplenium*)!; Seaver, Mycologia 28: 392. 1936 (ut *Chlorociboria*); Kobayasi, J. Jap. Bot. 13: 469. 1937 (ut *Chlorociboria*); Kobayasi in Asahina, Nippon Inkwasoyokubutu Dukan, p. 300, Pl. 141, figs. 1-2, 1939 (ut *Chlorociboria*); Seaver, N. Amer. Cup-Fungi (Inopercul.) Pl. 99, fig. 1, 1951 (ut *Midotis*); Dennis, Mycol. Pap. 62, p. 47, fig. 40, 1956 (ut *Chlorociboria*); Ramamurthi, Korf and Batra, Mycologia 49: 856, fig. 3, 1958 (ut *Chlorociboria*); Dennis, Brit. Cup Fung. Pl. 15, fig. G, 1960 (ut *Chlorociboria*); Dennis, Brit. Ascomycetes, Pl. 18, fig. G, 1968 (ut *Chlorosplenium*).

Exsiccati: Berkeley, British Fungi Exs. No. 274 (ut *Peziza*) FH (= CUP 52700); Ellis and Everhart, North American Fungi No. 988 (ut *Chlorosplenium*) [a mixed collection, packets in some herbaria are *Chlorenchocelia torta*!] CUP-D 11213 (77-61); Weese, Eumycetes Selecti Exs. No. 252 (ut *Chlorosplenium*) BPI (= CUP 51763).

Excluded Exsiccati: Herbar Barbey-Boissier No. 1285, issued as *Coryne versiformis* is *Rutstroemia bulgarioides*; de Thümen, Mycotheca Universalis No. 217 issued as *Helotium versiforme* is *Rutstroemia bulgarioides*.

Specimens Examined: U.S.A. - MICHIGAN: CUP 51708, 51709, 51777, 51778, 51797; CUP-D 10839 (77-115). MINNESOTA: CUP-D 10674 (77-114). NEW HAMPSHIRE: CUP-D 4529 (77-93). NEW YORK: CUP 51710, 51732, 51786, 51787, 51792; CUP-D 4522 (77-46), 4523 (77-47), 5984 (92-176); R.P.K. 871; NYS-Peck s.n., on old decayed log, Portville, September [? 1872], holotype of *Craterellus caespitosus*, isotypes: CUP 51721, CUP-D 6038 (77-100). NORTH CAROLINA: CUP 51772. OHIO: CUP-D 2687 (77-83), 4825 (77-98), 10720 (77-116). PENNSYLVANIA: CUP-D 3993 (77-90); PH-Schweinitz Syn. No. 900, (no substrate, no date, no collector - ? Schweinitz), Bethlehem, ut *Peziza versiformis* Pers. [= CUP-D 3993 (77-90)]. WEST VIRGINIA: CUP-D 6473 (77-104).

ARGENTINA: BA 21401.

CANADA - BRITISH COLUMBIA: BPI-Weir 2658. ONTARIO: BPI-Cain 10096 (= TRTC 10096), 30845, 32871 (= TRTC 32871); CUP-D 4532 (77-96); R.P.K. 2417 (= TRTC 30743). QUEBEC: BPI-Steenson s.n., Aug. 24-26, 1938.

DENMARK: CP-Rosenvinge s.n., 9-10-1888.

JAPAN - HOKKAIDO: CUP-JA 2636.

SWEDEN: CUP-D 29 (77-60).

UNION OF SOVIET SOCIALIST REPUBLICS - RUSSIA: TAA-Parasto 17785, Raïtviir 42566 (= R.P.K. 3380).

YUGOSLAVIA: S-Rehm, Voss s.n., (no date), auf Lindenholz, Lees in Krain, holotype of *Coryne sarcoides* var. *viridescens* (= CUP 52709).

LOCALITY UNKNOWN: UPS-Fries s.n., (collector, locality and date unknown), ut *Peziza versiformis* (= CUP 51737); L-Persoon Herb. 910, 256-1329 (= CUP 51760), presumed holotype of *P. versiformis*.

Notes: This species is distinguished from *C. torta* by its more filamentous tomentum hyphae, much lighter colored medullary hyphae, and larger cylindrical to allantoid ascospores. The ascocarp of this species is usually somewhat larger, 7-9 (-17) mm in diam, whereas *C. torta* is usually < 7 mm in diam. As in *C. torta* the tomentum hyphae and paraphyses are often highly pigmented and/or granulated, but normally not to the extent exhibited in that species.

2. *Chlorenchocelia torta* (Schw.) Dixon, *comb. nov.*
 = *Peziza torta* Schw., Trans. Amer. Philos. Soc. 4: 175. 1832. (!!)
- = *Chlorosplenium subtortum* Fr., Summa Veg. Scand. p. 356 (in nota). 1849, a gratuitous renaming.
- = *Peziza subtorta* (Fr.) de Not., Comment. Soc. Critt. Ital. 1: 376. 1864.
- = *Chlorosplenium tortum* (Schw.) Sacc., Syll. Fung. 8: 320. 1889.
- = *Helotium rugipes* Peck, Annual Rep. New York State Mus. 26: 82. 1874. (!!)
- = *Lanzia rugipes* (Peck) Sacc., Syll. Fung. 8: 480. 1889.
- = *Chlorociboria rugipes* (Peck) Ram. & Korf in Ram., Korf & Bat., Mycologia 49: 859. 1958.
- = *Chlorosplenium rugipes* (Peck) Korf, Bull. Natl. Sci. Mus. 4: 391. 1959.
- = *Ciboria olivacea* Rodway, Pap. & Proc. Roy. Soc. Tasmania 1924: 105. 1925. (!!)
- = *Chlorociboria versiformis* (Pers. per Pers. : Fr.) Seaver ex Ram., Korf & Bat. var. *olivacea* (Rodway) Dennis, Kew Bull. 13: 340. 1958.
- = *Chlorosplenium rodwayi* Korf, Bull. Natl. Sci. Mus. 4: 391. 1959, non *C. olivaceum* Rick 1931 nec *C. olivaceum* Seaver 1951.

(Figs. 30-33, 38)

Apothecia: superficial, solitary to gregarious, occasionally in caespitose clusters from a common stipe.

Disc: shallow cupulate to infundibuliform, becoming convex-expanded to repand in mature specimens, olive-yellow to olive-green in fresh specimens (Mars Yellow to Olive Citrine) becoming olive to deep olive green upon drying, edges of disc enrolling upon drying, < 7 (-12) mm in diam, mostly 3-7 mm in diam.

Receptacle: dark olive-green to brownish olive when fresh, with a pruinose greenish-yellow cast when dry, furrowed to rugose.

Stipe: < 3 × 0.5-1.0 mm, concolorous with the receptacle, glabrous, rugose especially upon drying.

Hymenium: (85-) 95-120 (-140) μm high, hyaline with brown portions due to abundance of pigmented paraphyses.

Asci: cylindrical-clavate with a long tapered stalk, (69-) 90-121 (-126) × 5-7 μm (mean of collections 101 × 6 μm), 8-spored, strongly J+, apex rounded to subconic, wall at apex 1.5-3 μm thick, 0.5-1.0 μm thick along the sides of the ascus, arising from repeating croziers.

Ascospores: irregularly biseriolate, unicellular, hyaline, smooth-walled, irregularly ellipsoid with rounded ends, prominently biguttulate, occasionally with several smaller guttules, (5.6-) 9-11 (-12) \times 2-4 μm (mean of collections 9.6 \times 3.0 μm).

Paraphyses: filiform, occasionally subclavate at the apex, unbranched or branching near the base with the point of branching being so low in some specimens as to appear unbranched, hyaline or filled with numerous guttules and/or green pigmented granules, septate, 2-3 μm in diam, scarcely longer than the asci.

Subhymenium: 20-35 μm thick, of hyaline and/or light brown *textura intricata*, hyphae 2-4 (-5) μm in diam.

Medullary Excipulum: of hyaline to dark brown-walled, loose to tightly compacted *textura intricata*, portions often with collapsed hyphae, in section darker than in *C. versiformis*, hyphae smooth and/or roughened with dark brown granulations, sympodially branched, 3-6 μm in diam with occasional hyphae ballooning out along their length to produce cells 13-20 \times 25-30 μm in diam.

Ectal Excipulum: 35-115 μm thick, of thin to thick-walled, hyaline to dark-walled *textura angularis* to *textura globulosa* (often remaining as *textura intricata*, especially near the margins), giving rise to stalked, sub-globose to definitely clavate tomentum hyphae oriented nearly perpendicularly to the flanks of the apothecium, tomentum hyphae 8-12 μm in diam and frequently containing green pigments and/or green granules, occasionally with algal elements interspersed among the cells of the ectal excipulum.

Habitat: on decayed wood; collected on *Acer*, *Betula*, *Fagus*, *Quercus*, *Tabebuia*, coniferous and unidentified wood.

Range and Seasons of Fructification: North America, Puerto Rico, Japan, New Zealand, Tasmania, Union of Soviet Socialist Republics; Summer and Autumn.

Name: from Latin, "tortus," twisted, crooked; referring to the shape of the apothecia.

Type Locality: Salem [now Winston-Salem], North Carolina, U.S.A.

Presumed Type Specimen: (substrate unknown), Salem, Schweinitz, (no date), PH-Schweinitz Syn. Fung. No. 876-113 (= CUP 51670); isotypes: CUP-D 3365 (77-58), 3566 (77-59); UPS-Fries s.n. (= CUP 51734).

Illustrations: Dennis, Kew Bull. 13: 340, fig. 22, 1958 (ut *Chlorociboria versiforme* var. *olivacea*)!; Ramamurthi, Korf and Batra, Mycologia 49: 856, fig. 4, 1958 (ut *Chlorociboria rugipes*); Korf, Sci. Rep. Yokohama Natl. Univ. Sect. 2, Biol. Sci. 7: 27, figs. 13-14, 1958 (ut Tax. sp. VI et *Chlorociboria* ? *rugipes*)!.

Exsiccati: Ellis and Everhart, North American Fungi No. 988 (ut *Chlorosplenium versiforme*) [a mixed collection, packets in some herbaria are *Chlorencoelia versiformis*!] CUP-A.

Specimens Examined: U.S.A. - ALABAMA: CUP-D 3564 (77-88). CONNECTICUT: CUP-D 3563 (77-87). GEORGIA: CUP 37277; R.P.K. 813. INDIANA: CUP 52461. IOWA: CUP-D 8052 (77-105). KENTUCKY: CUP-D 10525 (77-113). MAINE: CUP 51731, CUP-D 5271 (77-99). MASSACHUSETTS: BPI-Cain 40545 (= TRTC 40545), 40560 (= TRTC 40560); CUP-D 4530 (77-94); R.P.K. 3826. MICHIGAN: CUP 51798. NEW JERSEY: CUP 51790; CUP-D 4533 (77-87), 5981 (92-173). NEW YORK: CUP 51671, 51711, 51712, 51730, 51789, 51791, 51793, 51794, 51796, 52627; CUP-LG 12; NYS-Peck s.n., on decayed wood, East Worcester, Otsego Co., July (no year), holotype of *Helotium rugipes*, isotypes: CUP-D 5982 (92-174), R.P.K. 2620; CUP-D 5983 (92-175), (no substrate), Adirondack Mts., Dr. Peck, (no date), authentic material of *Helotium rugipes*. NORTH CAROLINA: CUP 51769, 51771; CUP-D 9469 (77-106); PH-Schweinitz Syn. Fung. No. 876-133, (substrate unknown), Salem, (no date), presumed holotype of *Peziza torta* (= CUP 51670). OHIO: BPI-Elliott 12488 (= DAOM 12488); CUP 51788; CUP-D 4531 (77-95). PENNSYLVANIA: BPI-Henry 1385, 3035; CUP-D 564 (77-84), 3565 (77-89). VIRGINIA: CUP 51781, 51782, 51784. WISCONSIN: CUP-D 10022 (77-111); R.P.K. 2792.

CANADA - ONTARIO: BPI-Groves & Biggs 9251; R.P.K. 2415. QUEBEC: BPI-Shear 4167b.

JAPAN - HONSHU: CUP-JA 178, 479. KYUSHU: CUP-JA 414.

NEW ZEALAND: R.P.K. 3243 (= Dingley 19026).

PUERTO RICO: CUP-PR 4054.

TASMANIA: HO-Rodway s.n., (no substrate), National Park, (no collector), June 1924 (= CUP 52628, = R.P.K. 2842), holotype of *Ciboria olivacea*.

UNION OF SOVIET SOCIALIST REPUBLICS - RUSSIA: TAA-Kullman & Raitviir 61253, Parmasto 15418, 15469 (= R.P.K. 3375), 16220.

LOCALITY UNKNOWN: L-Persoon 910, 256-1318 (locality, date and collector unknown) ut *Peziza versiformis* (= CUP 51761).

Notes: This species while distinct from *Chlorencoelia versiformis* is often confused with it. The ranges of *C. torta* and *C. versiformis* overlap. The paraphyses and the subglobose to definitely clavate tomentum hyphae of *C. torta* often have strongly green pigmented and heavily granular contents. I have examined specimens which appear to be malformed in that they possess a poorly developed hymenium. When this occurs, such specimens always exhibit paraphyses and tomentum hyphae with an abundance of pigmentation.

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