

Studies in *Galiella* (Ascomycota, Pezizales)

I. Notes on *Galiella rufa*

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Summary: In this first resuming study on the genus *Galiella*, *Galiella rufa*, the type species of this genus, is described based on macro- and microscopic characters. Colour pictures of fresh specimens and microscopic features are also given.

Keywords: *Sarcosomataceae*, *Plectania*, *Peziza hirtipes*, Eastern United States of America.

Riassunto: In questo primo studio sul genere *Galiella*, viene descritta macro- e microscopicamente *Galiella rufa*, la specie tipo di questo genere. Vengono fornite inoltre foto a colori di esemplari freschi e del quadro microscopico.

Parole chiave: *Sarcosomataceae*, *Plectania*, *Peziza hirtipes*, Stati Uniti d'America orientali.

Introduction

The genus *Galiella* was proposed by Nannfeldt and Korf (KORF, 1957) to accommodate all the “*Bulgaria-Sarcosoma*-like” fleshy species having warted ascospores with callose-pectic markings. The American species *Galiella rufa* (Schwein.) Nannf. & Korf was selected as the type species and three new combinations were proposed: *Galiella javanica* (Rehm) Nannf. & Korf, *Galiella celebica* (Henn.) Nannf. and *Galiella thwaitesii* (Berk. & Broome) Nannf. Three new combinations and three new species have been described so far as well, i.e. *Galiella amurensis* (Lj.N. Vassiljeva) Raitv. (VASSILJEVA, 1950; RAITVIIR, 1965), *G. japonica* (Yasuda) Y. Otani (YASUDA, 1921; OTANI, 1980), *G. spongiosa* (Berk. & M.A. Curtis) Pfister (BERKELEY, 1868; PFISTER, 1974), *G. coffeata* Gamundí (GAMUNDÍ, 1971), *G. oblongispora* J.Z. Cao and *G. sinensis* J.Z. Cao (CAO *et al.*, 1992). ZHUANG & WANG (1998) transferred *Galiella oblongispora* into the genus *Wolfina* Seaver and considered *Galiella sinensis* a synonym of *Galiella celebica*.

LE GAL (1958, 1960) and BOEDIJN (1959) considered *Galiella* a synonym of *Sarcosoma* Casp. whilst it was regarded as a distinct genus by many authors (e.g. KORF, 1957, 1972, 1973; OTANI, 1980; MORAVEC, 1983; PADEN, 1983; CAO *et al.*, 1992; ZHUANG & WANG, 1998; PANT & PRASAD, 2008), although in many cases their concept included species belonging to the genus *Trichaleurina* Rehm. CARBONE *et al.* (2013a) proved that *Galiella* is an independent genus in the family *Sarcosomataceae* Kobayasi and that at least two species formerly included in the genus, i.e. *G. javanica* and *G. celebica*, constitute an independent lineage within the *Chorioactidaceae* and are definitely unrelated to the type species *G. rufa*. The old generic name *Trichaleurina* was then restored for these two tropical taxa. A revision of the type species *Trichaleurina polytricha* Rehm (and also *Urnula philippinarum* Rehm) has been published by CARBONE *et al.* (2013b).

According to the available mycological literature, it seems possible that many ancient (and poorly known) species described in the genera *Sarcosoma*, *Wolfina* and *Bulgaria* Fr. could be very closely related to *Galiella*. Thus the aim of this study, and the further ones, is to clarify the identity of these species. The first step is to propose a good view of the type species *Galiella rufa* in order to delimit the generic concept of *Galiella*.

Material and methods

Morphological study

The microscopic studies were based on dried specimens. Two optical microscopes were used: Olympus CX41 trinocular and Optika B353 trinocular with plan-achromatic objectives 4×, 10×, 40×, 60×, 100× in oil immersion. The following main reagents were used: Melzer's reagent, Cotton Blue, Congo Red, 5% KOH. Water mounts were

used for the observation of the pigmentation and measurements. At least 30 spores were measured from each apothecium. MOMS is the acronym for the Missouri Mycological Society Herbarium; all of MOMS' vouchers are secured at the Dunn-Palmer Herbarium at the University of Missouri in Columbia (UMO).

Studied collection

Galiella rufa. U.S.A. Missouri, St. Louis County, Glencoe, Rockwood Reservation, on very moist dead wood. 11.VI.2004, *leg. et det.* Brad Bomanz (MOMS 207).

Taxonomy

Galiella rufa (Schwein.) Nannf. & Korf, *Mycologia*, 49 (1): 108 (1957)

Basionym: *Bulgaria rufa* Schwein., *Trans. Amer. Philos. Soc.*, n.s., 4 (2): 178 (1832).

Synonyms: *Sarcosoma rufum* (Schwein.) Rehm ex Durand, *J. Mycol.*, 9 (2): 102 (1903); *Gloeocalyx rufa* (Schwein.) Sacc., *Syll. Fung.*, 22: 726 (1913).

Peziza hirtipes Cooke, *Hedwigia*, 14 (6): 81 (1875), *fide* RIFAI (1968); *Plectania hirtipes* (Cooke) Sacc., *Syll. Fung.*, 8: 163 (1889).

Typification

Both DURAND (1907) and SEEVER (1928) reported to have studied collections by Ellis and Ravenel. Only DURAND (*op. cit.*) mentioned the existence of a type material in the “Schweinitz Herbarium” but without any further indication useful to locate it. Thanks to S. LaGreca, curator of CUP herbarium, we are aware that collection CUP-D-03901(32-35), in Durand's herbarium, is listed as “isotype” with the following note: “*Bulgaria rufa* Schw., Syn. N.A. no. 964. Part of type ex herb. Schweinitz”. According to STAFLEU & COWAN (1985), Schweinitz's fungi are housed by many herbaria and so we are doing a deep search to locate the other type material of *Bulgaria rufa*. The results of this search will be published in a next paper.

Original diagnosis

B. rufa, L. v. S., in ligno putrido Bethlehem hunc fungum rarius, sed tum maxima copia inveni. *B. magnitudine et substantia indoleque omnino B. inquinantis: forma autem magis Pezizoidea, breviter stipitata. Junioribus subturbinatis aut obovatis, clausis, vix autem velatis. Mox cupula dilatatur, margine undulato repando, disco, ascophoro, eleganter rufo. Extus umbrino-fusca, venoso-rugulosa, strigoso-pilosa, pilis tamen breviusculis. Statu madido attinet diametrum 2–3 uncialem, et colore laeto inter folia putrida oculos allicit; in sicco cornea et indurata sit mox autem reviviscens. Increscit more B. inquinatae lignis, putridioribus tamen, inter folia defossis.*

Macroscopical characters

Apothecium at first globose to urn-shaped, then concave to shallow cup-shaped, 2.5–3 cm across. **Hymenium** tan brown to brownish orange, smooth. **Margin** incurved to more opened in age, toothed to fringed. **Flesh** tough, rubbery and gelatinous, tan brown, brownish orange to blackish brown in age. **External surface** wrinkled, with a dense covering of hairs, blackish brown. **Stipe** mostly lacking but sometime a pseudostipe extending downward to 5 mm.

Microscopic characters

Asci on average $270 \times 12 \mu\text{m}$, cylindrical, operculate, inamyloid, eight-spored, with wall up to $1 \mu\text{m}$ thick and a tapered, flexuous, aporhynchous base. **Paraphyses** not exceeding the asci, $1.5\text{--}2 \mu\text{m}$ wide, cylindrical, septate, sometimes anastomosing, branched below, with a simple apex, slightly undulated or, in few cases, slightly lobed. **Hymenial hairs** cylindrical, as long as the paraphyses, $3\text{--}3.5 \mu\text{m}$ wide, with a simple apex, and a single septum at the very

base. **Ascospores** ellipsoid-subfusoid, slightly thick-walled, $(17\text{--})18\text{--}21\text{--}(23) \times 8\text{--}10 \mu\text{m}$, $Q = (1.9\text{--})2.1\text{--}2.5\text{--}(2.8)$, hyaline, very minutely verrucose (if seen in heated lactic Cotton Blue mounts), containing two large oil drops. **Subhymenium** ca. $100 \mu\text{m}$ thick, composed by a dense *textura intricata* of cylindrical, frequently septate hyphae, $3 \mu\text{m}$ diam., light brown if seen at low magnifications. **Medullary excipulum** very gelatinous, of *textura intricata* with cylindrical, septate, hyaline, slightly thick-walled hyphae, $2\text{--}3 \mu\text{m}$ wide. **Ectal excipulum** very thin, ca. $20 \mu\text{m}$ thick, of *textura subglobulosa* to *angularis* made up of elements up to $10 \mu\text{m}$ wide, dark brown due to the colored thick wall. **External hairs** cylindrical, septate, smooth, $4\text{--}5 \mu\text{m}$ wide, up to $220 \mu\text{m}$ long but on average $\leq 130 \mu\text{m}$, mostly straight but also slightly wavy, with tips blunt, and enlarged to bulbous base. They are light brown due to an epimembraneous pigmentation, with wall thickened up to $1 \mu\text{m}$.



Plate 1 – *Galiella rufa*

Upper: Fresh fruitbodies *in situ*; Bottom: Fresh fruitbodies. Photos: B. Bomanz

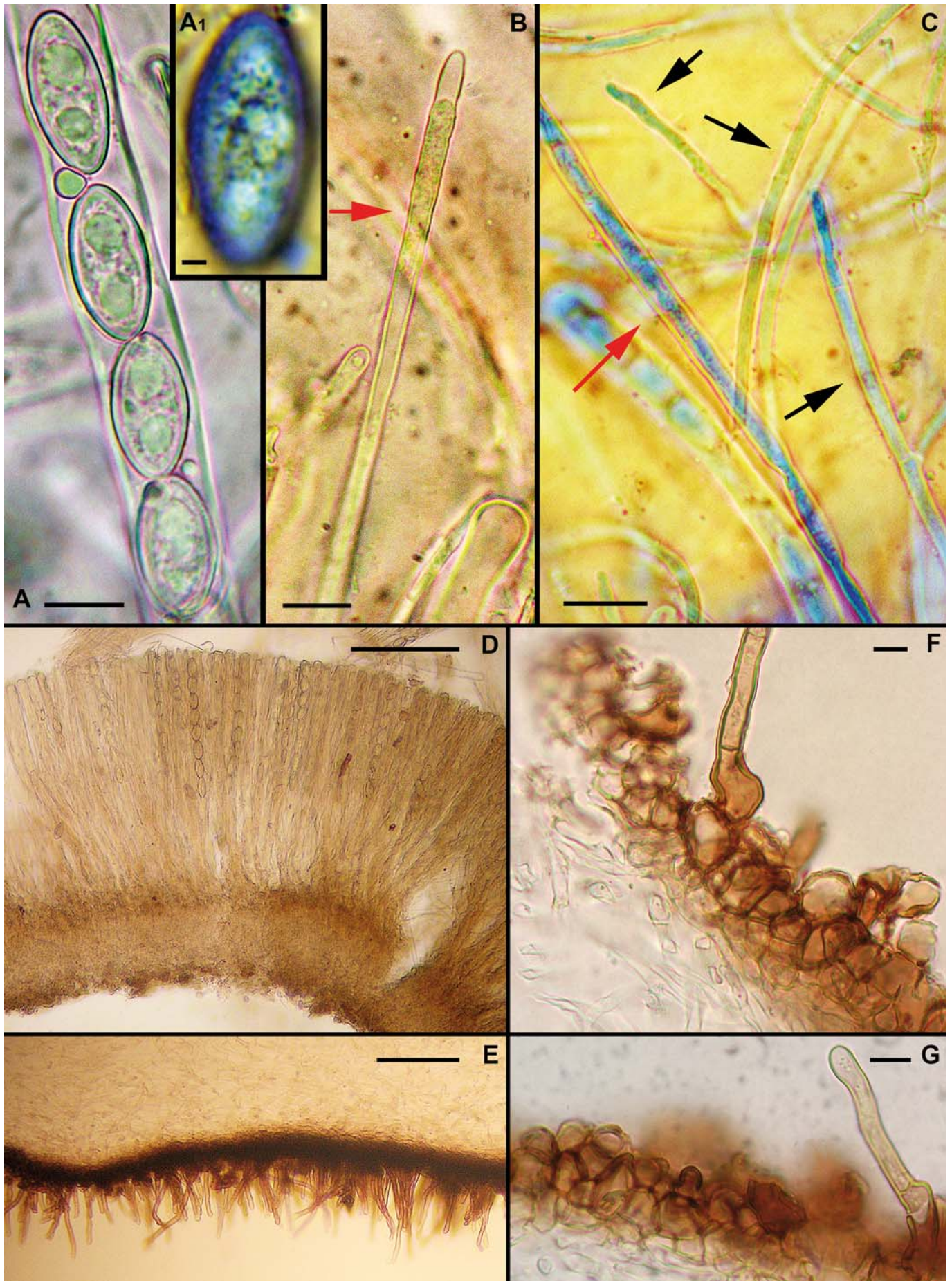


Plate 2 – *Galiella rufa*

All water mounts otherwise stated. A: Spores in ascus; A1: Spore in heated Cotton Blue; B: Hymenial hair; C: Hymenial hair (red arrow) and paraphyses (black arrows), in heated Cotton Blue; D: Hymenium and subhymenium; E: Medullary excipulum, ectal excipulum and external hairs; F-G: Ectal excipulum and external hairs. Scale bars: A-B-C-F-G = 10 µm; A1 = 2 µm; D-E = 100 µm. Photos: M. Carbone & C. Agnello.

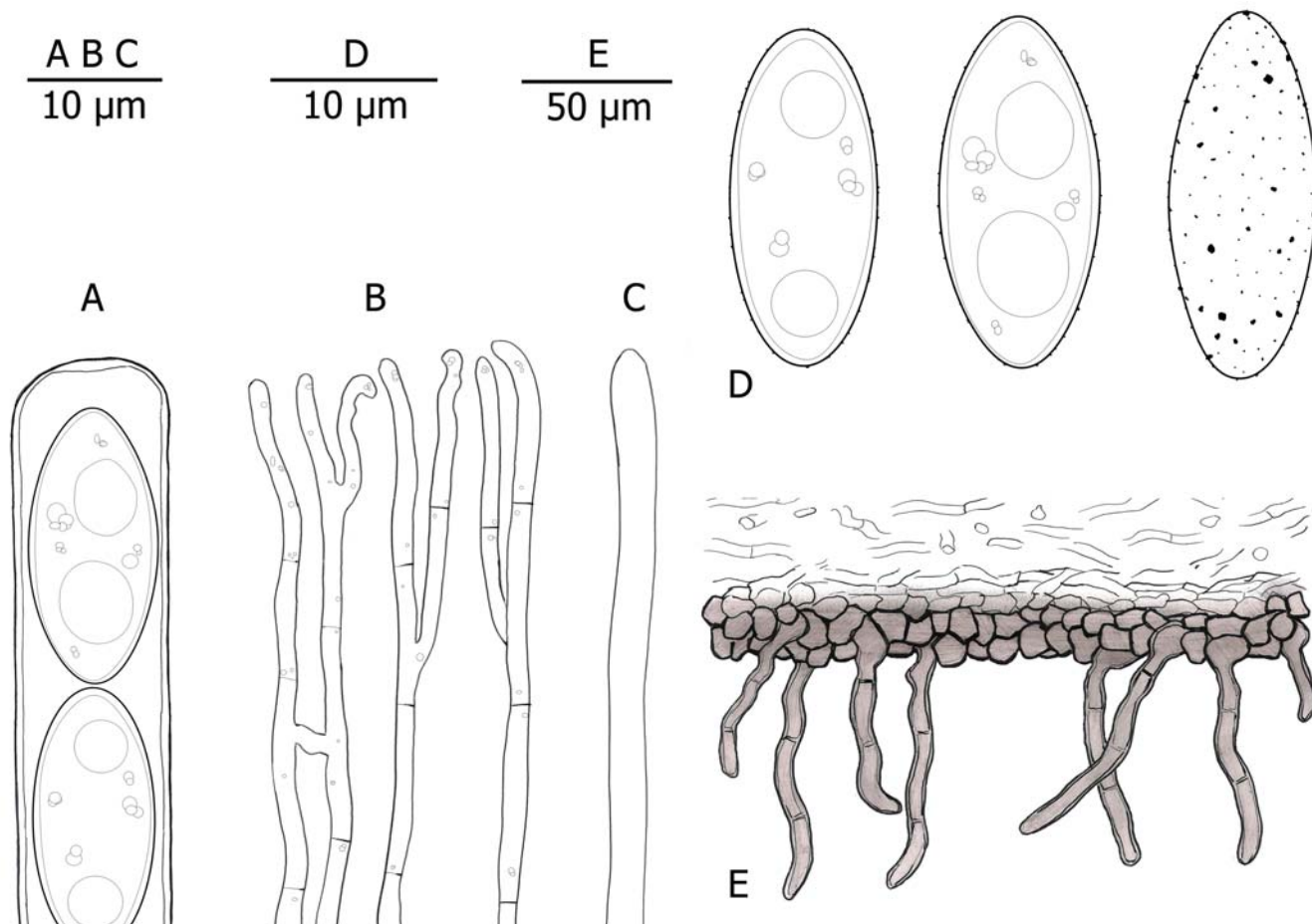


Plate 3 – *Galiella rufa*

A: Ascus tip with spores; B: Paraphyses; C: Hymenial hair; D: Ascospores; E: Ectal excipulum and external hairs. Drawings: C. Agnello

Ecology and phenology

The studied collection fruited in early summer on a wooded hillside. Found in small, loose clusters in a small group on a fallen decaying hardwood branch of an unidentified broadleaf tree, in forest litter.

Discussion

Galiella rufa is a well known eastern American species treated in many morphological works like DURAND (1903), SEAVER (1928, 1942), LE GAL (1951), ultrastructural (SAMUELSON *et al.*, 1980) and also many mushrooms field guides (e.g. BESSETTE *et al.*, 1997; PHILLIPS, 2005; BEUG *et al.*, 2014). It was first described by SCHWEINITZ (1832) from Bethlehem (Pennsylvania, USA), and then transferred into two others genera before being selected as the type species of the genus *Galiella* (KORF, 1957). It is characterized by a globose to shallow cupulate (sub)sessile apothecia with irregularly toothed margin, reddish-brown to orange-brown hymenium, blackish-brown external surface covered with hairs that give it a felt-like appearance; the flesh is gelatinous and rubbery; microscopically the main striking features are the subfusoid, very minutely warted spores, the presence of the so-called hymenial hairs and (mostly) straight, smooth, brown external hairs.

From a morphological point of view, the combination of gelatinous apothecia, warted spores, and smooth external hairs (of one kind only), are the main features distinguishing the genus *Galiella* in the family *Sarcosomataceae*.

In contrast to SEAVER (1928, 1942), who listed *Peziza hirtipes* Cooke as a synonym of *Plectania melastoma*, RIFAI (1968) regarded it as a

synonym of *Galiella rufa* after the study of the type specimen. We have not studied this type but, at present, we have no reasons to doubt in Rifai's proposal. Cooke's plate and description (COOKE, 1876) as well the English and Latin description (COOKE, 1875a, 1875b) seem to support this view. For a quick comparison we report here the original diagnosis: "*Substipitata, cupula carnosa, hemispherica (1-2 unc. lata) disco urceolato, extus atro-brunneo flocculosa, intus pallidior, margine leniter incurvato; stipite brevi, basi tomento denso radicante atro strigoso. Ascis cylindraceutis, sporidiis ellipticis (0.02 × 0.012 m.m.). Paraphysibus furcatis, hyalinis. Grevillea III fig. 91. Ad ramulos dejectos. Maine U.S. (Bolles 74) affinis P. melastomae. Sow.*"

PECK (1906) described the taxon *Bulgaria rufa* var. *magna* Peck from the New York State. He distinguished it mainly for a bigger size of the fruitbodies, ochre brown hymenium, little longer spores and habitat, growing in the ground under *Abies balsamea* (L.) Mill. We have not yet a final opinion on its identity but all these features seem too much different from those of *Galiella rufa* and such, at least until a type study will be done, we prefer not to consider it a variety of *Galiella rufa*. We know from MyCoPortal database that a collection NYS-F-001831 (housed in NYS herbarium) and listed as "possible type" does exist.

Finally, the records of *G. rufa* in Malaysia (ABDULLAH & RUSEA, 2009) seem doubtful and definitely need more studies. According to our morphological and phylogenetical studies (still unpublished) we believe that its geographical range should be restricted to the eastern part of North America.

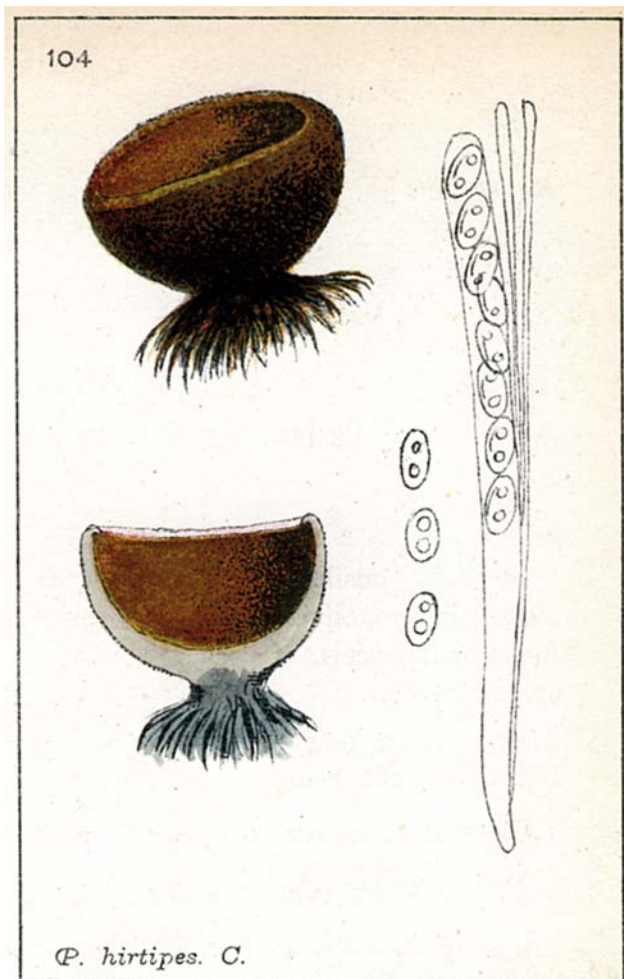


Plate 4 – *Peziza hirtipes* from COOKE (1876)

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