

## Sixteen gasteromycetes collected in Cuba 50 years ago

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Sixteen species of gasteromycetes were identified in 50-year old collections from Cuba, including five species new to this island. The species *Calvatia cyathiformis*, *Clathrus columnatus*, *Clathrus crispus*, *Cyathus limbatus*, *Diplocystis wrightii*, *Rhizopogon* sp., *Scleroderma tenerum* and *Tulostoma floridanum* had already been reported from Cuba, whereas *Disciseda hyalothrix* and *Lycogalopsis solmsii* represent new records for this country. Six species belong to the genus *Geastrum*, of which *G. pectinatum* agg., *G. schweinitzii* agg. and *G. velutinum* agg. were already known from Cuba, but three species, *G. corollinum*, *G. kotlaba* and *G. trichiferum*, are new to the Cuban mycobiota. Each species is provided with a brief description followed by taxonomic notes, and distribution.

**Key words:** new records, *Geastrum* spp., taxonomy, nomenclature, distribution.

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Celkově 16 druhů břichatek bylo určeno z 50 let starých sběrů z Kuby; z toho pět druhů je nových pro tento ostrov. *Calvatia cyathiformis*, *Clathrus columnatus*, *Clathrus crispus*, *Cyathus limbatus*, *Diplocystis wrightii*, *Rhizopogon* sp., *Scleroderma tenerum* a *Tulostoma floridanum* již byly z Kuby doloženy, kdežto *Disciseda hyalothrix* a *Lycogalopsis solmsii* představují prvně nalezené pro tento stát. Největším počtem druhů je zastoupen rod *Geastrum*, konkrétně *G. pectinatum* agg., *G. schweinitzii* agg. a *G. velutinum* agg., které jsou již z Kuby známy, avšak *G. corollinum*, *G. kotlaba* a *G. trichiferum* jsou pro Kubu nové. Stručná charakteristika každého druhu je doplněna o poznámky k jeho současnému taxonomickému pojetí a rozšíření.

### INTRODUCTION

In the herbarium of the Mycological Department of the National Museum in Prague (PRM) besides many other fungal collections some gasteroid fungi from Cuba are kept. They were collected mostly by the first author (often together with the Cuban J. Ramón Cuevas) and a few specimens by Czech botanists (E. Hadač, V. Samek) during a field survey in Cuba half a century ago (Kotlaba from 19 Nov 1966 to 19 Apr 1967).

In PRM many still unidentified collections of different groups of macromycetes from the Cuban territory are deposited, especially of the family *Corticaceae* s.l. and pyrenomycetes, which would deserve identification. František Kotlaba studied in the first place polypores of Cuba, so that he collected other fungi – including gasteromycetes – only occasionally. In total seven contributions to the mycobiota of Cuba were subsequently published in the years 1983 to 2013 [Kotlaba 1983 (in Czech), Kotlaba et al. 1984, Vampola et al. 1994, Pouzar 2003, Kotlaba & Pouzar 2003, 2008, 2013]. Of course, the list of gasteromycetes from Cuba is not complete, as the first author of this paper was not able to find a large number of species growing there.

This last contribution to the mycobiota of Cuba involves the gasteroid genera *Calvatia*, *Clathrus*, *Cyathus*, *Diplocystis*, *Disciseda*, *Geastrum*, *Lycogalopsis*, *Rhizopogon*, *Scleroderma* and *Tulostoma*. Each of these genera is represented by only one species, except for *Clathrus* represented by two and *Geastrum* by six species. One of the discussed species, *Diplocystis wrightii*, was originally described from Cuba. Fig. 2b probably represents *Geastrum fimbriatum*, but there are no herbarium specimens available, therefore this photo is the only evidence. This species was first published (represented by a single fruitbody) from Cuba by Ponce de León (1946) but without necessary details about this collection: “... un ejemplar de esta especie, que fué colectado por la Dra. Margarita Dumois en las Escaleras de Jaruco ...” [Jaruco SE of La Habana, Prov. Mayabeque]. Thus, according to the current knowledge, this species seems to be very rare in Cuba. A considerable number (5) of gasteroid fungi was collected at only one locality, Playa de Bailen SW of Pinar del Río.

The first author (F. Kotlaba, \*1927) has compiled this paper together with the other author (P. Zehnálek, \*1992), who studies among others the genus *Geastrum* in Panama.

#### MATERIAL AND METHODS

The gasteroid fungi were collected randomly at various localities on the territory of Cuba, most of them in the western part of the island, and then studied in the laboratory. Some of them have been sent to specialists for identification. In 2017–2018 the material was revised and studied microscopically in Prague using light microscopes (Olympus CX31, Leica ICC50 W) with oil immersion, observed under a magnification of 1000×, mounted in Melzer’s reagent or 3% KOH. Photos of microscopic structures were taken with a Leica ICC50 W digital camera. The macroscopic photos of Cuban landscapes (Fig. 1) were taken by the first author (Praktisix IIA), the photos of dry material were taken by the second author (Canon EOS 500D).



**Fig. 1.** Photos of Cuban landscapes acquired during the field survey: **a** – landscape with the palm *Roystonea regia*, Prov. Matanzas, 16 Apr 1967; **b** – village of La Melba above the river Jaguaní valley in Cuchillas de Toa NP, Prov. Oriente (presently Prov. Guantánamo), 15 Mar 1967; **c** – river Jaguaní valley in Cuchillas de Toa NP, 15 Mar 1967; **d** – Jaguaní river in Cuchillas de Toa NP, Mr V. Samek in foreground, 15 Mar 1967. Photos F. Kotlaba.

The localities of the collected species are arranged from west to east. The names of Cuban districts (provinces), abbreviated to Prov., are given in the current sense (the former names of provinces are in brackets). The names of the authors of this paper are abbreviated F.K. and P.Z., respectively.



**Fig. 2.** Original photos of two gasteromycetes from Cuba in situ: **a** – *Clathrus crispus*, probably La Habana, spring 1967?, photographer unknown; **b** – *Geastrum* cf. *fimbriatum*, in garden of Hotel Los Jasmynes, Viñales, Prov. Pinar del Río, May 1967, photo J. Křeček.

## RESULTS AND DISCUSSION

This part includes morphological descriptions, information on ecology and known distribution as well as taxonomical notes. It should be noted that morphological characters refer only to dry material which was available, so that fresh material may exhibit some differences. Concerning the distribution of the treated species we cite mostly original papers where possible. In the species complexes discussed below (*Geastrum pectinatum* agg., *G. schweinitzii* agg., *G. velutinum* agg.) we state the distribution of the whole complex.

### *Calvatia cyathiformis* (Bosc) Morgan 1890

Fig. 3

- = *Lycoperdon cyathiforme* Bosc 1811
- = *Lycoperdon fucatum* Lévl. 1844
- = *Hippoperdon pila* Lévl. 1844

**Brief description.** Fruitbodies small to medium-sized, club-shaped, 85 mm in the widest upper part, 37 mm in the basal part. Peridium grey to dark brown, smooth. Gleba brown or brown violaceous. Subgleba cellular. Spores globose, pale brown, roughly warty to spiny, 5.5–7 µm diam. (incl. ornamentation).

Description based on two collections each containing one sectioned fruitbody.

#### **Material studied**

Central Cuba. Prov. Villa Clara (former part of Las Villas), sabana near Manacas NW of Santa Clara, in grass on sandy loamy soil, 10 Feb 1967, leg. F.K. & L. Kotlabová, det. F.K. as *Calvatia lilacina*, rev. F.K. & P.Z., 6–27 Nov 2017 (PRM 871147); *ibid.*, det. H. Kreisel (PRM 874203).



**Notes.** Macroscopically *Calvatia fragilis* and *C. cyathiformis* are very similar in the violet tinge of peridium and gleba. Some authors consider *Calvatia fragilis* (= *C. lilacina*) a synonym of *Calvatia cyathiformis*, but there is a distinguishing character in the subgleba structure, *C. fragilis* having a compact subgleba and *C. cyathiformis* a cellular subgleba (Kreisel 1994). Nevertheless the concept of both species does not yet seem to be solved definitively.

**Distribution.** This species was described by Bosc (1811) as *Lycoperdon cyathiforme* from North America (Carolina). The first record for Cuba was provided by Hernández et al. (2008). It has a worldwide distribution including the USA and Canada (Coker & Couch 1928), Central America (Laferrière & Gilbertson 1992, Calonge et al. 2005), South America (Baseia 2003), Africa (Kreisel 2001), Asia (Gogoi & Vipin 2015), and Europe (France, introduced?; Kreisel 2001).

***Clathrus columnatus* Bosc 1811**

- = *Laternea columnata* (Bosc) Nees 1858 – *Linderia columnata* (Bosc) G. Cunn. 1931 – *Colonnaria columnata* (Bosc) E. Fisch. 1933 – *Linderiella columnata* (Bosc) G. Cunn. 1942
- = *Clathrus colonnarius* Léman 1817
- = *Clathrus brasiliensis* E. Fisch. 1886 – *Laternea brasiliensis* (E. Fisch.) Long & Stouffer 1948
- = *Clathrus trilobatus* Cobb 1906

**Brief description.** Fruitbody small-sized, 44 mm high, composed of four orange cellular columns connected in the upper part and encrusted by fine sand on the whole surface. Basal part of fruitbody covered by whitish volva with white rhizomorphs at the base. Gleba greenish, located under the connection of the columns. Spores narrowly elliptic to cylindrical, thin-walled, smooth, hyaline, 3–4 µm long and 1.5–2 µm wide.

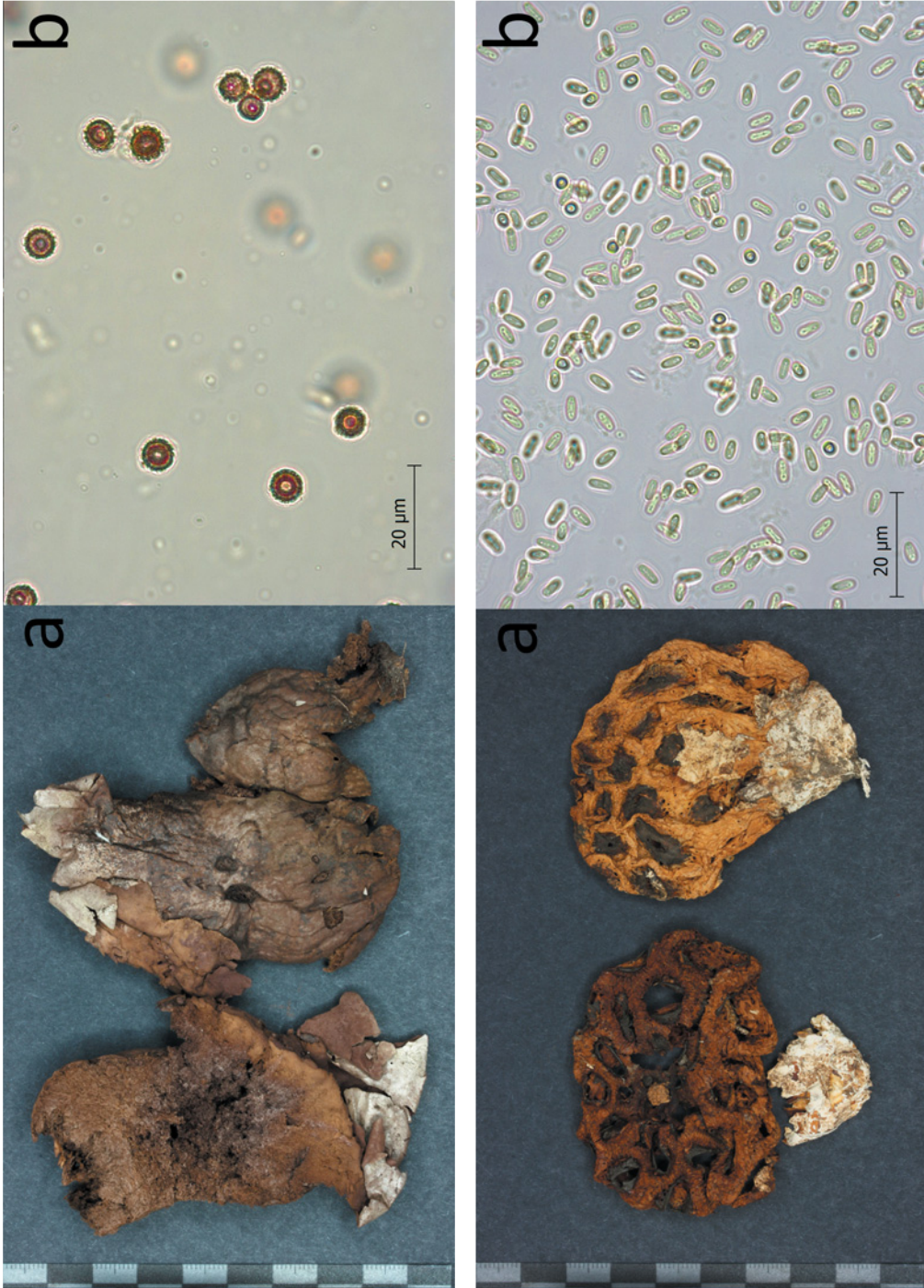
Description based on one collection containing one mature disintegrated fruitbody.

**Material studied**

**Cuba.** Prov. Pinar del Río, S of campus of the Academy of Sciences, Sandino near Guane, on the ground, 12 Jan 1968, leg. E. Hadač, det. P.Z. & F.K., 21 May 2018 (PRM 877416).

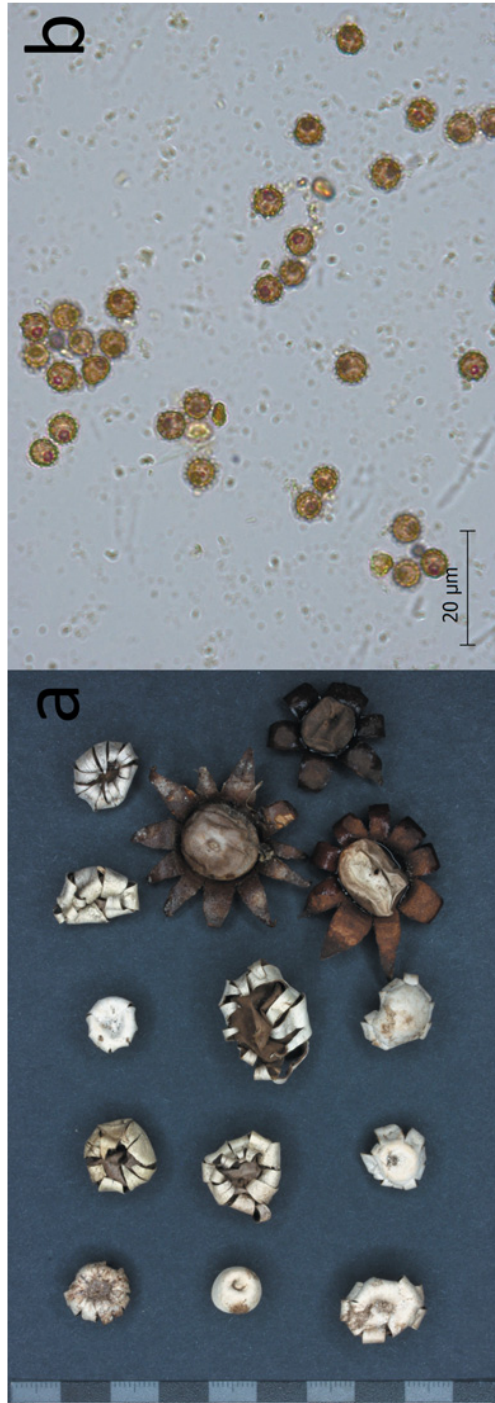
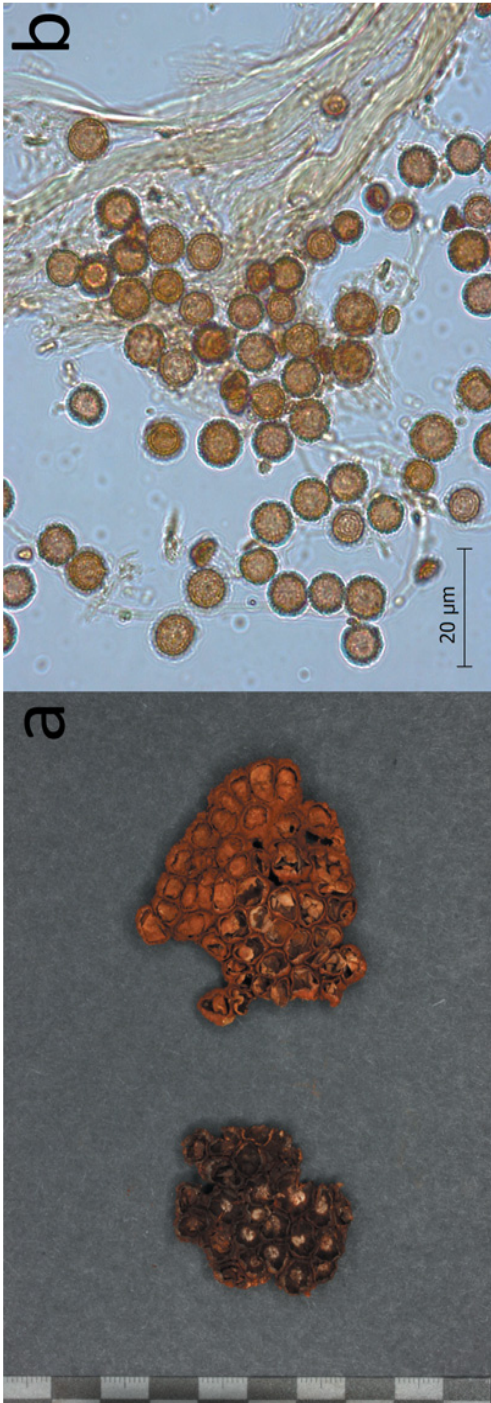
**Notes.** This terricolous species, remarkable by its orange colour, is distributed in warm and tropical regions. The morphological variability of this fungus has led to a relatively rich synonymy, including generic names. In our material we observed somewhat smaller spores than is usually stated (e.g. Magnago et al. 2013).

**Distribution.** This species was described from the USA (Carolina) by Bosc (1811). In the Caribbean region it is known from Puerto Rico (Lloyd 1909), Tobago (Reid 1977), the USA (Lloyd 1906, Coker & Couch 1928). Its distribution also covers Central America (Dring 1980), South America (Möller 1895), central Africa (Dissing & Lange 1962, Kreisel 2001), New Zealand (Cunningham 1944), and Hawaii (Lloyd 1909, Hemmes & Desjardin 2009).



**Fig. 3 (top).** *Calvatia cyathiformis* (PRM 871147): **a** – mature fruitbody, scale bar = 10 cm; **b** – verrucose spores, scale bar = 20 µm. **Fig. 4 (bottom).** *Clathrus crispus* (PRM 871133, PRM 877430): **a** – mature fruitbodies with whitish volva, scale bar = 10 cm; **b** – smooth thin-walled spores, scale bar = 20 µm. Photos P. Zelnálek.





**Fig. 5 (top).** *Diplocystis wrightii* (PRM 874191): **a** – opened and unopened fruitbodies in stroma, scale bar = 10 cm; **b** – verrucose spores, scale bar = 20 µm. **Fig. 6 (bottom).** *Geastrum corollinum* (PRM 874181a): **a** – one unopened fruitbody and dry or moistened mature fruitbodies, scale bar = 10 cm; **b** – globose ornamented spores, scale bar = 20 µm. Photos P. Zehnálek.

***Clathrus crispus*** Turpin 1820

Figs. 2a, 4

- ≡ *Clathrella crispa* (Turpin) E. Fisch. 1886
- = *Clathrus crispus* var. *obovatus* Berk. 1842
- = *Clathrus americanus* Lloyd 1909
- = *Clathrus pseudocrispus* Lloyd 1909

**Brief description.** Fruitbodies medium-sized, 38–62 mm wide, 60–73 mm high. Receptaculum globose to ovoid, grid-shaped, pale brown to orange. The olive-green gleba covers the surface of the receptaculum irregularly. Whitish, thin and smooth volva at the base. Spores narrowly elliptic to cylindrical, smooth, colourless, 1–3 µm long and 1.5–2 µm wide.

Description based on two collections containing three mature fruitbodies in total.

**Material studied**

W C u b a. Prov. La Habana, Marianao, on semihumous soil near a road in the town, 16 Feb 1967, leg. & det. F.K. as *Clathrus americanus*, rev. F.K. & P.Z., 7–14 Dec 2017 (PRM 877430). – E C u b a. Prov. Camagüey, town of Camagüey, on grassy soil in park called Casino deportivo, 10 Apr 1967, leg. F.K. & J. Ramón Cuevas, det. F.K. as *Clathrus americanus?*, rev. F.K. & P.Z., 7–14 Dec 2017 (PRM 871133).

**Notes.** The nomenclatural status of this species is problemless. A frequently used name in the literature is *Clathrus americanus*, but the priority name (correct name) is *C. crispus*. The wrinkled edge of particular meshes (Fig. 4) represents a character distinguishing this species from the north temperate species *C. ruber*.

**Distribution.** Species with a Neotropical distribution, rather common in the Caribbean region including Cuba (Berkeley & Curtis 1869, Lloyd 1909, Dennis 1953, Dring 1980). It is also known from the USA, Mexico (Dring 1980) and South America (Berkeley 1842, Domínguez de Toledo 1995, Cheype 2010).

***Cyathus limbatus*** Tul. & C. Tul. 1844

- ≡ *Cyathodes limbatum* (Tul. & C. Tul.) Kuntze 1891
- = *Nidularia striata* var. *pusilla* Berk. 1839

**Brief description.** Fruitbodies small-sized, cup-shaped, 8–11 mm high and 5–6 mm wide (in upper part). Outer surface of exoperidium brown to black (older fruitbodies), markedly hirsute. Inner surface grey brown, sulcate. Upper part of peridium tends to close during drying. Peridioles double-layered, lenticular, wrinkled, greyish black, 2.2–2.7 mm diam. Spores not observed.

Description based on one collection containing 11 opened as well as unopened fruitbodies.

**Material studied**

E C u b a. Prov. Guantánamo (former part of Oriente), Cuchillas de Toa NP, in Jaguaní river valley between La Melba and Los Lirios near Baracoa, on rotten twigs of frondose trees, 16 Mar 1967, leg. F.K., det. V. Demoulin, 17 Mar 1969 (PRM 871137).



**Notes.** Surprisingly, although this bird's nest fungus species was described in 1844, just one synonym exists in literature, *Cyathodes limbatus*. This species is problemless taxonomically as well as from a nomenclatorial point of view. *Cyathus limbatus* is remarkable by the double-layered cortex of the peridioles and size of the spores measuring about  $20 \times 11 \mu\text{m}$ . A similar species is *Cyathus poeppigii*, which can be distinguished by its up to  $40 \mu\text{m}$  long spores.

**Distribution.** This species was described from Guyana and Surinam (Tulasne & Tulasne 1844). For Cuba it was reported by Berkeley & Curtis (1869). Other records are from Central America (Calonge et al. 2005, Gube & Piepenbring 2009), South America (Berkeley & Cooke 1876, Dennis 1960, Trierveiler-Pereira & Baseia 2011), west and central Africa, Mauritius (Bottomley 1948, Kreisel 2001), Asia, the Pacific Islands, and Hawaii (Brodie 1975).

***Diplocystis wrightii* Berk. & M.A. Curtis 1869**

Fig. 5

**Brief description.** Fruitbodies small-sized, 3–7 mm wide, clustered in large groups and immersed in a tough brown stroma. Exoperidium cup-shaped, rigid, rusty brown or black-brown in old fruitbodies. Endoperidium covered by remnants of substrate in closed fruitbodies. On opened fruitbodies remnants of the strongly tomentose to fibrous greyish endoperidium are observable. Spores globose, pale brown, finely verrucose to spiny,  $5.5\text{--}8 \mu\text{m}$  diam. (incl. ornamentation).

Description based on one collection containing three fragments of stroma containing about 70 fruitbodies.

**Material studied**

Cuba. Prov. Pinar del Río, Sierra de Cajálbana Mts. near La Mulata, on serpentinic soil, 4 Apr 1967, leg. & det. F.K. (PRM 874191).

**Notes.** Unmistakable species without taxonomic or nomenclatural complications. It represents a unique case in mycology because it does not have a single synonym! *Diplocystis wrightii* is remarkable by its numerous groups of cup-shaped fruitbodies growing tightly in a firm stroma (Fig. 5). The phylogenetic position of this species in suborder *Sclerodermatinae* (*Boletales*) was proposed by Louzan et al. (2007).

**Distribution.** This species was described from Cuba by Berkeley & Curtis (1869) and then reported by Kreisel (1974) from seven localities, including Cajálbana in 1970, where it was found by the first author three years earlier (see above). Its further distribution is mostly restricted to the Caribbean region: Puerto Rico (Louzan et al. 2007), the Bahamas and Guadeloupe (Coker & Couch 1928), and Mexico (Herrera 1972).

***Disciseda hyalothrix*** (Cooke & Masee) Hollós 1902

- ≡ *Bovista hyalothrix* Cooke & Masee 1888 – *Catantoma hyalothrix* (Cooke & Masee) Lloyd 1905
- = *Disciseda pedicellata* (Morgan) Hollós 1902

**Brief description.** Fruitbodies rather small-sized, globose or slightly flattened, 10–20 mm diam. Exoperidium ephemeral, in mature fruitbodies forming a disc or a cup at the top, strongly encrusted with sand. Endoperidium grey to brown, smooth, finely tomentose. Peristome not observed. Spores globose, pale brown, warty to spiny, 8–10 µm diam. (incl. ornamentation), sometimes with pedicels of usually up to 5 µm long (rarely longer).

Description based on one collection containing two mature fruitbodies.

**Material studied**

W C u b a. Prov. Pinar del Río, Playa de Bailen SW of Pinar del Río, on sandy pasture, 29 Nov 1966, leg. F.K. & J. Ramón Cuevas, det. F.K. & P.Z., Nov 2017 (PRM 877420).

**Notes.** Moreno et al. (2003) studied the type material of *Disciseda pedicellata* and *D. hyalothrix* with the conclusion that these species are conspecific and that the correct name is *D. hyalothrix*. A distinguishing feature of this gasteromycete is the presence of pedicellate spores. In *D. pedicellata* the pedicels are reported to be somewhat longer than in *D. hyalothrix*. Accepting the conclusions of Moreno et al. (2003), there is only one species with a variable length of pedicels.

**Distribution.** This is the first record of *Disciseda hyalothrix* for Cuba. It was described from Australia as *Bovista hyalothrix* (Cooke 1888). It is also reported from the USA (Coker & Couch 1928), Mexico (Laferrière & Gilbertson 1992, Moreno et al. 2007), South America (Spegazzini 1912, da Silva & Baseia 2014), Europe (Jeppson et al. 2011) and southern Africa (Bottomley 1948).

***Geastrum corollinum*** (Batsch) Hollós 1903 (as *Geaster*)

Fig. 6

- ≡ *Lycoperdon corollinum* Batsch 1783
- = *Geastrum recolligens* (Woodw.) Desv. 1809 (as *Geaster*)
- = *Geastrum mammosum* Chev. 1836 (as *Geaster*)
- = *Geastrum lugubre* Kalchbr. 1881 (as *Geaster*)
- = *Geastrum argenteum* Cooke 1889 (as *Geaster*)

**Brief description.** Unexpanded fruitbodies onion-shaped with umbo. Expanded fruitbodies small to medium-sized. Exoperidium strongly hygroscopic, splitting into 9–14 rays. Mycelial layer smooth, greyish white, sometimes encrusted with soil debris. Pseudoparenchymatic layer dark brown. Endoperidial body sessile. Endoperidium glabrous, brown to dark brown. Peristome fibrous, delimited indistinctly. Spores globose, pale brown, verrucose, 6–7 µm diam. (incl. ornamentation).

Description based on two collections containing 67 and 55 fruitbodies, respectively.

**Material studied**

W C u b a. Prov. Pinar del Río, Playa de Bailen SW of Pinar del Río, on sandy pasture, 29 Nov 1966, leg. F.K. & J. Ramón Cuevas, det. F.K., rev. F.K. & P.Z., 6–27 Oct 2017 (PRM 874181a); *ibid.*, det. P.Z. & F.K., 6–27 Oct 2017 (PRM 877426).

**Notes.** Strongly hygroscopic (Fig. 6) species occurring in warm and xeric habitats. The taxonomy and nomenclature of this species is relatively clear. The synonym *G. recolligens* (e.g. Palmer 1957, Staněk 1958, Smith & Ponce de León 1982) and also *G. mammosum* (Lloyd 1902) have been used by many authors as the correct name for many decades. Zamora et al. (2014) established the new section *Corollina* based on molecular data.

**Distribution.** These collections represent the first records of *Geastrum corollinum* for Cuba. It is also known from the USA and Mexico (Esqueda et al. 2003, Bates 2004), South America (Kuhar et al. 2012), Europe (Staněk 1958, Sunhede 1989, Kreisel 2001, Legon & Henrici 2005), central and southern Africa (Bottomley 1948, Kreisel 2001), Asia (Dörfelt 2005, Kasuya et al. 2011), and Hawaii (Gilbertson et al. 2011).

***Geastrum kotlabae* V.J. Staněk 1958**

**Brief description.** Unexpanded fruitbodies not observed. Expanded fruitbodies small to medium-sized. Exoperidium hygroscopic, splitting into 7–9 rays. Mycelial layer whitish, encrusted with soil debris. Pseudoparenchymatic layer brown to dark brown. Endoperidial body sessile, endoperidium glabrous, whitish or creamy to grey brown. Peristome sulcate, not or indistinctly delimited. Spores globose, verrucose or spiny, beige to pale brown, 5–6 µm diam. (incl. ornamentation).

Description based on two collections containing a total of five expanded fruitbodies.

**Material studied**

W C u b a. Prov. Pinar del Río, Playa de Bailen SW of Pinar del Río, on sandy pasture with sparse vegetation, 29 Nov 1966, leg. F.K. & J. Ramón Cuevas, det. F.K. as *Geastrum floriforme*, rev. F.K. & P.Z., 10 Sep 2018 (PRM 877422).

**Notes.** Another strongly hygroscopic earthstar occurring in warm and xeric habitats. Taxonomically as well as nomenclaturally a rather clear species. This is the most important discovery, as it is not only the first for Cuba but also for the Caribbean region and South America. Zamora et al. (2014) placed *G. kotlabae* (based on molecular data) in section *Campestris*. It is interesting to mention that the species *G. kotlabae* and *G. pouzarii*, both named in honour of the long collaborating Czech mycologists F. Kotlaba and Z. Pouzar, are sister species (Zamora et al. 2014). We thank the reviewer very much for contributing to the correct identification of this species. It is also interesting that this species was collected in Cuba already nine years after its description, but not recognized until 50 years later.



**Distribution.** This earthstar is reported from Cuba for the first time. Its distribution is known to cover Mexico (Esqueda et al. 2003), Europe (Staněk 1958, Sunhede 1989, Kreisel 2001), western and eastern Asia (Kreisel 2001, Kasuya et al. 2012).

***Geastrum pectinatum*** Pers. 1801, agg.

Fig. 7

= *Geastrum calyculatum* Fuckel 1870 (as *Geaster calyculatus*)

**Brief description.** Unexpanded fruitbodies not observed. Mature fruitbodies medium-sized. Exoperidium non-hygroscopic, splitting into 5 rays. Mycelial layer encrusted with soil debris, fibrous layer pale beige covered by remnants of a blackish brown pseudoparenchymatic layer. Endoperidium connected by a long neck, glabrous, grey brown. Peristome sulcate, distinctly delimited, lighter than the rest of the endoperidium. Spores globose, roughly verrucose, pale brown, 5.2–7 µm diam. (incl. ornamentation).

Description based on one collection containing one expanded fruitbody.

**Material studied**

W Cuba. Prov. La Habana, El Salado close to Habana, on dry soil under shrubs (*Eugenia buxifolia*, *Comocladia dentata*, *Zanthoxylon fagara*, etc.), 5 Mar 1967, leg. & det. F.K. as *Geastrum nanum?*, rev. F.K. & P.Z., 10 Sep 2018 (PRM 877425).

**Notes.** This species is macroscopically remarkable by its long and smooth neck, sulcate peristome and microscopically by the roughly verrucose spores. *Geastrum pectinatum* occurs mostly in coniferous and mixed stands but it is also known from deciduous stands (see Sunhede 1989). Our collection (PRM 877425) represents a fruitbody of smaller size than usually stated. Zamora et al. (2015) described and brought back several species into the *G. pectinatum* complex (*G. meridionale*, *G. pectinatum* s. str., *G. plicatum*, and *G. tenuipes*). We thank the reviewer who has contributed essentially to the correct identification of the *G. pectinatum* specimen.

**Distribution.** Species described from Europe (Persoon 1801) with a worldwide distribution. This earthstar was reported for Cuba by Coker & Couch (1928) for the first time, but as *G. schmidelii*. This misinterpretation was corrected by Dennis (1953). It seems to be rather rare on the Cuban territory. It is also known from Central America and the USA (Coker & Couch 1928, Calonge et al. 2005), South America (Trierveiler-Pereira & Baseia 2009), Europe (Staněk 1958, Sunhede 1989, Kreisel 2001), southern Africa (Kreisel 2001), and Asia (Kasuya et al. 2012).

***Geastrum schweinitzii*** (Berk. & M.A. Curtis) Zeller 1948, agg.

= *Coilomyces schweinitzii* Berk. & M.A. Curtis 1853

= *Geastrum mirabile* Mont. 1855 (as *Geaster*)

= *Geastrum lignicola* Berk. 1881 (as *Geaster*)

**Brief description.** Unexpanded fruitbodies not observed. Mature fruitbodies small-sized. Exoperidium non-hygroscopic. Mycelial layer beige, encrusted with debris. Pseudoparenchymatic layer whitish or beige to dark brown. Endoperidial body sessile. Endoperidium smooth, grey to grey-brown. Peristome fibrous, indistinctly delimited. Spores globose, shortly and densely verrucose, pale brown, 4–4.5 µm diam. (incl. ornamentation).

Description based on one collection containing three damaged fruitbodies.

**Material studied**

W Cuba. Prov. La Habana, near El Salado SW of Habana, on dry soil under shrubs (*Eugenia buxifolia*, *Comiocladia dentata*, *Cocoloba uvifera*, etc.), 5 Mar 1967, leg. & det. F.K. as *Geastrum mirabile*, rev. P.Z. & F.K., 16–30 Oct 2017 (PRM 877427).

**Notes.** Berkeley & Curtis (1853) formerly described this species in a new monotypic genus, *Coilomyces*. Zeller (1948) revised type material of *Coilomyces schweinitzii* and transferred it to the genus *Geastrum*. From the group of *Geastrum* species growing on rotten wood, *G. schweinitzii* s.l. is the most common. It is distinct by growing on a large white subiculum covering the substrate, which usually carries a lot of small fruitbodies. According to the current knowledge, *G. schweinitzii* represents a complex of several phylogenetic lineages, all of them belonging to subsection *Epigaea* together with *G. trichiferum* in the section *Myceliostroma* (Zamora et al. 2014). Resolving this complex demands a comprehensive approach combining molecular data and sampling in all regions where it has been recorded. Therefore some of the synonyms might be used as correct names for species possibly separated from this complex (similarly as in *G. triplex*; Zamora et al. 2014).

**Distribution.** Species described from Surinam by Berkeley & Curtis (1853) with pantropical distribution. For Cuba it was reported by Coker & Couch (1928). Its further distribution is known to cover North America (Coker & Couch 1928), Central America (Garner 1956, Calonge et al. 2005), South America (Trierveiler-Pereira et al. 2011), western, central and southern Africa (Bottomley 1948, Dissing & Lange 1962, Kreisel 2001), Asia (Gogoi & Vipin 2015), and Australia (Cunningham 1944).

***Geastrum trichiferum*** (Lloyd) Lloyd 1907 (as *Geaster*)

= *Geastrum hirsutum* Baseia & Calonge 2006

**Brief description.** Fruitbodies small-sized. Unexpanded fruitbodies globose with distinct whitish or beige, richly branched rhizomorphs. Exoperidium non-hygroscopic, splitting into 5–8 rays. Mycelial layer hairy, beige or pale brown. In the older fruitbodies the hairs may partly disappear. Pseudoparenchymatic layer beige-brown. Endoperidial body sessile. Endoperidium smooth, greyish brown.

Peristome fibrous, indistinctly delimited. Spores globose, shortly and densely verrucose, pale brown, 4–4.5 µm diam. (incl. ornamentation).

Description based on one collection containing 20 unexpanded and expanded fruitbodies.

**Material studied**

W Cuba. Prov. Pinar del Río, Sierra de Cajálbana Mts. S of La Mulata, on serpentinic soil in *Pineto caribaeae* (+ *Brya ebenus*), 25 Nov 1966, leg. F.K., det. F.K. as *Geastrum mirabile*, rev. P.Z. & F.K., 16–30 Oct 2017 (PRM 877428).

**Notes.** Its growth on a well-developed subiculum is typical for fruitbodies of this species, similarly to the other species in section *Myceliostroma*. In the original description, ecology or substrate of *G. trichiferum* was not mentioned (Lloyd 1907). Baseia & Calonge (2006) mentioned its occurrence on decaying wood on an old termite nest. Nevertheless, this species was also found on the ground, usually on thick layers of litter (Castiglia et al. 2013, Zehnálek 2017). This corresponds with the treated Cuban collection collected on the ground, reported here. A similar variability in the choice of substrate was also shown for other species originally described from wood – e.g. *G. rusticum* and *G. inpaense* (Sousa et al. 2014a, Zehnálek 2017). Other species with a strigose exoperidium differ by the absence of a subiculum and by having larger fruitbodies, such as in *G. albo-nigrum* and *G. inpaense* (Calonge & Mata 2004, Cabral et al. 2014), or by having smaller fruitbodies and larger basidiospores, such as in *G. pusillipilosum* (Crous et al. 2016).

*Geastrum trichiferum* was an almost forgotten species described by Lloyd (1907) as a form of *G. mirabile* (= *G. schweinitzii*), but distinguished by a strigose exoperidium. A hundred years later, Baseia & Calonge (2006) described *G. hirsutum*, a lignicolous species with a hairy exoperidium from Brazil. Trierveiler-Pereira & da Silveira (2012), da Silva et al. (2015) and Zamora & Parra (2017) treated the tangled nomenclatural status of both species with the conclusion that the name *G. hirsutum* should be considered as a synonym of *G. trichiferum*.

**Distribution.** Here we report *G. trichiferum* from Cuba for the first time. The currently known distribution is restricted to the Neotropics: Jamaica (Coker & Couch 1928), Central America (Zehnálek 2017), and South America (Rick 1930, Dennis 1953, Baseia & Calonge 2006, Castiglia et al. 2013).

***Geastrum velutinum*** Morgan 1895 (as *Geaster*), agg.

= *Geastrum velutinum* var. *caespitosum* Lloyd 1902 (as *Geaster*)

= *Geastrum caespitosum* (Lloyd) Lloyd 1920 (as *Geaster*)

**Brief description.** Fruitbodies medium-sized with elongated stipe and mycelium remnants. Unexpanded fruitbodies ovoid with short umbo on the top.



Exoperidium non-hygroscopic, splitting into 6 rays. Mycelial layer smooth, finely felted, whitish beige. Pseudoparenchymatic layer grey. Endoperidial body sessile, grey to greyish brown. Peristome fibrous, not delimited. Spores globose, shortly verrucose, 3–4 µm diam. (incl. ornamentation).

Description based on one collection containing one mature fruitbody and two unexpanded fruitbodies.

**Material studied**

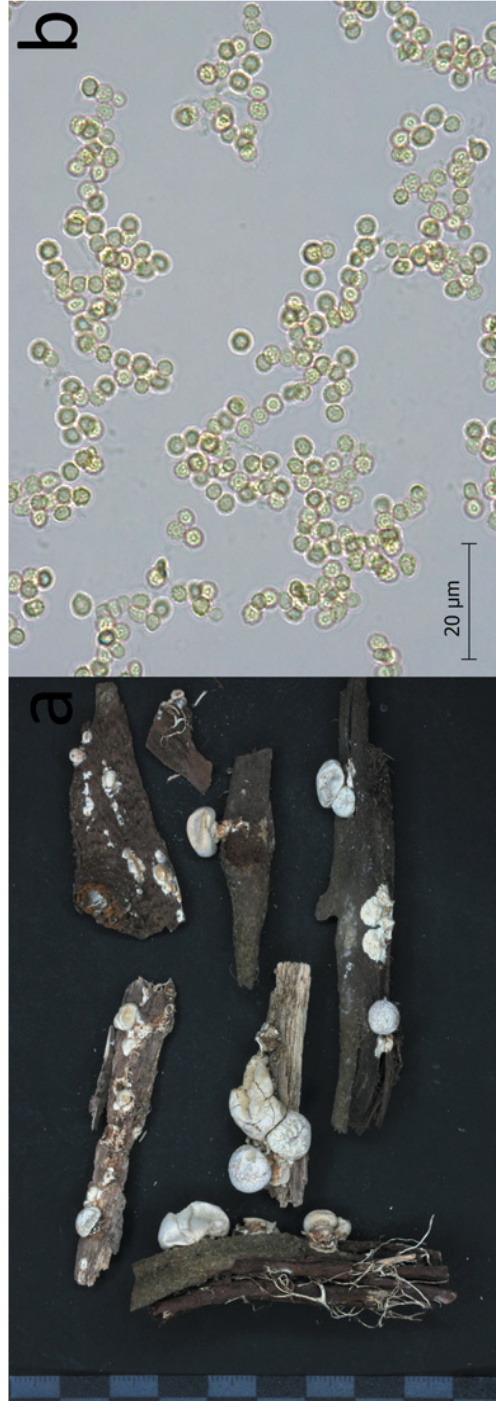
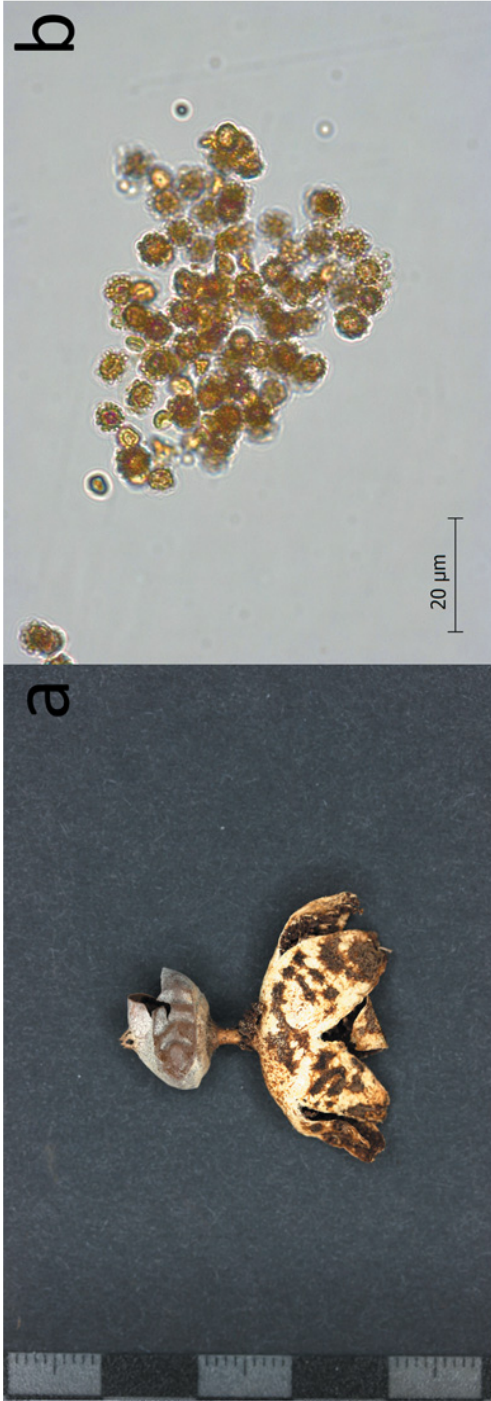
W Cuba. Prov. Pinar del Río, Playa de Bailen SW of Pinar del Río, on sandy pasture, 29 Nov 1966, leg. F.K. & J. Ramón Cuevas, det. P.Z. & F.K., Oct 2017 (PRM 874181b).

**Notes.** In contrast to the similar species *Geastrum schweinitzii*, *G. velutinum* agg. is usually found on litter, only rarely on decaying wood. *Geastrum velutinum* agg. belongs to subsection *Velutina* in section *Myceliostroma* (Zamora et al. 2014). It is a taxonomically problematic species, probably representing a complex of several species (Zamora et al. 2014, Zehnálek 2017). Some mycologists synonymise this species with *G. javanicum*, a species with contradictory concepts in the literature (Ponce de León 1968, Trierweiler-Pereira et al. 2011, Sousa et al. 2014a). Future taxonomic studies of the entire subsection *Velutina* need to be carried out, based on molecular data from comprehensive samplings.

**Distribution.** *Geastrum velutinum* was described from Florida, USA (Morgan 1895). From the Caribbean area it has been reported repeatedly, including Cuba (Coker & Couch 1928, Dennis 1953, Reid 1977). This earthstar is also known from Central America (Garner 1956, Calonge et al. 2005, Zehnálek 2017), South America (Rocabado et al. 2007, Leite et al. 2011), west, central and southern Africa (Coker & Couch 1928, Bottomley 1948, Kreisel 2001), south-east Asia (Léveillé 1846, Kasuya et al. 2012), Australia and Oceania (Cunningham 1944), and Hawaii (Hemmes & Desjardin 2011).

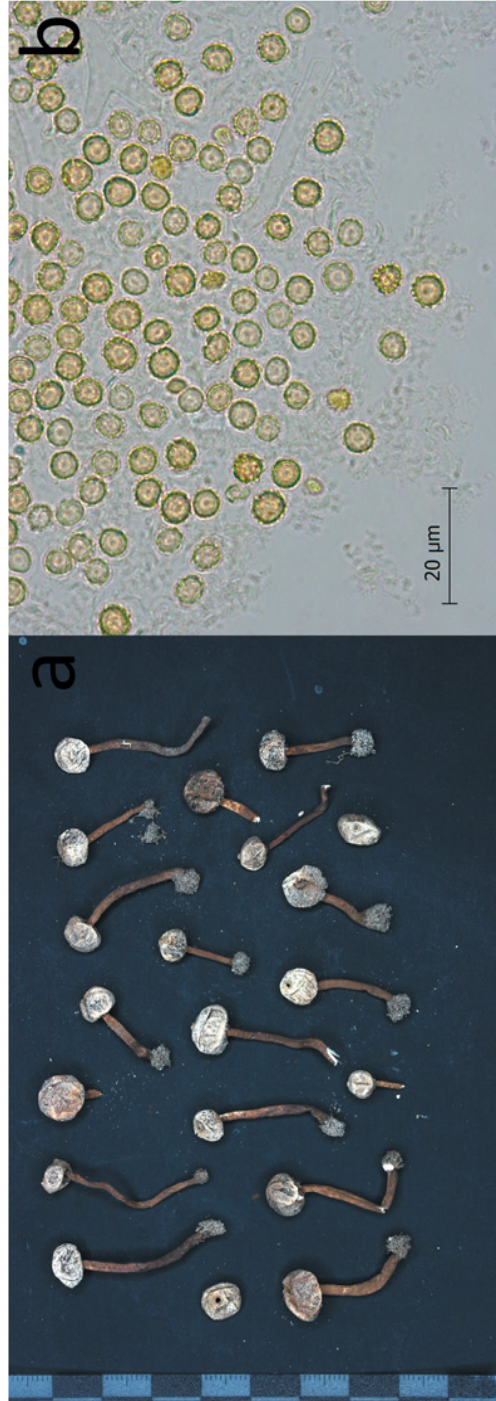
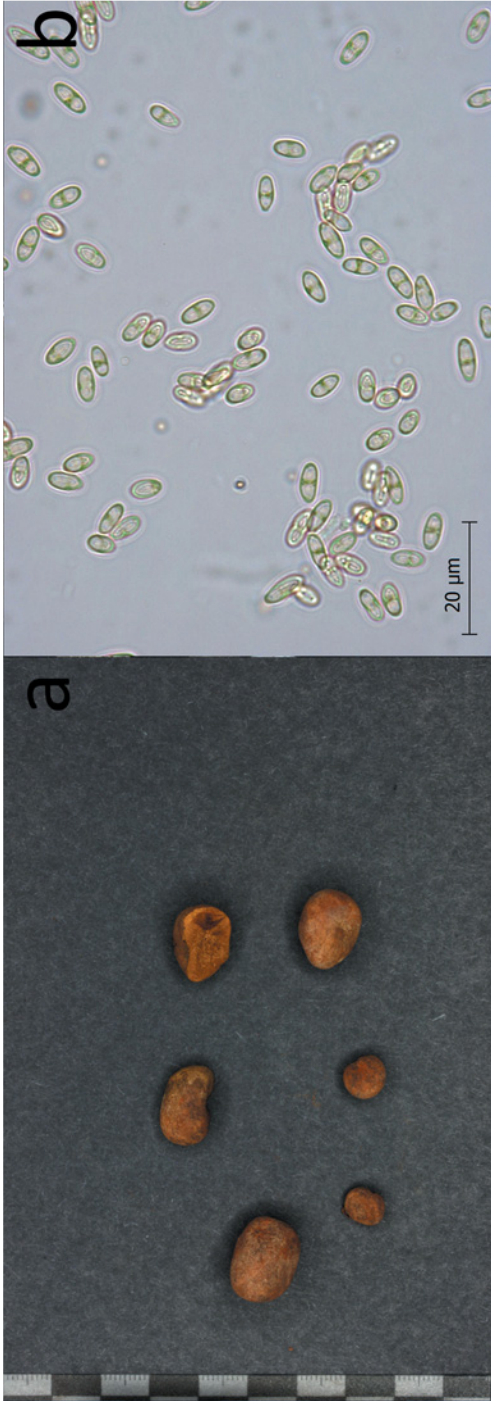
**Note on a *Geastrum* species described from Cuba**

Ponce de León (1946) described *Geastrum victorinii* as a new species from Moa, Prov. Oriente. Its description was especially based on the white colour of the fruitbody, which however has no taxonomic value. In accordance with Kreisel (2001) we consider this name a synonym of *G. minimum* Schwein. This earthstar seems to be rather rare in Cuba, whereas e.g. in Mexico it is known from many localities (Pérez-Silva et al. 1999). Nevertheless *G. minimum* was split into several species by Zamora (2014) based on molecular data.



**Fig. 7 (top).** *Geastrum pectinatum* (PRM 877425): **a** – mature fruitbody, scale bar = 5 cm; **b** – globose ornamented spores, scale bar = 20 µm.  
**Fig. 8 (bottom).** *Lycogalopsis solmsii* (PRM 871153): **a** – mature fruitbodies on fragments of wood, scale bar = 10 cm; **b** – verrucose spores, scale bar = 20 µm. Photos P. Zehnálek.





**Fig. 9 (top).** *Rhizopogon* sp. (PRM 877419): **a** – mature fruitbodies, scale bar = 10 cm; **b** – smooth ellipsitic spores with two large oil drops, scale bar = 20 µm. **Fig. 10 (bottom).** *Tulasoma floridanum* (PRM 874201): **a** – mature fruitbodies, scale bar = 10 cm; **b** – verrucose spores, scale bar = 20 µm. Photos P. Zehnálek.



***Lycogalopsis solmsii* E. Fisch. 1886**

Fig. 8

= *Lycoperdon albinum* Cooke in Masee 1887

**Brief description.** Fruitbodies small-sized, 5–15 mm in diam., globose to slightly flattened, ivory to yellowish white with many richly ramified rhizomorphs. Gleba yellowish white. Spores mostly globose, sometimes irregularly drop-shaped, finely verrucose, pale to hyaline, 3–4 µm diam. (incl. ornamentation).

Description based on one collection containing about 15 fruitbodies of variable sizes and degree of maturity.

**Material studied**

E Cuba. Prov. Guantánamo (former part of Oriente), Cuchillas de Toa NP, Arroyo Prieto in the vicinity of La Melba NW of Baracoa, on decaying twig of broadleaved tree, 15 Mar 1967, leg. F.K., det. H. Kreisel, 23 Apr 1968, rev. F.K. & P.Z., 6–27 Nov 2017 (PRM 871153).

**Notes.** *Lycogalopsis solmsii* is a lignicolous species growing gregariously and resembling members of the genus *Lycoperdon*. The most remarkable feature of *Lycogalopsis solmsii* is obviously the white subiculum (sometimes also called a stroma) covering the substrate (Fig. 8). Several names belonging to insufficiently known species (*Lycogalopsis dussi*, *L. subiculosa* and *L. africana*) are probably synonymous to this species. Demoulin et al. (2013) proposed a phylogenetic placement of *L. solmsii* in the gomphoid-phalloid clade, possibly close to the orders *Phallales* and *Hysterangiales*.

**Distribution.** This species was described from Java by Fischer (1886). Concerning the Caribbean area, it is known from several islands (Dennis 1953). Our herbarium specimen is obviously the first collection for Cuba. Kreisel (1971) mentioned this species in his key to Cuban gasteromycetes, but without any particular specimen or locality. The distribution of *L. solmsii* also includes Central America (Coker 1930, Garner 1956, Guzmán 2004), South America (Dennis 1960, Dreschler-Santos et al. 2008) and west and central Africa (Kreisel 2001).

***Rhizopogon* sp.**

Fig. 9

**Brief description.** Fruitbodies small or medium-sized, irregularly globose or tuberous, 8–17 mm wide. Surface indistinctly tomentose, finely warty to smooth, rusty brown or reddish brown. Peridium single-layered. Gleba pale brown, consisting of irregular and tiny chambers. Spores narrowly elliptic, usually with two large drops (looking like double-cell spores), smooth, colourless, 6.5–8(9) × 3 µm.

Description based on one collection containing five fruitbodies.

**Material studied**

E Cuba. Prov. Holguín (former part of Oriente), near Mayarí in Sierra de Nipe Mts. on serpentine soil in pine forest (*Pinus cubensis*), 13 Mar 1967, leg. F.K. (PRM 877417); *ibid.*, on lateritic soil in pine forest (*P. cubensis*), 16 Oct 1966, leg. Věroslav Samek (PRM 877419).

**Notes.** The species of this hypogeous gasteroid fungus genus are difficult to identify, especially if no fresh material is available. However in the infrageneric classification, our material seems to belong to section *Rhizopogon*, subsection *Angustispori*, based on the width of the spores (Grubisha et al. 2002). This unidentified species was collected under pines, a common mycorrhizal partner of *Rhizopogon*. We thank the reviewer for helpful comments to identity of this specimen.

**Distribution.** The members of this genus have been reported from all continents. Concerning the distribution of *Rhizopogon* species in Cuba, see Kreisel (1971).

***Scleroderma tenerum* Berk. & M.A. Curtis 1869**

= ? *Scleroderma nitidum* Berk. 1854

**Brief description.** Fruitbody without stipe, globose, pale brown, small to medium-sized, 25 mm wide. Surface smooth but cracked. Gleba dark brown with beige veins. Spores globose, densely spiny (spines 1–1.5 µm long), pale brown to brown, 10–11 µm diam. (incl. ornamentation).

Description based on one collection containing fragments of one fruitbody.

**Material studied**

W C u b a. Prov. Pinar del Río, between the villages La Fé and Cayuco SW of the town of Pinar del Río, on sandy soil in oak forest (*Quercus sagraeana*), 30 Nov 1966, leg. F.K., det. V. Demoulin as *Scleroderma tenerum*, 17 Mar 1969 (PRM 871128).

**Notes.** Terricolous species macroscopically similar to the common species *Scleroderma verrucosum*. The name *Scleroderma nitidum* frequently occurs in the literature as a synonym of *S. tenerum* in spite of the fact that *S. nitidum* was described from Nepal by Berkeley (1854), whereas *S. tenerum* from Cuba. There are possibly different characters between these species. The species *S. tenerum* was transferred to the genus *Veligaster* by Guzmán & Tapia (1995), but Louzan et al. (2007) showed that establishment of the genus *Veligaster* was doubtful because of its phylogenetic placement within the genus *Scleroderma*.

**Distribution.** The species *Scleroderma tenerum* was described from Cuba by Berkeley & Curtis (1869). Its further distribution is limited to the British Virgin Islands (Guzmán et al. 2004), Mexico (Guzmán et al. 2013), Costa Rica (Guzmán & Tapia 1995), Brazil (Gurgel et al. 2008, Trierveiler-Pereira & Baseia 2011), the USA (Lloyd 1906), Japan, and Thailand (Kasuya & Guzmán 2007).

***Tulostoma floridanum* Lloyd 1906**

Fig. 10

**Brief description.** Fruitbodies small-sized. Stipe rusty brown, 11–25 mm long and 1.1–2.5 mm thick. Upper part of stipe enlarged to a fibrous collar. Spore sac globose to slightly flattened, 5–10 mm wide. Endoperidium smooth, grey to

greyish brown, covered by substrate. Peristome not delimited, shortly tubular, finely scaly. Spores globose, verrucose, yellowish to pale beige, 5.5–6.5 µm diam. (incl. ornamentation).

Description based on one collection containing 33 mature fruitbodies.

**Material studied**

W Cuba. Prov. Pinar del Río, Playa Bailen SW of Pinar del Río, on sandy pasture, 29 Nov 1966, leg. F.K. & J. Ramón Cuevas, det. J.E. Wright, Oct 1971 (PRM 874201).

**Notes.** This *Tulostoma* grows in dry open habitats. A similar species is *T. squamosum*, which is distinguished by a membranous to verrucose exoperidium, leaving circular whitish plates when it falls off (Esqueda et al. 2004) and has a worldwide distribution. *Tulostoma floridanum* belongs to taxonomically and nomenclaturally clear species without a single synonym in the literature.

**Distribution.** This species with a rather limited distribution is known from the USA, Mexico, Cuba (Esqueda et al. 2004), and Brazil (da Silva 2013).

CONCLUSIONS

The aim of this study was to contribute to the knowledge of Cuban gasteroid fungi based on herbarium material collected by the first author 50 years ago and deposited in the PRM herbarium. We contribute to the diversity of Cuban macromycetes by reporting three earthstars (*Geastrum corollinum*, *G. kotlabae*, *G. trichiferum*) as well as *Disciseda hyalothrix* and *Lycogalopsis solmsii*, being new to Cuba. Surprisingly, already 50-year old finds of the mentioned gasteroid fungi include five new to the Cuban mycobiota. Undoubtedly further exploration in this group of fungi in Cuba will provide even more new finds.

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