New or interesting species of *Ascobolus* and *Saccobolus* in the USSR

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**SUMMARY**

In the study of coprophilous Discomycetes 17 interesting species from the genera *Ascobolus* and *Saccobolus* have been found on samples of dung of different animals, on soil and on plant remains. Two of them — *Ascobolus ursinus* Prokhorov, sp. nov. and *Saccobolus minimoides*, Prokhorov sp. nov. are described as new. Other species of these genera are rare or seldom collected ones. The most northern locality *A. scatigenus* has been detected in natural conditions.

**Introduction**

The species composition of coprophilous Discomycetes on the territory of the USSR has been poorly investigated until recent times. When a detailed study of this ecological group of fungi was started a few years ago by the first author only 15 most common species were known. They were, in general, fungi with relatively big or bright-coloured fruit bodies, well noticeable in field conditions. As a result of an analysis of extensive material originating from different regions of the USSR 96 coprophilous species belonging to 15 genera of Pezizales have been identified [6, 7, 8, 9, 10]. Among them are some interesting species so far found only occasionally. Also a species of *Ascobolus* growing on bear dung and a species of *Saccobolus* on squirrel dung collected in the Primorsk Region (the Far East) have certain peculiarities distinguishing them from the hitherto known species. They are here described as new taxa.

**Materials and methods**

The ascocarps of the majority of the species described in this paper were obtained by the first author using the method of incubation of samples of dung of different animals in moisture chambers under laboratory conditions. Some interesting species, however, have been collected fruiting under natural conditions by the second author and his collaborators and have been studied in the Herbarium of the Institute of Zoology and Botany of the Estonian Academy of Sciences (TAA). In the paper drawings of the first author have been presented.

**Discussion**

Intensive screening of abundant material collected in various regions of the USSR has allowed us to reveal species of coprophilous Discomycetes, which in literature have been reported only from few localities. The distribution area of many species is shown to be essentially wider northward and eastward.

Most coprophilous Discomycetes of which the distribution has been sufficiently investigated have evidently no regional limits connected with climate and flora. Therefore they may be regarded as a group of fungi of multiregional distribution. In connection with this there arises the problem of the so-called “rare” species. No doubt it is determined first and foremost by the state of investigation of coprotrophs in different regions of the world. Studies of this interesting ecological fungal group are carried out
relatively few countries by a small number of mycologists. Much depends on the methods of investigation. According to our experience by collecting their fruit bodies in nature the detection of not more than 5 per cent of the whole number of species known in the group is guaranteed. The method of incubation in moist chambers is undoubtedly more effective, nevertheless, it does not give a comprehensive idea of the species composition. Observations show that the appearance of apothecia of Discomycetes on different fragments of dung collected from one animal are very unequal. It often happens that the fruit bodies (or even one single apothecium) develop only on one out of 7-10 fragments of dung of roe, elk, hare and other animals. The role of chance is even more conspicuous when the samples from different animals of the same species are collected in different regions. This peculiarity is undoubtedly due to the dispersal of spores and the casualness according to which the spores pass the digestive tract of animals. The laws of spore dispersal are not yet clear. However, thorough investigations of extensive material in moisture chambers give us the possibility of more complete detection of coprophilous species. This has been confirmed by the present study.

**Systematic Part**

**Ascobolus aglaosporus** Heimrl


Apothecia 0.3 mm in diameter, pulvinate, sessile, scattered, whitish with violaceous tint, with smooth ectal surface. Ectal excipulum of textura angularis. Asci clavate-cylindrical, (100-) 135-141 × 20.4-23.5 μm. Ascospores broadly ellipsoid, violaceous, minutely echinulate or tuberculate, 15.8-16.7 × 9.3-9.9 μm. Paraphyses cylindrical, hyaline, apically swollen up to 5.0—5.6 μm in diameter. (Fig. 1, a).

**Distribution in the USSR**: the Tuva ASSR, Kyzyl, on the ground in flood-forest in the valley of the river Kaa-I lem, 18. 07. 1972 and 26. 07. 1972, coll. B. Kullman (TAA).

**A. behnitziensis** has been found so far only in a few European countries – Germany (Region Brandenburg), Great Britain, Italy, Norway, Czechoslovakia. This is the first find of the species in Asia.

**Ascobolus boudieri** Quel.

Ench. Fung. 293 (1886).

Apothecia discoid, saucer-shaped, 0.9-1.5 mm in diameter, sessile on tapering base, dark brown. Ectal excipulum of textura angularis. Asci clavate-cylindrical, 190-18.2 μm, amyloid. Ascospores ellipsoid, (18.6-) 19.9-22.4 × 9.9-11.6 μm, ornamented with small warts or ridges anastomosing into angular reticulum with elongated cells. Paraphyses filiform, septate, apically swollen up to 3.5-3.8 μm, embedded in lemon-yellow mucus, paraphys tips agglutinated with dark brown amorphous substance. (Fig. 1, c).

**Distribution in the USSR**: the Tadjik SSR, the Hissar Mountains, valley of the Varzob River, 3100 m a.s.l., on ibex dung, 17. 06. 1982, coll. B. Kullman (TAA); the Primors Region, the Lazo Nature Reserve, Popov Island, on horse dung, 20. 08. 1987, coll. V. Gromin.

This species has been found in Austria, Bulgaria (as *A. candidus*), Great Britain, Canada and the USA on the dung of cow, goat, deer and American bison.

**Ascobolus amoenuis** Oud.

Hedwigia 21: 165 (1852).

Apothecia hemispherical to ovoid, 0.4-0.8 mm in diameter, 0.6-0.8 mm high, superficial, scattered, reddish-brown, externally covered by loosely interwoven whitish hyphae, sometimes forming subicular basal mat. Ectal excipulum of textura angularis. Asci clavate-cylindrical, 166-188 × 22-25 μm, amyloid. Ascospores ellipsoid, 22.1-24.1 × 12.2-12.8 μm, violaceous, minutely warted. Paraphyses filiform, hyaline, septate, 1.9-2.4 μm thick, embedded in yellowish-green mucus. (Fig. 1, d).

**Distribution in the USSR**: the Sverdlovsk Region, the Beloyarsk District, on horse dung, 27. 07. 1987, coll. M. Rokhov; the Chelyabinsk Region, the Krasnoarmeisk District, Bordokalmak, on sheep dung, 17. 07. 1987, coll. I. Mozhiina.

This species has been known earlier only in Europe (Great Britain, Belguim, the Netherlands, France, Czechoslovakia) and now it was found for the first time in Asia in the Ural Mountains.

**Ascobolus cinii** Brumm.

Persoonia, Suppl. 1: 126 (1967).

Apothecia discoid, saucer-shaped, 0.2-0.25 mm in diameter, sessile on tapering base, whitish. Ectal excipulum of
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Fig. 1. The spores of Ascobolus species: a - A. amoenus; b - A. aglaosporus; c - A. behnitziensis; d - A. boudieri; e - A. degluptus; f - A. hawaiiensis; g - A. minutus; h - A. scatigenus.

textura angularis. Asci clavate-cylindrical, (44.0-)53.3-62.8 × 9.6-12.0 μm, amyloid. Ascospores ellipsoid, 9.6-10.6 × 4.5-4.8 μm, light violaceous, minutely warted. Paraphyses filiform, septate, 2.5 μm thick, apically swollen up to 4.5-5.0 μm. (Fig. 2).

Distribution in the USSR: the Ukrainian SSR, the Cher- kassk Region, the Kaniv District, on roe dung, 19.07.1987, coll. V. Tikhonenko.

A. cainii has been described on the basis of the material collected on Aug. 26, 1935 in Canada (2) and there have been no other data on this species up to now. Thus, this is the second find of A. cainii.

Ascobolus carletonii Boud.


Apothecia at first spherical, closed, then hemispherical with flat hymenial disc and feebly marked margin, 0.3-0.5 mm, smooth, whitish to pale yellowish-green, light brownish in the upper part with groups of angular yellow-gree-
nish cells, at base covered with flexuous septate hyaline hyphae 3.5-5.1 μm in diameter. Ectal excipulum of textura angularis. Asci cylindrical-clavate, gradually tapering into long stipe, 161-204(-220) × 21.3-25.1 μm. Ascospores ellipsoid, 12.8-13.6 × 7.7 μm, irregularly reticulate. In hymenium asci with bigger hypertrophic spores measuring 18.4-20.1 × 12.5-12.8 μm are found. Paraphyses cylindrical, septa not visible, 4.0-5.3 μm, apically swollen up to 6.4 μm. Hymenial mucus hyaline. (Fig. 3).


According to Brummelen (2) this species was found only twice, in 1912 and 1966, and both times in Great Britain (Scotland) on the dung of capercaillie and grouse. There are no other data on its occurrence. Obviously the species, as different from many other species of coprotrophic Discomycetes, occupies an limited area of distribution.
in the northern region of Holarctic Region and is associated with the dung of birds from the orders Galliformes and Anseriformes. Our specimens differ slightly in gross morphology from the description by Brummelen (2) but we suppose that they, however, represent the same species.

**Ascobolus degluptus** Brumm.

*Persoonia, Suppl. 1: 78–80 (1967).*

Apothecia at first spherical, then ovoid, 0.2–0.25 mm in diameter, superficial or slightly immersed, light yellowish-grayish. Ectal excipulum of textura angularis. Asci clavate-cylindrical, 125.0–241.6 × 22.5–33.3 μm, sometimes with 2–4 abortive spores, diffusely blue in Melzer's reagent. Spores ellipsoid, (16.7–)19.4–20.8(–22.2) × (10.0–)11.1–12.2 μm, intensively violaceous, ornamented with rather big (up to 0.8–1.0 μm in diameter) hemispherical warts, covered by hyaline mucilaginous envelope. Paraphyses filiform, septate, 2.5–3.0 μm thick, swollen above up to 6.4 μm, sometimes with dark violaceous pigment. (Fig. 1, f).

Distribution in the USSR: the Armenian SSR, the Ashtarak District, Sagmosavan, on cow dung, 21.04.1984, coll. M. Taslakhchyan; the Azerbaijan SSR, the Lenkoran District, Kyzyl-Agash, on buffalo dung, 25.07.1980, coll. H. Orazov; the Uzbek SSR, the Tashkent Region, the Bol. Chimgan Mountains, 2300 m a.s.l., on sheep dung, 24.04.1985, coll. V. Prokhorov; the Kirghiz SSR, the Bol. Kirghiz Mountains, Chon-Kurchak, 2900 m a.s.l., on cow dung, 25.07.1980; Turup, on cow dung, 27.06.1981, coll. S. Mosolova; the Turkmen SSR, the Ashkhabad Region, the Kaakhin District, Karakhan, on sheep dung, 01.05.1985, coll. Yu. Maleeva; the western bank of Lake Baikal, on sheep dung, 13.08.1988, coll. I. Reshetnikova; the Yakutsk ASSR, near the town of Yakutsk, on horse dung, 12.11.1988, coll. Yu. Rykova.

*A. hawaiiensis* Brumm. has been reported from the Hawaiian Islands, Japan, Norway, Denmark and Spain. The localities of this species in Yakutia and near Lake Baikal show that the distribution of this species extends far to the North. However, in the USSR *A. hawaiiensis* occurs more often in Central Asia and the Transcaucasus.

**Ascobolus minutus** Boud.

*Bull. Soc. bot. Fr. 34: 48 (1888).*

Apothecia hemispherical, barrel-shaped, oboconical or widely opened, 0.3–1 mm in diameter, scattered, sometimes in groups, yellowish-greenish, externally covered with clusters of brownish-greenish cells. Ectal excipulum of textura angularis in the basal part of the apothecium and of horizontally orientated narrow elongated cells in the marginal part of the fruit-body. Asci cylindrical-clavate, 109–141 × 11.2–14.4(–19.7) μm, amyloid. Ascospores broadly ellipsoid, 12.0–13.6 × 7.7–8.0 μm, violaceous, ornamented with longitudinal anastomosing striae, biseriate. Paraphyses filiform, septate, hyaline, apically
slightly swollen up to 3.2—4.5 μm, embedded in lemon-yellow mucus. (Fig. 1, g).

Distribution in the USSR: the Tuva ASSR, the Ulug-Khem District, the Ishi-Khem (the Western Tannu-Ola Mountains), on bear dung, 08. 1988, coll. N. Pashenova; the Tyumen Region, the Surgut District, the Great Yugan River, on dung of hare and mouse, 22. 08. 1988; the Yugan Nature Reserve, on dung of hare and mouse, 25. 08. 1988; the Perm Region, the Dobryansky District, Khokhlolvka and Skobelevka, on dung of cow and goat, 03. 09. 1988, coll. V. Prokhorov.

Up to the present time this species has been known only in Europe (Great Britain, France, Denmark, Czechoslovakia) and the USA but it seems to have a wide Holarctic distribution.

**Ascobolus scatigenus** (Berk.) Brumm.

Persoonia, Suppl. 1: 159 (1967).

Apothecia widely opened, saucer-shaped, 5—10 mm in diameter, sessile on narrow base, externally granular, olivaceous-brown. Ectal excipulum of textura angularis. Asci narrowly clavate, (141—)149—174 × 21.6—24.9 μm, amyloid. Ascospores ellipsoid to broadly ellipsoid, 25.5—28.2 × 11.6—12.0 μm, violaceous, minutely warted, sometimes with 1—2 longitudinal or oblique striae. Paraphyses filiform, septate, 1.8—2.6 μm, embedded in lemon-yellow mucus. (Fig. 1, h).

Distribution in the USSR: the Tadjik SSR, the Hissar Mountains, the Ziddin depression, Kuk-Teppa, 2750 m a.s.l., on dead stems of *Ligularia thomsonii*, 04. 10. 1980, coll. S. Faizova (TAA).

The area of distribution of this species is rather wide (India, Sri Lanka, Vietnam, China, Japan, Pakistan, the Philippines, Indonesia, North-West Borneo, Australia, North Rhodesia, Madagascar, Venezuela, the USA). All the finds, however, originate mainly from the Pantropic region. The cited locality is the most northern one under natural conditions.

**Ascobolus ursinus** Prokhorov, sp. nov.

Apothecia 0.3—1.1 mm in diameter, pallide luteo-viridula, sessilia, initio globularia, deinide subglobosa, dispersa, disco concavo, marginibus distinctis. Excipulum 225—418 μm crassa, in parte inferiora cellulis globosis, in parte superiori cellulis angularibus horizontaliter versis compositur. Hymenium 210—225 μm et subhymenium 70—97 μm crassum. Asci (151—)157—182 × 11.2—14.5 μm, octospori, operculati, anguste cylindraceo-clavati, parietibus iodo coerulescentibus. Ascospores ellipsoideae, 12.8—13.6 × 8.2—8.35 μm, violaceae, with fine isolated warts. Paraphyses filiformes, hyalineae, sparsa septatae, apicibus ad 4.8—6.8 μm, embedded in lemon-yellow mucus. (Fig. 4).

Holotype: on dung of brown bear *Ursus arctos* L., the Primorsk Region, the Lazo Nature Reserve, valley of the River Kaniheze, 19. 08. 1988, coll. Ye. M. Bulakh, in the Herbarium of the Moscow State University.

The fruit bodies appeared on the 21st day of incubation of the sample of dung in a moist chamber. The new taxon...
Saccobolus caesariatus Renny apud Phill.

Brit. Discom. 297 (1887).

Apothecia short-cylindrical to barrel-shaped, 0.17–0.25 mm in diameter, superficial, sessile, white or pale violaceous, externally with numerous tufts of aggregated conical hyphae, 70–92 μm long and up to 35 μm thick at base. Ectal excipulum of textura angularis, sometimes with amorphous enclosures of violaceous pigment. Ascii clavate, apically denser (92–)103–186 × (22.2–)26.4–36.1–(41.7) μm, amyloid. Spore clusters dense, aggregated according to type 2, 43.9–50.0 × 16.7–19.4 μm, with 2 lateral drops of hyaline mucus. Individual spores ellipsoid or slightly asymmetrical, (17.5–)19.4–22.2 × 8.3–8.4 μm, dark or gray violaceous, minutely warted. Paraphyses cylindrical, septate, branched, hyaline, 2.8 μm in diameter. (Fig. 5, a).

Distribution in the USSR: the Armenian SSR, the Ashtarak District, Samgosavan, on dung of horse and cow, 21. 04. 1984, coll. M. Taslakhchyan; the Azerbaijan SSR, the Bulakh, on dung of wild boar, 15. 07. 1984, on mouse dung, 04. 05. 1987, coll. V. Prokhorov.

Saccobolus dilutellus (Fuckel) Sacc.

Syll. Fung. 8: 526 (1889).

Apothecia pillow-shaped, 0.15–0.35 mm in diameter, whitish-grayish, whitish-blueish, scattered or in small groups, with a few (from 4–6 to 15) ripe asci. Ectal excipulum of textura globulosa-angularis, in the marginal part consisting of loosely interwoven vertically orientated hyphae. Ascii clavate, apically truncated or rounded, 67–103 × 17.7–25.0 μm. Spore clusters compact broadly ellipsoid or subspherical, spores aggregated according to type 4, 19.4–23.7 × 16.7–19.4 μm. Individual spores ellipsoid, (12.0–)12.8–16.6 × 6.4–8.3 μm, violaceous to dark grayish-violaceous, free spore surface ornamented with minute warts grouped in a compact margin on the line of contact between spores. Paraphyses cylindrical, septate, branched, apically slightly swollen up to 3.6–6.7 μm. (Fig. 5, b).

Distribution in the USSR: the Moscow Region, the Odintsovo District, the Zvenigorod Biostation of Moscow State University on horse dung, 18. 04. 1984, on dung of wild boar, 15. 07. 1984, on mouse dung, 04. 05. 1987, coll. V. Prokhorov.

Saccobolus minimoides Prokhorov, sp. nov.

Apothecia 0.1–0.2 mm in diameter, numerosa, frequenter confluentia, initio obconica, deinde pulvinata, aurea vel succinea. Excipulum in parte inferiori receptaculi ex textura angularis compositur. Asci 43.9–51.7–(53.0) × 11.7–12.8(–16.0) μm, cylindrococcavati, supra truncati, breviter stipitati, parietibus isidiis coerulescentibus. Sporae fasciculati compacti, elongati, 22.5–24.1 × 8.0–9.6 μm. Ascsporae secundum typum 2 vel raro typum 1 dispositae, ellipsoidae, 7.9–8.8(–9.64) × 3.7–4.3 μm,
initio pallide violascentes, deinde intense violasceae, tenuiter verrucosae, raro fissura sola transversa ornatae. Paraphyses ramosae, septatae, filiformes, 1.6–2.5 μm in diameter, cellulis superioribus contento laete luteo, apicibus ad 4.0–4.5 μm incrassatis. (Fig. 6).


Apothecia numerous, often anastomosing, 0.1–0.2 mm in diameter, oboconical when young, then pulvinate, golden-yellow to amber-yellow. Ectal excipulum of textura angularis, existing only in the lower part of the apothecium. Asci clavate to clavate-cylindrical, truncated above, with short stipe, 43.9–51.7(–53.0) × 11.7–12.8(–16.0) μm, turning blue in Melzer’s reagent. Spore clusters compact, firm, aggregated in general according to type 2, sometimes according to type 1, 22.5–24.1 × 8.0–9.6 μm. Individual spores ellipsoid, light violaceous when young, intensively violaceous when ripe, minutely verrucose, rarely with 1 transversal stria, 7.9–8.8(–9.64) × 3.7–4.3 μm. Paraphyses branched in the upper half, septate, the upper cell with bright yellow content, 1.6–2.5 μm in diameter, apically swollen up to 4.0–4.5 μm. (Fig. 6). Holotype: on the dung of squirrel Sciurus vulgaris L., the Primorsk Region, the Sikhote-Alin Nature Reserve, valley of the Bia river, 11. 08. 1987, coll. V. I. Krutova, in the Herbarium of the Moscow State University.

The fruit bodies appeared in a moist chamber on the 19th day of incubation. The species is externally and morphologically close to S. minimus Vel., differing from it mainly in smaller size of asci, spore clusters and spores. Taking into account the variability of size according to Brummelen (2) and Minoura and Yamada (4), S. minimus has asci 50–62 × 12–16 μm, spore clusters – 27–34 × 9–15 μm and spores – (10.0–)11.5–14.0 × 4.0–6.5(–7.5) μm.
Saccobolus quadrisporus Mass. et Salm.


Apothecia scattered, pillow-shaped, 0.2-0.25 mm in diameter, yellowish-brown, with a few ripe asci. Ectal excipulum of textura globulosa-angularis. Asci elongated-clavate, 4-spores, 85.3-141.2 x 19.3-31.3 μm, amyloid. Spore clusters aggregated according to type 5b, 44.9-50.6 x 12.0-19.3 μm. Spores ellipsoid, 20.1-22.0 x 10.4-11.2 μm, at first hyaline, then violaceous and brown-blackish, ornamented with unequally distributed big anastomosing globules of pigment. Paraphyses filiform, minutely septate, hyaline, slightly swollen above up to 3.5-6.4 μm. (Fig. 7).


The species is evidently rare, with a limited habitat and connected with animals. It was described for the first time in 1901 in Kew Garden on the fungus of Brantba leucopsis, then on the Island of Spitzbergen, on the North-East coast of Greenland (3) and in the north of Canada (1). The study of samples of dung of different birds and other animals has not revealed this species in other regions of the USSR so far.

Saccobolus saccoboloides (Seaver in Dodge et Seaver) Brumm.

Persoonia, Suppl. 1: 168 (1967).

Apothecia occurring in groups, pillow-shaped, 0.2-0.4 mm in diameter, numerous, golden-yellow to amber-yellow. Ectal excipulum of textura angularis. Asci clavate, (80-)94-104 x 19.3-24.1 μm, amyloid. Spore clusters aggregated according to type 1 or 2, 33.7-38.5 x 11.7-14.8 μm, disintegrating early on single spores. Individual spores slightly asymmetrical, ellipsoid, swollen in the centre, 14.4-16.1 x 7.1-7.4 μm, violaceous, smooth. Paraphyses filiform, seaptate, with bright yellow or yellow-green content in the upper cells, 2.5-4.3 μm in diameter. (Fig. 5, d).

Distribution in the USSR: the Estonian SSR, the Põlva District, Põlva, on sheep dung, 28.03.1986: the Võru District, Vastseliina, on sheep dung, 02.04.1986, coll. M. Saar (TAA); the Moldavian SSR, Kishinev, the Zoological Gardens, on elephant dung, 07.07.1987, coll. L. Afanasyeva.

S. saccoboloides has been found so far only in 4 countries, mainly in the tropical region (India, Indonesia, New Guinea, Argentina). The new finds essentially widen the known range of distribution of this species.

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