

## Non fimicolous Arctic-alpine *Ascomycetes* collected in Austria 1

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**Abstract:** A list of 67 species of non fimicolous artic-alpine *Pezizomycetes* (*Ascomycetes*) collected in the summer months of 2004 and 2005 in some localities in the Alps in Salzburg and Tyrol is given. Detailed descriptions and illustrations of macro- and microscopical features of the three most interesting species, *Marcelleina rickii*, *Peziza muscicola* and *Ramsbottomia asperior* are presented.

**Zusammenfassung:** Eine Liste mit 67 Arten nicht-dungbewohnender arktisch-alpiner *Pezizomycetes* (*Ascomycetes*), die in den Sommermonaten in den Jahren 2004 und 2005 an einigen Fundorten in den Alpen in Salzburg und Tirol gesammelt wurden, wird vorgestellt. Detaillierte Beschreibungen und Abbildungen makro- und mikroskopischer Merkmale der drei interessantesten Arten, *Marcelleina rickii*, *Peziza muscicola* und *Ramsbottomia asperior* werden gegeben.

The area near the border between Italy and Austria, with peaks among the higher of the middle-eastern region of the Alps, is rich in more or less extended glaciers and snow-covered grounds. The slopes of the valleys in-between are very interesting for studying *Ascomycetes*, but particularly those of Austria, because of their northern exposition. In these valleys, glaciers or snow-covered grounds are larger than in other ones, humidity and shadow higher, lakes and different streams more numerous.

In the last years, some Italian mountainsides have instead undergone climatic changes, particularly the southern exposed slopes; less snow in winter, sometimes falling very late, and few rain in summer are causing a progressive drying out of some zones: the glaciers are progressively narrowing, the streams less flowing, and in some areas the diversity and vitality of herbs and mosses appears to be reduced by now. In alpine environments, mosses and herbs are always very important, especially those with large leaves, because they are able to protect the ground and to keep the humidity, in summer creating a microclimate where artic-alpine *Ascomycetes* can grow well.

### Area of collection and some numerical results

After having considered accessibility, nature of the soil, exposition, altitude, presence of lakes and streams, we chose the Zillertaler Alpen in Tyrol and the Hohe Tauern in Salzburg (Fig. 1) for our study.

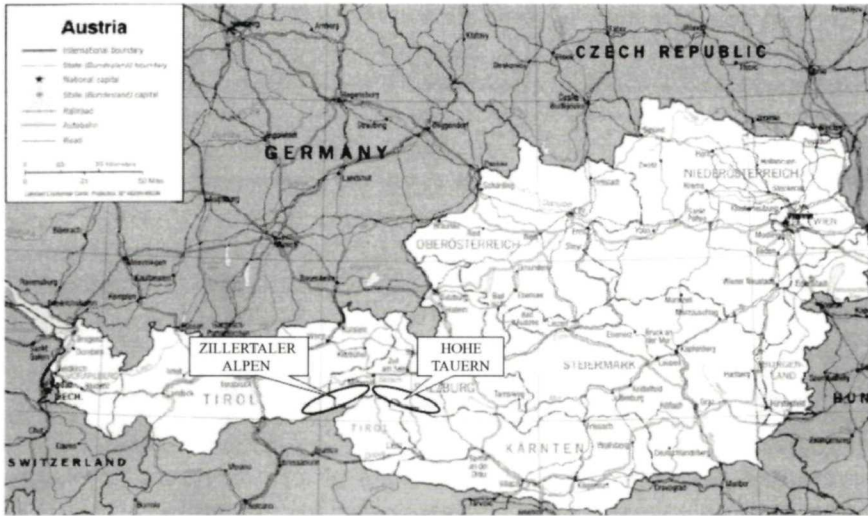


Fig. 1. Area of collection in Austria

These areas appeared to be particularly suitable, due to several lateral valleys with northern exposition. We intended to visit one valley a day in two different years. The soils are more or less acid except some small areas, where calcareous soil was noted, on the contrary of the Italian slopes where calcareous and acid soils are more equally distributed. We know the area would need more time in order to be better explored. However, we could determine 67 different taxa out of a total of 107 records.

In 2004/2005 we visited the districts (numbers given in the following list of species)

- 1) Felbertal (Mittersill, MTB 8840/2), 15. 8. 2005
- 2) Ferleintal (Ferleiten, MTB 8842/4), 14. 8. 2005
- 3) around Gerlospaß (Gerlos, MTB 8738/4), 21. 8. 2004, 17. 8. 2005, 19. 8. 2005
- 4) Uttendorf (Uttendorf, MTB 8841/2), 15. 8. 2005
- 5) Kaprunertal (Kaprun, MTB 8742/3) 13. 8. 2005
- 6) Stubachtal in the Hohe Tauern (Uttendorf, MTB 8841/2), 18. 8. 2005
- 7) Stilluptal (Mayrhofen, MTB 8937/1), 20. 8. 2004
- 8) Zillergrund in the Zillertaler Alpen (Mayrhofen, MTB 8837/4), 17. 8. & 18. 8. 2004

In 2005 we also revisited Gerlospaß twice, because it was very fruitful in the previous year; and again, although we explored a smaller area, the abundance of *Ascomycetes* was remarkable, more than in other places, maybe due to largely appropriate environmental conditions. It was the locality where we could make the highest number of collections (29); only Zillertal is near (24). In conclusion, the more productive area was Zillertaler Alpen (43 spp.); Hohe Tauern was less fruitful (31 spp.), even if we would have visited the Zillertaler Alpen only once.

We essentially explored the valleys from 1000 m s. m. up to the limit of the snow, looking for *Ascomycetes* near streams, swamps and on other places with a very humid ground, also around melting snow, with particular consideration to the mossy carpets and the ground covered by herbs; we also investigated degraded vegetal debris, like herbaceous stems in general and wood, both of conifers and deciduous trees.

## Materials and methods

The fungi were all photographed with a reflex camera in situ, and a few general notes for each collection were made; then they were dried, and microscopically examined with 40 × or 100 × (oil immersion) objectives at home during the following weeks.

Samples were re-hydrated in water, KOH (5%) or GCS (glycero-chloridric solution, commercial concentration); water was used in order to appreciate the colours of the fungal tissues; Melzer's reagent to check the amyloidity of the asci and the staining (green) of the pigments in the paraphyses of some species; Lactic Blue (0,05 g pigment per 30 g lactic acid) for the ornamentation of the spores; heated, in order to note the eventual dissolution of the ornamentation.

Specimens are deposited in the herbaria BR, C-F, B 70, M, K(M), UPS F, and in the personal herbarium of the author GFM.

## List of species with herbarium references, locality and number of records

Taxon	Herbarium references	Number of locality/ Number of records
01 <i>Anthracoobia maurilabra</i> (COOKE) BOUD.	K(M) 138525	4/1
02 <i>Arpinia inops</i> BERTHET	K(M) 138529	3/1
03 <i>Ascobolus carbonarius</i> P. KARST.	K(M) 138526	4/1
04 <i>Ascocoryne sarcoides</i> (JACQ.: FR.) J. W. GROVES & D. E. WILSON	M-0090800	7/1
05 <i>Boudiera dennisii</i> DISSING & SIVERTSEN	K(M) 138528	3/1
06 <i>Bryoscyphus conocephali</i> (BOYD) SPOONER	K(M) 138535	6/1
07 <i>Crocicreas cyathoideum</i> (BULL.: FR.) S. E. CARP.	K(M) 138544	1/1
08 <i>Cudoniella clavus</i> (ALB. & SCHWEIN.: FR.) DENNIS	B 70 0005709	8/1
09 <i>Discinella boudieri</i> (QUÉL.) BOUD.	C-F-74728, K(M) 138527	3/1, 6/1
10 <i>Geoglossum cookeanum</i> NANNF.	B 70 0005706	8/1
11 <i>Geopora nicaeensis</i> (BOUD.) M. TORRE	GFM, GFM	5/1, 6/1
12 <i>Helvella capucina</i> QUÉL.	UPS F-120234	8/1
13 <i>Helvella corium</i> (O. WEBERB.) MASSEE	K(M) 138550	5/1
14 <i>Helvella dovrensis</i> T. SCHUMACH.	K(M) 138546	5/1
15 <i>Hymenoscyphus laetus</i> (BOUD.) DENNIS	UPS F-120229, GFM, GFM, GFM	3/4
16 <i>Hymenoscyphus lutescens</i> (R. HEDW.: FR.) W. PHILLIPS	M-0090805	7/1
17 <i>Hymenoscyphus pileatus</i> (P. KARST.) O. KUNTZE	K(M) 131863	8/1
18 <i>Hymenoscyphus repandus</i> (W. PHILLIPS) DENNIS	K(M) 138545	5/1
19 <i>Hymenoscyphus vitellinus</i> (REHM) O. KUNTZE	K(M) 138538	6/1
20 <i>Lachnum bicolor</i> (BULL.: FR.) P. KARST.	K(M) 138541	1/1
21 <i>Lachnum corticale</i> (PERS.: FR.) CLEM.	C-F-74710	5/1
22 <i>Lachnum virgineum</i> (BATSCH: FR.) P. KARST.	C-F-74720, K(M) 138542	1/2
23 <i>Lamprospora ascoboloides</i> SEEVER	K(M) 138534	6/1
24 <i>Marcelleina persoonii</i> (P. CROUAN & H. CROUAN) BRUMM.	BR-156848,96, C-F-74714 - GFM	5/2, 8/1

25	<i>Marcellina rickii</i> (REHM) GRADDON	K(M) 131865, UPS F-120233, C-F-74726, GFM	3/3, 8/1
26	<i>Melastiza cornubiensis</i> (BERK. & BROOME) J. MORAVEC	K(M) 138530	3/1
27	<i>Mitruha paludosa</i> FR. : FR.	K(M) 131873	8/1
28	<i>Mollisia clavata</i> GREMMEN	K(M) 138547	5/1
29	<i>Mollisia ligni</i> (DESM.) P. KARST.	K(M) 131857	7/1
30	<i>Mollisia ventosa</i> P. KARST.	K(M) 138531	3/1
31	<i>Neottiella rutilans</i> (FR.: FR.) DENNIS	K(M) 128422, BR-156851,02	8/2
32	<i>Octospora coccinea</i> (P. CROUAN & H. CROUAN) BRUMM.	DAN, K(M) 138551	5/2
33	<i>Octospora humosa</i> (FR.: FR.) DENNIS	K(M) 128419, BR-156841,89	3/1, 8/1
34	<i>Octospora melina</i> (VELEN.) DENNIS & ITZEROTT	K(M) 128420	8/1
35	<i>Octospora moravecii</i> K. B. KHARE	C-F-74718	2/1
36	<i>Octospora pseudoampezzana</i> (SVRČEK) CAILLET & MOYNE	K(M) 138537	6/1
37	<i>Octospora roxheimii</i> DENNIS & ITZEROTT	K(M) 138536	6/1
38	<i>Orbilina luteorubella</i> (NYL.) P. KARST.	K(M) 131871	7/1
39	<i>Orbilina sarraziniana</i> BOUD.	UPS F-120231	7/1
40	<i>Pachyella babingtonii</i> (BERK. & BROOME) BOUD.	BR-156842,90	8/1
41	<i>Pachyella lazzariana</i> TRIMBACH	K(M) 131871	7/1
42	<i>Peziza alaskana</i> CASH	K(M) 128423, B 70 0005699, C-F-74711, GFM	2/1, 5/1, 8/2
43	<i>Peziza ampelina</i> QUÉL.	K(M) 131870	3/1
44	<i>Peziza badia</i> PERS.: FR.	C-F-74722, GFM	3/2
45	<i>Peziza depressa</i> PERS.: FR.	K(M) 138532	3/1
46	<i>Peziza gerardii</i> COOKE	K(M) 131862	8/1
47	<i>Peziza muscicola</i> DONADINI	K(M) 131861	8/1
48	<i>Peziza olivacea</i> QUÉL.	K(M) 128414	7/1
49	<i>Peziza violacea</i> PERS.: FR. f. <i>terricola</i> DONADINI	K(M) 131867, C-F-74723	3/2
50	<i>Phaeohelotium subcarneum</i> (SCHUMACH.) DENNIS	K(M) 131866	3/1
51	<i>Phaeohelotium trabinellum</i> (P. KARST.) DENNIS	K(M) 131868	3/1
52	<i>Pulvinula constellatio</i> (BERK. & BROOME) BOUD.	C-F-74707, GFM, GFM	3/2, 5/1
53	<i>Pulvinula convexella</i> (P. KARST.) PFISTER	B 70 0005697, C-F-74727	3/1, 8/1
54	<i>Pyrenopeziza carduorum</i> REHM	C-F-74719	1/1
55	<i>Ramsbottomia asperior</i> (NYL.) BENKERT & T. SCHUMACH.	C-F-74717, K(M) 138540, GFM, GFM	2/3, 3/1
56	<i>Ramsbottomia crec'hquervaultii</i> (P. CROUAN & H. CROUAN) BENKERT	K(M) 128421	8/1
57	<i>Rutstroemia microsperma</i> (SPEG.) GAMUNDI	K(M) 138548	5/1
58	<i>Scutellinia crinita</i> (BULL.: FR.) LAMBOTTE	K(M) 128410, K(M) 128411, K(M) 128415, UPS F-120230	3/1, 7/1, 8/2
59	<i>Scutellinia kerguelensis</i> (BERK.) O. KUNTZE	C-F-74715, GFM	2/2
60	<i>Scutellinia minor</i> (VELEN.) SVRČEK	C-F-74713, K(M) 138549, GFM	5/3
61	<i>Scutellinia nigrohirtula</i> (SVRČEK) LE GAL	K(M) 128408, GFM, GFM	3/2, 6/1

62	<i>Scutellinia subhirtella</i> SVRČEK	K(M) 128412	7/1
63	<i>Scutellinia superba</i> (VELEN.) LE GAL	K(M) 138539	2/1
64	<i>Scutellinia vitreola</i> KULLMAN	K(M) 128413, K(M) 128417, K(M) 128418, B 70 0005703, C-F-74716	2/1, 7/1, 8/3
65	<i>Tarzetta rosea</i> (PERS.) FÜCKEL	C-F-74729, K(M) 138533	6/2
66	<i>Tricharina ochroleuca</i> (BRES.) ECKBLAD	K(M) 131869	3/1
67	<i>Trichophaea hybrida</i> (SOWERBY) T. SCHUMACH.	B 70 0005696, C-F-74721, GFM	1/2, 8/1
Number of species per locality			1/5, 2/6, 3/20, 4/2, 5/12, 6/9, 7/10, 8/19

## Descriptions

*Marcellina rickii* (REHM) GRADDON, Trans. Brit. Mycol. Soc. **66**: 170, 1976

Basionym: *Detonia rickii* REHM – Hedwigia **38**: 243, 1899

≡ *Pulparia rickii* (REHM) DONADINI – Bull. Soc. Mycol. France **95**: 183, 1979

= *Lamprospora jetelae* VACEK – Stud. Bot. Cechoslov. **10**: 133, 1949

= *Pulparia jetelae* (VACEK) SVRČEK – Česka Mykol. **35**: 88, 1981

**Macroscopical characters:** apothecia up to 15 mm in diam., shallow cup-shaped or flattened, saucer-shaped, sessile. Hymenium smooth or delicately pruinose, purplish-brown or brown-violaceous, deeper if damp; outside concolourous or slightly darker than the hymenium, smooth or a bit rugulose. Margin more or less evident, normally concolourous. Flesh waxy, fragile, pale brownish-violet (Fig. 2 a).

**Microscopical characters:** spores spherical, 8-9 µm (MEDARDI 2006) or 9,2-10,2 µm (SCHUMACHER & JENSSEN 1992) in diameter, with sinuous and more or less long ridges sometimes anastomosing and forming a scarce, incomplete reticulum with opened meshes, hyaline, sometimes with one oil drop, uniseriate (Fig. 2 b). Asci cylindrical, 210-230 × 12-14 µm, non-amyloid, operculate, 8-spored. Paraphyses cylindrical, but slightly enlarged up to 6.5 µm at the apex, longer than the asci and curved in the upper part, unbranched, with feeble brownish-violaceous reflexes by a pigment contained. Ectal excipulum of textura globulosa-angularis, cells up to 30 µm wide, with slightly pigmented walls; medullary excipulum of textura intricata. Margin composed of faintly clavate cells, 25-35 µm long.

**Habitat:** in groups of few individuals or single, on humid bare ground, often near mossy carpets (in the protonematic stage, too), among herbs, also above the vegetation limit; summer.

**Distribution in Austria:** Our record is the fifth for Austria, the species is already known from three localities in Styria and one in Salzburg (Austrian Mycological Society, pers. comm.).

**Notes:** The main characters of this species are the dimensions and the scarce ornamentation of the spores; also the brownish colours of the apothecia can be a valuable hint for its determination.

It is near to *M. persoonii* (P. CROUAN & H. CROUAN) BRUMM., with equally shaped apothecia and the same habitat, in which the brownish tinges are replaced by violet-blue ones. The latter has a little bit wider spores, 9-10 µm (MEDARDI 2006) or 10-12 µm (AHTI & al. 2000) in diam., less densely ornamented, but with ribs some-

what forming a more closed reticulum. In addition, the paraphyses are often agglutinated by a brown epithecium (MEDARDI 2006).

Recently, other species of *Marcelleina* confusable with *M. rickii* have been described. *Marcelleina georgii* (SVRČEK) J. MORAVEC has the same habit, but is whitish-violaceous, sometimes with brownish reflex; it has spores with 7.5-9.7(-10.4)  $\mu\text{m}$  in diameter, ornamented by scarce warts or short ridges rarely anastomosing (MORAVEC 1987, HÄFFNER 1995). *Marcelleina brevicostatispora* J. MORAVEC is entirely blue-violet; it has spores with 9-11  $\mu\text{m}$  (MORAVEC 1971) or 8-10.2(-11.5)  $\mu\text{m}$  (MORAVEC 1987, HÄFFNER 1995) in diam., with coarse isolated warts and very short ridges. *Marcelleina benkertii* J. MORAVEC is evenly dark blackish-blue and has smooth spores with 9-11.4  $\mu\text{m}$  in diam.; the latter is also very close to *Smardaea planchonis* (DUNAL ex BOUD.) KORF & W.Y. ZHUANG [= *M. atroviolacea* (DELILE ex DE SEYNES) BRUMM., see below], but differs by the complete absence of the purplish pigments in asci and spores, notable in *S. planchonis*. *Marcelleina donadinii* ASTIER & J. MORAVEC has grey-violaceous to black-violaceous hymenium, paler outside, and globose spores, 10.5-15.5  $\mu\text{m}$  (or widely ellipsoidal, 13.5-16  $\times$  12.5-15  $\mu\text{m}$ ), with dense warts, connecting to form irregular plates (MORAVEC 1987, HÄFFNER 1995). All these species considered live in humid zones, among herbs and mosses.

*Smardaea planchonis* can be at first sight also confused with *M. rickii*; it has shallow cup-shaped and wholly dark violet apothecia, smooth spherical spores, 9-12  $\mu\text{m}$  in diameter, and evident violaceous pigments in the spores and in the asci. In this instance, the habitat is essential, because *S. planchonis* does not grow in arctic-alpine environment, but it is quite common in mediterranean zones; at the most it has been collected on the lower, warmer mountains of the Italian Alps (MEDARDI 2006).

In the genus *Peziza* there is a large group of species whose tinges can be similar to those of *M. rickii*; the distinction is in these cases quite easy, because in *Peziza* the asci are amyloid and the spores ellipsoidal.

***Peziza muscicola* DONADINI**, Bull. Soc. Mycol. France **93**: 177-187 (Fig. 2 c, d)

**Macroscopical characters:** apothecia up to 20 mm in diameter, subglobose, then cup-shaped, finally almost flattened, sessile. Hymenium smooth, deep brown with reddish tinges; outside quite smooth or scurfy, concolourous or paler. Margin often enrolled, concolourous with the outside. Flesh waxy, fragile, reddish-brown, no juice.

**Microscopical characters:** spores more or less strictly ellipsoidal, 17-19.5  $\times$  8-9.5  $\mu\text{m}$  (DONADINI 1977: 13.5-18  $\times$  7.5-9  $\mu\text{m}$ ), with curved ridges enlarged in some points, partially anastomosing to form an incomplete and open reticulum, mixed with scarce and  $\pm$  elongate warts, hyaline, with one or two oil drops, uniseriate. Asci cylindrical, 300-350  $\times$  14-15  $\mu\text{m}$ , amyloid, operculate, 8-spored, somewhat brownish. Paraphyses irregularly cylindrical, slightly inflated (6  $\mu\text{m}$ ) at the apex, septate. Ectal excipulum of *textura angularis*, cells about 20  $\mu\text{m}$  wide; medullary excipulum of *textura intricata*, mixed with some globose elements in the middle.

**Habitat:** in little groups on humid ground, among herbs and near mossy carpets; summer.

**Distribution in Austria:** There is no other record in the database of Austrian fungi (Austrian Mycological Society, pers. comm.).

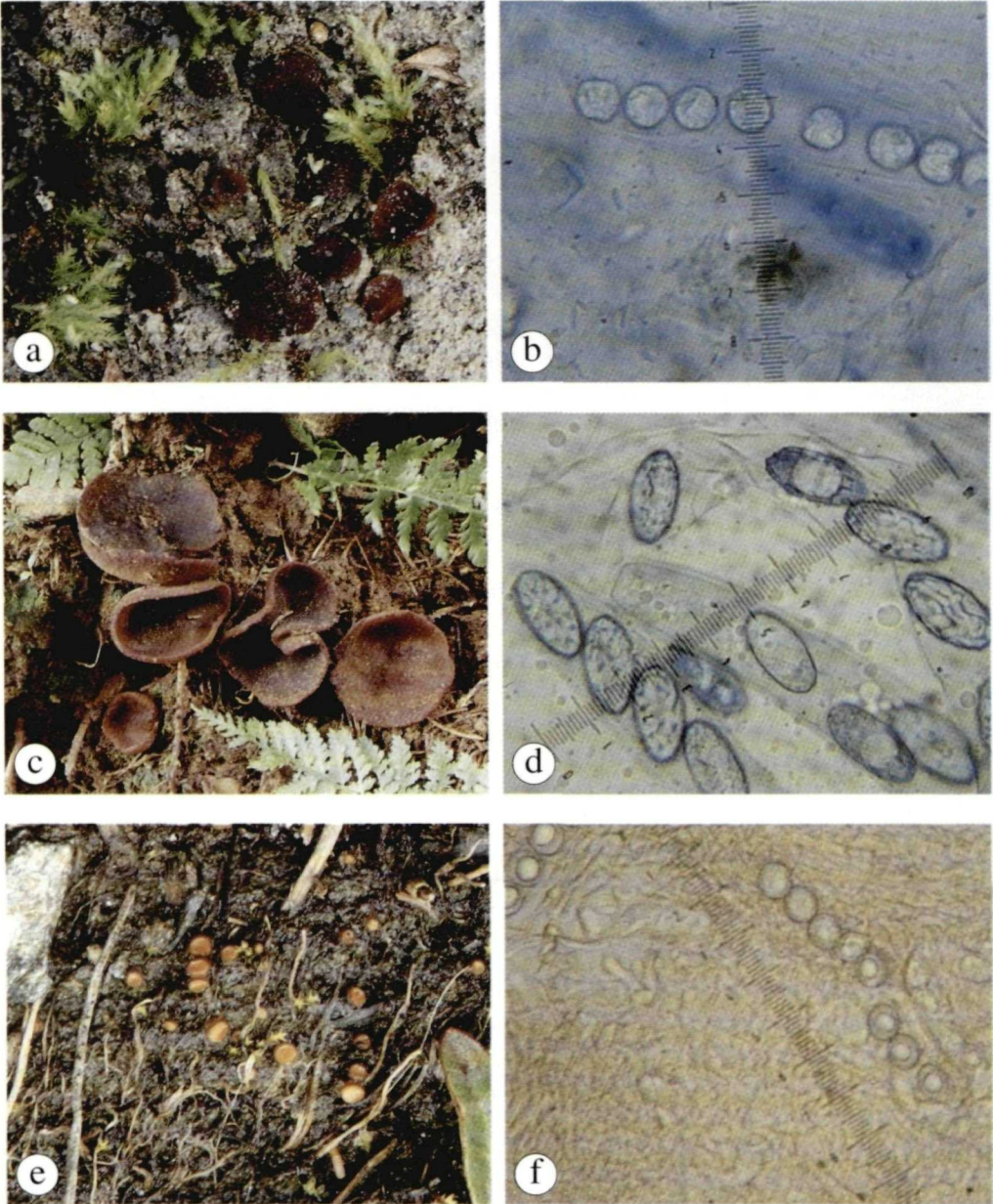


Fig. 2. *a, b. Marcelleina rickii*. *a* habit, *b* spores in lactic blue (1500 ×, oil immersion); *c, d. Peziza muscicola*. *c* habit, *d* spores in lactic blue (1500 ×, oil immersion); note the ornamentation. *e, f. Ramsbottomia asperior*. *e* habit, *f* spores in water (600 ×). – Phot. G. MEDARDI.

**Notes:** The ornamentation of the spores, consisting in scarce warts mixed with curved ribs inflated in some points, partly connected to form an incomplete opened reticulum, is the main discriminating character for species separation, because the habit is very similar to that of other *Peziza* spp.

Particularly, the same colours are also observable in *P. depressa* PERS.: FR., with ellipsoidal spores  $18-20 \times 9-10 \mu\text{m}$ , ornamented by coarse and scarce warts, only sometimes united to form short ribs; *P. kallioi* HARMAJA, with violaceous flesh and reddish-lilaceous apothecial base, with scurfy ellipsoidal spores  $18-19 \times 8-9.5 \mu\text{m}$ ; *P. berthetiana* DONADINI with the outside markedly paler than the hymenium, yielding a scarce yellow-green juice from the damaged flesh, with ellipsoidal spores  $15-16 \times 8-9 \mu\text{m}$ , ornamented by more or less elongated warts; *P. saccardiana* COOKE with scurfy ellipsoidal spores  $14-15.5 \times 9-10 \mu\text{m}$ , the latter growing on burnt ground (MEDARDI 2006).

*Peziza badia* PERS.: FR. has spores  $17-19 \times 10-11 \mu\text{m}$  with more or less the same kind of ornamentation as *P. muscicola*, only the ribs are not enlarged and not mixed with warts; it has also darker brown tinges, with weak reddish or olivaceous reflexes (MEDARDI 2006).

***Ramsbottomia asperior* (NYL.) BENKERT & T. SCHUMACH.**, Agarica **6**: 35-36, 1985  
= *Sphaerospora asperior* (NYL.) SACC. – Sylloge Fungorum **8**: 188, 1889  
= *Barlaea modesta* (P. KARST.) SACC. – Sylloge Fungorum **8**: 113, 1889  
= *Lamprospora modesta* (P. KARST.) BOUD. – Histoire et classification des Discomycètes d'Europe: 69, 1907  
= *Peziza modesta* P. KARST. – Mycologia Fennia. Pars prima. Discomycetes. Bidrag till Kännedom af Finlands Natur och Folk **19**: 64, 1871

**Macroscopical characters:** apothecia up to 3 mm in diameter, saucer-shaped, lens-shaped or pulvinate, sessile. Hymenium smooth, orange or egg-yolk-coloured; outside smooth or slightly pruinose because of short hairs not clearly visible (even with a magnifying lens), concolourous with the hymenium. Margin entire, evident, sometimes weakly darker. Flesh waxy, fragile, pale orange (Fig. 2 e).

**Microscopical characters:** spores spherical,  $17-18 \mu\text{m}$  in diameter, or largely ellipsoidal,  $18-19 \times 15-16 \mu\text{m}$ , with spines  $1-1.5 \mu\text{m}$  high, hyaline, with one large oil drop, uniseriate. Asci cylindrical,  $250-270 \times 18-21 \mu\text{m}$ , inamyloid, operculate, 8-spored (Fig. 2. f). Paraphyses scarce, cylindrical or slightly clavate in the upper part (up to  $6-7 \mu\text{m}$ ), with intracellular orange pigment. Hairs cylindrical-clavate, up to  $120 \times 15-16 \mu\text{m}$ , somewhat constricted near the scarce septa, brownish. Excipulum one-layered, of textura intricata.

**Habitat:** in small groups on wet ground, in swamps, among herbs and near mossy carpets; summer.

**Distribution in Austria:** Our record is the fifth for Austria, the species is already known from two localities in Styria, one in Carinthia and one in Salzburg (Austrian Mycological Society, pers. comm.).

**Notes:** The most important characters are microscopical: the spherical or subspherical spores with pointed spines  $1-1.5 \mu\text{m}$  high and the hairs up to  $120 \mu\text{m}$  long.



It is closely related with *R. crec'hqueraultii* (H. CROUAN & P. CROUAN) BENKERT, with the same habit, having wider, quite perfectly spherical spores, 19-21  $\mu\text{m}$  (MEDARDI 2006) or 16-19  $\mu\text{m}$  (ELLIS & ELLIS 1988) in diam., with dense, pointed spines up to 1.5  $\mu\text{m}$  long, and hairs 60-80  $\mu\text{m}$  long. *Ramsbottomia macracantha* (BOUD.) BENKERT, with equal habit, too, is easily distinguished by its sensibly wider spherical spores, 21-22  $\mu\text{m}$  (MEDARDI 2006) or 20-25  $\mu\text{m}$  (DENNIS 1981) in diam., ornamented by more evident spines, up to 5  $\mu\text{m}$  long (MEDARDI 2006).

*Octospora moravecii* K. B. KHARE shares habit and habitat; it can have largely ellipsoidal smaller spores, 15  $\times$  17.5  $\mu\text{m}$ , or spherical ones, 14.5-16.5  $\mu\text{m}$  in diam., with one wide oil drop and warts 1-1.5  $\mu\text{m}$  large and high; however, it has no hairs.

All the species considered grow on very humid ground, often in swamps, among herbs and mosses.

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