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Coprophilous fungi from Iceland

Michael J. Richardson

165 Braid Road, Edinburgh EH10 6JE U.K.

ABSTRACT: Eighty-one species of coprophilous fungi were recorded from 32 herbivore dung samples collected from Iceland in July 2002 and incubated in moist chambers. Almost half of the species are apparently new records for Iceland. Collections are described and the occurrence and distribution of species is discussed. The species richness of the Icelandic coprophilous mycota (lat. 64-66°N) is slightly higher than in northern UK (lat. 55-59°N).

KEY WORDS: ascomycetes, basidiomycetes, biogeography, diversity, ecology, fimicoles.

INTRODUCTION

During a visit to Iceland in July 2002, 32 samples of herbivore dung were collected and, on return to the UK, incubated in a damp chamber. The coprophilous zygomycetes, ascomycetes and basidiomycetes which developed were recorded. There is already a quite extensive list of Icelandic coprophils. ROSTRUP (1903) contains records of 25-30 coprophilous species, LARSEN (1932) compiled records of all fungi from his own collections and those of others, especially Ólafur Davíðsson, and these include about 50-60 coprophils. CHRISTENSEN (1941) recorded agarics, including some *Coprinus* species. Van BRUMMELEN (1967) examined material of three *Ascobolus* species, but no *Saccobolus*, from Iceland, and LUNDQVIST (1972) listed the occurrence of nine species of *Sordariaceae*, of which he verified five. LAUBE (1971) also recorded some ascomycetes. These records are brought together, with others, including a list by AAS (pers. comm. to Helgi Hallgrímsson 15.12.1993, of fungi identified from a foray of the Extra Nordic Mycological Congress, 4-7th of August 1993) as part of a check-list of the Icelandic mycota by HALLGRÍMSSON & EYJÓLFSDÓTTIR (2004). HANSEN & KNUDSEN (2000) provide the most recent compilation of information on some of the Nordic ascomycota, including that of Iceland but, as far as coprophils are concerned, their ascomycota is incomplete, since it does not include any of the *Sordariales* or the bitunicate groups (e.g. *Phaeotrichaceae* and *Sporormiaceae*), which contain many coprophils. It does, however include other groups which have coprophilous species (e.g. *Pezizaceae*, *Ascobolaceae*, *Pyronemataceae*, *Thelebolaceae* and *Xylariaceae*). HANSEN & KNUDSEN (1992) provide information on Icelandic, and other Nordic, basidiomycetes. Details of the fungi found from the current collection of samples are provided, and their distribution and occurrence are discussed within the context of records from over 650

samples providing over 6250 records from samples collected worldwide in recent years by the author, and in relation to the observations of others, especially BELL (1983), van BRUMMELEN (1967), and LUNDQVIST (1972).

MATERIAL AND METHODS

Samples were collected between 13 and 24 July 2002 (Table 1, Fig. 1). They were collected in paper envelopes and gently air dried, if not already dry when collected. Localities (latitude and longitude, WGS84 datum) were determined with a Magellan GPS 4000 XL satellite navigator, and place names are given according to the 1:300000 Kortabók (2001, Mál og menning, Reykjavík). Samples were rehydrated and incubated on 30 July 2002 on moist paper towelling in plastic boxes with lightly fitting transparent lids, under ambient light and at room temperature (ca 15-18° C). Care was taken to ensure that cultures were not

TABLE 1. Details of Icelandic dung samples and collection localities

Sample no.*	Locality	Elevation (m a.s.l.)	Lat (°N)	Long. (°W)	Habitat	Date	Substrate
22/02	F35 roadside, Bláfellsháls.	745	64.52	19.89	highland desert	13.7.02	sheep
23/02	Hveravellir, near camp ground	625	64.86	19.56	highland desert	13.7.02	sheep
24/02	Áfangafell, W. of Blöndulón	570	65.16	19.73	highland desert	14.7.02	sheep
25/02	Goðafoss	125	65.68	17.55	*Salix*/ericaceous heath	15.7.02	sheep
26/02	Goðafoss	125	65.68	17.55	*Salix*/ericaceous heath	15.7.02	ptarmigan
27/02	Hlíð campsite, Reykjahlíð, Mývatn	285	65.65	16.92	lava field	16.7.02	sheep
28/02	Námafjall, Reykjahlíð, Mývatn	360	65.64	16.76	grassland	16.7.02	sheep
29/02	near old bore at Víti, Krafla	600	65.72	16.75	mossy flush	16.7.02	sheep
30/02	Leirhnjúkshraun	480	65.70	16.84	herb rich lava field	6.7.02	ptarmigan
31/02	Hverfell, Reykjahlíð, Mývatn	305	65.59	16.90	*Betula*/*Salix* woodland	17.7.02	ptarmigan
32/02	Dimmuborgir, Reykjahlíð, Mývatn	310	65.59	16.91	*Betula*/*Salix* woodland	17.7.02	sheep
33/02	Route 85 roadside, Vogar	40	66.09	16.80	roadside grazing	17.7.02	sheep
34/02	Eyjan, Jökulsárgljúfur NP, Ásbyrgi	50	66.02	16.50	*Salix*/ericaceous heath	18.7.02	goose
35/02	Eyjan, Jökulsárgljúfur NP, Ásbyrgi	50	66.02	16.50	*Salix*/ericaceous heath	18.7.02	sheep
36/02	Beinalda, Jökulsá á Fjöllum valley	420	65.44	16.20	highland desert	19.7.02	sheep
37/02	F88 roadside, Fremstafell/Fossá ford	470	65.34	16.06	riverside vegetation	19.7.02	goose
38/02	F88 roadside, Fremstafell/Fossá ford	470	65.34	16.05	riverside vegetation	19.7.02	sheep
39/02	SE of Dreki camp ground, Askja	760	65.04	16.60	river gravel vegetation	20.7.02	goose
40/02	Möðrudalur	450	65.37	15.88	roadside grazing	20.7.02	horse
41/02	Möðrudalur	450	65.37	15.88	roadside grazing	20.7.02	sheep
42/02	Fossar, nr Berufjörður	45	64.75	14.48	roadside grazing	21.7.02	sheep
43/02	Jökulsárlón	20	64.05	16.18	roadside grazing	21.7.02	sheep
44/02	Skaftafell NP	310	64.04	16.98	*Salix*/ericaceous hillside	22.7.02	ptarmigan
45/02	Ingólfshöfði	75	63.80	16.64	clifftop grassland	23.7.02	sheep
46/02	Eldgjá	425	63.95	18.63	*Salix*/ericaceous valley edge	23.7.02	sheep
47/02	Eldgjá	480	63.97	18.62	*Salix*/ericaceous valley edge	23.7.02	sheep
48/02	Eldgjá	450	63.96	18.62	river gravel vegetation	23.7.02	goose
49/02	Landmannalaugar	595	63.99	19.05	river gravel vegetation	24.7.02	sheep
50/02	Landmannalaugar	595	63.99	19.05	river gravel vegetation	24.7.02	goose
51/02	Landmannalaugar	630	63.98	19.05	*Salix*/ericaceous hillside	24.7.02	sheep
52/02	Landmannalaugar	660	63.98	19.05	*Salix*/ericaceous hillside	24.7.02	ptarmigan
53/02	Landmannalaugar	605	63.99	19.06	paddock at camp site	24.7.02	horse

* MJR sample no. and year identifier

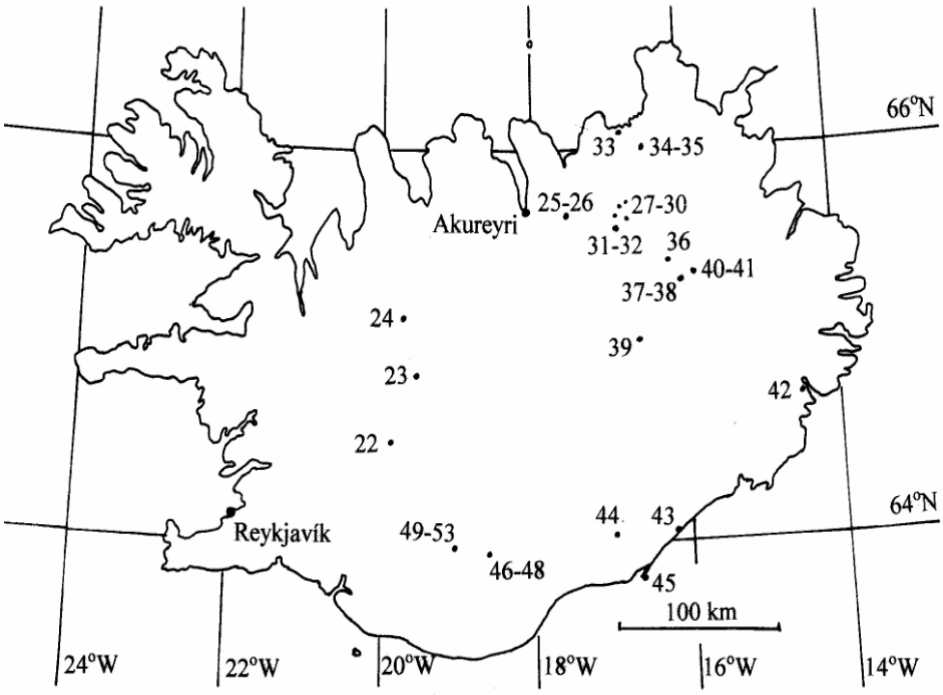

FIGURE 1. Sample collection localities in Iceland. Numbers are the MJR/02 sample numbers as in Table 1.

too wet. Samples were generally of similar size, with incubation chambers 10 x 7 cm, which would accommodate approx. 2-4 g dry wt (= 15 sheep/ptarmigan pellets), or 13 x 8 cm for horse (approx. 10 - 20 g dry wt). Samples were examined frequently at intervals of a few days, with a x 7 - 45 magnification stereomicroscope. Fruiting bodies were removed and mounted in water for examination and identification at higher magnification. Samples were incubated for 6 to 15½ wk, with observations continuing whilst new fungi were being observed. Selected material has been placed in the Herbarium of the Icelandic Institute of Natural History (AMNH) at Akureyri. In considering diversity, an estimate of species richness was made by constructing a cumulative species curve and deriving the equation for that curve ($y = ax^b$, where y = cumulative no. of species observed in x samples) and solving for $x = 50$ samples, and comparing with values obtained from a world-wide study of a similar range of substrates (RICHARDSON 2001). When using cumulative frequency curves to monitor diversity by assessing species richness it is more practical to plot the curve using the samples in the order in which they were collected. In theoretical considerations, however, such curves are best constructed using the mean value of several constructed from the same data set, with the samples arranged in a different sequence. In this paper curves from both the chronological sequence

and a set of 32 different sample sequences (the original chronological sequence, that sequence in reverse order, and 15 other similar sequence pairs starting at successive odd sample numbers (e.g. 3-32, then 1-2; 5-32, 1-4; 7-32, 1-6 *et seq*.) are presented to give an indication of the amount of variation in diversity estimates obtained from such curves (Fig. 2).

RESULTS AND DISCUSSION

Information on the dung samples and their origin are given in Table 1. Just over 300 records of 81 species were obtained during the period of incubation. The mean number of species from the 20 sheep and 2 horse samples was 12 (range 2-23), and fewer from the 10 avian samples (average 4, range 0-13). Although *Coprinus stercoreus* is the commonest species of *Coprinus* (e.g. occurring on 56% of sheep dung samples worldwide, RICHARDSON 2001), it was only recorded from two of the Icelandic samples, while the most frequent *Coprinus* species, *C. miser*, occurred on just over 43% of samples. Again, although the number of ptarmigan (*Lagopus mutus*) samples studied was very small, it was disappointing not to find *Ascobolus carletonii* Boud. It is regularly and frequently recorded from grouse (*Lagopus lagopus scoticus*) droppings in Scotland (RICHARDSON 2001), and ptarmigan is a closely related species which migrates between arctic regions and Scotland. Piia Juhntinen [pers. comm.] has recorded it twice from ptarmigan in Finland, and it has been recorded for Iceland (HANSEN & KNUDSEN 2000). *Saccobolus quadrisporus* (a 4-spored *Saccobolus* species) and *Ascobolus brantophilus* are two species characteristic of goose dung from arctic regions (DISSING 1989), and the finding of both in Iceland from such a small number of samples fills a gap in the knowledge of their distribution and suggests that they are not uncommon in such regions.

The identification of some species presents difficulties, especially those of the *Thelebolaceae*, *Sporormiella, Hypocopra* and *Coniochaeta*. *Sporormiella*, at the latest count, consists of at least 80 names and many, in particular the species with 4-celled spores, appear to differ mainly in the relative shape and size of component cells, subtle aspects of germ slit orientation, which seem to be quite variable characters, and they have a range of variability of spore size. There are, unfortunately, few recent monographic treatments of these genera. Those of AHMED & CAIN (1972) for *Sporormiella* and KRUG & CAIN (1974) for *Hypocopra* are now quite old and cannot take into account more recently described species. The authors of both these accounts take a very narrow view of species, and it is sometimes difficult, both when comparing descriptions and when trying to determine the identity of fresh material, to reach a comfortable conclusion as to the distinctness of different species and the identity of a particular collection. The more material one studies, the more one finds collections which are difficult to determine with confidence. Until numerous isolates, from different substrates and geographical regions, are studied in culture, and compared by DNA and mating studies, it is not possible to be confident about the specific identity of

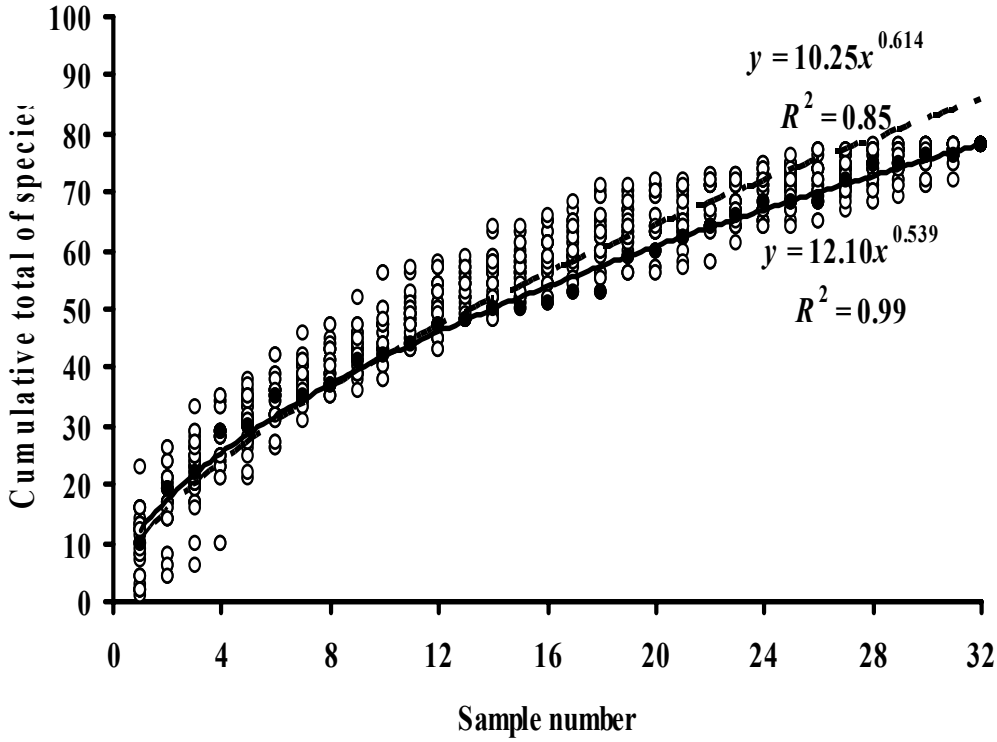

FIGURE 2. Cumulative total of taxa observed on 32 samples of dung collected in Iceland and incubated in moist chambers. Solid data points and regression line are for the samples plotted in order of collection; unfilled data points and the broken line are for thirty-two different sample sequences used to obtain an estimate of variation. Equations for the respective power curves are given below and above.

some collections, or their distinctness. On the basis of simple morphology, and using similar criteria, the human race could currently be considered to consist of several species - this is known not to be the case.

In considering diversity, the species richness of individual samples is much as expected, with 2-23 species being recorded from individual mammalian samples, and fewer from the avian substrates. The cumulative species curve (total no. of species recorded with successive samples, Fig. 2) plotted in the sequence of sample collection gives an estimate of 100 species from 50 samples. The better estimate from 32 different sample sequences allows a prediction of 110 species (S.E.M. = 2) from a collection of 50 samples. This value is somewhat higher than might have been anticipated for a coprophilous mycota from a latitude of 64-66°N from the data of RICHARDSON (2001), who demonstrated that there is a latitudinal gradient of species richness in coprophilous fungi, with 94-

108 species expected from 50 samples from latitudes 60-55°N, compared to 123 from 50-40°N/S and 151-153 from 40-0°N/S. These figures were derived from data sets which only included *Coprinus* species from the basidiomycetes, so the three non-*Coprinus* basidiomycetes recorded from the Icelandic samples were excluded from the calculations to ensure comparability.

In terms of community structure it is interesting that many normally infrequent species occurred on a relatively high proportion of the total collection - much higher than I have observed in other collections. For example *Arnium caballinum* occurred on 28% of the Icelandic samples (compared to 0.6% from 623 samples collected previously from other localities world-wide), *Delitschia perpusilla* 22% (cf. 1%), *Hypocopra parvula* and *Sporormiella pulchella* both 9% (cf. 1%), *Ascobolus hawaiiensis* 22% (cf. 4%), *Thelebolus microsporus* 25% (cf. 5%), *Ascobolus stictoideus* 22% (cf. 7%). The reasons for this are not clear. It may be that these species are the best adapted survivors and competitors amongst the fungi introduced with what was presumably a relatively small initial introduction of domestic animals to Iceland when it was first colonised and that, being a relatively remote island, the initial colonisers of the habitat have spread to occupy the niche in the absence of additional external inoculum pressure. It is, however, unlikely that so many 'rare' species would be associated with the early introductions, so a more likely explanation may simply be that the Icelandic environment is more suitable for them than other areas of the world from which my collections have been made.

RECORDS

Notes on species, and the sample numbers on which they were recorded, are given below. Dried material (M) and/or slides (S) have been deposited in the Herbarium of the Icelandic Institute of Natural History in Akureyri (AMNH). Earlier records are noted, and in the absence of any note it may be that the fungus is newly recorded from Iceland.

Abbreviations:-

NM 1 or NM 2 = recorded for Iceland in Nordic Macromycetes, vol. 1 & vol. 2, respectively (HANSEN & KNUDSEN 2000, 1992).

H & E = Checklist of Icelandic Fungi, HALLGRÍMSSON & EYJÓLFSDÓTTIR (2004), including records from AAS (pers. comm. to Helgi Hallgrímsson 15.12.1993, of fungi identified from a foray of the Extra Nordic Mycological Congress, 4-7th of August 1993) as (Aas).

Zygomycetes

Pilaira anomala (Ces.) Schroet.
MJR 45, 53/02. H & E.

Pilobolus crystallinus (F.H.Wigg.) Tode
MJR 22, 29, 41, 43, 45, 46, 49, 53/02. H & E.

Pilobolus kleinii Tiegh.
MJR 53/02. Recorded in LARSEN (1932). H & E.

Ascomycotina

Pezizales

Ascobolus albidus P. Crouan & H. Crouan
One of the commonest *Ascobolus* species worldwide, and one of the most frequent coprophils in the Icelandic samples, occurring on eight samples.

MJR 22, 27, 40, 41, 46, 48, 49, 53(M,S)/02. Recorded in LARSEN (1932, as *Ascobolus glaber*), and van BRUMMELEN (1967). H & E, NM 1.

Ascobolus brantophilus Dissing
This was described by DISSING (1989) from a large number of collections of goose dung from Canada, Greenland and Norway. As far as I know, there have been no other records, so it is interesting, if perhaps predictable, that it occurs in Iceland. Apothecia are pure white at first, discolouring brownish as they mature, 0.5-1.5 mm diam. Asci cylindrical, 210-380 x 22-29 µm. Spores ellipsoid, 1-2 seriate, clear purple, with a smooth exospore broken by a few distant cracks, 19-20 x 9.5-10 µm [21.5-23.3 x 9.9-11.2 µm in DISSING (1989)]. Paraphyses hyaline, with no coloured contents.

MJR 48, 50(M,S)/02. Strangely not included in the *Ascobolus* spp. treated in NM 1, since DISSING (1989) included observations on material from Norway when he described the species .

Ascobolus hawaiiensis Brumm.
When VAN BRUMMELEN (1967) described this species he noted that it was apparently very rare, but it has subsequently been recorded from New Zealand (BELL 1983), Spain (VALLDOSERA & GUARRO 1985), Pakistan (van BRUMMELEN 1990), various Central Asian and Transcaucasian states of the old USSR (PROKHOROV & RAITVIIR 1991) and Scotland (RICHARDSON 1998). Since then, I have also recorded it on material collected from France, Greece, Australia, Chile and the Falkland Islands, and now from Iceland, to make a total of 32 records from over 650 samples and 6250 records. Clearly, while it is not a common species, it can be considered to be cosmopolitan in its distribution. Most of the material I have seen has spores which are slightly smaller than those described

by van BRUMMELEN (1967), but otherwise the apothecial characters, spore ornamentation and complete gel are all characteristic of the species. The apothecia are hyaline, very small, often only about 200 µm diam, and so easily overlooked, which may partly explain its apparent rarity.

MJR 23, 25, 27(M), 29, 32, 46, 48/02. *A. hawaiiensis* is in NM 1 as 'poorly known, doubtful or so similar to [*A. immersus*] that it is not keyed out'. This is a general definition for that type of entry, and in this case *A. immersus* is distinctly different from *A. hawaiiensis*. No occurrence in Iceland is cited, so these records are possibly the first for that country, where it seems to be quite frequent.

Ascobolus immersus Pers.

One of the commonest and most striking *Ascobolus* spp., with its large and clear purple spores. Some of the spores in 40/02 were smaller than typical and almost spherical (39 x 32 µm), a character originally considered to warrant separation as *A. globularis* Rolland, but occurrence within the same apothecium of asci with semiglobose and typical ellipsoid spores, 48-65 x 32-35 µm, indicates that the separation is not warranted.

MJR 22, 25, 27, 29, 40/02. Recorded in LARSEN (1932), and by van BRUMMELEN (1967) and LAUBE (1971). H & E, NM 1.

Ascobolus stictoideus Speg.

Van BRUMMELEN (1967) observed that this appears to be a cosmopolitan species, and my observations confirm this, with 52 records from the Falkland Islands in the southern hemisphere to Iceland in the north. The records are from a wide range of substrates, but by far the highest proportion is from goose droppings, with it occurring on 7 out of the 19 samples studied. If the occurrence of *A. degluptus* Brumm., which is closely related if not synonymous, is considered, the frequency rises to 60% on goose dung.

MJR 22, 27, 42, 45, 46(M), 49, 50/02. This is another species included in NM 1 as 'poorly known, doubtful or so similar to [*A. immersus*] that it is not keyed out', but again it is very distinct from *A. immersus*. *Ascobolus elegans* is recorded for Iceland by H & E (Aas), and it is possible that this is a misidentification for *A. stictoideus*. *A. stictoideus* is not recorded for Iceland in NM 1, but *A. degluptus* is, and the spores illustrated in NM 1 as being of *A. stictoideus* appear to be those of *A. degluptus*. A further puzzle in NM 1 is that *A. degluptus* is included as an additional species in the *A. albidus* entry, which has a lined rather than verrucose exospore pattern. These records would appear to be the first of *A. stictoideus* identified as such from Iceland. BOOTH (1982) recorded it on snow goose dung collected from Devon Island, north east of Greenland at 75-76°N.

Coprotus sexdecimsporus (P.Crouan & H.Crouan) Kimbr. & Korf

This white apothecial 16-spored species, with asci 95-110 x 24-26 µm and hyaline ellipsoid spores 11.5-13 x 6.5-8 µm is quite distinctive. It tends to appear rather late in the incubation sequence (RICHARDSON 2002), and in these two samples was not observed until after 62 & 32 d incubation, respectively.

MJR 43(M,S), 46(M)/02. Apparently a new record for Iceland.

Coprotus sp.
Until there is a modern and comprehensive treatment of *Coprotus* and related fungi the identification of many species with 8-spored asci presents difficulty. These collections had white discoid apothecia, up to 500 µm diam, slightly conical with a short stalk, and with irregularly polygonal excipular cells 10-15 µm diam. Asci ± cylindrical, 90-105 x 16-20 µm. Spores biseriate, ellipsoid, hyaline, 10.2-11.5 x 6.5-7 µm. Paraphyses 1.5-3 µm wide, not enlarged at the apex but distinctly uncinate. This material does not fit comfortably with other white apothecial species, e.g. *C. lacteus* (which has smaller spores, shorter asci and slightly inflated paraphyses), *C. disculus* (has ± uniseriate spores and so narrower asci, and capitate paraphyses), or *C. leucopocillum* (has larger spores, paraphyses only slightly uncinate but enlarged to 3-4.5 µm at apex).

MJR 27(M,S), 46/02. AAS (1983) describes 7 species from Norway and NM 1 gives details of nine in Nordic countries, but none for Iceland. *C. aurora*, *C. granuliformis* and *C. lacteus* are recorded in H & E.

Iodophanus carneus (Pers.) Korf
This is a relatively frequent apothecial coprophil, and the anamorphic *Oedocephalum* state was observed on a few of the samples, but apothecia only developed on one.

MJR 43/02. H & E, NM 1.

Lasiobolus ciliatus (J.C. Schmidt: Fr.) Boud.
Apothecial setae up to 210 µm long, thin-walled and inflated at the base, and with horizontally elongated excipular cells. Asci cylindrical, 19-25 µm diam. Spores uniseriate, later partially biseriate, 22-24 x 11-13.5 µm. The identification of the *Lasiobolus* spp. is based largely on the monographic treatment by BEZERRA & KIMBROUGH (1975).

MJR 40(S)/02. H & E, NM 1, as *L. papillatus* (Pers.: Fr.) Sacc.

Lasiobolus cuniculi Velen.
Asci broad clavate, 28-38 µm diam. Spores biseriate, 20-24 x 12.5-15 µm.

MJR 23-25, 27, 45, 49, 51/02. H & E, NM 1.

Lasiobolus diversisporus (Fuckel) Sacc.
Asci broad clavate, 30-35 µm diam. Spores biseriate, 29-30.5 x 12.8-13.8 µm.

MJR 49/02. H & E, NM 1.

Lasiobolus intermedius J.L. Bezerra & Kimbr.
Asci cylindrical, <18 µm diam. Spores uniseriate, 17.5-19.5 x 9.5-11.5 µm.

MJR 35, 53(S)/02. H & E.

Lasiobolus lasioboloides Marchal
Asci broad clavate, 32-35 µm diam. Spores biseriate, 16-18 x 11-11.5 µm.

MJR 32/02. Newly recorded for Iceland.

Orbicula parietina (Schrad.) S.J. Hughes
This striking fungus is described as widespread, but not necessarily on dung. I have only seen it once before, on squirrel dung collected in Edinburgh in March 1998 (MJR 14/98). Its occurrence in Iceland, and late winter/early spring in Edinburgh, supports suggestions by others (e.g. CAMPBELL, RODGERS & MURRAY 1991) that it is psychrophilic.

MJR 48(M)/02. Newly recorded in Iceland

Peziza vesiculosa Bull.: Fr.
Apothecia slightly distorted, the largest 1.3 cm diam, with pale scurfy excipulum. Asci 320 x 18 µm, with 8 uniseriate, hyaline, smooth ellipsoid spores 19.3-21 x 10-11.2 µm. Paraphyses septate, cylindrical, 4-5 µm diam, not capitate. Primordia also developed on 53/02, but did not progress beyond the stage of a large primordium; given that this material was from the same area as 51/02 it is likely that this also was *P. vesiculosa*, but it was not recorded as such.

MJR 51(M)/02**.** This is recorded for Iceland in H & E and NM 1, although not as fimicolous.

Saccobolus depauperatus (Berk. & Broome) E.C. Hansen
MJR 38, 43, 48/02. This is apparently a new record for Iceland, so it has presumably been overlooked previously.

Saccobolus quadrisporus Massee & E.S. Salmon
This species is characteristically found on goose dung from high latitudes, so it is pleasing but not surprising to have found it on one of the five Icelandic goose dung samples incubated. DISSING (1987, 1989) collected from arctic regions and obtained numerous records of *S. quadrisporus* and related 4-spored species from Greenland, Norway and Arctic Canada, and BOOTH (1982) recorded it from goose dung from Churchill (59°N) and Devon Island (75°N) in NE Canada, but this may be the first record from Iceland. It was recorded by PROKHOROV & RAITVIIR (1991), also on goose dung, from Kolguyev Island in the Barents Sea, northern Russia (69°N), by DE SLOOVER (2002) from duck dung in Belgium, and I have two records of *S. quadrisporus* on goose dung from the Falkland Islands in the Southern Ocean (51-52°S).

MJR 48(M,S)/02. Again, as with *Ascobolus brantophilus*, this is not mentioned in NM 1, although DISSING (1987) records that it was recorded from Spitsbergen by ECKBLAD (1968).

Saccobolus versicolor (P.Karst.) P. Karst.
MJR 23, 24, 27, 46/02. This is apparently a new record for Iceland, so it has presumably been overlooked previously since, like *S. depauperatus*, it is a cosmopolitan and common species (VAN BRUMMELEN 1967).

Trichobolus sphaerosporus Kimbr.
Trichobolus sphaerosporus has setose apothecia ca 250 µm diam. The setae are not numerous, hyaline-yellowish, pointed, septate, in this material <300 µm long. Each apothecium is immersed, globose, filled by a single ascus containing a very large number of globose to subglobose hyaline spores 9-10 µm diam. *T. sphaerosporus* and the related *T. zukalii* (Heimerl) Kimbr., which has ellipsoid spores and longer setae, are usually associated with deer dung, but there are a few records from sheep and goat. They are infrequently recorded, but this may be due to their small size and ephemeral nature.

MJR 32/02. Recorded for Denmark and Norway in NM 1, but this appears to be the first record for Iceland.

Thelebolales

Thelebolus microsporus (Berk. & Broome) Kimbr.
Readily characterised by the small discoid apothecia, 170-250 µm diam, with short cylindrical 8-spored asci 60-70 x 10-11.5 µm, biseriate, ellipsoid, hyaline spores 6.5-8 x 3-4 µm, and paraphyses capitate to 5-6 µm diam, filled with yellowish green contents.

MJR 22, 25, 29, 36(M), 42, 43, 45, 49/02. H & E, NM 1.

Thelebolus stercoreus Tode
MJR 48/02. This is in NM 1 for Denmark, Norway, Finland and Sweden, but appears to be a new record for Iceland.

***Thelebolus* spp.**
Apothecia with 8, 32 and 64-spored asci, but otherwise very similar, were found on 6 samples. All were crowded, less than 200 µm diam, polyascal, pale but with light brown margins. The 8-spored material (on 25, 35 and 40/02) had cylindrical to clavate asci 50-65 x 11-13 µm, with hyaline ellipsoid biseriate spores, 6-10 x 3-5 µm. It is noted in NM 1 that, apart from *T. microsporus*, there are two or three other 8-spored taxa without names. The 32-spored material (33/02) had more rounded asci, 50 x 16 µm, like those of *T. nanus* and *T. polysporus*, with ellipsoid hyaline spores 8 x 4 µm, and is possibly *T. caninus*, which is recorded for Iceland in NM 1. The third species (on 33, 45 and 48/02) had longer sausage-shaped asci 60-85 x 22-30 µm, and spores 6-8 x 3-4 µm, and is possibly *T. crustaceus*. These last two species are both listed in H & E and NM1 for Iceland. KIMBROUGH & KORF (1967) noted that 'species delimitation within this genus is very confusing' and 'a number of findings complicate the species concept', and quote KARSTEN'S (1871) conclusion that there are 8-spored forms associated with multispored species, which he designated as varieties. They concluded that 'considerable developmental and taxonomic work is needed in the group', and that there is 'repeated association of forms with different spore numbers and a great overlapping of characters in the existing, described

species'. Unfortunately, in the 35 years since they made that statement, there has been little progress in monographing this difficult group at species level.

Sordariales

Arnium caballinum N. Lundqv.
Arnium spp. are distinguished from *Podospora* spp. by, among other characters, the absence of a primary appendage and the possession of two more or less equal caudae. LUNDQVIST (1972) described *A. caballinum* as having asymmetrical spores. I see them as ellipsoid, but with asymmetrical insertion of the caudae, with the mature spore body in the Icelandic collections 29-38.5 x 17.5-20 µm. Perithecia covered with flexuous hairs, some with short perpendicular blunt hairs at the neck, and with plaques of dark papillate cells on the upper part.

MJR 25, 27, 32(M), 42, 46, 47, 49(M), 51(M), 53/02. H & E.

Arnium hirtum (E.C. Hansen) N. Lundqv. & Krug
Perithecia semi-immersed, up to 800 µm high x 500 µm diam, covered below with dark flexuous hairs, some quite long and straggly and aggregating into strands, and with shorter perpendicular blunt hairs at the neck, up to 70 µm long. Asci 8-spored, long-stalked, ca 270-290 x 30 µm overall, blunt headed and with no apical structure. Spores ellipsoid, 37-38.5 x 22-22.5 µm with a cauda at each end, quite short when spores are first liberated, ca 25-30 µm long, tapering, and swelling in water and becoming difficult to see. LUNDQVIST (1972) notes that this species requires a fairly long time to develop on its substrate – at least one month, and still in good condition after three. In this material immature perithecia were first seen after 12 weeks incubation and mature spores a week later.

MJR 27, 33(M,S)/02. H & E.

Coniochaeta leucoplaca (Berk. & Ravenel) Cain
MJR 25, 30, 45, 52/02. H & E.

Coniochaeta ligniaria (Grev.) Massee
MJR 27, 28, 30-35, 40, 42, 45, 48/02. H & E, as *C. vagans*.

Coniochaeta saccardoi (Marchal) Cain
MJR 23, 25, 40, 53/02. H & E.

Coniochaeta scatigena (Berk. & Broome) Cain
MJR 27, 33, 42, 45, 47, 51/02. Recorded by LUNDQVIST (1981). H & E.

Podospora decipiens (G. Winter ex Fuckel) Niessl
One of the commoner *Podospora* species, especially on dung of cattle and other domesticated animals in temperate regions. *P. argentinensis* is a less frequent species with smaller spores [23-34 x 12-20 µm], and has been recorded from Iceland by LAUBE (1971, in H & E), but all the Icelandic material was well within

the range of *P. decipiens*, with spores 32-42 x 17.5-22.5 µm; some spores had very long primary appendages, up to 70 µm long.

MJR 22-24, 25(S), 29, 32, 33, 35, 42, 43, 45, 46(M), 47, 49, 51, 53/02. Recorded in LARSEN (1932, as *Sordaria decipiens*), and LUNDQVIST (1972). H & E.

Podospora setosa (Wint.) Niessl
This material agrees well with LUNDQVIST'S (1972) strict interpretation of the species, with 128-spored clavate asci, spores 17.5-19.5 x 10-11.5 µm, and the perithecial neck with uniformly distributed non-aggregated, non-inflated setae, dark at the base, becoming paler towards the blunt apex, up to 480 µm long. It is widespread, but not particularly common; LUNDQVIST (1972) examined material from Sweden and Denmark, other European countries and Canada and the USA, and noted records from Norway, Africa and Indonesia. I have 20 records from the UK, France, Morocco, Dominica, USA, Australia, St Helena and the Falkland Islands.

MJR 44(M), 45/02. Not previously recorded from Iceland.

Schizothecium cervinum (Cain) N. Lundqv.
MJR 38, 53/02. Not previously recorded for Iceland.

Schizothecium conicum (Fuckel) N. Lundqv.
MJR 22, 25, 29, 41-43, 45, 46, 49, 51, 53(M)/02. Recorded in LARSEN (1932, as *Sordaria curvula*), and by LUNDQVIST (1997). H & E.

Schizothecium* aff. *dakotense (Griff.) N. Lundqv.
S. dakotense is characterised by its 32-spored asci, and perithecia with the typical *Schizothecium*-type of scales at the neck composed of inflated cells. Perithecia of this material had these scales, but also setae composed of non-aggregated, non-inflated setae, dark at the base, becoming paler towards the apex. The number of spores in the asci were variable, from more than 8, mostly around 16, and some with more than 16, suggesting that the full complement might be 32 spores.

MJR 42(S)/02. Newly recorded for Iceland.

Schizothecium dubium (Hansen) N. Lundqv.
Characterised by 16-spored asci, with biseriate spores 29-32 x 17.5 µm.

MJR 40(S)/02. This appears to be a new record from Iceland; it is uncommon but widespread elsewhere. I have two records, from Colorado, USA and Chile, and it is recorded from Denmark, Sweden, northern Norway, other European countries, and Canada by LUNDQVIST (1972), and from USA and Pakistan by MIRZA & CAIN (1969).

Schizothecium* cf. *squamulosum (P. Crouan & H. Crouan) N.Lundqv.
This was only observed on one occasion, but agreed with the description in LUNDQVIST (1972), having very small and poorly developed scales and spores 26-29 x 16-17 µm.

MJR 23/02. Newly recorded for Iceland.

Schizothecium vesticola (Berk. & Broome) N. Lundqv.
One of the commonest coprophilous pyrenomycetes. Material on 53/02 was characteristic of *S. vesticola* in all respects, but spores were larger than normal, 22.5-25.5 x 12.8-13 µm, and may be nearer to *S. miniglutinans*, but not enough material was present to investigate this possibility.

MJR 22-25, 27, 29, 32-36, 40, 43, 46-48, 51, 53/02. Recorded in LARSEN (1932, as *Sordaria minuta*), and by LUNDQVIST (1997). H & E.

Sordaria baltica N. Lundqv.
This material agreed well with Lundqvist's (1972) description, particularly in the relatively narrow nature of the spores, with a width of less than half the length (25.5-27.5 x 12.5-13 µm), a broad gel invaginated at the basal germ pore, and the outer peridial wall composed of angular to rounded cells up to 16 µm wide. The holotype is from Sweden, and it has also been reported from Denmark, Norway and Czechoslovakia, and from Iceland (LUNDQVIST 1972).

MJR 40(S)/02. Recorded in LARSEN (1932, as *Hypocopra fimicola*, from about 120 km NW of the site where this material was collected), and LUNDQVIST (1972). H & E.

Sordaria fimicola (Rob.) Ces. & DeNot.
MJR 40/02. H & E.

Sordaria humana (Fuckel) G.Winter
MJR 42/02. H & E.

Sordaria minima Sacc. & Speg.
This is *S. minima ss*. LARSEN (1971) and RICHARDSON (1998), with tiny schizothecioid perithecia *ca* 160 µm high x 100-150 µm diam, with dark uniseriate ellipsoid spores 5.5-6 x 3 µm with an apical germ pore, but no gelatinous sheath. Asci cylindrical, *ca* 60 x 5 µm, with no apical apparatus. This would appear to be a rare, or overlooked, fungus, but it has been recorded from Denmark and the UK, including Fair Isle (DENNIS 1972).

MJR 25(S)/02. *Sordaria minima* was recorded for Iceland by ROSTRUP (1903, as *Hypocopra minima*), but this schizothecioid fungus is nothing like a *Hypocopra* as now understood, and it may be that the earlier Icelandic record refers to a different fungus. H & E.

***Strattonia* sp.**
LUNDQVIST (1972) describes 5 species of *Strattonia*, and three have since been described. This material matches none of them. It is morphologically very similar to *S. insignis*, as described by LUNDQVIST (1972), apart from the spore size which, from both perithecia studied, is much smaller than the 48-54 x 24-29 µm given for *S. insignis*. Perithecia superficial, but hidden beneath a densely felty-grey tomentum, up to 1000 µm high x 400 µm diam. Asci cylindrical above, with a long tapering stalk, overall ca 350-400 x 15-16 µm (small spored specimen) or x 32 µm (large spored sample), 8-spored. Ascus apex with a sordarioid pore, blue

in KI and faintly blue in lactophenol cotton blue. Spores obliquely uniseriate, ellipsoid, dark, 24-27 x 12.8-13.5 µm (small spored specimen) and 38-42 x 19.5-22.5 µm (large spored sample), with a hyaline, basal, ± cylindrical pedicel ca 3 x 2.5 µm (small spored) and 5 x 3 µm (large spored), and an apical germ pore. Spores surrounded by a marked and wide gelatinous sheath. Apart from the similarity to *S. insignis*, with the exception of spore size, *S. mesopotamica* Abdullah and *S. karachiensis* S. I. Ahmed & Asad, both treated by ABDULLAH (1983) were considered as possible identities. Both have spores which are of similar length (18.5-28 µm and 20-28 µm) to the smaller-spored Icelandic specimen, but wider (13-17 µm and 14-18 µm). *S. mesopotamica* is described as being only sparingly covered with hairs, and with distinct apical and basal gelatinous appendages, and *S. karachiensis* has much shorter but broader asci (137-180 x 30-35 µm), with a short stalk and biseriate spores. The marked difference in mature spore size observed from two perithecia, sampled on different dates from the same piece of dung, with no great within-perithecial variation, is strange. It is not unusual to find more than one species of the same genus developing on one dung collection but, with *Strattonia* not at all common (I have only recorded it once before), the probability of finding two new species on one piece of dung, differing only in the size of the spores from *S. insignis*, would be very low, so meantime I treat these as two aberrant forms of one species, possibly *S. insignis*.

Xylariales

Hypocopra* cf. *brefeldii (Zopf) Chenant

Perithecia solitary or in small groups, in a limited stroma, with a pale fringe around the ostioles. Ascus plug compound, as if composed of 2-3 concave discs on top of each other, deep blue in KI, then duller brown, 7-8 µm diam x 7-10 µm long. Spores uniseriate, slightly asymmetrical, less curved on one side than the other in some views, ellipsoid, 26-32 x 12.8-14.5 µm, and, in some very young spores, a birefractive hint of a basal cell, which was not seen in mature spores. Germ slit 16-18 µm long, difficult to see in mature, discharged spores. *H. annulata* Krug & Cain (KRUG & CAIN 1974) is very similar, with slightly longer but relatively narrower spores than *H. brefeldii*, according to KRUG & CAIN (1974), but the differences seem to be very slight when other descriptions of *H. brefeldii* are taken into account. KRUG & CAIN (1974) emphasise the blue to brown colour change of the ascus pore in KI as being diagnostic, together with solitary perithecia. The Icelandic material agrees well with LUNDQVIST'S description of *H. brefeldii* in NM 1, which allows for polyperithecial stroma and larger spores (24-32 x 12-16 µm), as against KRUG & CAIN'S (1974) values of 21-27 x 12-14 µm. On balance, I think this material is nearer to *H. brefeldii*.

MJR 45(M)/02. NM 1 records *H. brefeldii* for Denmark and Sweden, and *H. annulata* as one of the species not included in the key but known in the Nordic countries. This may be a new record for Iceland.

Hypocopra ornithophila Speg.
Perithecia solitary, in a limited stroma. Ascus plug blue in KI, relatively simple in structure, slightly tapered towards the base, 7-8 µm diam x 5 µm long. Spores uniseriate, slightly asymmetrical, pointed ellipsoid, 22.5-29 x 11.5-13.5 µm, and a germ slit extending for the whole length of the spore, and no sign of the small basal cell which is seen, sometimes with difficulty, in some species. This material agreed well with the characters for *H. ornithophila* given by KRUG & CAIN (1974), especially in respect of the spore size [22-29 x 11-14 µm], full length germ slit and no basal cell.

MJR 31(M), 34(M,S)/02. NM 1 keys 4 *Hypocopra* spp., and lists a further ten as occurring in the Nordic countries, of which *H. hornithophila* [sic] is one. This may be a new record for Iceland.

Hypocopra parvula Griff.
This *Hypocopra* is distinguished by the smallest spores known in the genus so far, in this material 10.3-11.6 x 5.5-6 µm. They are obliquely uniseriate in the ascus and slightly flattened on one side, with a germ slit along the centre of the flatter side of the spore, extending almost to the ends. Stroma are single or in small groups, partially immersed, each with a single globose perithecium, so the non-immersed portion is hemispherical, *ca* 400-500 µm diam. Apart from the ostiolar region, which appears black, the stroma is covered with a 'frosting' of white to grey hyphae. The ostiole is small, but distinct, 10-15 µm diam., with a fringe of dark brown cells elongated to 10 µm directed into the lumen, and surrounded by a very dark opaque zone about 25 µm wide It is not common, but widespread, at least in north temperate regions. I have eight other records (5 from Scotland [including 2 from sheep from St Kilda, an island group in the Atlantic about 1000 km SE of Iceland, collected in September 1967], and one each from the Scilly Isles [UK], southern France and Bryce Canyon NP, Utah, USA.

MJR 23(S), 24(M,S), 25(M,S)/02.

J. Krug (pers. comm.) has said that this material is probably not *H. parvula*, but a new species still to be described, which has been recorded from USA, Canada, Europe (Iceland, Austria, UK, Belgium, Netherlands, Switzerland, Norway, Sweden, Hungary, Germany and Bulgaria) and China, and from dung of sheep, horse, cattle, rabbit, chamois and various deer. The Icelandic material of the new species that Krug has examined is from three collections made by Lundqvist in July 1971. It is clear, therefore, that either *Hypocopra parvula* or a *Hypocopra parvula*-like fungus is known from Iceland. From descriptions kindly provided by J. Krug (pers. comm.) the two species are very close. One of the main differences between them would seem to be the overall length of the asci and the length of the stalk as described by KRUG (*in litt.*) (*H. parvula* - ascus, 125-

200 µm, stalk 30-80 µm; undescribed species - ascus, 100-120 µm, stalk 25-30 µm). The original description of *H. parvula* (GRIFFITHS 1905), however, gives the asci as 95-105 µm long, with a 'long crooked stipe'. Asci and stalks of the Icelandic material reported here were 120-170 µm and 39-77 µm, respectively (coll. 24/02, *n* = 20) and 115-145 µm and 30-67 µm (coll. 25/02, *n* = 5), with overall mean lengths of 140 µm and 54 µm for asci and stalks. The French material (MJR 12/03) had asci 106-138 µm long, with stalks 32-48µm. I have no material of the St Kildan collection referred to above, but I recorded total ascus length '*ca* 150 µm, fertile portion 80 µm long', so giving a stalk of *ca* 70 µm, and a *camera lucida* drawing shows an ascus 130 µm long with a stalk 50 µm., and I am confident that this is the same species as the Icelandic one. KRUG (*in litt.* to R. Watling, 4 November 1971) commented that 'the St Kildan …. collection …. belongs to a species which ….. we will describe', and this is the same species referred to in the personal communication from J. Krug cited above. Since the asci are readily observed and measured, and there appears to be some variation in their size, both in different collections (Table 2) and in the interpretation of *H. parvula* (e.g. 95-105 µm from the original description and 125-200 µm *ss*. Krug), and the differences in the other features which distinguish the two species are more subtle, I prefer to record the Icelandic material and my other collections as *H. parvula* until a proper comparison can be made.

Other material examined: **UK**. Sheep dung: Hirta, St Kilda, Scotland (57.8°N; 8.6°W), 9.1967, coll. MJR; Redpoint, Gairloch, Scotland (57.65°N; 5.8°W), 15.6.97 (MJR 56/97 (**E**)); Clover Law, Broughton, Scotland (55.63°N; 3.4°W), 20.9.98 (MJR 74/98 (**E**)); Rabbit dung: Gullane, Scotland (56.04°N; 2.83°W), 11.6.96 (MJR 6/96); Tresco, Scilly Isles, England (49.95°N; 6.33°W), 17.5.00, coll. R. Watling (MJR 20/00); **FRANCE**. Horse dung, la Frau Haute, Terroles, Aude (42.97°N; 2.36°E) (MJR 12/03); **USA.** Mule deer dung: Bryce Canyon NP, Utah (37.6°N; 112.21°W), 12.9.01 (MJR 65/01).

Hypocreales

Melanospora brevirostris (Fuckel) Höhnel

This fungus is parasitic on other fungi, especially ascomycetes, and is occasionally recorded on dung. On two of the samples perithecia were associated with orange stromata which looked like immature *Selinia stromata*, but no perithecia developed to confirm that they were *Selinia*.

MJR 33, 34(M), 41/02. Newly recorded for Iceland.

Selinia pulchra (G. Winter) Sacc.

Only old stroma were present, but the characteristic orange stromatic surface and typical *S. pulchra* ascospores, 45-51 x 21-25 µm, were sufficient to be in no doubt about its identity. *S. pulchra* appears to be uncommon but widespread. I have nine earlier records from Australia, Brazil and the Falkland Islands in the southern hemisphere, Dominica and Puerto Rico in the tropics, and France and the UK in the northern hemisphere.

MJR 25(M)/02. Recorded for Denmark, Sweden and Finland in NM 1, but this appears to be new to Iceland.

Pseudeurotiaceae

Pseudeurotium ovale Stolk
MJR 44(M)/02. Recorded from Iceland by Laube (1971) on grass, wood chips and decaying algae, but not on dung.

Dothideales

Delitschia perpusilla. Speg.
A small-spored *Delitschia*, with spores 9.5-10 x 4-5 µm, hardly constricted at the septum. Pseudothecia semi-immersed, up to 600 µm diam, with prominent necks 330-400 µm long x 130-140 µm diam. Originally described from Argentina, *D. per*pusilla seems to be infrequent but widespread. It was initially described from Argentina, LUCK-ALLEN & CAIN (1972) studied material from Canada, Mexico and Germany, and I have records from Scotland (RICHARDSON 1998), France, USA and Australia.

MJR 23, 24(S), 25(S), 38(M), 41(M,S), 43, 46/02. This is newly recorded for Iceland.

Sporormiella australis (Speg.) S.I. Ahmed & Cain
A widespread species morphologically similar to the more frequent *Sp. intermedia*, but with smaller spores, (34-) 41-48 x 8-9.5 µm. See comment under *Sp. intermedia* below.

MJR 27, 28, 34, 41(S)/02. H & E.

Sporormiella cymatomera S.I. Ahmed & Cain
Rather like *Sp. leporina*, but with the two central cells of the spore characteristically shorter than the clearly tapered terminal cells, overall 24-32 x 5.5-9 µm in these two collections.

MJR 30, 35/02. This would appear to be new to Iceland.

Sporormiella grandispora (Speg.) S.I. Ahmed & Cain
As with the *Sp. australis/intermedia* species pair, there seems to be some overlap between *Sp. grandispora* and *Sp. megalospora*. BELL (personal communication) sets the boundaries for *Sp. grandispora* as <56 x 13 µm, and >70 x 15 µm for *Sp. megalospora*. AHMED & CAIN'S (1972) boundaries are <60 x 14 µm for *Sp. grandispora* and >65 x 15 µm for *Sp. megalospora*. The latter authors distinguish the shallow septation, and tendency of component cells of *Sp. grandispora* not to separate, compared to the deep septation and ready disarticulation of *Sp. megalospora* spores. In the eight collections studied there was much inter- as well as intra-pseudothecial variation especially in respect of spore length and the tendency of the spores to be deeply or shallowly constricted at the septa. Exami-

nation of spores discharged onto the moist substrate showed that they tended to be larger and more deeply constricted, or even disarticulated, so the variation may be just a reflection on the state of their final maturity. Icelandic collections with shorter, narrower spores, (38.5-)45-67(-71) x (8-)11.5-16 µm, were considered to be *Sp. grandispora*. See also comments below under *Sp. megalospora*.

MJR 23, 27, 29, 33, 35, 42, 46, 47, 49, 51/02. This would appear to be new to Iceland.

Sporormiella intermedia (Auersw.) S.I. Ahmed & Cain
This is one of the commonest *Sporormiella* species worldwide. Within the genus there seems to be a lot of interspecific variation, and many species are described with subtle differences of morphology, especially of germ slit orientation and spore size. In many cases there seems to be overlap at the boundary between species which can make determination at the species level difficult on some occasions. In the case of *Sp. intermedia/australis* they both have characteristically short, abruptly stalked asci and 4-celled spores with non-tapering, rounded terminal cells. Those determined as *Sp. intermedia* in these collections have spores which are generally more robust, 48-58 x 9-11.5 µm, compared to the smaller, but similarly shaped spores of *Sp. australis* (41-48 x 8-9.5 µm).

MJR 23-25, 27, 32, 34, 35, 37, 43, 48, 49, 51/02. H & E.

Sporormiella isomera S.I. Ahmed & Cain
Asci 190-200 x 16-19 µm. Spores 4-celled, almost cylindrical, 41-45 x 7 µm, with each individual cell almost ellipsoid. The ascus and spore size are somewhat larger than described by AHMED & CAIN, and by KHAN & CAIN (1979), but in other respects the Icelandic material fitted Sp. isomera better than any other possible determinations.

MJR 40(S)/02. Not previously recorded in Iceland.

Sporormiella leporina (Niessl) S.I. Ahmed & Cain
Asci with tapered base, 125-180 x 15-16 µm. Four-celled spores with a tapered distal cell, 27.5-41.5 x 6-7.5 µm.

MJR 26, 34, 53/02. This would appear to be new to Iceland.

Sporormiella megalospora (Auersw.) S.I. Ahmed & Cain
A relatively large spored species, with tapering asci and 4-celled spores, with a tendency for the apical cells to be tapered, and with deep constrictions at the septa between cells. Spores 61-90 x 14.5-21 µm. Icelandic collections with large, wide spores were considered to be Sp. megalospora. See also comments above under Sp. grandispora.

MJR 24, 25(S), 32, 33, 35(S)/02. This would appear to be new to Iceland.

Sporormiella octomera (Auersw.) S.I. Ahmed & Cain
As indicated by the specific name, a species with 8-celled spores, all with the third cell from the ascus tip the largest. The three Icelandic collections had

spores showing a wide range of size variation, from 42-55 x 6-8 µm (31/02) to 51-55 x 8-9 µm (52/02). The spore length of the former collection spans the range of spore length for *Sp. octomera* and *Sp. schadospora* S.I.Ahmed & Cain, whilst the latter agrees more with the description of *Sp. schadospora*. I have other collections with spores which span the size range of the two species as described, e.g. 43-55 x 9.5-10 µm (59/01), 39-54 x 7-9 µm (71/01) and I prefer to consider them all to be *Sp. octomera*, with *Sp. schadospora* as possibly synonymous.

MJR 30(S), 31(M), 52(S)/02. H & E.

Other material examined: USA. Deer dung, Cedar Grove, Kings Canyon National Park, Ca (36.80°N; 118.60°W), 7.9.01(MJR 59/01). Hare dung, Berthoud Pass, Arapaho National Forest, Co (39.80°N; 105.78°W), 17.9.01 (MJR 71/01). UK. Grouse dung, Errochty, Scotland (56.77°N; 4.08°W), 15.8.99 (MJR 31/99).

Sporormiella ovina (Desm.) S.I. Ahmed & Cain

Spores of this collection were 4-celled, 99-122 x 16-18 µm, with tapering end cells, one end cell tending to be longer than the other. Deeply constricted at the septa, and tending to disarticulate when mature. Germ slits slightly oblique to ± parallel. *Sp. ovina* is close to *Sp. borealis* (I.Egel.) S.I.Ahmed & Cain, but the latter is distinguished by EGELAND (1969) on the basis of the translucent nature of the pseudothecial neck and non-tapering terminal cells, and shallow constrictions at the septa. It was described from Europe and I have two other records, from Australia and France.

MJR 41(S)/02. This would appear to be new to Iceland.

Sporormiella polymera (Cain) S.I. Ahmed & Cain

This collection agrees well with Cain's (1957) description of *Sporormiella polymera*. He describes the pseudothecium as 'globose, black, immersed, 500-750 µm diam, surrounded by dark brownish-black mycelium, ...[with]... peridium thick, coriaceous', which compares with my description of this material as having very large, firm, almost hard-walled superficial pseudothecia embedded in a weft of grey mycelium. The pseudothecia from this material are ca 500 µm diam, smooth, superficial. Asci clavate, tapered to a foot, 210 x 20 µm [Cain: 180-250 x 18-27 µm]. Spores mostly 15-celled, 57-70 x 6 µm, with the seventh cell from the apex larger than the rest, all cells rounded, constricted at the septa, with some fragmented spores seen. A very few 14-celled spores were seen, slightly smaller at 55 µm long, and with the sixth cell enlarged [Cain: spores 14-15 celled, 63-83 x 10-11 µm, with the seventh cell from the upper end abruptly larger in 15-celled spores, the fifth and sixth in 14-celled spores]. Germ slits oblique. The main points of difference between the Icelandic collection and Cain's description of his type material is that his spores are somewhat wider (10-11 µm cf. 6 µm) than in the Icelandic collection, and Cain interprets the large seventh cell in 15-celled spores as a giant cell resulting from a failure of a final cell division to make what would otherwise be a 16-celled spore, and the enlarged fifth and sixth cells as a

similar failure to divide on the part of two cells. I did not observe two larger cells in the relatively few 14-celled spores seen.

MJR 37(S)/02. The material described by CAIN (1957) was from caribou dung from Quebec, so its occurrence in a subarctic area would not be surprising. I know of no other records, so this is probably new to Iceland.

Sporormiella pulchella (Hansen) S.I. Ahmed & Cain

This species is characterised by its small 4-celled uniseriate spores, 16-19 x 5-6 µm. It is infrequent, but widespread, and I have records from Australia, Morocco, USA, and St Helena, and AHMED & CAIN (1972) examined material from Canada, the USA, Mexico and Europe.

MJR 24, 25(S), 35/02. This would appear to be new to Iceland.

Sporormiella subtilis S.I. Ahmed & Cain

Asci 12-16 µm diam, tapering below to a stalk, but spores cylindrical with rounded end cells, 23-29 x 5-6 µm, readily fragmenting and germ slits mostly ± parallel to the long axis. AHMED & CAIN (1972) distinguish it from *Sp. dakotensis*, which has narrower spores (3-4.5 µm) and asci (9-11 µm), and from *Sp. leporina* which has longer spores (30-37 µm) and at least the upper end cell tapered.

MJR 25(S), 29, 35(S)/02. This would appear to be new to Iceland.

***Sporormiella* sp.**

I have been unable to identify this *Sporormiella* sp. growing on the Icelandic material with very large, tough, almost hard-walled pseudothecia. There are differences in details of spore size and shape of the two collections, but the pseudothecial habit was the same and they are treated here as one meantime. The pseudothecia are almost globose, superficial, but immersed in a dense mycelial weft, to the extent that there is no indication that it contains pseudothecia. They are 600-700 µm diam, hard-walled, and on splitting reveal white contents with few mature asci. Asci clavate, tapering to a stalk below, 300 x 36 µm. Spores mostly 8-celled, 70-90 x 11-13 µm in 48/02, 58-72 x 8-9.5 µm in 34/02. The individual cells of the spores are rounded and constricted at the septa, often giving a bead-like appearance to the spore. In 48/02 the component cells of the spore were rounded, with cell 3 or 4 from the apex slightly larger than the others, and the basal cell slightly longer. This sample also had some 7- and 9-celled spores; the former were 70-71 µm long, the latter 77-87 µm. One pseudothecium from 34/02 contained spores with cells which were ± isodiametrical, of similar size, giving the spore a bead-like appearance, while another had spores in which the upper cells were isodiametric or slightly shorter than wide, whilst the lower cells were slightly longer than wide. There may be two taxa here, given the wide range and almost non-overlap of spore size, but the similarity of pseudothecial structure and relative scarcity of mature spores and asci suggest some commonality. The only species coming near in AHMED & CAIN (1972) is *Sp. commutata*, which has been recorded from Iceland (H & E.) but its spores and asci are even smaller.

MJR 34(S), 48(M,S)/02. Possibly an undescribed species, and unrecorded from Iceland.

Trichodelitschia bisporula (P. Crouan & H. Crouan) N. Lundqv.
Spores 22.5-24.5 x 9.5 µm.

MJR 24(S), 25, 27, 30(S), 33, 35(S), 38, 42, 45(S), 47, 49, 51/02. H & E.

Trichodelitschia microspora Ebersohn & Eicker
Material with small spores, 13.5-16 x 4.5-5 µm, agrees well with the description by EBERSOHN & EICKER (1992) of *T. microspora* from giraffe dung collected in South Africa in 1984. Other features which may distinguish this from other, larger spored species, are the tendency for the individual cells of the spores to be truncate-triangular rather than hemi-ellipsoid, the slightly papillate germ pores, and the randomly radiate nature of the setae. In other species the cervical setae appear as if they radiate from a common point. Pseudothecia of this material were relatively slim, ca 160 µm diam x 500 µm high, and setae were up to 130 µm long. These pseudothecial and setal measurements are a little larger than those given for the type material. I have a record of this species from Scotland, which was very similar, with setae up to 130 µm long, unshot asci 110-120 x 9-10 µm, and spores 13-14 x 5 µm. Note that although EBERSOHN & EICKER'S (1992) type description refers to 'Figures 1-4', the legend to those figures refers to T. sweniensis. Since the type locality is given as 'along the Sweni River' it is assumed that this reference to *T. sweniensis* is an error, and that this was possibly an earlier choice of name subsequently changed in the text but not for the figure. As far as I am aware, this is only the third record of T. microspora. Given the few sightings and the distance between the locality of the Icelandic material and that of the type collection (over 10000 km and 90 degrees of latitude) it would appear to be a cosmopolitan but rare species.

MJR 30(S)/02. Newly recorded in Iceland.

Other material examined: UK. Deer dung, Largmore, Scotland (55.12°N; 4.25°W), 2.11.98 (MJR 88/98).

Trichodelitschia munkii N. Lundqv.
Spores 17.5-19.5 x 6-8 µm.

MJR 30(S), 35, 47/02. H & E.

Basdidiomycotina

Coprinus cordisporus T. Gibbs
MJR 35, 46(M), 47/02. H & E, NM 2.

Coprinus* cf. *filamentifer Kühner
These collections, although slightly different from each other, both seemed nearest to *C. filamentifer* in most respects, with small basidiocarps, a thin greyish veil composed of thin walled, non-inflated narrow hyphae. In 29/02 basidia were 4-

spored, with spores 6.5-8 x 5 µm, which were, however, ellipsoid and not noticeably 'shouldered' as is usually the case in *C. filamentifer*. In 49/02 spores were smaller, slightly angular, with shoulders, 6.5 x 3.5 µm. Each was seen only once.

MJR 29, 49/02. *C. filamentifer* has not been recorded in Iceland.

Coprinus heptemerus M. Lange & A.H. Sm.
One of the most frequent *Coprinus* spp. on the Icelandic samples, characterised by the mixture of tapered setules and rufus-reddish sphaerocysts on the cap, and ellipsoid spores, 11-14 x 5.8-6.5 µm, with excentric germ pore.

MJR 22, 25, 29, 35, 36, 41-43, 45(M), 46, 51/02. This would appear to be new to Iceland.

Coprinus macrocephalus (Berk.) Berk.
Spores broad ellipsoid, 12.5-14.5 x 8-9 µm. An initial determination was *C. radiatus*, but that has narrower spores (6.5-7.5 µm). Although *C. radiatus* occurs more often on dung than *C. macrocephalus*, which is more often recorded from straw and manure, *C. macrocephalus* has been recorded on dung.

MJR 49(M)/02. *C. macrocephalus* is recorded by CHRISTENSEN (1941) for Iceland.

Coprinus miser P. Karst.
This *Coprinus* is common world-wide on a wide range of dung types. It is characterised by a completely smooth, orange pileus, and basidiospores which are elliptical in one view, angular-cordate in another, 7-10 x 7-9 x 5-6 µm. Two and 4-spored basidia occur.

MJR 22(M), 23-25, 32, 33, 35, 43, 45-49, 51, 53/02. H & E, NM 2.

Coprinus niveus (Pers.: Fr.) Fr.
Caps snow white, up to 15 mm diam, with dense and copious veil of spiky aggregations of sphaerocysts. Stipe without ring, 15 x 3 mm. Basidia 4-spored. Spores oddly shaped, quadrangular in some views, ellipsoid in others, with some spores invaginated on one side, and very variable in size, 9.5-14.5 x 8-11 µm. Apart from the irregular spores this agreed well with *C. niveus* as it is usually seen.

MJR 49/02. H & E, NM 2. It is common on dung in Iceland (Guðríður Gyða Eyjólfsdóttir, pers. comm.).

Coprinus pellucidus Karst.
Small, setulose caps (1-2 mm diam) and stipe. Cap setules < 25 µm long, those on the stipe < 30 µm, not capitate. No sphaerocysts or pleurocystidia. 4-spored basidia, spores ellipsoid, 9.5-10 x 4.8-5.2 µm. Two other samples produced single basidiocarps with many characters of *C. pellucidus*, e.g. small size, hyaline setules, no pleurocystidia and 4-spored basidia, but spores of both had slightly excentric germ pores, and one had spores larger than is normal for *C. pellucidus*. That on 36/02 was 3 mm diam, had similar sized spores, 9.5-11 x 5-5.2 µm. The

other collection, on 25/02 (M), had a cap 6 mm diam and spores 11-13 x 6 µm. The material was inadequate to reach a conclusion as to their identity.

MJR 40/02. This would appear to be new to Iceland.

Coprinus pseudoradiatus Kühner & Joss.

Like *C. radiatus* and *C. macrocephalus*, but with smaller spores, 8-9.5 x 4.5-5 µm.

MJR 53(M)/02. This would appear to be new to Iceland.

Coprinus stercoreus (Bull.) Fr.

This has been the most frequent *Coprinus* species recorded on the dung samples I have collected worldwide, so its occurrence on only two of the samples collected in Iceland was surprising.

MJR 29, 43/02. NM 2.

Panaeolus antillarum (Fr.) Dennis

MJR 40(M)/02. Det. R. Watling. This would appear to be new to Iceland.

Panaeolus semiovatus (Sow. ex Fr.) A. Pearson & Dennis

MJR 53(M)/02. H & E, NM 2 (as *P. fimiputris*).

Psilocybe subcoprophila (Britzelm.) Sacc.

MJR 27(M)/02. NM 2.

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