Additions to "Fungi Fimicoli Italici": An update on the occurrence of coprophilous Basidiomycetes and Ascomycetes in Italy with new records and descriptions.

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"Fungi Fimicoli Italici", the first monograph on coprophilous fungi from Italy, is regarded as the starting point of a survey on Basidiomycetes and Ascomycetes obligatorily or facultatively growing on any kind of dung. All fimicolous species recorded from Italy and described in that work or in subsequent author's papers are listed and their dung sources are mentioned. The occurrence on dung of different genera and species is reported in separate Tables, and their frequency on different types of excrements is discussed and compared with other parts of the world. An update on the families Gymnoascaceae, Microascaceae and Sporormiaceae, and keys to genera of Gymnoascaceae and Microascaceae, and to Italian species of *Gymnoascus s.l.* and *Sporormiella* with 8-celled ascospores are provided. *Chaetomidium fimeti*, *C. ancistrocladum*, *C. murorum*, *Gymnoascus dankaliensis*, *G. littoralis*, *G. ruber*, *Hypocopra equorum*, *Iodophanus difformis*, *Kernia cauquensis*, *Lophotrichus bartlettii*, *Orbicula parietina*, *Pithoascus intermedius*, and *Sporormiella affinis* are first described from Italy.

Key words – damp chambers – fimicolous fungi – frequency – keys – natural state – survey

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Introduction

"Fungi Fimicoli Italici" (Doveri 2004a) is the first monograph on Basidiomycetes and Ascomycetes living on faecal material in Italy, and one of few recent monographs worldwide on coprophilous fungi. I have stressed before (Doveri 2004a, 2010b) that this work has more than a regional significance and can be helpful to studies of these fungi in any part of the world, which so very easily spread through cattle freight. The finding, after my monograph, of several taxa new to Italy, developed either in the naural state or in damp chamber cultures, induced me to update the work with the introduction of new keys, descriptions of species, and an account on their ecology.

The present work must be regarded as complementary to the paper recently published in this journal (Doveri 2010b).

Methods

Dung samples of the following animals were collected intermittently from January 1992 to December 2010 and usually incubated in non-sterile damp chambers.

The design of the damp chambers, the examination of the incubating dung samples, and the description of macroscopic features of species appearing on incubated dung or detected in the field, follows those suggested by Doveri (2004a, 2010b).

The microscopic characteristics of species from damp chambers were studied on fresh material, those of species collected from the field were usually studied on dried material, using water, Congo red, Melzer's reagent, lactic cotton blue (or methyl blue), and Indian ink as mounting media.

All Basidiomycetes and most Ascomycetes were preserved as dried material or, exceptionally, as slides in the author's personal herbarium (CLSM) or rarely in herbarium of Pisa Botanical Garden (PI). *Chaetomium murorum*, *Cleistothelebolus nipigonensis*, and *Rodentomyces reticulatus* were also preserved as living cultures (PI)

Results

In my monograph on coprophilous fungi from Italy (Doveri 2004a) I described 81 taxa of Basidiomycota and 214 of Ascomycota growing both in the natural state or in damp chamber cultures. Since then my research has continued resulting in many publications (Doveri 2004b, 2005, 2006, 2007a,b, 2008a,b,c, 2010a,b, Doveri et al. 2005, 2010a,b, Doveri & Coué 2008a) reporting 43 additional species (5 Basidiomycota; 38 Ascomycota) new to Italy, 13 of which are described in this work, and one genus (*Rodentomyces* Doveri et al.), four species (*Podospora alexandri* Doveri, *Sporormiella hololasia* Doveri, *Thecotheus neoapiculatus* Doveri & Coué, *Coprinellus mitrinodulisporus* Doveri & Sarrocco), one variety (*Tripterosporella heterospora* var. *octaspora* Doveri) and one form (*Thecotheus formosanus* f. *collariatus* Doveri & Coué) new to science (Table 1).

badger (*Meles meles*)	goose (*Anser* sp.)	porcupine (*Hystrix cristata*)
beech marten (*Martes faina*)	hare (*Lepus* sp.)	rabbit (*Oryctolagus cuniculus*)
bird (various, except for *Anser* sp.)	hedgehog (*Erinaceus europaeus*)	rat (*Rattus rattus*)
cattle (*Bos taurus*)	horse (*Equus caballus*)	rock goat (*Capra ibex ibex*)
chamois (*Rupicapra rupicapra*)	insect (various)	roe deer (*Capreolus capreolus*)
deer (*Cervus elaphus*)	lizard (*Lacerta* sp.)	sheep (*Ovis aries*)
dog (*Canis familiaris*)	marmot (*Marmota marmota*)	snail (*Helix* sp.)
donkey (*Equus asinus*)	marten (*Martes martes*)	squirrel (*Sciurus* sp.)
dormouse (*Glis glis*)	mouflon (*Ovis musimon*)	toad (*Bufo* sp.)
fallow deer (*Dama dama*)	mouse (*Mus musculus*)	tortoise (*Testudo* sp.)
ferret (*Mustela furo*)	mule (*Equus mulus*)	weasel (*Putorius nivalis*)
fox (*Vulpes vulpes*)	ostrich (*Struthio camelus*)	wild pig (*Sus scrofa*)
gecko (*Tarentola mauritanica*)	pig (*Sus scrofa domesticus*)	wolf (*Canis lupus*)
goat (*Capra hircus*)	polecat (*Putorius foetidus*)	

I have recorded, at present, 544 collections of 92 Basidiomycota species from 722 dung samples in Italy.

303 records of 88 species came from 303 samples detected and identified in the field, listed as substrate sources, but not cultured. All but two (*Sebacina epigaea*; *Sphaerobolus stellatus*) are Agaricales, whose occurrence in Italy has recently been reported (Doveri 2010 b). The overall picture is unchanged, so I limit myself to summarise the results (Tables 2–3) and refer to that work for details.

I have recorded, at present, 2312 collections of 256 Ascomycota species from Italy. 573 records of 156 species came from samples detected and identified in the field. Leaving out 29 records from unidentified animals, most findings (96%) were made on bovine (27%), cervine (23%), equine (18%), leporine (13%), ovine (12%), and caprine (3%) dung, the remaining 4% on dung of other animals, with a slight preponderance of pyrenomycetes *s.l.* (53%) on discomycetes (45%), and with a marked preponderance of *Sporormiella* (19%), followed by *Ascobolus* Pers. (8%), *Lasiobolus* Sacc. (8%), *Sordaria* Ces. & De Not. (8%), *Cheilymenia* Boud. (7%), *Podospora* Ces., (7%), and *Schizothecium* Corda (7%). The preference for bovine dung is marked (72%) in *Cheilymenia*, slighter in *Ascobolus* (29%) and *Schizothecium* (20%), while a preference for cervine dung is manifest in *Lasiobolus* (38%), *Sporormiella* (30%) and *Podospora* (29%), for leporine dung (36%) in *Sordaria*.

Another 432 dung samples of 42 animal species were cultured in damp chambers and

Table 1 List of coprophilous Basidiomycota and Ascomycota from Italy.

BASIDIOMYCOTA *Agrocybe molesta* (Lasch) Singer	*Stropharia dorsipora* Esteve–Rav. & Barrasa	*Coprotus sexdecimsporus* (H. Crouan & P. Crouan) Kimbr. & Korf	*Saccobolus saccoboloides* (Seaver) Brumm.
Agrocybe pediades (Fr.) Fayod *s.* Watling	*Stropharia luteonitens* (Vahl) Quél.	*Coprotus subcylindrosporus* J. Moravec	*Saccobolus succineus* Brumm.
Agrocybe praecox (Pers.) Fayod	*Stropharia semiglobata* (Batsch) Quél.	*Delitschia didyma* Auersw.	*Saccobolus truncatus* Velen.
Agrocybe subpediades (Murrill) Watling *s.* Watling	*Volvariella gloiocephala* (DC.) Boekhout & Enderle	*Delitschia gigaspora* Cain	*Saccobolus verrucisporus* Brumm.
Agrocybe temulenta (Fr.) Singer *s.* Watling	**ASCOMYCOTA** *Aphanoascus fulvescens* (Cooke) Apinis	*Delitschia gigaspora* Cain var. *ceciliae* Doveri	*Saccobolus versicolor* (P. Karst.) P. Karst.
Bovista aestivalis (Bonord.) Demoulin	*Arnium arizonense* (Griffiths) N. Lundq. & J.C. Krug	*Delitschia intonsa* Luck–Allen	*Schizothecium aloides* (Fuckel) N. Lundq.
Bolbitius coprophilus (Peck) Hongo	*Arnium caballinum* N. Lundq.	*Delitschia leptospora* Oudem.	*Schizothecium conicum* (Fuckel) N. Lundq.
Bolbitius vitellinus var. *titubans* (Bull.) Bon & Courtec.	*Arnium cervinum* N. Lundq.	*Delitschia marchalii* Berl. & Voglino	*Schizothecium dakotense* (Griffiths) N. Lundq.
Bolbitius vitellinus var. *variicolor* (G.F. Atk.) Krieglst.	*Arnium imitans* N. Lundq.	*Delitschia patagonica* Speg.	*Schizothecium glutinans* (Cain) N. Lundq.
Bolbitius vitellinus (Pers.) Fr. var. *vitellinus*	*Arnium inaequilaterale* (Cain) N. Lundq. & J.C. Krug	*Delitschia vulgaris* Griffiths	*Schizothecium inaequale* (Cain) N. Lundq.
Conocybe alboradicans Arnolds	*Arnium septosporum* N. Lundq.	*Delitschia winteri* Plowr. ex G. Winter	*Schizothecium miniglutinans* (Mirza & Cain) N. Lundq.
Conocybe antipus (Lasch) Fayod	*Arnium sudermanniae* N. Lundq.	*Enterocarpus grenotii* Locq.-Lin.	*Schizothecium pilosum* (Mouton) N. Lundq.
Conocybe aurea (Jul. Schäff.) Hongo	*Ascobolus albidus* H. Crouan & P. Crouan	*Fimetariella microsperma* J.C. Krug	*Schizothecium simile* (E.C. Hansen) N. Lundq.
Conocybe brunneidisca (Murrill) Hauskn.	*Ascobolus brassicae* H. Crouan & P. Crouan	*Gymnoascus dankaliensis* (Castell. ex J.F.H. Beyma) Arx	*Schizothecium squamulosum* (H. Crouan & P. Crouan) N. Lundq.
Conocybe cettoiana Hauskn. & Enderle	*Ascobolus carletoni* Boud.	*Gymnoascus devroeyi* (G.F. Orr) Arx	*Schizothecium tetrasporum* (G. Winter) N. Lundq.
Conocybe coprophila (Kühner) Kühner	*Ascobolus costantinii* Rolland	*Gymnoascus littoralis* (G.F. Orr) Arx	*Schizothecium vesticola* (Berk. & Broome) N. Lundq.
Conocybe fuscimarginata (Murrill) Singer	*Ascobolus crenulatus* P. Karst.	*Gymnoascus reessii* Baran.	*Schizothecium vratislaviense* (Alf. Schmidt) Doveri & Coué
Conocybe gigasperma Enderle & Hauskn.	*Ascobolus elegans* J. Klein	*Gymnoascus ruber* Tiegh.	*Scutellinia crinita* (Bull) Lambotte
Conocybe pubescens (Gillet) Kühner	*Ascobolus furfuraceus* Pers.	*Hypocopra antarctica* (Speg.) Furuya & Udagawa	*Selinia pulchra* (G. Winter) Sacc.
Conocybe rickenii (Jul. Schäff.) Kühner	*Ascobolus hawaiiensis* Brumm.	*Hypocopra brefeldii* Zopf	*Sordaria fimicola* (Roberge) Ces. & De Not.
Conocybe siennophylla (Berk. & Broome) Singer	*Ascobolus immersus* Pers. ex Pers.	*Hypocopra equorum* (Fuckel) G. Winter	*Sordaria humana* (Fuckel) G. Winter
Conocybe siliginea (Fr.) Kühner	*Ascobolus lineolatus* Brumm.	*Hypocopra* aff. *festucacea* J.C. Krug & Cain	*Sordaria lappae* Potebnia
Conocybe singeriana Hauskn.	*Ascobolus mancus* (Rehm) Brumm.	*Hypocopra leporina* (Niessl ex Rehm) Doveri	*Sordaria macrospora* Auersw.

Table 1 (Continued) List of coprophilous Basidiomycota and Ascomycota from Italy.

Coprinellus bisporus (J.E. Lange) Vilgalys et al.	*Ascobolus michaudii* Boud.	*Hypocopra lojkaeana* (Rehm) Doveri	*Sordaria superba* De Not.
Coprinellus brevisetulosus (Arnolds) Redhead et al.	*Ascobolus* aff. *pseudocainii* Prokhorov	*Hypocopra merdaria* (Fr.) J. Kickx f.	*"Sordaria" minima* Speg. & Sacc.
Coprinellus congregatus (Bull.) P. Karst.	*Ascobolus reticulatus* Brumm.	*Iodophanus carneus* (Pers.) Korf	*Sphaeronaemella fimicola* Marchal
Coprinellus curtus (Kalchbr.) Vilgalys et al.	*Ascobolus roseopurpurascens* Rehm	*Iodophanus difformis* (P. Karst.) Kimbr. et al.	*Sporormia fimetaria* (De Not.) De Not.
Coprinellus doverii (Nagy) Nagy	*Ascobolus stictoideus* Speg.	*Kernia cauquensis* Calviello	*Sporormiella affinis* (Sacc. et al.) S.I. Ahmed & Cain
Coprinellus ephemerus (Bull.) Redhead et al.	*Ascodesmis microscopica* (H. Crouan & P. Crouan) Seaver	*Kernia nitida* (Sacc.) Nieuwl.	*Sporormiella antarctica* (Speg.) S.I. Ahmed & Cain
Coprinellus flocculosus (DC.) Vilgalys et al.	*Ascodesmis nana* Brumm.	*Lasiobolus ciliatus* (JC. Schmidt) Boud.	*Sporormiella australis* (Speg.) S.I. Ahmed & Cain
Coprinellus heptemerus (M. Lange & A.H. Sm.) Vilgalys et al.	*Ascodesmis nigricans* Tiegh.	*Lasiobolus cuniculi* Velen.	*Sporormiella capybarae* (Speg.) S.I. Ahmed & Cain
Coprinellus heterosetulosus (Locq. ex Watling) Vilgalys et al.	*Ascozonus woolhopensis* (Renny) Boud.	*Lasiobolus diversisporus* (Fuckel) Sacc.	*Sporormiella corynespora* (Niessl) S.I. Ahmed & Cain
Coprinellus marculentus (Britzelm.) Redhead et al.	*Bombardioidea stercoris* (DC.) N. Lundq.	*Lasiobolus intermedius* J.L. Bezerra & Kimbr.	*Sporormiella cylindrospora* S.I. Ahmed & Cain
Coprinellus pellucidus (P. Karst.) Redhead et al.	*Cercophora anisura* N. Lundq.	*Lasiobolus macrotrichus* Rea	*Sporormiella cymatomera* S.I. Ahmed & Cain
Coprinellus sassii (M. Lange & A.H. Sm.) Redhead et al.	*Cercophora coprophila* (Fr.) N. Lundq.	*Lasiobolus microsporus* J.L. Bezerra & Kimbr.	*Sporormiella dodecamera* S.I. Ahmed & Cain
Coprinopsis candidolanata (Doveri & Uljé) Keirle et al.	*Cercophora gossypina* N. Lundq.	*Lasiobolus monascus* Kimbr.	*Sporormiella dubia* S.I. Ahmed & Cain
Coprinopsis cinerea (Schaeff.) Redhead et al.	*Cercophora mirabilis* Fuckel	*Lasiobolus ruber* (Quél.) Sacc.	*Sporormiella gigantea* (E.C. Hansen) Doveri
Coprinopsis cothurnata (Godey) Redhead et al.	*Cercophora septentrionalis* N. Lundq.	*Lophotrichus bartlettii* (Massee & E.S. Salmon) Malloch & Cain	*Sporormiella grandispora* (Speg.) S.I. Ahmed & Cain
Coprinopsis filamentifera (Kühner) Redhead et al.	*Chaetomidium cephalothecoides* (Malloch & Benny) Arx	*Melanospora brevirostris* (Fuckel) Höhn.	*Sporormiella heptamera* (Auersw.) S.I. Ahmed & Cain
Coprinopsis luteocephala (Watling) Redhead et al.	*Chaetomidium fimeti* (Fuckel) Sacc.	*Melanospora zamiae* Corda	*Sporormiella hololasia* Doveri
Coprinopsis macrocephala (Berk.) Redhead et al.	*Chaetomidium megasporum* Doveri et al.	*Neocosmospora vasinfecta* E.F. Sm. var. *vasinfecta*	*Sporormiella intermedia* (Auersw.) S.I. Ahmed & Cain
Coprinopsis nivea (Pers.) Redhead et al.	*Chaetomium ancistrocladum* Udagawa & Cain	*Orbicula parietina* (Schrad.) S. Hughes	*Sporormiella kansensis* (Griffiths) S.I. Ahmed & Cain
Coprinopsis poliomallus (Romagn.) Doveri et al.	*Chaetomium bostrychodes* Zopf	*Persiciospora moreaui* P.F. Cannon & D. Hawksw.	*Sporormiella lageniformis* (Fuckel) S.I. Ahmed & Cain
Coprinopsis pseudocortinata (Locq. ex Doveri et al.) Doveri et al.	*Chaetomium carinthiacum* Sörgel	*Peziza fimeti* (Fuckel) E.C. Hansen	*Sporormiella lasiocarpa* Lorenzo
Coprinopsis pseudonivea (Bender & Uljé) Redhead et al. var. *pseudonivea*	*Chaetomium crispatum* (Fuckel) Fuckel	*Peziza merdae* Donadini	*Sporormiella leporina* (Niessl) S.I. Ahmed & Cain
Coprinopsis pseudoradiata (Watling) Redhead et al.	*Chaetomium cuniculorum* Fuckel	*Peziza perdicina* (Velen.) Svrček	*Sporormiella longisporopsis* S.I. Ahmed & Cain

Table 1 (Continued) List of coprophilous Basidiomycota and Ascomycota from Italy.

Coprinopsis radiata (Bolton) Redhead et al.	*Chaetomium elatum* Kunze: Fr	*Peziza vesiculosa* Bull.	*Sporormiella megalospora* (Auersw.) S.I. Ahmed & Cain
Coprinopsis stercorea (Scop. ex Fr.) Redhead et al.	*Chaetomium funicola* Cooke	*Pithoascus intermedius* (C.W. Emmons & B.O. Dodge) Arx	*Sporormiella minima* (Auersw.) S.I. Ahmed & Cain
Coprinopsis tuberosa (Quél.) Doveri et al.	*Chaetomium fusisporum* G. Sm.	*Pleospora herbarum* (Pers.) Rabenh.	*Sporormiella minimoides* S.I. Ahmed & Cain
Coprinopsis utrifera (Watling) Redhead et al.	*Chaetomium gangligerum* L.M. Ames	*Podospora alexandri* Doveri	*Sporormiella minipascua* S.I. Ahmed & Cain
Coprinopsis vermiculifera (Dennis) Redhead et al.	*Chaetomium globosum* Kunze: Fr	*Podospora anserina* (Ces. ex Rabenh.) Niessl	*Sporormiella octomera* (Auersw.) S.I. Ahmed & Cain
Coprinopsis xenobia (P.D. Orton) Redhead et al.	*Chaetomium homopilatum* Omvik	*Podospora australis* (Speg.) Niessl	*Sporormiella octonalis* S.I. Ahmed & Cain
Coprinus ephemeroides (Bull.) Fr.	*Chaetomium medusarum* J.A. Mey. & Lanneau	*Podospora bifida* N. Lundq.	*Sporormiella pascua* (Niessl) S.I. Ahmed & Cain
Coprinus patouillardii Quél.	*Chaetomium mollicellum* L.M. Ames	*Podospora communis* (Speg.) Niessl	*Sporormiella pilosa* (Cain) S.I. Ahmed & Cain
Coprinus spadiceisporus Bogart	*Chaetomium murorum* Corda	*Podospora curvicolla* (G. Winter) Niessl	*Sporormiella pulchella* (E.C. Hansen) S.I. Ahmed & Cain
Coprinus sterquilinus (Fr.) Fr.	*Chaetomium oblatum* Dreyfuss & Arx	*Podospora dasypogon* N. Lundq.	*Sporormiella teretispora* S.I. Ahmed & Cain
Crucibulum laeve (Huds.) Kambly	*Chaetomium robustum* L.M. Ames	*Podospora decipiens* (G. Winter ex Fuckel) Niessl	*Sporormiella trogospora* S.I. Ahmed & Cain
Cyathus stercoreus (Schwein.) De Toni	*Chaetomium semen–citrulli* Sergeeva	*Podospora excentrica* N. Lundq.	*Sporormiella vexans* (Auersw.) S.I. Ahmed & Cain
Leucocoprinus cretaceus (Bull.) Locq.	*Chaetomium spinosum* Chivers	*Podospora fimiseda* (Ces. & De Not.) Niessl	*Strattonia insignis* (E.C. Hansen) N. Lundq.
Lepista sordida (Schumach.) Singer	*Chaetomium subaffine* Sergeeva	*Podospora gigantea* Mirza & Cain	*Thecotheus cinereus* (H. Crouan & P. Crouan) Chenant.
Panaeolus acuminatus (Schaeff.) Quél.	*Chaetomium trigonosporum* (Marchal) Chivers	*Podospora globosa* (Massee & E.S. Salmon) Cain	*Thecotheus crustaceus* (Starbäck) Aas & N. Lundq.
Panaeolus alcis M.M. Moser	*Chaetomium variostiolatum* A. Carter	*Podospora granulostriata* N. Lundq.	*Thecotheus formosanus* Y.–Z. Wang
Panaeolus antillarum (Fr.) Dennis	*Chalazion erinaceum* Doveri et al.	*Podospora intestinacea* N. Lundq.	*Thecotheus formosanus* f. *collariatus* Doveri & Coué
Panaeolus cinctulus (Bolton) Sacc.	*Cheilymenia aurantiacorubra* K.S. Thind & S.C. Kaushal	*Podospora myriaspora* (H. Crouan & P. Crouan) Niessl	*Thecotheus holmskjoldii* (E.C. Hansen) Chenant.
Panaeolus fimicola (Fr.) Gillet	*Cheilymenia coprinaria* (Cooke) Boud.	*Podospora pleiospora* (G. Winter) Niessl	*Thecotheus lundqvistii* Aas
Panaeolus guttulatus Bres.	*Cheilymenia dennisii* J. Moravec	*Podospora pyriformis* (A. Bayer) Cain	*Thecotheus neoapiculatus* Doveri & Coué
Panaeolus papilionaceus (Bull.) Quél.	*Cheilymenia fraudans* (P. Karst.) Boud.	*Podospora setosa* (G. Winter) Niessl	*Thecotheus pelletieri* (H. Crouan & P. Crouan) Boud.
Panaeolus retirugis (Fr.) Gillet	*Cheilymenia granulata* (Bull.) J. Moravec	*Poronia erici* Lohmeyer & Benkert	*Thecotheus strangulatus* (Velen.) Aas & N. Lundq.
Panaeolus sphinctrinus (Fr.) Quél.	*Cheilymenia insignis* (H. Crouan & P. Crouan) Boud.	*Poronia punctata* (L.) Rabenh.	*Thelebolus caninus* (Auersw.) Jeng & J.C. Krug
Panaeolus semiovatus (With.) S. Lundell	*Cheilymenia pulcherrima* (H. Crouan & P. Crouan) Boud.	*Preussia fleischhakii* (Auersw.) Cain	*Thelebolus crustaceus* (Fuckel) Kimbr.

Table 1 (Continued) List of coprophilous Basidiomycota and Ascomycota from Italy.

Panaeolus subfirmus P. Karst.	*Cheilymenia rubra* (W. Phillips) Boud.	*Preussia funiculata* (Preuss) Fuckel	*Thelebolus dubius* var. *lagopi* (Rea) Doveri
Parasola misera (P. Karst.) Redhead et al.	*Cheilymenia stercorea* (Pers.) Boud.	*Preussia isomera* Cain	*Thelebolus microsporus* (Berk. & Broome) Kimbr.
Parasola schroeteri (P. Karst.) Redhead et al.	*Cheilymenia theleboloides* (Alb. & Schwein.) Boud.	*Preussia terricola* Cain	*Thelebolus polysporus* (P. Karst.) Y. Otani & Kanzawa
Psathyrella coprinoides Delannoy et al.	*Cleistothelebolus nipigonensis* Malloch & Cain	*Preussia typharum* (Sacc.) Cain	*Thelebolus stercoreus* Tode
Psathyrella hirta Peck	*Coniochaeta leucoplaca* (Sacc.) Cain	*Pseudombrophila bulbifera* (E.J. Durand) Brumm.	*Trichobolus octosporus* J.C. Krug
Psathyrella lacrymabunda (Bull.) M.M. Moser	*Coniochaeta scatigena* (Berk. & Broome) Cain	*Pseudombrophila fuscolilacina* (Grélet) Brumm.	*Trichobolus sphaerosporus* Kimbr.
Psathyrella prona (Fr.) Gillet var. *prona* f. *prona*	*Coniochaeta vagans* (Carestia & De Not.) N. Lundq.	*Pseudombrophila merdaria* (Fr.) Brumm.	*Trichobolus zukalii* (Heimerl) Kimbr.
Psilocybe coprophila (Bull.) P. Kumm.	*Copromyces bisporus* N. Lundq.	*Pseudombrophila minuta* Brumm.	*Trichodelitschia minuta* (Fuckel) N. Lundq.
Psilocybe crobulus (Fr.) Singer	*Coprotus aurora* (H. Crouan & P. Crouan) Kimbr. et al.	*Pseudombrophila theioleuca* Rolland	*Trichodelitschia munkii* N. Lundq.
Psilocybe cyanescens Wakef.	*Coprotus disculus* Kimbr. et al.	*Rodentomyces reticulatus* Doveri et al.	*Trichophaea gregaria* (Rehm) Boud.
Psilocybe inquilina (Fr.) Bres.	*Coprotus glaucellus* (Rehm) Kimbr.	*Saccobolus beckii* Heimerl	*Tripterosporella heterospora* var. *octaspora* Doveri
Psilocybe liniformans Guzmán & Bas	*Coprotus granuliformis* (H. Crouan & P. Crouan) Kimbr.	*Saccobolus caesariatus* Renny	*Tripterosporella pakistani* (Mirza) Malloch & Cain
Psilocybe merdaria (Fr.) Ricken	*Coprotus lacteus* (Cooke & W. Phillips in Cooke) Kimbr. et al.	*Saccobolus citrinus* Boud. & Torrend	*Xanthothecium peruvianum* (Cain) Arx & Samson
Psilocybe subcoprophila (Britzelm.) Sacc.	*Coprotus leucopocillum* Kimbr. et al.	*Saccobolus depauperatus* (Berk. & Broome) E.C. Hansen	*Zopfiella erostrata* (Griffiths) Udagawa & Furuya
Psylocybe semilanceata (Fr.) P. Kumm.	*Coprotus* aff. *luteus* Kimbr. et al.	*Saccobolus dilutellus* (Fuckel) Sacc.	*Zopfiella longicaudata* (Cain) Arx
Sebacina epigaea (Berk. & Broome) Neuhoff	*Coprotus niveus* (Fuckel) Kimbr. et al.	*Saccobolus glaber* (Pers.) Lambotte	*Zygopleurage zygospora* (Speg.) Boedijn
Sphaerobolus stellatus Tode : Pers.	*Coprotus* aff. *ochraceus* (H. Crouan & P. Crouan) J. Moravec	*Saccobolus minimus* Velen.	

provided 1739 collections of 203 Ascomycota species. Leaving out 7 collections from unidentified animals, most records (81%) came from equine (20%), bovine (17%), ovine (15%), cervine (10%), leporine (10%), and caprine (9%) dung, with a preponderance of pyrenomycetes *s.l.* (59%) on discomycetes (40%) and a high percentage (14%) of *Podospora*, followed by *Ascobolus* (10%), *Saccobolus* Boud. (9%), *Schizothecium* (9%), *Chaetomium* Kunze (8%), *Sporormiella* (8%), and *Sordaria* (7%).

In order to make the reading easier, I have gathered groups of species belonging to different genera in separate Tables, containing records from the field and the frequency in damp chamber cultures, and I have organised them following the systematics adopted by Kirk et al. (2008):

Dothideomycetes – Pleosporomycetidae – Pleosporales – Delitschiaceae

Delitschia Auersw (Table 4)

The genus *Delitschia* as a whole has a low frequency of occurrence on total dung samples in culture (1.1%), and a significant substrate preference (14%) for cattle dung. *D. winteri* preferably grows on cattle dung and, after Lundqvist (1972), it can be called "species with a high substrate preference" but also "with a wide tolerance" as it can inhabit a variety of dung types. Like mine from Italy, most records elsewhere (Phillips & Plowright 1874, Winter 1874, Spegazzini 1878,Marchal 1883, Griffiths 1901, Massee & Salmon 1901, Griffiths & Seaver 1910, Munk 1948, 1957, Lundqvist 1960, Breton 1965, Tóth 1965, 1967, García–Zorron 1973, Wicklow et al. 1980, Dennis 1981, Barrasa 1985, Barrasa & Checa 1990, Moyne & Petit 2006, Welt & Heine 2006a, Richardson 2008a,b) are from cattle dung (34%), many from horse (25%), rabbit (20%), and sheep (14%).

Dothideomycetes – Pleosporomycetidae – Pleosporales – Phaeotrichaceae

Trichodelitschia Munk (Table 5)

Leaving out pig dung (samples too scarce to estimate the frequency of occurrence), *T. minuta*, the commonest *Trichodelitschia* species in Italy, shows a slight preference for leporine dung, compared with cervine and leporine, and an increased preference when also records from the field are considered. It is a common species worldwide, and there are many records from Europe, mostly (56%) from leporine dung (Marchal 1883, Lundqvist 1960, Tóth 1963, Barrasa 1985, Valldosera 1991, Eriksson 1992, Richardson 2005, Heine & Welt 2008).

Dothideomycetes – Pleosporomycetidae – Pleosporales – Pleosporaceae

Pleospora Rabenh ex Ces. & De Not. (Table 6)

Dothideomycetes – Pleosporomycetidae – Pleosporales – Sporormiaceae

Preussia Fuckel (Table 7)

Refer to the taxonomic part of this work, under *Sporormiella affinis*, for discussion on taxonomy of *Preussia* and *Sporormiella*. In Italy the genus *Preussia* is less frequent (0.9%) on dung than *Sporormiella* (6.6%), and *Preussia* spp. appear to have a wide substrate tolerance, with the exception of *P. isomera*, which has always been found on horse dung. Unlike mine, the few world records of *P. isomera* known by me are usually from rabbit dung (Cain 1961, Mukerji 1970, Angel & Wicklow 1975).

Sporormia De Not. (Table 8)

Sporormia fimetaria is a rare but widespread species, preferably growing on bovine (44% of records worldwide) (De Notaris 1849, Pirotta 1878, Spegazzini 1878, Marchal 1883, Griffiths 1901, Massee & Salmon 1901, Angel & Wicklow 1975, Eriksson 1992, Chang & Wang 2009) and ovine (23%) dung (Stratton 1921, Narendra 1973, Richardson 1998). It shows, however, a wide substrate tolerance, as it has been recorded also from goat (Ahmed & Cain 1972, Ahmad & Sultana 1973, Udagawa & Sugiyama 1982) and a variety of dungs (Khan & Cain 1979, Dissing 1992, Richardson 2004a, 2008b)

Sporormiella Ellis & Everh. (Table 9)

Sporormiella is one of the most commonly encountered genera on dung (Bell 2005) and the most recorded by me from the field (19% of all records), particularly from cervine (30%) and leporine (22%) dung. It frequently occurs (8% of all samples) also in damp chamber cultures, and its frequency is much higher when only caprine and leporine dungs are considered. It shows, however, a wide tolerance for a variety of dungs.

S. intermedia and *S. minima* are two of the most common coprophilous pyrenomycetes *s.l.* in Italy, but less frequent than *Sordaria fimicola*, *Podospora decipiens* and *Chaetomium bostrychodes*. Both have a wide substrate tolerance, but *S. intermedia* preferably grows on caprine (26%) and leporine (26%) dung in culture, *S. minima* on ovine (25%) and caprine (23%) dung. My data concerning *S. intermedia* are in agreement with Richardson (2001a), who found it to be most frequent on leporine dung.

I have found more than 300 records worldwide of *S. minima*, confirming its wide substrate tolerance, but also a preference (23%) for bovine dung (Griffiths 1901, Lundqvist 1960, Tóth 1965, Parker 1979, Lundqvist 1997, De Meulder 2000b, Welt & Heine 2006b, Richardson 2008c, Chang & Wang 2009).

Table 2 Records from Italy of coprophilous Basidiomycota in the natural state.

		equine			cervine						
	cattle	**donkey**	**horse**	**mule**	**deer**	**fallow deer**	**roe deer**	**chamois**	**rabbit**	**wild pig**	**unidentified herbivore**
Bovista aestivalis	1										
Agrocybe molesta			1								
Agrocybe pediades s. Watling	4		1								1
Agrocybe praecox			1								
Agrocybe subpediades s. Watling	2		1								
Agrocybe temulenta s. Watling	1		1								
Total *Agrocybe*	**7**		**5**								**1**
Bolbitius coprophilus			5								
Bolbitius vitellinus var. *titubans*	1										
Bolbitius vitellinus var. *variicolor*			8								
Bolbitius vitellinus var. *vitellinus*	4	1									
Total *Bolbitius*	**5**	**1**	**13**								
Conocybe alboradicans			2								
Conocybe antipus	2										
Conocybe aurea	1										
Conocybe brunneidisca	5										
Conocybe cettoiana	1										
Conocybe coprophila	6										
Conocybe fuscimarginata	4										
Conocybe gigasperma			1								
Conocybe pubescens			2								
Conocybe rickenii	4	1	2								
Conocybe siennophylla	4		1								
Conocybe siliginea			2								
Conocybe singeriana	1										
Total *Conocybe*	**28**	**1**	**10**								
Coprinellus bisporus	2		1						1		3
Coprinellus brevisetulosus	3										
Coprinopsis cinerea	4	1	2								5
Coprinellus congregatus	3		2						1		1
Coprinopsis cothurnata	4		1								
Coprinellus curtus			2								
Coprinellus doverii											1

Table 2 (Continued) Records from Italy of coprophilous Basidiomycota in the natural state.

		equine			cervine						
	cattle	**donkey**	**horse**	**mule**	**deer**	**fallow deer**	**roe deer**	**chamois**	**rabbit**	**wild pig**	**unidentified herbivore**
“*Coprinus*” *ephemeroides*	1		3								
Coprinellus ephemerus	6		2								1
Coprinellus flocculosus	1		1								
Coprinellus heptemerus	5						1		1		
Coprinellus heterosetulosus			2								
Coprinopsis luteocephala			1								
Coprinopsis macrocephala	1		1								
Coprinellus marculentus	1		2								
Parasola misera			2								
Coprinellus mitrinodulisporus								1			
Coprinopsis nivea	10	1	4								
“*Coprinus” patouillardii*	2		4								
Coprinellus pellucidus	1										
Coprinopsis poliomallus			1								
Coprinopsis pseudocortinata			1								
Coprinopsis pseudonivea var. *pseudonivea*	2										
Coprinopsis pseudoradiata	1		1								
Coprinopsis radiata	1		8							1	
Coprinellus sassii			1								
Parasola schroeteri	2										
Coprinus spadiceisporus						2					
Coprinopsis stercorea	1								1		
Coprinus sterquilinus			2								
Coprinopsis tuberosa			1								2
Coprinopsis utrifera					1						
Coprinopsis xenobia	4										
Total *Coprinus* s.l.	**55**	**2**	**45**		**1**	**2**	**1**	**1**	**4**	**1**	**13**
Crucibulum laeve	1										
Cyathus stercoreus	1		2								
Lepista sordida	1										
Leucocoprinus cretaceus			4								
Panaeolus acuminatus	4										

Table 2 (Continued) Records from Italy of coprophilous Basidiomycota in the natural state.

		equine			**cervine**						
	cattle	**donkey**	**horse**	**mule**	**deer**	**fallow deer**	**roe deer**	**chamois**	**rabbit**	**wild pig**	**unidentified herbivore**
Panaeolus alcis											1
Panaeolus antillarum	5										
Panaeolus cinctulus	2		3								1
Panaeolus fimicola											1
Panaeolus guttulatus	1										
Panaeolus papilionaceus	2		3								1
Panaeolus retirugis	2			1							
Panaeolus semiovatus	3			1							1
Panaeolus sphinctrinus	6		3	1							
Panaeolus subfirmus			2								
Total *Panaeolus*	**25**		**11**	**3**							**5**
Psathyrella hirta	1		1								
Psathyrella lacrymabunda			1								
Psathyrella prona var. *prona* f. *prona*			1								
Total *Psathyrella*	**1**		**3**								
Psilocybe coprophila	2		3	1					2		5
Psilocybe crobulus	1										
Psilocybe cyanescens											1
Psilocybe inquilina			1								
Psilocybe liniformans	1										
Psilocybe merdaria	2										
Psilocybe semilanceata	1										
Psilocybe subcoprophila										1	
Total *Psilocybe*	**7**		**4**	**1**					**2**	**1**	**6**
Sebacina epigaea	1										
Sphaerobolus stellatus	1		1								
Stropharia dorsipora	1		6								1
Stropharia luteonitens											1
Stropharia semiglobata	9		3								2
Total *Stropharia*	**10**		**9**								**4**
Volvariella gloiocephala			1								

Table 3 Records from Italy and frequency (%) of coprophilous Basidiomycota on different dung types in damp chamber cultures (n° of dung samples in square brackets)*.

			equine		**cervine**			**caprine**			**leporine**					**ovine**			
	bird [27]	**cattle [55]**	**donkey [6]**	**horse [63]**	**Deer [24]**	**fallow deer [10]**	**roe deer [37]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**hare [20]**	**rabbit [19]**	**marmot [5]**	**marten [2]**	**pig [5]**	**sheep [51]**	**Mouflon [1]**	**tortoise [2]**	**wild pig [10]**
Bolbitius coprophilus				1 (2%)															
Coprinellus brevisetulosus		1 (2%)																	
Coprinopsis candidolanata					1 (4%)			1 (6%)								1 (2%)			
Coprinopsis cinerea	3 (11%)	1 (2%)								1 (12%)									
Coprinellus congregatus		1 (2%)																	
Coprinellus curtus				6 (9%)			1 (3%)	2 (12%)	1 (17%)		3 (15%)	3 (16%)							
"*Coprinus*" *ephemeroides*		1 (2%)																	
Coprinellus ephemerus		2 (4%)		2 (3%)			1 (3%)									2 (4%)		1	
Coprinopsis filamentifera		1 (2%)		1 (2%)		1 (10%)	1 (3%)	2 (12%)		1 (12%)					1 (20%)	3 (6%)			
Coprinellus heptemerus		4 (7%)		1 (2%)	1 (4%)	3 (30%)	2 (5%)	7 (44%)	1 (17%)	2 (25%)	2 (10%)	1 (5%)	1 (20%)			9 (18%)			
Coprinellus heterosetulosus		2 (4%)		14 (22%)												1 (2%)			
Parasola misera		6 (11%)		5 (8%)	3 (12%)	1 (10%)				2 (25%)		1 (5%)				5 (10%)			
Coprinopsis nivea		1 (2%)		1 (2%)						1 (12%)									
"*Coprinus*" *patouillardii*		4 (7%)	1 (17%)	14 (22%)															
Coprinellus pellucidus		2 (4%)			1 (4%)		1 (3%)	1 (6%)								2 (4%)			
Coprinopsis poliomallus		1 (2%)																	
Coprinopsis pseudocortinata		1 (2%)		1 (2%)															
Coprinopsis pseudocortinata		1 (2%)		1 (2%)															

Table 3 (Continued) Records from Italy and frequency (%) of coprophilous Basidiomycota on different dung types in damp chamber cultures (n° of dung samples in square brackets)*.

			equine		cervine			caprine			leporine					ovine			
	bird [27]	**cattle [55]**	**donkey [6]**	**horse [63]**	**Deer [24]**	**fallow deer [10]**	**roe deer [37]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**hare [20]**	**rabbit [19]**	**marmot [5]**	**marten [2]**	**pig [5]**	**sheep [51]**	**Mouflon [1]**	**tortoise [2]**	**wild pig [10]**
Coprinopsis pseudonivea var. *pseudonivea*		1 (2%)																	
Coprinopsis pseudoradiata				1 (2%)	1 (4%)											1 (2%)			
Coprinopsis radiata		5 (9%)	4 (67%)	17								2 (10%)				6 (12%)	1		
Coprinopsis stercorea		8 (14%)			2 (8%)	2 (20%)	7 (19%)	3 (19%)								9 (18%)			1 (10%)
Coprinus sterquilinus				1 (2%)															
Coprinopsis tuberosa												1 (5%)							
Coprinopsis utrifera		1 (2%)			1	1 (10%)	1 (3%)					1 (5%)				3 (6%)			
Coprinopsis vermiculifera					(4%)					1 (12%)									
Total ** *Coprinus s.l.*	**11%**	**49%**	**83%**	**73%**	**25%**	**60%**	**30%**	**56%**	**33%**	**75%**	**20%**	**31%**	**20%**		**20%**	**61%**			**10%**
			77%		**32%**			**57%**			**26%**								
Panaeolus papilionaceus				1 (2%)															
Psathyrella coprinoides							1 (3%)							1					
Psilocybe coprophila				1 (2%)															
Stropharia dorsipora				1 (2%)															
Stropharia semiglobata		1 (2%)																	
Total ** *Stropharia*		**2%**		**2%**															

*****The frequency (%) is not reported when samples of a dung type are less than five. °Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ******The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 4 Records from Italy of coprophilous *Delitschia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

			cervine				**caprine**			
	cattle [55]	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**hare [20]**	**goat [16]**	**rock goat [8]**	**pig [5]**	**sheep [51]**
D. didyma					1					
D. gigaspora								**1 (12%)**		
D. gigaspora var. *ceciliae*		**2 (4%)**								
D. intonsa	**3 (5%)**	**2 (4%)**			**1 (3%)**				1	
D. leptospora			1		**1 (3%)**	**1 (5%)**				
D. marchalii						**1 (5%)**	**1 (6%)**	**1 (12%)**		
D. patagonica	**1 (2%)**									
D. vulgaris	**1 (2%)**									
D. winteri	1+**4 (7%)**	1+**1 (2%)**		**1 (10%)**					1	**1 (2%)**
Total *Delitschia* in natural state	1	1	1		1				2	
Total *Delitschia* in damp chambers**	**9 (14%)**	**5 (6%)**		**1 (10%) (3%)**	**2 (3%)**	**2 (10%)**	**1 (6%) (12%)**	**2 (8%)**		**1 (2%)**

*****The frequency (%) is not reported when samples of a dung type are less than five. °Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ******The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 5 Records from Italy of coprophilous *Trichodelitschia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	cervine		**leporine**			
	deer [24]	**roe deer [37]**	**hare [20]**	**rabbit [19]**	**pig [5]**	**sheep [51]**
T. minuta	2+**1 (4%)**	**1 (3%)**	3+**1 (5%)**	2+**1 (5%)**	**1 (20%)**	**2 (4%)**
T. munkii						**1 (2%)**
Total *Trichodelitschia* in natural state	2		3	2		
Total *Trichodelitschia* in damp chambers**	**1 (4%)**	**1 (3%)**	**1 (5%)**	**1 (5%)**	**1**	**3**
	(3%)		**(5%)**		**(20%)**	**(6%)**

°Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. **The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 6 Records from Italy of coprophilous *Pleospora* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	sheep [51]
P. herbarum	1

° Records from dung in the natural state, in normal type. Records from dung in damp chambers, in bold type.

Table 7 Records from Italy of coprophilous *Preussia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

		equine		**cervine**					
	cattle [55]	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**rabbit [19]**	**sheep [51]**	**wild pig [10]**
P. fleischhakii	**1 (2%)**	1	**2 (3%)**						
P. funiculata						**1 (3%)**		**1(2%)**	1+**1 (10%)**
P. isomera			2+**3 (5%)**						
P. terricola	**2 (4%)**								
P. typharum	**1 (2%)**			**2 (8%)**	**1 (10%)**		**1 (5%)**		
Total *Preussia* in natural state		1	2						1
Total *Preussia* in Damp chambers**	**4 (7%)**		**5 (6%)**	**2 (8%)**	**1 (10%)**	**1 (3%)**	**1 (5%)**	**1 (2%)**	**1 (10%)**
		(6%)		**(6%)**					

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 8 Records from Italy of coprophilous *Sporormia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	deer [24]	**marmot [5]**
S. fimetaria	**2 (8%)**	**1 (20%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 9 Records from Italy of coprophilous *Sporormiella* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

				equine		**cervine**				**leporine**		**caprine**								
	beech-marten [3]	**bird [27]**	**cattle [55]**	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**fox [7]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**hedge-hog [12]**	**marmot [5]**	**pig [5]**	**sheep [51]**	**wild pig [10]**	**unidentified animal [2]**
S. affinis										1										
S. antarctica						1														
S. australis		1+**1** **(4%)**				4+**2** **(8%)**		6+**3** **(8%)**	**1** **(14%)**	3	1	**1** **(6%)**		1				1+**1** **(2%)**		1
S. capybarae			1					1												
S. corynespora								**1** **(3%)**			**1** **(5%)**									
S. cylindrospora			3			1+**1** **(4%)**		**1** **(3%)**									1	1		
S. cymatomera								**1** **(3%)**												
S. dodecamera								**1** **(3%)**												
S. dubia				1	1															
S. gigantea			1																	
S. grandispora			**2** **(4%)**		1	**1** **(4%)**	1										1		1	
S. heptamera								**1** **(3%)**									1			1
S. ***hololasia***											**1** **(5%)**									
S. intermedia			1+**5** **(9%)**		2+**2** **(3%)**	4+**1** **(4%)**	1+**2** **(20%)**	4+**4** **(11%)**	**2** **(28%)**	3+**5** **(25%)**	3+**5** **(26%)**	**4** **(25%)**	**3** **(50%)**	1+**1** **(12%)**	**1** **(8%)**	**1** **(20%)**		4+**6** **(12%)**		**1**
S. kansensis					1															
S. lageniformis					**2** **(3%)**			**1** **(3%)**	**1** **(14%)**											
S. lasiocarpa											**2** **(10%)**									
S. leporina					**1** **(2%)**	1+**2** **(8%)**		1+**2** **(5%)**		3	1		**1** **(17%)**							2+**1**
S. longisporopsis					**1(2%)**					1	**1(5%)**									
S. megalospora			2+**2** **(4%)**		1+**1** **(2%)**	2+**2** **(8%)**		1+**1** **(3%)**			**1** **(5%)**						**1(20%)**	2		
S. minima	**1**		7+**9** **(16%)**	**2** **(33%)**	2+**6** **(9%)**		1+**2** **(20%)**	2+**3** **(8%)**		**2** **(10%)**	2+**2** **(10%)**	2+**4** **(25%)**		**3** **(37%)**		**1** **(20%)**		2+**13** **(25%)**		1+**1**
S. minimoides										1	1+**1** **(5%)**									
S. minipascua			1																	

Table 9 (Continued) Records from Italy of coprophilous *Sporormiella* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*****°.

				equine		cervine				leporine		caprine								
	beech–marten [3]	**bird [27]**	**cattle [55]**	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**fox [7]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**Hedge-hog [12]**	**marmot [5]**	**pig [5]**	**sheep [51]**	**wild pig [10]**	**unidentified animal [2]**
S. octomera										1	1									
S. octonalis			1					1									**1 (20%)**			1
S. pascua			**1 (2%)**							1										
S. pilosa					**1 (2%)**				**1 (14%)**											
S. pulchella						1														
S. teretispora			1		1															
S. trogospora						1														
S. vexans								**1 (3%)**			1						1			
Total *Sporormiella* natural state		1	18	1	8	15	3	15		14	10	2		2			4	10	1	6
Total *Sporormiella* in damp chambers**	**1**	**1 (4%)**	**19 (29%)**	**2 (33%)** **(19%)**	**14 (17%)**	**9 (25%)**	**4 (40%)** **(31%)**	**20 (38%)**	**5 (29%)**	**7 (25%)** **(44%)**	**14 (63%)**	**9 (44%)**	**4 (67%)** **(47%)**	**4 (37%)**	**1 (8%)**	**2 (40%)**	**2 (20%)**	**20 (37%)**		**3**

*****The frequency (%) is not reported when samples of a dung type are less than five.
°Records from dung in the natural state, in normal type.
Records from dung in damp chambers and frequency (%), in bold type.
******The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples**[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 10 Records from Italy of coprophilous *Gymnoascus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*****°.

	badger [2]	**bat [1]**	**bird [27]**	**cattle [55]**	**horse [63]**	**roe deer [37]**	**dormouse [4]**	**hedgehog [12]**	**pig [5]**	**sheep [51]**
G. dankaliensis				**1 (2%)**	**1 (2%)**				**1 (20%)**	**2 (4%)**
G. devroeyi		**1**				**1 (3%)**	**1**	**1 (8%)**		
G. littoralis	**1**									
G. reessii			**1 (4%)**							
G. ruber				**1 (2%)**						
Total *Gymnoascus* in damp chambers**	**1**	**1**	**1 (4%)**	**2 (4%)**	**1 (2%)**	**1 (3%)**	**1**	**1 (8%)**	**1 (20%)**	**2 (4%)**

*****The frequency (%) is not reported when samples of a dung type are less than five.
°Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.
******The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Eurotiomycetes – Eurotiomycetidae –Onygenales – Gymnoascaceae

Gymnoascus Baran. (Table 10)

Refer to the taxonomic part of this work for discussion about the facultative coprophily of Gymnoascaceae. In Italy, like elsewhere, species of *Gymnoascus* grow on a variety of dungs, where they are able to decompose substances (cellulose) unutilised by other fungi.

Eurotiomycetes – Eurotiomycetidae – Onygenales – Onygenaceae

Aphanoascus Zukal. (Table 11)

Table 11 Records from Italy of coprophilous *Aphanoascus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

		cervine			
	beech-marten [3]	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**goat [16]**
A. fulvescens	1	**1 (4%)**	**1 (10%) (4%)**	**1 (3%)**	**2 (12%)**

*The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Xanthothecium Arx & Samson (Table 12)

Table 12 Records from Italy of coprophilous *Xanthothecium* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	cattle [55]	**sheep [51]**
X. peruvianum	**1 (2%)**	**1 (2%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Like the Gymnoascaceae, the Onygenaceae are facultatively coprophilous. Their keratinolytic capability allows them to inhabit a variety of dungs, particularly carnivore dung, which contains large amounts of keratinic remnants (hairs, nails, etc.). *Xanthothecium* is an atypical Onygenacea as it is not keratinophilic (Currah 1985), but *Xanthothecium peruvianum* has frequently been isolated from carnivore dung (Stolk 1955, Cain 1957).

The keratinolytic *Aphanoascus* has often been isolated from carnivore dung and bird of prey pellets (Cain 1957, Currah 1985, Cano & Guarro 1990, Valldosera 1991, Valldosera & Guarro 1992, Doveri 2006).

Leotiomycetes – Thelebolales – Thelebolaceae

Ascozonus (Renny) E.C. Hansen. (Table 13)

Table 13 Records from Italy of coprophilous *Ascozonus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	unidentified animal [2]
A. woolhopensis	1

* The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers, in bold type.

The psychrophilic genus *Ascozonus* is absolutely coprophilous (Eckblad 1968), and most records worldwide come from leporine dung (75%). Also *A. woolhopensis* preferably develops on leporine dung (58% of records found by us) (Otani & Kanzawa 1970, Dennis 1981, Derbsch & Schmitt 1987, Prokhorov, 1989a, Valldosera & Guarro 1992, Schavey 1999, Coste & Rey 2000, Richardson 2008b).

Cleistothelebolus Malloch & Cain (Table 14)

Table 14 Records from Italy of coprophilous *Cleistothelebolus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	fox [7]
C. nipigonensis	**1 (14%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Mine is the second finding worldwide of *C. nipigonensis*. I have made a morphological, cultural and molecular study, and the work is in preparation.

Coprotus Korf & Kimbr. (Table 15)

The absolutely coprophilous genus *Coprotus* has a wide substrate tolerance (Kim brough et al. 1972), but decidedly prefers cattle and horse dung in Italy, where *C. disculus* and *C. sexdecimsporus* are the most frequent. The former does not have a particular substrate preference, while the latter preferably grows on horse and cattle dung. There are numerous records worldwide confirming the wide substrate tolerance of *C. disculus* and *C. sexedcimsporus*, but the former has a slight preference for cattle dung (Barrasa 1985, Valldosera & Guarro 1985, Korf & Zhuang 1991a, Korf & Dirig 2009), the latter a high preference (52% of records) for horse (Cooke 1864, Fuckel 1866, Phillips 1893, Bednarczyk 1974, Aas 1978, Engel & Hanff 1985, Wang 1995, Ramos et al. 2008) and cattle (Crouan & Crouan 1858, Massee 1895, Prokhorov 1989a, Abdullah & Alutbi 1994, De Meulder 2000) dung.

Thelebolus Tode (Table 16)

The psychrophilic genus *Thelebolus* is widespread worldwide, and the commonest species, *T. stercoreus s. str*., has a wide substrate tolerance and no preference for particular types of dung (de Hoog et al. 2005).

Refer to de Hoog et al. (2005) for the synonymy between *T. stercoreus* and other *Thelebolus* spp.

Pezizomycetes – Pezizomycetidae – Pezizales – Ascobolaceae

Ascobolus Pers (Table 17)

In Italy the genus *Ascobolus* is one of the commonest on dung, with 45 (8%) records from the field and 174 (10%) from damp chambers. Its frequency of occurrence on total samples is quite high (8%) and the highest frequencies are on ovine, caprine and marmot dung.

The cosmopolitan *A. immersus* is the most commonly recorded species from dung in Italy. There are 27 finding in the natural state and 98 in damp chambers (frequency of occurrence on total samples = 6%). Its preference for ovine dung is considerable (frequency = 61%). I have found 234 records worldwide, partly confirming my data, as bovine dung is the most mentioned (30% of all records) (Crouan & Crouan 1857, Coemans 1862, Denison 1963, Ahmed et al. 1971, Barrasa 1985, Derbsch & Schmitt 1987, Abdullah & Alutbi 1993, Wang 1993, 1999, De Meulder 2000a, Delgado Avila et al. 2001a, Calonge & Menezes de Sequeira 2003, García Alonso, 2007, Cheype 2008), followed by ovine (23%) (Berkeley & Broome 1865, Guarro Artigas 1983, Engel & Hanff 1984, Jahn 1997, Richardson 2005, 2008a, De Meulder 2007a) and equine (19%) (Green 1931, Marasas et al. 1966, Dissing & Raitviir 1973, Coste & Rey 1996, Van Vooren & Gaignou 2002).

I have recorded the rare *A. carletoni* only once from tetraonid dung, like most records elsewhere (Boudier 1912, van Brummelen 1967, Richardson 1972, 1998, 2007). *A. michaudii* is quite frequent on dung in Italy, particularly in damp chambers, where it has a slight preference for ovine (12%) and equine (10%) dung. Unlike mine, most records worldwide (46%) are from cattle dung (Persoon 1796, Rattan & El-Buni 1980, Aguirre-Acosta & Ulloa 1982, Abdullah & Alutbi 1993, Wang 1993, 1999, Richardson 1998).

Saccobolus Boud (Table 18)

In Italy the occurrence on dung of the genus *Saccobolus*, both in the natural and artificial state, is very similar to *Ascobolus*, but *Saccobolus* shows a high preference for equine and bovine dung, with a fairly good tolerance for other types. A lower tolerance is possessed by *S. verrucisporus* which has been recorded almost exclusively (91%) from cervine dung, with a 23% frequency on this type in culture. Records from deer dung (van Brummelen 1967, Larsen 1970, Häffner 1986, Richardson 2001b) are prevalent (28%) elsewhere, but not with the same frequency as in Italy.

S. depauperatus is very common in Italy, where it absolutely prefers equine dung (41% of records from damp chambers). I have found numerous records worldwide proving its preference for equine dung (26%) (Seaver 1928, Guarro Artigas 1983, Ranalli & Mercuri 1995a, Jahn 1997, Spooner & Butterfill 1999), but also for ovine (24%) (Raitviir & Prokhorov 1988, Valldosera 1991, Richardson 2004b, 2005, De Meulder 2007a), and a wide tolerance for other types of dung.

Table 15 Records from Italy of coprophilous *Coprotus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

			cervine					**caprine**				
	cattle [55]	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**fox [7]**	**rabbit [19]**	**goat [16]**	**rock goat [8]**	**sheep [51]**	**wild pig [10]**	**unidentified animal [2]**
C. aurora	2						1					
C. disculus	1+**1 (2%)**		1+**1 (4%)**		**1 (3%)**		1+**1 (5%)**	**1 (6%)**	**1 (12%)**		**1 (10%)**	
C. glaucellus			1		2+**1 (3%)**							
C. granuliformis	2+**4 (7%)**									1+**1 (2%)**		
C. lacteus	1				**1 (3%)**					**1 (2%)**		
C. leucopocillum		**1 (2%)**								1+**1 (2%)**		
C. aff. *luteus*	**2 (4%)**	**1 (2%)**										
C. niveus	**1 (2%)**											
C. aff. *ochraceus*												1
C. sexdecimsporus	1+**10 (18%)**	**15 (24%)**		**1 (10%)**	**4 (11%)**	**1 (14%)**	**1 (5%)**		**1 (12%)**	**4 (8%)**	**1 (10%)**	
C. subcylindrosporus		1	1		**1 (3%)**							
Total *Coprotus* in natural state	6		2		2		2			2		1
Total *Coprotus* in damp chambers**	**14 (25%)**	**17 (25%)**	**1 (4%)**	**1 (10%)** **(14%)**	**8 (22%)**	**1 (14%)**	**2 (5%)**	**1 (6%)**	**2 (12%)** **(8%)**	**7 (14%)**	**2 (20%)**	

***** The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 16 Records from Italy of coprophilous *Thelebolus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

				cervine		**leporine**		**caprine**					
	bird [27]	**cattle [55]**	**horse [63]**	**deer [24]**	**roe deer [37]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**rock goat [8]**	**porcupine [1]**	**sheep [51]**	**wild pig [10]**	**unidentified animal [2]**
T. caninus					**1 (3%)**								
T. crustaceus		1				**1 (5%)**				**1**			
T.dubius var. *lagopi*		**1 (2%)**			**1 (3%)**	1	**1 (5%)**						
T. microsporus	**1 (4%)**	1+**2 (4%)**			**1 (3%)**				**2 (25%)**		**2 (4%)**		
T. polysporus		1	1		1+**1 (3%)**		1	1+**1 (6%)**			1+**3 (6%)**	**1 (10%)**	1
T. stercoreus	**1 (4%)**	**1 (2%)**	**1 (2%)**	**1 (4%)**	4+**3 (8%)**	**2 (10%)**	1+**1 (5%)**				**2 (4%)**		**1**
Total *Thelebolus* in natural state		3	1		5		2	1			1		1
Total *Thelebolus* in damp chambers**	**2 (7%)**	**4 (5%)**	**1 (2%)**	**1 (4%)**	**7 (19%)**	**3 (15%)**	**2 (5%)**	**1 (6%)**	**2 (25%)**	**1**	**7 (14%)**	**1 (10%)**	**1**
				(13%)		**(10%)**		**(12%)**					

***** The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 17 Records from Italy of coprophilous *Ascobolus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)***°**.

			equine		cervine						leporine		caprine								ovine					
	bird [27]	cattle [55]	donkey [6]	horse [63]	deer [24]	fallow deer [10]	roe deer [37]	duck [1]	fox [7]	goose [1]	hare [20]	rabbit [19]	goat [16]	chamois [6]	rock goat [8]	hedgehog [12]	marmot [5]	marten [2]	ostrich [1]	rat [1]	sheep [51]	mouflon [1]	weasel [1]	wild pig [10]	wolf [1]	unidentified animal [2]
A. albidus		1 (2%)		1+9 (14%)	1								2 (12%)											1		
A. brassicae																				1					1	
A. carletoni	1 (4%)																									
A. costantinii																										1
A. crenulatus											1 (5%)	2 (10%)				1 (8%)				1			1	1 (10%)		1+1
A.elegans				5 (8%)																						
A. furfuraceus		5+5 (9%)		1+3 (5%)	1+1 (4%)		2 (5%)						1 (6%)		2 (25%)			1			1 (2%)			1 (10%)		
A. hawaiiensis				1																	3					
A. immersus		7+16 (29%)	3 (50%)	8+13 (21%)	1+1 (4%)	2 (20%)	2+8 (22%)		2 (28%)		4 (20%)	1+2 (10%)	1+5 (31%)	1 (17%)	5 (62%)		3 (60%)				7+30 (59%)	1		1 (10%)	1	
A. lineolatus									1 (14%)																	
A. mancus		1 (2%)	1 (17%)	1+2 (3%)									1 (6%)													
A. michaudii		2 (4%)	1 (17%)	1+6 (9%)	1 (4%)	2 (20%)						1 (5%)	1 (6%)						1		6 (12%)	1				
A. reticulatus										1																
A. roseopurpurascens																										1
A. stictoideus		1		1+1 (2%)				1												1						
Total *Ascobolus* in natural state		13	13		3		2	1				1	1					1			7				1	2
Total *Ascobolus*** in damp chambers	1 (4%)	25 (34%)	5 (67%)	40 (48%)	3 (8%)	4 (25%)	10 (24%)		3 (43%)	1	5 (25%)	5 (21%)	10 (62%)	1 (17%)	7 (87%)	1 (8%)	3 (60%)		1	3	37 (63%)	2 (63%)	1	3 (20%)	1	2
			(49%)			(21%)					(23%)			(60%)												

***** The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 18 Records from Italy of coprophilous *Saccobolus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)***°**.

		equine		cervine			leporine		caprine								
	cattle [55]	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**marmot [5]**	**pig [5]**	**sheep [51]**	**wild pig [10]**	**wolf [1]**	**unidentified animal [2]**
S. beckii	1			3+**4 (17%)**	**1 (10%)**	2+**2 (5%)**				**2 (33%)**							
S. caesariatus	**3 (5%)**							1+**2 (10%)**	**1 (6%)**		**1 (12%)**			**2 (4%)**			
S. citrinus	**2 (4%)**		**1 (2%)**	**3 (12%)**	1	**2 (5%)**								**2 (4%)**			
S. depauperatus	**3 (5%)**	**3 (50%)**	1+**25 (40%)**	**1 (4%)**	**1 (10%)**	2+**1 (3%)**	1+**1 (5%)**		**1 (6%)**			**1 (20%)**		**6 (12%)**			
S. dilutellus								1									
S. glaber	1+**5 (9%)**												**1 (20%)**	1+**1 (2%)**			1
S. minimus	**1 (2%)**	2	1+**7 (11%)**	**1 (4%)**	**2 (20%)**	**1 (3%)**			**2 (12%)**		**1 (12%)**			**4 (8%)**	**1 (10%)**		
S. saccoboloides	**1 (2%)**		**1 (2%)**			**1 (3%)**								**1 (2%)**			
S. succineus	**7 (13%)**		**2 (3%)**														
S. truncatus	**3 (5%)**		**7 (11%)**					**1 (5%)**	**1 (6%)**					**3 (6%)**			
S. verrucisporus			**1 (2%)**	3+**5 (21%)**		1+**11 (30%)**								**1 (2%)**			
S. versicolor	3+**9 (16%)**	**1 (17%)**	**2 (3%)**				**1 (5%)**	2+**3 (16%)**	**1 (6%)**		**3 (37%)**			**1 (2%)**		**1**	
Total *Saccobolus* (natural state)	5	2	2	6	1	5	1	4						1			1
Total *Saccobolus*** in damp chambers	**34 (54%)**	**4 (67%)** **(67%)**	**46 (67%)**	**14 (46%)**	**4 (30%)** **(42%)**	**8 (43%)**	**2 (10%)** **(20%)**	**6 (31%)**	**6 (31%)**	**2 (33%)** **(37%)**	**5 (50%)**	**1 (20%)**	**1 (20%)**	**21 (33%)**	**1 (10%)**	**1**	

***** The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples**[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 19 Records from Italy of coprophilous *Thecotheus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)***°**.

			cervine				caprine				
	cattle [55]	**corse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**pig [5]**	**sheep [51]**
T. cinereus	1										
T. crustaceus		**2 (3%)**								**1 (20%)**	
T. formosanus		1									
T. formosanus f. *collariatus*		1									
T. holmskjoldii	1+**10 (18%)**		1	**2 (20%)**	2+**2 (5%)**	**1 (5%)**	**3 (19%)**	**1 (17%)**			1+**7 (14%)**
T. lundqvistii	**6 (11%)**		1	**2 (20%)**	2+**1 (3%)**	**1 (5%)**	**1 (6%)**		**2 (25%)**		**3 (6%)**
T. neoapiculatus	2										
T. pelletieri	1+**1 (2%)**	**4 (6%)**	**1 (4%)**								1
T. strangulatus											1
Total *Thecotheus* in natural state	5	2	2		4						3
Total *Thecotheus* ** in damp chambers	**17 (31%)**	**6 (9%)**	**1 (4%)**	**4 (40%)** **(11%)**	**3 (8%)**	**2 (10%)**	**4 (25%)**	**1 (17%)** **(23%)**	**2 (25%)**	**1 (20%)**	**10 (20%)**

* The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Also *S. minimus* is quite frequent in Italy, where it has not a particular substrate preference. It grows on a variety of dung also elsewhere, preferably (35% of records) on sheep dung (Rattan & El-Buni 1980, Guarro Artigas 1983, Valldosera 1991, Richardson 2008c).

Thecotheus Boud (Table 19)

The genus *Thecotheus* is quite frequent in Italy, where it has a wide substrate tolerance but preferably grows on bovine and caprine dung. *T. holmskjoldii* is the most frequent (46% of all records) and has a slight preference for bovine dung.

I refer to Aas' (1992) world monograph for the most detailed information about the ecology and distribution of *Thecotheus*. In that work, the records of *T. holmskjoldii* from bovine dung are 54% out of a total of 145.

Pezizomycetes – Pezizomycetidae – Pezizales – Ascodesmidaceae

Ascodesmis Tiegh (Table 20)

Brummelen (1981) monographed *Ascodesmis* and recorded about 50 collections worldwide, more than 50% from carnivore dung. Several subsequent records have been found by me, but a minority (20%) from carnivore dung (Currah 1986, Derbsch & Schmitt 1987, Patil & Ghadge 1987, Kristiansen 1994, Jahn 1997).

Lasiobolus Sacc (Table 21)

Lasiobolus was monographed by Bezerra & Kimbrough (1975), who studied numerous collections worldwide but did not specify their dung sources.

The genus *Lasiobolus* is quite frequent in Italy, both in the natural and artificial state, and it has a wide substrate tolerance, with a preference for cervine dung in the field (38% of records), for caprine in damp chambers, followed by ovine and wild pig dung.

L. cuniculi is the most frequent (68% of records from Italy) and prefers caprine dung (30% of frequency of occurrence), particularly rock goat dung (62%). Also elsewhere its frequeny of occurrence on caprine dung is high (25% of records found by us) (Moyne 2006, De Meulder 2007b, Richardson 2004a, 2008a), and equal to ovine (Barrasa 1985, Korf & Zhuang 1991b, Richardson 2004b).

Trichobolus (Sacc.) Kimbr. & Cain (Table 22)

Trichobolus zukalii is one of the commonest discomycetes and the commonest *Trichobolus* sp. (96% of all records) in Italy. It has a fair substrate tolerance but a preference for caprine and cervine dung, particularly for goat. *T. zukalii* is less frequent elsewhere: I have found 30 records only, similar to mine, i.e. 43% from caprine, particularly goat dung (Korf & Zhuang 1991b, Valldosera 1991, Moyne 2006, Richardson 2008a,b), 33% from cervine dung (Heimerl 1889, Kimbrough 1966, Richardson 1972, 1998, Bronckers 2002, Moyne & Petit 2006).

Pezizomycetes – Pezizomycetidae – Pezizales – Pezizaceae

Iodophanus Korf (Table 23)

Iodophanus carneus is a very common discomycete in Italy, second only to *Ascobolus immersus*. It has been recorded especially from bovine dung in the natural state, and from many types of dung in damp chambers, with a marked preference for bovine, caprine, and ovine dung (61% of records from these types).

Kimbrough et al. (1969) monographed *Iodophanus* and described *I. carneus* as one of the commonest coprophilous discomycetes, particularly recording it from bovine dung (57% of records worldwide). There are more than 200 additional records worldwide, partularly from bovine (24%) (Karsten 1861, Coemans 1862, Spegazzini 1878, Heimerl 1889, Denison 1963, Bednarczyk 1974, Thind & Kaushal 1978, Mouso & Ranalli 1989, Prokhorov 1989b, Wang, 1999, De Meulder 2000a, Wang & Wang 2000, Cinto et al. 2007, Richardson 2008c) and ovine dung (23%) (Ahmed et al. 1971, Guarro Artigas 1983, Barrasa 1985, Abdullah & Alutbi 1993, Richardson 2004b, 2005, 2008b,c).

Peziza Fr. (Table 24)

Collections of coprophilous *Peziza* spp. are very scarce in Italy, and the overwhelming majority of records are from the field. Only *P. fimeti* has been recorded once from a damp

Table 20 Records from Italy of coprophilous *Ascodesmis* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*****°.

	badger [2]	**beech-marten[3]**	**bird [27]**	**rabbit [19]**	**hedgehog [12]**	**insect [9]**	**ostrich [1]**	**pig [5]**	**rat [1]**	**sheep [51]**	**toad [2]**
A. microscopica					**1 (8%)**	**1 (11%)**				**1 (2%)**	
A. nana			**1 (4%)**								
A. nigricans	**2**	**1**	**2 (7%)**	**1 (5%)**			**1**	**1 (20%)**	**1**		**1**
Total *Ascodesmis* ** in damp chambers			**3 (11%)**	**1 (5%)**	**1 (8%)**	**1 (11%)**		**1 (20%)**		**1 (2%)**	

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type.

°Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 21 Records from Italy of coprophilous *Lasiobolus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*****°.

		equine		**cervine**				**leporine**		**caprine**										
	cattle [55]	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**fox [7]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**marmot [5]**	**marten [2]**	**pig [5]**	**porcupine [1]**	**rat [1]**	**sheep [51]**	**wild pig[10]**	**unidentified animalm[2]**
L. ciliatus	4		7+**2 (3%)**	1		1			1			**1 (12%)**						1		
L. cuniculi	5+**3 (5%)**		2+**7 (11%)**	4	2+**2 (20%)**	3+**5 (13%)**		**1 (5%)**		1+**4 (25%)**		**5 (62%)**	**1 (20%)**			**1**		6+**12 (23%)**	**2 (20%)**	2
L. diversisporus	2		**1 (2%)**									**1 (12%)**								
L. intermedius		**1 (17%)**				**1 (3%)**												1+**1 (2%)**		
L. macrotrichus				**1 (4%)**		**1 (3%)**				1				**1**				1		
L. microsporus			**1 (2%)**							**1 (6%)**					**1 (20%)**		**1**		**1 (10%)**	
L. monascus							**1 (14%)**													
L. ruber	1			3		3					**1 (17%)**									
Total *Lasiobolus* in natural state	12		4	9	2	7			1	2								8		2
Total *Lasiobolus* in damp chambers **	**3 (5%)**	**1 (17%)**	**11 (17%)** **(17%)**	**1 (4%)**	**2 (20%)** **(14%)**	**7 (19%)**	**1 (14%)**	**1 (5%) (3%)**		**5 (31%)**	**1 (17%)** **(43%)**	**7 (87%)**	**1 (20%)**	**1**	**1 (20%)**	**1**	**1**	**13 (25%)**	**3 (30%)**	

***** The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. °Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]** The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 22 Records from Italy of coprophilous *Trichobolus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*****°.

		cervine			leporine		caprine							
	cattle [55]	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**marmot [5]**	**marten [2]**	**sheep [51]**	**wild pig [10]**	**unidentified animal [2]**
T. octosporus						**1 (5%)**								
T. sphaerosporus				1										
T. zukalii	1+**2 (4%)**	1+**2 (8%)**	1+**3 (30%)**	4+**10 (27%)**	**1 (5%)**	1	1+**9 (56%)**	**1 (17%)**	1	**1 (20%)**	**1**	3+**8 (16%)**	**1 (10%)**	1
Total *Trichobolus* in natural state	1	1	1	5		1	1		1			3		1
Total *Trichobolus* in damp chambers **	**2 (4%)**	**2 (8%)**	**3 (30%)** **(21%)**	**10 (27%)**	**1 (5%)** **(5%)**	**1 (5%)**	**9 (56%)** **(33%)**	**1 (17%)**		**1 (20%)**	**1**	**8 (16%)**	**1 (10%)**	

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type.

° Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]** The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 23 Records from Italy of coprophilous *Iodophanus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*****°.

				cervine				leporine		caprine										
	bird [27]	**cattle [55]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**goose [1]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**insect [9]**	**marmot [5]**	**mouse [2]**	**rat [1]**	**sheep [51]**	**snail [1]**	**tortoise [2]**	**unidentified animal [2]**
I. carneus	**3 (11%)**	8+**24 (44%)**	1+**8 (13%)**	1+**2 (8%)**	**1 (10%)**	**8 (22%)**	**1**	**2 (10%)**	**2 (10%)**	**5 (31%)**	**2 (33%)**	**5 (62%)**	**1 (11%)**	**1 (20%)**	**1**	**1**	1+**17 (33%)**	**1**	**2**	1
I. difformis		**1(2%)**																		
Total *Iodophanus* in natural state		8	1	1													1			1
Total *Iodophanus* in damp chambers**	**3 (11%)**	**25 (45%)**	**8 (13%)**	**2 (8%)**	**1 (10%)** **(15%)**	**8 (22%)**	**1**	**2 (10%)** **(10%)**	**2 (10%)**	**5 (31%)**	**2 (33%)** **(40%)**	**5 (62%)**	**1 (11%)**	**1 (20%)**	**1**	**1**	**17 (33%)**	**1**	**2**	

***** The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 24 Records from Italy of coprophilous *Peziza* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*****°.

	equine		cervine				
	donkey [6]	**horse [63]**	**deer [24]**	**fallow deer [10]**	**human [0]**	**sheep [51]**	**unidentifiedanimal [2]**
P. fimeti		3+**1 (2%)**	1	**1 (10%)**			1
P. merdae					1		1
P. perdicina						1	
P. vesiculosa	1	6					
Total *Peziza* in natural state	1	9	1		1	1	2
Total *Peziza* in damp chambers		**1 (2%)** **(1%)**		**1 (10%)** **(3%)**			

***** The frequency (%) is not reported when samples of a dung type are less than five.

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 25 Records from Italy of coprophilous *Chalazion* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	Hedgehog [12]
C. erinaceum	**1 (8%)**

° Records from dung in damp chambers and frequency (%), in bold type.

chamber. *P. vesiculosa* is the most frequent in the natural state, and absolutely prefers equine dung (67% of collections). It is a cosmopolitan species, which preferably grows (56% of records found by us) on equine dung or manure (Dodge 1914, Jülich 1968, Donadini 1979, Barrasa 1985, Derbsch & Schmitt 1987, Arroyo et al. 1990, Calonge et al. 1991, Siquier & Lillo 1994, Hansen et al. 2000).

Pezizomycetes – Pezizomycetidae – Pezizales – Pyronemataceae

Chalazion Dissing & Sivertsen (Table 25)

Refer to Doveri et al. (1998b) for the original diagnosis of *C. erinaceum*, which is known so far only from the type collection. The other two *Chalazion* spp., *C. sociabile* Dissing & Sivertsen and *C. helveticum* Dissing, are terricolous (Dissing & Sivertsen 1975, Dissing 1980, Kristiansen 1990).

Cheilymenia Boud. (Table 26)

The cosmopolitan genus *Cheilymenia* does not develop in damp chambers in Italy, so all records (40) are from the field, mostly from cattle (72%) and horse (17%) dung. *C. granulata*, *C. stercorea*, and *C. theleboloides* are the most frequent, all with preference for cattle dung.

The genus was monographed by Moravec (2005), who confirmed "the impossibility, with only few exceptions, to obtain fresh apothecia by an incubation of dung in moist chambers". He studied numerous world collections of *C. granulata* (87% of records from cattle dung), *C. stercorea* (66% from cattle dung), and *C. theleboloides*, the latter with a wide range of substrate tolerance, but with preference for cattle dung (50% of fimicolous records).

Orbicula Cooke (Table 27)

See the taxonomic part of this work for discussion about *Orbicula*.

Pseudombrophila Boud. (Table 28)

Pseudombrophila is the only genus of *Pyronemataceae* to easily develop also in damp chamber cultures (50% of my records). It does not grow frequently in Italy, so it is too early to estimate its occurrence on different types of dung. The genus was monographed by van Brummelen (1995) who regarded it as predominantly fimicolous and, like us, recorded *P. cervaria* particularly (55%) from deer dung.

Scutellinia (Cooke) Lambotte (Table 29)

Scutellinia is exceptionally coprophilous and *S. crinita* has rarely been found on excrements (Schumacher 1990).

Trichophaea Boud. (Table 30)

Trichophaea spp. usually grow on bare or burnt soils, humus, and decaying woody debris, while they have rarely been recorded from dung (Valldosera & Guarro 1990a, Häffner & Christan 1991, Jamoni 1998). As far as I know, no collection of *T. gregaria*, except for mine, is known from dung.

Sordariomycetes – Sordariomycetidae – Coniochaetales – Coniochaetaceae

Coniochaeta (Sacc.) Cooke (Table 31)

Coprophilous collections of *Coniochaeta* are quite infrequent in Italy (less than 1% of records from damp chambers), and *C. leucoplaca* is the commonest species on a variety of dungs, while it has been recorded elsewhere particularly from bovine (26% of records found by us) (Griffiths 1901, Khan & Krug 1994, Richardson 2008b) and leporine dung (23%) (Cain 1957, Tóth 1967, Muroi & Udagawa 1984, Valldosera & Guarro 1984b, Valldosera 1991, Moyne & Petit 2006).

Sordariomycetes – Hypocreomycetidae – Hypocreales – Bionectriaceae

Selinia P. Karst. (Table 32)

The four recognised *Selinia* spp. have always been recorded from dung of various herbivores, and *S. pulchra* particularly from bovine (34% of records found by me worldwide) (Wang 1994, Ranalli & Mercuri 1995b, Rossman et al. 1999) and ovine (34%) dung (Saccardo 1878, Richardson 2001b, 2004b, Welt & Heine 2006a).

Sordariomycetes – Hypocreomycetidae – Hypocreales – Nectriaceae

Neocosmospora E.F. Sm. (Table 33) *Neocosmospora* spp. are usually isolated from soil or plants. *N. vasinfecta* var. *vasinfecta* is pathogenic on crops (Rossman et al.

Table 26 Records from Italy of coprophilous *Cheilymenia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	cattle [55]	**horse [63]**	**dog [0]**	**human [0]**	**unidentified animal [2]**
C. aurantiacorubra	2	1			1
C. coprinaria	2	1			
C. dennisii		1			1
C. fraudans	1				
C. granulata	6				
C. insignis	3				
C. pulcherrima	2				
C. rubra	2	1			
C. stercorea	6	1			
C. theleboloides	5	2	1	1	
Total *Cheilymenia* in natural state	29	7	1	1	2

° Records from dung in the natural state, in normal type. Records from dung in damp chambers, in bold type.

Table 27 Records from Italy of coprophilous *Orbicula* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	hare [20]
O. parietina	**1 (5%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 28 Records from Italy of coprophilous *Pseudombrophila* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

			cervine						
	cattle [55]	**horse [63]**	**deer [24]**	**roe deer [37]**	**rabbit [19]**	**goat [16]**	**marten [2]**	**sheep [51]**	**unidentified animal [2]**
P. bulbifera					1				
P. cervaria			**1 (4%)**	2			**1**	1	
P. fuscolilacina								1	
P. merdaria	3				**1 (5%)**				1
P. minuta		**1 (2%)**				**1 (6%)**		**1 (2%)**	
P. theioleuca				**2 (5%)**		**1 (6%)**			
Total *Pseudombrophila* in natural state	3			2	1			2	1
Total *Pseudombrophila* in damp chambers**		**1 (2%)**	**1 (4%) 2 (5%) (5%)**		**1 (5%)**	**2 (12%)**	**1**	**1 (2%)**	

***** The frequency (%) is not reported when samples of a dung type are less than five.
° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.
** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 29 Records from Italy of coprophilous *Scutellinia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	unidentified animal [2]
S. crinita	1

° Records from dung in the natural state, in normal type. Records from dung in damp chambers, in bold type.

Table 30 Records from Italy of coprophilous *Trichophaea* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	unidentified animal [2]
T. gregaria	1

° Records from dung in the natural state, in normal type. Records from dung in damp chambers, in bold type.

Table 31 Records from Italy of coprophilous *Coniochaeta* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

			cervine					
	cattle [55]	**horse [63]**	**deer [24]**	**roe deer [37]**	**rabbit [19]**	**chamois [6]**	**rock goat [8]**	**pig [5]**
C. leucoplaca	2+**3 (5%)**	**1 (2%)**	**1 (4%)**	**1 (3%)**	**2 (10%)**	**1 (17%)**		
C. scatigena					**1 (5%)**			**1 (20%)**
C. vagans	1+**2 (4%)**	1+**1 (2%)**	1		1		**1 (12%)**	
Total *Coniochaeta* in natural state	3	1	1		1			
Total *Coniochaeta* in damp chambers**	**5 (9%)**	**2 (3%)**	**1 (4%)** **(3%)**	**1 (3%)**	**3 (15%)**	**1 (17%)**	**1 (12%)**	**1 (20%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples**. [ ]** The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 32 Records from Italy of coprophilous *Selinia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	cattle [55]	**sheep [51]**
S. pulchra	**1 (2%)**	**1 (2%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 33 Records from Italy of coprophilous *Neocosmospora* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	rabbit [19]
N. vasinfecta var. *vasinfecta*	**1 (5%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 34 Records from Italy of coprophilous *Rodentomyces* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	dormouse [4]
R. reticulatus	**1**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers, in bold type.

1999), and it has exceptionally isolated from dung (Cailleux 1971a).

Rodentomyces Doveri, Pecchia, Sarrocco & Vannacci (Table 34)

Refer to Doveri et al. (2010a) for the protologue of *Rodentomyces* gen. nov., *R. reticulatus* sp. nov.

Sordariomycetes – Hypocreomycetidae – Melanosporales – Ceratostomataceae

Melanospora Corda (Table 35)

The genus *Melanospora* is usually isolated from decaying vegetables and soil, or detected in association with other fungi, also on dung, possibly behaving as a mycoparasite (Cannon & Hawksworth 1982). Coprophilous collections of *Melanospora* are unusual (Faurel & Schotter 1965, Calviello 1976, Lorenzo 1990, Richardson 2004a, 2008b), and I have rarely found records of *M. brevirostris* (Hansen et al. 1998, Delgado Avila et al. 2001b, Moyne et Petit 2006) and *M. zamiae* (Seth 1968, Lorenzo 1992, Valldosera & Guarro 1992, Piontelli et al. 2006) directly from dung.

Persiciospora P.F. Cannon & D. Hawksw. (Table 36)

Mine and Eriksson's (2009) are the only three collections of *Persiciospora* known from dung, where it possibly behaves as a mycoparasite (Cannon & Hawksworth 1982).

"*Sordaria*" *minima* (Table 37)

"*Sordaria*" *minima* is possibly a *Melanospora* sp. (Lundqvist pers. comm.), but it has not been recombined yet in this genus. Like some *Melanospora* spp., this rare species has been found on dung in association with other fungi, particularly with *Thelebolus* (Lund qvist pers. comm.). Besides mine, a few other collections of *S. minima* have been recorded from various kinds of dung (Massee & Salmon 1901, Larsen 1971, Richardson 1998, 2004b, Moyne & Petit 2006, Welt & Heine 2007).

Sordariomycetes – Hypocreomycetidae – Microascales – Microascaceae

Enterocarpus Locq.–Lin. (Table 38)

See the taxonomic part of this work, under *Lophotrichus bartlettii*, for discussion on *Enterocarpus grenotii*.

Kernia Nieuwl. (Table 39)

K. nitida is the commonest species of this genus, found by me in Italy on a variety of dungs with low frequency of occurrence in damp chambers (1%). Like other *Kernia* spp. and many Microascaceae with a cellulytic and proteolytic activity (Lumley et al. 2000), it has been found on a variety of substrates and dungs, particularly (24% of fimicolous records worldwide) on sheep dung (Tóth 1965, 1967, Udagawa 1980, Guarro Artigas 1983, Valldosera 1991, Richardson 2004a).

Lophotrichus R.K. Benj. (Table 40)

See the taxonomic part of this work, under *Lophotrichus bartlettii*, for discussion on *Lophotrichus*.

Pithoascus Arx (Table 41)

See the taxonomic part of this work, under *Pithoascus intermedius*, for discussion on Microascaceae, *Pithoascus*, and *Microascus*.

Sphaeronaemella P. Karst. (Table 42)

Out of five recognised species of *Sphaeronaemella* (Kirk et al. 2008), only one, *S. fimicola*, has been isolated from dung, where it can behave as a facultative mycoparasite (Cain & Weresub 1957, Weber & Webster 1997, 1998). *S. fimicola* has a wide substrate tolerance, carnivore dung included (Marchal 1891, Pease 1948, Cain 1957), but it prefers leporine (32% of several records worldwide) (Massee & Salmon 1902, Dennis 1981) and cervine (26%) (Cannon & Hawksworth 1982, Lundqvist 1989) dung.

Sordariomycetes – Sordariomycetidae – Sordariales – Chaetomiaceae

Chaetomidium (Zopf) Sacc. (Table 43)

See the taxonomic part of this work, under *Chaetomidium fimeti*, for discussion on the genus *Chaetomidium*, *C. megasporum*, and *C. fimeti*.

Table 35 Records from Italy of coprophilous *Melanospora* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	badger [2]	**dormouse [4]**	**sheep [51]**
M. brevirostris		1	
M. zamiae	**1**		**1 (2%)**
Total *Melanospora* in damp chambers**	**1**	**1**	**1 (2%)**

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 36 Records from Italy of coprophilous *Persiciospora* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	fox [7]	**polecat [5]**
P. moreaui	**1 (14%)**	**1 (20%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 37 Records from Italy of "*Sordaria*" *minima* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	roe deer [37]	**rabbit [19]**
S. minima	**1 (3%)**	**1 (5%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 38 Records from Italy of coprophilous *Enterocarpus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	horse [63]
E. grenotii	**1 (2%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 39 Records from Italy of coprophilous *Kernia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	cattle [55]	**horse [63]**	**goat [16]**	**ostrich [1]**	**pig [5]**	**sheep [51]**	**unidentified animal [2]**
K. cauquensis						**1 (2%)**	**1**
K. nitida	**5 (9%)**	**4 (6%)**	**1 (6%)**	**1**	**1 (20%)**	2+**4 (8%)**	
Total *Kernia* in natural state						2	
Total *Kernia* in damp chambers**	**5 (9%)**	**4 (6%)**	**1 (6%)**	**1**	**1 (20%)**	**5 (10%)**	**1**

***** The frequency (%) is not reported when samples of a dung type are less than five.
° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.
** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 40 Records from Italy of coprophilous *Lophotrichus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	sheep [51]
L. bartlettii	**1 (2%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 41 Records from Italy of coprophilous *Pithoascus* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	pig [5]
P. intermedius	**1 (20%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 42 Records from Italy of coprophilous *Sphaeronaemella* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	sheep [51]
S. fimicola	**2 (4%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type

C. cephalothecoides is quite common in Italy, particularly on polecat and goat dung. It is less frequent elsewhere, and recorded from mouse (Malloch & Benny 1973) and sheep dung (Valldosera & Guarro 1992, Moyne & Petit 2006).

Chaetomium Kunze (Table 44)

The genus *Chaetomium* is not obligetorely coprophilous, and non-coprophilous collections show a wide substrate tolerance, like those from dung. It is quite frequent in my damp chamber cultures (8% of records), exceeded only by *Podospora* (14%), *Ascobolus* (10%), *Saccobolus* (9%), and *Schizothecium* (9%), and it has the highest frequency on wild pig and leporine dung.

C. bostrychodes is the most frequent in Italy (47% of all *Chaetomium* records from damp chambers), and it particularly occurs on wild pig, hedgehog, rabbit, and bird dung. It is very common elsewhere, and I have found a lot of records from dung, particularly from leporine (36%) (Marchal 1884a, Tóth 1963, Dennis 1986, Valldosera 1991, Malaval 2004, Favre 2008, Richardson 2008b), also from carnivore (9%) (Mouton 1886, Bainier 1909, Palliser 1910, Stratton 1921, Meyer 1941).

Also *C. globosum* and *C. murorum* are fairly common on a variety of dungs in Italy. Both are widespread worldwide and have a wide substrate tolerance. Coprophilous collections of *C. globosum* have been recorded also from carnivore dung (4% of records found by me) (Skolko & Groves 1953, Seth 1970), especially from leporine (16%) (Udagawa 1960, Calviello 1971, Roy 1971, Lorenzo 1993), cervine (15%) (Tóth 1965, 1967, Caretta & Piontelli 1996, Cruys & Ericson 2008, Piasai & Manoch 2009), and bovine (14%) (Ahmed et al. 1971, Jeamjitt et al. 2007) dung.

C. murorum has been recorded from a variety of dungs, carnivore included (6% of all records worldwide) (Karsten 1888, Skolko & Groves 1953, Ames 1963, Hubálek 1974), but I have found that it has a slight preference (19% of records) for leporine droppings (Mirza & Nasir 1968, Seth 1968, Piontelli et al. 2006, Favre 2008).

Sordariomycetes – Sordariomycetidae – Sordariales – Lasiosphaeriaceae

Arnium Nitschke ex G. Winter (Table 45)

The genus *Arnium* has a slow development on dung in damp chambers, and its frequency of occurrence has possibly been underestimated by me, as it often grows semi- to almost fully immersed. Leaving out its frequency on pig dung (few samples incubated), it prefers bovine and cervine dung in Italy. *A. arizonense* is the commonest species, with the higest occurrence on bovine dung, while the less common *A. cervinum* has been isolated from cervine dung exclusively.

A. arizonense is widespread worldwide, and there are many records (28%) from bovine dung (Lundqvist 1972, Rattan & El-Buni 1980, Lorenzo & Havrylenko 2001), but also many (27%) from ovine (Valldosera 1991, Richardson 2008a,b), while the seven, mostly

European, collections of *A. cervinum* are known from cervine droppings only (Lundqvist 1972, 1974, 1989).

Bombardioidea C. Moreau ex N. Lundq. (Table 46)

Lundqvist (1972) described the European species of *Bombardioidea*, and Krug & Scott (1994) produced a world monograph of this genus, which preferably grows on leporine and cervine dung.

B. stercoris is widespread but uncommon, and mostly grows on leporine (90% of world records), particularly hare (67%) dung (Winter 1887, Cain 1957, Lundqvist 1972, Muroi & Udagawa 1984, Valldosera 1991, Lorenzo 1992, Krug & Scott 1994, Leenurm 1998, Richardson 2005, 2008b, Moyne & Petit 2006, Eriksson 2009).

Cercophora Fuckel (Table 47)

Lundqvist (1972) widely described the nordic species of *Cercophora*, and Doveri (2004a) provided a world key to coprophilous species.

Cercophora is uncommon in Italy and restricted to bovine and equine dung. These types of dung are the most preferred also elsewhere (Lundqvist 1972).

I have found *C. mirabilis* both in the natural state and in damp chambers, always on cattle dung, and there are records worldwide (78%) confirming its marked preference for bovine dung (Lundqvist 1972, 1981, Udagawa & Muroi 1979, Barrasa & Moreno 1984, Barrasa 1985, Wang 1994, Chang & Wang 2005, Richardson 2008c; Eriksson 2009).

Fimetariella N. Lundq. (Table 48)

The fimicolous genus *Fimetariella* was monographed by Krug (1995), who also studied its phylogenetic relationships, and recorded the rare *F. microsperma* from North and Central America and Europe. The European collections of *F. microsperma* are recorded from the Mediterranean area (Richardson, Lundqvist in Krug 1995, Richardson 2008b), all from cattle dung, another collection from goat dung in the Canary Islands (Lundqvist 1997), whereas the North and Central American records (Krug 1995) are from American moose and burro dung.

Podospora Ces. (Table 49)

Mirza & Cain (1969) and Lundqvist (1972) monographed *Podospora* and Doveri (2008b) provided a key to the species and a world bibliography.

Podospora is the most common coprophilous genus in Italy, with 41 (7%) records from the field and 240 (14%) from my damp chambers, and with the higest frequency of occurrence (39%) on all incubated samples. It preferably grows on equine (67% frequency), leporine (67%) and bovine (65%) dung, and is represented by a wide variety of species on horse and cattle dung (number of records/ number of dung samples = >1).

In Italy *P. decipiens* is one of the commonest coprophilous pyrenomycetes *s.l.* (7% of records from damp chambers), second only to *Sordaria fimicola*. It has a wide substrate tolerance, but absolutely prefers bovine dung. Lundqvist (1972) verified 286 findings worldwide of this very common and widespread species and stated that "it is fastidious in its substrate choice" as 75% of all records are from cow and horse dung" and "the gap to the third preferred matrix (5%) is large". After Lundqvist, I have found 81 records worldwide, which prove a larger substrate tolerance and a smaller gap, as 31% are from horse (Abdullah & Rattan 1978, Caillet & Moyne 1983, Barrasa 1985, Bokhary et al. 1989, Beyer 1999) and cattle (García-Zorrón 1973, Dennis 1981, Khan & Krug 1989, Wang 1994), 30% from ovine (Lundqvist 1973, Rattan & El–Buni 1980, Guarro Artigas 1983, Wang 2000, Richardson 2005, 2008a,b), 17% from leporine dung (Slupinski 1991, Moyne & Petit 2006). Adding these latest records to Lundqvist's and mine from Italy, I have 38% from bovine dung, 26% from equine, 11% from ovine, and 10% from leporine.

Lundqvist (1972) also verified findings worldwide of *P. myriaspora* and *P. pleiospora*, two less common species morphologically similar to *P. decipiens*, but the former with64-spored asci, the latter with 16–32-spored asci, and he concluded that *P. myriaspora* is linked to cow and horse dung (64% of records), while

Table 43 Records from Italy of coprophilous *Chaetomidium* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

					cervine			leporine											
	beech–marten [3]	**bird [27]**	**cattle [55]**	**horse [63]**	**fallow deer [10]**	**roe deer [37]**	**goose [1]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**hedgehog [12]**	**insect [9]**	**lizard [3]**	**marmot [5]**	**pig [5]**	**polecat [5]**	**sheep [51]**	**tortoise [2]**	**weasel [1]**
C. cephalothecoides	**2**	**4 (15%)**	**2 (4%)**	**4 (6%)**	**1 (10%)**	**3 (8%)**	**1**	**2 (10%)**	**3 (16%)**	**5 (31%)**	**2 (17%)**	**1 (11%)**	**2**	**1 (20%)**	**1(20%)**	**2(40%)**	**8 (16%)**	**1**	**1**
C. fimeti				**1 (2%)**															
C. megasporum			1																
Total *Chaetomidium* in natural state			1																
Total *Chaetomidium* in damp chambers**	**2**	**4 (15%)**	**2 (4%)**	**5 (8%)**	**1 (10%)** **(8%)**	**3 (8%)**	**1**	**2 (10%)** **(13%)**	**3 (16%)**	**5 (31%)**	**2 (17%)**	**1 (11%)**	**2**	**1 (20%)**	**1 (20%)**	**2 (40%)**	**8 (16%)**	**1**	**1**

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 44 Records from Italy of coprophilous *Chaetomium* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

						equine		cervine						leporine		caprine									ovine							
	badger[2]	bat [1]	beech-marten[3]	bird[27]	cattle[55]	donkey[6]	horse[63]	deer[24]	fallow deer [10]	roe deer [37]	dormouse[4]	fox[7]	gecko [1]	hare[20]	rabbit[19]	goat [16]	chamois[6]	hedgehog[12]	lizard[3]	mouse [2]	pig[5]	polecat[5]	porcupine[1]	rat[1]	sheep[51]	mouflon[1]	snail[1]	squirrel[3]	toad[2]	tortoise[2]	weasel[1]	wild pig[10]
C. ancistrocladum											1																					
C. bostrychodes	1		2	1+8 (30%)	1 (2%)		4 (6%)		2 (20%)	3 (8%)	1	2 (28%)	1	3 (15%)	1+6 (31%)	1 (6%)	1 (17%)	4 (33%)	3	1		1 (20%)	1	1	9 (18%)		1	1	2	1	1	4 (40%)
C. carinthiacum				1 (4%)																												
C. crispatum										1 (3%)																						
C. cuniculorum														1+2 (10%)	3 (16%)										1 (2%)							
C. elatum							1																		1 (2%)							
C. funicola							2 (3%)			1 (3%)				1 (5%)																		
C. fusisporum																									1 (2%)							
C. gangligerum					1 (2%)			1		1 (3%)						1 (6%)									1 (2%)							
C. globosum	1			1 (4%)	1		2 (3%)				2			1+1 (5%)				1 (8%)							2 (4%)							
C. homopilatum										1 (3%)																						
C. medusarum				1 (4%)																												
C. mollicellum			1									1 (14%)						1 (8%)	2					1								2 (20%)
C. murorum		1			1 (2%)						2			1 (5%)	1 (5%)			1 (8%)							4 (8%)	1	1					
C. oblatum						1 (17%)																										
C. robustum	1+1									1 (3%)	3				2 (10%)				1								1					
C. semencitrulli				1 (4%)	1 (2%)																		1								1	
C. spinosum					2 (4%)																											
C. subaffine					2 (4%)																1 (20%)											
C. trigonosporum																						1 (20%)										

Table 44 (Continued) Records from Italy of coprophilous *Chaetomium* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

						equine		cervine						leporine		caprine									ovine							
	badger[2]	**bat [1]**	**beech-marten[3]**	**bird[27]**	**cattle[55]**	**donkey[6]**	**horse[63]**	**deer[24]**	**fallow deer [10]**	**roe deer [37]**	**dormouse[4]**	**fox[7]**	**gecko [1]**	**hare[20]**	**rabbit[19]**	**goat [16]**	**chamois[6]**	**hedgehog[12]**	**lizard[3]**	**mouse [2]**	**pig[5]**	**polecat[5]**	**porcupine[1]**	**rat[1]**	**sheep[51]**	**mouflon[1]**	**snail[1]**	**squirrel[3]**	**toad[2]**	**tortoise[2]**	**weasel[1]**	**wild pig[10]**
C. variostiolatum					**2 (4%)**									**1 (5%)**																		
Total *Chaetomium* in natural state	1			1			1	1						2	1																	
Total *Chaetomium* in damp chambers**	**3**	**1**	**3**	**12 (37%)**	**10 (14%)**	**1 (17%)** **(12%)**	**8 (11%)**	**2 (20%)** **(13%)**		**8 (19%)**	**9**	**3 (43%)**	**1**	**9 (35%)** **(46%)**	**12 (58%)**	**2 (12%)** **(14%)**	**1 (17%)**	**7 (42%)**	**6**	**1**	**1 (20%)**	**2 (40%)**	**2**	**2**	**19 (31%)** **(33%)**	**1**	**3**	**1**	**2**	**1**	**2**	**6 (60%)**

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 45 Records from Italy of coprophilous *Arnium* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

			cervine			
	cattle [55]	**horse [63]**	**deer [24]**	**roe deer [37]**	**sheep [51]**	**pig [5]**
A. arizonense	2+**13 (24%)**		1		2+**8 (16%)**	
A. caballinum	1	**2 (3%)**	**2 (8%)**			
A. cervinum			**3 (12%)**	2+**3 (8%)**		
A. imitans			1+**4 (17%)**	**4 (11%)**		
A. inaequilaterale				**1 (3%)**		**1 (20%)**
A. septosporum						**1 (20%)**
A. sudermanniae			1			
Total *Arnium* in natural state	3		3	2	2	
Total *Arnium* in damp chambers**	**13 (24%)**	**2 (3%)**	**9 (25%)** **(20%)**	**8 (16%)**	**8 (16%)**	**2 (40%)**

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type.
° Records from dung in damp chambers and frequency (%), in bold type.
** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 46 Records from Italy of coprophilous *Bombardioidea* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	rabbit [19]
B. stercoris	**1 (5%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 47 Records from Italy of coprophilous *Cercophora* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	cattle [55]	**horse [63]**
C. anisura		**1 (2%)**
C. coprophila	2	
C. gossypina	1	
C. mirabilis	2+**1 (2%)**	
C. septentrionalis		**1 (2%)**
Total *Cercophora* in natural state	5	
Total *Cercophora* in damp chambers**	**1 (2%)**	**2 (3%)**

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 48 Records from Italy of coprophilous *Fimetariella* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	cattle [55]
F. microsperma	**1 (2%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 49 Records from Italy of coprophilous *Podospora* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

					equine		cervine				leporine		caprine								
	badger [2]	**beech–marten [3]**	**bird [27]**	**cattle [55]**	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**duck [1]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**hedgehog [12]**	**lizard [3]**	**marmot [5]**	**pig [5]**	**sheep [51]**	**wild pig [10]**
P. alexandri						1															
P. anserina			**1 (4%)**	**3 (5%)**	**1 (17%)**	2+**8 (13%)**	1		1		**1 (5%)**	**3 (16%)**						**1 (20%)**		1+**5 (10%)**	
P. australis				**1 (2%)**		**3 (5%)**		**1 (10%)**	1+**2 (5%)**		**1 (5%)**	**1 (5%)**	**2 (12%)**							**1 (2%)**	
P. bifida						**1 (2%)**														**1 (2%)**	
P. communis				**10 (18%)**	**1 (17%)**	**10 (16%)**	1		**1 (3%)**			**1 (5%)**	**1 (6%)**							**3 (6%)**	
P. curvicolla								**1 (10%)**	1		**1 (5%)**	1+**2 (10%)**									
P. dasypogon				**1 (2%)**																	
P. decipiens				10+**24 (44%)**	1	2+**18 (28%)**	3+**2 (8%)**	**1 (10%)**	1+**4 (11%)**		**4 (20%)**	**1 (5%)**	1	**1 (17%)**	**2 (25%)**				**1 (20%)**	2+**16 (31%)**	1
P. excentrica												**1 (5%)**									
P. fimiseda				5+**4 (7%)**		1+**3 (5%)**					**1 (5%)**									**2 (4%)**	
P. gigantea				1																	
P. globosa				**1 (2%)**								**1 (5%)**									
P. granulostriata							1		**1 (3%)**											**1 (2%)**	
P. intestinacea				**1 (2%)**		**3 (5%)**													1		
P. myriaspora					**1 (17%)**	**4 (6%)**			**1 (3%)**				**1 (6%)**							1	
P. pleiospora				1+**1 (2%)**		**3 (5%)**	1		**1 (3%)**		**5 (25%)**	1+**5 (26%)**	**1 (6%)**							1	
P. pyriformis				**6 (11%)**																**1 (2%)**	
P. setosa	**1**	**1**	**3 (11%)**	**5 (9%)**	1	2+**12 (19%)**	**1 (4%)**	**3 (30%)**	1+**1 (3%)**	**1**		1+**3 (16%)**	**5 (31%)**			**1 (8%)**	**1**			3+**11 (21%)**	**1 (10%)**
Total *Podospora* in natural state				7	2	8	7		5			3	1						1	8	1
Total *Podospora* in damp chambers**	**1**	**1**	**4 (11%)**	**56 (65%)**	**3 (50%)**	**65 (68%)**	**3 (8%)**	**6 (30%)**	**11 (24%)**	**1**	**13 (45%)**	**18 (89%)**	**10 (37%)**	**1 (17%)**	2 **(25%)**	**1 (8%)**	**1**	**1 (20%)**	**1 (20%)**	**41 (49%)**	**1 (10%)**
					(67%)		**(20%)**				**(67%)**		**(30%)**								

***** The frequency (%) is not reported when samples of a dung type are less than five.
° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.
** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples**[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

P. pleiospora to leporine (hare and rabbit) dung (83%). My data from Italy partly confirm Lundqvist's, as 62% of *P. myriaspora*records are from equine dung (none from bovine) and the percentage of *P. pleiospora* records from leporine dung is lower (55% versus 83%). After Lundqvist (1972), *P. myriaspora* has frequently (56%) been recorded from bovine and equine dung (Lundqvist 1973, Jahn 1993, Wang 1994, 2000, Leenurm 1998), and *P. pleiospora* from leporine (56%) (Dennis 1981, Lundqvist 1973, 1981, Muroi & Udagawa 1984, Barrasa 1985, Valldosera 1991, Jahn 1993, Lorenzo & Havrylenko 2001, Beyer 2004, Hu et al. 2006, Moyne & Petit 2006, Richardson, 2008b).

Schizothecium Corda (Table 50)

In Italy *Schizothecium* is one of the commonest pyrenomycetous genera on dung, both in the field and in damp chambers (9% of records), and it shows a wide substrate tolerance with a slightly higer frequency of occurrence on cattle dung. *S. conicum* is very frequent in Italy (4% of all ascomycete records from dung) and the third commonest pyrenomycete *s.l.* (9% of pyrenomycete and 55% of *Schizothecium* records), following *Sordaria fimicola* and *Podospora decipiens*. It grows on a variety of dungs, but it has a marked preference for bovine (44% of frequency in damp chambers). Its relationship with caprine dung is quite strange, as it grows on it with a medium frequency (26%), but with the highest on rock goat dung (50%).

I have found about 250 records worldwide of this cosmopolitan species, 50% from equine (Fuckel 1869, Griffiths 1901, Piontelli et al. 1981, Lorenzo & Havrylenko 2001) and bovine dung (Cooke 1876, Marchal 1883, Goi dànich 1932, Meyer 1941, Munk 1948, 1957, Breton 1965, García-Zorrón 1975, Barrasa 1985, Barrasa & Soláns 1989), 18% from ovine dung (Schmidt 1912, Guarro Artigas 1983, Loh meyer 1995, Wang 2000, Richardson 2004b, 2005, Welt & Heine 2006a). *S. vesticola* is another common coprophilous species in Italy, like elsewhere. In my country it has the highest frequency on caprine (26% of occurrence in damp chambers), cervine (22%) and ovine (20%) dung. More than 200 records worldwide partly disagree with mine, as 29% of them are from ovine dung (Barrasa 1985, Richardson 2004b, 2005, Welt & Heine 2006a), 25% from leporine (Marchal 1884a, Tóth 1967 Caillet & Moyne 1984, Bell & Mahoney 1995, Lorenzo & Havrylenko 2001), only 9% from caprine (De Meulder 2007c, Richardson 2008a), and 8% from cervine dung (Tóth 1965, Moravec 1968, Kruys & Ericson 2008).

Strattonia Cif. (Table 51)

Lundqvist (1972) emended the genus *Strattonia* and recognised three terricolous and nine fimicolous species, *S. insignis* included. He revised about twenty collections of *S. insignis* from Europe and North and South America, and regarded it as restricted to old horse dung, exceptionally to roe deer. Most latter records (Barrasa 1985, Valldosera & Guarro 1990a, Valldosera 1991, Lorenzo 1992, Moyne & Petit 2006) are from horse dung, unlike mine and Leenurm (1998) from elk dung.

Tripterosporella Subram. & Lodha (Table 52)

The genus *Tripterosporella* encompasses four taxa: *T. coprophila* Subram. & Lodha, *T. pakistani* (Mirza) Malloch & Cain, *T. heterospora* (Mukerji, R.N. Kumar & N. Singh) Doveri var. *heterospora*, and *T. heterospora* var. *octaspora* Doveri, but the first two are possibly synonyms (von Arx 1973a, Doveri 2010a). All are very rare, and *T. heterospora* is only known from the type locality, the var. *heterospora* from cervine (sambur) dung (Mukerji et al. 1995), the var. *octaspora* from horse dung (Doveri 2010a). *T. pakistani* has been recorded from horse (Mirza 1968) and rabbit (Mukerji et al. 1995) dung, *T. coprophila* from horse (Abdullah & Rattan 1978), sheep, and elephant (Subramanian & Lodha 1968, Khan & Krug 1994) dung.

Zopfiella G. Winter (Table 53)

In Italy almost all collections of *Zopfiella* have been isolated from horse dung, on which the genus as a whole has a high frequency of occurrence.

Lundqvist (1969b) monographed *Tripterospora* Cain (= *Zopfiella*) and verified several records worldwide of *Z. erostrata* and some of the rarer *Z. longicaudata*. I have found a good many world records of *Z. erostrata* proving, together with Lundqvist's records, this species

Table 50 Records from Italy of coprophilous *Schizothecium* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

		equine		cervine				leporine		caprine				ovine				
	cattle [55]	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**fox [7]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**chamois [6]**	**rock goat [8]**	**marmot [5]**	**sheep [51]**	**mouflon [1]**	**wild pig [10]**	**wolf [1]**	**unidentified animal [2]**
S. aloides	4+**3** **(5%)**																	
S. conicum	7+**24** **(44%)**	1+**1** **(17%)**	2+**18** **(29)**	1+**4** **(17%)**		**5** **(13%)**		**1** **(5%)**	**1** **(5%)**	1+**4** **(25%)**		**4** **(50%)**	**1** **(20%)**	4+**9** **(18%)**	**1**		**1**	
S. dakotense	**2 (4%)**			**1 (4%)**				**1** **(5%)**	**3** **(16%)**	**1** **(6%)**								
S. glutinans				**1** **(4%)**														
S. inaequale			**1** **(2%)**															
S. miniglutinans	**3** **(5%)**		**3** **(5%)**	**3** **(12%)**				**1** **(5%)**						2+**2** **(4%)**				
S. pilosum	**1** **(2%)**																	
S. simile			1															
S. squamulosum						**1** **(3%)**												
S. tetrasporum			1+**2** **(3%)**	**1** **(4%)**			**1** **(14%)**	**1** **(5%)**	1+**7** **(37%)**					**2** **(4%)**		1		
S. vesticola	**3** **(5%)**		2+**9** **(14%)**	3+**8** **(33%)**	1	**8** **(22%)**	**1** **(14%)**	**1** **(5%)**	1	**4** **(25%)**	**2** **(33%)**	**2** **(25%)**	**1** **(20%)**	2+**10** **(20%)**		1		1
S. vratislaviense			**1** **(2%)**															
Total *Schizothecium* in natural state	11	1	5	4	1				1	1				8		2		1
Total *schizothecium* in dampchambers**	**36** **(51%)**	**1** **(17%)**	**34** **(43%)**	**18** **(62%)**		**14** **(32%)**	**2** **(14%)**	**5** **(25%)**	**11** **(42%)**	**9** **(44%)**	**2** **(33%)**	**6** **(62%)**	**2** **(20%)**	**1** **(37%)**	**23**		**1**	
		(40%)		**(38%)**				**(33%)**		**(47%)**				**(38%)**				

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 51 Records from Italy of coprophilous *Stattonia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	cattle [55]	**pig [5]**
S. insignis	1	**1 (20%)**

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 52 Records from Italy of coprophilous *Tripterosporella* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

	horse [63]
T. heterospora var. *Octaspora*	**1 (2%)**
T. pakistani	1+**1 (2%)**
Total *Tripterosporella* in natural state	1
Total *Tripterosporella* in damp chambers**	**2 (3%)**

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples**.**

Table 53 Records from Italy of coprophilous *Zopfiella* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	horse [63]	**sheep [51]**
Z. erostrata	**5 (8%)**	
Z. longicaudata	7+**10 (16%)**	**1 (2%)**
Total *Zopfiella* in natural state	7	
Total *Zopfiella* in damp chambers	**15 (22%)**	**1 (2%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

to have a wide substrate tolerance and a slight preference (19% of all records) for equine dung (Wilson 1947, Ahmed et al. 1971, Guarro Artigas 1983, Richardson 2004a). *Z. longicaudata*, on the contrary, is fastidious in its substrate choice, as 87% of all records are from horse dung (Lorenzo 1990, Valldosera 1991, Valldosera & Guarro 1992, Jahn 1993, Caretta et al. 1994, Holm & Ryman 2000, Heine & Welt 2008).

Zygopleurage Boedijn (Table 54).

Table 54 Records from Italy of coprophilous *Zygopleurage* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	cattle [55]	**horse [63]**	**goat [16]**
Z. zygospora	2+**2 (4%)**	**1 (2%)**	**1 (6%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

The genus *Zygopleurage* was monographed by Lundqvist (1969a), who verified 18 collections of *Z. zygospora* out of 71 recorded worldwide, and noticed its tolerance for a variety of dungs but also a marked preference for bovine dung. This choice is also confirmed by my records from Italy (4 out of 6 from bovine dung) and about 50% of world records found by me (Spegazzini 1878, Griffiths 1901, Kohlman-Adamska 1965, Cailleux 1971b, Furuya & Udagawa 1973, García-Zorrón 1973, Singh & Mukerji 1979, Lundqvist 1981, Khan & Krug 1989, Valldsosera 1991, Soláns 1994, Delgado et al. 2000, Moyne & Petit 2006, Welt & Heine 2007, Heine & Welt 2008, Richardson 2008b,c).

Sordariomycetes – Sordariomycetidae – Sordariales – Sordariaceae

Copromyces N. Lundq. (Table 55)

Copromyces is a very rare and strictly fimicolous genus, encompassing only one species so far. Besides mine, I know few collections worldwide: two from Sweden (Lundqvist 1967) and one from Great Britain (Richardson 1998) on rabbit dung, and two from Venezuela (Delgado Avila et al. 2002) on rabbit and fox dung. Some other collections from rabbit dung in U.S.A. were recorded by D.P. Mahoney (in Lundqvist 1989), and other two from Mallorca (Spain) and California (USA) were recorded by Lundqvist (in Richardson 1998), but the dung source is unknown.

Table 55 Records from Italy of coprophilous *Copromyces* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	Cattle [55]
C. bisporus	**1 (2%)**

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Sordaria Ces. & De Not. (Table 56)

In Italy *Sordaria* is one of the commonest pyrenomycetous genera on dung (13% of my records), with a wide substrate tolerance, but a preference for leporine droppings in damp chamber cultures (51% frequency of occurrence). *S. fimicola* is the commonest *Sordaria* sp. (72% of records; 6% frequency of occurrence on all samples in damp chambers), with the highest frequency of occurrence on equine and caprine dung. It is widespread worldwide and recorded from a variety of substrates, particularly from dung. I have found hundreds of records worldwide, so I limit myself to mention that Lundqvist (1972) recorded more than 600 world collections, particularly from equine (35%) and leporine (31%) dung.

Unlike *S. fimicola*, *S. macrospora* is a fastidious species in its substrate choice, as I have constantly found it on leporine dung and 88% of records worldwide (those found by me added to findings verified by Lundqvist 1972) are from this type of dung (Furuya & Udagawa 1973, Barrasa 1985, Hilber & Hilber 1987, Valldosera & Guarro 1990a, Valldosera 1991, Jahn 1993, Lundqvist 1997, Leenurm 1998, Coste & Rey 2000, Moyne & Petit 2006, Favre 2008, Richardson 2008b).

Sordariomycetes – Sordariomycetidae – Xylariales – Xylariaceae

Hypocopra (Fr.) J. Kicks f. (Table 57)

Hypocopra is infrequent in Italy, but possibly underestimated as its perithecia develop late in damp chambers and grow almost fully immersed in dung. It has been found on a variety of herbivore dungs, but it prefers leporine droppings (5 records out of 11). *H. equorum* has been found once on horse dung, *H.* aff. *festucacea* only on cervine, and *H. brefeldii*, *H. leporina* and *H. lojkaeana* only on leporine dung. *H. equorum* is absolutely linked to equine dung also elsewhere (Phillips & Plowright 1876, Griffiths 1901, Lundqvist 1960, in litt., Moreau 1953), and collections from other types of dung possibly refer to *H. leporina* (= *H. equorum* f. *leporina* Niessl ex Rehm).

Three collections of the rare *H. festucacea* has been isolated from cervine dung (Krug & Cain 1974), like mine, three from sheep (Valldosera & Guarro 1987, Moyne & Petit 2006, Richardson 2008b), and one from goat (Valldosera 1991).

I know some records from Europe (Lundqvist 1981, Moyne & Petit 2006, Richardson 2008b) of the less infrequent *H. brefeldii*, all from leporine dung, and I know very few records of *H. leporina* (Rehm 1889, Eriksson 2009) and *H. lojkaeana* (Rehm 1888, Eriksson 2009) from the same substrate.

Poronia Willd. (Table 58)

The genus *Poronia* is rare in Italy and it has been always found in the natural state. It is less rare and widespread in other temperate regions, but less common than in 19th century (Reid 1986, Whalley & Dickson 1986).

P. punctata is linked, with rare exceptions (Mukerji et al. 1969, Cribb 1988), to equine (74% of records worldwide) (Linnaeus 1755, de Jaczewski 1895, Dawson 1900, Traverso 1907, Miller 1942, Munk 1957, Dennis 1959, 1981, Tóth 1963, Pilát 1972, Moreno & Bar rasa, 1977, García Bona 1978, Caillet & Moy ne 1984, Barrasa 1985, Reid 1986, Whalley & Dickson 1986, Eriksson 1992, Calonge et al. 1993, Coste & Rey 1993, Matočec 2000, Fouchier et al. 2009, Gube 2010) and bovine dung (19%) (Willdenow 1787, Pérez-Silva 1970, Stiers 1974, García Bona 1978, Barrasa 1985, Hladki de Sanz 1997). *P. erici* has been recorded in Australia from a variety of herbivore dungs (Lundqvist 1989, Lohmeyer 1994), in Europe from leporine droppings (Lohmeyer & Benkert 1988, Jalink 1992, Schavey 1994, Ves terholt 2000), except for my collection from Italy, and in Central America (San Martín et al. 1998) from equine and unidentified dung.

Taxonomy

In this section I describe and discuss 13 fimicolous species new to Italy, and I update

Table 56 Records from Italy of coprophilous *Sordaria* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

			equine		cervine								leporine		caprine										
	bird [27]	**cattle [55]**	**donkey [6]**	**horse [63]**	**deer [24]**	**fallow deer [10]**	**roe deer [37]**	**hog [0]**	**dormouse[4]**	**ferret [1]**	**fox [7]**	**goose[1]**	**hare [20]**	**rabbit [19]**	**goat [16]**	**rock goat [8]**	**hedgehog [12]**	**marmot [5]**	**mouse [2]**	**pig [5]**	**polecat [5]**	**porcupine[1]**	**sheep [51]**	**wild pig [10]**	**unidentified animal [2]**
S. fimicola	**5 (18%)**	**2 (4%)**	**2 (33%)**	7+**21 (33%)**	**1 (4%)**	**2 (20%)**	1+**5 (13%)**	1	**1**	**1**	**2 (28%)**		6+**5 (25%)**	4+**6 (31%)**	4+**6 (37%)**	**3 (37%)**	**1 (8%)**	**1 (20%)**		**1 (20%)**	**1 (20%)**	1	5+**15 (29%)**	**1 (10%)**	2+**1**
S. humana	**1 (4%)**	**1 (2%)**		**1 (2%)**			**1 (3%)**	1					**1 (5%)**	1+**2 (10%)**					**1**						
S. lappae				1+**1 (2%)**				1				**1**		**1 (5%)**									**1 (2%)**		
S. macro spora													**3 (15%)**	5+**4 (21%)**											
S. superba	**5 (18%)**			1+**1 (2%)**		**1 (10%)**	**2 (5%)**				**2 (28%)**		**3 (15%)**			2+**1 (12%)**	**1 (8%)**	1+**1 (20%)**					**3 (6%)**	**1 (10%)**	1+**1**
Total *Sordaria* in natural state				9			1	3					6	10	4	2		1				1	5		3
Total *Sordaria* in damp chambers**	**11 (37%)**	**3 (5%)**	**2 (33%)**	**24 (36%)**	**1 (4%)**	**3 (20%)**	**8 (13%)**		**1**	**1**	**4 (43%)**		**12 (50%)**	**13 (53%)**	**6 (37%)**	**4 (25%)**	**2 (17%)**	**2 (40%)**	**1**	**1 (20%)**	**1 (20%)**		**19 (31%)**	**2 (20%)**	**2**
			(36%)			**(11%)**							**(51%)**		**(33%)**										

***** The frequency (%) is not reported when samples of a dung type are less than five. ° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type. ** The frequency (%) of a genus as whole, on each dung type in damp chamber, results from the ratio between the total number of occurrences of that genus and the number of dung samples **[ ]**. The total occurrence of a genus does not result from a simple addition of occurrences of all species belonging to it, because the genus as whole must be regarded as occurring only once in one sample even if two species, or more, occur in that sample.

Table 57 Records from Italy of coprophilous *Hypocopra* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)*°.

			Cervine		**Leporine**		
	cattle [55]	**horse [63]**	**deer [24]**	**roe deer [37]**	**hare [20]**	**rabbit [19]**	**marmot [5]**
H. antarctica	1				1		
H. brefeldii						2	
H. equorum		1					
H. aff. *festucacea*			1	**1 (3%)**			
H. leporina					1		
H. lojkaeana					1		
H. merdaria				**1 (3%)**			**1 (20%)**
Total *Hypocopra* in natural state	1	1	1		3	2	
Total *Hypocopra* in damp chambers**				**2 (5%)**			**1 (20%)**

***** The frequency (%) is not reported when samples of a dung type are less than five.
° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

Table 58 Records from Italy of coprophilous *Poronia* on different dung types (n° of dung samples in damp chamber cultures, in square brackets)°.

	cattle [55]	**donkey [6]**
P. erici	1	
P. punctata		1

° Records from dung in the natural state, in normal type. Records from dung in damp chambers and frequency (%), in bold type.

some taxa following the same nomenclatural order as in section "Results"

Dothideomycetes – Pleosporomycetidae – Pleosporales – Sporormiaceae

Sporormiella affinis (Sacc., E. Bommer & M. Rousseau) S.I. Ahmed & Cain, Canadian Journal Botany 50: 425, 1972. Figs 1–9

≡ *Sporormia affinis* Sacc., E. Bommer & M. Rousseau in Bommer & Rousseau, Mem. Soc. Roy. Bot. Belg. 25(1): 171, 1886.

≡ *Preussia affinis* (Sacc., E. Bommer & M. Rousseau) Valldos. & Guarro, Bol. Soc. Micol. Madrid 14: 82, 1990.

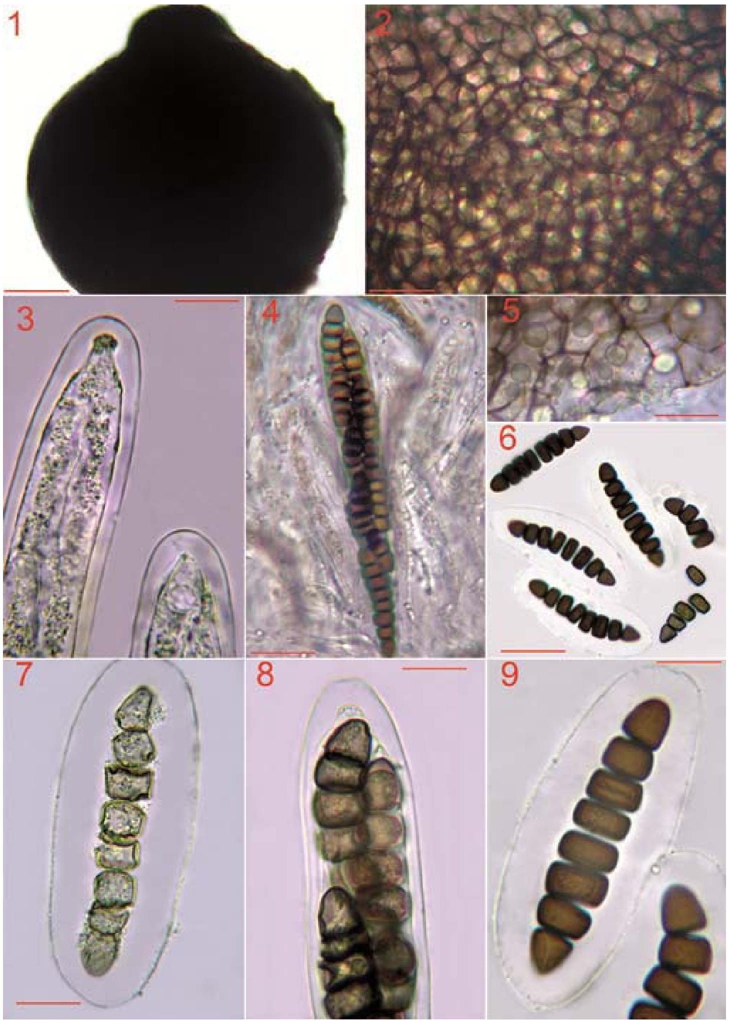
= *Sporormia octomera* var. *macrospora* Feltgen, Piltz-Flora Luxenburg. 1, 2: 223, 1901.

Pseudothecia ostiolate, subglobose, 400–600 µm diam., membranous, glabrous, blackish, with a papillate, scarcely differentiated neck, up to 200 µm diam. Peridium two-layered, pseudoparenchymatous: 1) endostratum of pale, thin-walled, polygonal cells, up to 25 µm diam.; 2) exostratum of dark brown, very thick-walled, polygonal cells, 5–12 × 4–9 µm. Pseudoparaphyses plentiful, cylindric-filiform, exceeding the asci, 2.5–4 µm diam., narrowing at the septa, branched, containing several hyaline vacuoles, not inflated at their tips. Asci bitunicate, non-amyloid, 8-spored, 250–270 × 25–33 µm, cylindric-claviform, rounded at the apex, short-stalked (stalk up to 30 µm long). Ascospores bi- to triseriate above, uniseriate in the lower part of the ascus, surrounded by a broad gelatinous sheath, 70–75 × 14–15 µm, cylindric-claviform, usually slightly curved, hyaline at first, dark brown at maturity, smooth, thick-walled, 8-celled, deeply constrictted at the transverse septa, with cells easily separating from each other, each with a diagonal germ slit. End cells subconical, longer than wide (11–12.2 × 9–10 µm), longer than the middle cells, the uppermost with a slightly pointed apex, the lowermost with a blunt apex. Middle cells cylindric, wider than long, the third from the upper end the widest.

Material examined – Italy, Reggio Emilia, Ramiseto, Pratizzano, 1200 m a.s.l., about ten immersed, gregarious specimens on hare dung, L. Levorato, 23.5.2008, 217.2–Ramiseto, CLSM 006.08.

Notes – The family Sporormiaceae is characterised by ascoloculate, aperiphysate, perithecioid or cleistothecioid ascomata, fissitunicate asci with a scarcely developed apical apparatus, and dark, septate, exceptionally one-celled, thick-walled ascospores, often with germ slits and breaking into part-spores at maturity (Barr 2000). The Sporormiaceae, which multigene analyses have proved to form a monophyletic group (Kruys & Wedin 2009, Schoch et al. 2009, Zhang et al. 2009), encompass ten saprobic, mostly coprophilous genera (Kirk et al. 2008), two of which, *Preussia* Fuckel and *Sporormiella*, have so similar features that the question of their reciprocal independence is open for several years. *Preussia* was conceived (Fuckel 1867) as having "carbonaceous, non-ostiolate unevenly breaking and finally fragmenting perithecia, suffused with a soft flocculose, spurious hyphopodium, clavate, long-stalked, 8-spored asci, no paraphyses, elongate-cylindric sporidia, finally fragmenting into four ovoidal and angular, dark brown parts". *Preussia funiculata* Fuckel, was recorded from decaying oak wood and described as the type species.

Ellis & Everhart (1892) established *Sporormiella* and assigned to this genus "soft-carnose perithecia, embedded in a flattish, semi-immersed, subcarnose stroma, asci and sporidia as in *Sporormia*" i.e. "elongated, 8-spored asci, 4–20-celled sporidia, with soon separating, dark colored cells; mostly fimicolous". *Sporormiella nigropurpurea* Ellis & Everh., a species with ostiolate ascomata and



Figs 1–**9** – *Sporormiella affinis*. **1** Pseudothecium. **2** Detail of exoperidium. **3** Apices of bitunicate, immature asci. **4, 8** Mature ascus with ascospores. **5** Detail of endoperidium. **6, 7, 9** Free ascospores in different stages. Bars 1 = 100 µm, 2, 3, 5 = 20 µm, 4, 6 = 40 µm, **7, 8, 9** = 15 µm.

4-celled ascospores, was recorded from dung and described as type.

There are, at the present, two schools of thought, resulting from different interpretations of the original diagnoses. The former (Cain 1961, Ahmed & Cain 1972, Barrasa & Checa 1991, Doveri 2004a, Lumbsch & Huhndorf 2007, Kirk et al. 2008) based on morphological morphological and ecological characteristics, regards the two genera as distinct and *Sporormiella* characterised by semi-immersed or immersed, ostiolate pseudothecia, cylindrical to cylindric-clavate asci, 4- to poly-celled spores, and a preferable growth on dung, with more than 75% of species developing on this substrate. These features are opposite to those observed in *Preussia*, which has superficial, globose, cleistothecioid pseudothecia, clavate to broadly clavate asci, 4-celled spores, preferable growth on soil and decaying wood or textiles (von Arx & van der Aa 1987), occasional growth on dung. The latter, opposing view does not acknowledge the independence of *Sporormiella* and regards it as a later synonym of *Preussia*, as the characters utilised for distinguishing the two genera, for instance the presence or absence of an ostiolum, are considerably affectted by environmental factors, such as changes of culture conditions (von Arx 1973a, Guarro et al. 1997a, Chang & Wang 2009). This view has produced the recombination in *Preussia* of the majority of *Sporormiella* spp. (von Arx 1973a, Valldosera & Guarro 1990b, Guarro et al. 1997a,b, Abdullah et al. 1999, Arenal et al. 2004, 2005, 2007, Chang & Wang 2009, Kruys & Wedin 2009), but has not induced me to recombine in *Preussia* my newly established *Sporormiella* spp. (Doveri 2005, 2007, Doveri & Coué 2008b), because, in my opinion, neither the latest and most extensive phylogenetic study on Sporormiaceae (Kruys & Wedin 2009) definitely resolves the question of synonymy.

Sporormiella was monographed by Ahmed & Cain (1972), who described more than 60 coprophilous species and a few others from different substrates. Their work, although rather old, must be regarded as still topical. Since then several new species have been published, all briefly discussed by Doveri (2004a), who also updated their bibliography. New additional taxa were later described (Arenal et al. 2005, 2007, Bell 2005, Doveri 2005, 2007, Welt & Heine 2006, Doveri & Couè 2008, Chang & Wang 2009, Asgari & Zare 2010), some as *Preussia*, so the genus *Sporormiella* encompasses, at present, more than 80 species.

S. affinis belongs to the group of species with 8-celled spores, the third cell from the upper end being the broadest. It differs from the others with such features *S. corynespora* (Niessl) S.I. Ahmed & Cain; *S. octomera* (Auersw.) S.I. Ahmed & Cain; *S. octonalis* S.I. Ahmed & Cain; *S. schadospora* S.I. Ahmed & Cain) particularly in having larger spores. The very similar *S. tomilinii* O.V. Korol. can be distinguished from *S. affinis* by its somewhat shorter spores (55–70 µm) and narrower asci (20–23 µm diam., Korolyova 2000).

S. affinis has always been recorded (Bommer & Russeau 1886, Cain 1934, Ahmed & Cain 1972, Angel & Wicklow 1975, Barrasa & Moreno 1980, Valldosera & Guarro 1990b) from leporid pellets.

I provide an updated key to coprophilous species of *Sporormiella* with 8-celled ascospores from Italy:

1) Spores with the fourth cell from the upper end broader than the others 2
1*) Spores with the third cell from the upper end the broadest 3

2) Spores 40–51.5 × 7.5–8.5 µm (40–49 × 8–9, Ahmed & Cain 1972) ....*S. pascua*
2*) Spores 34–42 × 7 µm (32–36 × 5.5–6.5, Ahmed & Cain 1972) ....*S. minipascua*

3) Spores 38–43.5 × 8–9 µm (40–48 × 7–8, Ahmed & Cain 1972). End cells conic–ovoid ....*S. octomera*
3*) Spores larger. End cells hemispheric or conic-ovoid 4

4) Spores 48.5–63 × 12.5–14.5 µm (48–58 × 12–14, Ahmed & Cain 1972), with hemispheric end cells. Asci abruptly contracted towards the base.. *S. octonalis*
4*) End cells subconical. Asci gently narrowing towards the base 5

5) Spores 52.5–60 × 9.5–10.5 µm (50–59 × 10–11.5, Ahmed & Cain 1972) ....*S. corynespora*
5*) Spores 70–75 × 14–15 µm (65–80 × 12–15, Ahmed & Cain 1972) ....*S. affinis*

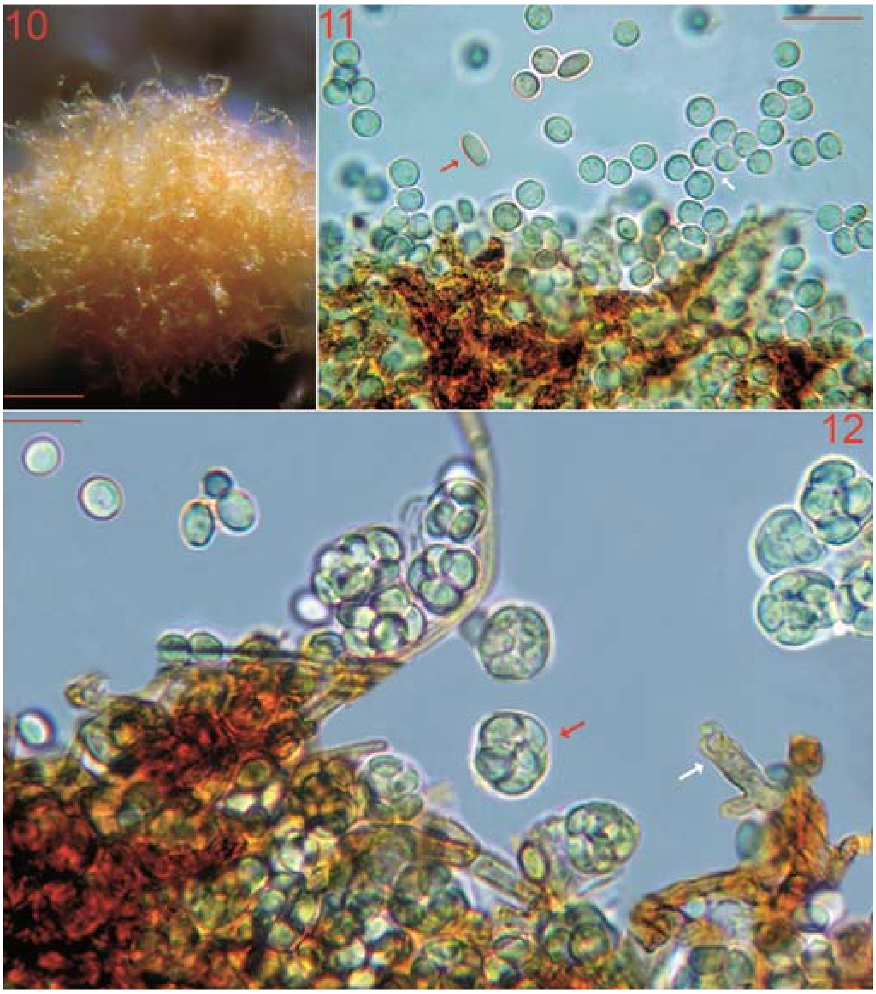
Eurotiomycetes – Eurotiomycetidae – Onygenales – Gymnoascaceae

Onygenalean fungi – modern history and update.

No species of Onygenales was described in “Fungi Fimicoli Italici” (Doveri 2004), but *Gymnoascus reessii* Baran., *G. devroeyi* (G.F. Orr) Arx (Gymnoascaceae) (Figs 10–12), *Aphanoascus fulvescens* (Cooke) Apinis, and *Xanthothecium peruvianum* (Cain) Arx & Samson (Onygenaceae Berk.) were later identified and discussed (Doveri 2006). Since then other onygenalean fungi have been isolated from dung, i.e. the species of Gymnoascaceae here described, and a new *Neogymnomyces* (*N. virgineus* ad interim), which I am about to publish after studying its morphological, physiological and molecular features.

The Gymnoascaceae are characterised by usually brightly coloured ascomata, sometimes without a well differentiated peridium, or with a gymnothecial peridium of interwoven hyphae forming a complete or incomplete, appendiculate or non-appendiculate reticulum, inside which an interascal tissue is absent, and the pseudoprototunicate, usually irregularly disposed, asci release ascospores by deliquescence. The one-celled ascospores lack a gelatinous equipment and are oblate, very pale to brightly coloured, never pitted, smooth or with polar thickenings and/or equatorial ridges or furrows. Anamorphs are absent or simply arthroconidial (Currah 1985, Cannon & Kirk 2007).

Unlike Onygenaceae, members of Gymnoascaceae are not keratinolytic (Ulfig et al.



Figs 10–12 – *Gymnoascus devroeyi*. **10** Gymnothecium. **11** Free, oblate ascospores in side (red arrow) and frontal (white arrow) view. **12** Free ascospores and 8-spored asci (red arrow) above encrusted and thick-walled peridial hyphae (white arrow). Bars 10 = 100 µm, 11 = 12 µm, 12 = 10 µm.

1998, Scott & Untereiner 2004), but some are keratinophilic, i.e. they have not specific proteolytic enzymes but utilise simpler substances of the early keratinic decomposition (Filipello Marchisio 2000, Blyskal 2009), some are mildly cellulolytic (Howard 2002), others possibly chitinolytic (Orr 1977b, Lumley and Currah 1995). This explains why species of Gymnoascaceae have been isolated from soil, decaying wood, plants, dung, and human tissues, wherērarely they behave as pathogens (de Hoog et al. 2000, Iwen et al. 2000).

Currah (1985) accepted *Acitheca* Currah, *Arachniotus* J. Schröt. (1893), *Gymnascella* Peck (1884), *Gymnoascoideus* G.F. Orr et al. (1977), and *Gymnoascus s.str*., in Gymnoascaceae, regarding *Narasimhella* Thirum. & P.N. Mathur. (1965), *Petalosporus* G.R. Ghosh et al. (1963), *Plunkettomyces* G.F. Orr (1977b), and *Pseudoarachniotus* Kuehn (1957) as synonyms of *Gymnascella*. He recognised three types of hyphal peridium, i.e. a “reticuloperidium” of branched and anastomosed, thick-walled, often appendiculate hyphae, differentiated from the vegetative hyphae, an “incompositoperidium” of scarce and uncomposed, thick-walled hyphae, and a “telaperidium” of thin-walled hyphae, scarcely differentiated from the vegetative hyphae. The peridial frame, together with the ascospore shape, ornamentation and arrangement inside the asci, and absence or possible presence of a simple mitosporic stage, were regarded as important features to differentiate genera. So, according to Currah (1985), *Acitheca* has a reticuloperidium with pointed appendages, smooth ascospores, and an unknown anamorph, *Arachniotus* an unappendiculate, sometimes absent telaperidium, bivalvate ascospores (with an equatorial groove bordered by two ridges), and no anamorph, *Gymnascella* an unappendiculate telaperidium, sometimes with intervals of thick-walled hyphae, ascospores smooth or with an equatorial groove or ridge and/or polar thickenings, and no or arthroconidial anamorphs, *Gymnoascoideus*, a reticuloperidium lacking appendages, smooth ascospores with a petaloid arrangement inside the asci, and an arthroconidial anamorph, *Gymnoascus s.str*., an appendiculate reticuloperidium, smooth asco-spores, and no anamorph.

Von Arx (1986) stated that the presence or absence of a peridium and peridial appendages are inadequate to circumscribe genera in Gymnoascaceae, as some species can develop a normal peridium in natural conditions and completely lack it in subcultures. Starting from this assumption, he conceived *Gymnoascus* in a much broader sense than Currah (1985) and emended it, including *Acitheca*, *Arachniotus*, *Gymnascella*, and *Gymnoascoideus* in this genus. He also accepted *Narasimhella* with its often stipitate ascomata, unequally bivalvate, hyaline rather than pigmented ascospores, and asci not born from croziers.

Although von Arx (1987) attempted a new classification of the Gymnoascaceae, based on ascospore morphology, Currah's (1985) systematics was widely followed for many years and re-examined with the introduction of molecular techniques and phylogenetic studies.

Unlike the assumption by Currah (1985, 1994) that Gymnoascaceae are polyphyletic, data of Bowman et al. (1996) and Sugiyama et al. (1999) from small subunit rDNA genes sequences were consistent with a monophyletic descendance of this family.

Subsequent studies (Sugiyama & Mikawa 2001, Sugiyama et al. 2002), based on large subunit ribosomal DNA sequences, confirmed the monophyletic nature of the Gymnoascaceae, but also proved that within a major clade, species are grouped in four subclades, *Gymnascella* is not monophyletic, and "the ascospore morphology and phylogenetic structure are incongruent".

These latest results have induced Lumbsch & Huhndorf (2007) to keep independent the genera accepted by Currah (1985) and also include in Gymnoascaceae *Narasimhella*, *Kraurogymnocarpa* Udagawa & Uchiyama (1999), *Mallochia* Arx & Samson (1986), and *Orromyces* Sur & G.R. Ghosh (Ghosh & Sur 1985). *Kraurogymnocarpa* and *Mallochia* have bivalvate, respectively aculeate-tuberculate and spiny ascospores, an atypical feature in Gymnoascaceae, the former has also a reticuloperidium with pointed appendages, the latter lacks peridial hyphae. According to Sigler et al. (1998) the monotypic *Orromyces*, with its pitted ascospores and spiralate peridial appendages is a synonym of *Uncinocarpus queenslandicus* (Apinis & R.G. Rees) Sigler in Onygenaceae.

A phylogenetic analysis of the ITS region and 5.8S ribosomal DNA gene sequences (Solé et al. 2002) proved that the majority of collections isolated in pure culture, and classified by Currah (1985) and von Arx (1986) as *Arachniotus*, *Gymnascella*, *Gymnoascoideus*, *Gymnoascus*, and *Narasimhella*, forms a monophyletic clade. Molecular data, in combination with morphological features, supported the proposal to unify these taxa under the prior genus *Gymnoascus*, to which a key was also provided (Solé et al. 2002).

After Solé et al. (2002), I conceive *Gymnoascus* in a broad sense, and under this name I classify my Italian collections of Gymnoascaceae. I also provide the following key to genera of Gymnoascaceae, and to species of *Gymnoascus s.l.* from Italy:

1) Peridium a complete net of thick-walled hyphae (reticuloperidium) with pointed appendages 2
1*) Peridium of thin- or thick-walled hyphae. Appendages, when present, different in shape. *Gymnoascus s.l.* 3

2) Ascospores aculeate-tuberculate, bivalvate .... *Kraurogymnocarpa*
2*) Ascospores smooth .... *Acitheca*

3) Peridium a complete net of thick-walled hyphae. Ascospores 3V.5–4 × 3.5–4 × 2.5–3 µm... 4
3*) Peridial hyphae thin-walled (telaperidium), or thick-walled and forming an incomplete net (incompositoperidium). Ascospores larger 5

4) Peridium with hooked appendages. Ascospores smooth .... *G. reessii*
4*) Peridium not appendiculate. Ascospores with an equatorial furrow lined with two parallel ridges .... *G. ruber*

5) Ascospores smooth, 4.5–5 × 4.5–5 × 3–3.5 µm. Hyphae forming an incomposito-peridium............................... *G. devroeyi*
5*) Ascospores ornamented. Hyphae forming both a telaperidium and an incomposito-peridium.. 6

6) Ascospores 4.5–6 × 4.5–6 × 3.5–4.5 µm, smooth, with an equatorial rim............... .... *G. littoralis*
6*) Ascospores 6–7.5 × 5.5–6.5 × 3.5–4.5 µm, rough, with an equatorial rim and polar thickenings .... *G. dankaliensis*

Gymnoascus dankaliensis (Castell. ex J.F.H. Beyma) Arx, Persoonia 13: 177, 1986.
Figs 13–15

≡ *Trichophyton dankaliense* Castell., J. Trop. Med. Hyg. 40: 315, 1937 (nom. inval., art. 34, 36 ICBN).

≡ *Arachniotus dankaliensis* Castell. ex J.F.H. Beyma, Antonie van Leeuwenhoek 8: 107, 1942.

≡ *Gymnascella dankaliensis* (Castell. ex J.F.H. Beyma) Currah, Mycotaxon 24: 77, 1985.

= *Pseudoarachniotus roseus* Kuehn, Mycologia 49: 695, 1957 (fide von Arx, 1971).

= *Arachniotus flavoluteus* Kuehn & G.F. Orr, Mycologia 51: 864, 1959 (fide Currah, 1985).

= *Waldemaria pernambucensis* Bat. et al., Atas Inst. Micol. Univ. Recife 1: 8, 1960 (fide von Arx, 1971).

= *Pseudoarachniotus flavus* Thirum. & P.N. Mathur, in Mathur & Thirumalachar, Mycopath. Mycol. appl. 40(2): 99, 1970 (fide von Arx, 1971).

= *Pseudoarachniotus halophilus* Panwar et al., in Mathur & Thirumalachar, Mycopath. Mycol. appl. 40(2): 100, 1970 (fide von Arx, 1971).

= *Pseudoarachniotus terrestris* Thirum. & P.N. Mathur, in Mathur & Thirumalachar, Mycopath. Mycol. appl. 40(2): 102, 1970 (fide von Arx, 1971).

= *Pseudoarachniotus thirumalacharii* P.N. Mathur, in Mathur & Thirumalachar, Mycopath. Mycol. appl. 40(2): 101, 1970 (fide von Arx, 1971).

= *Pseudoarachniotus flavoluteus* (Kuehn & G.F. Orr) G.F. Orr et al., Mycologia 69: 154, 1977 (fide Currah, 1985).

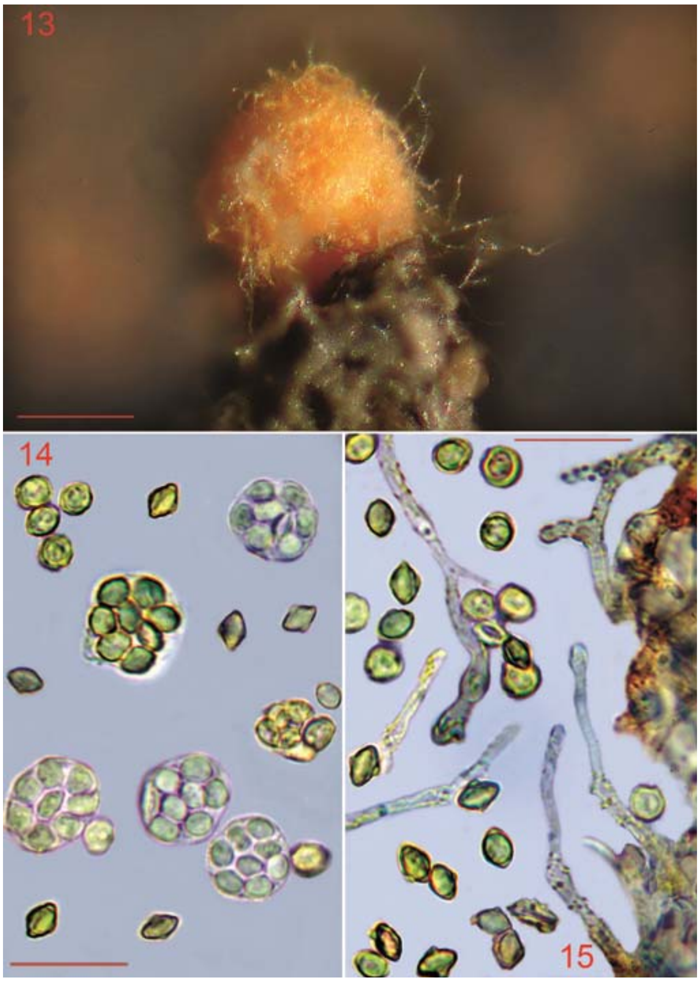
Ascomata globose or subglobose, yellow to bright orange, downy gymnothecia, 80–150 µm diam., rarely covered with scarce, white, aerial hyphae. Peridium a wide mesh of thin, branched, septate hyphae, 2–7 µm diam., sometimes slightly swollen at the septa, finely encrusted with a yellowish orange crystalline material. Well differentiated appendage absent. Asci ephemeral, globose or broadly ellipsoidal, 8-spored, thin-walled, 14–17 × 10–14 µm. Ascospores 6–7.5 × 5.5–6.5 × 3.5–4.5 µm, oblate, globose in frontal view, ellipsoid-fusiform with a broad equatorial ridge and two polar thickenings in side view, thick-walled, yellowish, asperulate, conglobate inside the asci, lacking a petaloid arrangement. Anamorph not detected.

Material examined – Italy, Livorno, Montioni, 0 m a.s.l., usually gregarious, sometimes crowded, superficial specimens, on sheep dung in a damp chamber culture, F. Doveri, 18.3.2009, 306.3–Suvereto, CLSM 005.09; Grosseto, Suvereto, Azienda Agricola “La Suveraia”, 0 m a.s.l., on horse dung in a damp chamber culture, F. Doveri, 18.3.2009, 306.3–Suvereto, CLSM 005.09 bis; Livorno, Bibbona, Fattoria di Faltona, 50 m, on sheep dung in a damp chamber culture, F. Doveri, 18.3.09, 295.3–Sassa, CLSM 005.09 ter; Pisa, Volterra, Villamagna, podere Vallicella, 200 m, on pig dung in a damp chamber culture, F. Doveri, 13.4.09, 285.3–Lajatico, CLSM 005.09 quarter; Pisa, Volterra, Villamagna, podere Vallicella, 200 m, on cattle dung in a damp chamber culture, F. Doveri, 13.4.09, 285.3–Lajatico, CLSM 005.09 penta.

Notes – *G. dankaliensis* is characterised by a telaperidium, and comparatively large and rough ascospores with a broad equatorial ridge and polar thickenings.

G. marginisporus (Kuehn & G.F. Orr) Solé et al. has similar ascospores which, however, are smaller (2.2–3 × 4–4.4 µm, Kuehn & Orr 1963) and lack polar thickenings.

G. citrinus (Massee & E.S. Salmon) Arx has ascospores with polar and equatorial



Figs 13–15 – *Gymnoascus dankaliensis*. **13** Gymnothecium. **14** Free, oblate ascospores and 8-spored asci. **15** Free ascospores mixed with end peridial hyphae. Bars 13 = 50 µm, 14, 15 = 20 µm.

thickenings, like *G. dankaliensis*, but also lemon-yellow ascomata and smooth, slightly smaller ascospores with a narrower and much less marked equatorial rim (Currah 1985).

G. dankaliensis has been isolated from several substrates, often from different kinds of dung (Kuehn & Orr 1959, Mirza & Nasir 1968, Currah 1985, Valldosera & Guarro 1988, Elshafie 2005). It was proved to be keratinophilic (Caretta et al. 1992, Cugnani 2000) and occasionally a weak and tardy keratinolytic (Ulfig et al. 1998).

Gymnoascus littoralis (G.F. Orr) Arx, Persoonia 13: 179, 1986. Figs. 16–18

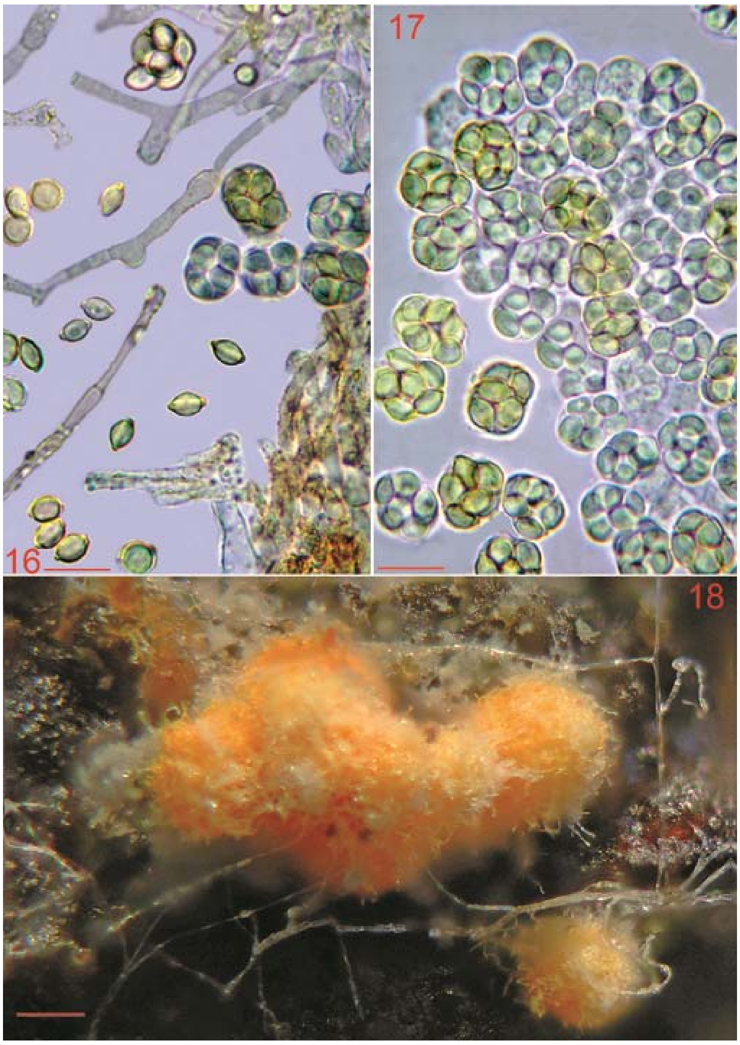
≡ *Plunkettomyces littoralis* G.F. Orr, Mycotaxon 6: 34, 1977.

≡ *Arachniotus littoralis* (G.F. Orr) Arx, Persoonia 9: 397, 1977.

≡ *Gymnascella littoralis* (G.F. Orr) Currah, Mycotaxon 24: 87, 1985.

Ascomata globose or subglobose, pale yellow to bright orange, downy gymnothecia, 50–450 µm diam., rarely covered with scarce, white, aerial hyphae, with a darker orange, much less filamentous inner part. Peridium a wide mesh of thin- to thick-walled, smooth or asperulate, hyaline to pale yellowish or orange, branched, septate hyphae, 2–4 µm diam., with usually rounded ends. Racket hyphae (swollen at the septa) present but scarce. Well differentiated appendages absent. Asci ephemeral, globose or broadly ellipsoidal, 8-spored, thin-walled, 9–11 × 7–10 µm. Ascospores 4.5–6 × 4.5–6 × 3.5–4.5 µm, oblate, globose in frontal view, ellipsoid-fusiform with a narrow equatorial rim (0.3–0.5 µm, rarely up to 1 µm diam.) in side view, thick-walled, yellowish, smooth, conglobate inside the asci, lacking a petaloid arrangement. Anamorph not detected.

Material examined – Italy, Reggio Emilia, Ramiseto, Pratizzano, 1200 m a.s.l., usually gregarious, often crowded, superficial



Figs 16–18 – *Gymnoascus littoralis*. **16** Free, oblate ascospores and asci mixed with peridial hyphae. **17** Asci with ascospores in different stages. **18** Gymnothecia. Bars 16, 17 = 10 µm, 18 = 150 µm.

specimens, on badger dung in a damp chamber culture, G. Robich, 24.5.2008, 217.2-Ramiseto, CLSM 008.08.

Notes – Comparatively large and smooth ascospores with a narrow equatorial rim, and thin- to thick-walled peridial hypae characterise *G. littoralis*. Ascospores with a marked equatorial rim are also observable in *G. marginisporus* and *G. punctatus* (B.G. Dutta & G.R. Ghosh) Arx. Both have, however, rough rather than smooth ascospores, smaller in the former (see above, under *G. dankaliensis*), and provided with a broader equatorial rim in the latter, attaining one third of the spore width (Currah 1985).

The majority of *Gymnoascus* species have been isolated from dung, litter, soil, and fresh water polluted with animal dejections (Currah 1985, Ulfig et al. 1998) but, before my Italian collection, *G. littoralis* had been isolated only from beached chitinous materials (Orr 1977a) or other substrates likely containing chitin (Lumley & Currah 1995, Ulfig et al. 1998), giving birth to the hypothesis of its chitinolytic activity (Lumley & Currah 1995).

Techniques for isolating chitinophilic fungi and proving their chitinolytic ability are known and have been utilised for many years (De Boer et al. 1999, Shubakov & Kucheryavykh 2004, Swiontek-Brzezinska et al. 2007) but, as far as I know, *G. littoralis* has never been isolated with specific techniques, neither its capability to degrade chitin has been tested.

Chitin is a natural polysaccaride, essential component of the exoskeleton of arthropodes, both crustaceans and insects, radula of mollusks, and beaks of cephalopods (Jeuniaux et al. 1993). Variable amounts of chitin are present on any kind of dung samples, both fresh and dried, in natural conditions or in damp chambers, particularly linked to the shells of beetles or coats of colonising mites and worms, as remnants of dead animals or sheddings. So the hypothesis of a chitinolytic activity can be extended to my collection of *G. littoralis* from dung as well as to other collections of *Gymnoascus* spp. from this substrate. The chitinolytic hypothesis is also supported by my experience in cultivating coprophilous fungi in damp chambers, according to which all collections of *Gymnoascus* spp. from dung have a tardy development in comparison with other families of Ascomycota Berk. This slowness can been explained, in my opinion, by lack of nutritional competition between Gymnoascaceae and other fungi of this coenosis, which early develop by feeding on simpler and more degradable substances. Materials containing chitin are later available, when, since about the second week, the life cycle of worms and insects makes for the way down in damp chamber, and *Gymnoascus* spp. begins to appear.

From now on, *G. littoralis* can be called occasional or facultative coprophilous, as it optionally grows on dung and does not need to pass through the digestive tract of an host in order to germinate (Massee & Salmon 1901, Webster 1970, Wicklow 1992).

Gymnoascus ruber Tiegh., Bull. Soc. Bot. Fr. 24: 159, 1877. Figs. 19–20

≡ *Arachniotus ruber* (Tiegh.) J. Schröt., in Cohn, Krypt.-Fl. Schlesien 3: 210, 1893.

≡ *Pseudoarachniotus ruber* (Tiegh.) G.F. Orr et al., Mycologia 69: 153, 1977.

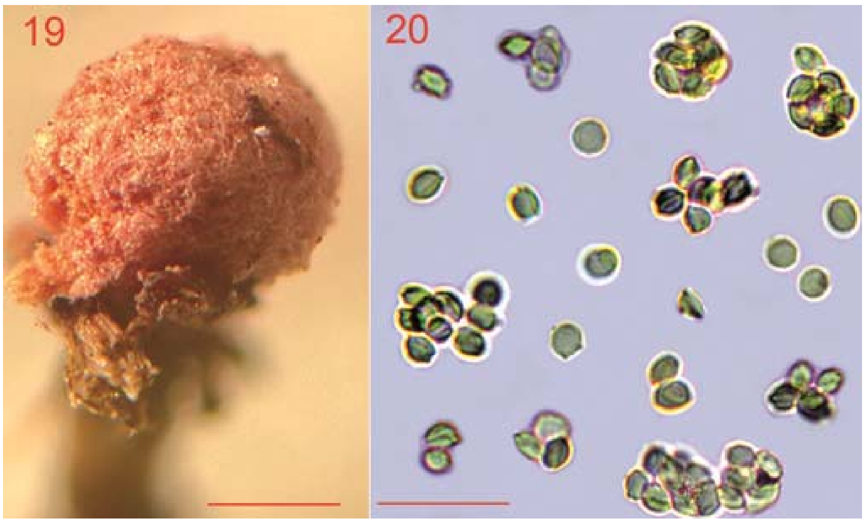
≡ *Pseudoarachniotus trochleosporus* Kuehn & G.F. Orr, in Orr & Kuehn, Mycologia 64: 58, 1972 (fide Currah, 1985).

Ascomata gymnothecial, globose to pulvinate, dull orange, sometimes with pinkish shades, mealy, 30–100 µm diam. Peridial hyphae scarce, sometimes absent, ephemeral, soon collapsed, smooth, hyaline, septate, 1.5–4 µm diam. Asci ephemeral, globose or broadly ellipsoidal, 8-spored, thin-walled, 7.5–9 × 6.5–7.5 µm. Ascospores 3.5–4(–4.5) × 3.5–4 × 2.5–3 µm, oblate, globose in frontal view, ellipsoidal with a deep equatorial furrow bordered by two ridges ("pulley-wheel"-shaped, Currah 1985) in side view, pale yellowish orange, smooth, conglobate inside the asci, lacking a petaloid arrangement. Anamorph: not detected.

Material examined – Italy, Livorno, Bibbona, Fattoria di Faltona, 50 m a.s.l., about ten isolated or gregarious, superficial specimens, on cattle dung in a damp chamber culture, F. Doveri, 18.3.2009, 295.3-Sassa, CLSM 003.09.

Notes – Orange to red gymnothecia, and small and pulley-wheel-shaped ascospores are the main features of *G. ruber*, partly shared with *G. confluens* Sartory & Bainier, which has ascospores similar in size, but with a shallow depression not lined with ridges (Currah 1985).

G. ruber has been isolated from several substrates, often from different kinds of dung



Figs 19–20 – *Gymnoascus ruber*. **19** Gymnothecium. **20** Free, oblate ascospores and 8-spored asci. Bars 19 = 40 µm, 20 = 15 µm.

(van Tieghem 1877, Schroeter 1893, Massee 1895, Massee & Salmon 1901, 1902, Apinis 1964, Currah 1985).

Pezizomycetes – Pezizomycetidae – Pezizales – Pezizaceae

Iodophanus difformis (P. Karst.) Kimbr., Luck-Allen & Cain, Am. J. Bot. 56(10): 1198, 1969. Figs 21–29

≡ *Ascobolus testaceus* var. *difformis* P. Karst., Syn. Pez. Ascob. Fenn. 43, 1861.

≡ *Ascobolus difformis* (P. Karst.) Nyl., Notis. Faun. Fl. Fenn. 10: 85, 1869.

≡ *Ascophanus difformis* (P. Karst.) Boud., Ann. Sci. Natur. Bot. V, 10: 252, 1869.

≡ *Peziza difformis* (P. Karst.) P. Karst., Bidr. Finl. Natur. Folk. 19: 61, 1871.

Apothecia cleistohymenial, sessile, membranous-gelatinous, pale yellowish brown, globose in the early stages, often becoming pulvinate, 0.5–0.7 mm diam., with a hardly differentiated, slightly darker margin. Disc slightly convex, papillate owing to the protruding asci, the same colour as the outer surface. The latter smooth, with abundant basal hyphoid hairs. Subhymenium a *textura angularis* of polygonal cells, up to 10 µm diam. Medullary excipulum a *textura intricata* of hyaline, cylindric or ellipsoidal hyphae, 5–9 µm diam., narrowing at the septa. Ectal excipulum a *textura globulosa-angularis* of thick-walled, yellowish cells, up to 35 µm diam., scarcely elongated towards the apothecial margin. Many septate, thick-walled hyphoid hairs, 2–4 µm diam., with an enlarged base, are observable at the base of apothecia. Paraphyses exceeding the asci, 3–6 µm diam., simple or sometimes branched at the base, containing abundant yellowish pigments, septate, straight or slightly curved at the apex, non or slightly inflated at the tips. Asci 175–220 × 20–30 µm, 8-spored, weakly but diffusely amyloid, operculate, congophilous, cylindric-claviform, thick-walled, short-stalked, rounded at the apex. Ascospores uni- to irregularly biseriate, (16–) 16.5–19 (–19.5) × (9.5–) 10–11.5 µm, ellipsoidal (Q = 1.54–1.88; average Q = 1.69), symmetrical, each with a hardly observable gelatinous sheath, hyaline, without oil droplets or gaseous bubbles, thick-walled in the early stages, roundish at the ends, smooth, with a wrinkled, cyanophilous episporium.

Material examined – Italy, Livorno, Bibbona, Fattoria di Faltona, 50 m, about ten gregarious or isolated, superficial specimens on old cattle dung in a damp chamber culture, F. Doveri,18.03.2009,295.3-Sassa,CLSM 004.09.

Notes – The genus *Iodophanus* Korf was originally placed (Kimbrough & Korf 1967, Kimbrough et al., 1969) in tribus Pezizae Fr. (Pezizaceae Dumort.) on account of its amyloid asci, cyanophilic episporic markings, and an *Oedocephalum* Preuss anamorph. Despite subsequent systematic changes, it finally was confirmed in Pezizaceae by molecular phylogenetic studies (Landvik et al 1997, 1998, Hansen et al. 2001, 2005), which also proved this family to be monophyletic (Hansen et al. 2005, Hansen & Pfister 2006).

The latest worldwide monograph on *Iodophanus* dates back to more than forty years ago (Kimbrough et al. 1969). Nine taxa were described and placed in a key, which was later updated (Doveri 2004a) with the addition of six new species. Since then no new species have been published.

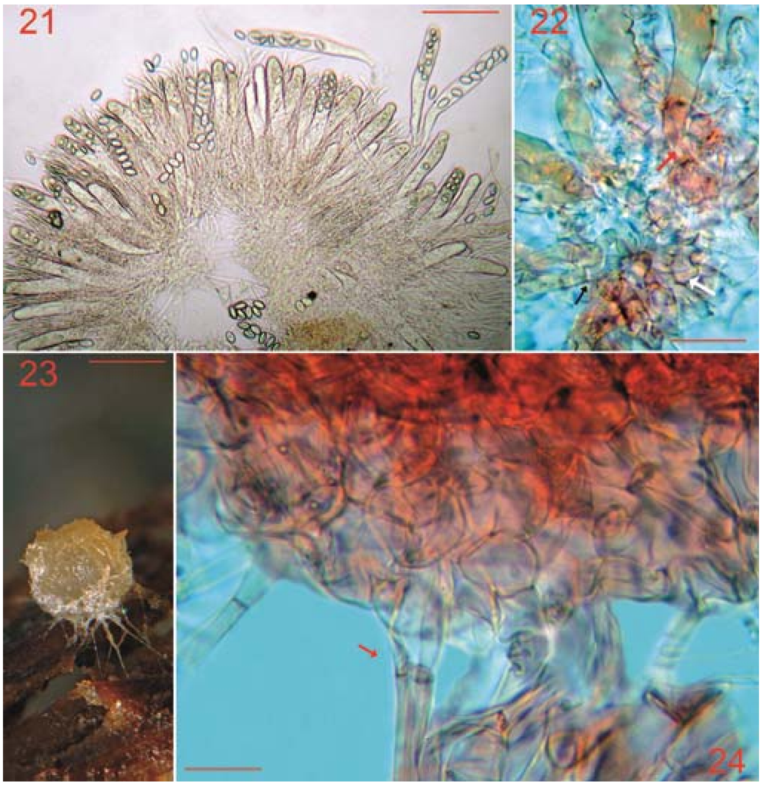
I. difformis is characterised by yellowish apothecia and paraphyses with yellow contents, and it is unique in lacking episporic, cyanophilic markings, although its smooth epispore strongly stains all the same in cotton blue. As previously observed (Kimbrough et al. 1969), and also noticed by me in my collection, the ascospores wrinkle in some solvents and appear to be transversely furrowed.

Most *Iodophanus* sp. are coprophilous, but *I. difformis* has been isolated from several substrates, particularly from textiles and paper (Karsten 1861, 1870, Kimbrough et al. 1969). I also have found records of this seemingly rare species from horse (Prokhorov 1989b), sheep, and donkey (Abdullah & Alutbi 1993) dung.

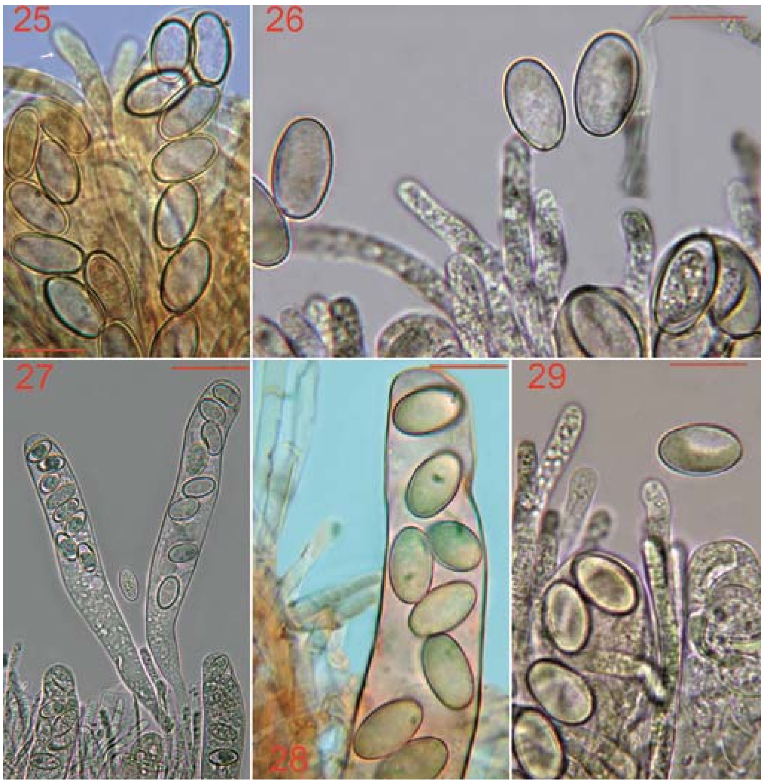
Pezizomycetes – Pezizomycetidae – Pezizales – Pyronemataceae

Orbicula parietina (Schrad.) S. Hughes, Mycological Papers 42: 1, 1951. Figs 30–42

≡ *Didymium parietinum* Schrad., Nova genera plantarum: 24, 1797.



Figs 21–24 – *Iodophanus difformis*. **21** Overall view of hymenium. **22** (Congo red) Cells of subymenium (white arrow) with bases of asci (red arrow) and paraphyses (black arrow). **23** Cleistohymenial apothecium. **24** (Congo red) Hyphoid hairs (arrow) arising from the outermost cells of ectal excipulum. Bars 21 = 100 µm, 22, 24 = 20 µm, 23 = 500 µm.



Figs 25–29 – *Iodophanus difformis*. **25** (Melzer) Apices of paraphyses (white arrow) between 8-spored asci. **26, 29** Free ascospores above apices of paraphyses and asci. **27** Immature asci. **28** (Congo red) Mature ascus with ascospores. Bars 25, 28, 29 = 18 µm, 26 = 12 µm, 27 = 40 µm.

≡ *Lycogala parietinum* (Schrad.) Fr., Syst. Mycol. 3: 83, 1829.

≡ *Mycogala parietinum* (Schrad.) Sacc., Syll. Fung. 3: 185, 1884.

≡ *Anixia parietina* (Schrad.) Lindau, in Engler & Prantl, Nat. Pflanzenfam., Teil. I , 1: 334, 1897.

≡ *Licea bicolor* Pers., Syn. Meth. Fung.: 195, 1801 (nom. nov.).

≡ *Tubulina bicolor* (Pers.) Poir., in Lamarck, Enc. Meth. Bot. 8: 131, 1808.

= *Anixia truncigena* Hoffm., Icon. Analyt. Fung. 3: 70, 1863.

= *Anixia spadicea* Fuckel, Jb. Nassau. Ver. Naturk. 23–24: 91, 1870.

= *Sphaeria cyclospora* Cooke, Pop. Sci. Rev. 10: 12, 1871.

= *Orbicula cyclospora* (Cooke) Cooke, Handb. Brit. Fung. 2: 926, 1871.

= *Anixia cyclospora* (Cooke) Sacc., Syll. Fung. 1: 36, 1882.

= *Chaetomium glabrum* Berk. in Berk. & Broome, Ann. Mag. Nat. Hist. Ser. 4, 11: 349, 1873.

= *Orbicula perichaenoides* Cooke, Grevillea 8 (no. 45): 10, 1879.

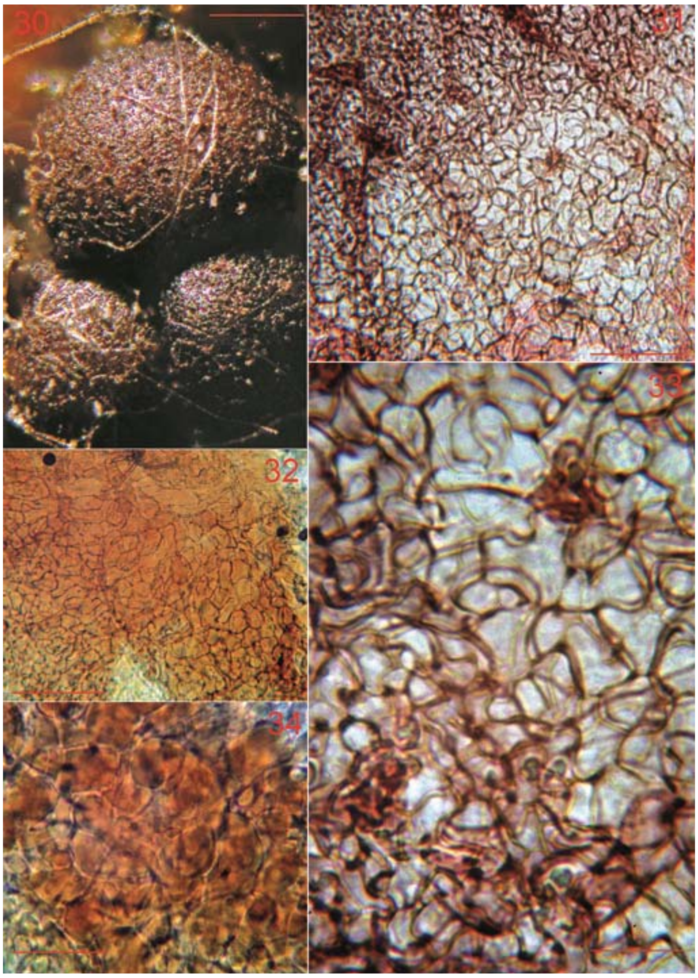
Ascomata cleistothecioid, 400–800 µm diam., 200–300 µm high, subglobose to pulvinate, flattened or slightly concave at their bases, semi-membranous, brown, violet dotted, glabrous in the upper portion, with hyphoid hairs in the lower, with yellowish contents. Peridium friable, two-layered: endostratum a *textura globulosa-angularis* with pale, thin-walled, roundish or polygonal cells, 8–20 µm diam.; exostratum a *textura epidermoidea*, *angularis* at intervals, of irregularly lobed, thick-walled, dark brown cells, 4–15 µm diam., interspaced with an amorphous, purplish pigment. Hyphoid hairs arising from the outermost exoperidial cells, brown, darker at the base, thick-walled, wavy, sometimes fasciculate, sparsely septate, more densely septate at their base, sometimes swollen at the septa, 4–17 µm diam. Subhymenium placed at the cleistothecial base, formed of small, hyaline, thin–walled cells. Paraphyses numerous, mixed with asci and usually exceeding them, 2–2.5 µm diam., non– or slightly enlarged at the apex (up to 4 µm diam.), sraight or somewhat curved, septate, often branched in the lower portion, sometimes anastomosed, filled with a few pigments. Asci numerous, unitunicate, non-amyloid, inoperculate, 8-spored, cylindrical, 100–130 × 11–14 µm, thin-walled, long-stalked, rounded at the apex, evanescent. Ascospores regularly or sometimes irregularly uniseriate, oblate, 8–10.5 × 8–10.5 × 7–9 µm, globose to subglobose in frontal view, broadly ellipsoidal in side view, hyaline to pale yellowish, smooth, thick-walled, forming a powdery mass at maturity, when asci disintegrate.

Material examined – Italy, Vicenza, Tonezza del Cimone, Altopiano dei Fiorentini, 1450 m a.s.l., more than fifty scattered or crowded, superficial specimens on hare dung in a damp chamber culture, A. Bizzi, 13.7.2008, 082.3–Arsiero, CLSM 002.10.

Notes – The monospecific genus *Orbicula* Cooke was at first accomodated (Malloch & Cain 1971a, Malloch & Benny 1973, Benny & Kimbrough 1980), together with *Cleistothelebolus* Malloch & Cain and *Lasiobolidium* Malloch & Cain, in Eoterfeziaceae G.F. Atk., a family of plectomycetous fungi with an uncertain position in Ascomycota, characterised by cleistothecial ascomata, globose, thin-walled and evanescent asci, one-celled, oblate or ellipsoidal ascospores, and an unknown anamorph (Kirk et al. 2001, Cannon & Kirk 2007).

Orbicula and *Lasiobolidium* were later transferred (Jeng & Krug 1976) to tribe Theleboleae Korf of Pyronemataceae Corda (Pezizales J. Schröt.), which is the equivalent of the current Thelebolaceae Eckblad, where also *Coprotiella* Jeng & J.C. Krug, and most genera previously placed in Eoterfeziaceae, were accomodated.

Currently *Orbicula* nests, with *Lasiobolidium* and *Pseudombrophila* Boud., in a well defined clade of Pyronemataceae (Hansen & Pfister 2006, Perry et al. 2007), a family mostly including apothecioid discomycetes, but also a minority of cleistothecial fungi evolved from an apothecial ancestor (Hansen et al. 2005). As its epithet means, *Lasiobolidium orbiculoides* is similar to *Orbicula parietina*, but differs from the latter in having a simpler, one-layered peridium, widespread, sometimes coiled hairs rather than hyphoid hairs restricted to the peridial base, and slightly larger ascospores on average (10–14 × 9–12 µm, Malloch & Benny 1973, versus 7–13 × 8–10 µm, Hughes 1951), although a collection of *O. parietina* associated



Figs 30–34 – *Orbicula parietina*. **30** Cleistothecioid ascomata. **31, 32, 33** Details of exoperidium (32 = Melzer). **34** Detail of endoperidium (Melzer). Bars 30 = 150 µm, 31, 32 = 30 µm, 33 = 15 µm, 34 = 20 µm.

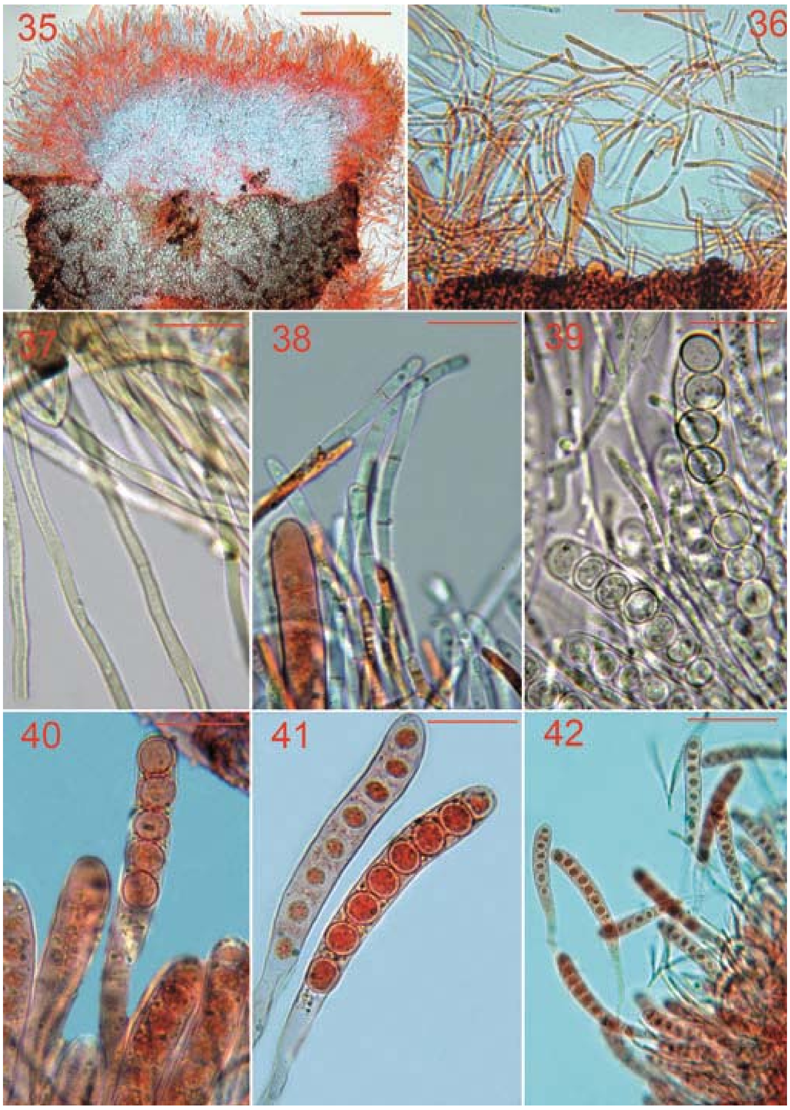
with oat kernels has ascospores 12–16 × 10–14 µm (Campbell et al. 1991).

The psychrophilic (von Arx 1981, Campbell et al. 1991, Richardson 2004b) *O. parietina* has often been isolated from several kinds of dung (Marchal 1884b, Udagawa & Furuya 1972, Bokhary 1985, Richardson 2004b, Moyne & Petit 2006), but also from decaying plants, bark and paper, straw, compost and similar substrates (Marchal 1884b, Hughes 1951, Dennis 1981).

Sordariomycetes – Hypocreomycetidae – Microascales – Microascaceae

Microascaceae – An update.

The Microascaceae are a monophyletic family (Berbee & Taylor 1992, Hausner et al. 1993, Spatafora & Blackwell 1994, Lee & Hanlin 1999), characterised by cellular, dark, often immersed, perithecioid or cleistothecioid ascomata, single or catenulate, globose to clavate, evanescent asci, absence of an interascal tissue, and small, one-celled, dextrinoid, pale to copper coloured ascospores, with one or two or no germ pores. The anamorph is aleurio-, annello-, arthro-conidial or absent (Luttrell 1951, Malloch 1970, Benny & Kimbrough 1980, Arx et al. 1988, Barr 1990, Cannon & Kirk 2007). They behave as saprophytes on soil, dung, and rotting plants, sometimes as agents of animal and human infections (de Hoog et al. 2000, Issakainen et al. 2003, Rainer & de Hoog 2006), particular immunocompromised patiens (Baddley et al. 2000, Mohammedi et al. 2004). Benny & Kimbrough (1980) also erected the family Pithoascaceae, inclusive of *Pithoascus* Arx and *Faurelina* Locq.-Lin., very close to Microascaceae but with constantly fusoid to navicular spores, lacking germ pores, and arthroconidial or no anamorphs. Nowadays the Pithoascaceae are regarded as a later synonym



Figs 35–42 – *Orbicula parietina* (35, 36, 38, 40, 41, 42 Congo red). **35** Longitudinal section of ascoma. **36, 38** Paraphyses above immature asci. **37** Hyphoid hairs. **39, 40, 41, 42** Asci with ascospores in different stages. Bars 35 = 200 µm, 36, 37, 42 = 40 µm, 38, 39, 40, 41 = 20 µm.

of Microascaceae (Cannon & Kirk 2007, Lumbsch & Huhndorf 2007, Kirk et al. 2008), *Faurelina* has been transferred in Chadefaudiellaceae Faurel & Schotter ex Benny & Kimbr., and *Pithoascus* is considered a later synonym of *Microascus* Zukal by Lumbsch & Huhndorf (2007), in agreement with Abbott et al. (2002), but an independent genus by Kirk et al. (2008), the latter following Arx (1973b, 1975b, 1978), Arx et al. (1988), Eriksson & Hawksworth (1998), Barr (1990).

The family Microascaceae includes the following theleomorphic genera: *Canariomyces* Arx (1984), *Enterocarpus* Locq.-Lin. (1977), *Kernia* Nieuwl.; *Lophotrichus* R.K. Benj. (1949), *Microascus* Zukal (1885), *Petriella* Curzi (1930b), *Pithoascus* Arx (1973b), *Pseudallescheria* Negr. & I. Fisch., *Petriellopsis* Gilgado et al.

The genus *Petriellopsis* was recently erected (2007) to accommodate *Pseudallescheria africana* (Arx & G. Franz) Gilgado et al., which molecular studies (Issakainen et al. 1999, 2003, Rainer & de Hoog 2006, Gilgado et al. 2007) proved not to nest with the other *Pseudallescheria* spp.

I provide the following key to genera of Microascaceae, which must be regarded as supplementary to Arx (1978) and Arx et al. (1988):

1) Ascospores asymmetrical, with inconspicuous or no germ pores. Ascomata smooth or with hyphal hairs at most. 2

1*) Ascospores symmetrical or asymmetrical, with 1 or 2 germ pores. Ascomata smooth or with well differentiated hairs or setae. 3

2) Ascomata not ostiolate. Peridium of *textura epidermoidea*. Asci clavate. Ascospores broadly ellipsoidal. Anamorph *Scedosporium* and *Graphium*. .... *Petriellopsis*

2*) Ascomata non-ostiolate or with an ostiolate papilla. Peridium of *textura angularis* or *epidermoidea*. Asci broadly clavate to globose. Ascospores elongated, usually more than twice as long as broad, variable in shape, reniform to cylindrical. Anamorph *Geniculosporium*, *Scedosporium*, *Scopulariopsis* or absent. .... *Pithoascus*

3) Peridium of *textura epidermoidea*. Ascospores with 2 germ pores, 1 at each end. Anamorph *Graphium*, *Scedosporium*, *Scopulariopsis*. 4

3*) Peridium of *textura angularis*. Ascospores with 1 or 2 germ pores. 5

4) Ascomata globose, non-ostiolate, glabrous. Ascospores ellipsodal to broadly fusiform, symmetrical............................ .... *Pseudallescheria*

4*) Ascomata often ampulliform with an ostiolate beak or papilla, surrounded with differentiated hairs or setae. Ascospores asymmetrical, usually lunate. .... *Petriella*

5) Ascomata with a non-ostiolate papilla, surrounded with a tuft of dark hairs, and with an inner skein of dark hyphae (capillitium). Ascospores ovoidal or ellipsoiddal, symmetrical, with 1 or 2 germ pores. Anamorph unknown. .... *Enterocarpus*

5*) Capillitium absent................................. 6

6) Ascospores with 2 germ pores, rarely asymmetrical. Ascomata non-ostiolate or with a hairy, ostiolate beak or papilla. No anamorph. ....*Lophotricus*

6*) Ascospores with 1 germ pore, symmetrical or asymmetrical. Anamorph usually present.. 7

7) Ascomata with an ostiolate, hairy, long beaked or sometimes with an ostiolate papilla. Ascospores asymmetrical, variable in shape, triangular to reniform or lunate. Anamorph *Scopulariopsis*, *Wardomyces*, *Wardomycopsis*..... *Microascus*

7*) Ascomata non-ostiolate. Ascospores usually symmetrical.............................. 8

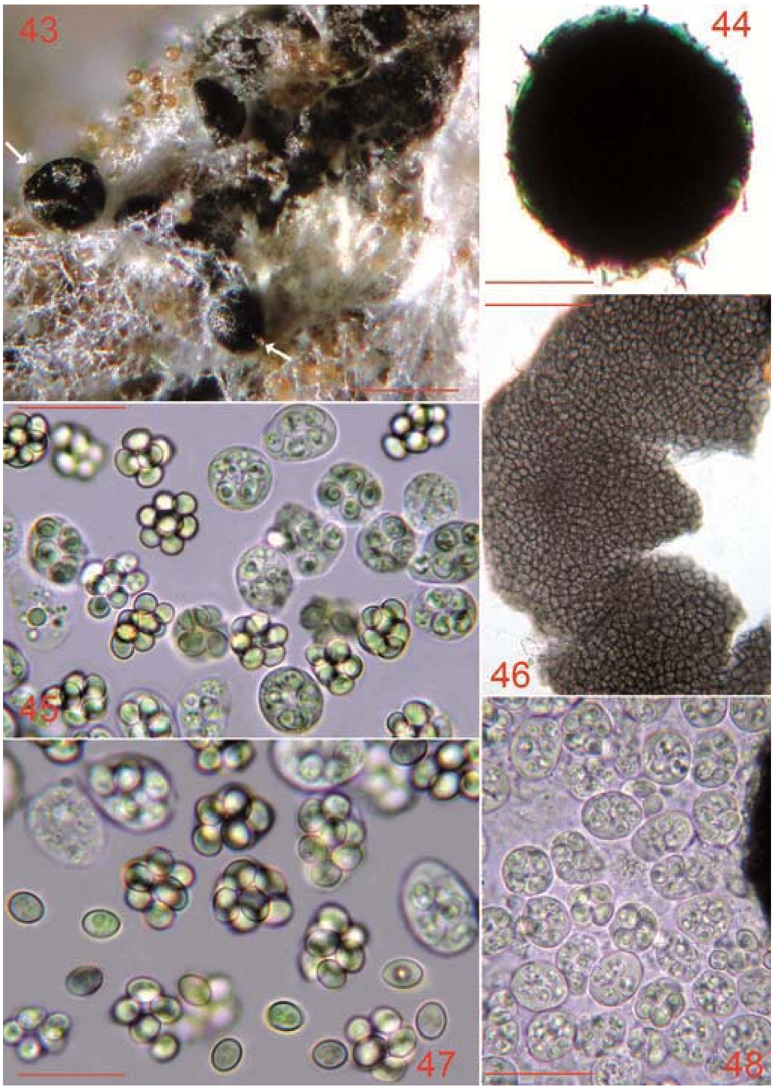
8) Ascomata globose, glabrous. Ascospores comparatively dark, greyish brown, ellipsoidal to broadly fusiform, with attenuated ends. Anamorph *Chrysonilia*-like. .... *Canariomyces*

8*) Ascomata globose or angular, then with hairy angles. Ascospores ellipsoidal or ovoidal or rarely asymmetrical (reniform), straw-coloured or pale brown to pale reddish brown. Anamorph as above or *Graphium*, or absent................ *Kernia*

Kernia cauquensis Calviello, Rev. Mus. Arg. Cie. Nat. 5(12): 240, 1979. Figs 43–48

Ascomata cleistothecioid, globose or subglobose, sometimes hemispherical with a flattened base, black shining, smooth, membranous, 80–140 μm diam. Peridium two-layered, pseudoparenchymatous, the inner layer of pale, polygonal, comparatively thin-walled cells, 6–14 × 6–11 μm, the outer layer of dark brown, thick-walled, polygonal cells (*textura angularis*), 3–10 μm diam. Exceptionally single or sparse hairs can be observed, short, brown, thick-walled, septate, 2 μm diam., with a bulbous base, 3–3.5 μm diam. Interascal tissue absent. Asci irregularly disposed, evanescent, unitunicate, inoperculate, non-amyloid, (6–8-spored, 10–15 × 9–11 μm, sessile, globose or broadly ellipsoidal to broadly clavate. Ascospores conglobate, 5–6 × 3.5–4.5 μm, broadly ellipsoidal or ovoidal, (Q = 1.25–1.66; averageQ = 1.40), equilateral, hyaline and dextrinoid at first, with one to several droplets, thick-walled, becoming olive-pale brown, with an apical germ pore, usually with a de Bary bubble in aqueous media. Anamorph not observed.

Material examined – Italy, Livorno, Montioni, 0 m a.s.l., dozens of gregarious or isolated specimens, superficial, but fully covered with a white aerial mycelium, on sheep dung in a damp chamber culture, F. Doveri, 18.03.2009, 306.3-Suvereto, CLSM 006.09; Vercelli, Alagna, Alpe Pianalunga, 2000 m



Figs 43–48 – *Kernia cauquensis*. **43** Cleistothecia on dung (white arrows). **44** Cleistothecium in water. **45** Asci with ascospores in different stages. **46** Detail of exoperidium. **47** Free and clustered ascospores inside the asci. **48** Immature asci. Bars 43 = 200 µm, 44, 46 = 50 µm, 45, 47 = 15 µm, 48 = 20 µm.

a.s.l., on dung of unidentified animal in a damp chamber culture, A. Bizzi, 27.08.2008, 071.2-Alagna, CLSM 006.09 bis.

Notes – The latest extensive work on sordariaceous fungi without ascospore ejaculation (von Arx et al. 1988) recognised a group of species including *K. cauquensis*, *K. ovata* (C. Booth) Malloch & Cain, *K. pachypleura* Malloch & Cain, *K. retardata* Udagawa & T. Muroi, and *K. setadispersa* Locq.-Lin., characterised by globose or subglobose ascomata and distinctly pigmented, ovoidal or ellipsoidal ascospores.

Since then only one new spicies, *K. peruviana* Udagawa & Furuya, has been published, characterised by ascospores variable in shape, reniform, roughly triangular, sometimes ellipsoidal or ovoid (Udagawa & Furuya 1988), similar to those of *K. hyppocrepida* Malloch & Cain, but smaller (3–4.5 × 3–3.5 µm).

C. cauquensis is also characterised by usually glabrous ascomata, ascospores with a single, apical germ pore, and a *Scopulariopsis* Bainier anamorph. It is similar to *K. pachypleura*, which differs, however, in having ascospores with two germ pores, a much thicker (37–46 µm) peridium (Malloch & Cain 1971b), and sometimes 4-spored asci (Delgado Avila et al. 2001b). The former was isolated only once from avutard droppings (Calviello 1979), while the latter would seem commoner, as it was found on elephant (Malloch & Cain 1971b), deer, monkey, parrot, tortoise, rabbit (Delgado Avila et al. 2001b) goat, buffalo, and cow

(Chang & Wang 2008) dung. *K. ovata*, isolated once from seeds, differs from *K. cauquensis* in lacking an anamorph and having longer asci and ascospores (6–9 × 4.5–5.5 vs. 5–6.8 × 4–5.3 µm) with a subapical germ pore (Booth 1964, Malloch & Cain 1973).

K. setadispersa has an unknown anamorph; isolated from goat dung, it differs from *K. cauquensis* in having ascomata covered with 10–30, dark, long hairs, and slightly narrower (3.5–4.5 µm) ascospores (Locquin-Linard 1980). The teleomorphs of *K. retardata*, isolated from soil (Udagawa & Muroi 1981), rotten wood and skunk dung (Lumley et al. 2000), have, in my opinion, morphological features fully matching *K. cauquensis*, including the pale coloured ascospores, but the colonies of the former, unlike the latter, slowly develop in common media, and *K. retardata* has a slightly different *Scopulariopsis* anamorph, e.g., somewhat wider conidia.

I have called "affinis" *cauquensis* my collection of *Kernia* because unfortunately I could not isolate it in pure culture and study its possible anamorph. Besides I have preferred to call it "affinis" *cauquensis* rather than "affinis" *retardata* because I have exceptionally observed ascomata with sparse brown hairs, and ascomata with such feature ("ascomata glabrous, sometimes with sparse, short hairs) were described in the protologue of *K. cauquensis* (Calviello 1979).

A key to the recognised species of *Kernia* Nieuwl. was provided by me (Doveri 2004a).

Lophotrichus bartlettii (Massee & E.S. Salmon) Malloch & Cain, Can. J. Bot. 49: 866, 1971. Figs 49–57

≡ *Magnusia bartlettii* Massee & E.S. Salmon, Ann. Bot. 15: 333, 1901.

≡ *Kernia bartlettii* (Massee & E.S. Salmon) R.K. Benj., Aliso 3: 344, 1956.

= *Lophotrichus brevirostratus* L.M. Ames, Monogr. Chaetomiaceae: 52, 1963 (fide Malloch & Cain, 1971).

= *Kernia bifurcotricha* A.S. Saxena & Mukerji, Trans. Brit. Mycol. Soc. 54: 146, 1970 (fide Arx et al., 1988).

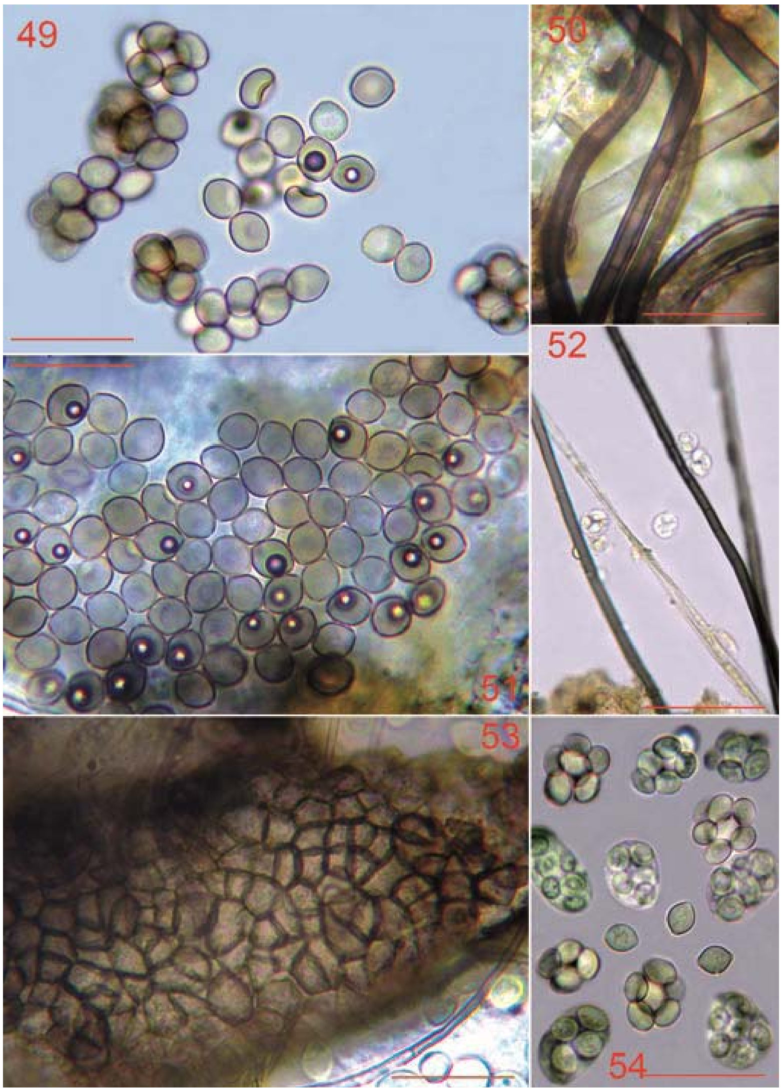
Ascomata perithecioid, subglobose, 250–280 µm diam., blackish, semi-membranous, with an apical papilla surrounded by a tuft of dark hairs, and with paler sparse hairs. Peridium some layers of very thick-walled, polygonal cells (*textura angularis*), 5–8 × 4–6 µm, the outermost dark brown, the innermost paler and with thinner walls. Apical hairs 500–1000 µm long, 5–6 µm diam., up to 10 µm diam. at their base, smooth, thick-walled (about 2 µm), dark greyish brown, densely septate, wavy, sometimes circinate. Sparse hairs paler and thinner, occasionally bifurcate. Asci soon vanishing, broadly clavate to ovoidal or saccate, usually with a short stalk, thin-walled, 8-spored, unitunicate, non-amyloid, 20–24 × 12–18 µm. Ascospores 8–8.5 × 6–6.5 µm (Q = 1.23–1.45; average Q = 1.32), irregularly biseriate to conglobate, dextrinoid in the early stages, often with a gaseous bubble, fairly thick-walled, hyaline at first, becoming yellowish, finally olive-brown, broadly fusiform or ellipsoidal, with apiculate ends, each with a germ pore. Anamorph not observed.

Material examined – Italy, Livorno, Bibbona, Fattoria di Faltona, 50 m a.s.l., dozens of semi-immersed specimens on sheep dung in a damp chamber culture, F. Doveri, 19.3.2009, 295.3-Sassa, CLSM 007.07 bis.

Notes – The genus *Lophotrichus* R.K. Benj. includes coprophilous species both with hairy ostiolate and glabrous non-ostiolate ascomata, a peridium of *textura angularis*, pale to reddish brown, ellipsoidal to broadly fusiform, sometimes asymmetrical ascospores with two germ pores, and no anamorph.

Von Arx et al. (1988) recognised six *Lophotrichus* spp., most (*L. ampullus* R.K. Benj., *L. geniculosporus* Locq.-Lin., *L. martinii* R.K. Benj., *L. plumbescens* Morinaga et al.) distinguishable from *L. bartlettii* by having ascomata with a well differentiated beak (Benjamin 1949, von Arx et al. 1988), *L. geniculisporus* and *L. plumbescens* also by their smaller ascospores (respectively 6–8 × 4.5 µm, Locquin-Linard 1986, 6–7.5 × 5–6 µm, von Arx et al. 1988, versus 8–12 × 5–7.5 µm, Massee & Salmon 1901, von Arx et al. 1988).

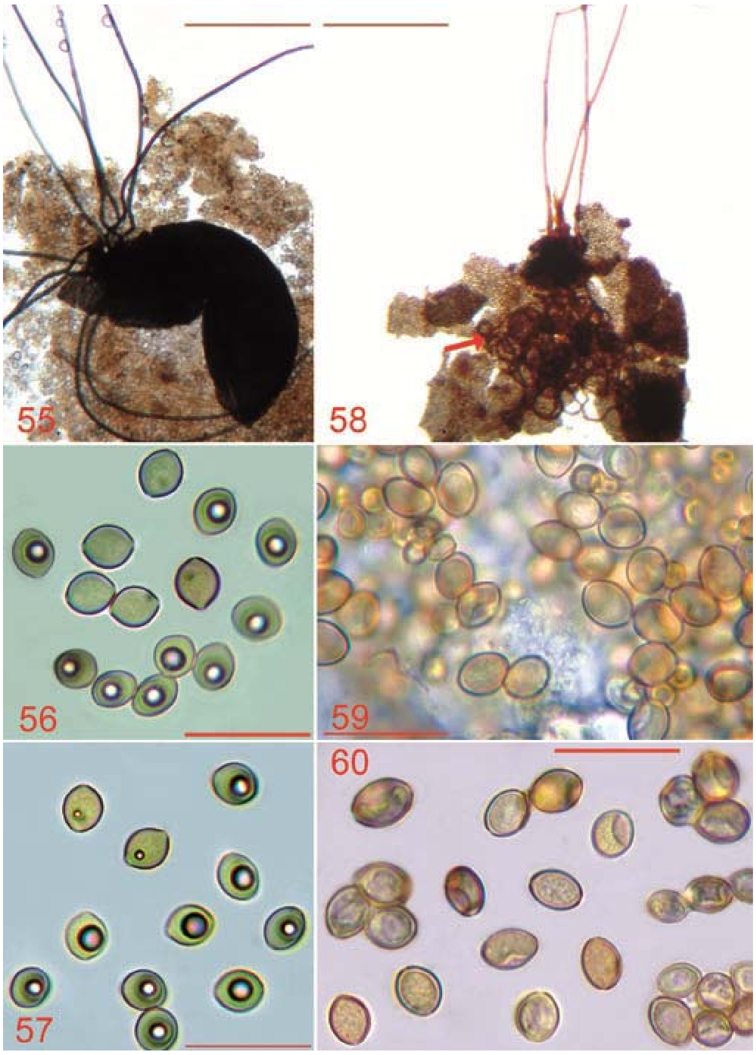
L. macrosporus (Faurel & Locq.-Lin.) Arx et al., with its globose, non-ostiolate ascomata, often covered with some apical hyphal hairs, resembles *L. bartlettii* when the latter develops non-ostiolate instead of the usual papillate ascomata with well differentiated, brown hairs around the ostiole. *L. macrosporus*, however can be always distinguished by its



Figs 49–54 – *Lophotrichus bartlettii*. **49** Free or clustered ascospores inside evanescent asci. **50, 52** Details of apical hairs. **51** Free ascospores. **53** Detail of exoperidium. **54** Three free ascospores and asci in different stages. Bars 49, 51 = 20 µm, 50, 54 = 30 µm, 52 = 60 µm, 53 = 15 µm.

larger ascospores (13–14 × 9 µm., Locquin-Linard 1977).

After von Arx et al. (1988), no new species of *Lophotrichus* was published, but a recombination, *Lophotrichus fimeti* (Arx et al.) Gilgado et al., was stated. Gilgado et al. (2007) validly published this name, although they incorrectly cited the basionym (art. 33.4, 33.5 ICBN 2006), which is *Petriellidium fimeti* Arx et al. (in von Arx 1978), not *Pseudallescheria fimeti* (von Arx et al.) McGinnis et al (1982). The genus *Petriellidium* Malloch, however, must be regarded (McGinnis et al. 1982) as a later synonym of *Pseudallescheria* Negr. and I. Fisch. Gilgado et al. (2007) transferred *Pseudallescheria fimeti* to the genus *Lophotrichus* based on morphological features and phylogenetic analyses, the latter proving the genus *Pseudallescheria* to be polyphyletic (Issakainen et al. 1999, Rainer & de Hoog 2006, Gilgado et al. 2007) and *P. fimeti* not to cluster with other *Pseudallescheria* spp. but to nest with *Lophotrichus plumbescens*. The main morphological features of *L. fimeti* are typical of a *Lophotrichus* species (see my discussion above) and contrast with *Pseudallescheria*, which has a peridium of *textura epidermoidea* and a *Scedosporium* Sacc. ex Castell & Chalm or *Graphium* Corda anamorph (McGinnis et al. 1982). Both *Graphium* anamorph and chlamydospores were observed (Arx 1978) in the original strain (CBS 129.78) of *Petriellidium fimeti*, but this living culture was later proved (McGinnis et al. 1982) to be a mixture of *P. fimeti* and *Pithoascus langeronii* Arx, and to develop peridia of a *textura angularis*

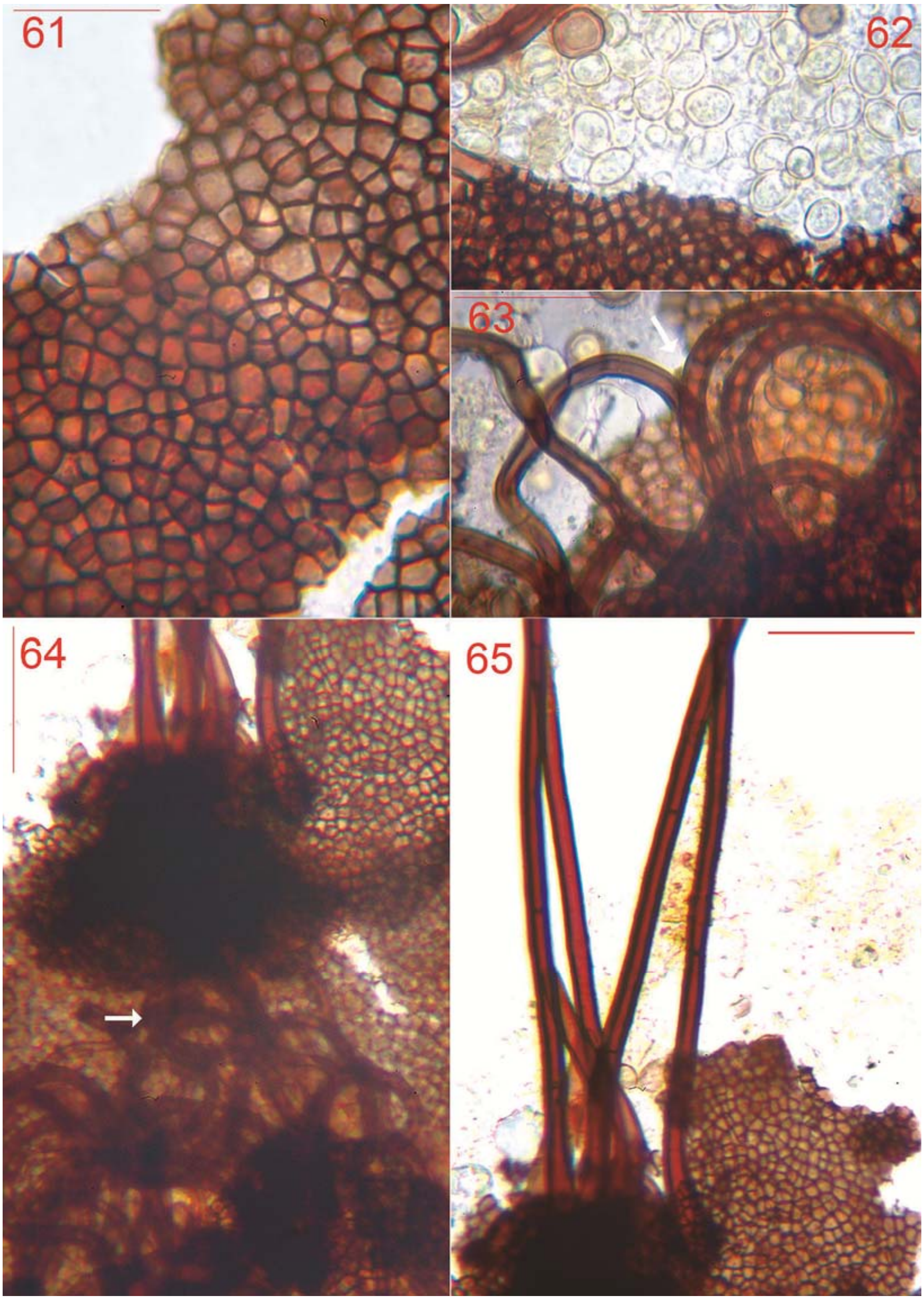


Figs 55–60 – *Lophotrichus bartlettii*. **55** Squashed perithecium with apical hairs. **56, 57** Ascospores – *Enterocarpus grenotii* **58** Squashed cleistothecium with apical hairs and capillitium (arrow). **59, 60** Ascospores. Bars 55, 58 = 125 µm, 56, 57, 59, 60 = 20 µm.

(not *epidermoidea*, as stated in the protologue) and no anamorph (Gilgado et al. 2007).

L. fimeti has spherical, non-ostiolate ascomata, covered with sparse, brown, hyphoid hairs and ellipsoidal ascospores, 11–13 × 8–10 µm (von Arx 1978), so it can be distinguished from the non-ostiolate forms of *L. bartlettii* by its somewhat larger ascospores, but it is hardly distinguishable from *L. macrosporus* which, in my opinion, has only somewhat smaller asci (30–40 × 25 versus 40–70 × 18–25 µm).

Enterocarpus grenotii Locq.-Lin. was regarded as a later synonym of *L. bartlettii* (von Arx 1981, von Arx et al. 1988, Valldosera 1991), possibly because both have papillate ascomata with a tuft of hairs, a peridium of *textura angularis*, ascospores very similar in shape and size with two germ pores, and no anamorph. I think, however, this synonymy was stated incorrectly, as the study of *L. bartlettii* type culture was only wished (von Arx 1981), and I personally observed (Doveri et al. 1997) non-ostiolate ascomata and a capillitium in *E. grenotii* (Figs 58–65), which are typical features of *Enterocarpus* Locq.-Linard, recognised at the present as an independent genus (Lumbsch & Huhndorf 2007, Kirk et al. 2008). Besides I do not think that the numerous mycologists who studied *L. bartlettii* (Ames 1963, Tornabene & Davis 1966, Asad & Ahmad 1968, Seth 1971, Ahmed et al. 1971, Furuya & Udagawa 1973, Pathak & Agrawal 1974, Valldosera & Guarro 1984a, Valldosera 1991, Wang 1992, Horie & Li 1997, Delgado Avila et al. 2001b), overlooked and did not describe the presence of a capillitium. Both species are coprophilous, but *E. grenotii* is very rare and it has been isolated



Figs 61–65 – *Enterocarpus grenotii*. **61** Detail of exoperidium. **62** Immature ascospores above exoperidial cells. **63** Hyphae of capillitium (white arrow). **64** The whole capillitium (arrow) beneath the bases of apical hairs. Portion of exoperidium on the right. **65** Basal and medium portion of apical hairs, and exoperidial cells. Bars 61 = 20 µm, 62 = 25 µm, 63 = 40 µm, 64, 65 = 60 µm.

from fox (Locquin-Linard 1977) and horse (Doveri et al. 1997) dung, while *L. bartlettii* is quite common and found on various kinds of dung (Furuya & Udagawa 1973, Horie & Li 1997)

Pithoascus intermedius (C.W. Emmons & B.O. Dodge) Arx, *Proc. Konink. Ned. Akad. Wetensch., ser. C, Biol. Med. Sci.* 76: 292, 1973. Figs 66–71

≡ *Microascus intermedius* C.W. Emmons & B.O. Dodge, *Mycologia* 23: 324, 1931.

Ascomata 120–200 µm diam., often perithecioid, with a minute, apical papilla, or cleistothecioid, spherical to subglobose, black, opaque, subcoriaceous, seemingly smooth, but covered all over with sparse, very short, hyphoid hairs. Peridium pseudoparenchymatous, dark brown, layered, a *textura angularis* of thick-walled, polygonal cells, 5–11 × 3–7 µm, the innermost cells paler and slightly larger. Hyphoid hairs subhyaline or brown, septate, 2–3 µm diam., Asci 8-spored, irregularly disposed, non-amyloid, inoperculate, ephemeral, non-fasciculate, broadly ellipsoidal or clavate, or doliiform, even subglobose, 11–15 × 7–9 µm. Interascal tissue absent. Ascospores strongly dextrinoid in the early stages, conglobate inside the ascus, 5–6 × 2–2.5 µm, cymbiform (navicular) in frontal view, subtriangular (plano-convex), sometimes subreniform (slightly concavo-convex) in side view, with slightly pointed ends, thin-walled, hyaline at first, pale yellow when mature, lacking oil drops, de Bary bubbles and germ pores. Anamorph not observed.

Material examined – Italy, Pisa, Volterra, Villamagna, podere Vallicella, 200 m a.s.l., more than fifty superficial or usually immersed specimens on pig dung in a damp chamber culture, usually crowded, tending to form crusts, covered with a white, aerial mycelium, F. Doveri, 13.4.2009, 285.3-Lajatico, CLSM 008.09.

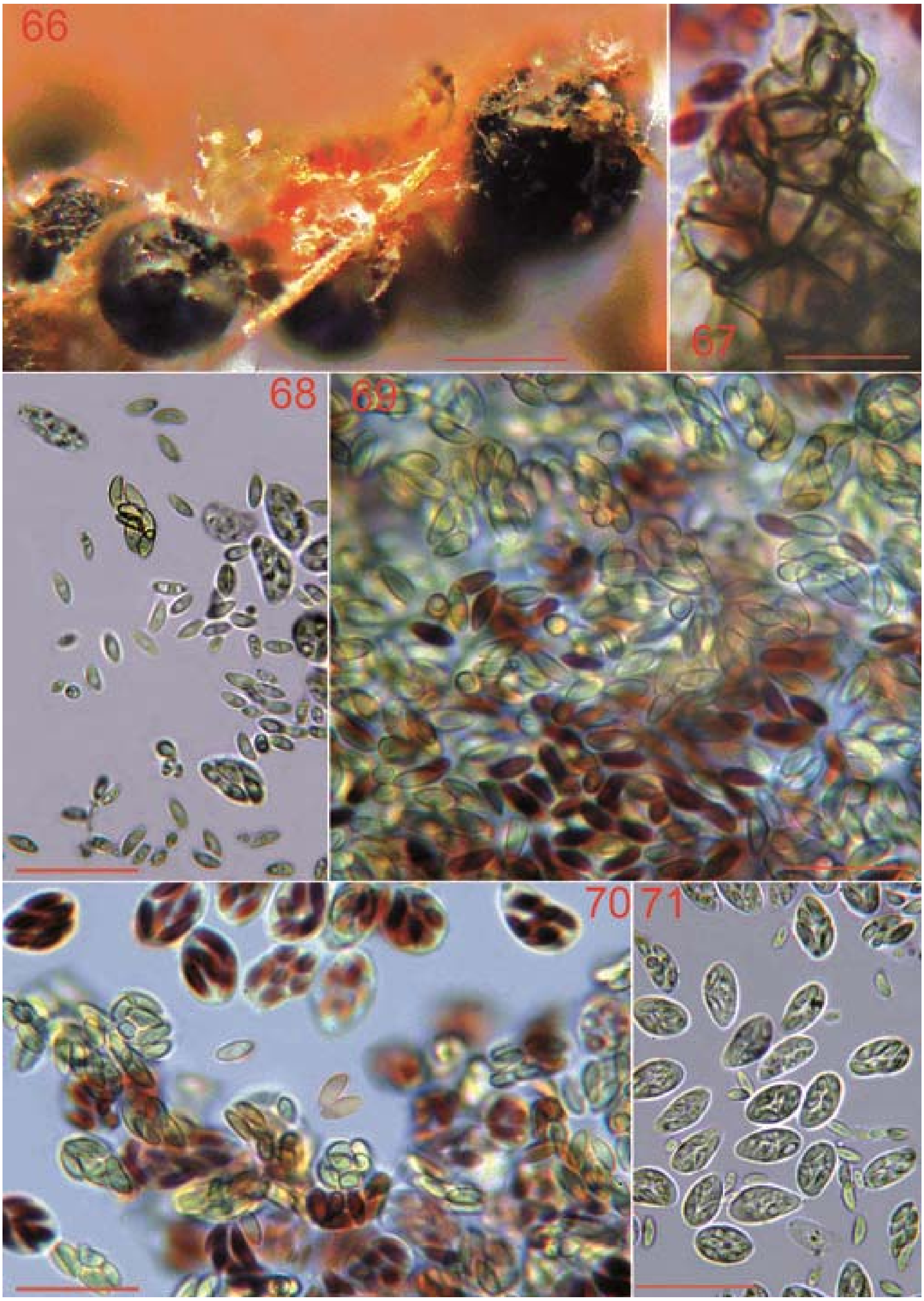
Notes – In my key to genera of Microascaceae, I have mentioned the main differentiating features between *Microascus* and *Pithoascus*, indirectly recognising their independence at genus rank, as originally stated by von Arx (1973b, 1975b, 1978) and followed by others (Valmaseda et al. 1987, Arx et al. 1988, Kirk et al. 2008). In the original conception *Pithoascus* has non-ostiolate or small papillate ascomata, narrower and paler spores lacking germ pores, no conidial state, and slower growing colonies.

The independence of *Pithoascus* from *Microascus* was later questioned, when some taxa were noticed to possess ascoma and spore features typical of the former, a conidial state and growth rates of the latter (Malloch & Hubart 1987), or when the association between *M. intermedius* and a *Scopulariopsis* anamorph was proved (Roberts 1975, Domsch et al. 1980), and a reduced anamorphic stage was observed in *M. intermedius* (Abbott et al. 2002).

Lumbsch & Huhndorf (2007) regard *Pithoascus* as a later synonym of *Microascus*, although molecular studies (Issakainen et al. 2003) have proved *Pithoascus intermedius* and *P. nidicola* (Massee & E.S. Salmon) Arx to cluster in a definite subclade inside the *Microascus s. l.* main clade, leaving the matter open whether to split or redefine the genus *Microascus*.

If conceived in a broad sense, i.e. inclusive of *Pithoascus*, *Microascus* has papillate to long-beaked, rarely cleistothecioid ascomata with a pseudoparenchymatous peridium of angular (*textura angularis*) or exceptionally epidermoid (*textura epidermoidea*) cells, and asymmetrical, naviculate, (sub) triangular (plano-convex), reniform (concavo-convex), or heart-shaped ascospores with one or no germ pore. The anamorph is often *Scopulariopsis* Bainier (Zukal 1885, Curzi 1930a, 1931, Barron et al. 1961, Udagawa 1962, von Arx 1975b, Abbott et al. 1998, Abbott & Sigler 2001). Species of *Microascus* are usually saprobic on soil (Mathur & Thirumalachar 1962, Sage et al. 1995, Mouchacca 1999) dung(Zukal 1885, Massee & Salmon 1901, 1902, Tóth 1965, Dal Vesco et al. 1967, Saxena & Mukerji 1973, Piontelli et al. 1981, Valldosera 1991), and rotting wood (Lumley et al. 2000), sometimes pathogenic for plants (Morton & Smith 1963), humans, and animals (Jones 1936, Barron et al. 1961, Baddley et al. 2000), insects included (Skou 1973). They have a cellulolytic (Verona et al. 1967) and proteolytic (Malloch & Hubart 1987) activity, which explains the high frequency of occurrence on dung (Lumley et al. 2000).

P. intermedius is characterised by usually papillate and ostiolate ascomata, a perium of *textura angularis*, and small, navicular ascospores, (Emmons & Dodge 1931, von Arx 1973b, von Arx et al. 1988). It has often been compared (Barron et al. 1961, Udagawa 1962, Morton & Smith 1963, von Arx 1973b, von Arx et al. 1988, Abbott et al. 2002) with *P. nidicola* and *P. stoveri* Arx, and distinguished from both by its shorter (4.5–6 versus 6–8 µm) ascospores, usually plano-convex rather than concavo-convex in lateral view, from *P. stoveri*



Figs 66–**71** – *Pithoascus intermedius*. **66** Semi-immersed ascomata. **67** Detail of exoperidium. **68, 71** Free ascospores and asci in different stages. **69, 70** Strongly dextrinoid ascospores, free or clustered inside asci. Bars 66 = 100 µm, 67, 69, 70 = 15 µm, 68, 71 = 20 µm.

also by usually ostiolate rather than non-ostiolate ascomata, from *P. nidicola* by the ability to develop a reduced anamorph.

P. intermedius has been isolated from rotting plants (Emmons & Dodge 1931, Barron et al. 1961, von Arx 1973b), soil (Emmons in Barron et al. 1961), rarely from dung (Barron et al. 1961).

Sordariomycetes – Sordariomycetidae – Sordariales – Chaetomiaceae

Chaetomidium fimeti (Fuckel) Sacc., Syll. Fung. 1: 39, 1882. Figs 72–80

≡ *Chetomium fimeti* Fuckel, Jahrb. Ver. Naturk. Herzog. Nassau 15: 64, 1860.

≡ *Thielavia fimeti* (Fuckel) Malloch & Cain, Mycologia 65: 1064, 1973.

≡ *Chaetomidium chlorochaetum* Speg., An. Mus. Nac. Buenos Aires, ser. III, 12: 336, 1909 (fide Calviello, 1978).

Cleistothecia globose, 300–350 µm diam., dark brown, membranous, wholly covered with comparatively short, greenish hairs, and a whorl of long, blackish, basal hairs. Peridium layered: 1) endostratum a *textura angularis* of hyaline, thin-walled, polygonal cells; 2) exostratum some layers of dark brown, thick-walled, polygonal cells (*textura angularis*), 5–8 µm diam., disposed in a petaloid pattern around the basal hairs. Greenish hairs strongly encrusted, thin-walled, flexuous, densely septate, tapering upwards, 2.5–4.5 µm diam., up to 350 µm long. Blackish hairs flexuous, smooth, septate, sometimes narrowing at the septa, with pointed tips and elarged, sometimes bulbous bases, thick-walled (1 µm or more), 4.5–6 µm diam., up to 1500 µm long. Paraphyses not observed. Asci fasciculate, clavate, 8-spored, long-stalked, 65–75 × 17–20 µm. Ascospores irregularly biseriate, thick-walled, limoniform, sometimes subglobose in frontal view, bilaterally flattened so ellipsoidal in side view, (11–) 12–14 (–16) × 9–11 (–11.5) × 7.5–8 µm (Q = 1.09–1.55; average Q = 1.28), hyaline at first, pale brown at maturity, biapiculate, sometimes deformed, with one apical germ pore. Conidia lacking.

Material examined – Italy, Pisa, Chiecinella, 70 m a.s.l., about twenty superficial, gregarious specimens, late maturing (at 32–35 days) on horse dung in a damp chamber culture, F. Doveri, 13.4.09, 274.3-Montopoli in Val d'Arno, CLSM 023.04 bis.

Notes – The genus *Thielavia* Zopf, inclusive of *Chaetomidium*, was monographed by Malloch & Cain (1973), who stated that the presence of differentiated hairs in *Chaetomidium* and glabrous cleistothecia in *Thielavia* are not a difference enough to warrant their independence at genus rank, as species with intermediate forms are known.

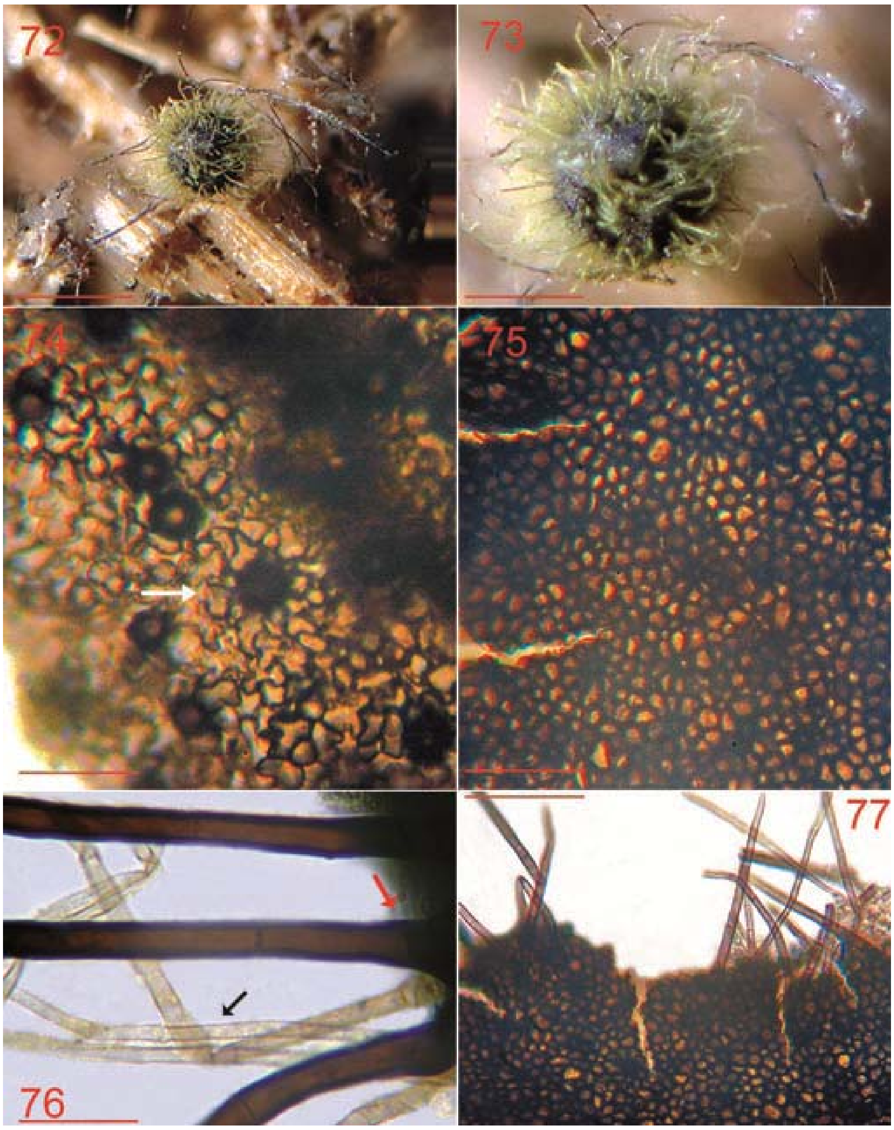
Von Arx (1975a) did not attach the same importance to the presence of differentiated hairs and regarded *Thielavia* as having glabrous, setose or tomentose peridia with a *textura epidermoidea*, and fusiform, clavate, obovate or ellipsoidal ascospores, and *Chaetomidium*, the non-ostiolate counterpart of *Chaetomium*, as having hairy or setose, pseudoparenchymatous cleistothecia, and limoniform, laterally flattened ascospores.

Von Arx et al. (1988) kept the same conception of *Thielavia* and *Chaetomidium*, but assigned both limoniform and broadly fusiform ascospores to the latter. Their key to *Chaetomidium* species is based on ascospore shape and peridial frame (*textura angularis* or *textura epidermoidea*).

The main morphological features of the genus *Chaetomidium* were described by Doveri (2004a), who also provided a key to the species with a cephalothecoid peridium.

Two new *Chaetomidium* spp. were later published, *C. galaicum* Stchigel & Guarro and *C. triangulare* Stchigel & Guarro, isolated from granite rock and soil. The former is similar to *C. khodense* Cano et al. (1993) and to *C. megasporum* Doveri et al. (1998a) on account of its cephalothecoid peridium and ellipsoid-fusiform ascospores, but differs from *C. khodense* in having less hairy ascomata and longer ascospores (14–19 × 5–7 µm vs. 11–13 × 6.5–7 µm, Stchigel et al. 2004), from *C. megasporum* in having smooth hairs and smaller ascospores (19–21.5 × 11–13 µm in *C. megasporum*); *C. triangulare* belongs to the group lacking a cephalothecoid peridium and can be easily distinguished from all the others by its glabrous ascomata and triangular ascospores.

The latest key to *Chaetomidium* spp. was provided by Stchigel et al. (2004). Studies of developmental morphology (Greif & Currah 2007) showed that *Aporothielavia leptoderma* (C. Booth) Malloch & Cain has a cephalothecoid peridium and dehiscence very similar to *Chaetomidium arxii* Benny (1980), and it must be recombined in *Chaetomidium leptoderma* (C. Booth) Greif & Currah. It differs from *C. arxii* in having sparse, shorter, and wavy peridial hairs, and narrower ascospores (14.5–16.5 × 5.5–7 µm vs. 10.5–19 × 7.5–12.5 µm, (Greif& Currah 2007). It also differs from all the other *Chaetomidium* spp. in having knob-



Figs 72–77 – *Chaetomidium fimeti*. **72, 73** Cleistothecium. **74** Petaloid arrangement of exoperidial cells around the hair bases (white arrow). **75** Detail of exoperidium. **76** Lower portion of blackish, basal hairs (red arrow), and greenish hairs (black arrow). **77** Detail of exoperidium with hairs. Bars 72 = 400 µm, 73 = 200 µm, 74 = 30 µm, 75 = 40 µm, 76 = 20 µm, 77 = 70 µm.

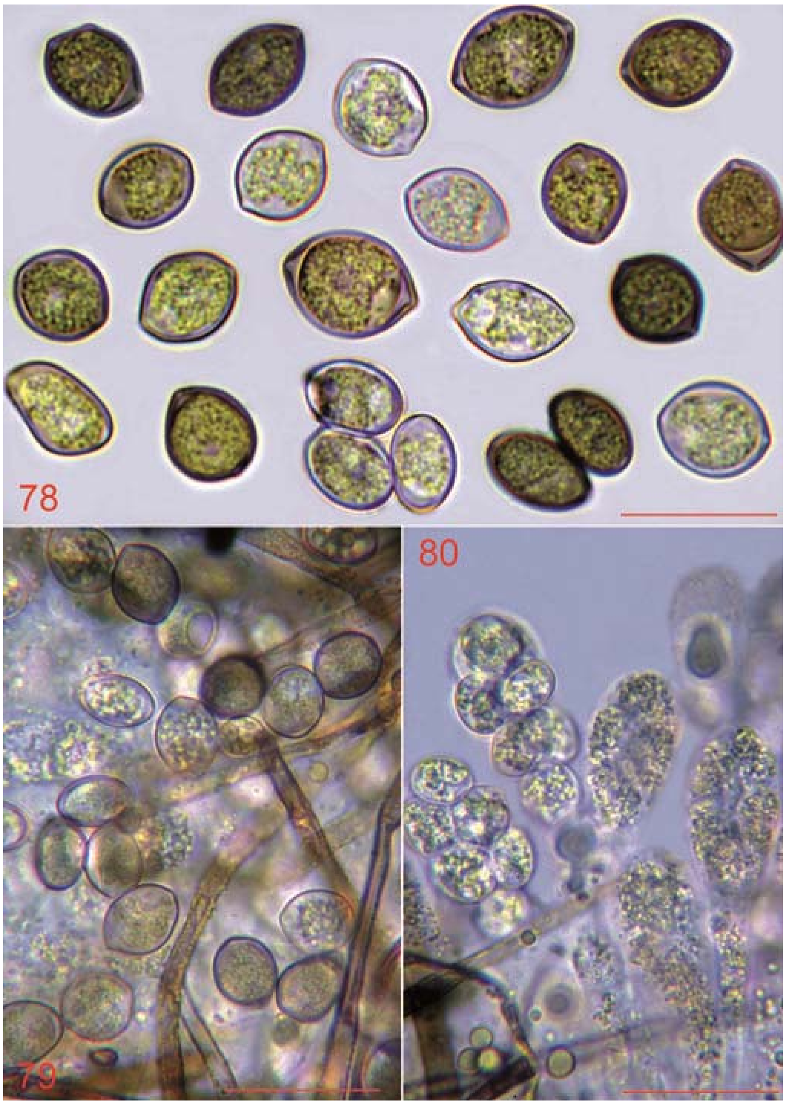
like protrusions on the peridial cells.

Twelve *Chaetomidium* spp. have been recognised so far, but phylogenetic analyses (Greif et al. 2009) prove that the genus is polyphyletic and must be restricted to *C. fimeti* and *C. subfimeti*, being the other species scattered through the Chaetomiaceae G. Winter and Lasiosphaeriaceae Nannf.

C. fimeti, the type of *Chaetomidium*, is characterised by limoniform, laterally flattened ascospores, and a non–cephalothecoid peridium. Unlike others (Whiteside 1962), I have not been able to observe filaments of sterile cells in centrum of my collection. *Chaetomidium subfimeti* Seth has all morphological features similar to *C. fimeti*, but smaller ascospores (8–10 × 6–7 µm, Seth 1967).

C. fimeti has been isolated from horse (Fuckel 1860), rabbit (Munk 1957, Seth 1968), cock (Munk 1957), and unspecified dung (Malloch & Cain 1973), and from manure (Winter 1887). It must be regarded as facultatively coprophilous, as it was also recorded from nests of free-living birds (Hubálek 1974), decaying plants and wood (Winter 1887, Bainier 1909, Spegazzini 1909, Calviello 1978), seeds, and soil (Malloch & Cain 1973).

Chaetomium murorum Corda, Icon. Fung. 1: 24, 1837. Figs 81–91



Figs 78–80 – *Chaetomidium fimeti*. **78, 79** Limoniform, bilaterally flattened ascospores in different stages. **80** Immature asci. Bars 78 = 15 µm, 79, 80 = 20 µm.

= *Chaetomium tomentosum* Preuss, Linnaea 24: 99, 1851.

= *Bolacotricha grisea* Berk. & Broome, Ann. Mag. nat. Hist., Ser. 2: 7, 1851.

= *Chaetomium griseum* (Berk. & Broome) Cooke, Grevillea 1: 175, 1873.

= *Chaetomium humanum* P. Karst., Not. Fauna Flora Fenn. 8: 193, 1882.

= *Chaetomium macrosporum* Sacc. & Penz., Michelia 2: 591, 1882.

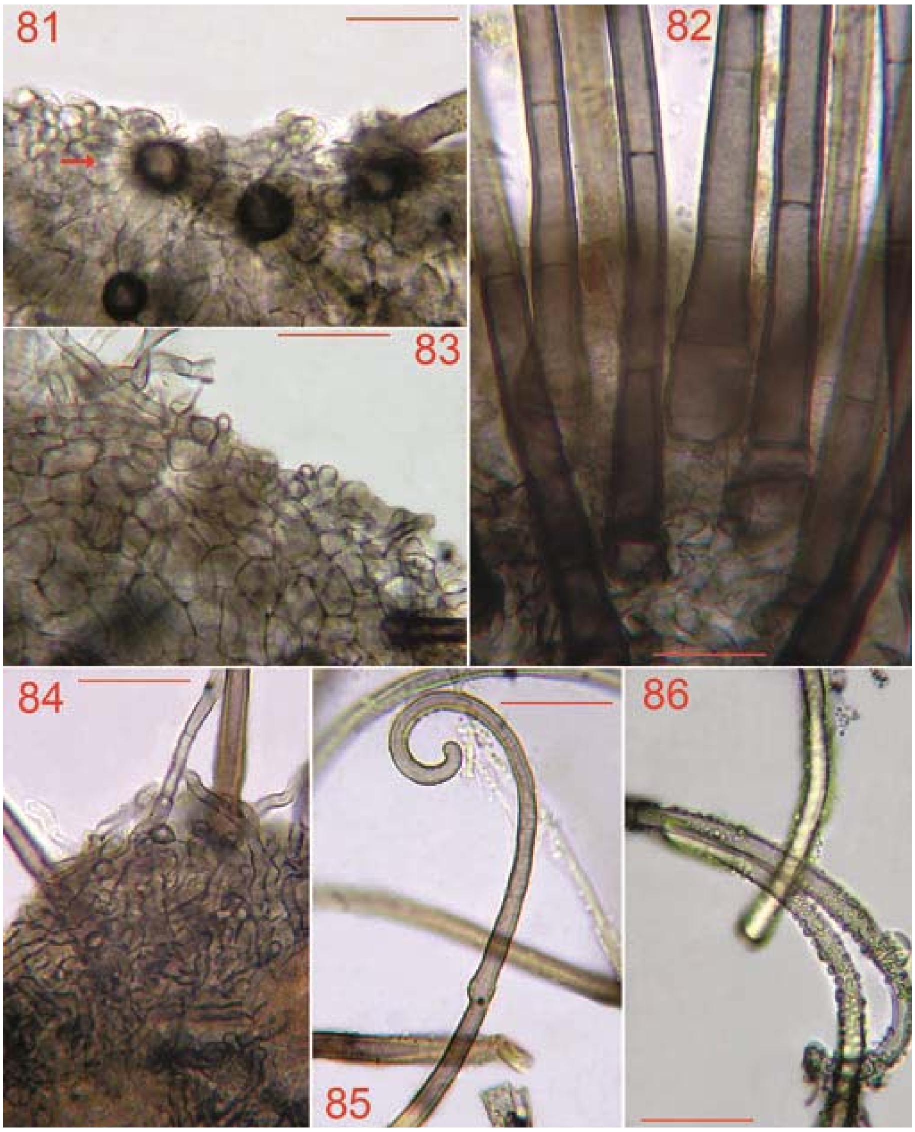
= *Chaetomium contortum* Bainier, Bull. Soc. Mycol. Fr. 25: 205, 1910.

= *Chaetomium pampaninii* Cif., Bull. Soc. Bot. Ital. 1923: 98, 1923.

= *Chaetomium elongatum* Czerepan., Notul. syst. Sect. cryptog. Inst. bot. Acad. Sci. U.S.S.R. 15: 80, 1962.

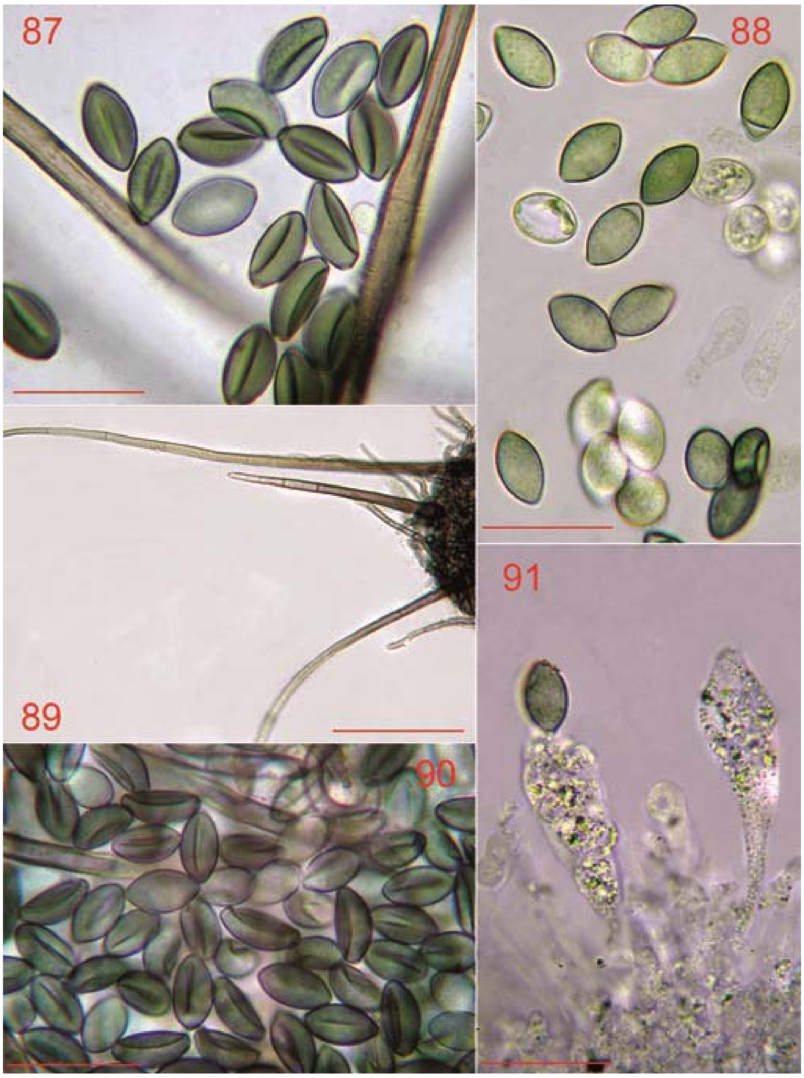
Colonies on Emerson YpSs (Yeast protein Soluble starch Agar) attaining 70 mm diam. at 12 d, with a white aerial mycelium in vague concentric rings, without exudates. Reverse olivaceous.

Perithecia 170–200 µm diam., globose or rarely subglobose, exceptionally ovoidal, dark greyish brown, membranous, wholly hairy, with an ostiole variable in size, sometimes scarcely visible. Peridium two-layered: 1) endostratum a *textura angularis* of pale brown polygonal cells, somewhat larger, 8–13 × 7–10 µm, and with thinner walls than the exoperidial cells; 2) exostratum darker brown, with a complex frame: a *textura epidermoidea*, with hyphae 2–4 µm diam., interspaced with a *textura angularis* (variable in percentage) of polygonal cells, 5–9 × 4–8 µm, sometimes with a *textura*



Figs 81–86 – *Chaetomium murorum*. **81** Petaloid arrangement of peridial hyphae around the hair bases (arrow). **82** Basal portion of apical hairs. **83** Peridial detail of *textura angularis*. **84** Peridial detail of *textura epidermoidea*. **85** Circinate apex of apical hair. **86** Detail of apical hairs. Bars 81, 84, 85, 86 = 20 µm, 82 = 12 µm, 83 = 15 µm.

cephalothecoidea (petaloid) around the hairs. Basal hairs hyphoid, 2.5–3.5 µm diam., dense, thin-walled, pale brown, flexuous, septate, smooth. Lateral hairs 100–300 × 2–4 µm, thick-walled, rigid, straight in the basal portion, flexuous above, tapering upwards, smooth to encrusted, pale brown, paler at their tips, septate, with an enlarged, often bulbous base and a slightly pointed apex. Apical hairs 450–1000 × 5–6 µm, thick-walled, sometimes smooth, but also covered with a refractive crystalline-material, poly-septate, brown, but paler and with a scarce number of septa in the apical portion, straight at the base, flexuous above and often open-circinate at their blunt or slightly pointed apex. Basal cell enlarged, often bulbous, 10–15 µm long, 8–11 µm wide, often with germs of roots. Paler apical hairs present in different percentages, sometimes absent, thinner-walled, septate, wavy, 3–4 µm diam., often more encrusted than the darker hairs, but becoming smooth owing to the easily detachable refractive encrustations. Paraphyses ephemeral, cylindrical, somewhat narrowing at the septa, 3–4 µm diam. Asci unitunicate, fasciculate, clavate, 8-spored, 50–60 × 15–17 µm, fairly long-stalked. Ascospores irregularly biseriate or conglobate, 13–16 (–16.5) × (7–) 7.5–9 (–10) µm, symmetrical, ellipsoidal to narrowly elipsoidal (Q = 1.55–2.00; average



Figs 87–91 – *Chaetomium murorum*. **87, 88, 90** Ascospores. **89** Lateral hairs. **91** Immature asci. Bars 87 = 20 µm, 88, 90, 91 = 25 µm, 89 = 40 µm.

Q = 1.73), with attenuated ends and one apical germ pore, sometimes with one slightly apiculate pole opposite to the germ pore, hyaline at first, becoming brown, often collapsing to form a longitudinal furrow. Anamorph absent.

Material examined – Italia, Vicenza, Villaga-Monte Tondo, 250 m a.s.l., about ten gregarious, superficial specimens, on hedgehog dung in a damp chamber culture, A. Bizzi, 19.8.07, 125.2–Longare, CLSM 010.08; Asti, Agliano Terme, 250 m a.s.l., on bat dung in a damp chamber culture, M. Filippa, 20.6.05, 193.1-Canelli, CLSM 010.08 bis; Vicenza, Lumignano, Monte Brosimo, 100 m a.s.l., on dormouse dung in a damp chamber culture, A. Bizzi, 24.11.08, 125.2-Longare, CLSM 010.08 ter; Livorno, Montioni, 0 m a.s.l., on rabbit dung in a damp chamber culture, F. Doveri, 18.3.09, 306.3-Suvereto, CLSM 010.08 quater; Livorno, Bibbona, Fattoria di Faltona, 50 m a.s.l., on sheep dung in a damp chamber culture, F. Doveri, 18.3.09, 295.3-Sassa, CLSM 010.08 penta; Pisa, Orciatico, 50 m a.s.l., on sheep dung in a damp chamber culture, F. Doveri, 13.4.09, 285.3-Lajatico, CLSM 010.08 esa; Pisa, Volterra, Villamagna, Podere Vallicella, 200 m a.s.l., on cattle dung in a damp chamber culture, F. Doveri, 13.4.09, 285.3-Lajatico, CLSM 010.08 epta; on sheep dung in a damp chamber culture, CLSM 010.08 octa; Vicenza, Tonezza del Cimone, Altopiano dei Fiorentini, 1450 m a.s.l., on hare dung in a damp chamber culture, A. Bizzi, 13.7.08, 082.3-Arsiero, CLSM 010.08 ena; Vicenza, Solagna, Campeggia, 980 m a.s.l., on mouflon dung in a damp chamber culture, A. Bizzi, 2.6.09, 083.3-Monte Grappa, CLSM 010.08 deca; Vicenza, Longare, Lumignano, Monte Brosimo, 350 m a.s.l., on snail dung in a damp chamber culture, A. Bizzi, 11.6.09, 125.2-Longare, CLSM 010.08-XI; on dormouse dung in a damp chamber culture, 22.6.09, CLSM 010.08-XII; Novara, Druogno, Santa Maria, 850 m a.s.l., on sheep dung in a damp chamber culture, F. Doveri, 15.5.10, 116.1-Bellinzago, CLSM 010.08-XIII.

Chaetomium ancistrocladum Udagawa & Cain, Can. J. Bot. 47: 1943, 1969. Figs 92–100

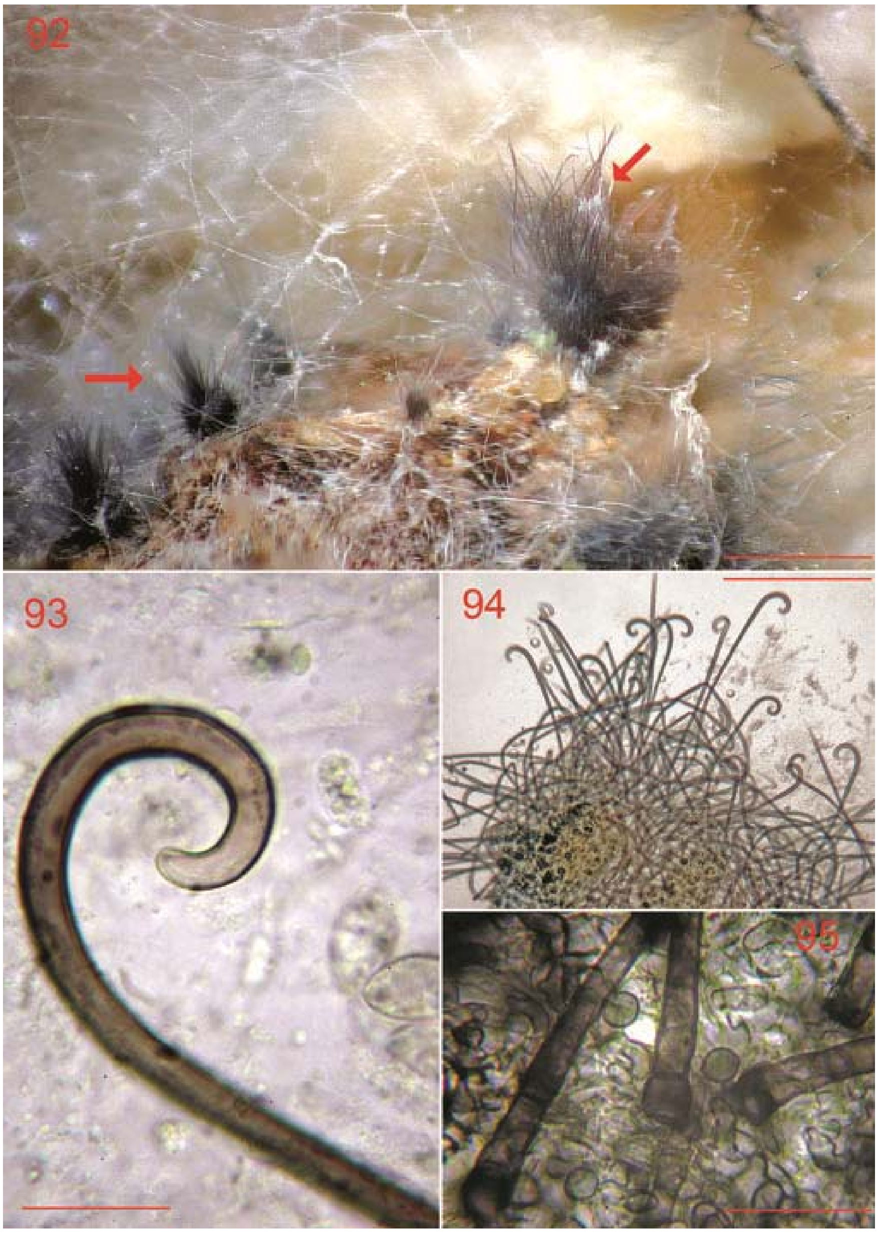
Perithecia subglobose to broadly ellipsoidal, 280–350 × 250–280 µm, dark greyish brown, membranous, wholly hairy, rounded or sometimes slightly pointed at their base, with a scarcely visible ostiole. Peridium two layered: endostratum a *textura angularis* of pale brown, thin-walled, polygonal cells, 10–20 × 8–15 µm; exostratum a *textura cephalothecoidea* of wavy, dark brown, thick-walled, short hyphae, 2–4 µm diam., radially arranged around the hair bases (petaloid arrangement). Basal hairs hyphoid, 2–4 µm diam., thin-walled, pale brown to almost hyaline, wavy, septate, smooth. Lateral hairs intergrading to the basal ones, thick-walled, rigid, usually straight or sometimes slightly wavy, tapering upwards, smooth, brown, paler at their tips, septate, with an enlarged base, somewhat narrower than the apical hairs. Apical hairs 4–7 µm diam., up to 600 µm long, parallel, thick-walled (up to 1 µm), usually smooth in the upper portion, finely encrusted towards the base, poly-septate, greyish brown, paler at the apex, straight or slightly curved at maturity, usually open circinate at their blunt or slightly pointed apex, enlarged at the base up to 10 µm. Paraphyses ephemeral, thin-walled, septate, 4–8 µm diam., slightly enlarged at their tips. Asci unitunicate, fasciculate, clavate, 8-spored, 80–110 × 18–20 µm, long-stalked. Ascospores biseriate in the upper portion of ascus, uniseriate in the lower, hyaline at first, becoming greyish brown, (15–) 15.5–17.5 (–19) × (8.5–) 9–10.5 (–11) µm, ellipsoidal to narrowly ellipsoidal (Q = 1.45–2.05; average Q = 1.73), sometimes slightly inaequilateral, with attenuated, often apiculate to subumbonate ends, with one apical, sometimes prominent, large (about 1 µm diam.) germ pore and a hyaline small spot at the opposite end. Anamorph not detected.

Material examined – Italy, Vicenza, Lumignano, Monte Brosimo, 100 m a.s.l., on dormouse dung in a damp chamber culture, A. Bizzi, 24.11.08, 125.2-Longare, CLSM 009.08; 22.6.09, CLSM 009.08 bis.

Notes – *C. ancistrocladum* is close to *C. murorum* and its relatives, i.e. to the group of species characterised by comparatively large ascomata (> 150 µm diam.), clavate asci, non-dextrinoid, medium-large (11–20 µm long), ellipsoidal ascospores, with attenuated ends and one apical germ pore. I have called *C. ancistrocladum* my collection because its features fully match those described in the protologue (Udagawa & Cain 1969) except for the absence of a second kind of short, coiled hairs around the ostiole, concealed by the spore mass at maturity, not observed by me even in immature specimens, when spores are not formed or not extruded yet. The peridial frame of *C. ancistrocladum* was not described in the protologue, but von Arx et al. (1986) affirmed “it was described as cephalothecoid” and considered this feature as distinctive inside the *murorum*-group. I cannot know to whom they assigned this description, because I have not found any record of this species but that of the original diagnosis.

C. piluliferum J. Daniels differs from other species of the group (*C. murorum*, *C. ancistrocladum*, *C. circinatum* Chivers) particularly in having abundant rather than scarce or absent botryose aleurioconidia (von Arx et al. 1986). Besides it differs from *C. ancistrocladum* in having a variable peridial frame, ranging from *intricata* to *epidermoidea*, sometimes *angularis* or *cephalothecoidea* at intervals, flexuous to circinate and somewhat narrower apical hairs (Daniels 1961, Mazzucchetti 1965, Seth 1970, Arx et al. 1986, Bell 2005), shorter asci (up to 60 µm long), and slightly smaller ascospores on average (13–)16 (–17) × 8–10 µm; 7–8 µm broad in one collection from rotting wood (Lumley et al. 2000).

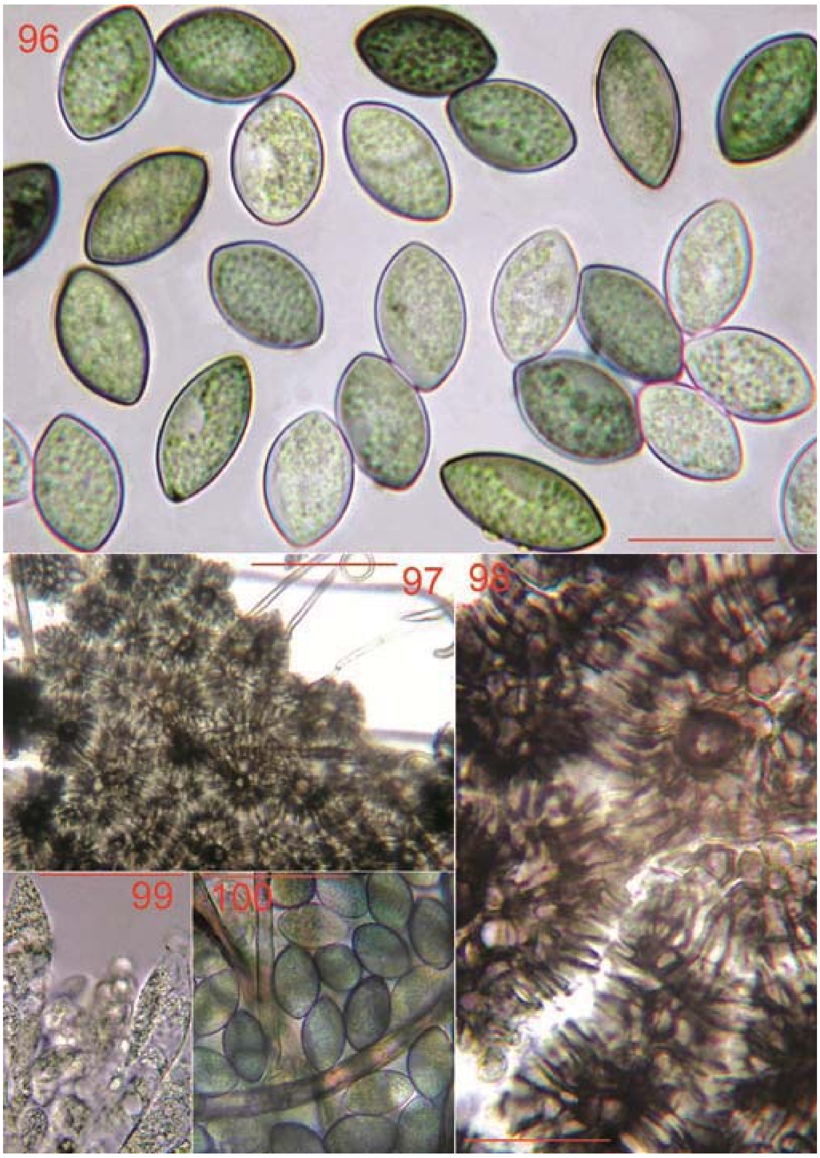
C. murorum resembles *C. piluliferum* in most respects, except for lacking a botryose anamorph (von Arx et al. 1986), but I can recognise additional differences deduced from literature, i.e. more flexuous apical hairs (Winter 1887, Palliser 1910, Stratton 1921, Greathouse & Ames 1945, Munk 1957, Seth



Figs 92–95 – *Chaetomium ancistrocladum*. **92** Ascomata on dung (arrows). **93** Circinate tip of apical hair. **94** Apical hairs. **95** Bases of apical hairs. Bars 92 = 600 µm, 93 = 20 µm, 94 = 100 µm, 95 = 40 µm.

1968, 1984, Ahmad & Sultana 1973, Valldosera & Guarro 1984b, Arx et al. 1986, Bell 2005) and usually ascospores with three darker longitudinal bands (Arx et al. 1986) in *C. murorum*. These features are also useful to distinguish *C. murorum* from *C. ancistrocladum*.

C. circinatum differs from *C. ancistrocladum* in having a peridium with a *textura intricata* (Millner 1975), flexuous apical hairs with closed circinate, 2–3 times recurved tips, shorter asci, and somewhat smaller spores on average (Skolko & Groves 1953, Ames 1963, Seth 1970, Ahmed et al. 1971, Lorenzo 1993). Mine is the second record worldwide of *C. ancistrocladum*, coming from dung like the original record and most collections of *C. piluliferum* (Marchal 1885, Caretta et al. 1994, Caretta & Piontelli 1996, Bell 2005), *C. circinatum* (Ahmed et al. 1971, Millner 1975, Lorenzo 1993) and *C. murorum* (Karsten 1888, Massee & Salmon 1901, 1902, Bainier 1909, Palliser 1910, Stratton 1921, Ames 1963, Tóth 1963, 1965, 1967, Mirza & Nasir 1968, Seth 1968, 1970, Calviello 1971, Ahmad & Sultana1973, Hubálek 1974, Matsushima 1975,



Figs 96–100 – *Chaetomium ancistrocladum*. **96, 100** Ascospores. **97** Cephalothecoid peridium. **98** Petaloid plates of *textura cephalothecoidea*. **99** Immature asci. Bars 96 = 15 µm, 97 = 200 µm, 98 = 20 µm, 99 = 50 µm, 100 = 25 µm.

Mill ner 1975, Carter & Khan 1982, Barrasa 1985, Bokhary & Parvez 1986, Valldosera 1991, Eriksson 1992, Caretta et al. 1994, 1998, Caretta & Piontelli 1996, Beyer 1999, Richard son 2004, Elshafie 2005, Piontelli et al. 2006).

A brief update on the genus *Chaetomium*

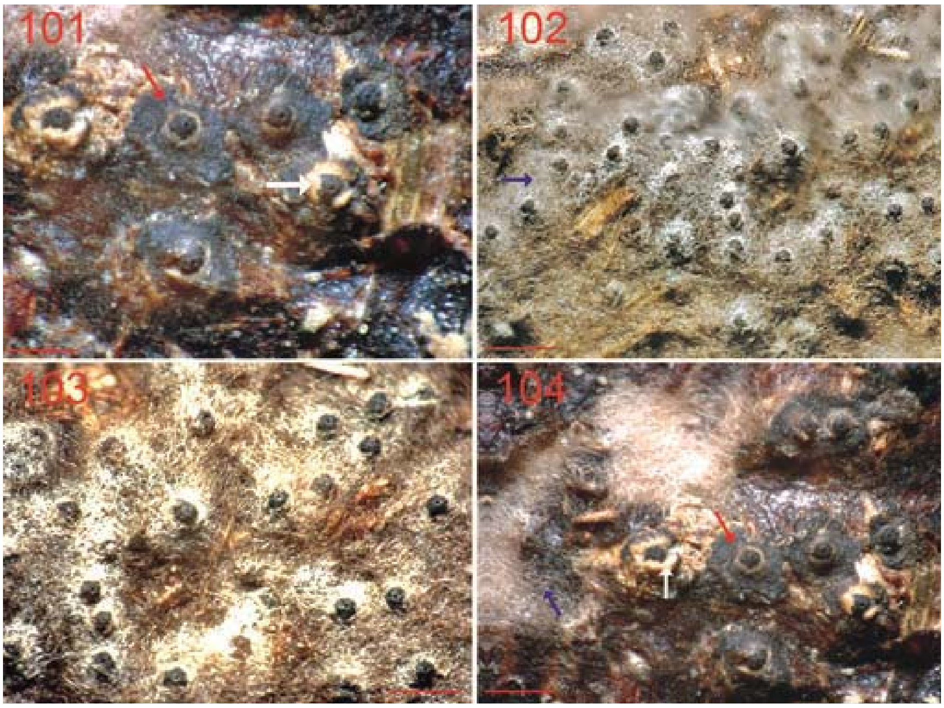
I previously provided (Doveri, 2008a) an update on *Chaetomium* Kunze, describing some coprophilous species new to Italy, and placing them in key. In the same work I provided an updated version of von Arx et al. (1986) key to *Chaetomium* species, in which I inserted all new taxa described after their monograph on the genus.

Since then only one new species, *C. heterothallicum* Mahoney, has been described (in preparation), isolated from river otter dung and characterised by a *Scopulariopsis*-like anamorph, heterothallism, and absolute need of crustacean chitin for developing in axenic culture.

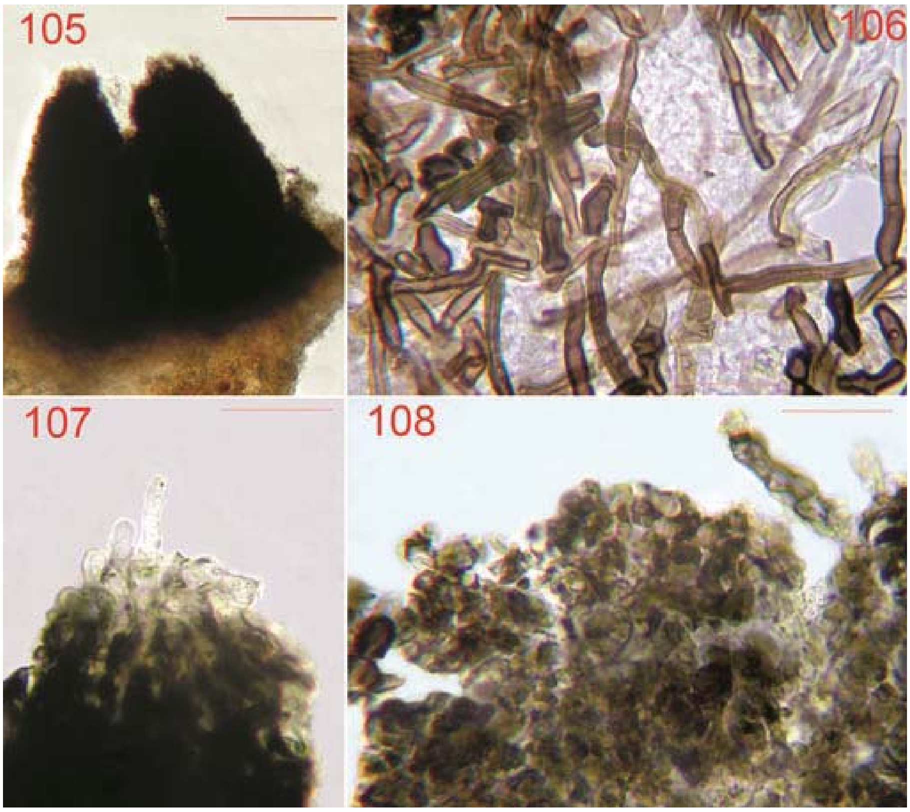
Sordariomycetes – Sordariomycetidae – Xylariales – Xylariaceae

Hypocopra equorum (Fuckel) G. Winter in Rabenhorst, Rabenh. Krypt.-Fl. 1 (2): 178, 1887. Figs 101–118

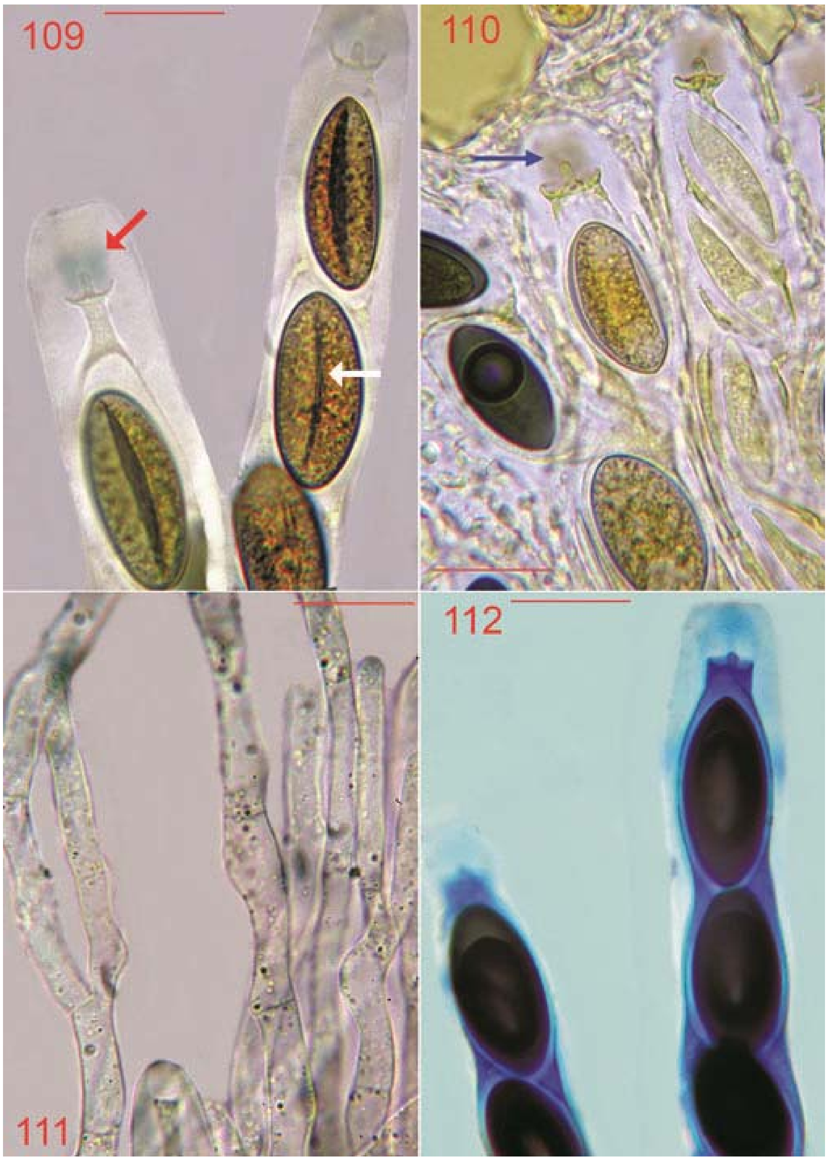
≡ *Hypoxilon equorum* Fuckel, Fungi Rhenani: 1058, 1864.



Figs 101–104 – *Hypocopra equorum*. **101, 102, 103, 104** Immersed perithecia with emerging necks surrounded by clypeate stromata (endostromata = white arrows, ectostromata = red arrows), embedded within a hyphal mat (blue arrows). Bars 101, 104 = 1 mm, 102, 103 = 2 mm.



Figs 105–108 – *Hypocopra equorum*. **105** Perithecial neck. **106** Detail of the hyphal mat. **107** Upper portion of a perithecial neck. **108** Detail of stroma. Bars 105 = 70 µm, 106, 108 = 20 µm, 107 = 15 µm.

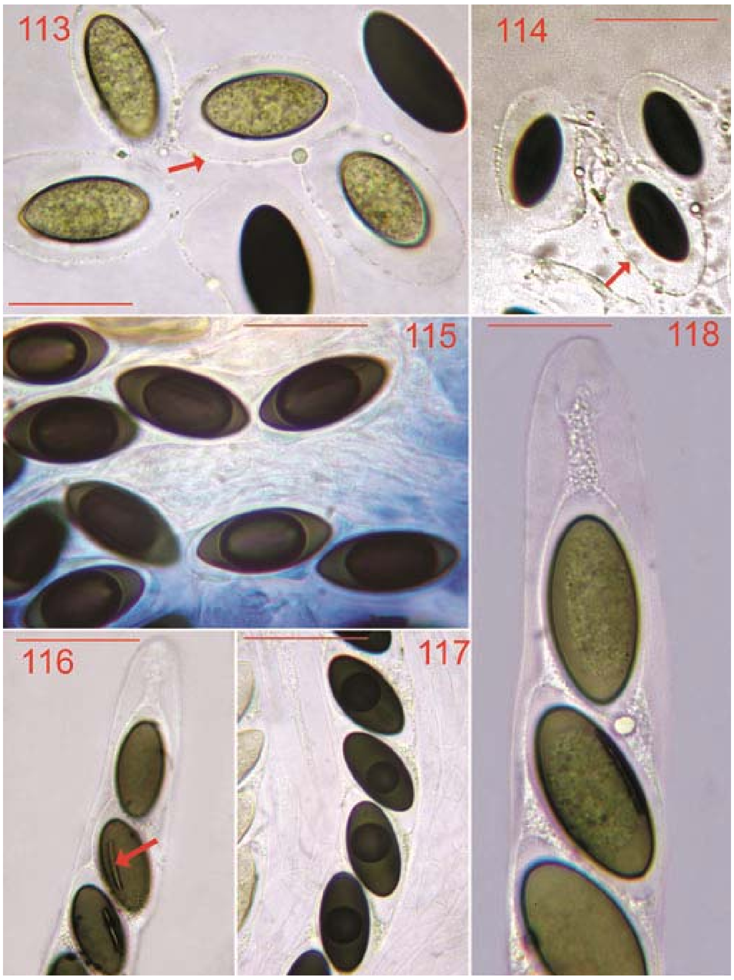


Figs 109–112 – *Hypocopra equorum*. **109** (Melzer) Apical portion of asci with uniseriate ascospores (germ slit = white arrow). Early amyloid reaction of the apical apparatus (red arrow). **110** (Melzer) Dextrinoid change of the apical apparatus (blue arrow). **111** Paraphyses. **112** Apical portion of asci (methyl blue). Bars 109, 112 = 18 µm, 110, 111 = 20 µm.

≡ *Coprolepa equorum* Fuckel, Jb. Nassau Ver. Naturk. 23–24: 240, 1869.

≡ *Sordaria equorum* G. Winter, Abhand. Naturf. Gesellsch. Halle 13 (1): 13, 1873.

Stromata embedded within a hyphal mat, clypeate to widely spreading on the substrate, thick, suberose, dark grey outside, straw-coloured inside, often revolute and crown- or collar-shaped around the ostiole, containing a single or usually several perithecia, made up of dark brown (the innermost much paler), thick-walled, polygonal cells, 4–7 µm diam. Hyphal mat whitish at first, becoming greyish brown, dense, loosening with age, formed of brown, thick-walled, densely septate, branched and anastomosed hyphae, 1.5–3.5 µm diam., with short ends blunt at their tips. Perithecia subglobose, 800–900 × 650–750 µm, membranous, smooth, pale yellow, with a papillate, subcylindrical, coriaceous, somewhat rough, blackish neck, wider than high, 100–120 × 200–220 µm. Peridium seemingly two-layered, with an exostratum typically formed of pale pigmented, septate, elongated, thin-walled cells, 2–5 µm diam., arranged in compressed rows, and an endostratum of pale, thin-walled, cylindrical to polygonal cells, 7–15 µm diam. Exoperidial cells scarcely observable at the neck, as covered by a carbonaceous material, cylindrical towards the ostiole, 3.5–5 µm



Figs 113–118 – *Hypocopra equorum*. **113, 114** Ascospores surrounded by a gelatinous perisporium (arrows). **115, 116, 117, 118** Detail of asci with uniseriate ascospores in different stages (germ slit = arrow). Bars 113, 115 = 20 µm, 114, 116, 117 = 30 µm, 118 = 15 µm.

diam., septate, with an enlarged, papillate end. Paraphyses simplex or branched, exceeding the asci, cylindric, septate, 9–12 µm diam. at the base, tapering upwards, containing many hyaline vacuoles. Asci 8-spored, 200–260 × 20–25 µm, cylindric, roundish or slightly pointed at the apex, short-stalked. Apical apparatus cylindrical, 7–8 µm diam., weakly amyloid, pale blue staining at first, soon becoming pale brick-red. Ascospores surrounded by a broad gelatinous sheath, obliquely to vertically uniseriate, (22–)25–28.5(–31) × 12–13 µm, narrowly ellipsoidal to subfusiform in frontal view, slightly to quite asymmetrical (flattened at one side) in lateral view, thick-walled, smooth, hyaline at first, becoming yellowish, finally dark brown, one-celled as lacking a basal apiculum. Each spore with a longitudinal, eccentric, narrow germ slit, 12–15 µm long.

Material examined – Italy, Trento, Tres, Monte Corno, 1600 m a.s.l., more than one hundred, gregarious, almost fully immersed (except for the neck, which protrudes above the stroma) specimens, on horse dung, A. Bizzi, 4.10.08, 043.4-Cles, CLSM 002.09.

Notes – *H. equorum* is characterised by dark, widespread stromata immersed in a hyphal mat, one-celled, asymmetrical, medium size ascospores, with short germ slits, and weakly amyloid to dextrinoid asci. It differs from *H. leporina* (Niessl ex Rehm) J.C. Krug & N. Lundq. ex Doveri (= *H. equorum* f. *leporina* Niesll ex Rehm) in having one-celled, less flattened, and larger ascospores [in *H. leporina* 20–24 × 8–10 µm (Lundqvist in Hansen & Knudsen 2000); 17–19 × 7.5–8.5 µm (Doveri 2004a)], asci with a wider apical cylinder, and growth on equine (Winter 1873, 1887, Phillips & Plowright 1876, Griffiths 1901, Lundqvist 1960) rather than on leporid dung. According to Lundqvist (pers. comm.) "it would be surprising if *H. leporina* could be shown to grow on any other substrate than hare dung or possibly leporid dung, as well as *H. equorum* on anything but horse dung". One collection of *H. equorum* from rabbit dung has been, however, described by Breton (1965), another recorded by Richardson (2008b) from hare. Other *Hypocopra* spp. are characterised, like *H. equorum*, by perithecia embedded within a hyphal mat, but most (*H. anomala* J.C. Krug & Cain, *H. punicea* J.C. Krug & Cain, *H. rostrata* Griffiths) can be easily distinguished from the latter by lacking a stroma and having a constantly amyloid apical apparatus. *H. rostrata* has also larger, equilateral ascospores (27–32 × 13–18 µm, Griffiths 1901), *H. anomala* and *H. punicea* smaller ascospores (18–23 × 9–10 µm, Krug & Cain 1974).

H. chionopsis J.C. Krug & N. Lundq. (nom. inv.) is very close to *H. equorum* owing to the presence of a hyphal mat, a dark stroma containing one to several perithecia, a dextrinoid apical apparatus, and ascospores similar in size 24–29 × 10–12 µm (Lundqvist in Hansen & Knudsen 2000), but differs in its two-celled, strongly flattened ascospores, with a longer germ slit, growth on elk and roe deer dung, and "stromata often preceded by pink sporodochia".

Spores of my collection of *H. equorum* are slightly larger than those described by Fuckel (1869), quite larger than in Winter (1873, 1887, Krug & Cain 1974), but similar in size to those described by others (Griffiths 1901, Cain 1934, Moreau 1953, Lohmeyer 1995, Richardson & Watling 1997).

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