

The genus *Parasola* in Britain

including *Parasola cuniculorum* sp. nov.

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The genus *Parasola* was erected by Redhead *et al.* (2001) as one of four genera that now accommodate what was previously the genus *Coprinus* Pers. The present paper provides keys to and descriptions of 12 *Parasola* species found in Britain including one new species: *P. cuniculorum* D.J. Schaf. is here proposed for a taxon previously regarded as a two-spored form of *P. misera*.

Introduction

Parasola species that were previously included in *Coprinus* s.l. are distinguished by: a strongly pleated (plicate), membranous, umbrella-like cap at maturity; a glabrous cap, lacking bristle-like thin-walled cystidia; veil absent from the cap; cystidia absent from the stem – see Schafer (2010). In section *Auricomi* of *Parasola*, thick-walled, usually golden/yellow-brown narrow setae are present. Similar setae are also present in *Parasola conopilus*, a species until recently placed in *Psathyrella* but whose inclusion in *Parasola* is supported by DNA phylogeny. Its cap cuticle (see species description below) also supports its inclusion in *Parasola*, despite its lacking the pleated mature cap of other *Parasola* species.

Parasola species are common, saprotrophic fungi, living on decayed organic matter in bare soil, grassland, on woody debris including wood chips and on dung. *Parasola misera* and *P. cuniculorum* are obligate dung species, the remainder may occur on dung but are usually found in other habitats.

The pleating (Figs 2A, 4A, 6A, 7A, 9A, 10A, 11A) is caused by the cap tissue splitting along the middle of each gill as the cap expands. The setae present in section *Auricomi* lie flat on the surface and are invisible under a hand lens except (occasionally) in very young primordia. They are very distinctive under the microscope (Figs 2E, 3B).

Mature specimens of some *Coprinopsis* species, e.g. *C. cortinata* may have a rather

similar plicate cap but have veil cells on the cap, which are usually rather distinct if looked for.

Young *Parasola* fruitbodies initially lack the pleated appearance of more mature specimens (Figs 2A, 4A, 6A, 7B-C, 8A-B, 9A, 10A, 11A) and can resemble *Coprinellus* species in section *Setulosi*. However, the latter have bristle-like caulocystidia on the stem, which can be easily seen under a hand lens even when the cap bristles, which they also have, are less clearly visible.

Parasola species do not deliquesce in the way that many “Inkcaps” do – a process in which the release of spores is followed by the liquefaction of the portion of the gill that bears mature basidia, starting with the edge of the gill nearest the cap margin and moving steadily inward and upward as further basidia mature and release their spores in a programmed fashion. Instead, in *Parasola*, although release of spores proceeds in the same way, the gills remain intact. They are initially covered in cystidia (Figs 2C-D, 6C, 7J, 8C, 11C) which collapse at maturity and are only visible in the area of the gill closest to the stipe in the mature fruitbody. At maturity and depending on the conditions, *Parasola* fruitbodies may lack turgor and collapse somewhat, or remain relatively firm and (having shed most of their dark spores) resemble some *Marasmius* species. All except *Parasola conopilus* have basidia of varying lengths (heteromorphic), surrounded by rounded sterile cells (“pavement cells” otherwise known as pseudoparaphyses, Fig. 10C) and protruding to varying extents, as in other Inkcaps.

Names and species boundaries

One of the problems in *Parasola* is that names have been applied in different senses at different times and in different places. Earlier names allocated to these species may not have been accompanied by the microscopic detail currently attached to recognised species. Over time, those names have been attached to various collections

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often with quite different sets of characters. This is discussed below under the species described.

The species boundaries recognised here were generally supported by studies of ITS and LSU DNA sequences (Nagy *et al.*, 2009) except that collections identified by Nagy *et al.* as *Parasola galericuliformis* nested with *P. leiocephala* (see comments under *P. galericuliformis*); some collections identified as *P. lilatincta*, but without lilaceous colour, did not nest with another distinct group identified as *P. lilatincta* (see discussion below under that species); and *P. schroeteri* and *P. megasperma* were not clearly separated. Only single sequences of *P. kuehneri* and *P. hercules* were included, limiting the conclusions that can be drawn about them.

DNA studies based on ITS and LSU sequences do not, on their own, provide a definitive identification of species boundaries. If individual collections identified by morphology as one species appear scattered in different places in a well-founded molecular phylogram (“tree”), that provides evidence against that particular morphological species and/or the identification. If, on the other hand, two or three morphological species are grouped closely together, they may still be either several different species or one variable species.

SPECIES

General Description (except for *Parasola conopilus*):

Cap unopened ellipsoid or acorn-shaped, sometimes rather elongate-cylindrical, initially

evenly coloured from yellow-brown, pale ochre, tawny, reddish-brown to tawny or paler. Translucently striate to sulcate up to the central disc, the cap opening through campanulate, conical, hemispherical and parasol shapes, but usually not applanate, as the cap tissue splits between the gill faces to form a strongly pleated but intact cap surface, the edges facing down and the central disc remaining smooth and becoming somewhat depressed. The pleated surface becomes paler in hue but grey as the spores mature and the colour remains most intense in the centre; hygrophanous, the coloured centre often surrounded by a paler zone. The mature cap usually appears smooth under a hand lens.

Gills more or less free (Figs. 2C, 7D, 8C, 10B, 11A), may be separated from the stem by a ring of tissue (‘pseudocollarium’) – this seems to be formed as the tissue in the centre of the cap expands, tearing the gills away from the stem area (see Fig. 7D) and may vary depending on the conditions of growth. Gills initially white, becoming dark, eventually black as the spores mature, although under the right conditions the more or less complete discharge of spores can leave gills whitish again but sprinkled with small clumps of dark spores. See description of *Parasola auricoma* for observations on cap setae and gill attachment.

Stem typically 1–3 mm wide, straight, more or less cylindrical (may narrow slightly towards the apex) and hollow, somewhat swollen at the base, length variable depending on habitat but typically 90–110 mm when fully extended, white

Key to *Parasola* Sections *Auricomi* and *Glabri*

1. Long, narrow, thick-walled usually golden-brown hairs (setae) present in the cap tissue, best seen in a scalp from the centre of the cap. The setae are typically 100–350 µm long, 2–5 µm wide, but may be 1000 µm or more long; usually lying flat in older specimens and only visible with a hand lens in young and fresh fruitbodies, especially primordia (section *Auricomi*) 2
1. Setae absent (section *Glabri*) 3
2. Cap opening to a typical pleated parasol shape when mature. Basidia surrounded by rounded sterile cells (pseudoparaphyses). Spores brown under the microscope, ellipsoid to somewhat elongate-ovoid with a central (occasionally slightly eccentric) germ pore. Pleurocystidia present, but gill cystidia collapsing in older fruitbodies ***Parasola auricoma***
2. Cap remaining conical and not splitting into a pleated surface. Basidia not surrounded by pseudoparaphyses. Spores dark brown under the microscope, ellipsoid, slightly flattened, germ pore varying from central to eccentric. Pleurocystidia absent ***Parasola conopilus***

3. Average breadth of spores $>10\ \mu\text{m}$ 4
3. Average breadth of spores $<10\ \mu\text{m}$ 7
4. Cap when young and fresh with lilac colour (and a pale bloom, that wipes off); gill edge cystidia and cap cells with oily granules; spores broadly hexagonal, rounded-rhomboid to broadly angular heart-shaped, occasional spores octagonal. With apical papilla ***Parasola lilatincta***
4. Cap when young without lilaceous tinges; gill edge cystidia and cap cells without oily droplets; spores with broad rounded apex, lacking apical papilla 5
5. Spores with average breadth $>12\ \mu\text{m}$, breadth sometimes exceeding length; cap small, up to 13 (-17) mm wide when open; stem narrow, up to 1.3 mm thick; never on dung . . . ***Parasola hercules***
5. Spores with average breadth $<12\ \mu\text{m}$; cap larger, up to 30 mm wide when open; stem wider, 1.5 to 3 mm thick; on soil or often on dung 6
6. Spores in face view (broadly) ellipsoid to ovoid, average $Q > 1.4$, not strongly lentiform, average length $> 13.8\ \mu\text{m}$ ***Parasola megasperma***
6. Spores in face view rounded triangular/shield-shaped, $Q < 1.4$, strongly lentiform, average length $<13.6\ \mu\text{m}$ ***Parasola schroeteri***
7. Always on dung; small species, cap < 10 mm wide when open; pleurocystidia absent; spores with rounded angles, lacking apical papilla, breadth sometimes exceeding length 8
7. Usually not on dung; larger species; pleurocystidia present; spores with apical papilla (except *P. galericuliformis*) 9
8. Basidia four-spored. On dung of various species. ***Parasola misera***
8. Basidia two-spored. Often on rabbit dung ***Parasola cuniculorum***
9. Average breadth of spores $< 7.8\ \mu\text{m}$; spores rounded narrowly triangular, rhomboid to mitriform, brown under the microscope. Cap with reddish hue when young ***Parasola kuehneri***
9. Average breadth of spores $> 7.8\ \mu\text{m}$; spores 5–6 angular with apical papilla (occasionally almost ellipsoid) or globose/subglobose to rounded (broadly) triangular with or without apical papilla, spores dark red-brown to almost black under the microscope. Cap colour less reddish 10
10. Cap lilaceous with pale bloom when young and fresh; gill edge cystidia and cap cells with oily granules; spores with average breadth $>9\ \mu\text{m}$ and rhomboid to broadly angular, some octagonal see *Parasola lilatincta* couplet 4
10. Young cap without lilaceous tinges; gill edge cystidia and cap cells without oily granules; average breadth of spores 8–10 μm 11
11. Average length of spores $<11\ \mu\text{m}$ (or $<12\ \mu\text{m}$ and $Q < 1.25$); spores with 5–6 rounded angles (or more rounded) in face view, with or without an apical papilla 12
11. Average length of spores $>12\ \mu\text{m}$ (or $>11\ \mu\text{m}$ and $Q > 1.25$); spores elongate with 5–6 rounded angles (occasionally almost ellipsoid) and apical papilla ***Parasola plicatilis***
12. Spores with apical papilla; heart shaped in face view with rounded angles or more rounded ***Parasola leioccephala***
12. Spores lacking apical papilla; globose, subglobose or broadly triangular in face view ***Parasola galericuliformis***

or translucent tinted with cap colour. The expanded stem is smooth, without any pubescence from cystidia. Younger fruitbodies may have fibrillose tissue attached at the base, which can be carried some way up the stem as it expands and the stem may be somewhat fibrillose before it is fully extended.

Size of fruitbody varies strongly but is consistently very small in *Parasola misera* and *P. cuniculorum*.

Mature spores are dark, varying from very dark red-brown (almost black) under the compound microscope to (dark) yellowish-brown. Spores mature very rapidly and those on gill tissue can provide workable measurements, although a spore print or selecting spores that have already fallen on to the stem is better. Some collections have mature spores mixed with immature spores with paler colours, so colour comparisons need to be made with caution and spore measurements may vary depending on criteria chosen for selecting spores. Spores are generally lentiform (flattened): under the compound microscope they

appear wider in face view than in side view. Since they are usually more dense than the liquid they are suspended in, they lie flat on a slide and this is the view one sees of the majority of free spores. In this (face) view, they generally have some angular character, contrasting with the regular ellipsoid to slightly amygdaloid shape in side view. The overall shape is best seen (but not measured!) by tapping a slide gently with a needle to move the spores around.

Spores have an eccentric germ pore and the germ pore end of the spore may be rounded or have an apical papilla ('lemon-shaped'). See Fig.1. The dimensions are L – the length measured along the “long” axis (the longest length in a plane intersecting the apiculus and germ pore in side view – this can sometimes be shorter than the breadth); B – the breadth in face view; W – the width in side view. Q is the ratio of L to B.

Basidia are usually 4-spored and of different lengths and shapes (heteromorphic) on the same gill.

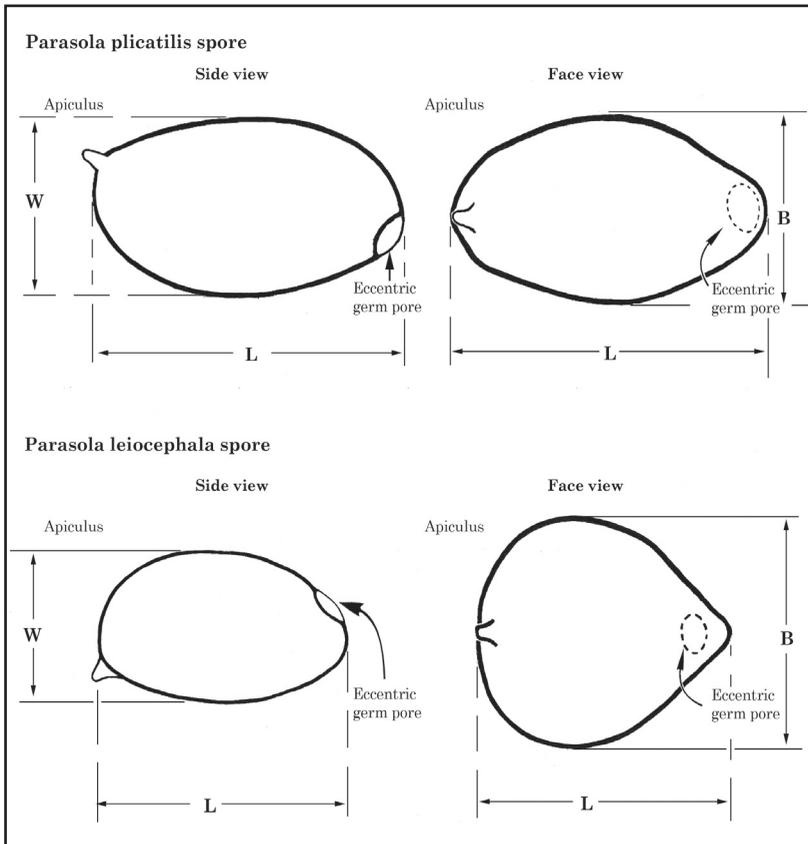


Fig. 1. Spores of *Parasola plicatilis* and *P. leiocephala*.

The young gill edge is initially covered in cheilocystidia, the gill face with numerous pleurocystidia especially near the gill edge; the dimensions of cystidia vary with the conditions and stage of development of the fruitbody and they eventually collapse as the fruitbody matures.

Gill cystidia are mainly broadly lageniform or elongate utriform, varying with the state of development of the fruitbody.

Cap structure. The cap is a hymeniderm with a palisade of globose or (sometimes quite elongate) clavate cells, their apex thin-walled and rounded, attached to the cap tissue by a somewhat thicker-walled often coloured pedicel (Figs 2F, 6D, 7H, 8F). The shape of these cells and the length of their pedicels vary within individual fruitbodies, being shorter towards the edge of the cap.

Clamp connections present, can be found in all tissues.

Species Descriptions

Parasola auricoma (Pat.) Redhead, Vilgalys & Hopple Fig. 2

Description:

Unopened cap 5–30 mm high, 3–20 mm wide, ellipsoid or acorn-shaped, a rich chestnut, red-brown or ochre-brown colour. Open cap up to 60 mm in diameter, hygrophanous, the centre often surrounded by a paler zone. **Gills** fairly crowded ($L = 30\text{--}40$), more or less free (slightly notched) and not separated from the stem by the pseudocollarium found in some other *Parasola* species. **Stem** 2–3 mm wide, length variable depending on habitat but typically 90–110 mm, white or translucent tinted with pale ochre/cap colour. **Expanded stem** is smooth, without any pubescence from cystidia, the mature cap usually also appearing smooth under a hand lens. The cap setae in very young fruitbodies may be visible under a hand lens as a flat hairy golden coat, less commonly as strigose hairs. **Spores** 10.5–14.3 x 6.5–8.0 μm , $Q = 1.6\text{--}1.9$; dark red-brown; ellipsoid to somewhat elongate-ovoid with a central or slightly eccentric germ pore on a rounded base. **Basidia** 4-spored. **Gill cystidia** are mainly elongate-utriform. **Cap cuticle** a hymeniderm, interspersed with numerous long narrow thick-walled setae, usually 100–350 μm long but up to 1 mm or more, 2–5 μm wide. **Clamp connections** present in all tissues.

Ecology and Distribution: Widespread

throughout the British Isles, this common species occurs on bare soil, paths and especially on wood chip or soil containing buried wood chips or woody debris. It occurs most frequently in the first half of the year, typically from April to June but can occur at other times.

Discussion: The cap colour and lack of a pseudocollarium between the stem and gills can provide a tentative identification in the field, easily confirmed by the presence of setae in a scalp of the cap and by the ellipsoid, brown spores with more or less central germ pore. A number of taxa recorded in the past have been synonymised with this species – see discussion of *P. hemerobia* below.

Illustrations & Descriptions: B&K4 266 p.226; Buczacki (2012) p.85; Lange (1939) p.118, pl.160B, as *Coprinus hansenii*; Ludwig (2007) 93.19; Orton & Watling (1979) species 83, p.98; Sterry & Hughes (2009) p.220; Uljé (2005) species 1, p.34; Uljé & Bas (1988), p.435; Vesterholt *et al.* (2007) p.32.

Parasola conopilus (Fr.) Örstadius & E. Larss. Fig. 3

Description:

Young cap initially ellipsoid, dark reddish brown, rapidly becoming conical and striate, 20–35 mm high x 25–55 mm broad, remaining essentially conical; becoming rich dark brown and finely striate to 3/4 of cap; hygrophanous, becoming paler rapidly from the top of the cap. **Veil** absent. **Gills** crowded, adnate, pale brown, becoming darker as the spores mature. **Stem** 90–190 x 2–5 mm, tapering upwards, whitish, hollow, may be brownish towards the sometimes bulbous base. **Spores** 12.5–17.5 x 6.5–9 μm , ellipsoid, slightly lentiform, dark reddish brown, with a large (2–2.5 μm) central to distinctly eccentric germ pore. **Basidia** 4-spored. **Pleurocystidia** absent. **Cheilocystidia** a mix of lageniform and shorter, wider subutriform to subfusiform cells. **Cap cuticle** a hymeniderm, interspersed with numerous long narrow thick-walled setae, usually 100–400 μm long but up to 1 mm.

Ecology and Distribution: Gregarious but not fasciculate, growing on deciduous wood, in rich soil, humus, rubbish heaps, wood chip and soil containing wood chips or woody debris. Common in Britain in the second half of the year.

Discussion: This species lacks the pleated cap and the palisade of pseudoparaphyses

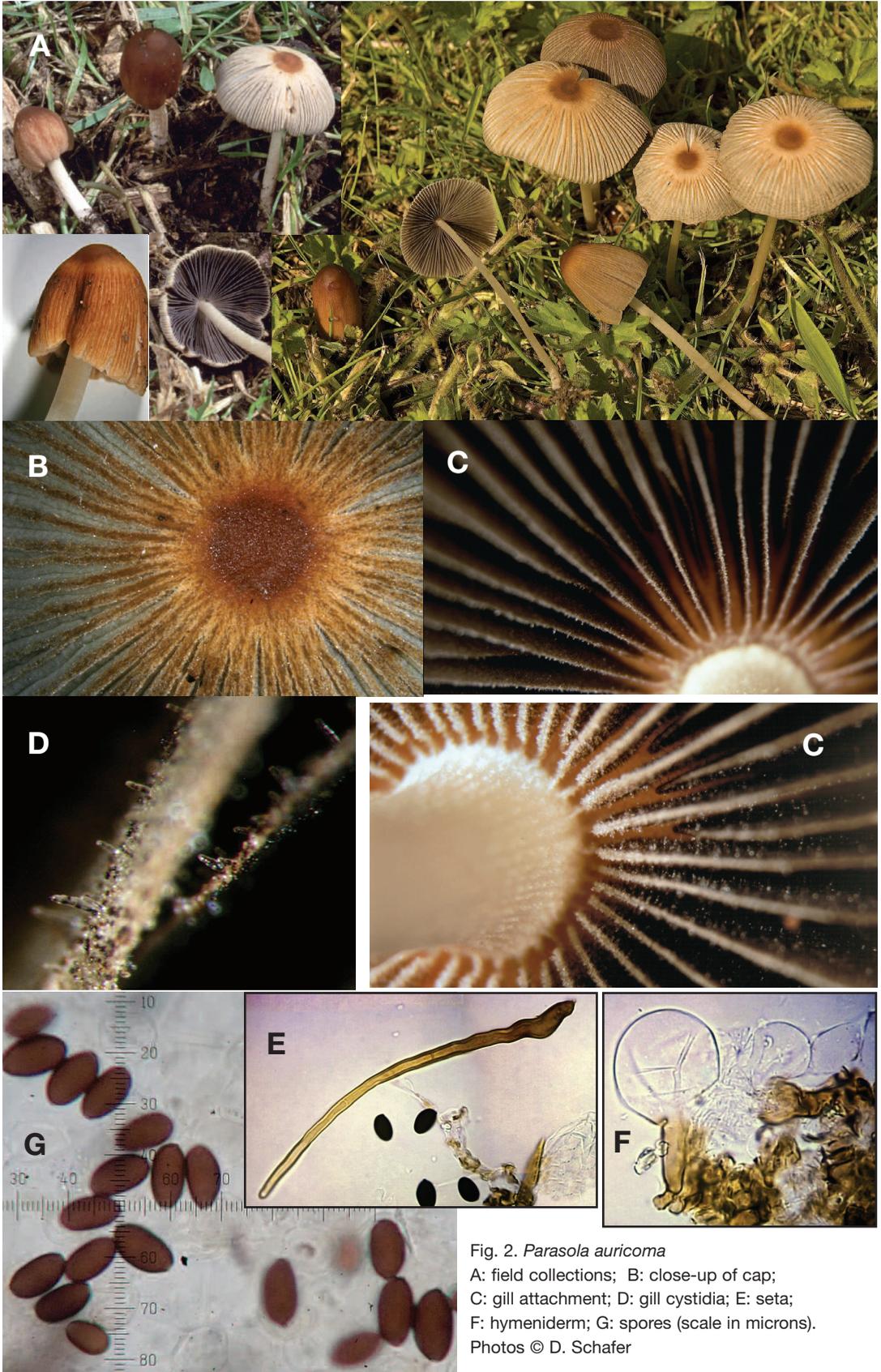


Fig. 2. *Parasola auricoma*
A: field collections; B: close-up of cap;
C: gill attachment; D: gill cystidia; E: seta;
F: hymeniderm; G: spores (scale in microns).
Photos © D. Schafer

“pavement cells”) separating its basidia that are distinct features of other *Parasola* species and other Inkcaps. It has been treated as a *Psathyrella* in the past. However, its cap cuticle has been known to be different from other *Psathyrella* species (van Waveren, 1985, p.106) in being a single layer hymeniderm, unlike the 2–4 cell layer of rounded cells in other *Psathyrella* species. This, and the cap setae very similar to those in *Parasola auricoma* place it close to other *Parasola* species. This is confirmed by DNA studies (Larsson & Örstadius, 2008; Nagy *et al.* 2009).

Illustrations & Descriptions: B&K4 326, p. 266; Buczacki (2012) p. 89; Courtecuisse & Duhem (1995) p. 264, pl. 790; Dähncke (1993) p. 566, 567; Lange (1939) p. 99, pl. 155D (as *Psathyra conopilea*), 155E (as var. *subatrata*); Larsson & Örstadius (2008) p. 1179; Sterry & Hughes (2009) p. 216; van Waveren (1985) p. 104–107.

Parasola cuniculorum D.J. Schaf., sp. nov.

Fig. 4

[Index Fungorum registration number 550589]

Etymology: latinised Greek ‘cuniculorum’ = of rabbits.

Description:

Cap very small. **Young cap** ellipsoid or acorn-shaped, initially 2–5 x 1–3 mm, tawny-orange, fading rapidly to pale cinnamon- or buff-brown then translucent and almost colourless or greyish from the spores, with a cinnamon- or buff-brown centre remaining, opening rapidly through campanulate, conical, hemispherical, parasol and eventually applanate as the tissue splits between the gill faces near the cap surface to form a strongly pleated surface. The open cap is a translucent grey, some colour remaining in the centre. **Gills** free, separated from the stem by a narrow (pseudo)collarium, (L = 9–16). Initially white, becoming grey then black as the spores mature, less so as they are discharged. **Stem** to 50 x 0.5 mm, translucent and smooth when fully extended but silky-striate when young, fibrillose and somewhat pruinose at the somewhat bulbous base, the fibrillose hyphae often being carried part way up the stem as it extends. **Spores** 8.3–12.0 x 8.1–12.2 x 6.3–7.5 µm, strongly lentiform; in face view heart shaped, rounded triangular, irregularly globose or with rounded slightly angular sides; in side view, ellipsoid.

Cheilocystidia (sub)globose. **Pleurocystidia** absent. **Basidia** 2-spored. **Clamp connections** present.

Ecology and Distribution: On dung, often on rabbit dung.

Holotype: UK, England, South West Yorkshire, (Vice County 63, Grid Ref. SE6804), Hatfield Moor, 9th June 2011 on rabbit dung, collected 17th May 2011, D.J. Schafer K(M)191984. Additional collection examined 23rd September 2013 on rabbit dung from England, South Hampshire, (Vice County 11) S. Rogerson DJS 20130923001.

Discussion: A two-spored form of *P. misera* has been recognised for some time (Orton & Watling, 1979, Uljé & Bas, 1988). This species is distinguished from *P. misera* by the consistently 2-spored basidia throughout the whole fruitbody. The preference for rabbit dung has not been noted before now. The distinction between the two-spored and four-spored taxa is supported by molecular phylogeny (Nagy *et al.*, unpubl. cited in Nagy *et al.*, 2010, p.134).

Parasola galericuliformis (Watling)

Redhead, Vilgalys & Hopple. Fig. 5

Description:

Cap at first 5–15 x 3–10 mm, ovoid or cylindrical-ovoid 5–23 mm diameter when expanded, ochraceous buff with darker date-brown centre to rust or rusty tawny. **Spores** 10–12 x 8.5–10.9 x 5.3–8.5 µm; in face view broadly ovoid, subglobose, irregularly globose, more rarely rounded angular; in side view broadly ellipsoid to ellipsoid; germ pore strongly eccentric; lentiform; some strongly lentiform and 5-angled as with typical *P. leiocephala*. **Basidia** 4-spored. **Cheilocystidia** lageniform, utriform, subcylindrical, ellipsoid to globose. **Pleurocystidia** elongate utriform, oblong or cylindrical.

Ecology and Distribution: On soil under trees or shrubs, along paths, in mossy grass or disturbed ground.

Discussion: This species, described by Watling (1967), p.42, is close to *P. leiocephala* and the two species have been claimed to be synonymous, tentatively by Uljé & Bas (1988) and firmly by Nagy *et al.* (2010), supported by DNA evidence grouping recent collections identified as *P. galericuliformis* with *P. leiocephala*. If they are synonymous, *P. galericuliformis* would have priority of date (but see discussion under *P. leiocephala*



Fig. 3. *Parasola conopilus*. Top: fruitbodies; Bottom: Cap cuticle with setae (scale divisions = 10 μ m). Photos © D. Schafer.

p. 88, about *P. lactea* with an even earlier date).

The main difference between *P. galericuliformis* and *P. leiocephala* is the very rounded, swollen shape of the spores in the former, lacking an apical papilla. The spores resemble a shorter, smaller *P. schroeteri* spore or a large *P. misera* spore. The spore shape is regarded by Nagy *et al.* (2010) as being due to immature fruitbodies, the final shape of mature spores being those characteristic of *P. leiocephala*. I very rarely find collections of *P. leiocephala* with these rounded spores and have not been able to confirm this suggestion, although the presence of some spores with the typical *P. leiocephala* shapes in *P. galericuliformis* collections is clear and the rounded spores might be an aberrant form. For now, I prefer to regard *P. galericuliformis* as a separate species but there is a need to find and study further collections, including further DNA studies, to resolve the question of synonymy with *P. leiocephala*.

A further form of spore found occasionally is spherical in face view but lentiform and with a small but distinct apical papilla (Fig.11C). I have attributed this to *P. leiocephala* rather than *P. galericuliformis*. It is close to, but somewhat more spherical in face view than the spore depicted as *P. galericuliformis* in *Funga Nordica* (2012, p.690, H) and may represent a further undescribed species.

Watling used the epithet *galericuliformis* in the belief that he was validating *Coprinus galericuliformis*, invalidly described by Losa España (1943). However, as noted by Uljé & Bas (1988), Losa España's spore dimensions would correspond to what we now call *Parasola kuehneri*. The name "*Coprinus galericuliformis* Losa" was used by Loquin (1947) but his description, reflected also in Kühner & Romagnesi (1953), had spores corresponding to what we would now call *Parasola schroeteri*.

Illustrations & Descriptions: Ludwig (2007) 93.16; Orton & Watling (1979) species 87, p.102; Uljé (2005) species 4, p.36; Uljé & Bas (1988) p.441.

Parasola hercules (Uljé & Bas) Redhead, Vilgalys & Hople.

Description:

Cap small (usually up to 15 mm when fully open, can be up to 20 mm), orange-brown to red-brown when young or at the centre. **Gills** free but not

separated from stem by a distinct pseudocollarium; L = 16–24 (-30). **Stem** up to 1.5 mm wide, up to 75 mm long. **Spores** 12.4–17.5 x 11.3–16.9 x 8.2–11.0 µm, average L = 13.6–15.8 µm, average B = 12–13.3 µm, Q = 1.04–1.28, average Q 1.07–1.19, very dark red-brown to almost black. **Basidia** 4-spored, 22–51 x 13–16 µm. There are 5–8 pseudoparaphyses surrounding each basidium.

Ecology and Distribution: Occurs on soil in grass and lawns. One Yorkshire collection was on a sandy ride in Wykeham Forest. Rarely reported in Britain but may be overlooked. I have only collected it in the Channel Islands.

Discussion: Can be recognised by the very wide, large, lentiform spores combined with diminutive fruitbody and rather large (up to 8) pseudoparaphyses surrounding each basidium. Uljé & Bas (1985), based on Netherlands collections, suggested that this species could be tentatively identified in the field by the small fruitbodies with small number of gills, along with the coloured cap centre. However, in Uljé & Bas (1988), they noted collections from elsewhere with somewhat larger fruitbodies, where this might not be the case. According to Nagy *et al.* (2010), collections of *P. schroeteri* can be unusually small and *P. hercules* can occur on dung, leaving only spore dimensions to distinguish them, although the existence of these two species is strongly supported by DNA studies (Nagy *et al.*, 2009).

Illustrations & Descriptions: Ludwig (2007) 93.14; Uljé & Bas (1985) p.483; Uljé (2005) species 8, p.38; Uljé & Bas (1988, p.442); Vesterholt *et al.* (2007) p. 33.

Parasola kuehneri (Uljé & Bas) Redhead, Vilgalys & Hople. Fig. 6

Description:

Young cap initially up to 17.5 x 11 mm, usually rather dark red-brown but may be paler orange- or yellow-brown, fading rapidly with the original, but paler cap colour remaining in the centre. **Gills** crowded, free, separated from the stem by a pseudocollarium, which is sometimes indistinct; L = 32–50. **Spores** 6.5–10.4 x 5.5–8.4 x 5.0–6.3 µm, strongly lentiform; in face view rounded triangular, rhomboid, mitriform, ovate with conical apex to rounded heart-shaped; in side view ellipsoid to somewhat amygdaliform. **Cheilocystidia** elongate-utriform to cylindrical,

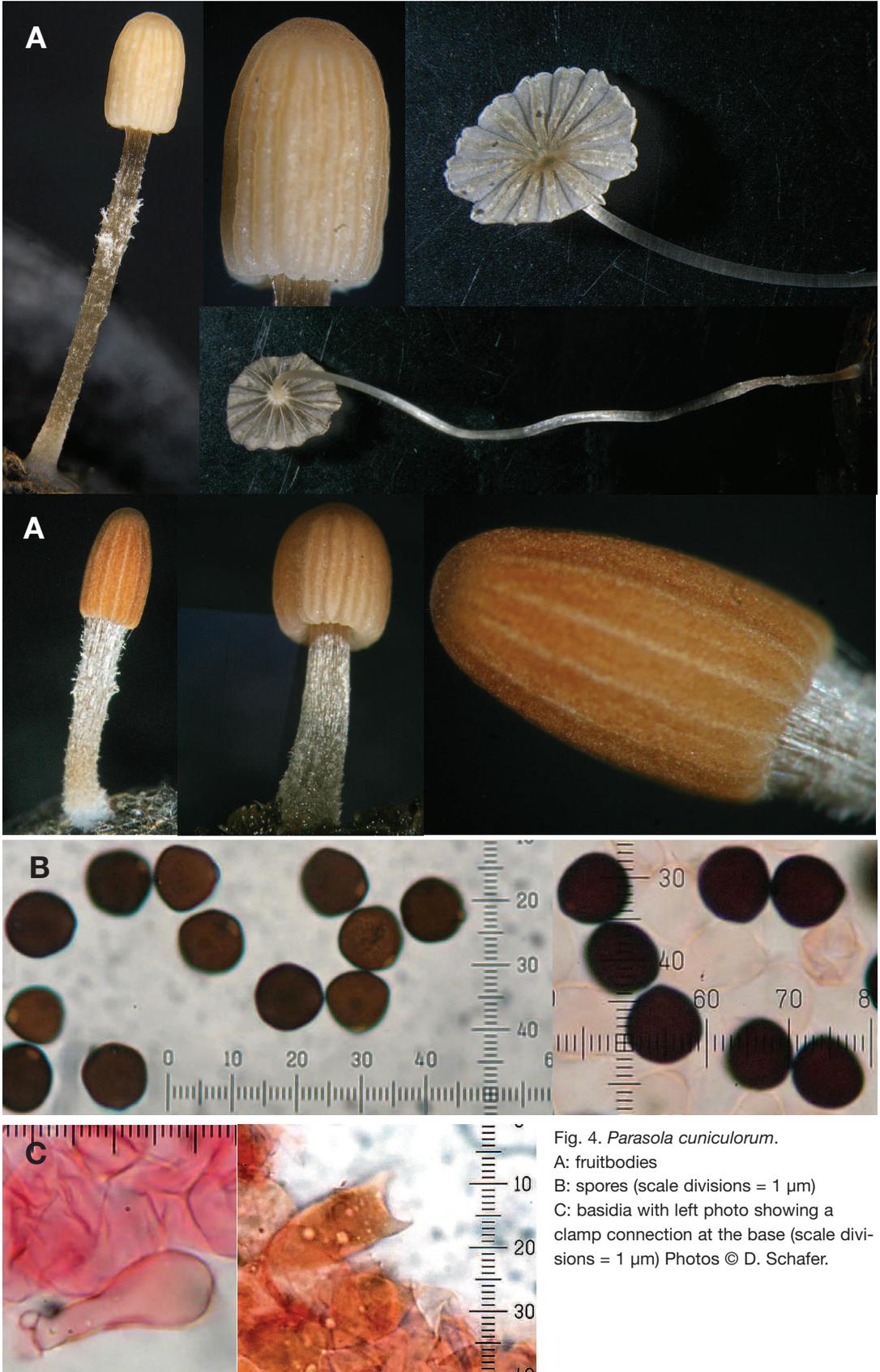


Fig. 4. *Parasola cuniculorum*.
A: fruitbodies
B: spores (scale divisions = 1 μ m)
C: basidia with left photo showing a clamp connection at the base (scale divisions = 1 μ m) Photos © D. Schafer.

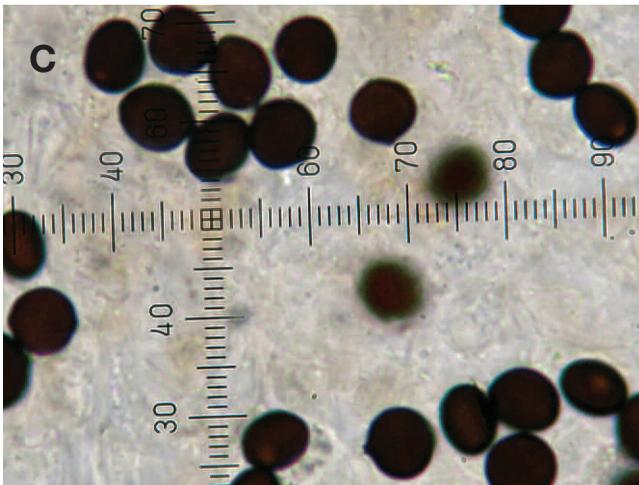
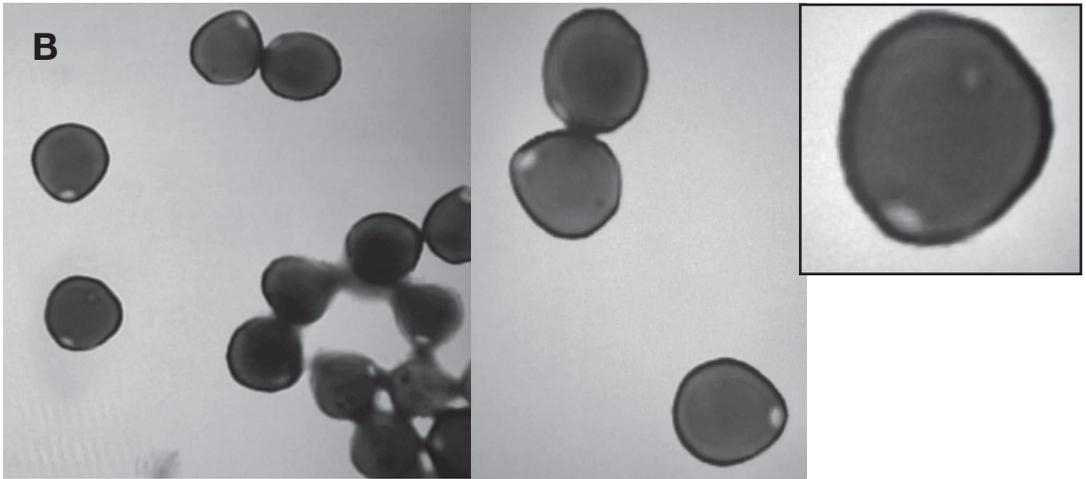


Fig. 5. *Parasola galericuliformis*.
 A: fruitbodies (© Alan Outen, I have not examined this collection microscopically)
 B: Spores (© D. Schafer, black & white photo) from collection K(M) 70884, Reid 1968
 C: spores of *P. cf. leioccephala* DJS 20130916001 coll. T. Hering)

sometimes clavate to (sub)globose. **Pleurocystidia** similar. **Basidia** 4-spored.

Ecology and Distribution: On soil under trees or shrubs, less often in grassland, occasionally on wood chip and rarely on dung. Widespread and common, probably under-recorded because of confusion with other species.

Discussion: This species can be tentatively recognised in the field by the bright red-brown colours, although *P. schroeteri* growing on soil can look similar; *P. leiocephala* usually has paler cap colours lacking any reddish hue and *P. plicatilis* is more often found in grassland. *P. kuehneri* is distinguished by the narrow triangular to mitriform/rhomboid spores, which are smaller than those of *P. leiocephala* and distinctly narrower, also lighter in colour (although the spore print is very dark). *P. schroeteri* and *P. plicatilis* have much larger spores.

Coprinus kuehneri was described by Uljé & Bas (1988) based on Kühner's *Coprinus plicatilis* var. *microsporus*. *Coprinus leiocephalus* was described earlier (Orton, 1969) based on this same taxon but Orton's type, examined by Uljé, was regarded as a different, valid species. See comments below under *P. leiocephala*.

Illustrations & Descriptions: B&K4 285, p.238; Buczacki (2012) p.85; Ludwig (2007) 93.13A, B; Uljé (2005) species 3, p.35; Uljé & Bas (1988) p.438; Vesterholt *et al.* (2007) p.34.

Parasola leiocephala (P.D. Orton) Redhead, Vilgalys & Hopple. Fig. 7

Description:

Cap unopened yellow-brown to dull red-brown, fading as it matures. **Gills** free, separated from stem by a pseudocollarium, fairly crowded, L = 20–50. **Stem** up to 140 x 3 mm. **Spores** 8–12 x 7–10.5 x 5–7.5 µm, in face view rounded heart-shaped with extended, somewhat papillate apex (see Fig.1) or with five rounded angles – a flattened base with the apiculus at the centre, two sides either more or less square or more obtuse and rounded and two sides forming an obtuse cone leading to the germ pore end; in side view ellipsoid; germ pore eccentric; spores dark red-brown to almost black. **Basidia** 4-spored. **Cheilocystidia** and **pleurocystidia** mostly broadly lageniform to extended utriform or clavate, dimensions varying with the conditions and stage of development of the fruitbody. **Cap cuticle** a hymeniderm with globose-clavate cells.

Ecology and Distribution: On soil under trees or shrubs, along paths, in grassland, on wood chip and especially in soil mixed with wood chips or, occasionally on rotten logs, and rarely on dung.

Discussion: This is the commonest *Parasola*, at least in the south of England in the summer and autumn. Spore shape and size is the most critical character in distinguishing it from other *Parasola* species. Collections with the characteristic rounded heart-shape in face view with a distinct apical papilla, less than 11 µm long and around 9 µm breadth are common and easy to recognise. *P. plicatilis* has longer, narrower spores and usually somewhat smaller fruitbodies and less crowded gills and it does not generally occur outside its grassland habitat. *P. kuehneri* has short but also distinctly narrower spores, which are less dark (more noticeably brown under the microscope) and a different shape – triangular, mitriform or rhomboid. It also has more orange-red colour in its cap. For distinctions from *P. galericuliformis* see the Discussion under that species. Nagy *et al.* (2010) studied the type of an earlier North American species, *Pseudocoprinus lacteus* – now *Parasola lactea*, published in 1946, and considered it synonymous. If accepted, that name would have priority but other North American species have been found to have extralimital variations that cast doubt on such synonymy. I think that further published studies are needed before a change of name can be envisioned.

Illustrations & Descriptions: Buczacki (2012) p.85; Ludwig (2007) 93.12; Orton & Watling (1979) 88, p.102 (pp. – the description includes *P. kuehneri* as understood here); Uljé (2005) 2, p.34; Uljé & Bas (1988) p.440; Vesterholt *et al.* (2007) p.35; .

Parasola lilatincta (Bender & Uljé) Redhead, Vilgalys & Hopple. Fig. 8

Description:

Cap unopened up to 30 mm high, 16 mm wide. Initially rather elongate cylindrical (cap length up to 2.4 x diameter). Young fresh fruitbodies lilac, fading rapidly to a lilaceous pale brown or pinky/cream then to pale grey-brown, the lilac colour remaining longest at the centre, with hygrophanous bands of varying colour intensity. The young fruitbodies have a distinctive bloom, which disappears when touched or rubbed off. It

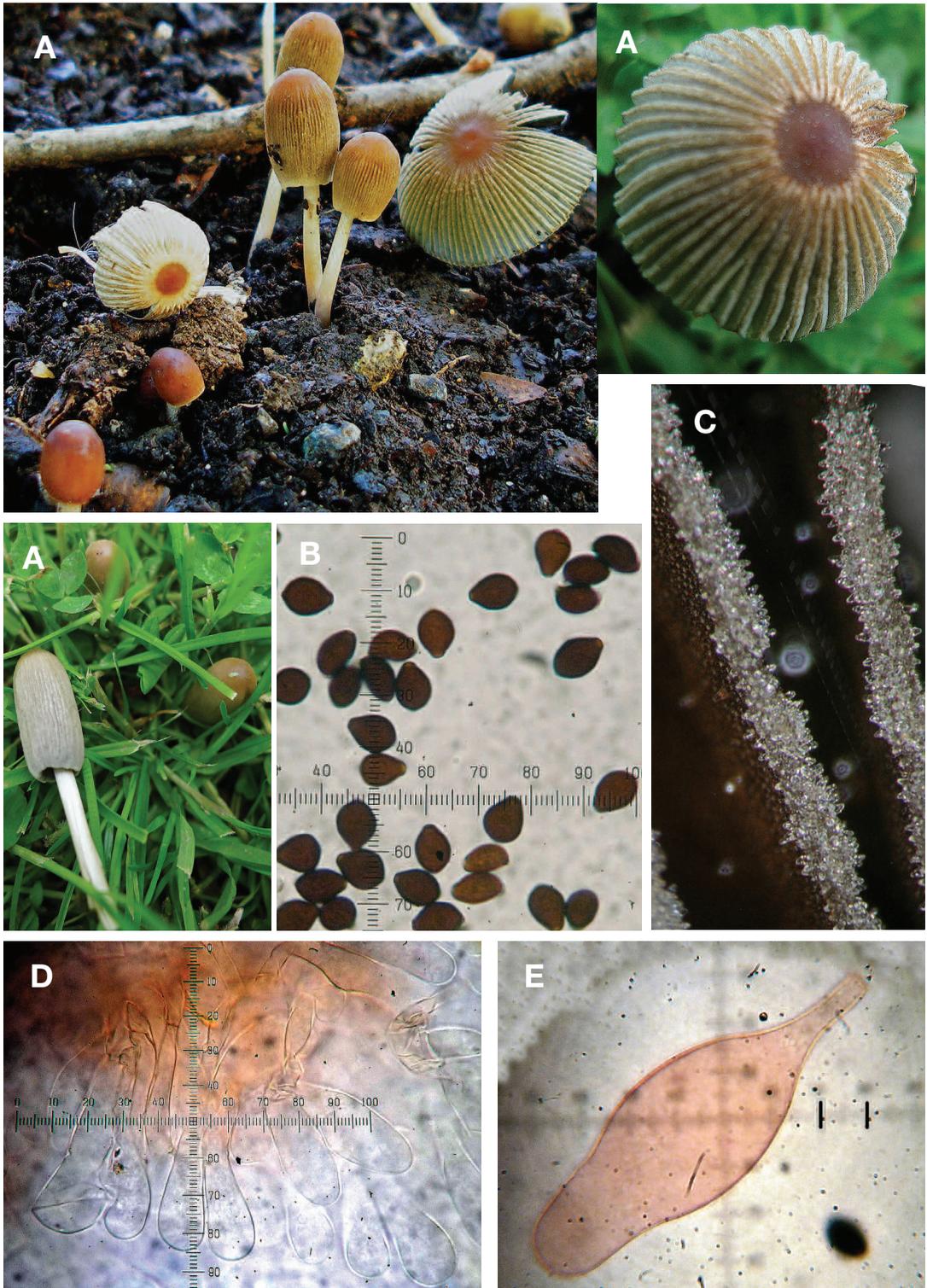


Fig. 6. *Parasola kuehneri*. A: fruitbodies (top left © Penny Cullington); B: gills; C: young gills showing gill cystidia; D: cap cuticle; E: pleurocystidium. Photos © D. Schafer except where noted.

does not appear to be associated with any veil or cystidia. Cap opening to a plicate parasol up to 50 mm in diameter. The pleated surface becomes paler in hue but grey as the spores mature and the mature fruitbodies are hardly distinguishable from, for example, *Parasola leiocephala*. **Gills** fairly crowded (L = 30–45), separated from the stem by a narrow pseudocollarium. **Stem** 2–3 mm wide, length up to 100 mm. **Spores**, according to Uljé & Bender (1997), 9.6–13.3 x 9.0–11.2 x 6.1–8.3 µm, Q = 1.12–1.22; average L = 10.7–12.3, average B = 9.5–10.1 µm, 5-angular and heart-shaped with slightly elongate apex in face view, ellipsoid in side view. My collections have been within this range. **Basidia** 4-spored. **Cheilocystidia** and **pleurocystidia** reported by Uljé & Bender (1997) as vesiculose, ellipsoid, obovoid or subcylindric sometimes a few utriform; I have found utriform cystidia more common. **Cap cuticle** hymeniderm cells are often quite elongated. Cystidia and the clavate cells of the hymeniderm contain oily droplets when fresh.

Ecology and Distribution: Occurs on wood chip and soil containing wood chip. Although regarded as rare, this species seems to be quite widespread in Britain and may be generally overlooked since it is only distinctly different from other *Parasola* species in its young, fresh state.

Discussion: Young, fresh fruitbodies of this species are very distinctive. The lilac colour can disappear very rapidly but distinctly elongate, pinky cream unopened fruit bodies with a bloom at the apex can still be recognised in the field. The oily contents of cystidia and hymeniderm cells may not be visible in older fruitbodies but can be very distinctive in fresh, young collections. The spores, although described as somewhat larger, are similar in size to some collections of *Parasola leiocephala* and, like that species, strongly lentiform with a prominent apical papilla. They are however rather more angular, somewhat triangular or rhomboid overall (rather than rounded heart-shaped), a few with an octagonal profile in face view. Basidia 4-spored.

Nagy *et al.* (2009) found that nine collections identified as *P. lilatincta* grouped together based on ITS and combined ITS/LSU DNA phylogeny. Six of them lacked any lilac colour (and were identified by their spores and oily contents in their cells). Two other collections, also lacking

lilac colour but with only a few oily granules, were in a separate clade (but adjacent based on LSU sequences alone). My current working hypothesis is that such collections would not be identified as *P. lilatincta* as described here but it is necessary to recognise that more mature collections keying out close to *P. leiocephala* but with differently shaped spores may belong to as yet undescribed species.

Illustrations & Descriptions: Ludwig (2007) 93.17; Uljé (2005) species 6, p.37; Uljé & Bender (1997) p.373.

Parasola megasperma (P.D. Orton) Redhead, Vilgalys & Hopple. Fig. 9.

Description:

Cap unopened 5–20 mm high, 3–15 mm wide, a rich chestnut-brown, red-brown or ochre-tawny colour. Cap opening up to 35 mm in diameter. **Gills** fairly crowded (L = 30–40), free and separated from the stem by a pseudocollarium. **Stem** 1.5–3 mm wide, 50–100 mm long, smooth to slightly fibrillose at base, white or translucent, tinted with cap colour near the base. **Spores** 12.5–18.5 x 9–12 µm, slightly to strongly lentiform, broadly ellipsoid to ovoid with a slightly or strongly eccentric germ pore on a rounded base. **Basidia** 4-spored. **Gill cystidia** utriform.

Ecology and Distribution: Rare in Britain, on soil, but also on dung.

Discussion: Collections with chestnut-brown or red-brown cap colour, large, broadly ellipsoid spores, only slightly eccentric germ pore and a habitat on dung can be identified as this species. Collections on soil or with more angular, lentiform character in the spores raise borderline issues with other species. Spores with wider profiles in face view may overlap with those of *P. schroeteri*. In fact, Nagy *et al.* (2009) found these two species were not clearly distinguished in DNA studies. The original description claimed ellipsoid spores with a central germ pore. In the type, Uljé found an (albeit not strongly) eccentric germ pore and Nagy *et al.* (2010) found a similar germ pore and distinctly lentiform character. Other collections have a distinctly eccentric germ pore. Published spore drawings suggest occasional angular character with a suggestion of an apical papilla in some spores. This might then overlap with rather large-spored collections of *P. plicatilis*, although cap colour would possibly

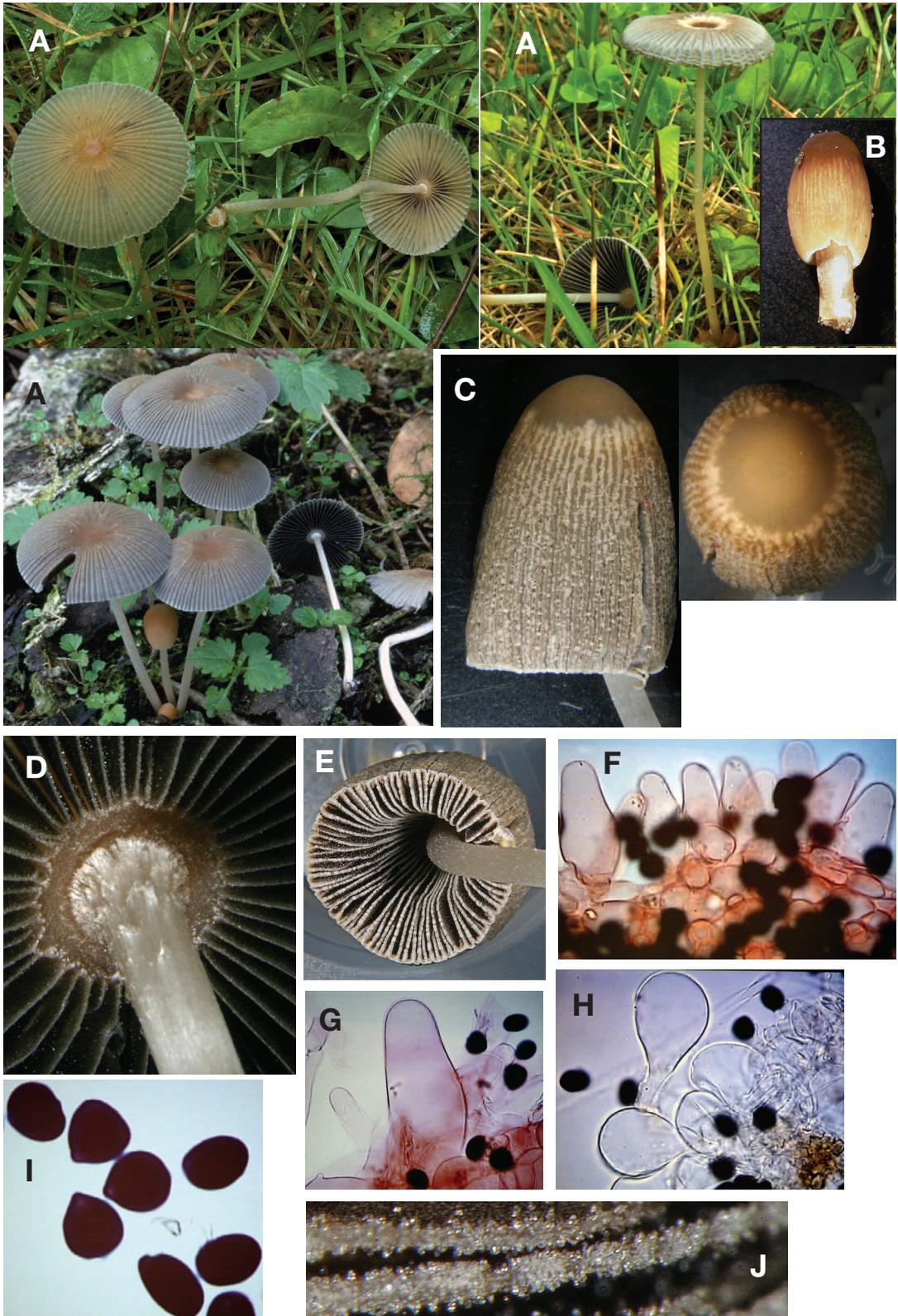


Fig. 7. *Parasola leioccephala*. A: fruitbodies in opened stage; B: fruitbody in early unopened stage; C: fruitbody beginning to open; D: gills showing pseudocollarium forming as cap tissue enlarges in centre; E: early stage gills with cystidia; F: cheilocystidia; G: pleurocystidium; H: Cap hymeniderm; I: spores; J: Gills. Photos © D. Schafer.

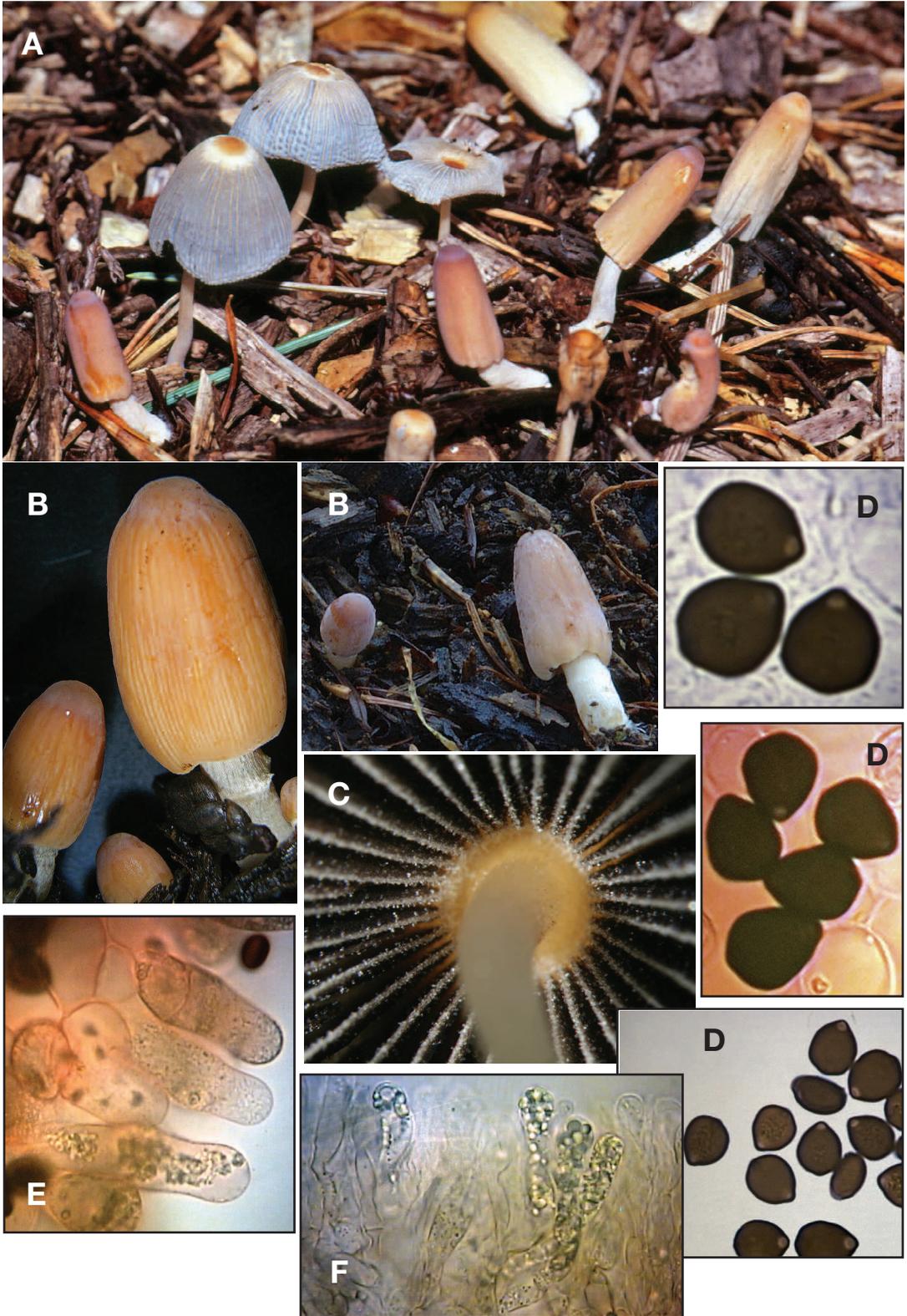


Fig. 8. *Parasola lilatincta*. A: fruitbodies on woodchip (© Alan Outen); B: close-up of young fruitbodies; C: gill attachment; D: Spores; E: gill edge cystidia; F: cap hymeniderm. Photos © D. Schafer except where noted.

distinguish and the two species are strongly separated in DNA studies. The collection illustrated here is from Cyprus, so may not reflect British material at all – this is a rare species and more collections need to be looked at!

Illustrations & Descriptions: Ludwig (2007) 93.15; Orton & Watling (1979) 85, p.100; Richter & Bender (1998); Uljé (2005) species 10, p.39; Uljé & Bas (1988), p. 442.

Parasola misera (P. Karst.) Redhead, Vilgalys & Hopple. Fig. 10

Description:

Cap very small. Young cap initially 2–5 x 1–3 mm, bright tawny-orange, fading rapidly to cinnamon-brown then translucent and almost colourless or greyish from the spores, with a cinnamon-brown centre remaining, opening to a translucent pale grey, some colour remaining in the centre. **Gills** free, separated from the stem by a narrow (pseudo)collarium. L = 9–16. **Stem** to 50 x 0.5 mm, translucent and smooth when fully extended but silky-striate when young, fibrillose and somewhat pruinose at the bulbous base, the fibrillose hyphae often being carried part way up the stem as it extends. **Spores** 7.0–10.6 x 6.5–10.0 x 5.9–6.6 µm, strongly lentiform; in face view heart-shaped, rounded triangular, irregularly globose or with rounded slightly angular sides; in side view ellipsoid, sometimes broader than long. **Cheilocystidia** (sub)globose. **Pleurocystidia** absent. **Basidia** 4-spored.

Ecology and Distribution: Always on dung. Widespread and common on cow, horse, deer and other animal dung.

Discussion: This very common species is easily recognised by its small size, initially orange then translucent grey caps lacking pileocystidia, the lack of pleurocystidia and the short, lentiform spores with eccentric germ pore. A less common two-spored taxon is phylogenetically distinct according to Nagy *et al.* (2010) and is described here as a new species (p. 83).

Illustrations & Descriptions: Lange (1939) pl.157B; Ludwig (2007) 93.18; Orton & Watling (1979) species 90, p.104; Uljé (2005) species 9, p.39; Uljé & Bas (1988) p.439; Vesterholt *et al.* (2007) p. 35.

Parasola plicatilis (Curtis: Fr.) Redhead, Vilgalys & Hopple. Fig 11

Description:

Cap unopened 5–10 x 8–20 mm, initially yellow-brown to dull pinkish-brown, expanded up to 35 mm. **Gills** free with pseudocollarium, L = 24–40. **Spores** (Figs 1 & 12C) 9.9–14.3 x 7.2–10.3 x 6.5–8.1 µm; in face view variably shaped from weakly and irregularly hexagonal, lemon-shaped, with five rounded angles, sometimes ovoid or broadly ellipsoid; in side view ellipsoid or subamygdaliform; germ pore eccentric. **Basidia** 4-spored. **Cheilocystidia** and **pleurocystidia** mostly broadly lageniform to extended utriform or clavate. **Cap cuticle** a hymeniderm with globose to clavate cells.

Ecology and Distribution: On soil in lawns, in roadside grass, rarely among woody debris, seemingly less common than *P. leiocephala* even in grasslands.

Discussion: This species is close to *P. leiocephala*, from which it differs by longer spores, relatively narrower ($Q > 1.25$) in face view. *P. plicatilis* also seems to be generally more restricted to open grassy habitat, although *P. leiocephala* is found in the same habitat at least as often. *P. plicatilis* may have slightly less crowded gills, although this could merely reflect generally smaller fruitbodies in this habitat. Although some collections are borderline, there seems to be, as noted by Uljé & Bas (1988) a broad separation between the two types of spore and this is supported by DNA studies (Nagy *et al.*, 2009).

The original description of *Agaricus plicatilis* Curtis (1787) could apply to most *Parasola* species. The engraving in that reference has recently been designated as lectotype for the present species and a recent collection designated as epitype and described (Nagy *et al.*, 2010). Before the description of *Coprinus leiocephalus*, microscopic details of *C. plicatilis* encompassed both what would now be considered *P. leiocephala* and *P. plicatilis* (see e.g. Kühner & Jossierand (1934); the species depicted as *Coprinus plicatilis* in Lange (1939), p.119, pl. 160 A, would, for example, now be considered to be *P. leiocephala*. This has no doubt led to some confusion and many past collections recorded as '*plicatilis*' will have referred to species other than what is currently covered by that epithet. There is now a general consensus to apply the epithet to

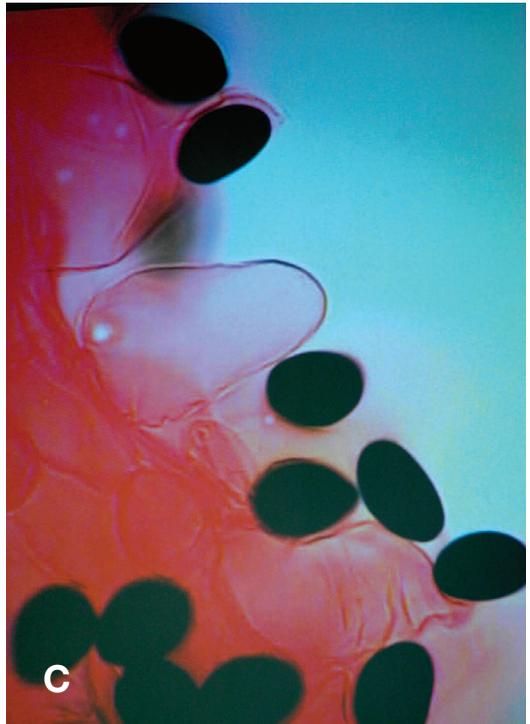
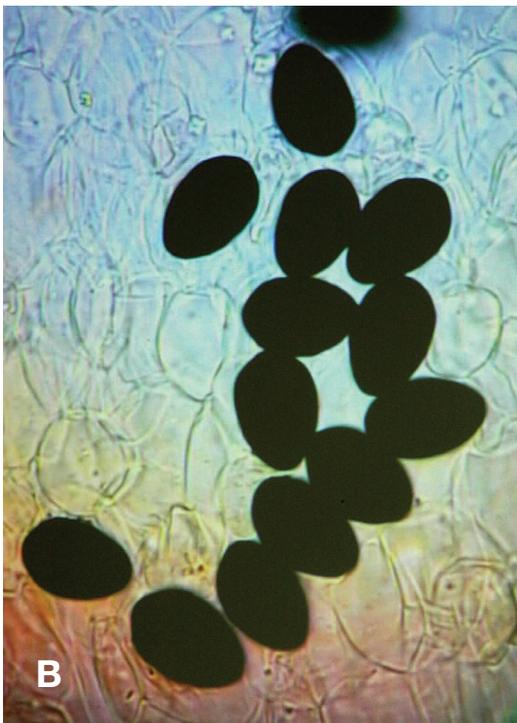


Fig. 9. *Parasola megasperma*. A: fruitbodies (© Caroline Hobart); B: spores (16–19 x 11–12 μm); C: gill-edge cystidia. Photos © D. Schafer except where noted.

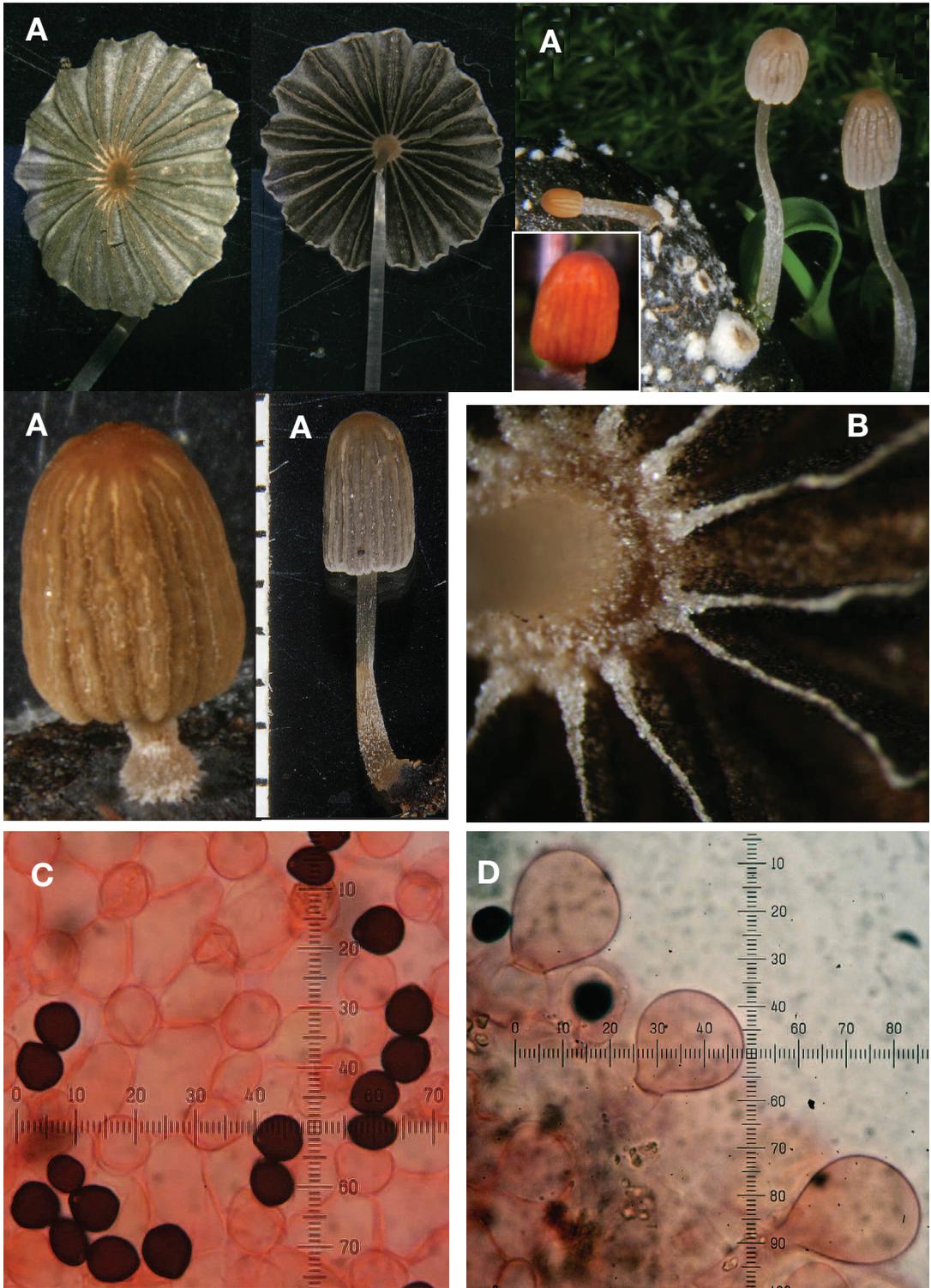


Fig. 10. *Parasola misera*. A: fruitbodies (top row and centre row left 2 photos); B: gill attachment; C: spores and basidia (scale divisions - 1 μm); D: cheilocystidia (scale divisions = 1 μm). Photos © D. Schafer.

the species with longer spores. Collections with spores that are ellipsoid in face view are discussed under *P. hemerobius* below.

Illustrations & Descriptions: Ludwig (2007) 93.11; Orton & Watling (1979) species 86, p.101; Phillips (2006) p.261d; Rald (2001); Uljé (2005) species 5, p.36; Uljé & Bas (1988) p.441; Vesterholt *et al.* (2007) p.36.

Parasola schroeteri (P. Karst.) Redhead, Vilgalys & Hopple. Fig. 12

Description:

Cap up to 30 mm diameter when fully open. Ochraceous brown, yellow-brown or greyish red-brown when young or at the centre of the cap. **Gills** free, separated from stem by a pseudocolarium. L = 24–36. **Spores** 10–15 x 9–13 x 8.0–8.6 µm, average L = 11.5–13.6 µm, B = 10.2–11.6 µm, Q = 1.11–1.21, rounded triangular/shield-shaped with rounded apex, lacking an apical papilla, dark red-brown to almost black.

Ecology and Distribution: Occurs on dung and also on soil, in grass.

Discussion: Earlier British records are under the species epithet *nudiceps*, *Coprinus* (now *Parasola*) *nudiceps* being described by P.D. Orton in 1972 from Scotland on cow and horse dung. This was synonymised with the earlier Karsten species, (now) *Parasola schroeteri*, by Uljé & Bender (1997). The large, rounded shield-shaped, lentiform spores distinguish it from other species except *P. hercules*, which has even broader spores. Collections on soil, in grass, are somewhat different macroscopically from those on dung, although as noted by Uljé & Bas (1988), similar microscopically. In that paper, differences (attributed to H. Bender) included a crenate edge to the cap, more crowded lamellae and more lamellulae, as well as a yellower colour in the species on dung, with more reddish colours in the soil species. However, in Uljé & Bender (1997), the synonymy was accepted. The possibility that the two taxa might be different remains and seems worthy of further study.

Illustrations & Descriptions: Bender & Enderle (1988) p.48 (as *nudiceps*); Buczacki p.85; Orton & Watling (1979) species 89, p.103 (as *nudiceps*); Uljé (2005) species 7, p.38; Uljé & Bas (1988) p.435 (as *nudiceps*); Uljé & Bender (1997) p.376; Vesterholt *et al.* (2007) p. 37.

EXCLUDED SPECIES

Parasola hemerobia

This taxon, originally named by Fries, has been interpreted in various ways by subsequent authors, its original description lacking microscopic detail or a type. Uljé & Bas (1988) argued, based on colour and gill attachment, that the original description would fit what we currently call *Parasola auricoma*, *P. kuehneri* or *P. megasperma*. They regarded the species *Coprinus hemerobius* in Lange (1939, p.118) as being *Coprinus auricomus* (based on cap colour, gill attachment and spore shape), and considered it the same species as Lange's *Coprinus hansenii*. They argued that Lange's *C. hansenii* was this species, an interpretation that had also been adopted by Kühner & Romagnesi (1953). The counter-argument cited but not accepted by Uljé & Bas (1988) that "it is improbable that an excellent mycologist as J. Lange would have missed the hairs on the pileus" is made no less intriguing by Lange's own comments (Lange, 1939, p.100) comparing "*Psathyrella conopilea* var. *subatrata*" with "*Psathyrella conopilea*": "It remains to be ascertained whether the brown, setulose hairs which – even if very scanty – I have never found entirely lacking, are also to be met with in the typical *P. conopilea*".

Orton & Watling (1979) accepted Lange's *Coprinus hemerobius*, (Lange, 1939, Pl. 160C). However, their description is closer to some collections of what is now *Parasola plicatilis*. The shape of *Parasola plicatilis* spores varies and, although usually with distinct angular character in face view, can be more or less ellipsoid. The difference between breadth and width is relatively small, the lentiform character usually being emphasised by the angular profile in face view (Fig.1). Many of the collections deposited in herbaria under the name *hemerobius* were assigned by Uljé (Uljé & Bas, 1988) on examination to *plicatilis*.

Considering collections with spores that are more or less ellipsoid in face view as a distinct species was not supported by DNA studies (Nagy *et al.*, 2009, where they nested with other *plicatilis* collections). This is not conclusive and further investigation might conceivably support such a species. However, the application of the epithet *hemerobius* to it would seem unwise, given its confusing prior use.



Fig. 11. *Parasola plicatilis*

A: fruitbodies

B: spores, scale divisions on right photo = 1 μ m

C: cystidia on young gills

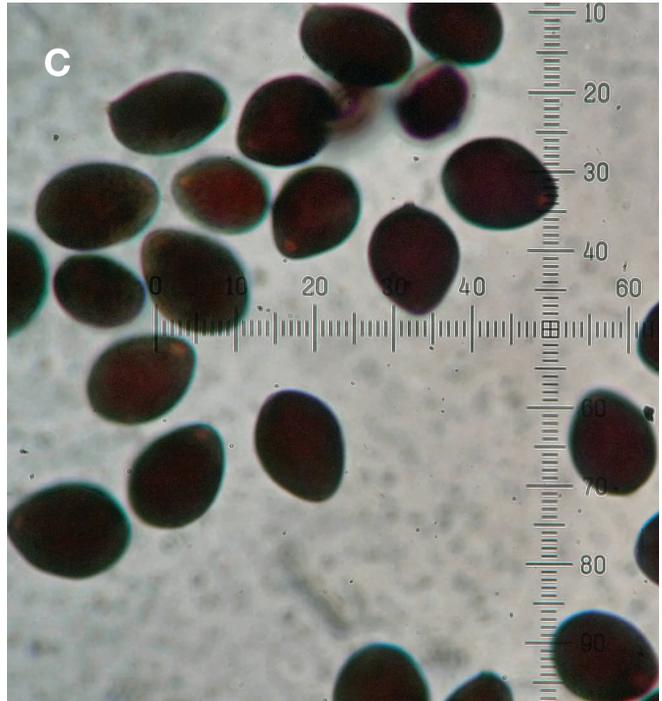


Fig. 12. *Parasola schroeteri*.
A: fruitbodies on dung (© Alan Outen);
B: fruitbodies on soil;
C: spores (scale divisions = 1 μ m);
D: specimen from Sardinia. Photos © D. Schafer except where noted.

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