

Ascobolus-Schlüssel

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The following keys reproduce the keys from J. van Brummelen's "A world monograph of the genera *Ascobolus* and *Saccobolus*", Persoonia Supp. Vol. 1 (1967). In order to facilitate the usage of the keys, species names are colored according to their habitat where growth on **dung**, **plant debris**, **burnt places** and **soil** is distinguished.

1 Synoptic key to the sections of *Ascobolus*

1. Ascomata cleistohymenial. Excipulum of *textura angularis*, *globulosa*, or *epidermoidea* when seen from outside 2
1. Ascomata eugymnohymenial or paragymnohymenial. Excipulum often with other types of textures .. 4
2. Ascomata opening in the telohymenial phase or rarely not opening at all; immersed or superficial, never stalked, the surface often covered with appressed, thick hyphae; diameter rarely exceeding 1 mm. Ascospores ellipsoid or rarely subglobular. Asci saccate to cylindric-clavate, with large dome-shaped apex. Episporium smooth, granular, or warted, sometimes with irregular cracks, never with a pattern of anastomosing striae. On dung *Ascobolus* sect. *Dasyobolus*
2. Ascomata opening in the mesohymenial phase; superficial; smooth or furfuraceous, sometimes covered with fine divaricating hyphae in the lower part or with secondary mycelium near the base; diameter 0.3-12 mm. Ascospores ellipsoid, subglobular or globular. Asci cylindric-clavate. Episporium with anastomosing striae, with a net-work of striae, or warted, rarely smooth or granular 3
3. Ascomata opening in the late mesohymenial phase; diameter 0.3-1.5 mm. Ascospores globular. Episporium with rounded warts. Asci clavate-cylindrical or cylindric-clavate . *Ascobolus* sect. *Sphaeridiobolus*
3. Ascomata opening in the early or mid-mesohymenial phase; diameter 0.3-12 mm. Ascospores ellipsoid, fusiform, subglobular or globular. Episporium with anastomosing striae, with a network of striae or warted, rarely smooth or granular. If ascospores globular then episporium not with rounded warts. Asci cylindric-clavate *Ascobolus* sect. *Ascobolus*
4. Ascomata paragymnohymenial, with the habit of *Ascodesmis*; very small, 0.1-0.5 mm diameter. Asci relatively short; the wall not Blue with iodine. Ascospores globular or subglobular. Episporium consisting of a reticulum of pigment. On dung *Ascobolus* sect. *Pseudascodesmis*
4. Ascomata paragymnohymenial or eugymnohymenial; small or large, 0.3-30 mm diameter. Ascus-wall stains Blue with iodine. Ascospores ellipsoid, not with a reticulum of pigment 5
5. Ascomata paragymnohymenial or eugymnohymenial, with the habit of *Saccobolus*. Asci short with a broad base. Ascospores fusiform-ellipsoid, often with blunt ends and asymmetrical. Episporium at first smooth or granulated, then with a network of fine crevices or warted. Paraphyses with yellowish contents. On burnt places *Ascobolus* sect. *Pseudosaccobolus*
5. Ascomata eugymnohymenial, not with the habit of *Saccobolus*. Asci oblong-clavate to cylindric-clavate. Ascospores symmetrical, ellipsoid, without any tendency to aggregate. Paraphyses without colored contents 6
6. Apothecia small, up to about 1 mm diameter; without marginal growing zone. Excipulum scarcely developed. Episporium echinulate or warted *Ascobolus* sect. *Heimerlia*
6. Apothecia large or medium-sized; 0.8-30 mm diameter; a marginal growing zone with distinct activity. Excipulum well-developed. Episporium smooth or finely punctate *Ascobolus* sect. *Gymnascobolus*

2 Artificial key to the sections of *Ascobolus*

1. Ascospores globular or subglobular 2
1. Ascospores ellipsoid or fusoid 5
2. Ascospores exactly globular 3
2. Ascospores subglobular 4
- 3a. Ascospores warted *Ascobolus* sect. *Sphaeridiobolus*
- 3b. Ascospores smooth, sometimes with some fine irregular crevices *Ascobolus* sect. *Dasyobolus*
- 3c. Ascospores with subparallel anastomosing crevices *Ascobolus* *crosslandii*
- 3d. Ascospores with a network of pigment *Ascobolus* sect. *Pseudascodesmis*
- 4a. Ascospores with a network of pigment *Ascobolus* sect. *Pseudascodesmis*
- 4b. Ascospores smooth, sometimes with some fine irregular crevices *Ascobolus* sect. *Dasyobolus*
- 4c. Ascospores with isolated fine warts *Ascobolus* sect. *Dasyobolus*
- 4d. Ascospores with longitudinal anastomosing crevices or with a network of crevices
..... *Ascobolus* sect. *Ascobolus*
5. Episporium smooth or finely granular when just formed, sometimes with one or a few fine fissures; in old ascospores an irregular network of crevices is sometimes found, rarely becoming warted 6
5. Episporium neither smooth nor finely granular when just formed 11
6. Apothecia scutellate; 1-30 mm diameter 7
6. Apothecia globular, semiglobular, lenticular, pulvinate or turbinate; 0.2-10 mm, rarely up to 1.5 mm diameter 8
7. On dung or on wood *Ascobolus* sect. *Gymnascobolus*
7. On soil *Ascobolus* *geophilus*
8. Young fruit-bodies not closed; habitus and form of asci similar to certain species of *Saccobolus*. Ascospores often asymmetrical and somewhat ventricose *Ascobolus* sect. *Pseudosaccobolus*
8. Young fruit-bodies at first closed; not similar to *Saccobolus*. Ascospores mostly symmetrical 9
9. Ascospores 9-10 μm long. Episporium finely granular *Ascobolus* *cainii*
9. Ascospores more than 10 μm long 10
10. Apothecia turbinate, superficial. Receptacle white; surface white furfuraceous; margin rather regular and smooth, although thin. Disk white. Ascospores 13-17 \times 7.5-8.5 μm . Episporium at first smooth, finally mostly with an irregular network of fine fissures, rarely becoming apparently warted *Ascobolus* *carletonii*
10. Apothecia subglobular or pyriform, immersed or superficial; white or variously colored. Receptacle smooth, tomentose or furfuraceous (if furfuraceous then not white). Margin of excipulum irregularly torn by the protruding ripe asci *Ascobolus* sect. *Dasyobolus*
11. Episporium with a pattern of subparallel, anastomosing crevices, or with irregular, short, curved, non-anastomosing crevices, or with longitudinal ridges of pigment separated by rather broad crevices; in old or overripe ascospores often changing into a network of crevices *Ascobolus* sect. *Ascobolus*
11. Episporium with another type of ornamentation 12
12. Episporium warted or echinulate 13
12. Episporium with a network of crevices from the beginning 17

13. On dung	14
13. On rotten wood, on soil or on burnt places	15
14. Apothecia subglobular or pyriform, often immersed; white or variously coloured. Excipular margin irregularly torn by the protruding ripe asci. Episporium not echinulate	<i>Ascobolus sect. Dasyobolus</i>
14. Apothecia pulvinate or lenticular, superficial; white. Excipular margin regular and smooth. Episporium echinulate or more rarely with isolated warts	<i>Ascobolus sect. Heimerlia</i>
15. Full-grown apothecia lenticular or discoid. Habit of apothecia and shape of asci as in <i>Saccobolus</i> . Ascospores often asymmetrical or somewhat ventricose; less than 15 µm long. On burnt places	<i>Ascobolus sect. Pseudosaccobolus</i>
15. Full-grown apothecia scutellate and flattened. Habit of apothecia and shape of asci not as in <i>Saccobolus</i> . Ascospores mostly symmetrical; more than 15 µm long	16
16. On soil or burnt places. Ascospores 17-28 x 11-15 µm	<i>Ascobolus sect. Ascobolus</i>
16. On rotten wood. Ascospores 32-37 x 13-16 µm	<i>Ascobolus xylophilus</i>
17. Apothecia lenticular or discoid; similar to those in <i>Saccobolus</i> . Ascospores often asymmetrical or somewhat ventricose; less than 15 µm long. On burnt places	<i>Ascobolus sect. Pseudosaccobolus</i>
17. Apothecia not lenticular or discoid; not similar to those in <i>Saccobolus</i> . Ascospores mostly symmetrical; more than 15 µm long. Not on burnt places	18
18. Ascospores more than 35 µm long. On dung	19
18. Ascospores less than 25 µm long. On humid soil	<i>Ascobolus sect. Ascobolus</i>
19. Apothecia umbilicate, with a prominent margin. Ascospores 40-45 x 21-23 µm . cf. <i>Ascobolus asininus</i>	
19. Apothecia subglobular, without a prominent margin. Ascospores (35-)58 x 71 (-81) x (24-)28-36 µm .	<i>Ascobolus immersus</i>

3 Key to the species of *Ascobolus sect. Dasyobolus*

1. Episporium smooth or finely granular	2
1. Episporium warted or with a network of irregular fine crevices	8
2. Ascospores globular or subglobular; more than 33 µm long; with all-sided gelatinous envelope	<i>Ascobolus immersus</i>
2. Ascospores ellipsoid	3
3. Ascospores more than 50 µm long and surrounded by a gelatinous envelope. Episporium smooth or with some irregular fine crevices	<i>Ascobolus immersus</i>
3. Ascospores less than 50 µm long	4
4. Ascospores more than 17 µm long	5
4. Ascospores less than 17 µm long	7
5. Excipulum smooth, tomentose or rarely finely powdery; not brown; not furfuraceous. Hymenial mucus greenish-yellow	6
5. Excipulum rich with brown intercellular pigment; in the upper part covered with brown warts. Hymenial mucus vivid sulphur-yellow. Ascospores 20-25 x 11-13 µm	<i>Ascobolus boudieri</i>
6a. Ascospores 29-38(-48) x 14-18(-21) µm	<i>Ascobolus amoenus</i>
6b. Ascospores 23-29 x 12-17 µm	<i>Ascobolus elegans</i>
6c. Ascospores (17.5-)19-23(-24) x 10-12(-13) µm	<i>Ascobolus mancus</i>

- 6d. Ascospores 42-48 × 20-25 μm cf. "*Ascobolus quezelii*"
- 7. Ascospores 15-16 × 6-7 μm cf. *Ascobolus masseei*
- 7. Ascospores 11-13 × 6-8 μm cf. *Ascobolus candidus*
- 8. Ascospores ellipsoid. Ascus-wall staining Blue with iodine 9
- 8. Ascospores subglobular to very shortly ellipsoid; 17-20 × 15-17 μm. Ascuswall not Blue with iodine ...
..... *Ascobolus siamensis*
- 9. Episporium with a reticulum of irregular fine crevices. Ascospores more than 50 μm long
..... *Ascobolus immersus*
- 9. Episporium warted 10
- 10. Ascospores 50-60 × 30-36 μm *Ascobolus bistisii*
- 10. Ascospores less than 50 μm long 11
- 11. Apothecia with a thick margin. Ascospores 40-45 × 21-33 μm cf. *Ascobolus asininus*
- 11. Apothecia without a prominent margin. Ascospores less than 40 μm long 12
- 12. Apothecia immersed. Ascospores more than 25 μm long 13
- 12. Apothecia superficial. Ascospores 18.5-21 × 10-11.5 μm *Ascobolus hawaiiensis*
- 13. Episporium with a regular pattern of warts. Ascospores 26-31 × 15-17.5 μm *Ascobolus stictoideus*
- 13. Episporium besides having a pattern of warts also with large and thick caps of pigment and a submedian pigmentfree zone. Ascospores 30-34 × 16-18 μm *Ascobolus degluptus*

4 Key to the species of *Ascobolus* sect. *Sphaeridiobolus*

- 1. Apothecia 0.5-1.5 mm diameter. Receptacle finely furfuraceous, rarely smooth. Ascospores 10.5-13.5 μm diameter. Episporium of small, isolated, rounded warts *Ascobolus brassicae*
- 1. Apothecia 0.3-0.5 mm diameter. Receptacle smooth. Ascospores 17-20 μm diameter (pigment included). Episporium consisting of a rather regular pattern of semi-globular knobs 1.8-4.0 μm diameter, together with very fine rounded warts only 0.2-0.4 μm diameter *Ascobolus nodulosporus*

5 Key to the species of *Ascobolus* sect. *Ascobolus*

- 1. Ascospores globular or subglobular 2
- 1. Ascospores ellipsoid, fusiform-ellipsoid or fusoid 4
- 2. Ascospores globular; 11.5-13.5 μm diameter. Episporium with a pattern of subparallel, rarely anastomosing crevices *Ascobolus crosslandii*
- 2. Ascospores subglobular 3
- 3. Receptacle greenish-yellow, finely furfuraceous. Ascospores 16-19 × 3-16 μm (pigment included). Episporium very thick (2.5-3.0 μm); with a pattern of longitudinal, repeatedly anastomosing or reticulating crevices; with very prominent projections. On soil *Ascobolus subglobosus*
- 3. Receptacle grass-green, "hairy". Ascospores 18-19 × 16-18 μm. Episporium of normal thickness; with fine, longitudinal anastomosing crevices. On dung *Ascobolus strobolinus*
- 4. Episporium with a pattern of subparallel, anastomosing crevices, or with a pattern of irregular, short, nonanastomosing crevices; in old or overripe ascospores sometimes changing into a network of crevices (young episporium never smooth or granular) 5
- 4. Episporium with other types of ornamentation 27

5. Episporium with very densely placed subparallel crevices (more than 12 crevices are visible at each view of the ascospore)	6
5. Episporium not with such a very dense pattern of crevices	8
6. Ascospores less than 15 µm long. Episporium with relatively broad transverse or oblique crevices	<i>Ascobolus lineolatus</i>
6. Ascospores more than 20 µm long. Episporium with relatively narrow, about longitudinal crevices ...	7
7. Ascus-wall clearly Blue in Melzer's reagent. Episporium not more than 1.0 µm thick. On dung	<i>Ascobolus laevisporus</i>
7. Ascus-wall not or scarcely Blue in Melzer's reagent. Episporium rather thick, up to 2.2 µm. On soil covered with algae	<i>Ascobolus demangei</i>
8. Receptacle and disk white or whitish	9
8. Receptacle and disk yellowish, greenish, brownish, vinaceous or purplish	10
9. Receptacle smooth, without a prominent margin. Ascospores 20-36 × 11-14 µm. Episporium with longitudinal occasionally anastomosing crevices or sometimes with short, more or less curved crevices	<i>Ascobolus albidus</i>
9. Receptacle finely furfuraceous, with a prominent margin. Ascospores 16-20 × 9-10 µm. Episporium with longitudinal anastomosing crevices	<i>Ascobolus sacchariferus</i>
10. Receptacle and disk yellowish-brown, brownish, vinaceous or purplish (beware of a covering of coloured ascospores!). Apothecia up to 2 mm diameter	11
10. Receptacle and disk yellowish, greenish-yellow, greenish, or olive-coloured	13
11. Receptacle and disk vinaceous, pinkish-red, purplish or purplish-brown; smooth or finely furfuraceous; with a clearly differentiated margin. Excipulum, when seen from outside, of <i>textura epidermoidea</i> . Vinaceous or purplish intercellular, amorphous pigment in the outer layers of the excipulum and among the tips of paraphyses present. Ascospores ellipsoid with blunt ends, 18-28 × 10-12 µm	<i>Ascobolus roseopurpurascens</i>
11. Receptacle and disk yellowish-brown, brownish or blackish-brown; smooth; without a prominent margin. Excipulum, when seen from outside of <i>textura angularis</i> , only rarely in the lower parts of <i>textura globulosa</i> or <i>epidermoidea</i> . Intercellular amorphous pigment brownish if present	12
12. Receptacle brownish-yellow to brown. Disk brownish-yellow. Accumulations of intercellular pigment lacking. Ascospores ellipsoid, 12.5-14.5 × 7-8.5 µm. Hymenial mucus yellow	<i>Ascobolus minutus</i>
12. Receptacle and disk brown or blackish-brown. Deposits of intercellular pigment in excipulum and hymenium. Ascospores oblong-ellipsoid, (18-)20-36(-39) × (9-)11-14(-16) µm. Hymenial mucus colourless or brownish	<i>Ascobolus albidus</i>
13. Receptacle in the upper part smooth, yellowish-green, in the lower part densely white-villose. Ascospores normally 25-30 × 13-14 µm, but also considerably larger 45-50 × 18-24 µm	<i>Ascobolus semivestitus</i>
13. Receptacle furfuraceous or smooth, not white-villose in the lower part	14
14. Excipulum covered with small regular groups of subglobular or pyriform cells with rust-brown walls ..	15
14. Excipulum smooth or covered with regular or irregular groups of subglobular cells with hyaline or yellowish walls	19
15. Episporium with a pattern of irregular, short, curved nonanastomosing crevices	<i>Ascobolus singeri</i>
15. Episporium with subparallel, anastomosing crevices	16
16. Ascospores fusoid or fusiform-ellipsoid	17
16. Ascospores ellipsoid with rounded or obtuse ends	18

17. Ascospores fusoid or ellipsoid with pointed ends, 17.5-19.5 × 7.0-9.0 μm. Episporium with rather narrow longitudinal anastomosing crevices. On rotten wood, leaves, or paper *Ascobolus epimyces*
17. Ascospores fusoid, 28.5-37.5 × 11-14 μm. Episporium with longitudinal ridges of pigment, separated by very broad crevices. On humid soil *Ascobolus viridis*
18. Receptacle stalked; with a permanently furfuraceous margin. Excipular warts of subglobular and pyriform cells. Episporium always with longitudinal anastomosing crevices, often becoming reticulated with age. Ascospores with strong tendency to swell when ripe. On rotten leaves, stalks, wood, and bark *Ascobolus foliicola*
18. Receptacle sessile; margin only furfuraceous in very young fruit-bodies, but soon smooth. Excipular warts of subglobular cells. Episporium with longitudinal, transverse or oblique anastomosing crevices, sometimes with nonanastomosing very narrow crevices or with locally very thick cap-shaped deposits of pigment. On all kinds of substrata *Ascobolus denudatus*
19. Ascospores exceeding 16 μm in length 20
19. Ascospores not exceeding 16 μm in length 24
20. Receptacle yellow or lemon-yellow, white or yellow furfuraceous, substipitate or with a short stalk. Disk greenish-yellow. Ascospores 17-22 × 9.5-12 μm. Episporium with only a very few widely spread longitudinal or oblique crevices, that rarely anastomose; 1-6 crevices visible at each view of the ascospore *Ascobolus michaudii*
20. Receptacle and disk yellow, yellowish, greenish-yellow or green. Episporium with more closely spaced, subparallel anastomosing crevices, normally 7-12 of which visible at each view of the ascospore 21
21. Apothecia large, 5-12 mm diameter; with a distinct stalk. Ascospores ellipsoid to fusiform-ellipsoid with blunt ends; 16-19.5 × 8.5-10 μm *Ascobolus lignatilis*
21. Apothecia medium-sized, 0.5-5 mm diameter; sessile or with a very short stalk 22
22. Apothecia sessile or with a very short stalk. Ascospores fusoid or ellipsoid with pointed ends (16-)17.5-19.5(-20) × (6.5-)7-9(-10) μm *Ascobolus epimyces*
22. Apothecia without a distinct stalk. Ascospores regularly ellipsoid; 19-28 × 10-14 μm 23
23. Apothecia rather thin, up to 0.3 mm high, substipitate or on a narrow base. Receptacle on the whole surface finely furfuraceous or powdered. Excipulum rather thin, 12-22 μm thick; of one or a few layers of subglobular cells 7-19 μm diameter. Only the walls of young asci pale Blue in Melzer's reagent *Ascobolus perplexans*
23. Apothecia 0.4-0.8 mm high, sessile. Receptacle wholly or partially, coarsely or finely furfuraceous, almost smooth or smooth. Excipulum near the margin 20-50 μm thick, near the base often much thicker; of subglobular, ellipsoid or oblong cells 10-50(-90) × 10-30(-60) μm. Ascus-wall always clearly Blue in Melzer's reagent *Ascobolus furfuraceus*
24. Apothecia stipitate or substiptate. Receptacle and disk ochraceous or lemon-yellow. Ascospores ellipsoid to fusiform-ellipsoid. On rotten leaves and branches *Ascobolus costantinii*
24. Apothecia sessile, with a rather broad base, rarely on a narrow base. Receptacle and disk greenish-yellow or olive-coloured. Ascospores ellipsoid 25
25. Receptacle and disk olive-coloured. Ascospores 14.5-16 × 8-9 μm *Ascobolus cervinus*
25. Receptacle and disk greenish-yellow. Ascospores smaller, 10-15 × 6-8 μm 26
26. Receptacle with a prominent margin. Ascospores rather uniform. Episporium ornamented with a regular pattern of longitudinal, rarely anastomosing striae *Ascobolus crenulatus*
26. Receptacle with a very narrow or scarcely developed margin. Ascospores extremely heterogeneous. Episporium with very different types of ornamentation (see Fig. 28; cf. also *A. lineolatus*) *Ascobolus cubensis*

27. Ascospores 9-10 µm long. Episporium finely granular	<i>Ascobolus cainii</i>
27. Ascospores more than 10 µm long	28
28. Receptacle and disk white	29
28. Receptacle and disk not white	30
29. Apothecia 0.4-1.0 mm diameter. Ascospores 13-17 × 7.5-8.5 µm. Episporium smooth, but finally often with an irregular network of fine lines. On dung	<i>Ascobolus carletonii</i>
29. Apothecia 4-5 mm diameter. Ascospores 20-26 × 12 µm. Episporium warted. On humid soil	<i>Ascobolus albinus</i>
30. Ascospores fusoid or ellipsoid with strongly pointed ends; 28.5-37.5 × 11-14 µm. Episporium consisting of long or short longitudinal ridges of pigment	<i>Ascobolus viridis</i>
30. Ascospores ellipsoid. Episporium punctate, warted, smooth, granular or with a network of crevices from the beginning	31
31. Ascospores punctate or warted. On wood or burnt substrata	32
31. Ascospores smooth, finely granular or with a network of crevices. On dung or humid soil	34
32. Ascospores 32-37 × 13-16 µm. Episporium punctate or finely warted. On rotten wood	<i>Ascobolus xylophilus</i>
32. Ascospores less than 30 µm long. Episporium rather coarsely warted. On charcoal or burnt soil	33
33. Receptacle almost smooth. Ascospores 17.5-22 × 9-11.5 µm. Episporium with a very regular pattern of round warts 1.0-1.5 µm diameter; without truncate polar thickenings	<i>Ascobolus archeri</i>
33. Receptacle finely mealy or sealy. Ascospores 17.5-25(-27.5) × (11.5)13-14.5 µm. Episporium with irregular or rounded warts varying considerably in size; with truncate polar thickenings ..	<i>Ascobolus carbonarius</i>
34. Ascospores 40-45 × 21-23 µm. On dung	cf. <i>Ascobolus asininus</i>
34. Ascospores 17-27 × 9-15 µm. On humid soil	35
35. Episporium at first smooth or extremely fine granular then with a pattern of very short, fine crevices in all directions, finally often reticulated or warted	<i>Ascobolus geophilus</i>
35. Episporium with a fine network of crevices from the beginning	<i>Ascobolus behntziensis</i>

6 Key to the species of *Ascobolus* sect. *Pseudascodesmis*

1. *Ascobolus reticulatus*

7 Key to the species of *Ascobolus* sect. *Pseudosaccobolus*

1. *Ascobolus pusillus*

8 Key to the species of *Ascobolus* sect. *Heimerlia*

1. Ascospores 14.5-17 × 8-10 µm. Episporium echinulate or warted *Ascobolus aglaosporus*
 1. Ascospores 11-13 × 6-8 µm. Episporium smooth cf. *Ascobolus candidus*

9 Key to the species of *Ascobolus* sect. *Gymnascobolus*

1. Episporium smooth. On dung 2
1. Episporium granular or finely warted . Ascospores 32-37 × 13-16 μm. On wood
..... cf. *Ascobolus xylophilus*
2. Ascospores ellipsoid, length-width ratio about 2.0 3
2. Ascospores shortly ellipsoid, with blunt ends; length-width ratio smaller than 1.6; 20-28 × 15-18 μm ..
..... cf. *Ascobolus moellerianus*
3. Ascospores 21-26 × 11.5-13 μm. Episporium smooth with a single longitudinal or oblique fine fissure,
sometimes with two fissures or finely reticulated *Ascobolus scatigenus*
3. Ascospores 15-19.5 × 7.5-9.0 μm. Episporium perfectly smooth *Ascobolus castaneus*

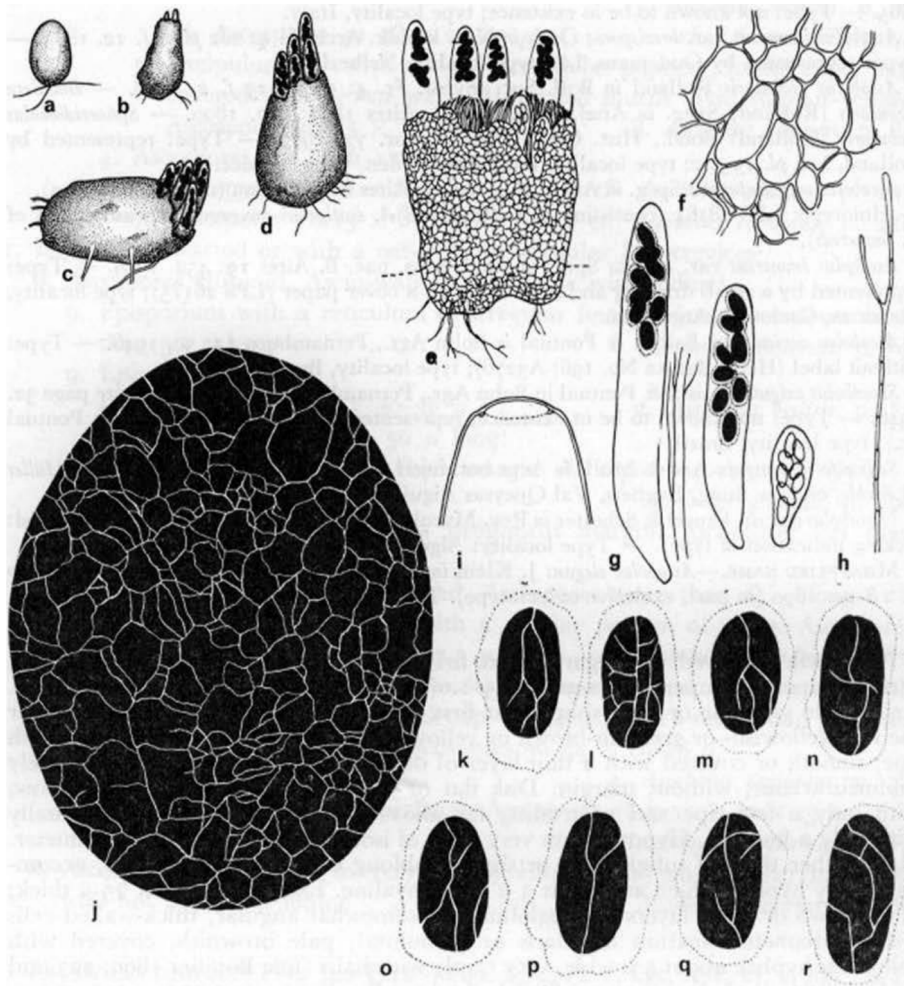


Abbildung 1: *Ascobolus immersus*: a-d, habit of fruit-bodies $\times 25$; e, fruit-body seen in transmitted light $\times 40$; f, texture of excipulum seen from outside $\times 275$; g, asci $\times 65$; h, branched paraphysis $\times 275$; i, top of ascus $\times 275$; j, shortly ellipsoid ascospore with reticulated episporium $\times 1600$; k-r, ascospores $\times 275$.

10 Descriptions

10.1 *Ascobolus* sect. *Dasyobolus*

10.1.1 *Ascobolus immersus*

Apothecia scattered or gregarious, at first often immersed or partly immersed, then erumpent or superficial, sessile, 0.5-1.0(-1.5) mm diameter, 0.5-0.7 mm high. Receptacle globular or pear-shaped, at first closed, then irregularly opening near the top, yellowish- or greenish-brown or yellowish, rarely with a reddish or purplish hue; smooth or covered with a thin layer of downy colourless hyphae, more rarely subfurfuraceous; without margin. Disk flat or convex, yellow or greenish-yellow, with only a few ripe asci protruding far above the surface. Hymenium usually with only a few asci. Hypothecium very thin, of isodiametric cells 3-10 μm diameter. Flesh rather thin; of subglobular or slightly oblong cells 7- 19 μm , diameter, accompanied by hyphae which are about 3 μm wide; hyaline. Excipulum about 25 μm thick; of only two or three layers of subglobular or somewhat angular, thick-walled cells 6-20 μm diameter (*textura angularis* or *globulosa*), pale brownish, covered with colourless hyphae about 5 μm wide, very rarely with hairs (fide Boudier 1869: 227 and Le Gal 1961: 455). Asci 1-40 per fruitbody, broadly clavate, 490-720 \times 100-130 μm , with a short stalk, rounded above, 8-spored, but very often with only a part of the spores developed; the wall stains deep blue in Melzer's reagent. Ascospores biseriate or irregularly disposed; oblong-ellipsoid, more rarely cylindrical or subglobular, rounded at the ends; at first hyaline, then purple or violet, finally sometimes purplish-brown; (35-)58-71(-81) \times (24-)28-36(-40) μm ; smooth or with one or a few lines which occasionally anastomose, sometimes with a coarse or fine net-work of narrow lines; a thick gelatinous envelope surrounding each spore. Paraphyses simple or branched, septate, filiform, 2-3 μm thick, not enlarged at the tip, hyaline, embedded in abundant greenish-yellow mucus.

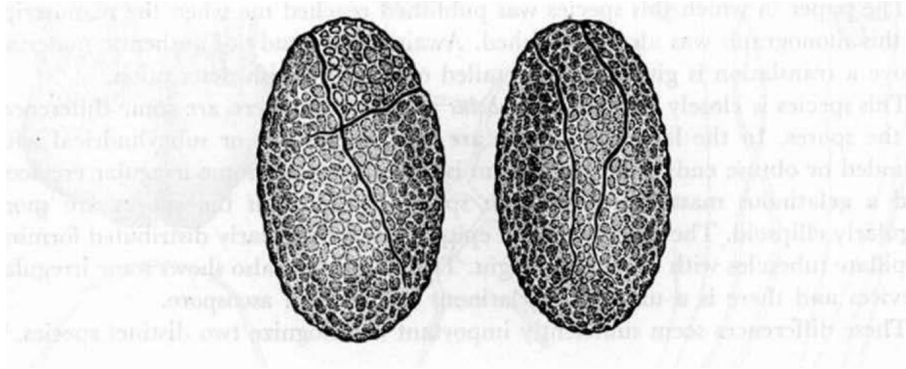


Abbildung 2: *Ascobolus bistisii*, ascospores $\times 800$ (after Gamundi & Ranalli, 1966.)

On dung of cow, horse, sheep, goat, nilgai, antelope, elephant, dog, hare, and rabbit.

10.1.2 *Ascobolus bistisii*

Apothecia small, half buried in the substratum, globular, with very few (2-6) asci, the latter simultaneously emerging from the convex hymenial surface like the fingers of a glove in different directions; young apothecia of a light green colour (=“flavovirens” of Saccardo) and surrounded by hyaline aerial hyphae; the apothecia first remain in the substratum, but emerge later making the aerial hyphae less conspicuous; margin hardly noticeable; outside in fully ripe state glabrous, of a light green colour, sometimes with an ochraceous hue. Consistency fleshy and soft. Diameter: 560-960 μm . Asci with 8 spores, claviform, abruptly ending at the base, with an apical central operculum in the form of a dome, where the wall of the ascus is much thinner; having a weak amyloid reaction in the ascus-wall, and with many light-refracting vacuoles. Occasionally asci with 2 and 6 ascospores; 370-480 \times 64-80 μm . Paraphyses filiform, with numerous septa, containing light-refracting greenish granules, embedded in a light green mucilage, amyloid reaction manifest in both their walls and contents. Diameter: 2.5-4 μm at the apex. Ascospores irregularly arranged in the ascus, ellipsoidal (relation between length and width: 2:1), at first hyaline, uninuclear and with a thick light-refracting wall, later purplish, finally chestnut brown; the pigment of the episporium being irregularly distributed, forming papillate tubercles; the latter in the form of low elevations but with irregular margin, and of dark chestnut colour which is lighter at the base of the tubercle in the fully mature ascospores, giving the impression of a network of the type found in *Ascobolus americanus*, but more irregular and less conspicuous. Fissures 1-3, generally median or oblique, sometimes joined transversally by a few other fissures which are wavy and follow the grooves between the papillae; with a lenticular mass of mucilage laterally; 50-60 \times 30-36 μm . Medulla (= flesh) of “*textura globulosa*”, with collapsed cells mixed with connective hyphae of a dense content, which unite the basal cells of the cortex with the subhymenium; globular cells of 16-32 μm diameter. Context of “*textura globulosa*” to “*angularis*” when seen from outside, formed by cells with walls of light green colour, with contents, 16-32 μm diameter. Oidia present in the aerial mycelium, hyaline, cylindrical, 12-15 \times 4 μm .

Only known from dung of horse.

10.1.3 *Ascobolus stictoides*

Apothecia scattered, gregarious or closely crowded, completely immersed or rarely superficial, 300-600 μm diameter, 400-650 μm high. Receptacle at first closed and globular or pyriform, then opening by irregular rupturing of the wall, watery-white, greenish-yellow or olive in colour; thinly tomentose or rarely smooth; without a margin. Disk flat or slightly concave, pale olivaceous to almost colourless, with a few almost black, ripe asci strongly protruding. Hymenium 230-280 μm thick, containing up to 40 asci. Hypothecium very thin, of isodiametric cells 6-12 μm diameter. Flesh not sharply differentiated or very thin. Excipulum about 15 μm thick, of more or less isodiametric, polygonal, thick-walled cells 9-25 μm diameter (*textura angularis*), with pale yellowish cell-walls, often covered with a thin layer of interwoven, cylindrical, irregularly branched, hyaline, 4-9 μm wide hyphae. Asci clavate or clavate-saccate, gradually tapering downwards in to a rather thick base, rounded above, 150-400 \times 39-55 μm , 8-spored; the wall deep blue in Melzer’s reagent. Ascospores biserial or irregularly disposed, ellipsoid; at first hyaline, then pale violet, finally dark violet, (25.5-)26.5-30.5(-32) \times (14.5-)16-17.5 μm , ornamented with rather coarse, rounded warts; pigment often rather thick up to 1.5 μm ; with unilateral, mucilaginous substance. Paraphyses filiform, simple, septate, 2.8-3.8 μm thick, not enlarged

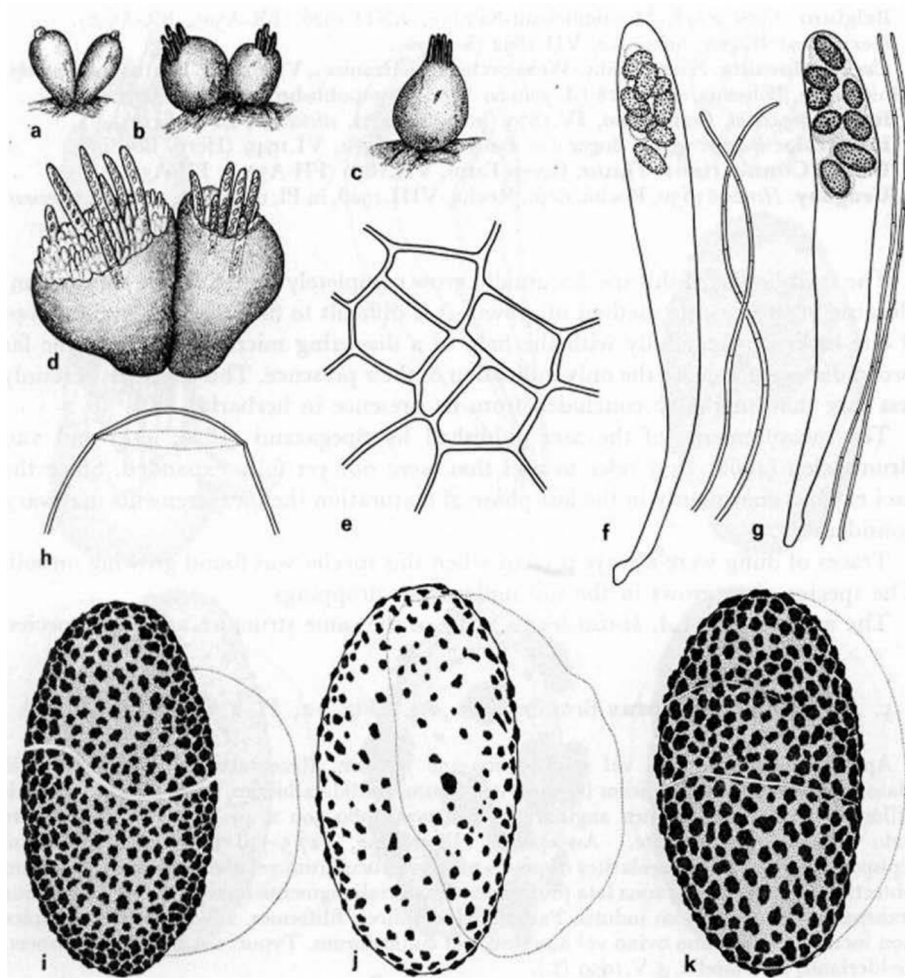


Abbildung 3: *Ascobolus stictoideus*: a-c, habit of fruit-bodies $\times 30$; d, two fruit-bodies $\times 65$; e, texture of excipulum seen from outside $\times 740$; f, g, asci and paraphyses $\times 175$; h, top of ascus $\times 1000$; i-k, ascospores $\times 1600$. (From living material.)

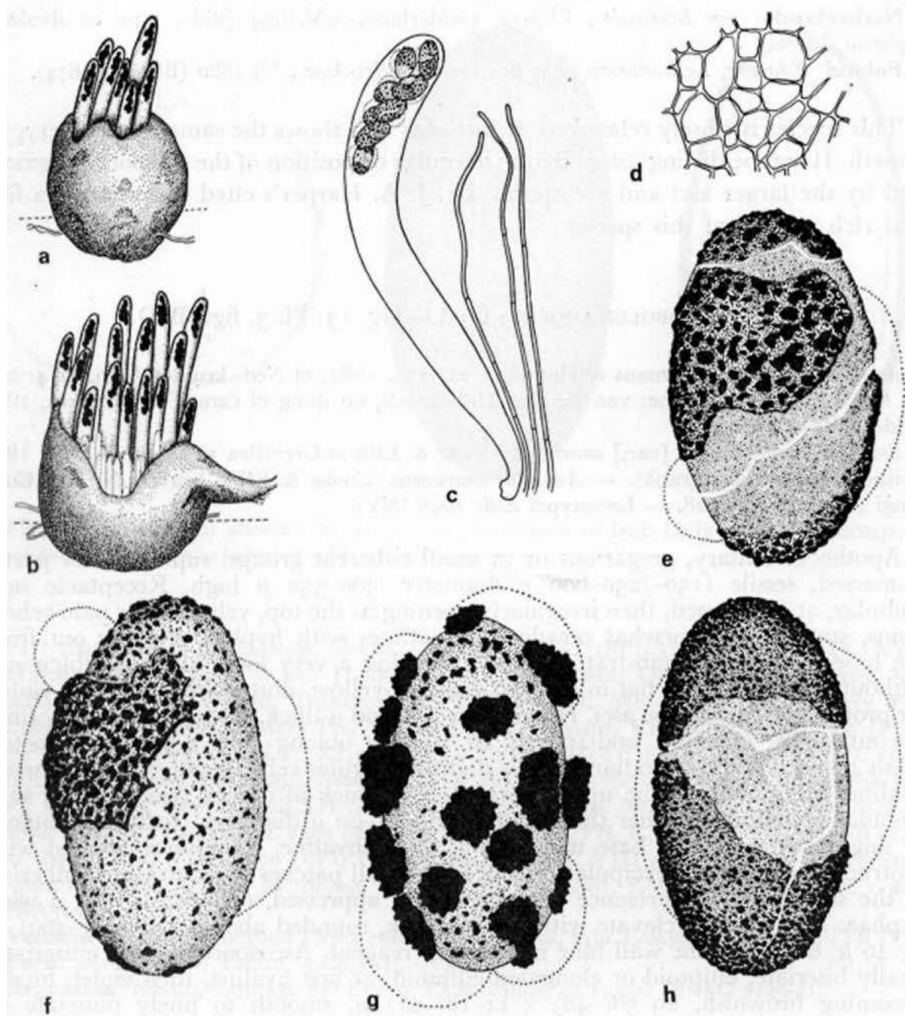


Abbildung 4: *Ascobolus degluptus*: a, b, habit of fruit-bodies $\times 75$; c, ascus and paraphyses $\times 460$; d, texture of excipulum seen from outside $\times 275$; e-h, ascospores $\times 1600$ (g, a rare, abnormal type of ornamentation).

upwards, sometimes slightly narrowed at the tip 2.5- 3.2 μm thick, hyaline, embedded in pale yellowish or colourless mucus.

On dung of cow, horse, sheep, dog, rabbit, muskrat, and goose, also on soil dirtied with dung.

10.1.4 *Ascobolus degluptus*

Apothecia scattered, gregarious or crowded, half-immersed or superficial, 200-450 μm across, 300-350 μm high. Receptacle globular, at first closed, then irregularly opening, dirty whitish or pale brownish, smooth or clothed with some hyaline hyphae, especially near the base, without a prominent margin. Disk flat, watery-white, with the dark purplish-violet tips of ripe asci far protruding. Hymenium about 200 μm thick. Hypothecium very thin, of isodiametric cells 8-11 μm diameter. Flesh very thin, of rounded isodiametric cells 8-12 μm diameter, colourless. Excipulum 12-15 μm thick, of more or less isodiametric, polygonal cells 9-30 μm diameter (*textura angularis*), colourless or pale brownish especially near the base, often covered with a thin layer of hyaline, cylindrical, irregularly branched hyphae, about 4 μm thick. Asci clavate, with a short stalk, rounded above, 380-500 \times 49-56 μm , 8-spored; the wall deep blue in Melzer's reagent. Ascospores biserial or irregularly disposed; ellipsoidal; at first hyaline, then pale brownish-violet, finally very dark purplish-violet; (27.5-)30-33.5(-35) \times 16-18 μm ; partly covered with irregularly disposed pigment, in the form of caps or warts; usually with a broad zone in which pigment is almost absent; pigment up to 2 μm thick; each spore with sub-equatorial transparent, mucilaginous cap or girdle. Paraphyses simple, septate, filiform, 2.8-4.0 μm thick, not thickened above, hyaline, embedded in colourless, somewhat granular mucus.

On dung of sheep, rabbit and goose.

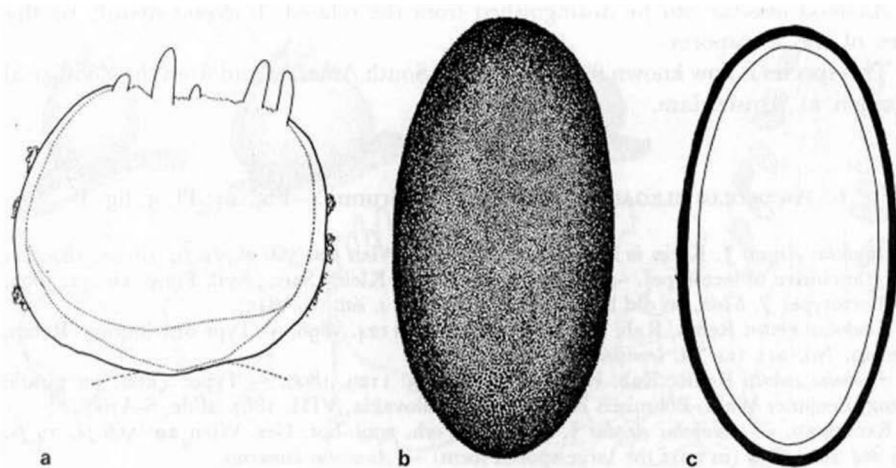


Abbildung 5: *Ascobolus amoenus*: a, diagrammatic section of fruit-body $\times 80$; h, ascospore $\times 1600$; c, id. in optical section.

10.1.5 *Ascobolus amoenus*

Apothecia solitary, gregarious or in small coherent groups, superficial or partly immersed, sessile (150-)250-600 μm diameter, 300-550 μm high. Receptacle subglobose, at first closed, then irregularly opening at the top, yellowish or pale ochraceous, smooth or somewhat powdery; sometimes with hyphae growing out from the base towards the substratum, rarely forming a very loose kind of subiculum; without a margin. Disk flat to convex, greenish-yellow, dotted with the dark violet, far protruding tips of ripe asci. Hymenium 200-300 μm thick. Hypothecium very thin, discontinuous, of small isodiametric or slightly oblong cells 4.5-6 μm diameter. Flesh 45-60 μm thick, of isodiametric or slightly irregular cells 13-20(-32) μm diameter, hyaline. Excipulum in the upper part 22-29 μm thick of one or two layers of subglobose or angular, rather thick-walled cells 14-20 μm diameter (*textura globulosa* or *angularis*), near the base up to 80 μm thick, hyaline, some times covered with protruding superficial, excipular cells or with small patches of substratum, adhering to the surface by the presence of more or less appressed, cylindrical, 2-4 μm wide hyphae. Asci broadly clavate with a short stalk, rounded above, 170-300(-400) \times 35-40 μm , 8-spored; the wall blue in Melzer's reagent. Ascospores at first uniseriate, finally biseriate, ellipsoid or elongated-ellipsoid, at first hyaline, then violet, finally becoming brownish, 29-38(-48) \times 14-18(-21) μm , smooth to finely punctate or densely granular; pigment in a very regular layer about 1.2 μm thick. Paraphyses simple, with only a few septae, filiform, about 2.5 μm thick, not enlarged upwards, hyaline, embedded in greenish-yellow mucus.

On dung of cow, horse, camel, goat, rabbit and muskrat.

10.1.6 *Ascobolus elegans*

Apothecia gregarious or closely crowded, superficial or partly immersed, sessile, sometimes formed on a kind of subiculum, 200-470 μm diameter, 200-530 μm high. Receptacle at first subglobose, sometimes with a broad base, finally often more or less hemispherical, yellowish-brown or brownish; smooth or more rarely thinly tomentose, without a margin. Disk flat, greenish-yellow or pale yellowish-brown, dotted with the violet protruding tips of ripe asci. Hymenium 200-240 μm thick. Hypothecium scarcely differentiated, very thin, of isodiametric cells 7-15 μm thick, sometimes almost lacking, of subglobose cells 9-20 μm diameter or of intertwined branched hyphae 4.5-7.5 μm wide, with cells 15-30 μm long, hyaline. Excipulum 19-26 μm thick, of isodiametric or oblong, often somewhat angular cells (8-)12-25(-35) \times (4.5-)7-15(-19) μm (*textura globulosa*, *epidermoidea* or *angularis*), colourless or pale brownish, sometimes covered with a thin layer of 3-4 μm wide hyphae. Asci cylindric-clavate, tapering downwards into a rather short stalk, rounded above, 170-300 \times 28-35(-38) μm , 8-spored; the wall deep blue in Melzer's reagent. Ascospores biseriate, ellipsoid, at first hyaline, then pale violet, finally violet or purplish-brown, 23-29(-32) \times 11.5-17.5 μm , smooth or extremely fine granular; the pigment in a very uniform layer; with unilateral or concentric mucilaginous substance. Paraphyses simple or branched, septate, filiform, about 3 μm thick, not or scarcely enlarged above, hyaline, embedded in abundant greenish-yellow or somewhat brownish mucus.

Known from dung of horse, cow, zebra, giraffe, rabbit, hare, and goose.

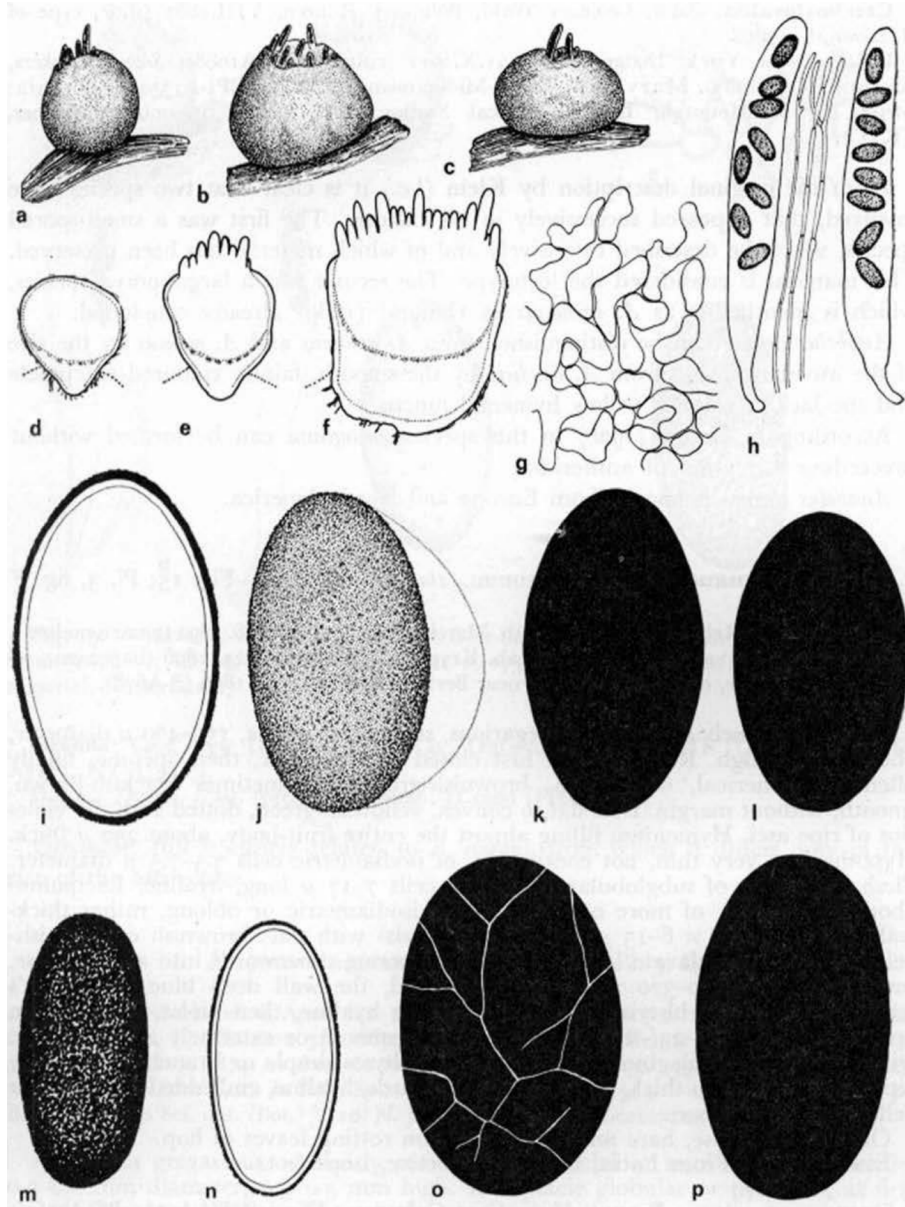


Abbildung 6: *Ascobolus elegans*: a-c, habit of fruit-bodies $\times 80$; d-f, diagrammatic sections of fruit-bodies $\times 65$; g, texture of excipulum seen from outside $\times 600$; h, asci and paraphyses $\times 175$; i, n, ascospores in optical section $\times 1600$; j-m, o-p, ascospores $\times 1600$.

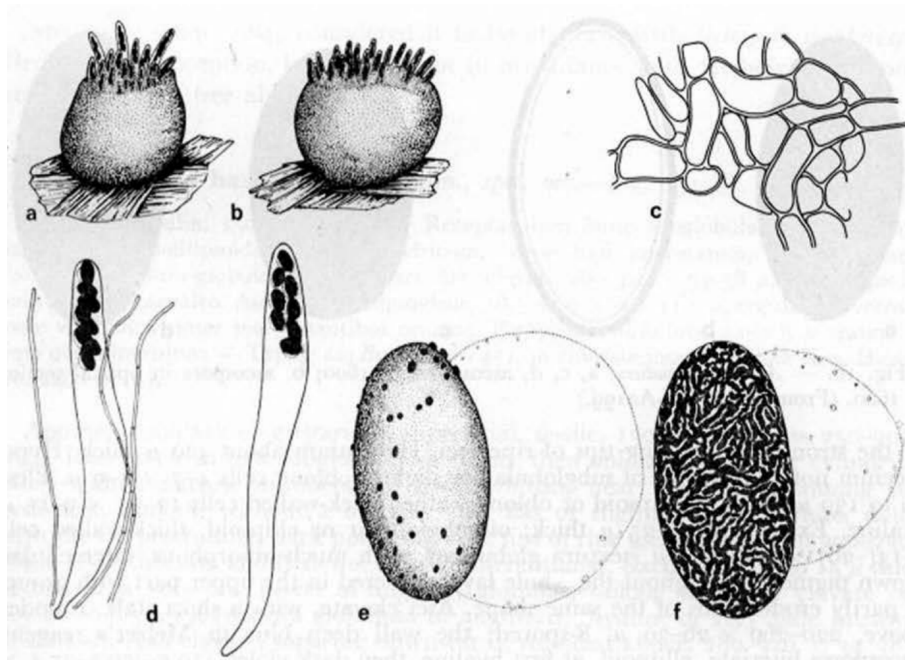


Abbildung 7: *Ascobolus mancus*: a, b, habit of fruit-bodies $\times 50$; c, texture of excipulum seen from outside $\times 600$; d, asci and paraphyses $\times 175$; e, f, ascospores $\times 1600$.

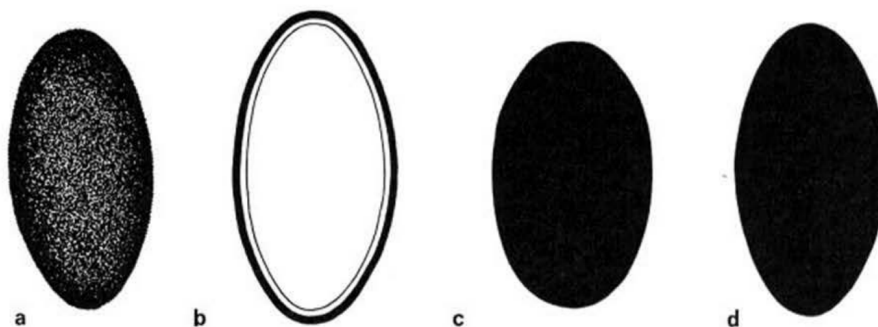


Abbildung 8: *Ascobolus boudieri*: a, c, d, ascospores $\times 1600$; b, ascospore in optical section $\times 1600$.

10.1.7 *Ascobolus mancus*

Apothecia closely crowded or gregarious, superficial, sessile, 150-400 μm diameter, about 300 μm high. Receptacle at first closed and globular, then opening, finally often hemispherical, olivegreen, brownish-green or sometimes blackish-brown, smooth, without margin. Disk flat to convex, yellowish-green, dotted with the violet tips of ripe asci. Hymenium filling almost the entire fruit-body, about 230 μm thick. Hypothecium very thin, not continuous, of isodiametric cells 3.5-7.5 μm diameter. Flesh very thin, of subglobular or oblong cells 7-17 μm long, hyaline. Excipulum about 15 μm thick, of more or less angular, isodiametric or oblong, rather thick-walled cells 10-30 \times 6-15 μm (*textura angularis*) with pale brownish or greenish-yellow walls. Asci clavate, slightly curved, tapering downwards into a short base, rounded above, 230-320 \times 29-32 μm , 8-spored, the wall deep blue in Melzer's reagent. Ascospores biserial, ellipsoid, at first hyaline, then violet, finally often brownish, (17.5-)19-23(-24) \times 10-12(-13) μm , smooth or extremely fine granular, with unilateral mucilaginous substance. Paraphyses simple or branched, with few septa, filiform, 2-3 μm thick, not enlarged upwards, hyaline, embedded in abundant yellowish-green mucus.

On dung of horse, hare and rabbit, also on rotting leaves of hop.

10.1.8 *Ascobolus boudieri*

Apothecia gregarious or closely crowded, superficial or semi-immersed, sessile, 0.3-0.6 mm diameter, 0.3-0.5 mm high. Receptacle globular or pyriform, at first closed, then irregularly opening at the top, often with a narrow

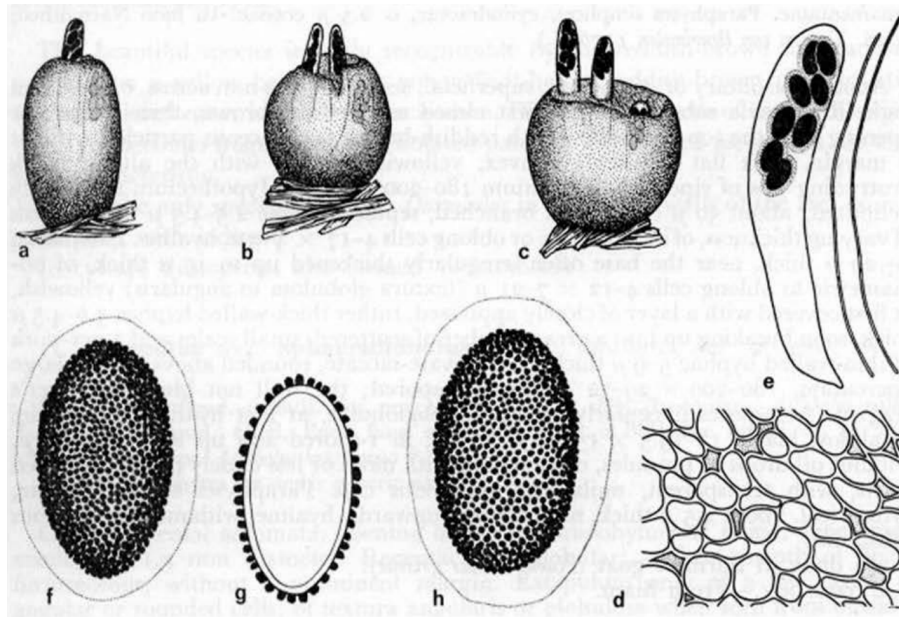


Abbildung 9: *Ascobolus hawaiiensis*: a-c, habit of fruit-bodies $\times 80$; d, texture of excipulum seen from outside $\times 600$; e, ascus and paraphyses $\times 275$; f, h, ascospores $\times 1600$; g, ascospore in optical section $\times 1600$.

base, rather dark brown; surface finely warted or furfuraceous, especially in the upper half; margin not very prominent but often apparently so because of the sharp colour-differences between excipulum and hymenium. Disk flat or convex, sulphur yellow, roughened by the strongly protruding tips of ripe asci. Hymenium about $220 \mu\text{m}$, thick. Hypothecium not continuous, of subglobular or slightly oblong cells $4-7 \times 4-9 \mu\text{m}$. Flesh up to $130 \mu\text{m}$ thick, of ellipsoid or oblong, rather thick-walled cells $12-35 \times 9-15 \mu\text{m}$, hyaline. Excipulum $13-25 \mu\text{m}$ thick; of subglobular or ellipsoid, thick-walled cells $7-13(-26) \times 5-8(-20) \mu\text{m}$ (*textura globulosa*), with much amorphous, intercellular, brown pigment throughout the whole layer, covered in the upper part with groups of partly eroded cells of the same shape. Asci clavate, with a short stalk, rounded above, $220-260 \times 26-30 \mu\text{m}$, 8-spored; the wall deep blue in Melzer's reagent. Ascospores biserial, ellipsoid, at first hyaline, then dark violet, $(19.5-20.5-25.5 \times (10-11.5-13) \mu\text{m}$, smooth or extremely fine granular, with lateral mucilaginous substance. Paraphyses simple, septate, filiform, $1.5-2.0 \mu\text{m}$ thick, not enlarged at the tip, hyaline, embedded in abundant sulphur yellow mucus.

On dung of cow, horse, hare, rabbit; but also on mushroom compost, on rotten wood and on mud from a manure-pit.

10.1.9 *Ascobolus hawaiiensis*

Apothecia solitary or gregarious, superficial, sessile, $150-250 \mu\text{m}$ across, $250-300 \mu\text{m}$ high. Receptacle at first subglobular or ovoid, then oblong-ellipsoid or cylindrical, often with a narrow or obconical base, whitish, near the base becoming pale brownish, smooth, without a margin. Disk flat or slightly convex, white, dotted with the far protruding, dark purplish-violet tips of ripe asci. Hymenium $200-230 \mu\text{m}$ thick. Hypothecium and flesh not clearly differentiated. Excipulum up to $15 \mu\text{m}$ thick; of one or a very few layers of angular, globular, oblong or rarely clavate cells $6.5-20 \times 6.5-13 \mu\text{m}$ (*textura globulosa* or *angularis*), hyaline or very pale brownish or pinkish. Asci clavate, tapering downwards, rounded above, $280-320 \times 34-38 \mu\text{m}$, 8-spored; the wall deep blue in Melzer's reagent. Ascospores biserial, ellipsoid, at first hyaline, then purplish-violet, finally purplish-brown, $18.5-21 \times 10-11.5 \mu\text{m}$, ornamented with a regular pattern of very fine warts or isolated punctae; pigment in a layer of uniform thickness; surrounded by a thick gelatinous envelope. Paraphyses simple or branched, filiform, with few septae, $2.0-2.5 \mu\text{m}$ thick, not enlarged above, hyaline, without mucus.

Known only from dung of sheep.

10.1.10 *Ascobolus siamensis*

Apothecia solitary or gregarious, superficial, sessile $0.3-0.9 \text{ mm}$ across, $0.3-0.6 \text{ mm}$ high. Receptacle subglobular, at first closed and reddish-brown, then irregularly opening near the top and yellow with reddish-brown furfuraceous particles, without a margin. Disk flat to slightly convex, yellowish, dotted with the almost black

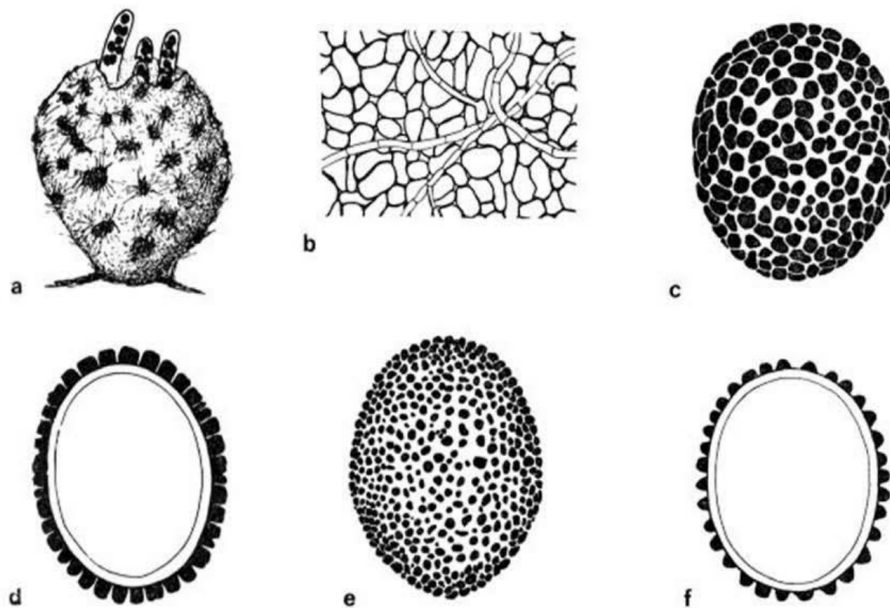


Abbildung 10: *Ascobolus siamensis*: a, habit of fruit-body $\times 50$; b, texture of excipulum seen from outside $\times 160$; c, e, ascospores $\times 1600$; d, f, ascospores in optical section $\times 1600$.

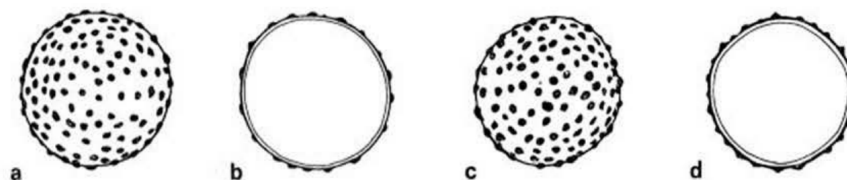


Abbildung 11: *Ascobolus brassicae*: a, c, ascospores; b, d, id. in optical section. All $\times 1600$.

protruding tips of ripe asci. Hymenium 180-200 μm thick. Hypothecium not clearly delimited, about 30 μm thick, with branched, septate hyphae 2.5-4.5 μm thick. Flesh of varying thickness, of isodiametric or oblong cells 4-17 \times 4-9 μm , hyaline. Excipulum 20-29 μm thick, near the base often irregularly thickened up to 45 μm thick, of isodiametric to oblong cells 4-12 \times 7-21 μm (*textura globulosa* to *angularis*) yellowish, at first covered with a layer of closely appressed, rather thick-walled hyphae 3.0-4.5 μm thick, soon breaking up into a great number of scattered, small scales and a net-work of thin-walled hyphae 5-9 μm thick. Asci clavate-saccate, rounded above, with a large operculum, 180-200 \times 29-32 μm , up to 8-spored; the wall not blue in Melzer's reagent. Ascospores irregularly biseriata, subglobular, at first hyaline, then violet to almost black, 17-19.5 \times 15-16.6(-17) μm , in 1-spored asci up to 31.5 \times 29 μm , without oil-drops or granules, ornamented with more or less closely placed, rounded warts, with transparent, unilateral, gelatinous cap. Paraphyses simple, septate, cylindrical, about 2.5 μm thick, not enlarged upwards, hyaline, without mucilaginous substance.

On dung of Burmese goat (*Naemorhedus griseus*).

10.2 *Ascobolus* sect. *Sphaeridiobolus*

10.2.1 *Ascobolus brassicae*

Apothecia gregarious or closely crowded, superficial, sessile, 0.5-1.5 mm diameter (according to Croan 1-3 mm), 0.3-0.6 mm high. Receptacle at first closed and spherical, then opening at the top and hemispherical, lenticular or slightly obconical, finally often scutellate on a small base, white or pale yellowish-brown, very finely furfuraceous, rarely smooth, with a very prominent membranaceous or crenulate margin. Disk flat, white, then pale flesh-colour or brownish, dotted with the pale brownish-violet tips of ripe asci. Hymenium up to 200 μm thick. Hypothecium not clearly differentiated. Flesh 140-200 μm thick, of rather broad hyphae with ellipsoid or elongated, swollen cells, 10-28 \times 6-11 μm , hyaline. Excipulum about 20 μm thick near the margin, up to 50(-110) μm near the base, of isodiametric and ellipsoid, often somewhat flattened or angular cells 15-46(-70) \times 9-30 μm (*textura angularis* or *globulosa*); in the furfuraceous particles and at the extreme margin

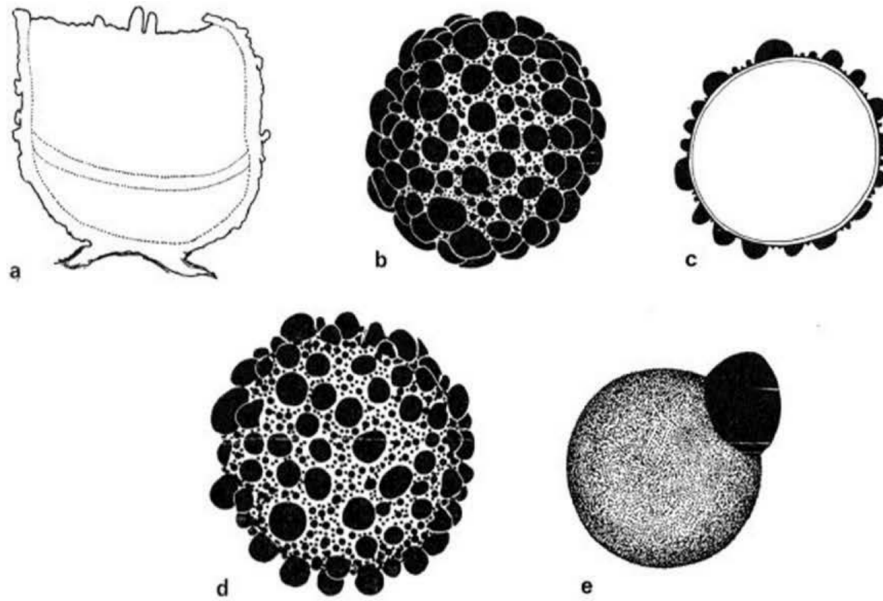


Abbildung 12: *Ascobolus nodulosporus*: a, diagrammatic section of fruit-body $\times 100$; b, d, normal ascospores $\times 1600$; c, ascospore in optical section $\times 1600$; d, very rare, abnormal type of ascospore $\times 1600$.

globular or pear-shaped cells 6-18(-26) μm diameter; colourless. Asci at first cylindrical, then cylindric-clavate, with a rather thick base, rounded above, 145-229 \times 22-30 μm , 8-spored; the wall blue in Melzer's reagent. Ascospores at first uniseriate, finally multiseriate or irregularly disposed, brownish-violet, 10.5-13.5(-15) μm diameter, ornamented with small, isolated, round or angular warts 0.3-0.7 μm diameter, without any gelatinous substance. Paraphyses branched, especially near the tip, septate, filiform-cylindrical, 2.5- 3.5 μm thick, not or slightly enlarged up to 6 μm at the tip, embedded in colourless mucus.

On dung of fox, lemming, rabbit, hare, and mouse, also on owl-pellets and rotten stems of cabbage.

10.2.2 *Ascobolus nodulosporus*

Apothecia gregarious or crowded, superficial, sessile, 0.3-0.5 mm across, about 0.3 mm high. Receptacle at first spherical, then hemispherical, on a small base, pale brownish or dirty yellowish-brown, smooth, margin serrate. Disk flat, roughened by the protruding asci. Hymenium about 240 μm thick. Hypothecium not clearly differentiated. Flesh 85-120 μm thick, in the upper part of thin-walled, isodiametric or elongated, angular cells 7-20(-46) \times 6-12 μm , in the lower part of remarkably thick-walled, isodiametric cells 5- 13 μm diameter (walls up to 3 μm thick), hyaline. Excipulum 19-33 μm thick, of thick-walled, spherical, angular, often somewhat elongated cells 7-20 \times 6-14 μm (*textura angularis*), hyaline. Asci clavate-cylindrical, rounded at the apex, 235-275 \times 23-32 μm , 8-spored, the wall pale blue in Melzer's reagent. Ascospores uniseriate, finally irregularly biseriate, spherical, at first hyaline, then purple, finally purplish-brown, (16-)17-19.5 μm diameter (pigment included), ornamented with a rather regular pattern of knobs 1.8-4.0 μm diameter and very fine rounded warts only 0.2-0.4 μm diameter; pigment in a rather thick layer; primary spore-wall very thick (up to 2.6 μm), especially when immature. Paraphyses branched, septate, filiform-cylindrical, about 2 μm thick, at the tip slightly enlarged up to 5 μm , hyaline.

Known only from dung of rat.

10.3 *Ascobolus* sect. *Ascobolus*

10.3.1 *Ascobolus albidus*

Apothecia scattered or gregarious, superficial, sessile on a narrow base, 0.3-1.0(-1.5) mm diameter, 0.4-0.8 mm high. Receptacle at first closed, subcylindrical or barrel-shaped, then obconical, cylindrical with an obconical base or urceolate, white with pale yellowish-brown base, more or less translucent, finally often entirely yellowish-brown, rarely (only known from the British isles) wholly blackish-brown or brownish, smooth, without a margin. Disk flat, white, dotted with the strongly protruding tips of ripe asci. Hymenium 240-300 μm thick. Hypothecium very thin or not clearly differentiated, of isodiametric cells, 5-12 μm diameter. Flesh very thin,

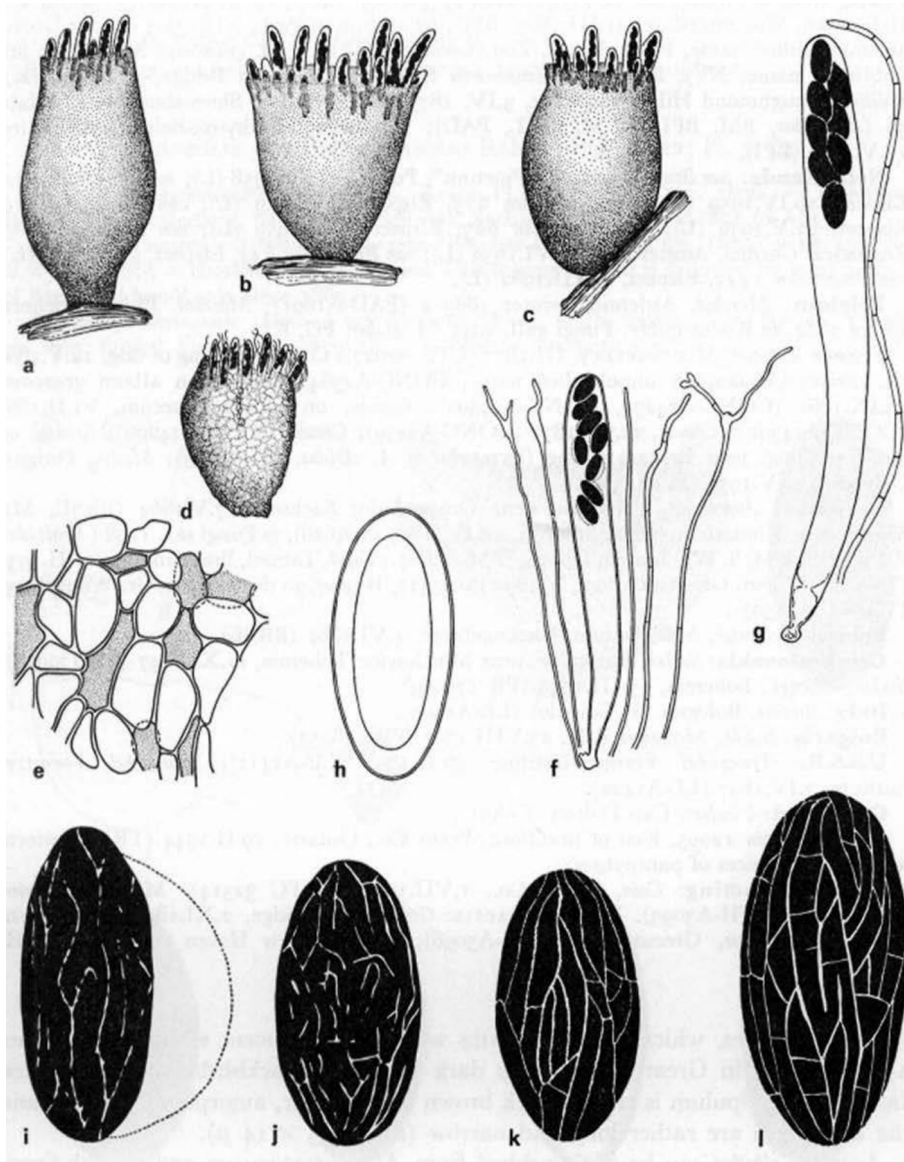


Abbildung 13: *Ascobolus albidus*: a-c., habit of fruit-bodies $\times 75$; d , fruit-body in transmitted light $\times 65$; e, texture of excipulum seen from outside; f, ascus and paraphyses $\times 175$; g, ascus and paraphysis $\times 275$; h, young ascospore in optical section $\times 1600$; i-l, ascospores $\times 1600$.

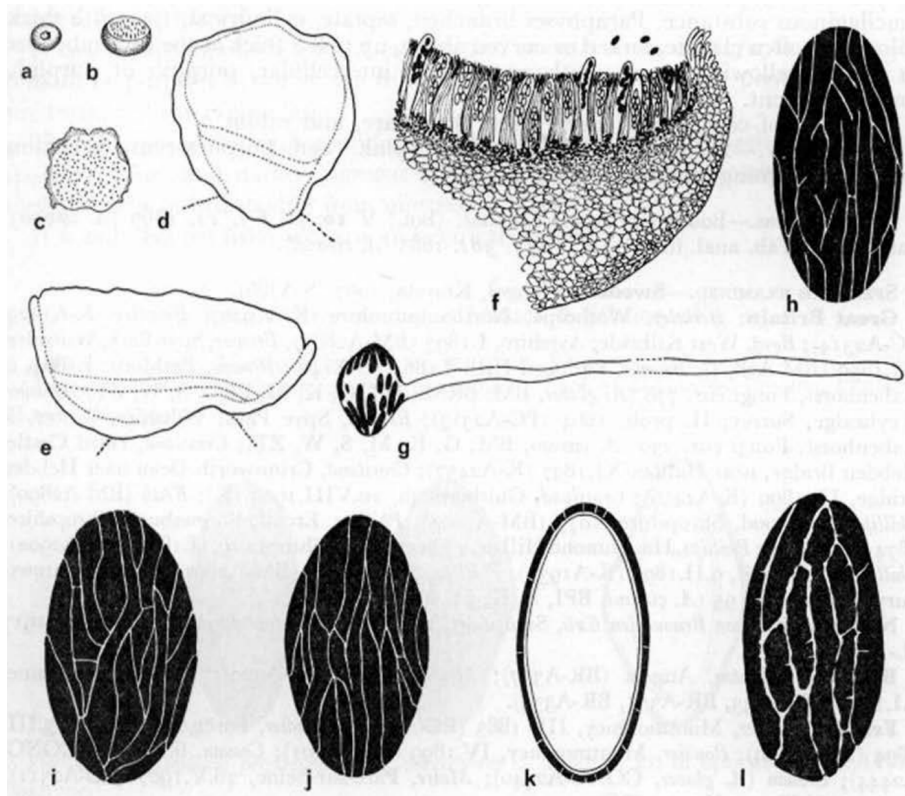


Abbildung 14: *Ascobolus roseopurpurascens*: a-c, habit of fruit-bodies $\times 12$; d, e, diagrammatic sections of fruit-bodies $\times 60$; f, median section through part of fruit-body $\times 65$; g, germinated ascospore $\times 460$; h-j, l, ascospores $\times 1600$; k, ascospore in optical section $\times 1600$.

up to 100 μm thick, of rounded, elongated cells 7- 19 \times 5-8 μm , hyaline. Excipulum in the upper part 7-13 μm thick, near the base 20-39 μm thick, of isodiametric or slightly elongated, rounded or angular cells 14-43 \times 8-29 μm (mostly *textura angularis*), hyaline. Asci cylindric-clavate, gradually tapering downwards, rounded above, (160-)300-410 \times 26-38 μm , 8-spored; the wall deep blue in Melzer's reagent. Ascospores biseriata, ellipsoid-oblong, at first hyaline, then pale violet, finally violet, (18-)20-36(-39) \times (9-)11-14(-16) μm ; usually with longitudinal occasionally anastomosing striae, sometimes with short more or less curved striae; with thick, transparent, unilateral, gelatinous cap. Paraphyses branched, septate, cylindrical, 1.7- 3.2 μm thick, slightly clavate, filiform or forked above, 1.0- 4.7 μm thick at the tip, hyaline, embedded in a colourless mucus, which quickly dissolves in water.

Known from dung of cow, horse, sheep, goat, moose, dog, wolf, rabbit, hare, and muskrat.

10.3.2 *Ascobolus roseopurpurascens*

Apothecia gregarious or crowded, superficial, sessile, 0.3-1.7 mm diameter, 0.3-0.6 mm high. Receptacle at first closed and spherical, then opening and expanding, finally often scutellate, pinkish-red, yellowish-green with a purplish hue, purple or purplish-brown, smooth or rarely finely furfuraceous; margin sometimes irregularly dentate or lobed, membranaceous, finally smooth. Disk flat or slightly concave, finally convex, at first yellowish, pinkish, or pale purplish, then purplish-brown or brown, dotted with the almost black protruding tips of ripe asci. Hymenium 170-220 μm thick. Hypothecium clearly differentiated, 25-30 μm thick, of isodiametric or somewhat elongated cells 5-10 \times 4-7 μm . Flesh 25-260 μm thick, of more or less isodiametric cells 8-17 μm diameter, colourless or with amorphous, intercellular, purplish-brown pigment in the outer zone. Excipulum 14-30(-40) μm thick, of irregular, elongate or lobed cells 12-29 \times 7-12 μm (*textura epidermoidea*), with purplish or purplish-brown, amorphous, intercellular pigment, especially near the margin. Asci clavate, rounded above, 175-240 \times 20-26 μm , 8-spored; the wall blue in Melzer's reagent. Ascospores biseriata, ellipsoid with blunt ends, at first hyaline, then pinkish-violet, finally violet or brownish-violet, (16-)18-28(-29) \times (9-)10-12(-13) μm , ornamented with longitudinal, anastomosing lines, with unilateral mucilaginous substance. Paraphyses branched, septate, cylindrical, 1.5-2.5 μm thick, colourless, often clavate, forked or curved above, up to 8 μm thick at the tip, embedded in a pale yellowish mucus, with amorphous, intercellular, purplish or purplish-brown

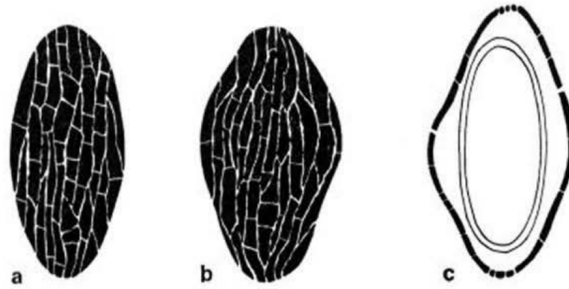


Abbildung 15: *Ascobolus perplexans*: a, b, ascospores $\times 1600$; c, id. in optical section.

pigment.

On dung of cow, horse, sheep, deer, dog, hare, and rabbit.

10.3.3 *Ascobolus perplexans*

Apothecia scattered or gregarious, superficial, sessile on a small base or sub-stipitate, 0.5-3 mm diameter, up to 0.3 mm high. Receptacle at first pyriform, then expanding and scutellate, finally flattened, greenish-yellow, becoming brownish, finely furfuraceous or powdered, sometimes almost smooth, with an acute or irregularly dentate margin; stipe up to 170 μm high and 450-700 μm diameter, strongly enlarged at the base. Disk at first slightly concave or flat, finally convex, dirty greenish-yellow, dotted with the almost black protruding tips of ripe asci. Hymenium 140-160 μm thick. Hypothecium not clearly differentiated. Flesh of varying thickness, in the upper part pseudoparenchymatous, in the basal part - especially in the stipe - plectenchymatous, hyaline. Excipulum 12-22 μm thick, of one or a very few layers of subglobular cells 7-19 μm diameter, pale brownish or almost colourless, covered with very small isolated groups of subglobular cells 10-19 μm diameter. Asci clavate-cylindrical, with a narrow base, rounded above, 185-240 \times 20-27 μm , 8-spored; only when young the wall pale blue in Melzer's reagent. Ascospores uniseriate to biseriata, ellipsoid, at first hyaline, then violet, finally purplish-brown, 19-22(-25) \times 9.5-13 μm ; often swollen and showing a loose episporium, ornamented with longitudinal, anastomosing striae, finally often also with short transverse crevices. Paraphyses simple or branched, septate, filiform, 2.5-3.0 μm thick, slightly clavate at the tip, hyaline embedded in greenish-yellow mucus.

On dung of sheep and kangaroo. According to Masee & Salmon (1901: 328) also "on dung of *Raphiceri melanotidis* (Grijs-bok), *Elephantis africana* (Elephant), *Cervi elaphi* (Red Deer), *Ovis vignei* (Ural Wild Sheep) and horse."

10.3.4 *Ascobolus furfuraceus*

Apothecia solitary or gregarious, superficial, sessile, 0.5-5 mm across, 0.4-0.8 mm high. Receptacle at first closed and subglobular, then opening and hemispherical or cup-shaped, finally saucer-shaped, yellowish-green or yellowish, often becoming olive-green, ochraceous or brownish; wholly or partially, coarsely or finely, whitish furfuraceous, almost smooth or smooth; margin furfuraceous, denticulated, membranaceous or smooth. Disk slightly concave or flat, at first yellowish, greenish or yellowish-green, dotted with the almost black protruding tips of ripe asci, finally often brownish or blackish-brown. Hymenium (120-)150-200(-220) μm thick. Hypothecium 20-50 μm thick, of isodiametric, rounded cells 7-12 μm diameter. Flesh up to 500 μm thick, of subglobular or slightly ellipsoid cells 10-40 μm diameter, accompanied by irregularly undulating, branched hyphae which are connected with the paraphyses, hyaline. Excipulum near the margin 20-50 μm thick, near the base sometimes reaching 170 μm ; of globular, ellipsoid or oblong cells 10-50(-90) \times 10-30(-60) μm (*textura globulosa*); hyaline or sometimes with some brownish, amorphous, intercellular pigment; the external zone usually roughened by protruding groups of globular or oblong cells, often with irregular fissures giving rise to eroded groups of cells; sometimes almost smooth. Asci clavate, tapering downwards into a rather short stalk, rounded above, (120-)180-250 \times (20-)24-30(-32) μm , 8-spored; the wall blue in Melzer's reagent. Ascospores at maturity biseriata or irregularly disposed, ellipsoid, at first hyaline, then violet, finally often purplish-brown, (16-)19-28(-32) \times (9-)10-14(-16) μm ; ornamented with more or less longitudinal, occasionally anastomosing striae, rarely swollen and reticulated, with unilateral mucilaginous substance. Paraphyses simple or branched, septate, filiform, 2-4 μm thick, usually scarcely thickened above, only very rarely with ellipsoid, strongly swollen cells up to 21 μm thick, embedded in yellowish or yellowish-green mucus.

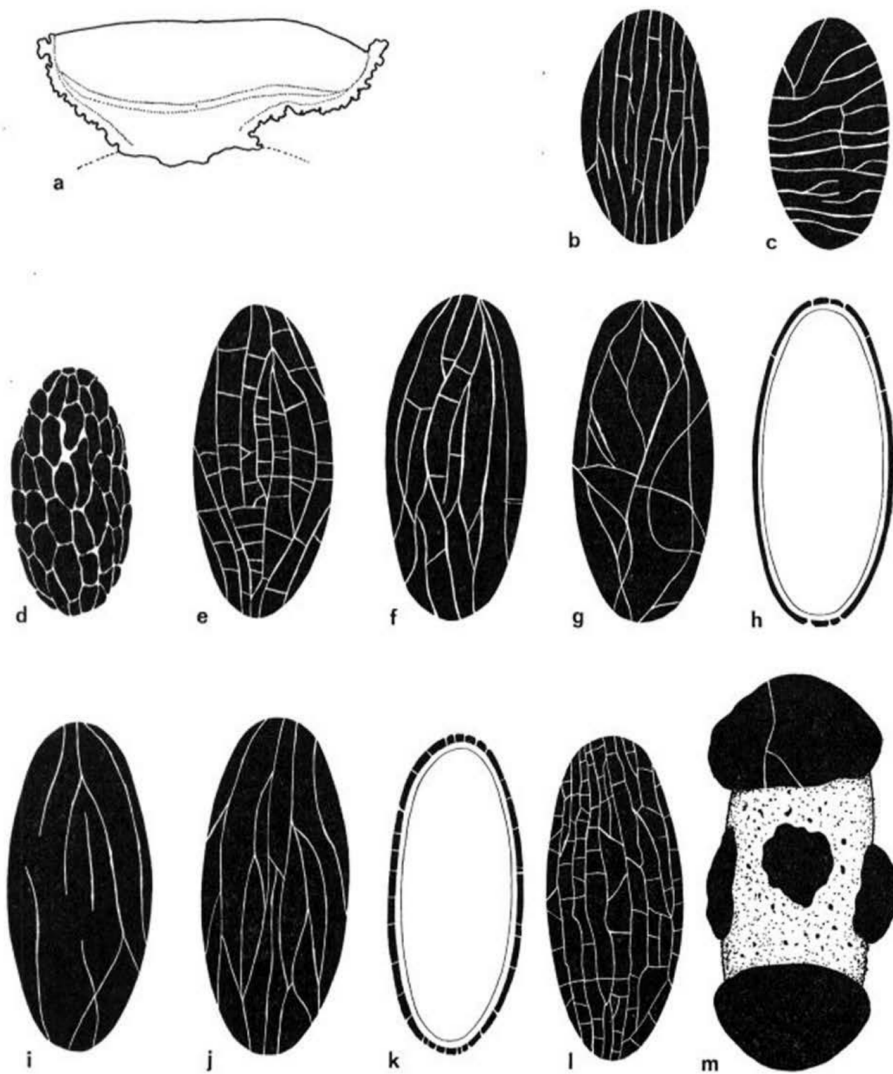


Abbildung 16: *Ascobolus furfuraceus*: a, diagrammatic section of fruit-body $\times 40$; b-g, i, j, l, ascospores $\times 1600$; h, k, id. in optical section; m, very rare, abnormal type of ascospore $\times 1600$.

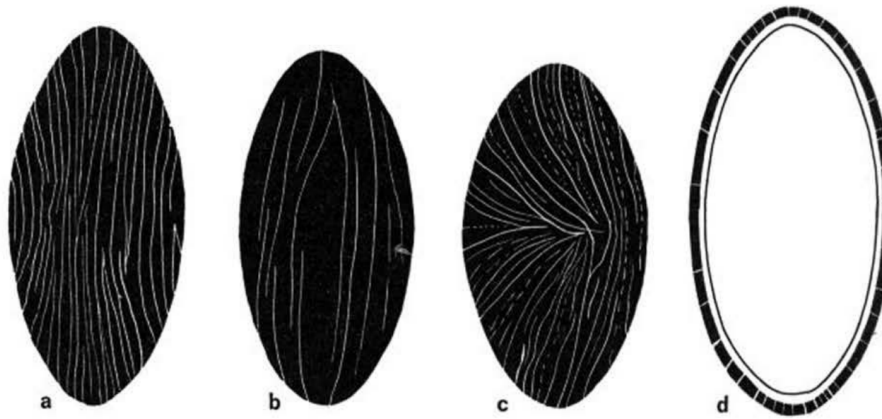


Abbildung 17: *Ascobolus laevisporus*: a-c, ascospores; d, ascospore in optical section. All $\times 1600$

On dung of cow, horse, deer, goat, yak, bear, pig, fox, rabbit, and hare, on manured soil, on rotten refuse, and on rotten stems of cabbage.

10.3.5 *Ascobolus laevisporus*

Apothecia scattered or in small coherent groups, superficial, sessile, 3-8 mm diameter. Receptacle at first globular, then expanding, and becoming scutellate, externally coarsely white-furfuraceous, greenish; margin acute, more or less denticulate. Disk slightly concave or flat, becoming dirty greenish, dotted with the protruding ends of the ripe asci. Hymenium about 175 μm thick. Hypothecium 20-25 μm thick. Flesh about 270 μm thick, of subglobular cells, 16-40 μm in diameter, accompanied by irregular undulating hyphae 6-10 μm thick. Excipulum 30-45 μm thick, composed of globular cells 10-25 μm in diameter, with round, cylindrical or pear-shaped cells only 7-12 μm wide near the margin and on the outside of the furfuraceous particles. Asci cylindrical-clavate, 200-250 \times 30 μm , 8-spored; the wall blue in Melzer's reagent. Ascospores ellipsoid, at first hyaline, then pinkish-violet, becoming violet, 22-27.5 \times 12-13.5 μm , ornamented with closely spaced, extremely fine subparallel striae which only rarely anastomose and of which usually fifteen to twenty-five are visible on each view of the spore, with lateral mucilaginous substance. Paraphyses slender, hyaline, often branched above, about 3 μm thick, near the tip slightly enlarged up to 3-5 μm , embedded in greenish mucus.

On cow dung.

10.3.6 *Ascobolus michaudii*

Apothecia gregarious or scattered, superficial, substipitate or with a short stalk, 0.7-2.5 mm diameter, 0.5-2.0 mm high. Receptacle at first closed, globular, barrel-shaped or cylindrical, then opening and expanding, finally more or less obconical or with a short stalk, yellow or lemon-yellow, covered with very small whitish grains, mealy or scurfy, rarely almost smooth; the margin dentate or mealy, finally almost smooth. Disk concave or flat, finally slightly convex, yellow or greenish-yellow, dotted with the purplish-black protruding tips of ripe asci. Hymenium about 140 μm thick. Hypothecium 20-25 μm thick, of closely compacted isodiametric cells 4.5-10 μm diameter. Flesh of subglobular cells 7-18(-44) μm diameter, hyaline. Excipulum of varying thickness, of subglobular, ellipsoid or angular cells 19-38(-55) μm diameter (*textura globulosa* or *angularis*), lemon-yellow, covered with small groups of globular or ellipsoid cells 10-32 \times 10-23 μm . Asci clavate-cylindrical, gradually tapering downwards, rounded above, 180-280 \times 22-26 μm , 8-spored; the wall blue in Melzer's reagent. Ascospores uniseriate, finally biseriate, ellipsoid; at first hyaline, then pale or dark violet, finally sometimes brownish; 17-22 \times 9.5-12 μm ; ornamented with more or less longitudinal or oblique, rather widely spread, rarely anastomosing lines; with unilateral mucilaginous substance. Paraphyses simple or branched, septate, cylindrical or clavate, 2.2-3.5(-7) μm thick, enlarged, narrowed or forked above, at the apex 1.5-12 μm thick, hyaline, embedded in abundant greenish-yellow mucus.

On dung of cow, horse, and rabbit.

10.3.7 *Ascobolus crenulatus*

Apothecia gregarious, superficial, sessile or rarely substipitate, 0.3-1.8 mm diameter, 0.2-0.9 mm high. Receptacle at first subglobular and closed, then opening and expanding, becoming hemispherical, greenish-yellow or

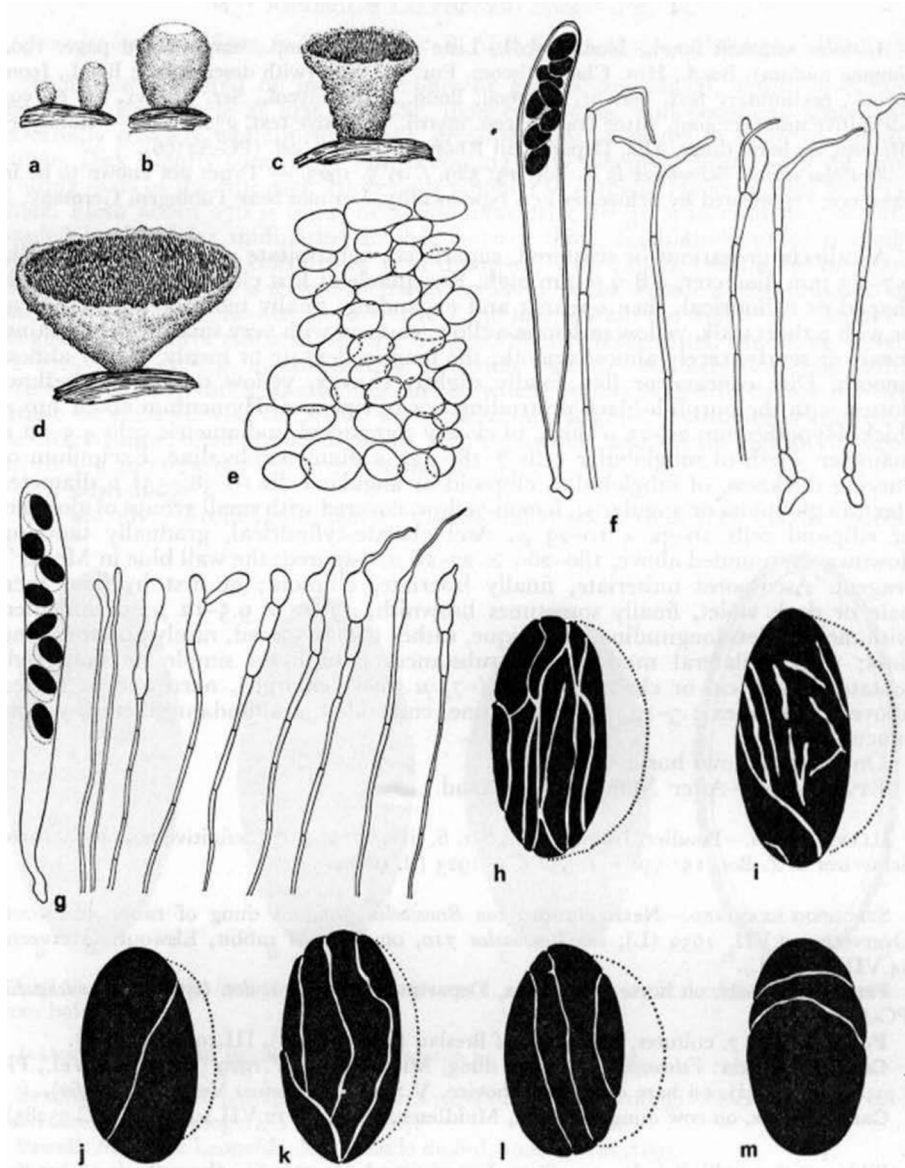


Abbildung 18: *Ascobolus michaudii*: a-d, habit of fruit-bodies $\times 15$; e, texture of excipulum seen from outside $\times 275$; f, g, asci and paraphyses $\times 275$; h-m, ascospores $\times 1600$.)

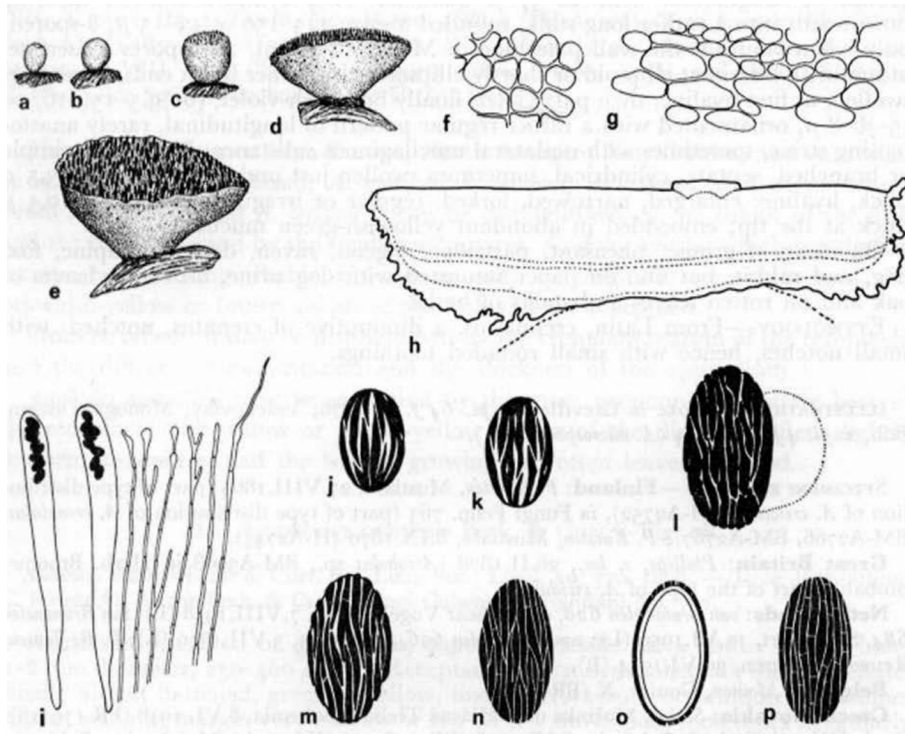


Abbildung 19: *Ascobolus crenulatus*: a-e, habit of fruit-bodies $\times 12$; f, g, texture of excipulum seen from outside, near base (f) and margin (g) of receptacle $\times 275$; h, diagrammatic section of fruit-body $\times 140$; i, asci and paraphyses $\times 275$; j-n, μm ascospores $\times 1600$; o, ascospore in optical section $\times 1600$.

pale olive-green, coarsely or finely furfuraceous or granulated, especially near the margin, rarely almost smooth, with prominent crenulate margin. Disk concave, then flat, greenish-yellow, dotted with the dark purplish tips of ripe asci. Hymenium 115-140 μm thick not always clearly differentiated, of closely compacted isodiametric cells 4.5-7(-15) μm . Flesh of varying thickness, of isodiametric or oblong cells 4.5-20 \times 4.5-14 μm , hyaline. Excipulum 15-30(-65) μm , thick, of globular, subangular or oblong rather thick-walled cells 7-30(-40) \times 7-20 μm (*textura globulosa* or *angularis*); the walls pale yellowish; margin consisting of fragments of excipular layer covered with groups of subglobular cells 20-37 μm diameter. Asci cylindric-clavate, tapering downwards into a rather long stalk, rounded above, 125-150 \times 13-15 μm , 8-spored; only when young is the wall pale blue in Melzer's reagent. Ascospores uniseriate, at maturity biseriate; ellipsoid or shortly ellipsoid with rather blunt ends, sometimes swollen, at first hyaline, then pale violet, finally brownish-violet, (8-)9.5-15(-16) \times (5-)6-8 μm , ornamented with a rather regular pattern of longitudinal, rarely anastomosing striae, sometimes with unilateral mucilaginous substance. Paraphyses simple or branched, septate, cylindrical, sometimes swollen just under the septae, 2-3.5 μm thick, hyaline; enlarged, narrowed, forked, regular or irregular above, 2.0-10.5 μm thick at the tip; embedded in abundant yellowish-green mucus.

On dung of grouse, pheasant, partridge, pigeon, raven, deer, porcupine, fox, dog, and rabbit, but also on paper saturated with dog urine, on rotten leaves of oak and on rotten leaves and stalks of herbs.

10.3.8 *Ascobolus cubensis*

Apothecia scattered or gregarious, superficial, sessile on a rather broad base, 1-2 mm diameter, 250-400 μm high. Receptacle at first hemispherical, then scutellate, finally almost flattened, greenish-yellow, finely furfuraceous or pruinose, sometimes almost smooth; margin very narrow or not clearly developed, sometimes irregularly rough in young fruit-bodies. Disk slightly concave or flat, finally sometimes slightly convex, greenish-yellow ("viridiflavus"), dotted with the dark protruding tips of ripe asci. Hymenium 120-140 μm thick. Hypothecium clearly differentiated, 35-50 μm thick, of compacted isodiametric cells 4-14 μm diameter. Flesh 160-200 μm thick, of somewhat irregularly oblong cells 21-35 \times 12-16 μm , hyaline. Excipulum 15-30 μm thick, of subglobular or oblong cells 20-37 \times 12-30 μm , pale brownish, covered with small groups of subglobular cells. Asci cylindric-clavate, gradually tapering downwards into a narrow base, rounded above, 150-180 \times 11-13 μm , 8-spored, but often with only a part of the spores developed; the wall not blue in Melzer's reagent. Ascospores uniseriate to biseriate, ellipsoid, at first hyaline, (then probably violet) finally pale purplish-brown; 11.5-14 \times

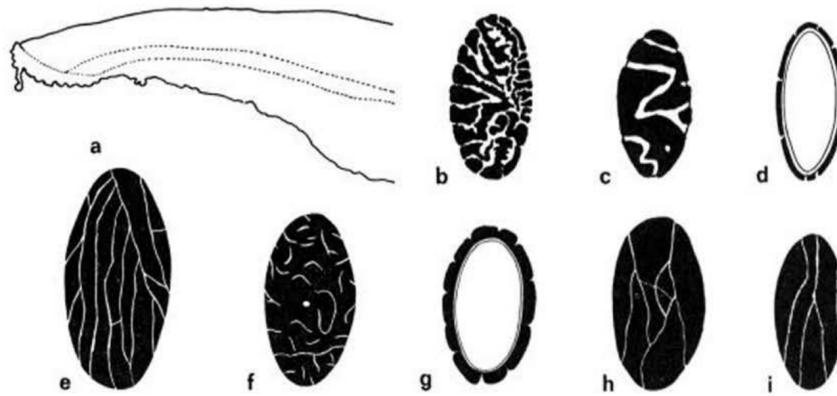


Abbildung 20: *Ascobolus cubensis*: a, diagrammatic section of fruit-body $\times 65$; b, c, e, f, h, i, ascospores $\times 1600$; d, g, id. in optical section.

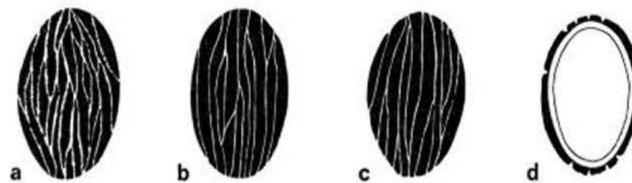


Abbildung 21: *Ascobolus minutus*: a-c, ascospores; d, ascospore in optical section. All $\times 1600$.

6-7.5 μm in 8-spored asci, sometimes up to 17.5 \times 9 μm in 2-spored asci. Episporium with extremely variable ornamentation: with few or many longitudinal, occasionally anastomosing lines, or with repeatedly anastomosing or reticulating lines, or with short curved or irregularly bending lines, or with irregular more or less transversal lines; pigment often in a thick layer up to 1.3 μm thick. Paraphyses simple or branched, septate, filiform, 2.0-2.5 μm thick, thickened, narrowed or curved above, 2.0-7.5 μm thick at the tip, embedded in greenish-yellow mucus.

On hogs' dung.

10.3.9 *Ascobolus minutus*

Apothecia scattered or gregarious, superficial, sessile on a small base, 0.3-1.2 mm diameter, 0.2-0.4 mm high. Receptacle at first closed and subglobular, then opening and obconical or hemispherical, finally expanding and lenticular or discoid, brownish-yellow to brown, smooth; margin rarely differentiated. Disk flat or slightly convex, brownish-yellow, dotted with the almost black protruding ends of ripe asci. Hymenium about 140 μm thick. Hypothecium not clearly differentiated. Flesh 150-200 μm thick, of isodiametric or oblong cells 5-20 \times 5-15 μm , hyaline. Excipulum 15-20 μm thick; of oblong or isodiametric, more or less angular thin-walled cells 7-24 \times 5-12 μm (*textura angularis*, the largest cells near the margin), with intercellular, pale brown pigment, especially between the superficial cells. Asci cylindrical-clavate, gradually tapering downwards into a thin stalk, rounded above, 140-170 \times 13-14 μm (according to Boudier, 1888: XLVIII), 8-spored; the wall only pale blue in Melzer's reagent. Ascospores uniseriate to biseriata, ellipsoid, at first hyaline, then violet, finally purplish-brown, 12.5-14.5 \times (6.5-)7-8.5 μm , ornamented with very regular longitudinal striae that only rarely anastomose. Paraphyses simple or branched, cylindrical, about 2 μm thick, slightly clavate above, up to 7 μm thick at the tip, hyaline, embedded in yellow mucus.

On dung of fox, hare, and rabbit.

10.3.10 *Ascobolus lineolatus*

Apothecia scattered, superficial, sessile, up to 1.0 mm across, 0.4-0.5 mm high. Receptacle at first subglobular and closed, then opening and hemispherical with an obconical base, finally slightly flattened, greenish, covered with small, isolated, white granules, with a narrow, sometimes slightly crenulate margin. Disk concave, then flat, greenish, roughened by the protruding tips of ripe asci. Hymenium about 130 μm thick. Hypothecium 15-23 μm thick, of subglobular cells 4-7 μm diameter. Flesh 140-200 μm thick, of subglobular, angular or

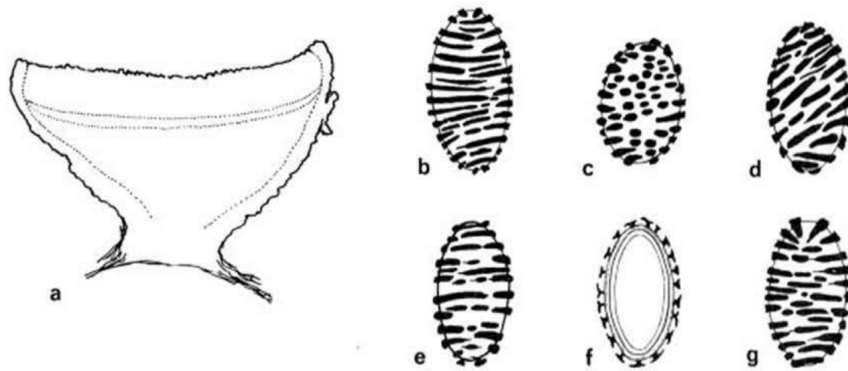


Abbildung 22: *Ascobolus lineolatus*: a, diagrammatic section of fruit-body $\times 50$; b- e, g, ascospores $\times 1600$; f, ascospore in optical section $\times 1600$ (different layers of primary spore wall, staining differently with trypan blue).

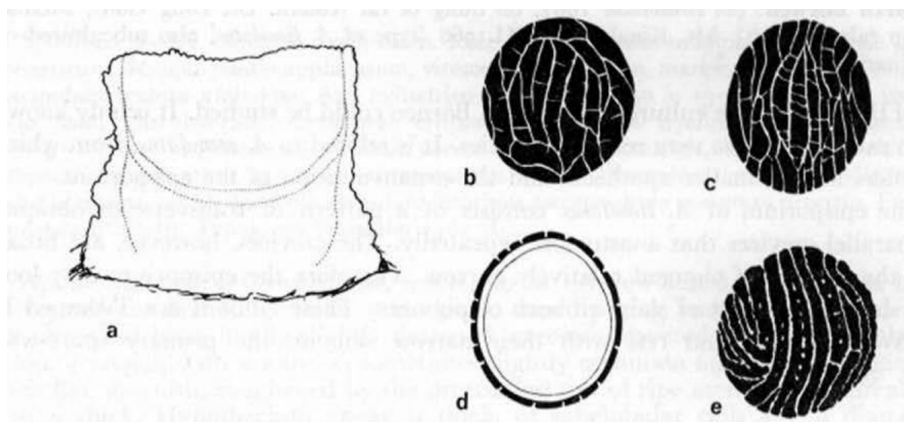


Abbildung 23: *Ascobolus crosslandii*: a, diagrammatic section of fruit-body $\times 110$; b, c, e, ascospores $\times 1600$; d, ascospore in optical section $\times 1600$.

oblong cells $7-42 \times 6-23 \mu\text{m}$, hyaline. Excipulum near the margin $28-35 \mu\text{m}$ thick, near the base up to $75 \mu\text{m}$ thick, of subglobular or elongated cells $8-35 \times 8-23 \mu\text{m}$ (*textura globulosa*), at the base mainly consisting of a layer of closely compacted, intertwined, cylindrical, septate hyphae $3.5-6 \mu\text{m}$ wide, pale yellowish-brown, covered with small isolated groups of globular cells. Asci cylindric-clavate, tapering downwards, rounded above, $130-150 \times 15-18 \mu\text{m}$, 8-spored; the wall not blue in Melzer's reagent. Ascospores biserial; ellipsoid; at first hyaline, then violet; $13-14.5 \times 7.5-8.5 \mu\text{m}$; ornamented with very delicate, closely spaced, transverse or oblique, subparallel lines that anastomose repeatedly; pigment very thin, about $0.3 \mu\text{m}$ thick. Paraphyses branched, septate, cylindrical, $2.0-2.5 \mu\text{m}$ thick, not or scarcely enlarged at the tip, embedded in greenish mucus.

Only known from dung of rat.

10.3.11 *Ascobolus crosslandii*

Apothecia scattered or in small groups, superficial, sessile, $0.5-2.0 \text{ mm}$ across, about 0.6 mm high. Receptacle at first subglobular, then hemispherical, finally expanding; yellowish-green, blackish-brown when dry, smooth or finely furfuraceous, with an irregular dentate margin. Disk concave, then flat, yellowish-green, dotted with the black protruding tips of ripe asci. Hymenium up to $200 \mu\text{m}$ thick. Hypothecium up to about $30 \mu\text{m}$ thick, of subglobular or oblong cells $4-10 \times 3-6 \mu\text{m}$. Flesh up to about $400 \mu\text{m}$ thick, of subglobular or elongated cells $8-20 \times 7-16 \mu\text{m}$ hyaline. Excipulum near the margin $19-25 \mu\text{m}$ thick, in the lower part $26-38 \mu\text{m}$ thick; of subglobular cells ($7-12-24 \mu\text{m}$ diameter (*textura globulosa*), hyaline or brownish; covered with small groups of globular cells. Asci clavate, gradually tapering downwards, rounded above, " $170-200 \times$ about $25 \mu\text{m}$ " (according to Soppitt & Crossland 1899, μm 30: $130-170 \times 16-20 \mu\text{m}$), 8-spored; the wall clearly blue in Melzer's reagent. Ascospores at first uniseriate, finally irregularly biserial, spherical, at first hyaline, then violet, finally becoming brownish, $11.5-13.4 \mu\text{m}$ diameter, ornamented with sinuous, subparallel, occasionally anastomosing lines, often together with rows of small pits. Paraphyses simple, septate, cylindrical, $2-4 \mu\text{m}$ thick, not thickened to strongly

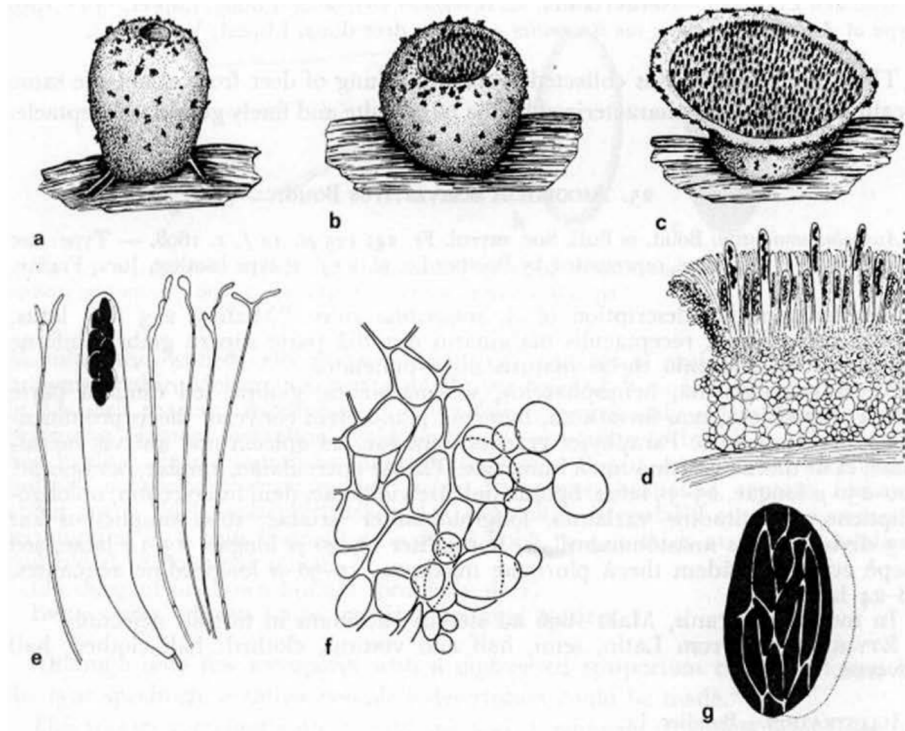


Abbildung 24: *Ascobolus sacchariferus*: a-c, habit of fruit-bodies $\times 20$; d, median section through part of fruit-body $\times 40$; e, ascus and paraphyses $\times 175$; f, detail of excipulum $\times 275$; g, ascospore $\times 1600$.

swollen at the apex, 2-11 μm thick at the tip, embedded in yellow mucus.
On dung of dog.

10.3.12 *Ascobolus sacchariferus*

Apothecia scattered, superficial, sessile, 0.7-1.7 mm across, 0.5-0.8 mm high. Receptacle at first closed and globular, then opening at the top and hemispherical, finally high saucer-shaped, white, finally darkened by the adhering ascospores, covered regularly with fine, white granules especially at the margin, with a narrow, clearly developed margin. Disk concave then Hat, white, dotted with the violet, protruding tips of ripe asci. Hymenium. 150-160 μm thick. Hypothecium of isodiametric cells up to 7 μm diameter. Flesh 300- 500 μm thick, of subglobular cells 16-25 μm diameter, together with cylindrical hyphae, hyaline. Excipulum about 35 μm thick near the margin, of isodiametric, thick-walled cells 16-32 μm diameter, near the margin often of more oblong cells 13-48 \times 7-16 μm (*textura angularis*), colourless, covered with small groups of globular cells. Asci cylindrical-clavate, with a slightly curved stalk, rounded above, 190-226 \times 16-24 μm , 8-spored; when young the wall blue in Melzer's reagent. Ascospores at first uniseriate, finally biseriata, ellipsoid, at first hyaline, then violet, 16-20 \times 9-10 μm , ornamented with longitudinal, anastomosing striae; with strongly swelling (up to 19 \times 15 μm), unilateral, gelatinous cap. Paraphyses simple or branched, septate, cylindrical, 1.5-2.5 μm thick, forked, swollen or irregular above, 2.5-7 μm thick at the tip, hyaline, embedded in somewhat granular, colourless mucus.

Known only from dung of deer.

10.3.13 *Ascobolus semivestitus*

Boudier's specific description of *A. semivestitus* runs: "Medius, 2-3 mm latus, sessilis, luteo-virens, receptaculis marginatus dimidiâ parte superâ glabrâ, inferne albido-villosâ, hymenio thecis maturis nigro-punctato. Receptacula sessilia, hemisphaerica, sub-marginata, glabra, sed dimidiâ parte inferâ albo-villosâ, non furfuracea, hymenio plano, dein convexo, thecis prominentibus nigro-punctato. Paraphyses graciles, septatae, ad apicem non aut vix incrassatae, et ut thecae gelatinâ lutea immersae. Thecae operculatae, amplae, octosporae, 200-250 μm longae, 25-35 latae. Sporae pulchre violaceae, dein fusciscentes, oblongo-ellipticae, magnitudine variantes, longitudinaliter striatae, striis simplicibus aut 2-3 divisis, rarius anastomosantibus, normaliter 25-30 μm longae, 13-14 latae, sed saepè etiam in eâdem thecâ plurimae maximae, 45-50 μm longitudine aequantes,

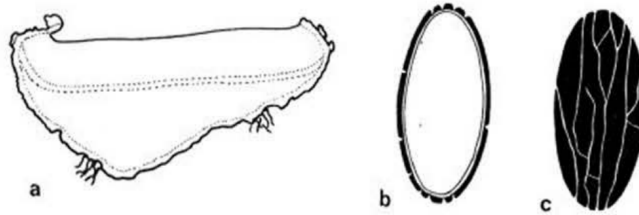


Abbildung 25: *Ascobolus cervinus*: a, diagrammatic section of fruit-body $\times 40$; b, ascospore in optical section $\times 1600$; c, ascospore $\times 1600$.

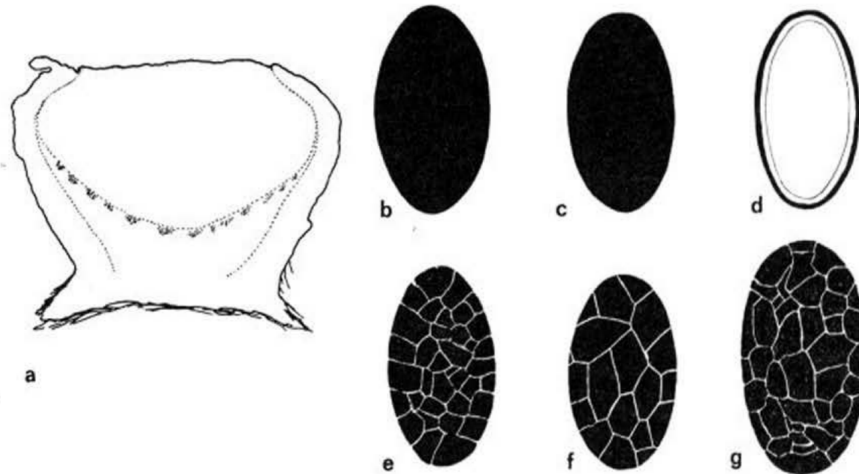


Abbildung 26: *Ascobolus carletonii*: a, diagrammatic section of fruit-body $\times 160$; b, c, e-g, ascospores $\times 1600$; d, id. in optical section.

18-24 latitudine.

In montibus juranis, Maio 1896 ad sterces vaccinum in turfosis dejectum."

10.3.14 *Ascobolus cervinus*

Apothecia gregarious or crowded, superficial, sessile on a broad base, up to 1.5 mm across, up to 0.5 mm high. Receptacle at first closed and globular, then opening at the top and hemispherical, finally expanding and scutellate, olive-green, finely furfuraceous, with a prominent margin. Disk concave to flat, olive-green. Hymenium about 130 μm thick. Hypothecium clearly differentiated, about 30 μm thick, of closely compacted subglobular cells 6-12 μm diameter. Flesh up to 300 μm thick, of isodiametric cells 12-22 μm diameter, hyaline. Excipulum 20-30 μm thick, of irregular or subglobular cells 12-15 μm diameter (the largest cells at the surface), near the base with 3.0-3.5 μm wide hyphae which connect the fruit-body with the substratum; covered with furfuraceous particles consisting of loose groups of subglobular, thin-walled cells 25-50 μm diameter; contents of excipular cells staining brownish-red in Melzer's reagent. Asci not yet ripened, 8-spored; the wall not blue in Melzer's reagent. Ascospores (not yet fully ripened, only a few spores with a beginning pigment-formation could be found) uniseriate to biseriata, ellipsoid, at first hyaline, then coloured by pigment, 14.5-16 \times 8-0 μm , ornamented with longitudinal, occasionally anastomosing striae. Paraphyses branched, septate, filiform, about 2.5 μm thick, scarcely thickened above, often irregularly curved, sometimes terminating in a thin filament or a small knob, 2-4 μm thick at the tip, hyaline, embedded in coloured mucus.

On dung of unknown animal (probably deer).

10.3.15 *Ascobolus carletonii*

Apothecia superficial, sessile, 0.4-1.0 mm across, 0.3-0.4 mm high. Receptacle at first subglobular and closed, then opening and turbinate, white, smooth in the upper part, coarsely or finely furfuraceous near the base, without a prominent margin. Disk slightly concave, then flat, white, dotted with the dark protruding tips of ripe asci. Hymenium 150-200 μm thick. Hypothecium not continuous, locally up to 40 μm thick, of closely

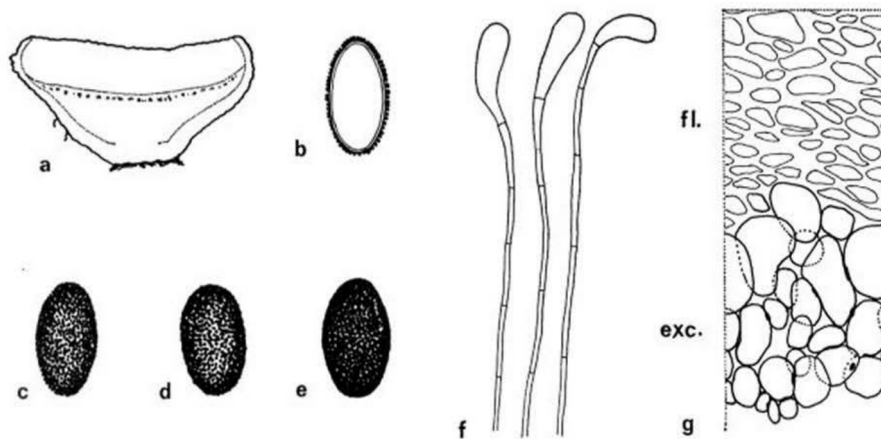


Abbildung 27: *Ascobolus cainii*: a, diagrammatic section of fruit-body $\times 110$; b, ascospore in optical section $\times 1600$; c-e, ascospores $\times 1600$; f, upper parts of paraphyses $\times 1100$; g, flesh (fl.) and excipulum (exc.) in a median section halfway between base and margin $\times 1100$.

compacted subglobular cells 4-8 μm diameter. Flesh 115-149 μm thick, of subglobular, angular or oblong cells 6-20 \times 6-13 μm , hyaline. Excipulum near the margin 20-33 μm thick, near the base up to 60 μm thick, of subglobular or slightly angular cells 7-26 μm diameter (*textura angularis* to *globulosa*); the smaller cells near the margin, the larger ones near the base; colourless; near the base with small groups of subglobular cells protruding. Asci clavate, gradually tapering downwards, rounded above, "160-220 \times 18-20 μm ", 8-spored; the wall deep blue in Melzer's reagent. Ascospores 1-2 seriate, ellipsoid, at first hyaline, then violet, 13-17 \times 7.5-8.5 μm , when hypertrophied 14.5-19 \times 8.5-10.5 μm , smooth, but finally often with an irregular net-work of fine lines; with unilateral, transparent, gelatinous cap. Paraphyses simple or branched, with only a few septae, filiform, about 1.5 μm thick, irregularly swollen and often forked above, up to 4 μm thick at the tip, hyaline.

On dung of capercaillie and grouse.

10.3.16 *Ascobolus cainii*

Apothecia scattered or gregarious, superficial, sessile on a small base, 0.4-0.8 mm across, 200-250 μm high. Receptacle hemispherical, finally flattened, finely furfuraceous, with an almost smooth margin. Disk concave, then flat, violaceous, roughened by the protruding tips of ripe asci. Hymenium up to about 75 μm thick. Hypothecium not clearly differentiated as a distinct layer, consisting of isolated groups of winding, septate hyphae 2-5 μm wide. Flesh about 70 μm thick, of subglobular or oblong, rather thick-walled cells 5-13 \times 4-8 μm , hyaline. Excipulum 19-26 μm thick, near the base up to 60 μm thick; of subglobular and oblong cells 7-20 \times 6-13 μm (*textura globulosa*), near the base often a part with closely compacted, winding, cylindrical, septate, thick-walled hyphae 2.0-2.5 μm thick, hyaline, covered with small groups of subglobular cells. Asci cylindrical-clavate, with a short stalk, rounded above, 65-80 \times 9-11 μm , 8-spored; the wall clearly blue in Melzer's reagent. Ascospores biseriate, ellipsoid, at first hyaline, then violet, 8.5-10 \times 5-5.5 μm , ornamented with a rather thick layer of closely spaced, very fine granules. Paraphyses simple, with only a few septae, clavate, 1.6-2.6 μm thick, gradually enlarged upwards into an oblong-clavate, 4-6 μm thick apex, hyaline.

On dung of deer.

10.3.17 *Ascobolus lignatilis*

Apothecia scattered or gregarious, superficial, usually with a very distinct stalk, (2-)5-12 mm diameter, up to 5 mm high. Receptacle at first closed and subglobular or cylindrical, then opening at the top and becoming scutellate or cyathiform, finally flattened, with a distinct furrowed or furfuraceous stipe, which often broadens at the base, dingy yellow to greenish-yellow, furfuraceous; the margin at first often slightly crenulate or fimbriate, prominent, rather thin, finally often slightly curved outward. Disk flat, finally sometimes slightly convex, dingy yellowish-green to yellowish, dotted with the almost black protruding tips of ripe asci. Hymenium 150-190 μm thick. Hypothecium about 30 μm thick, of closely compacted, isodiametric cells 7-11 μm diameter. Flesh of varying thickness, up to more than 4000 μm thick in the central part, of subglobular or rounded cells 7-12 μm diameter, hyaline. Excipulum 24-50(-65) μm thick, of subglobular cells 12-20 μm diameter, hyaline, covered with irregularly formed groups of globular cells. Asci clavate, gradually tapering downwards, rounded

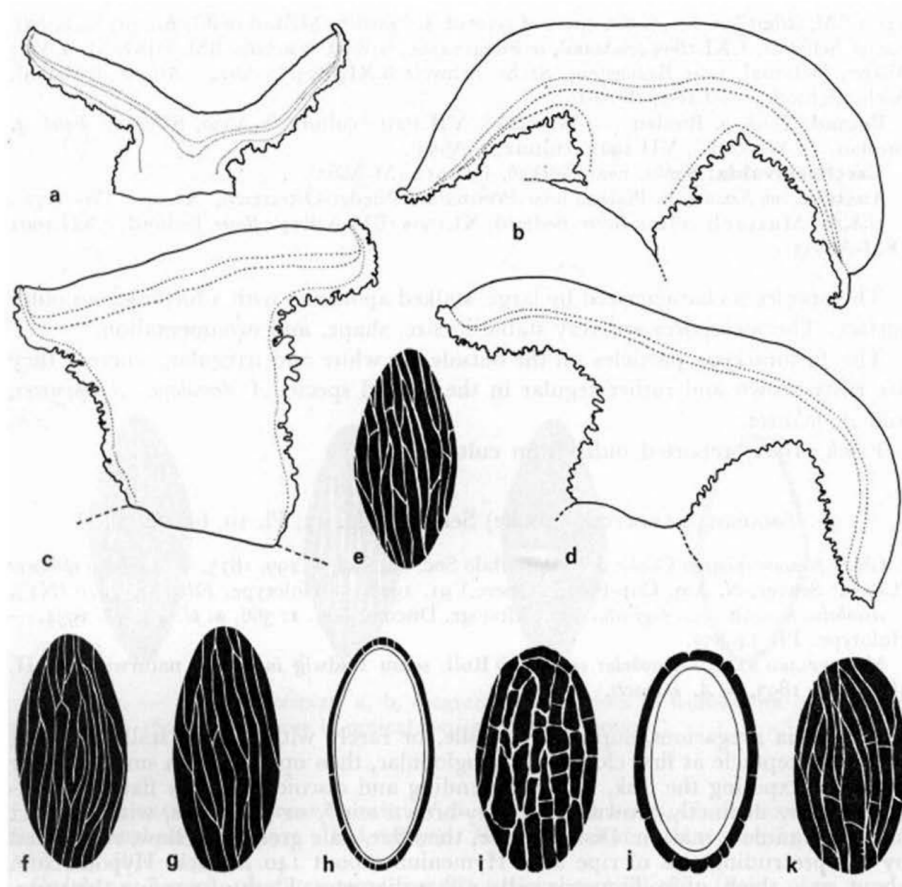


Abbildung 28: *Ascobolus lignatilis*: a, b, diagrammatic sections of fruit-bodies $\times 40$; c, d, idem $\times 25$; c-g, i-k, ascospores $\times 1600$; h,j, id. optical section.

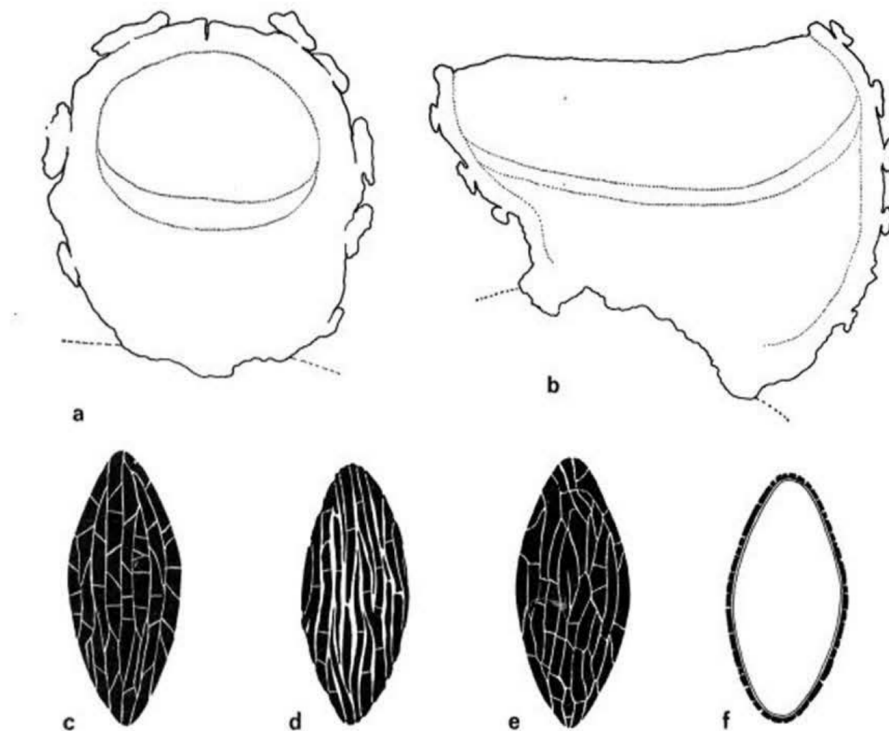


Abbildung 29: *Ascobolus epimyces*: a, b, diagrammatic sections of fruit-bodies $\times 160$; c-e ascospores $\times 1600$; f, ascospore in optical section.

above, $160\text{-}230 \times 16\text{-}20 \mu\text{m}$, 8-spored; the wall blue in Melzer's reagent. Ascospores biseriata; ellipsoid to fusiform-ellipsoid, with blunt ends, at first hyaline, then violet, finally sometimes purplish-brown, $16\text{-}19.5 \times 8.5\text{-}10 \mu\text{m}$, when swollen reaching $22 \times 13 \mu\text{m}$, ornamented with subparallel, usually longitudinal lines, that only occasionally anastomose, more or less reticulated when swollen. Paraphyses simple or branched, septate, cylindrical, $1.5\text{-}2.5 \mu\text{m}$ thick, clavate or irregularly swollen to $6 \mu\text{m}$ thick at the tip, embedded in greenish-yellow mucus.

On rotten wood, branches or leaves, on manure heap, on rotten straw and old paper, on humus in a hot-house, on owl-pellets, on dung of cow and man, and on all kinds of substrata which have been dirtied or mixed with dung or urine.

10.3.18 *Ascobolus epimyces*

Apothecia gregarious, superficial, sessile, or rarely with a short stalk, 1-4 mm across. Receptacle at first closed and subglobular, then opening by a small circular aperture, exposing the disk, finally expanding and discoid to nearly flat, greenish-yellow, very distinctly brownish or rusty-brown scurfy or granulose, with an erect narrow granulose margin. Disk concave, then flat, pale greenish-yellow, roughened by the protruding tips of ripe asci. Hymenium about $140 \mu\text{m}$ thick. Hypothecium about $20 \mu\text{m}$ thick, of isodiametric cells $4\text{-}8 \mu\text{m}$ diameter. Flesh of varying thickness, of subglobular or angular cells $8.5\text{-}15 \mu\text{m}$ diameter, hyaline. Excipulum $20\text{-}28 \mu\text{m}$ thick near the margin, up to $40 \mu\text{m}$ thick in the lower parts of the fruit-body, of subglobular cells $12\text{-}26 \mu\text{m}$ diameter, covered with scaly or granular particles consisting of globular cells with pale brownish walls. Asci cylindrical-clavate, tapering downwards, $140\text{-}150 \times 13\text{-}15 \mu\text{m}$, 8-spored; the wall not blue in Melzer's reagent. Ascospores biseriata, fusoid or ellipsoid with pointed ends, at first hyaline, then violet, finally purplish-brown, $(15.5\text{-})17.5\text{-}19.5\text{-}(20) \times (6.5\text{-})7\text{-}9\text{-}(10) \mu\text{m}$, ornamented with longitudinal anastomosing lines, when swollen also with many, fine, short; transverse lines. Paraphyses simple or branched, septate, cylindrical, $2.0\text{-}2.5 \mu\text{m}$ thick, hyaline, clavate or irregularly swollen up to $4.5 \mu\text{m}$ thick at the tip, rarely narrowed above, embedded in greenish-yellow mucus.

On rotten wood, on rotten leaves of trees and on old paper.

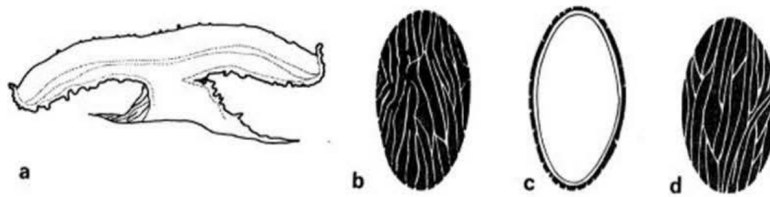


Abbildung 30: *Ascobolus costantinii*: a, diagrammatic section of fruit-body $\times 40$; b, d, ascospores $\times 1600$; c, ascospore in optical section $\times 1600$.

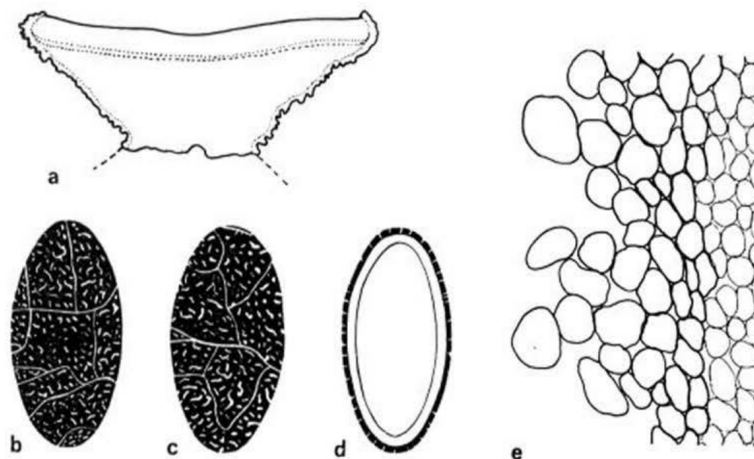


Abbildung 31: *Ascobolus singeri*: a, diagrammatic section of fruit-body $\times 25$; b, c, ascospores $\times 1600$; d, id. in optical section; e, detail of excipulum in median section $\times 460$.

10.3.19 *Ascobolus costantinii*

Apothecia gregarious or closely crowded, superficial, with a short stalk or sub-stipitate, 1.0-2.5 mm diameter, up to 0.7 mm high. Receptacle at first closed and subglobular, soon opening at the top and becoming scutellate, finally more flattened and discoid, often with a narrow base or with a stalk which is enlarged at the base, ochraceous or vivid lemon-yellow, granular, especially toward the margin; margin thin, crenulate. Disc concave, then flat, yellow or lemon-yellow, finally more brownish, dotted with the dark brown protruding tips of ripe asci. Hymenium 115-130 μm thick. Hypothecium 20-29 μm thick, of closely compacted isodiametric or oblong cells 4-16 \times 4-8 μm . Flesh of varying thickness, up to 500 μm in the central part of the fruit-body, of subglobular cells 7-20 μm diameter, hyaline. Excipulum 20-40 μm thick, of globular cells 10-21 μm diameter, hyaline, covered with groups of large globular cells, especially near the margin; at the base of the stalk with many colourless, 2-4 μm wide hyphae, which are connected with the substrate. Asci cylindrical-clavate, tapering downwards into a short stalk, rounded above, 130-160 \times 14-16 μm , 8-spored; the wall not, or scarcely, blue in Melzer's reagent. Ascospores at first obliquely uniseriate, finally biseriate, ellipsoid or fusiform-ellipsoid, at first hyaline, then violet, 13-15 \times 7.5-8.5 μm , ornamented with more or less longitudinal, subparallel lines that only occasionally anastomose. Paraphyses simple or branched, septate, cylindrical, about 2 μm thick, hyaline, clavate or irregularly swollen to 8 μm thick at the tip, sometimes forked near the tip, embedded in lemon-yellow mucus.

On rotten leaves and branches.

10.3.20 *Ascobolus singeri*

Apothecia gregarious or scattered, superficial, sessile on a narrow base, 1.0-2.5 mm diameter, 0.6-0.7 mm high. Receptacle at first closed and globular, then opening at the top and becoming cup-shaped, finally flattened and scutellate, sometimes substipitate, greenish-yellow, furfuraceous or warted, with a prominent margin. Disk concave to flat, greenish-yellow, dotted with the almost black protruding tips of ripe asci. Hymenium 115-130 μm thick. Hypothecium 22-29 μm thick, of closely compacted, subglobular cells 6-10 μm diameter. Flesh up to more than 500 μm thick, of subglobular cells 6-18 μm diameter, hyaline. Excipulum 30-60 μm thick, of sub-globular or angular, thick-walled cells 10-25 μm diameter, pale brownish-yellow, covered with more or less

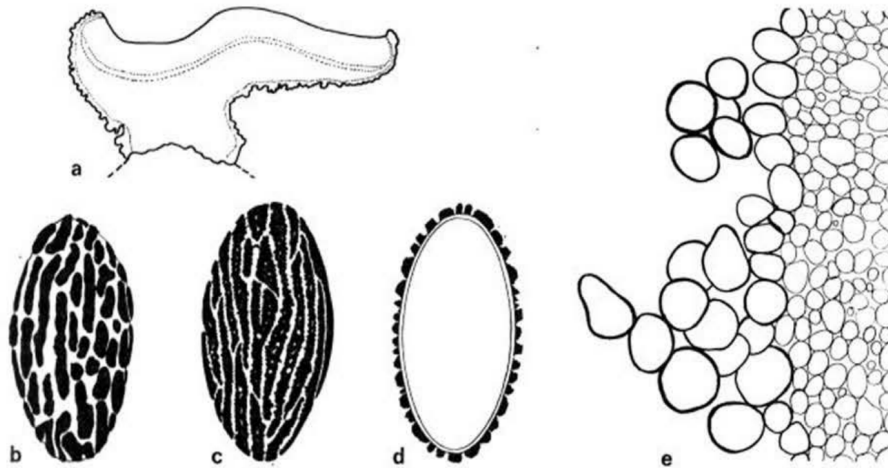


Abbildung 32: *Ascobolus foliicola*: a, diagrammatic section of fruit-body $\times 25$; b, c, ascospores $\times 1600$; d, ascospore in optical section $\times 1600$; e, detail of excipulum in a median section $\times 460$.

regularly disposed groups of globular cells. Asci clavate, about $130 \times 16 \mu\text{m}$, 8-spored; the wall not blue in Melzer's reagent. Ascospores biseriata, ellipsoid, at first hyaline, then violet, finally purplish-brown; $17.5\text{-}19.5 \times 8.5\text{-}9.5 \mu\text{m}$, almost smooth with some irregularly arranged very fine lines together with a pattern of fine, short fissures and small pits. Paraphyses branched, septate, cylindrical, about $2 \mu\text{m}$ thick, clavate or irregularly swollen to $5 \mu\text{m}$ thick at the tip, hyaline, embedded in abundant greenish-yellow mucus.

On rotten leaves and stalks of palm, *Urtica*, *Acer*, and *Alnus*.

10.3.21 *Ascobolus foliicola*

Apothecia solitary or gregarious, superficial, with a short stalk; 1-5 mm across, 0.5-1 mm high. Receptacle at first closed and subglobular, then opening at the top and becoming cup-shaped, finally expanded and scutellate with a short, subcentral stalk, greenish-yellow, with reddish-brown furfuraceous particles or warts regularly distributed over the surface; with a prominent margin, sometimes curved back against the substratum in old fruit-bodies. Disk concave when young, later becoming flat or slightly undulate, greenish-yellow, then brownish, dotted with the almost black protruding tips of ripe asci. Hymenium $140\text{-}180 \mu\text{m}$ thick. Hypothecium about $35 \mu\text{m}$ thick, of closely compacted, subglobular cells $5\text{-}10 \mu\text{m}$ diameter. Flesh of varying thickness, of subglobular cells $4.5\text{-}14 \mu\text{m}$ diameter, hyaline. Excipulum $30\text{-}45 \mu\text{m}$ thick, of globular, thick-walled cells $15\text{-}30 \mu\text{m}$ diameter, brownish, covered with more or less conical groups of globular or pear-shaped cells. Asci cylindrical-clavate, tapering downwards, rounded above, $170\text{-}200 \times 18\text{-}20 \mu\text{m}$, 8-spored; the wall not, or scarcely, blue in Melzer's reagent. Ascospores biseriata, ellipsoid with rounded or obtuse ends, with strong tendency to swell; at first hyaline, then violet, finally purplish-brown, $15.5\text{-}22 \times 8\text{-}11.5 \mu\text{m}$, ornamented with longitudinal anastomosing striae, when swollen often with reticulating striae. Paraphyses branched, septate, cylindrical, about $2 \mu\text{m}$ thick, clavate or irregularly swollen to $5 \mu\text{m}$ thick at the tip, hyaline, embedded in greenish-yellow mucus.

On rotten leaves, stalks, wood and bark of plants.

10.3.22 *Ascobolus denudatus*

Apothecia gregarious or more rarely crowded, superficial, sessile, often on a small base, 2-10 mm diameter, up to 1 mm high. Receptacle at first closed and subglobular, then opening at the top and cup-shaped, finally expanding and scutellate, sometimes undulate, greenish-yellow to yellowish-green, finally more brownish, covered with rusty-brown powder, finally sometimes more or less smooth, especially near the margin; with a prominent, often somewhat crenulate or dentate margin, almost disappearing with age. Disk at first concave, then flat, greenish-yellow to yellowish-green, dotted with the violet or brown protruding tips of ripe asci, finally often more brownish or violet by a covering layer of ripe ascospores. Hymenium $140\text{-}210 \mu\text{m}$ thick. Hypothecium $30\text{-}43 \mu\text{m}$ thick, of closely compacted isodiametric cells $6\text{-}9\text{-}(14) \mu\text{m}$ diameter. Flesh of varying thickness $180\text{-}600 \mu\text{m}$ thick in the centre, of subglobular or slightly angular cells $22\text{-}57 \times 20\text{-}43 \mu\text{m}$, hyaline, often in the upper part with a clearly distinct layer of small, subglobular or somewhat irregularly shaped cells $6\text{-}13 \mu\text{m}$ diameter, together with irregularly swollen hyphae $4\text{-}7 \mu\text{m}$ thick rich in plasm. Excipulum near the margin $20\text{-}63 \mu\text{m}$

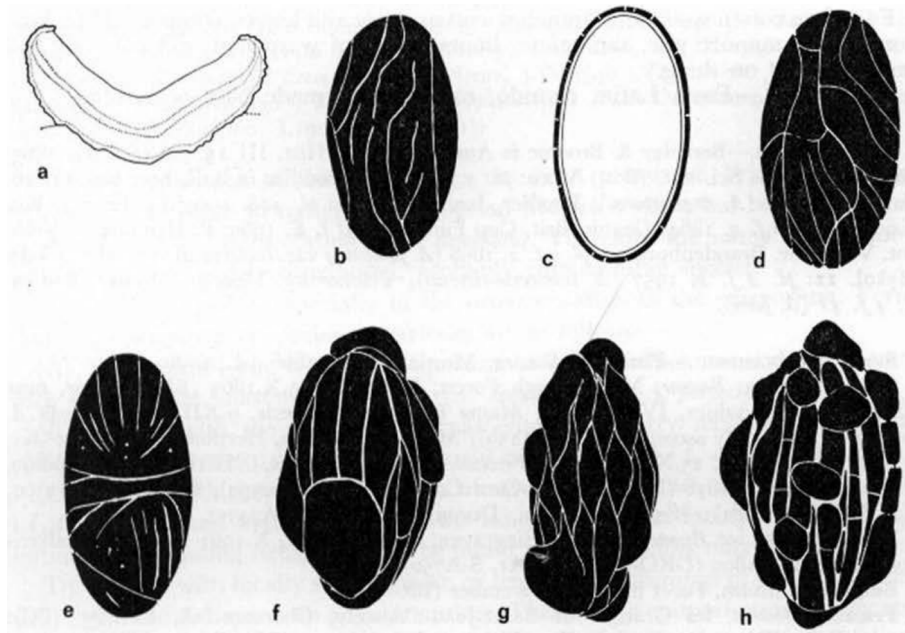


Abbildung 33: *Ascobolus denudatus*: a, diagrammatic section of fruit-body $\times 25$; b, d-h, ascospores $\times 1600$; c, ascospore in optical section $\times 1600$.

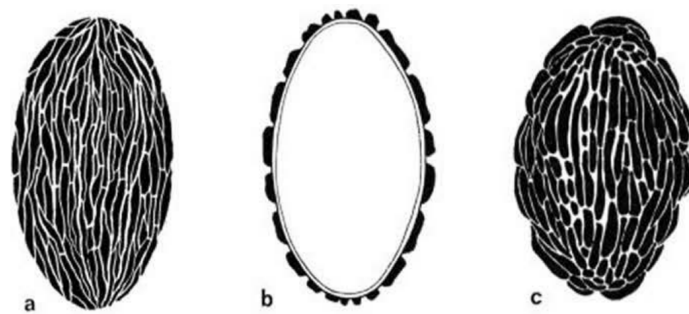


Abbildung 34: *Ascobolus demangei*: a, c, ascospores $\times 1600$; b, ascospore in optical section.

thick, in the lower parts sometimes up to 145 μm thick, of subglobular or slightly elongated, thick-walled cells (7-)10-50(-115) μm diameter (the smaller cells near the margin, the largest cells near the base), hyaline or brownish, covered with groups of subglobular, brownish, thick-walled cells; at the extreme base often with up to 200 μm thick conglomerations of hyaline, septate, cylindrical, 4-6 μm wide hyphae, partly penetrating into the substrate. Asci cylindrical-clavate, tapering downwards, rounded above, 170-230 \times 16-23 μm , 8-spored; only when young is the wall blue in Melzer's reagent. Ascospores biserial, ellipsoid, with blunt ends, at first hyaline, then violet, finally often purplish-brown, (16-)18-22(-23) \times (5.5-)9.5-11.5 μm , when swollen sometimes up to 30 \times 16 μm ; usually ornamented with longitudinal, subparallel, anastomosing lines, sometimes with the lines all or in part transversely or obliquely arranged; the pigment layer in most cases of uniform thickness, only rarely with thick warts or lumps of pigment; with unilateral mucilaginous cap. Paraphyses simple or branched, septate, cylindrical, 2.5-3.0 μm thick, hyaline, usually not or only slightly enlarged upwards, sometimes forked or more strongly swollen, 3-7(-g) μm thick at the tip, embedded in greenish-yellow mucus.

Found on rotten wood and branches, rotten straw and leaves, composted bracken, humid soil, manure pile, tan refuse, honey comb of wasp nest, old compost, old carpet, rarely on dung.

10.3.23 *Ascobolus demangei*

Apothecia gregarious or scattered, superficial, sessile on a broad base, 2-8 mm diameter, about 0.6 mm high. Receptacle at first closed and subglobular, then opening and cup-shaped, finally expanding and scutellate or discoid, yellowish or greenish-yellow, becoming dark brown with age, smooth near the margin, finely furfuraeous at the underside; margin often rather broad, rounded, soon smooth. Disk concave, then flat, greenish,

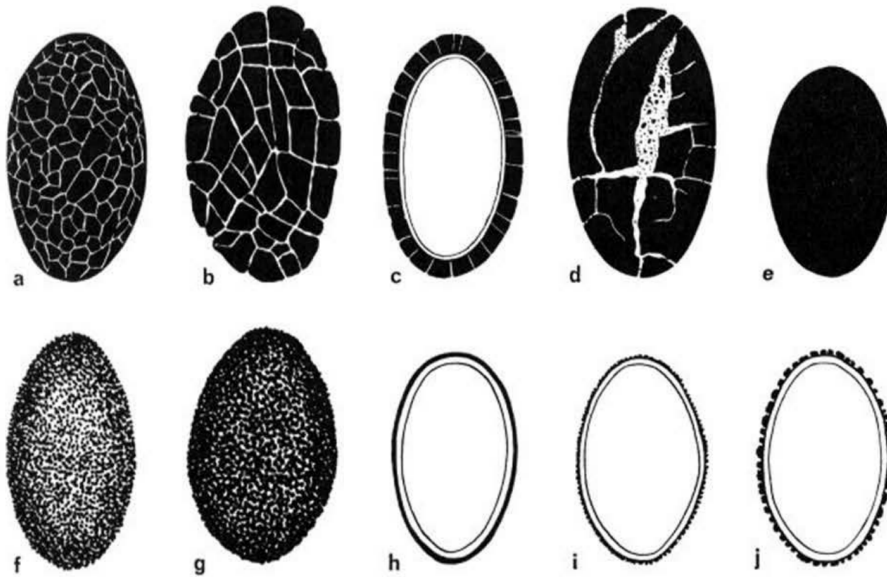


Abbildung 35: *Ascobolus geophilus*: a, b, d-g, ascospores; c, h-j, id. in optical section (c, h, very young spores with thin layer of pigment, not yet swollen; f, g, a, b, successive stages in pigmentation and swelling; b, d, rather extreme types). All $\times 1600$.

then more brownish, finally almost black, roughened by the protruding asci. Hymenium 170-220 μm thick. Hypothecium 39-50 μm thick, of closely compacted isodiametric or elongated cells 4-12 \times 4-8 μm . Flesh 200-260 μm thick, of subglobular, angular or oblong cells 8-34 \times 7-25 μm , the larger cells near the outside, hyaline. Excipulum 37-62 μm thick near the margin, near the base often not clearly distinguishable from the flesh, of subglobular or slightly elongated cells 13-33 \times 13-26 μm (*textura globulosa*), with amorphous, brown, intercellular pigment, at the underside covered with small, irregular groups of subglobular cells. Asci cylindrical-clavate, tapering downwards, rounded above, 200-250 \times 20-22 μm ; 8-spored; the wall not, or scarcely, blue in Melzer's reagent. Ascospores uniseriate, finally more or less biseriate, ellipsoid with rounded or blunt ends, at first hyaline, then dark violet, finally dark purplish-brown to blackish-brown, 21-25 \times (10.5-)12-13(-15.5) μm ; ornamented with closely spaced, longitudinal, anastomosing lines, fifteen to twenty-five of which are usually visible on each view of the spore; pigment up to 2.2 μm thick. Paraphyses branched, septate, cylindrical, 2.0-2.5 μm thick, slightly enlarged up to 5 μm thick at the tip, hyaline, embedded in yellowish-green mucus, which becomes brownish with age.

On humid soil, often overgrown with algae or mixed with vegetable debris.

10.3.24 *Ascobolus geophilus*

Apothecia scattered, gregarious or crowded, superficial, sessile on a broad base, 1-5 mm diameter, rarely reaching 10 mm, 0.5-0.8 mm high. Receptacle at first subglobular, then expanding and scutellate or discoid, greenish-yellow, more brownish with age, finely furfuraceous, especially near the base; the margin often smooth and eroded. Disk slightly concave, then flat, greenish-yellow, finally dark brown to almost black, roughened by the protruding tips of ripe asci. Hymenium about 160 μm thick. Hypothecium 28-42 μm thick, of closely compacted, isodiametric cells 5-12 μm diameter. Flesh 250-400 μm thick, of subglobular or oblong cells 9-26 \times 7-20 μm , with a zone rich in amorphous, brown, intercellular pigment near the excipulum. Excipulum of varying thickness, up to more than 75 μm thick in the margin, in the lower parts often not sharply differentiated from the flesh, of subglobular or slightly angular cells 9-30 μm diameter, with amorphous, brown, intercellular pigment in the deeper layers near the margin. Asci cylindrical-clavate, tapering downwards, rounded above, 160-200 \times 17-20 μm (according to Seaver 1916, l.c.: "200-250 \times 15-18 μm "), 8-spored; the wall not, or scarcely, blue in Melzer's reagent. Ascospores uniseriate, finally often more or less biseriate, ellipsoid, at first hyaline, then violet, finally dark purplish-brown, (17-)19-22.5(-24) \times (9-)9.5-13 μm , often in part swollen; at first smooth or extremely finely granular, then with a pattern of very short, fine fissures in all directions, finally often reticulated or warted, pigment in a rather thick layer, 1.0-1.5(-1.7) μm thick. Paraphyses simple or branched, septate, filiform, 1.5-2.0 μm thick, hyaline, scarcely thickened above, embedded in yellowish mucus which becomes brownish with age.

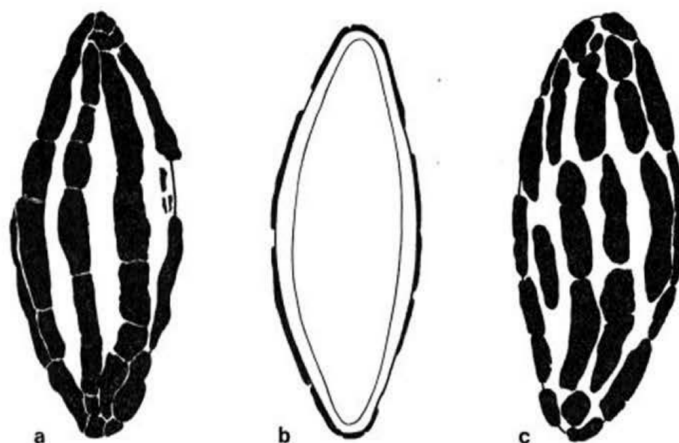


Abbildung 36: *Ascobolus viridis*: a, c, ascospores; b, ascospore in optical section. All $\times 1600$.

On humid soil, especially when covered with algae, also on bark of a tree covered with mud.

10.3.25 *Ascobolus viridis*

Apothecia scattered or gregarious, superficial, sessile, rarely with a stalk, 3-6(-8) mm diameter, 1-2 mm high. Receptacle cup-shaped, then scutellate, yellowish-green, finally more olive-brown, coarsely brownish furfuraceous; margin not very prominent, furfuraceous. Disk slightly concave or flat, of about the same colour as the receptacle, dotted with the almost black protruding tips of ripe asci. Hymenium 230-300 μm thick. Hypothecium about 25 μm thick, of oblong cells 7-12 \times 3-4.5 μm . Flesh of varying thickness, of subglobular or elongated cells 16-50 \times 9-30 μm ; the smaller cells in the upper part, the larger cells near the outside; hyaline, near the base pale brownish. Excipulum 35-65 μm thick; of subglobular, thick-walled cells 16-40 μm diameter, together with thick, irregularly swollen hyphae, brownish, covered with groups of subglobular, thick-walled cells. Asci cylindrical-clavate, tapering downwards, rounded above, 240-350 \times 23-30 μm 8-spored; only when young the wall blue in Melzer's reagent. Ascospores finally biseriata, fusiform or ellipsoid with strongly pointed ends, at first hyaline, then violet, (23.5-)28.5-37.5 \times (10-)11-14 μm (exceptionally up to 52 \times 24 μm), ornamented with long or short longitudinal ridges of pigment; pigment up to 2 μm thick. Paraphyses simple or branched, septate, cylindrical, 2.5-3.1 μm thick, hyaline, swollen to 7 μm thick at the tip, embedded in yellowish-green or pale greenish mucus.

Only known from humid soil, especially in woods.

10.3.26 *Ascobolus albinus*

"Apothecia gregarious, at first subglobose, expanding and becoming scutellate, reaching a diameter of 4-5 mm, externally pure white, minutely rough; hymenium plane or nearly plane, at first whitish, becoming darkened by the maturing spores; asci cylindrical or subcylindrical, 8-spored, reaching a length of about 200 μm and a diameter of about 25 μm ; spores at first obliquely 1-seriate, becoming 2-seriate or irregularly crowded, ellipsoid, becoming purple then brown, 20- 26 \times 12 μm , rough; spore roughening consisting of minute warts; paraphyses very slender, hyaline."

"On damp soil in woods."

This species can easily be distinguished from the related *A. behnitziensis* by the pure white colour of the fruit-body and the finely warted episporium.

10.3.27 *Ascobolus behnitziensis*

Apothecia gregarious or scattered, superficial, sessile on a broad base, up to 10 mm across, 0.3-0.6 mm high. Receptacle at first closed and subglobular, then opening and cup-shaped with sharp sinuate margin, finally expanding and scutellate or flat, olive-brown or purplish, coarsely furfuraceous. Disk concave, then flat, olive or purplish, darkening with age, roughened by the protruding asci. Hymenium 130-170 μm thick. Hypothecium about 22 μm thick, of closely compacted, isodiametric or oblong cells 6-12 \times 4.5-7 μm . Flesh of varying thickness, of isodiametric or slightly elongated cells, 6-20 μm diameter, with a purplish or brownish coloured zone near the excipular layer. Excipulum about 30 μm thick, near the margin sometimes reaching 170 μm ,

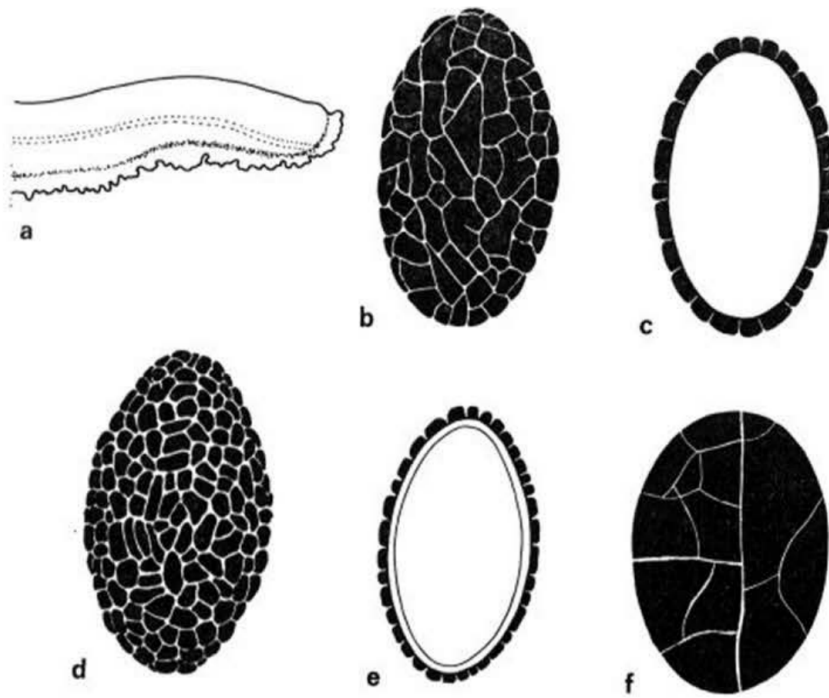


Abbildung 37: *Ascobolus behnitziensis*: a, diagrammatic section of fruit-body $\times 25$; b, d, f, ascospores $\times 1600$ (f, abnormal type from 2-spored ascus); c, e, id. in optical section.

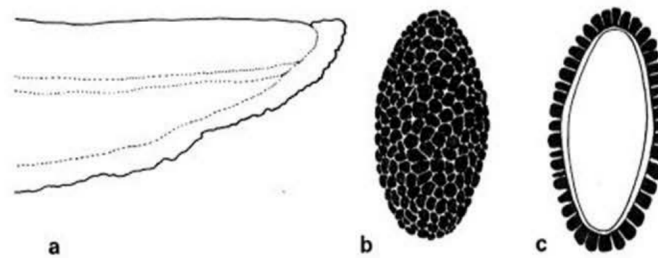


Abbildung 38: *Ascobolus archeri*: a, diagrammatic section of fruit-body $\times 40$; b, ascospore $\times 1600$; c, id. in optical section.

of subglobular or oblong cells $11-28 \times 8-28 \mu\text{m}$; with brownish or purplish, intercellular, amorphous pigment, covered with irregular groups of large globular cells. Asci cylindric-clavate, tapering downwards, rounded above, $160-200 \times 17-23 \mu\text{m}$, 8-spored; only when young the wall blue in Melzer's reagent. Ascospores uniseriate, finally more or less biseriata, ellipsoid; at first hyaline, then pale violet or pale brownish, finally dark violet or dark purplish-brown, $19-22.5(-23.5) \times 11-13.5(-14.5) \mu\text{m}$, ornamented with a fine net-work of striae; pigment in a rather thick layer. Paraphyses simple or branched, septate, cylindrical, $2-3 \mu\text{m}$ thick, hyaline, slightly enlarged up to $4 \mu\text{m}$ thick at the tip, embedded in coloured mucilaginous substance.

Only known from humid soil.

10.3.28 *Ascobolus archeri*

Apothecia gregarious, superficial, sessile, up to 4 mm across. Receptacle scutellate, finally slightly undulate, "vinoso-fusca" at maturity, almost smooth, with a rounded, somewhat eroded margin. Disk concave, then flat, brownish at maturity, roughened by the protruding asci. Hymenium up to $230 \mu\text{m}$. Hypothecium clearly differentiated, $30-40 \mu\text{m}$ thick, of isodiametric, rounded cells $6-12 \mu\text{m}$ diameter. Flesh of subglobular or slightly elongated cells $7-18 \mu\text{m}$ diameter, hyaline. Excipulum up to $80 \mu\text{m}$ thick near the margin, of subglobular, rather thick-walled cells $10-26 \mu\text{m}$ diameter, brownish, irregularly eroded at the outside. Asci cylindric-clavate, tapering downwards, roughened above, up to $250 \times 23 \mu\text{m}$, 8-spored; only when very young the wall pale blue in Melzer's reagent. Ascospores uniseriate, finally more or less biseriata ellipsoid, at first hyaline, then violet,

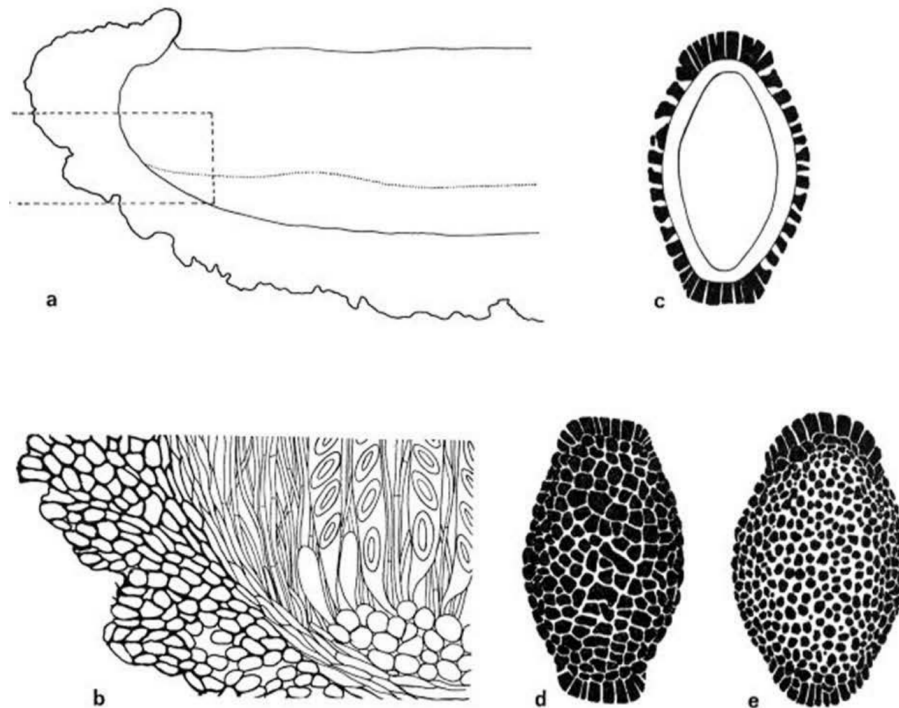


Abbildung 39: *Ascobolus carbonarius*: a, diagrammatic section of fruit-body $\times 110$; b, detail of a median section through fruit-body $\times 275$; c, ascospore in optical section $\times 1600$; d, e, ascospores in optical section $\times 1600$.

finally purplish-brown, $17.5-22 \times 9-11.5 \mu\text{m}$ (pigment included), often swollen, ornamented with a very regular pattern of round warts $1.0-1.3 \mu\text{m}$ diameter; pigment in a $1.5-2.5 \mu\text{m}$ thick layer; without oildrops or granules. Paraphyses branched, septate, cylindrical, about $2 \mu\text{m}$ thick, not or only very slightly enlarged up to $3 \mu\text{m}$ at the tip, embedded with the tips in coloured mucus.

On charcoal.

10.3.29 *Ascobolus carbonarius*

Apothecia gregarious or crowded, superficial, sessile, 2-5 mm diameter, up to 1 mm high. Receptacle at first subglobular, then scutellate, finally flattened, greenish-yellow, becoming more brownish with age, finally blackish-brown, finely mealy or scaly; margin crenulate, finally almost smooth and blunt. Disk concave, then flat, yellowish-green, more brownish with age, dotted with the black protruding tips of ripe asci, finally almost black. Hymenium $180-250 \mu\text{m}$ thick. Hypothecium $30-43 \mu\text{m}$ thick, of closely compacted isodiametric cells $5-10 \mu\text{m}$ diameter. Flesh of varying thickness, up to $600 \mu\text{m}$ thick, of subglobular or elongated cells $13-30(-40) \times 10-22(-26) \mu\text{m}$, hyaline. Excipulum about $60 \mu\text{m}$ thick, in the margin sometimes up to $170 \mu\text{m}$ thick, of subglobular, angular and oblong, thick-walled cells $8-22(-35) \times 6-17(-23) \mu\text{m}$, together with irregularly bending, branched hyphae $2.5-4.0 \mu\text{m}$ wide, brown, covered with more or less protruding groups of subglobular cells and hyphae. Asci cylindric-clavate, tapering downwards, rounded above, $190-270 \times 22-26 \mu\text{m}$, 8-spored; only when young the wall pale blue in Melzer's reagent. Ascospores uniseriate, finally more or less biseriate; when immature (without pigment) ellipsoid with pointed ends, when mature (with pigment) ellipsoid with truncate ends; at first hyaline, then dark violet, finally dark purplish-brown, $17.5-25(-27.5) \times (11.5-)13-14.5 \mu\text{m}$, (pigment included), rarely swollen; ornamented with irregular or rounded, isolated warts varying considerably in size; pigment in a very thick layer, at the sides $1.5-2.7 \mu\text{m}$ thick, at the ends $2.4-3.1 \mu\text{m}$ thick. Paraphyses occasionally branched, septate, cylindrical, about $2 \mu\text{m}$ thick, not or scarcely thickened above, up to $3.5 \mu\text{m}$ thick at the tip, embedded in yellowish-green mucus.

On charcoal, burnt vegetable debris, and burnt soil, rarely on humid soil without remnants of a fire.

10.3.30 *Ascobolus subglobosus*

Apothecia scattered, gregarious or crowded, superficial, sessile, 2-5 mm diameter, about 0.5 mm high. Receptacle at first closed and subglobular, then opening at the top and cup-shaped, finally expanding and discoid,

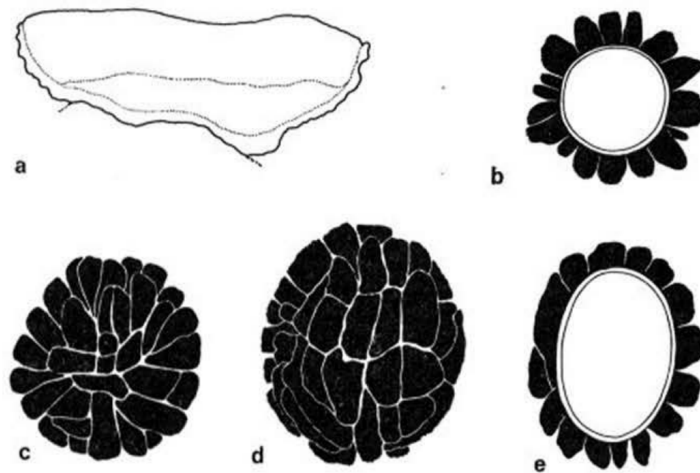


Abbildung 40: *Ascobolus subglobosus*: a, diagrammatic section of fruit-body $\times 40$; c, d, ascospores $\times 1600$; b, c, id. in optical section (b, c, in polar view; d, e, in lateral view).

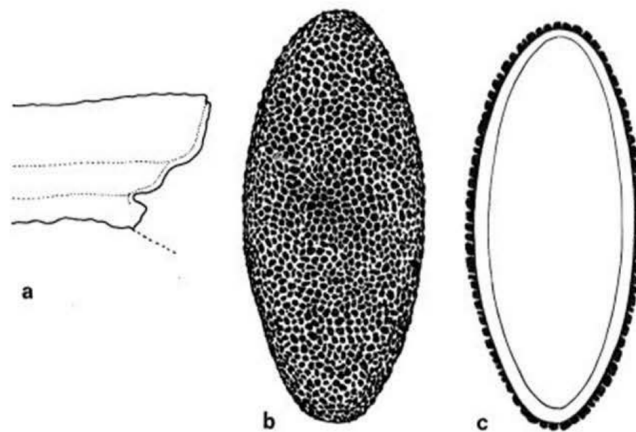


Abbildung 41: *Ascobolus xylophilus*: a, diagrammatic section of fruit-body $\times 40$; b, ascospore $\times 1600$; c, id. in optical section.

“greenish-yellow”, more brownish with age, finely furfuraceous; margin not very prominent, almost smooth. Disk concave, then flat, finally convex or irregularly convolute, greenish-yellow, dotted with the almost black protruding tips of ripe asci, finally dark brownish-black. Hymenium 200-230 μm thick. Hypothecium not always clearly differentiated, often not continuous, sometimes forming a distinct, 20-27 μm thick layer of isodiametric or slightly elongated cells 5-10 \times 5-8 μm . Flesh up to 250 μm thick, of subglobular, angular or oblong 7-16 \times 5-16 μm hyaline. Excipulum near the margin 26-40 μm thick, of subglobular cells 9-13 μm diameter (*textura globulosa*), in the lower part up to 85 μm thick, of subglobular or elongated cells up to 39 \times 26 μm , covered with groups of subglobular cells, with intercellular, amorphous, brown pigment. Asci cylindrical to cylindrical-clavate, gradually tapering downwards, rounded above, 215-240 \times 20-28 μm , 8-spored; only when young the wall pale blue in Melzer’s reagent. Ascospores at first uniseriate, finally more or less biseriate, subglobular to shortly ellipsoid (length-breadth ratio = 1.5-1.43, rarely up to 1.66), at first hyaline, then violet, finally very dark brown, 16-19(-22) \times (12-)13-16(-17) μm (including the pigment), ornamented with more or less longitudinal repeatedly anastomosing or reticulating striae, the pigment areas between them developing into very prominent projections; pigment in a very thick layer, 2.5-3.0 μm thick. Paraphyses simple or branched, septate, cylindrical, 2.5-3.0 μm thick, scarcely or irregularly swollen up to 5 μm thick at the tip, embedded in golden-yellow, mucilaginous substance.

Only known from damp soil.

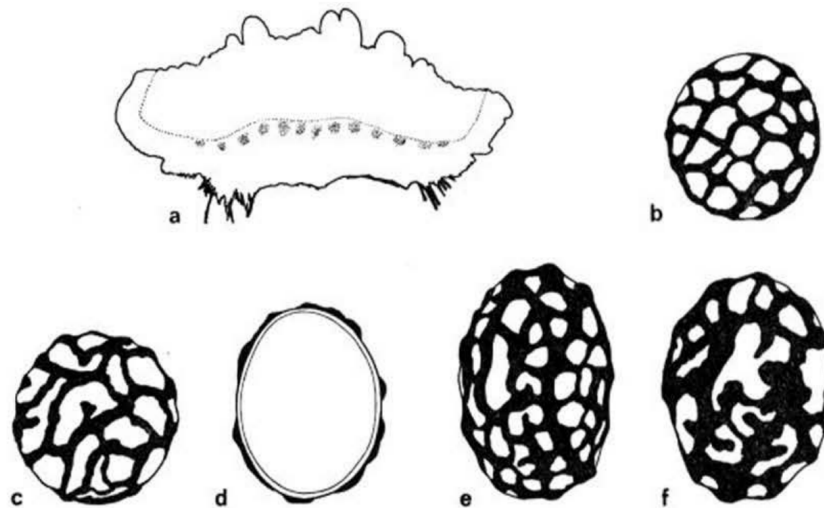


Abbildung 42: *Ascobolus reticulatus*: a, diagrammatic section of fruit-body; b, c, e, f, ascospores $\times 1600$; d, id. in optical section.

10.3.31 *Ascobolus xylophilus*

Apothecia gregarious, superficial, sessile, 1- 2 mm across, about 0.6 mm high. Receptacle at first subglobular, then expanding and becoming scutellate to discoid, reddish-brown or brownish, darker with age, smooth, without a prominent margin. Disk slightly concave or nearly flat, greenish, becoming darker with age, finally almost black, roughened by the protruding tips of ripe asci. Hymenium up to 230 μm thick. Hypothecium not very compact, sometimes up to 75 μm thick, of subglobular cells 5-10 μm diameter, the contents of which stain intensively with methyl blue. Flesh rather thin, of subglobular cells 5-10 μm diameter, together with intertwining, septate hyphae 2- 4 μm thick, hyaline. Excipulum rather thin, 13- 25 μm thick near the margin, of subparallel intertwining hyphae 2-5 μm wide, together with subglobular or oblong cells 6-20 \times 5-14 μm , pale brownish. Asci large, clavate, tapering downwards into a stem-like base, rounded above, 175-235 \times 30-35 μm , 8-spored; the wall deep blue in Melzer's reagent. Ascospores finally biseriate; oblong-ellipsoid, rarely with somewhat narrowed ends, at first hyaline, then beautifully purple, finally brown, 32-37 \times 13-16 μm ; ornamented with minute warts or finely punctate. Paraphyses simple, septate, filiform, about 2.0 μm thick, not or scarcely enlarged above, hyaline.

Only known from rotten coniferous wood.

10.4 *Ascobolus* sect. *Pseudascodesmis*

10.4.1 *Ascobolus reticulatus*

Apothecia solitary, superficial, sessile, up to 0.5 mm across, about 0.2 mm high. Receptacle at first globular, then lenticular or discoid, yellowish or yellowish-brown, smooth or covered with rather rigid hyphae especially near the broad base. Disk flat or slightly convex, colourless or pale yellowish-brown, roughened by the protruding asci. Hymenium 70-80 μm thick. Hypothecium not clearly differentiated. Flesh about 115 μm thick, of isodiametric, angular cells 6-17 μm diameter, hyaline. Excipulum 16-26 μm thick, of subparallel hyphae with cylindrical or oblong cells 8-27 \times 4-7 μm (*textura prismatica* or *porrecta*), especially near the base with rather thick-walled hyphae 4-7 μm wide, colourless or somewhat brownish; cell-walls up to 1.0 μm thick. Asci shortly saccate-clavate, with rounded apex, 75-90 \times 25 μm , 8-spored; the wall not blued with iodine. Ascospores at first biseriate, finally multi-seriate; at first spherical, at maturity usually short-ellipsoid; at first hyaline, then brown; 13-19.5 \times 13-15.5 μm ; ornamented with an irregular net-work of pigment. Paraphyses, simple or branched, septate, filiform, about 3 μm thick, slightly enlarged up to 5 μm at the tip, hyaline, sometimes with hook-shaped tip.

Known only from dung of giraffe.

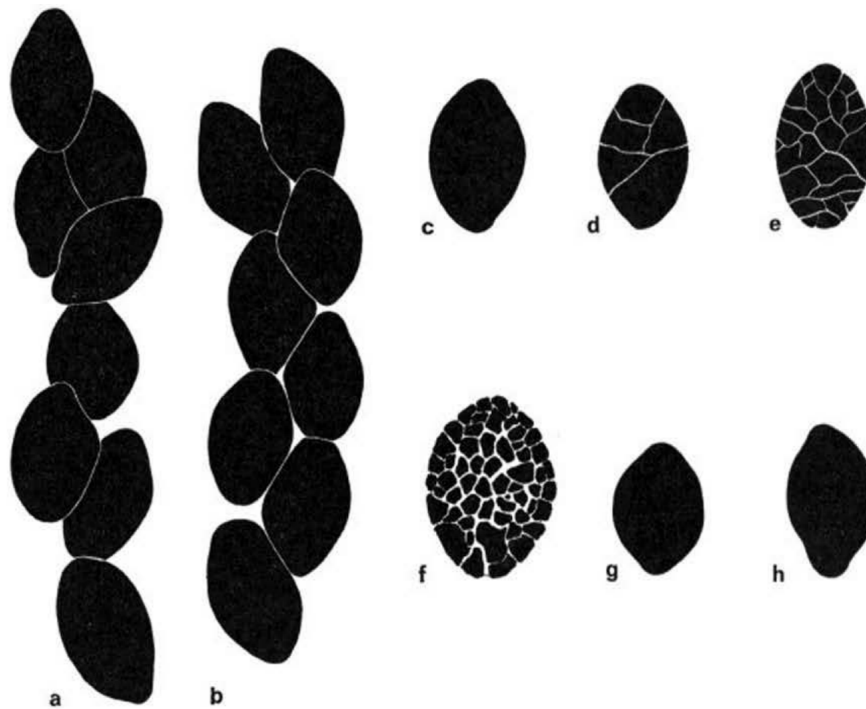


Abbildung 43: *Ascobolus pusillus*: a, b, ascospores of two asci; c- h, ascospores. All $\times 1600$.

10.5 *Ascobolus* sect. *Pseudosaccobolus*

10.5.1 *Ascobolus pusillus*

Apothecia scattered or in small groups, superficial, sessile on a broad base, 0.4-1.2 mm diameter, about 0.3 mm high. Receptacle hemispherical, then discoid or lenticular, "pale purplish-yellow, darker near the margin", smooth, without a distinct margin. Disk flat, then convex, "purplish-yellow", roughened by the protruding tips of ripe asci. Hymenium 100-170 μm thick. Hypothecium not clearly differentiated as a continuous layer, of isolated groups of isodiametric or elongated cells 4-9 \times 4-7 μm . Flesh 100-200 μm thick, of subglobular cells 4-10 μm diameter, together with cylindrical hyphae 2.5-5.0 μm thick, hyaline. Excipulum 20-29 μm thick, of subglobular or oblong, rather thick-walled cells 6-16 \times 4-12 μm (*textura globulosa* or *prismatica*), with some pale yellowish-brown pigment. Asci broadly clavate, rounded above, 120-150 \times 5 μm (according to Boudier, 1911 μm 234: "170-200 \times 25-27 μm "), 8-spored; the wall deep blue in Melzer's reagent. Ascospores biserial, fusiform-ellipsoid, often with blunt ends, finally swollen, at first hyaline, then violet, finally often brownish, 10-12.5 \times 6.5-7.5 μm , when swollen up to 16 \times 9 μm ; ornamented with granules or warts, more rarely with reticulating striae; pigment in a rather thick layer. Paraphyses simple or branched, septate, clavate, 2.2-2.9 μm thick, gradually enlarged up to 7 μm at the tip, with pale yellowish contents.

On burnt soil.

10.6 *Ascobolus* sect. *Heimerlia*

10.6.1 *Ascobolus aglaosporus*

Apothecia scattered, superficial, sessile on a broad base, 0.3-0.9 mm across, 180-250 μm high. Receptacle pulvinate or lenticular, almost white, smooth, without a prominent margin. Disk flat, then convex; almost white, then pale lilac, dotted with the violet protruding tips of ripe asci. Hymenium 100-150 μm thick. Hypothecium not forming a continuous layer, not very compact, locally up to 27 μm thick, of subglobular or elongated cells 4-10 \times 4-7 μm . Flesh up to about 90 μm thick, of subglobular cells 5-20 μm diameter, near the base often with a layer up to 50 μm thick of closely compacted small cells 4-13 \times 2-6 μm hyaline. Excipulum scarcely developed. Asci oblong-clavate, with a very short stalk, rounded above, 100-160 \times 20-22 μm (according to Heimerl: 146-166 \times 26-27 μm), 8-spored; the wall clearly blue in Melzer's reagent. Ascospores biserial, ellipsoid, at first hyaline, then pale violet, finally pale brown, (13-)14.5-17 \times (7.5-)8-10 μm (according to Heimerl: 15-18.5 \times 8.5-10 μm), ornamented with small isolated warts or spines, with a mucilaginous envelope round each spore.

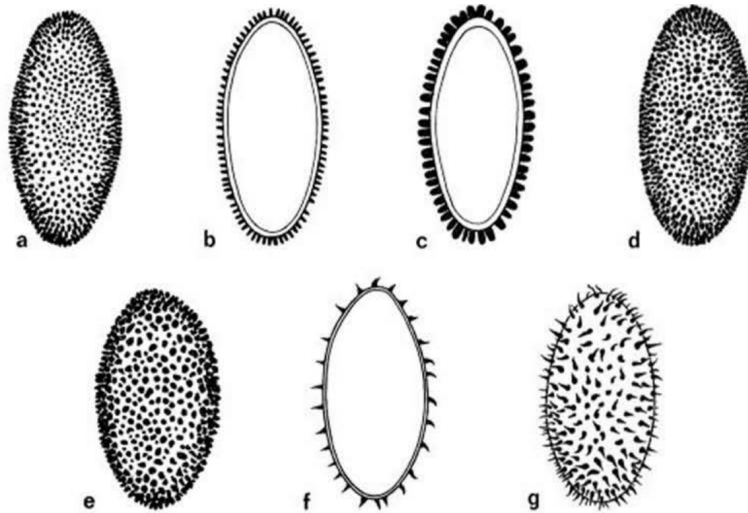


Abbildung 44: *Ascobolus aglaosporus*: a, d, c, g, ascospores; b, c, f, id. in optical section. All $\times 1600$.

Paraphyses branched, septate, cylindrical, 1.5- 2.0 μm thick, irregularly swollen or clavate above, up to 6 μm thick at the tip, without mucus.

On dung of cow, goat, deer, and American bison.

10.7 *Ascobolus* sect. *Gymnascobolus*

10.7.1 *Ascobolus scatigenus*

Apothecia solitary or gregarious, superficial, sessile, 0.5-3.0 mm diameter, 1-5 mm high. Receptacle at first subglobular but not closed, then more or less cup-shaped, finally scutellate or flat, white or whitish, becoming brown or greenish-brown, often wrinkled or irregularly curved, finely pruinose or granular; margin white or brownish, smooth or granular, rather thick, involute, sometimes undulate. Disk concave, then flat or undulate, greenish-yellow, brownish or reddish-brown, always darker than the excipulum, roughened by the protruding tips of ripe asci. Hymenium 170-200 μm thick. Hypothecium clearly differentiated, about 25 μm thick, of closely compacted, subglobular cells 6-12 μm diameter. Flesh 350-1000 μm thick or even more, of globular or oblong cells 10-25(-65) \times 7-17 μm , accompanied by irregular undulating hyphae 5-9 μm wide, hyaline or brownish. Excipulum 50-60 μm thick, of intertwined hyphae 2-4 μm diameter, hyaline. Asci cylindrical-clavate, with a short, narrow stalk, 140-280 \times 16-25 μm , 8-spored; the wall blue in Melzer's reagent. Ascospores uniseriate, finally irregularly biseriate, ellipsoid, very rarely slightly asymmetrical; at first hyaline, then pale pinkish-violet, finally violet or purplish-brown; (20-)21.5-25.5(-27.5) \times (μm)11.5-13(-14) μm smooth with a single longitudinal or oblique fine fissure, sometimes with two fissures or finely reticulated; with pigment in a layer of very uniform thickness, 0.5- 1.0 μm thick. Paraphyses simple or branched, septate, cylindrical, 2.5-3.5 μm thick, slightly clavate at the 4.5-7 μm thick tip, hyaline or yellowish.

On dung of cow, buffalo, carabao, and horse, also on manured soil, on manure pile, and on rotten wood.

10.7.2 *Ascobolus castaneus*

Apothecia scattered, gregarious or more rarely crowded, superficial, sessile, 0.8-5 mm across, 0.4-0.6 mm high. Receptacle at first globular, then cup-shaped, finally flattened and scutellate to discoid, "at first Mikado brown, becoming chestnut brown, drying blackish", almost smooth, near the base often somewhat roughened to furfuraceous; with a smooth not very prominent margin, curved outwards with age. Disk concave, then flat, of the same colour as the receptacle, finally very dark brown, roughened by the protruding asci. Hymenium 130-160 μm thick. Hypothecium 28-40 μm thick, of closely compacted isodiametric cells 3-7 μm diameter. Flesh 300-350 μm thick, of subglobular cells 7-21 μm diameter, hyaline. Excipulum 28-55 μm thick, of globular, angular or oblong cells 19-27 \times 15-20 μm (*textura globulosa* especially near the margin, *textura angularis* near the base), with brown, amorphous, intercellular pigment, together with purplish, intracellular pigment in the outer cell-layer, especially near the base (visible as globular granulae in dried material); covered with small groups of globular cells, especially near the base. Asci cylindrical-clavate, 113-160 \times 12-18 μm , 8-spored; the wall blue in Melzer's reagent. Ascospores 1-2 seriate, ellipsoid, at first hyaline, "then brown", 15-19.5 \times 7.5-9 μm ,

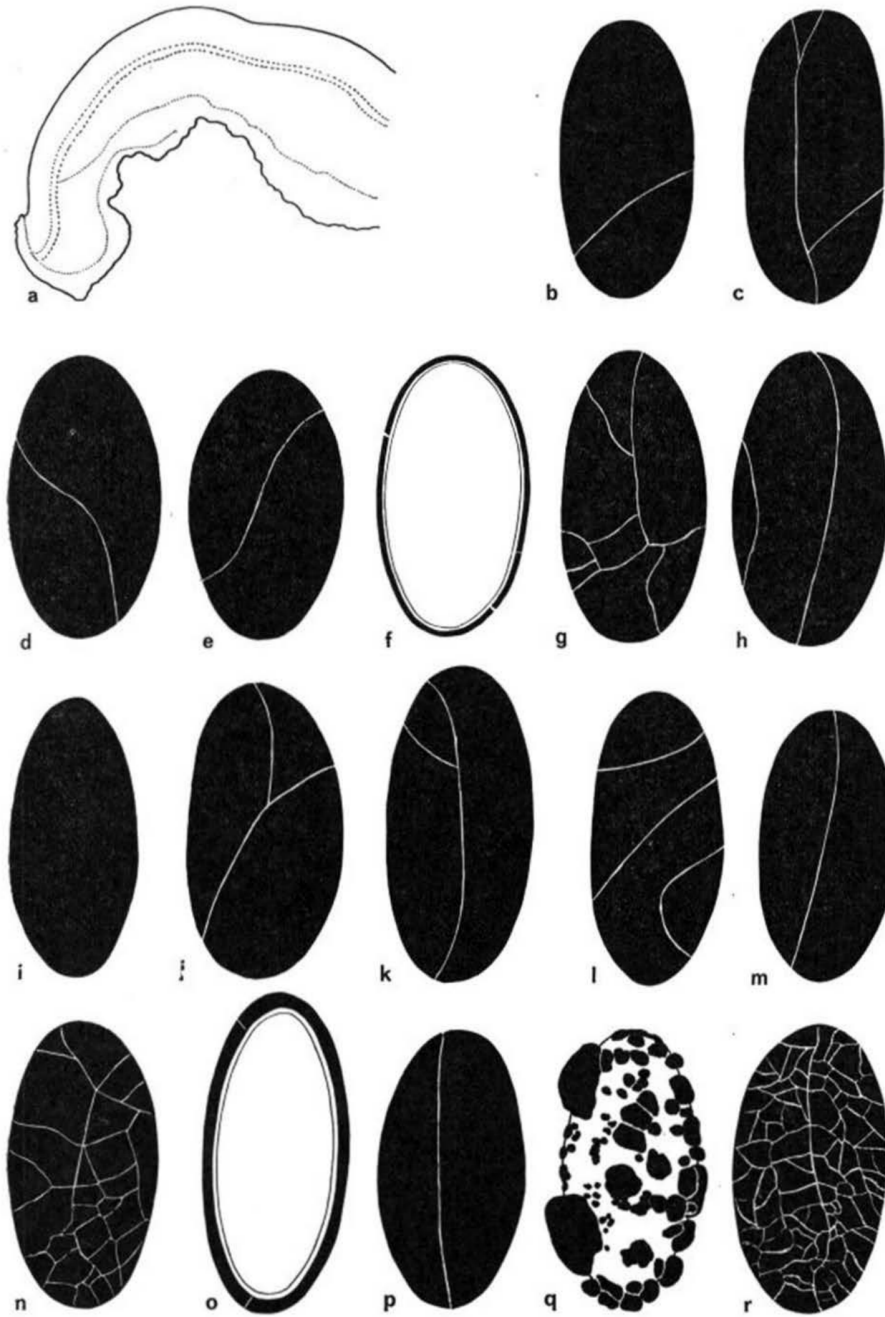


Abbildung 45: *Ascobolus scatigenus*: a, diagrammatic section of fruit-body $\times 25$; b-e, g-n, p-r, ascospores $\times 1600$ (q, represents a rare, abnormal type of ornamentation); f, o, ascospores in optical section.

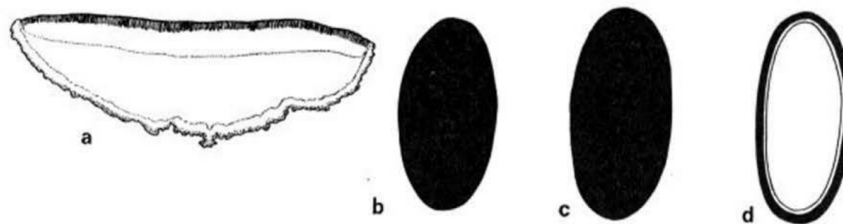


Abbildung 46: *Ascobolus castaneus*: a, diagrammatic section of fruit-body $\times 110$; b, c, ascospores $\times 1600$; d, ascospore in optical section $\times 1600$.

completely smooth; pigment 0.5-0.7 μm thick. Paraphyses branched, septate, cylindrical, 2.0- 2.8 μm thick, not or scarcely thickened above, hyaline, with brownish, amorphous, intercellular pigment, especially between the upper parts.

On dung of Musk-deer.