

brought from Amani, German East Africa. Allied to *P. Kleinii*, but differing in the dimensions of its parts.

*Pilaira* van Tieghem, *Nouv. Rech.* in Ann. Sci. Nat. ser. 6, vol. i, p. 51 (1875).

Fruit-body consisting of a sporangiophore and a sporangium. Sporangiophore arising from the mycelium without a septum at its base. It is evenly cylindrical and has no basal or subsporangial swelling. Sporangium black, separated from the sporangiophore by a columella, and having its wall highly cutinised and persistent when immersed in water. When mature the sporangiophore collapses and there is no projection of the sporangium. The species are all coprophilous.

*Pilaira* differs from *Pilobolus* in that its sporangiophore has no septum at the base, no basal swelling, and no subsporangial swelling, and in that its sporangium is not violently projected.

In 1930 Fitzpatrick, in his book on the Phycomycetes, suggested that the genus *Pilaira* is "based on abnormal material of *Pilobolus*." There can be no doubt that this view is erroneous. Not only van Tieghem and Brefeld but also Buller, I myself, and others have observed and cultivated the type of the genus, *Pilaira anomala*, and have found it to be quite distinct from any abnormal form of *Pilobolus*.

Five species of *Pilaira* are known. The key to them, given below, is founded on that of Ling Yong.

#### KEY TO THE SPECIES OF PILAIRA

	{ Spores round . . . . .	<i>nigrescens</i>
	{ Spores oval or elongated . . . . .	1
1	{ Sporangiohores branched . . . . .	<i>Saccardiana</i>
	{ Sporangiohores simple . . . . .	2
2	{ Sporangiohores only about 1 mm. high . . . . .	<i>dimidiata</i>
	{ Sporangiohores up to 10 cm. high . . . . .	3
3	{ Spores oval, up to 10 $\mu$ long . . . . .	<i>anomala</i>
	{ Spores elongated, up to 22 $\mu$ long . . . . .	<i>Moreaui</i>

1. *Pilaira anomala* (Ces.) Schröter, *Pilze*, in Cohn's Kryptogamen-Flora von Schlesien, vol. iii, p. 211 (1889). Sacc. Syll. vii. 188.

*Pilobolus anomalus* Cesati, in Klotzsch, *Herb. viv. mycol.*, no. 1542 (1851). Brefeld, *Botan. Untersuch.* part 4, pp. 60-5, pl. 4, f. 18, 23-28.

*Ascophora Cesatii* Coemans, *Monographie*, p. 63, pl. 2, f. E (1861).

*Pilobolus Mucedo* Brefeld, *Botan. Untersuch.* part 1, p. 27, pl. 1, f. 25, 26 (1872).

*Pilaira Cesatii* van Tiegh. in Ann. Sci. Nat. ser. 6, vol. i, p. 52, pl. 1, f. 14-24 (1875). Bainier, *Étude*, pp. 29-32, pl. 1, f. 16-18. Grove, in Journ. Bot., vol. xxii, p. 132, pl. 245, f. 6; *Pilobolidae*, p. 337, pl. 6, f. 7, 8.

Sporangiophore cylindrical, colourless, at first erect, 1-2 cm. high, then growing to a height of 9-12 (or even 20) cm., at length shrivelling and falling down on the substratum. Sporangium at first yellow, black when mature, more or less globular, 120-250  $\mu$  diam., then hemispherical with a small granular apophysis below; columella colourless, hemispherical, but somewhat depressed; spores ovoid, nearly colourless (but yellowish in mass), 8-12  $\times$  6-7  $\mu$ .

Zygosporcs black, globose or ovoid, up to 115  $\mu$  diam., episporc covered with numerous minute papillae (Brefeld. *l.c.* part 4. f. 26-28).

On dung of sheep, goats, gazelles, hares, rabbits, goose, pig, ass, and horse. Europe, U.S.A. (Pennsylvania). Rather uncommon.

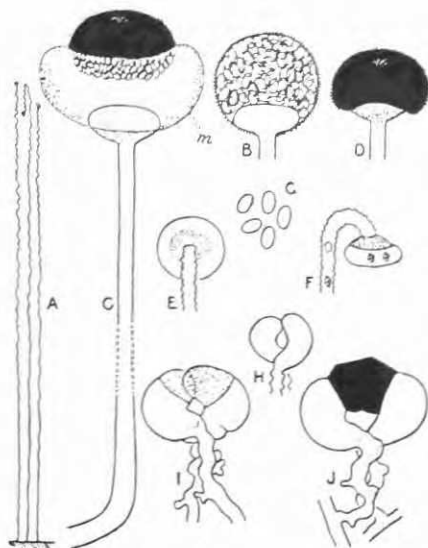


FIG. 107.—*Pilaira anomala* (Ces.) Schröter. A, three fruit-bodies, collapsing. B, longitudinal optical section of a sporangium. C, upper and lower part of a fruit-body, after the dehiscence of the sporangium; *m*, protruding mucilage. D, sporangium in air, before dehiscence. E, columella, seen from below, after the fall of the sporangium. F, a similar columella, in lateral view; there are crystalloids in both the stipe and columella. G, spores. H, I, and J, three successive stages in the formation of a zygospore. Copied by A. H. R. Buller from van Tieghem's *Nouvelles Recherches*. Magnification: A, natural size; B-F, 90; G, 350; H-J, 200.

The zygospores were found by Brefeld on horse dung which had borne luxuriant crops of fruit bodies (*cf.* Fig. 107, H-J).

Illustration : Fig. 107.

2. *Pilaira nigrescens* van Tiegh. in Ann. Sci. Nat. ser. 6, vol. i, p. 60, pl. 1, f. 25-8 (1875). Grove, *Pilobolidae*, p. 337. Sacc. Syll. vii. 189.

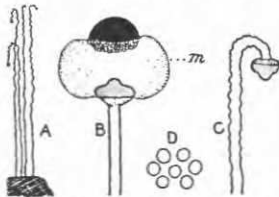


FIG. 108.—*Pilaira nigrescens* v. Tiegh. A, four fruit-bodies, collapsing. B, upper part of a fruit-body after dehiscence of the sporangium; *m*, protruding mucilage. C, upper part of a fruit-body after the fall of the sporangium. D, spores. Copied by A. H. R. Buller from van Tieghem's *Nouvelles Recherches*. Magnification : A, natural size; B and C, 90; D, 380.

Sporangiophore shorter than in the preceding species (1.5-2 cm.) and more slender. Sporangium also smaller, but having a similar granular apophysis; columella blackish-violaceous or bluish, hemispherical, and ending in a conical papilla. Spores globose, colourless, 5-6  $\mu$  in diameter.

On dung of rabbit. France; rare. Distinguished by its size, its spores, and its conical and coloured columella.

Illustration : Fig. 108.

3. *Pilaira dimidiata* Grove, in Journ. Bot. vol. xxii, p. 132, pl. 245, f. 7 a-d (1884); *Pilobolidae*, p. 338, pl. 6, f. 10 a-c. Sacc. Syll. vii. 189.

Sporangiophore slender, cylindrical, and while erect not more than 0.5-1.0 mm. high, then bending down towards the substratum and becoming 3-4 mm. long. Sporangium at first yellow, then black, hemispherical, 100-120  $\mu$  diam.; immediately beneath it the sporangiophore is widened somewhat

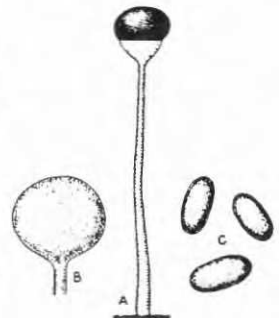


FIG. 109.—*Pilaira dimidiata* Grove. A, mature fruit-body. B, columella. C, spores. Drawn by A. H. R. Buller from sketches made by W. B. Grove in 1883 without the use of a camera lucida. *Cf.* Plate 245, Fig. 7, a-d, in Grove's *New or Noteworthy Fungi*, 1884. Magnification : A, 116; B, 240; C, 660.

like the apophysis of a moss-capsule (*Funaria*). Spores ellipsoid, almost colourless,  $12-14 \times 5-6 \mu$ .

On dog's dung. England (Worcestershire); found only once, March and April. Distinguished from *Pilaira anomala* not only by its much smaller size, but also by its peculiar apophysis, which is almost as large as the sporangium, but slightly less in diameter, and not granular. It was growing luxuriantly on a rich substratum.

Illustration : Fig. 109.

4. *Pilaira Saccardiana* Morini, first mentioned in Rendic. Sess.

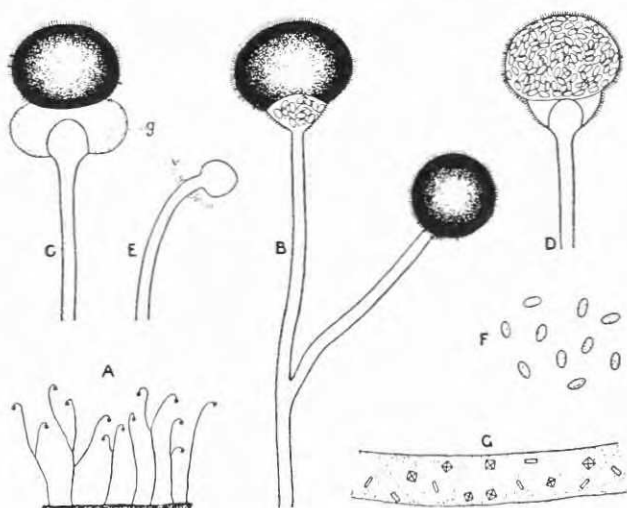


FIG. 110.—*Pilaira Saccardiana* Morini. A, fruit-bodies, sporangiophores branched : sporangia mature and now hanging down. B, a branched sporangiophore bearing two sporangia, one in side view and the other seen from above. C, a sporangium after dehiscence ; g, swollen jelly. D, optical longitudinal section of a sporangium, showing the spores and the columella. E, the sporangium has gone ; the columella remains and, about its base, can be seen a gelatinous substance derived from the liquefaction of the inferior zone of the sporangial membrane. F, spores. G, part of a sporangiophore whose sporangium had not yet ripened ; in the protoplasm are numerous crystalloids of mucorine. Copied by A. H. R. Buller from Morini's *Ricerche intorno ad una nuova forma di Pilaira*. Magnification : A, natural size ; B-G, not stated.

R. Accad. Sci. Ist. Bologna, 1904, with plate, and then named *P. Saccardiana* in Mem. R. Accad. Sci. Ist. Bologna, ser. 6, vol. iii, p. 128 (1906). Sacc. Syll. xxi. 827.

Sporangiophore rarely emerging from a rudimentary trophocyst (which is usually wanting), slender, simple or branched, with at most two branches. Sporangium globose, faintly depressed from above, 90–130  $\mu$  in transverse diameter, brown above, then blackish, lower zone not cutinised and forming a broad annulus of the membrane by the gelatinisation of which the spores are afterwards set free; columella shortly conical, deep-violet in colour; spores oval, 7–10  $\mu$  long, hyaline, but with a smooth pallid violaceous membrane.

On dung, in the north of Italy.

Illustration: Fig. 110.

5. *Pilaira Moreau* Ling, in "Étude morphologique, cytologique

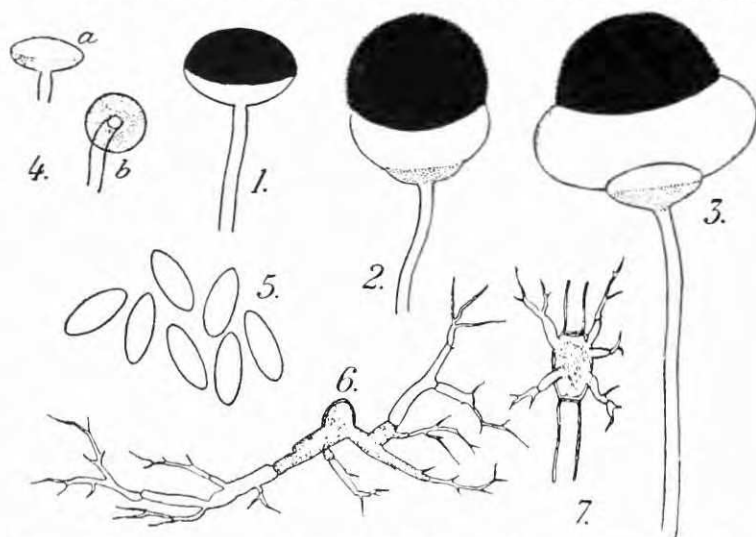


FIG. 111.—*Pilaira Moreau* Ling. No. 1, young sporangium. No. 2, mature sporangium, seen in moist air. No. 3, the dehiscence of the sporangium under the influence of water which swells its lower part. No. 4, columellae after the fall of the sporangium: *a*, in profile; *b*, from below. No. 5, spores. No. 6, a germinating spore. No. 7, a germinating chlamydo-spore. From Ling Yong's *Étude*. Magnification: nos. 1–4, 60; no. 5, 300; nos. 6 and 7, 70.

et microchimique d'une nouvelle Mucorinée, *Pilaira Moreau*" (1926). See also *Rev. générale de Botanique*, xlii. 743.

Sporangiophores lax, hyaline, not branched, erect, soon decumbent, 10–12 cm. high, 30  $\mu$  broad. Sporangia at first yellow, depressed, when mature globose, intensely bluish-black, 300–400  $\mu$

in diameter (in dwarfed specimens only 80  $\mu$ ), membrane encrusted, the upper zone cutinised, persistent, the lower gelatinous, deliquescent; columella flattened, broadly adnate, 150-180  $\times$  90-100  $\mu$ . Spores cylindric-ellipsoid, smooth, hyaline, 18-20  $\times$  8-10  $\mu$  (sometimes as much as 24  $\mu$  long), granular within, agglutinated; chlamydospores few, intercalary in the submerged mycelium; zygospores not seen.

On dung of horses and rabbits. France. Allied to *P. anomala*, from which it differs chiefly in its larger spores. It forms a gall with *Chaetocladium Jonesii*.

Illustration: Fig. 111.

**Bibliography.**—The following list includes all those papers and books which refer more particularly to the species of the Pilobolidae and their differentiation. Some additional works, which treat of the physiology, ecology, and other aspects of the group, are cited in the preceding Chapters written by Professor Buller.

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