

Species of *Pilobolus* and *Pilaira* from India

By Krishna Nand and B. S. Mehrotra,
Botany Department, University of Allahabad.

The first elaborate account of the genus *Pilobolus* and *Pilaira* was presented by Buller (1934) in his *Researches on Fungi* Vol. VI which included Grove's monographic treatment of these two genera. Since then McVickar (1942) has reported three additional species of *Pilobolus*, namely *Pilobolus simplex*, *P. proliferens*, and *P. ramosus*, and Boedijn (1958) reported a new species from Indonesia, viz., *Pilobolus hyalosporus*. In all, nearly twenty one species of *Pilobolus* are known. Grove (1934) has described five species of *Pilaira* in his monograph and since then the number of species has not increased. Out of these five species only *Pilaira anomala* Schröt. seems to be more common, since it has been reported by a number of workers dealing with soil fungi.

Previous reports from India are: *Pilobolus crystallinus* Tode and *P. longipes* van Tiegh. by Mahju (1933) from Punjab, *Pilobolus kleinii* van Tiegh. by Ginai (1936) from Punjab, and *Pilobolus roridus* van Tiegh. and *P. nanus* van Tiegh. by Rudmini (1956) from Sagar. Therefore, in all five species of *Pilobolus* and none of *Pilaira* have been reported from India.

No concerted attempt seems to have been made to find out the species of *Pilobolus* and *Pilaira* present in India. The present investigation is the first attempt in this direction. Ten species of *Pilobolus* and one of *Pilaira* have been studied, out of these six are new reports from India.

Key to the species of *Pilobolus* (Known in India)

- A. Sporangiohores long (usually above 4 cm.), trophocysts very long
P. longipes
- AA. Sporangiohores short (usually less than 4 cm.), trophocysts ovoid or napiform B
- B. Sporangiohores disposed in bundless, sporangia yellow
P. nanus
- BB. Sporangiohores usually single, sporangia not yellow C
- C. Sporangiospores globose or subglobose D
- CC. Sporangiospores ellipsoidal and elliptic only E
- D. Sporangiospores double-walled
P. oedipus

DD.	Sporangiospores single-walled	F
E.	Sporangiospores heterosporus	
	<i>P. heterosporus</i>	
EE.	Sporangiospores not heterosporus	G
F.	Sporangiospores with deep yellow contents 8—15 μ in diameter	
	<i>P. borjianus</i>	
FF.	Sporangiospores colourless, yellowish in mass, 6.5—12.5 μ in diameter	
	<i>P. sphaerosporus</i>	
G.	Sporangium umbonate in shape	
	<i>P. umbonatus</i>	
GG.	Sporangium rounded above	H
H.	Sporangiospores mostly larger than 10 μ	
	<i>P. klenii</i>	
HH.	Sporangiospores less than 10 μ	I
I.	Sporangiospores 5.0—11.5 \times 2.5—5.0 μ (mostly 7.5 \times 5.0 μ)	
	<i>P. crystallinus</i>	
II.	Sporangiospores 3.5—7.5 \times 2.0—3.5 μ (mostly (\times 3.3 μ)	
	<i>P. roridus</i>	

Pilobolus crystallinus (Wiggers) Tode, Schr. Natfo, Fr., Berlin, 5. S. 96, 1784.

Mycelium submerged; trophocysts ovate, often concealed in the substratum, terminal, sometimes intercalary; sporangiophores arising from trophocyst, smooth, cylindrical, nonseptate, unbranched, phototrophic, pale yellow in colour, 1.0—3.8 cm. in length, mostly 2.5 cm., 200—250 μ in width; subsporangial swelling ovoid or elliptic ovoid, well grown fruit bodies 200—600 μ in length, 150—450 μ in width, pale, orange-red; sporangia convex, from half as wide to nearly as wide as the subsporangial swelling; 220—450 μ in width, 40—300 μ long, at maturity fully black, wet, heavily cutinized, many-spores; columella conical, faintly blackish blue, 80—200 μ high, 150—300 μ broad; sporangiospores ellipsoid, yellowish or quite hyaline, 5.0—11.5 μ long, 2.5—5.0 μ broad, mostly 7.5 \times 5.0 μ , thin-walled; zygospores and chlamydo-spores not sen.

Description of the present isolate based on the culture isolated from cow, buffalo and camel dung at Allahabad. Slide preparations of the isolate deposited in BSM Culture Collection, Botany Department, University of Allahabad, under No. Mx-84.

It was first reported in India by Mahju (1933) from dung of horse and buffalo and by G in a i (1936) from donkey and buffalo dung. *Pilobolus umbonatus* Buller, Researches on Fungi, London, Vol. VI, 169—178, 1934.

Mycelium submerged; trophocyst oval to napi-form, terminal or intercalary; sporangiophores single, 1.5—5.0 mm. in length, 80—250 μ in width, smooth, cylindrical, light brown in colour, variable in length, nonseptate, unbranched, phototrophic; sub-sporangial swelling ellipsoid, sometimes ovoid, 90—500 μ in length, 80—400 μ in width, pale, orange-

subsporangial swelling; sporangia umbonate in shape and more or less conical, 160—320 μ in length, 100—200 μ in width or about one-half red band of protoplasm at the junction of the sporangiophore and the diameter of subsporangial swelling, shrinking on drying after discharge and becoming acutely pointed; black, heavily cutinized; columella very bluntly conical or rounded, grayish, distinctly darker than the subsporangial swelling; sporangiospores ellipsoid, oval, hyaline, yellow in mass, smooth, $5.0-8.0 \times 3.7-4.4 \mu$; zygospores and chlamydo-spores not seen.

The above description is based on an isolate collected from dung of cow at Allahabad. Slide preparations of the isolate were deposited in BSM Culture Collection, Botany Department, University of Allahabad, under No. Mx 85. It is being reported here for the first time from India.

The present isolate differs from the description of the species given by Buller (1934) in the spore size which is slightly more.

Pilobolus oedipus Montagne, Ann. Soc. Linn. de Lyon, 1—7, 1828.

Mycelium submerged; trophocyst roundish or napiform, filled with yellow protoplasmic contents, submerged; sporangiophores red, form a thick turf above the substratum, usually short, yellow, nonseptate, smooth, variable in length, unbranched, 0.5—2.0 mm. (or even 3—6 mm. in length); subsporangial swelling ovoid or hemispherical, black, 200—400 μ in width, 400—600 μ in length, thin-walled, smooth, hyaline, faint yellow or orange at the base; sporangia hemispherical, large, almost as wide as the subsporangial vesicle, black, heavily cutinized, 100—500 μ in width, 110—300 μ in length, occasionally in the form of a hexagonal arch like structure; columella conical or subcylindrical, slightly narrowed in the middle, sometimes so high that it reaches almost to the top of the sporangium, 100—150 μ in width, 80—110 μ in length, smooth, thin-walled; sporangiospores globose, yellowish-red, 7.8—15.0 μ in diameter, with a wall composed of two distinct layers, of which the epispore is thick and often bluish while inner is thin and yellowish in colour.

Description based on a isolate from human excreta at Allahabad. Preparation of slides were deposited in BSM Culture Collection, Botany Department, University of Allahabad under No. Mx 86. It is being reported for the first time from India.

Pilobolus borzianus Morini, Mem. Accad. Sci. Ist. Bologna, ser. 6, Vol. iii, p. 126 (1906).

Mycelium submerged; trophocysts ovoid; sporangiophores arising in group of two to four, cylindric, phototrophic, smooth, nonseptate, unbranched, variable in length, 1.0—6 mm. high; 100—250 μ in width; subsporangial swelling globose, subglobose or shortly ovoid, 100—350 μ high, 80—300 μ broad, almost colourless or quite hyaline; sporangium

globose, very much flattened from above, 100—300 μ in diameter, bluish-black, heavily cutinized, wet, many-spored; columella hemispherical or conical 60—100 μ high, 80—240 μ broad near the base; sporangiospores spherical, deep yellow, 8—15 μ in diameter; zygospores and chlamydo-spores not seen.

Description based on the isolate collected from the soil at Allahabad. Preparation of the slides were deposited in BSM Culture Collection, Botany Department, University of Allahabad, under No. Mx 87. It is being reported here for the first time from India.

Pilobolus roridus (Bolt) Pers., Syn. Meth. p. 118 (1801).

Mycelium submerged in substratum; trophocysts intercalary between two mycelial swellings, submerged, filled with granular contents, ovate in shape, orange in colour; sporangiophores arising from trophocysts, 1—1.5 cm. in length, 80—150 μ in width, nearly colourless, cylindrical, erect, phototrophic, non-septate, unbranched, smooth; subsporangial swelling oval or almost globose, upto 300—600 μ in diameter; sporangium nearly globose, black, heavily cutinized, terminal, 90—200 μ in length, 90—300 μ in width, wet, many-spored; columella convex, sometimes conical bluish black, 80—120 μ high, 100—200 μ broad; sporangiospores ellipsoid, hyaline, 3.5—7.5 \times 2.0—3.5 μ .

Description based on the isolate collected from the dung of goat, rabbit and pea-cock. Preparation of slides were deposited in BSM Culture Collection, Botany Department, University of Allahabad, under No. Mx 88. It was first reported from India by Rugimini (1956) from horse dung.

Pilobolus sphaerosporus Palla, Österr. Bot. Zeitschr. Vol. 50, p. 400, pl. 10 (1900).

Mycelium submerged; trophocyst napiform in shape, buried in the substratum, dark brown, smooth-walled, intercalary; sporangiophores arising singly from the trophocysts, cylindrical, smooth, phototrophic, erect, nonseptate, unbranched, variable in length, light brown in colour, 1.08—2.0 mm. in length, 80—100 μ in width; subsporangial swelling ellipsoid, 400—500 \times 350—450 μ , smooth, upper half with yellowish content; sporangia globose, sub-globose, at maturity black in colour with colourless base, heavily cutinized, wet, many-spored, 300—400 \times 240—350 μ ; columella conical, smooth, at first colourless later yellowish in colour; 100—160 μ long, 80—180 μ wide; sporangiospores subglobose to globose, thin-walled, smooth, yellow or orange, variable in size, 6.5—12.5 μ in diameter; zygospores and chlamydo-spores not seen.

Description of the above species is based on the isolate which were found on the various dungs of cat, pea-cock and cow at Allahabad. Preparation of the slides were deposited in BSM Culture Collection, Botany Department, University of Allahabad under No. Mx 89. It is being reported here for the first time from India.

Pilobolus longipes van Tieghem — Ann. Sci. Nat. ser. 6, Vol. IV, pp. 338—340, pl. 10, f. 11—5 (1876).

Mycelium submerged; trophocysts usually external to the substratum, elongated horizontally 100—500 μ long, golden-yellow, cylindrical and tapered at one end, giving rise to a sporangiophore at the other end; sporangiophores 2—5 cm. in length, sometimes 4—8 cm., cylindrical, smooth, erect, unbranched, phototrophic, subsporangial swelling oval, 200—800 μ broad; sporangium nearly globose, black, heavily cutinized, 100—600 μ in diameter, wet, many-spored; columella broadly conical, bluish black, 100—250 μ long, 120—182 μ broad; sporangiospores smooth, globose or ovoid, the wall often thick and tinged with bluish black, contents yellow orange, 8—12 \times 6—12 μ in diameter; zygospores and chlamyospores not seen.

The description of the present isolate has been based on the culture isolated from horse dung at Allahabad. Slide preparation has been deposited in BSM Culture Collection, Botany Department, University of Allahabad, India under No. Mx 90. This species is easily differentiated by large globose spores, its elongated trophocysts and very long sporangiophores.

It was first reported in India by Mahju (1933) on dung of buffalo, horse and smabhar and Ginai (1936) from dung of cow, donkey and buffalo.

Pilobolus kleinii van Tieghem — Ann. Sci. Nat. ser. 6, Vol. IV, pp. 337—8, pl. 10, f. 6—10 (1876).

Mycelium submerged; trophocyst ovate-cylindrical, filled with orange red granular contents; sporangiophores cylindrical, erect, phototrophic, smooth, non-septate, unbranched, 1—6 (10) mm in length, 60—100 μ in width; subsporangial swelling ovoid or subellipsoid, 400—500 μ in length; sporangia dark black, heavily cutinized, subglobose to globose, more or less depressed, about two-third as wide as the length to nearly as wide; columella faint blackish, generally hyaline, broadly conical, but occasionally narrowed in the middle so that the apex resembles like a papilla; 150—180 μ long, 140—180 μ broad at the base; sporangiospores hyaline, in mass varying shades of orange-yellow, ellipsoid, smooth, thin-walled, 8—15 \times 4—8 μ ; zygospores and chlamyospores not seen.

Description based on the isolate collected from the dung of horse, donkey and goat at Allahabad. Slide preparations have been repositied in BSM Culture Collection, Botany Department, University of Allahabad, under No. Mx 91. It was first reported from India by Ginai (1936) from dung of nilghai.

Pilobolus nanus van Tieghem, Ann. Sci. Nat. ser., 6, 4: 340—342, 1876.

Mycelium submerged, fruiting primordium at first yellow; trophocysts submerged, intercalary; sporangiophores erect, cylindrical, 0.5—

1.0 mm high, sometimes arising singly or in groups of two or three, non-septate, unbranched, smooth, phototrophic; subsporangial swelling subglobose, hyaline, 90—350 μ in length, 100—400 μ in width; sporangia globose, with the membrane of the upper part cutinized and yellow; 100—200 μ in diameter; columella "depressed-convex"; sporangiospores globose or ovoid, hyaline, yellow in mass, 3.75—6.0 μ in diameter, zygospores and chlamydo-spores not seen.

Description based on the isolate from rat dung at Allahabad. Preparation of the slides were deposited in BSM Culture Collection, Botany Department, University of Allahabad, India, under No. Mx 92.

It was first reported from India by G in a i (1936) on dung of nilghai and donkey.

Pilobolus heterosporus Palla, Österr. Bot. Zeitschr. Vol. 50, p. 349, pl. 10, f. 1—5 (1900).

Submerged mycelium distended; trophocyst, usually submerged in substratum, ellipsoid, rarely globose, yellow, thick-walled; sporangiophores cylindric, erect, phototrophic, smooth, non-septate, unbranched, variable in length, yellow in colour; subsporangial swelling ovoid or ellipsoid, 200—600 μ high, 100—350 μ broad, provided at the insertion of the columella with a thin narrow annular zone; sporangia broad, deep-black, heavily cutinized, 100—350 μ broad; columella more or less deeply constricted in the middle, rounded at the apex, reaching nearly to the top of the sporangium; sporangiospores yellow or orange-red, thin-walled, ellipsoid, oval, 6.5—12.5 μ in length, 3.75—9.5 μ in width; zygospores and chlamydo-spores not seen.

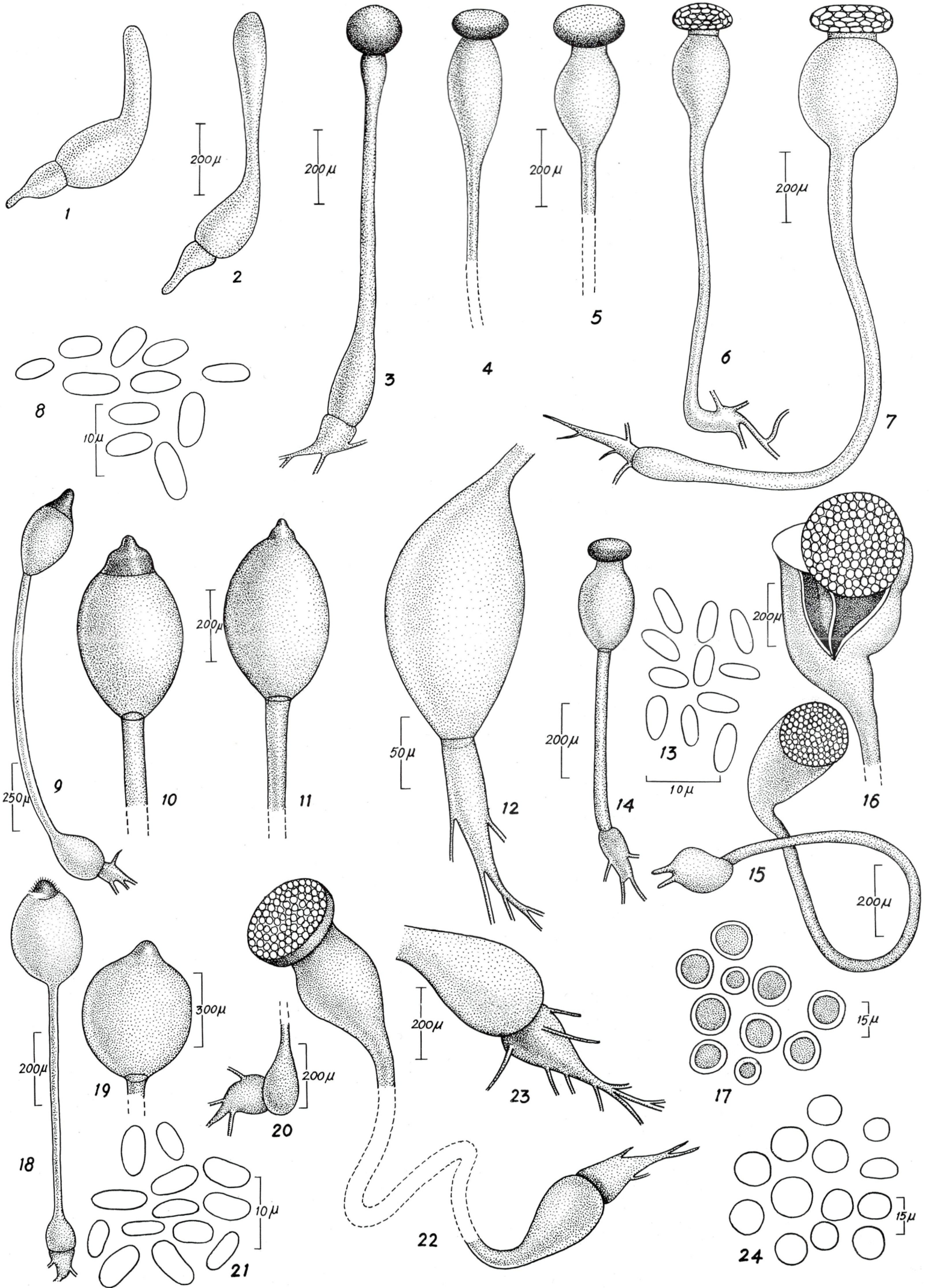
Description based on the isolate collected from the dung of rat, cow and pea-cock at Allahabad. Preparation of the slides were deposited in BSM Culture Collection, Botany Department, University of Allahabad, India, under No. Mx 93.

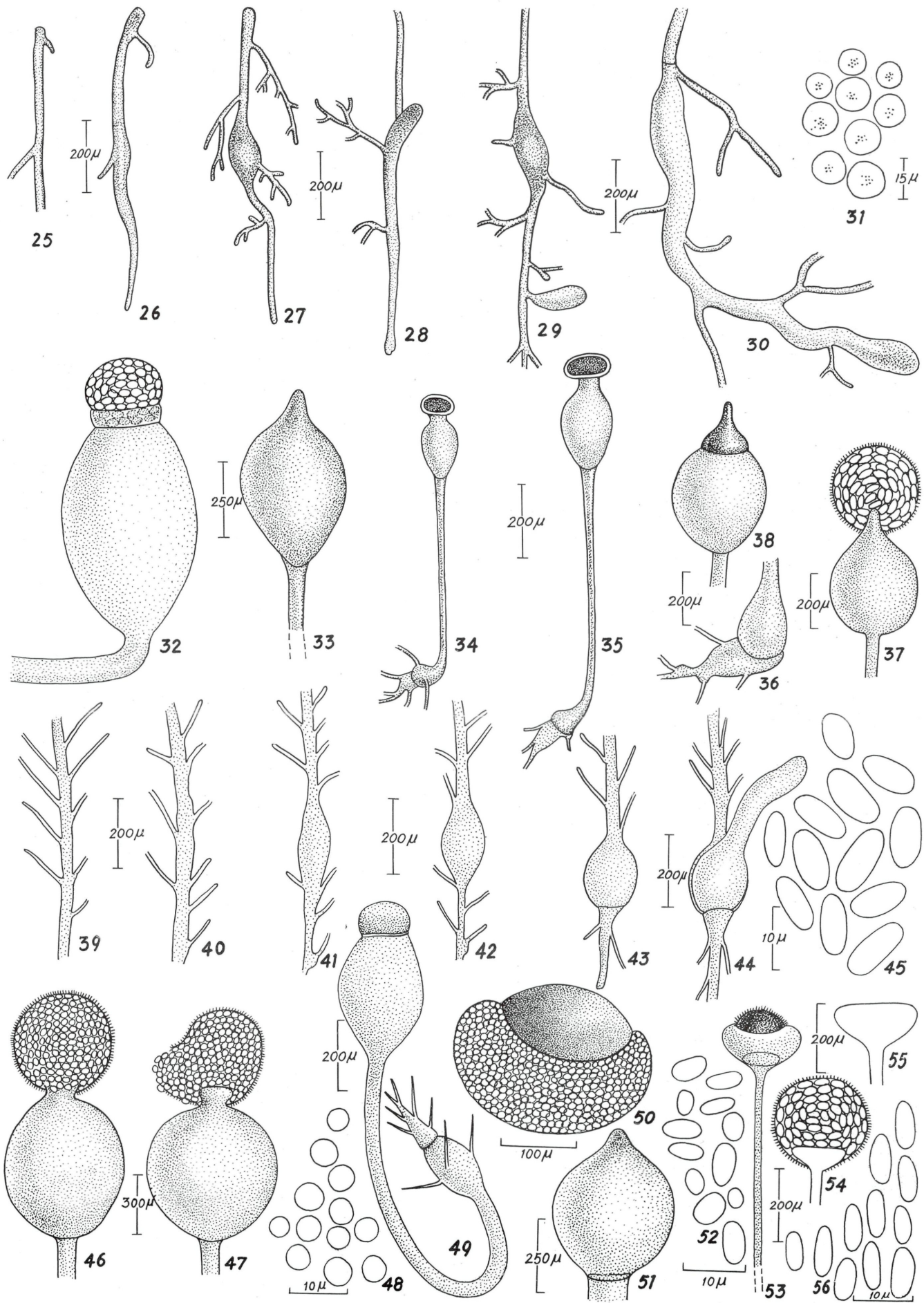
It is being reported here for the first time from India.

Pilaira anomala (Cesati) Schröter, Cohn's Kryptogamenflora von Schlesien, Vol. iii, p. 211 (1889).

Mycelium submerged; sporangiophore single thread-like, non-septate, 1—5 cm. high, and 30—100 μ thick, very soon collapsing and forming a high, loose, hyaline felt on which black sporangia appear as black points, long cylindric, without basal and subsporangial swellings, hyaline; sporangia terminal, at first spherical, thin, at first white then yellow, at maturity black with colourless base, wet, globose, 60—300 μ in diameter, many-spored; columella large, disc like, flat or knob-shaped, persistent, smooth, colourless, 80—160 μ in width, 40—80 μ in length; sporangiospores elliptical, oval, hyaline, smooth, thin-walled, 6—10 \times 4—6 μ ; zygospores and chamydo-spores not seen.

Description based on the isolate collected from the dung of rat, cow and pea-cock at Allahabad. Preparation of the slides were deposited





in BSM Culture Collection, Botany Department, University of Allahabad, India, under No. Mx 94.

It is being reported here for the first time from India.

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Explanation of the Plates

Plate XXIV.

- Fig. 1—8. *Pilobolus crystallinus* Tode, 1—2. Basal swelling with trophocyst. 3—7, Sporangiophores showing development of the sporangium. 8. Sporangiospores.
- Fig. 9—13. *Pilobolus umbonatus* Buller, 9. A young sporangiophore. 10. Sporangiophore showing mature sporangium and subsporangial vesicle. 11. Subsporangial vesicle with small columella seen after discharge of sporangia. 12. Trophocyst enlarged. 13. Sporangiospores.
- Fig. 14—17. *Pilobolus oedipus* Montagne. 14—15. Sporangiophores. 16. Mature sporangium on subsporangial vesicle as seen in slide mount. 17. Doubled-walled sporangiospores.
- Fig. 18—21. *Pilobolus roridus* (Bolt.) Pers. 18. Sporangiophore with sporangium. 19. A conial columella left after discharge of sporangium. 20. Trophocyst. 21. Sporangiospores.
- Fig. 22—24. *Pilobolus sphaerosporus* Palla. 22. Sporangiophore with large oval sporangium at the top. 23, Trophocyst. 24. Sporangiospores.

Plate XXV.

- Fig. 25—33. *Pilobolus longipes* Van Tiegh. 25—30. Developing trophocysts. 31. Sporangiospores. 32. Subsporangial vesicle with sporangium. 33. Subsporangial vesicle with short pointed columella.
- Fig. 34—45. *Pilobolus kleini* van Tiegh. 34—35. Sporangiophore with sporangium at the tip. 36. Mature trophocysts. 37. Subsporangial vesicle with papillate columella seen after discharge of sporangia. 39—44. Developing trophocysts. 45. Sporangiospores.

- Fig. 46—48. *Pilobolus nanus* van Tiegh. 46—47. Subsporangial swelling, with columella seen in one (Fig. 47). 48. Sporangiospores.
- Fig. 49—52. *Pilobolus heterosporus* Palla 49. A sporangiophore with sporangium. 50. Subsporangial vesicle. 51. A discharge sporangium showing upper portion cutinized. 52. Sporangiospores.
- Fig. 53—56. *Pilaira anomala* (Cesati) Schröter. 53. Upper part of sporangiophore. 54. Sporangium. 55. Columella. 56. Sporangiospores.

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