

# THE GENUS *PALLAVICINIA* GRAY IN INDIA

## 1. *Pallavicinia canarus* St.\*

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### INTRODUCTION

THE genus *Pallavicinia* Gray, of the older systematists has been split up now into three genera, namely, *Pallavicinia* Gray, *Moerckia* Gottsche and *Makednothallus* Verdoorn. It is equivalent to Lindberg's sub-genus *Eu-pallavicinia*, as defined by Schiffner (1909), and to Stephani's group *Procumbentes*. In this restricted sense it includes about 30 species. Evans (1939) has given a critical and comprehensive account of the history of the genus.

In India *Pallavicinia* is represented by about half a dozen species distributed as follows:—

1. *P. ambiguous* (Mitt.) St.—Assam, Khasia mountains.
2. *P. canarus* St.—Canara.
3. *P. himalayensis* Schiffn.—Sikkim-Himalayas, Kurseong.
4. *P. decipiens* (Mitt.) St.—Ceylon.
5. *P. indicus* Schiffn.—Nepal.
6. *P. crispatus* (Mont.) St.—Nilgherry mountains.

In 1936, Pandé and Misra collected a species of *Moerckia* from the neighbourhood of Khati (7,200 ft.), Western Himalayas. Apparently this is the first record of this genus from India.

Ghosh and Chakravarty (1943) reported an undertermined species of *Pallavicinia* from Dacca, describing some taxonomic features of the species but, as far as the authors are aware, no detailed work has been done so far on the genus in this country. The present paper deals with the taxonomy of *P. canarus* St., a species established by Stephani (1917, p. 62) on the basis of a specimen collected by Pfeiderer from Canara, in the Western Ghats. The plant is known so far only from its Latin diagnosis (Stephani, 1917, p. 62) which consists merely of the vegetative features of the thallus and the involucre.

Besides the type locality, *P. canarus* has been frequently collected from other parts of the country as well (e.g., Madhya Pradesh, Pachmarhi, Misra, 1949, Pandé and Srivastava, 1951; Western Ghats, Travancore, Pillai, 1951; Agumbe, Pandé and Srivastava, 1950; and Mahabalé, 1951 and 1952). The present paper attempts to give a complete account of the species based largely on specimens collected from Agumbe and Pachmarhi.

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## DESCRIPTION

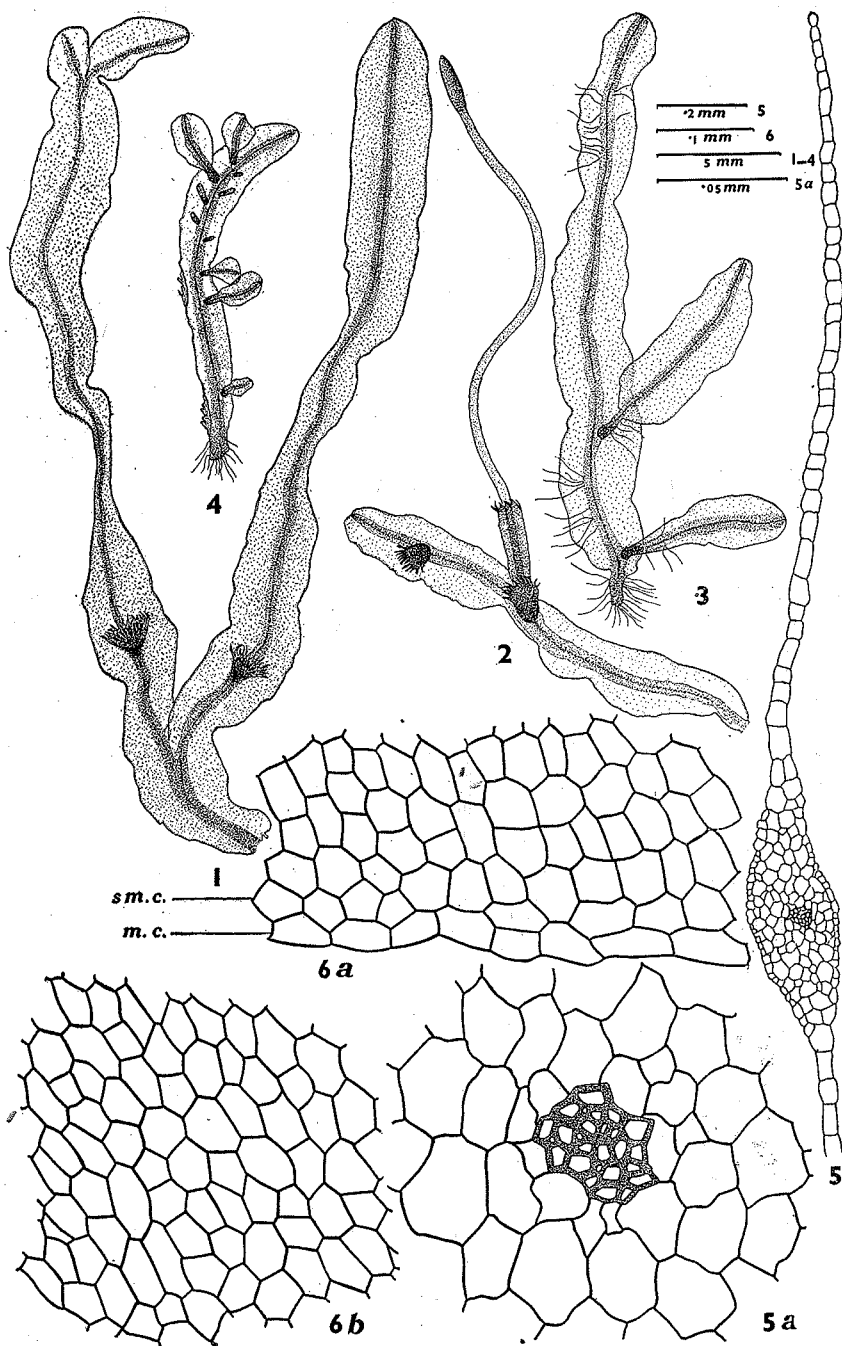
*P. canarus* grows at Pachmarhi during the monsoon months and forms dense clusters along the water courses and channels. Its most favourable habitats are the shady sides of the perennial streams, and the slopes and sides of the waterfalls, where the plants are frequently bathed by the stream or receive a constant spray of water from it. It is often associated with *Dumortiera hirsuta* R. Bl. et Nees and *Riccardia levieri* Schiffn. Sometimes the plants may grow completely submerged under water. In such habitats the species shows very prolific growth. It multiplies mostly vegetatively and even the most vigorously growing plants, collected as late as February and March, do not develop generally any mature sporophytes.

The vegetative body of the plant (Figs. 1-4, 8, 11, 12) consists of a creeping prostrate thallus 2-6 cm. long and 3-4 mm. broad. It has a prominent midrib, and may be simple (Figs. 2, 11 and 12) or branched (Figs. 1 and 8). The midrib is about .5 mm. thick, and many layered (Fig. 5). Ventrally the thallus bears numerous, unicellular simple and hyaline rhizoids which anchor it to the substratum. Branching is profuse in plants growing under favourable conditions. It is either apical or adventitious. In the former case the branches arise from the apical cell and have their midrib and conducting tissues continuous with those of the main shoot (Figs. 1 and 8). Adventitious shoots arise from the ventral side of the midrib, and their midrib and the conducting tissues are not continuous with those of the main thallus (Figs. 3 and 4). Sometimes a plant may bear about a dozen adventitious shoots. Fig. 4 shows as many as 10 such shoots developing from a male plant.

The thallus is about 15 cells thick in the middle (Fig. 5) and has a central conducting strand consisting of about 30 thick-walled cells (Figs. 5 and 5a). The midrib gradually passes into a broad lamina one cell thick.

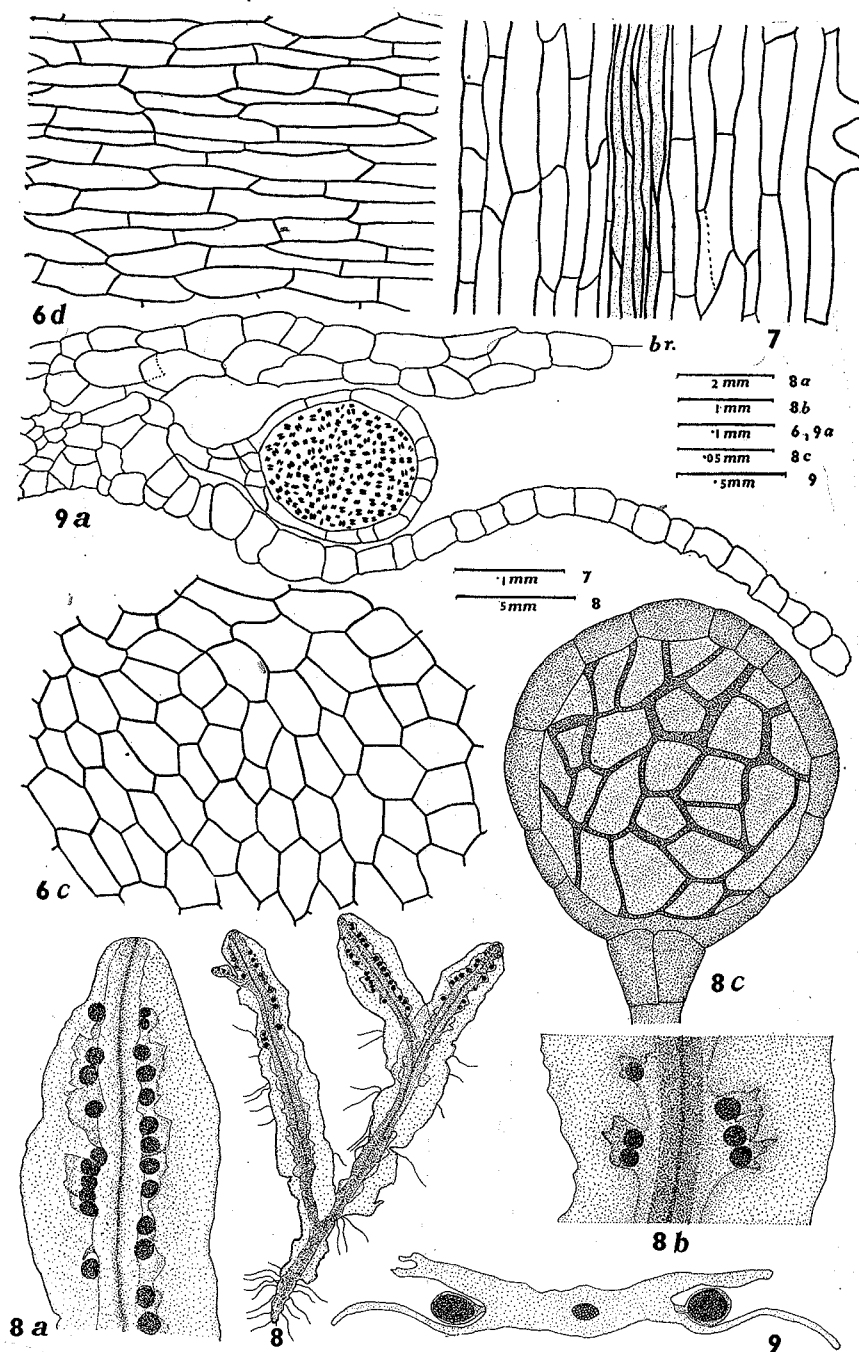
The size of the cells in the various parts of the thallus is somewhat variable. Marginal cells (Fig. 6a, m.c.) measure  $32 \times 62 \mu$ , submarginal cells (Fig. 6a, sm.c.)  $38 \times 50 \mu$ , cells about the middle of the wing (Fig. 6b)  $38 \times 54 \mu$ , cells near the costa (Fig. 6c)  $38 \times 76 \mu$ , upper epidermal cells above the midrib (Fig. 6d)  $25 \times 125 \mu$ , and midrib cells (in L.S., Fig. 7)  $28 \times 130 \mu$ . These observations on the vegetative structure of the thallus in general, agree with those of Stephani.

*P. canarus* is strictly dioecious and the sex-organs are borne on the dorsal surface of the thallus. The male plants (Figs. 4 and 8) are invariably smaller than the female (Figs. 1, 2, 3, 11 and 12), and in nature, the latter are apparently more abundant, although often these do not produce mature sporophytes. Obviously at Pachmarhi propagation by spores is rare and the species multiplies mostly by the separation of the vegetative branches. It is perennial along the permanent water-courses on this plateau, but under adverse conditions thick and, more or less, tuberous ventral shoots are formed which serve both for perennation and propagation.



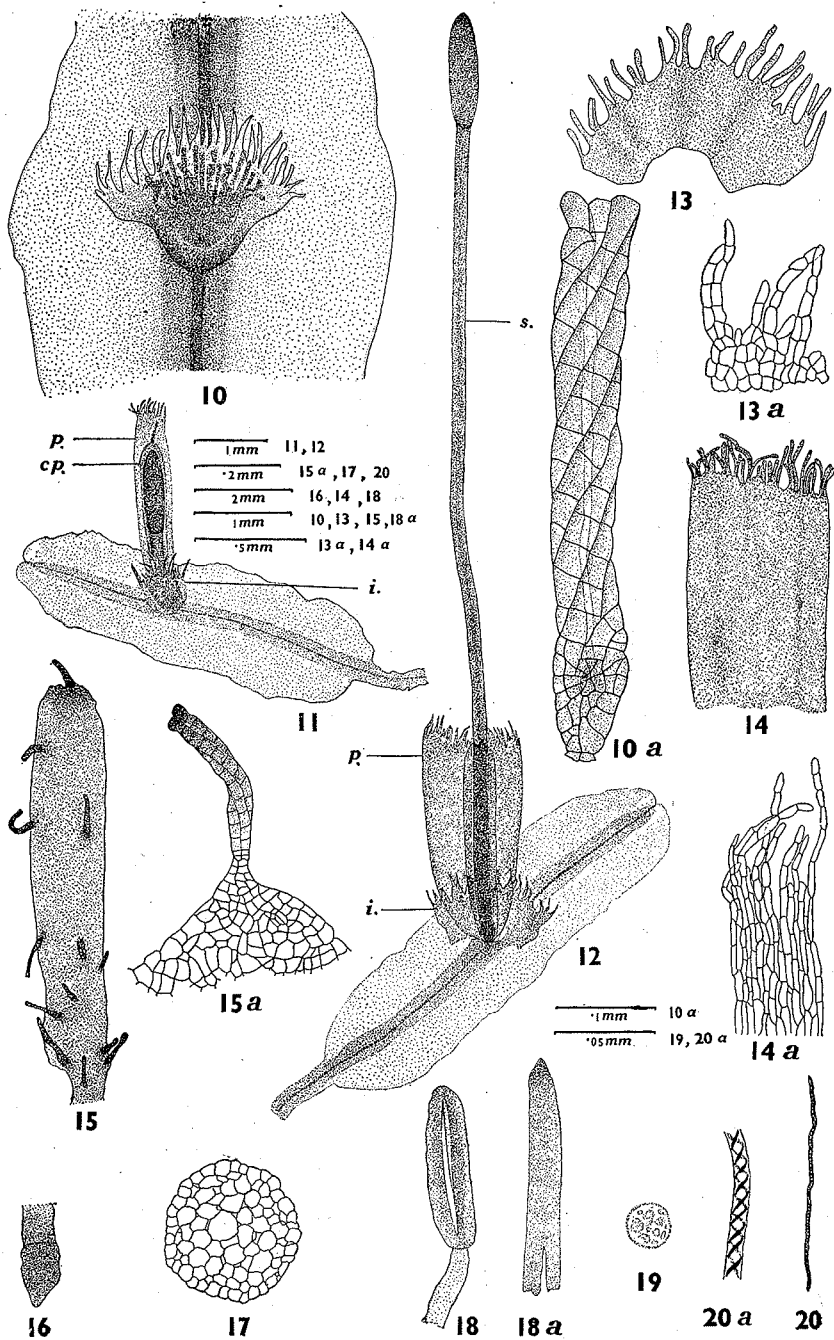
FIGS. 1-6 b

Fig. 1. Female thallus. Fig. 2. Thallus with mature sporophyte. Fig. 3. Female thallus with two ventral innovations (ventral view). Fig. 4. Male thallus with ten ventral innovations (ventral view). Fig. 5. T.S. of thallus (lamina on one side shown only partly). Fig. 5 a. A part of the midrib showing conducting strand. Fig. 6 a. m.c., marginal and sm.c., submarginal cells. Fig. 6 b. Cells from near the middle part of lamina.



FIGS. 6c-9a

Fig. 6c. Cells adjoining midrib; Fig. 6d, midrib cells in surface view. Fig. 7. L.S. midrib. Fig. 8. Male thallus. Note the arrangement of antheridia. Fig. 8a. A part of the above. Fig. 8b. A part of male thallus showing antheridia and bracts. Fig. 8c. Antheridium. Fig. 9. T.S. of male thallus showing attachment of antheridia. Fig. 9a. A part of the above; *br.*, bract.



Figs 10-20 a

Fig. 10. Part of female thallus with receptacle. Fig. 10 *a*. Archegonium, note the twisted neck. Fig. 11. Thallus with a young sporophyte enclosed within the perianth, *p.*, and the calyptra, *cp.* Fig. 12. Thallus with mature sporophyte. Involucre and perianth opened out. Fig. 13. Involucre dissected out. Fig. 13 *a*. Portion of the above. Fig. 14. Perianth dissected out. Fig. 14 *a*. Portion of the above. Fig. 15. Calyptra. Note the unfertilised archegonia carried by the calyptra. Fig. 15 *a*. Apex of calyptra. Fig. 16. Foot. Fig. 17. T.S. of seta. Fig. 18. Mature capsule. Note incomplete dehiscence. Fig. 18 *a*. A valve. Fig. 19. Spore. Fig. 20. Elater. Fig. 20 *a*. Part of elater.

*The Antheridium.*—The antheridia develop in acropetal succession and occur in a row on either side of the midrib (Figs. 8, 8 *a* and 8 *b*). They are protected by a shelf-like toothed or lobed covering, the *involucre*, which develops from the scales or *male bracts*. The antheridia may occur in a long continuous row or may be interrupted by patches of sterile tissue. The mature antheridium has a spherical body borne on a short stalk (Figs. 8 *c*, 9 and 9 *a*) and is attached obliquely to the lateral side of the midrib. It is more or less directed forward. The longitudinal diameter of the antheridium is about 160–80  $\mu$ , and its wall is single layered and about 20  $\mu$  thick. It is filled with numerous biciliate sperms.

*The archegonium.*—The archegonia occur in clusters on the dorsal surface of the midrib (Figs. 1 and 10). They are enclosed by a protective covering, the *involucre*. Within the involucre each archegonium is surrounded by another protective sheath, the *perianth*. The latter is represented by a few scales before fertilisation, and is inconspicuous. After fertilisation it becomes very prominent and forms a long cylindrical sheath around the developing embryo and mature sporophyte (Figs. 11, *p.*, and 12, *p.*). A thallus may bear one, two or more groups of archegonia. In plants from Pachmarhi the authors have often observed as many as half a dozen archegonial involucre with archegonia in different stages of development on a single plant. The mature archegonium has a long twisted neck and a somewhat dilated ventre (Fig. 10 *a*). The neck consists of 5 tiers of cells and encloses the neck-canal cells in the centre. It is 400–600  $\mu$  long and 40–50  $\mu$  broad. In an involucre generally only one archegonium develops into mature sporophyte, while the rest of them degenerate.

*The perianth.*—The perianth is oblong and cylindrical (Fig. 11, *p.*). Its mouth is open and the margin bears long hair-like processes (Figs. 14 and 14 *a*).

*The calyptra.*—The calyptra (Fig. 11, *cp.*) is shorter than the perianth and is invariably enclosed by it. It carries all over its body the remains of the unfertilised archegonia (Fig. 15).

*The involucre.*—The mature involucre (Fig. 11, *i.*), as stated by Stephani (1917, p. 62), is more or less cupulate and its mouth is fringed with a number of thick hairs which are sometimes branched (Figs. 10, 11, *i.*; 12, *i.*; 13 and 13 *a*), as described by Stephani. In *P. crispatus* (Mont.) St. (Stephani, 1900, p. 316) the involucre is shortly cylindrical and 4 or 5 lobed, the lobes extending upto the middle.

*Sporophyte.*—The sporophyte (Figs. 2 and 12) consists of a cylindrical capsule, a long seta and a conical foot. While young (Fig. 11)

it is enclosed within the calyptra, which arises from the neck of the archegonium.

The mature sporophyte is about 3–4 cm. long, and bears a capsule 3 mm. in length. The latter dehisces by 4 valves that remain attached at the apex (Fig. 18). The seta (Fig. 12, *s.*) is comparatively long and consists of parenchymatous cells (Fig. 17). The foot (Fig. 16) is more or less wedge-shaped and lies embedded in the thallus.

The spore (Fig. 19) is spherical, golden yellow and  $20\mu$  in diameter. The elaters are of the same colour as the spores. They are about  $650\mu$  long,  $6\mu$  broad and bispiral (Figs. 20 and 20 *a*).

#### SUMMARY

1. *P. canarus* grows in dense clusters during monsoon months in the Western Ghats and Pachmarhi.
2. The species is dioecious; male plants are invariably smaller than female plants.
3. The thallus has a prominent midrib and a broad lamina. The midrib is many cells thick and includes a conducting strand with thick-walled cells. The lamina is one cell thick.
4. The antheridia occur on the dorsal surface of the thallus in one row on either side of the midrib and are protected by an involucre from behind.
5. The archegonia occur in clusters along the midrib on the dorsal surface of the thallus. Each archegonial group is enclosed in an involucre within which lies the perianth. The mouth of the involucre is fringed with a number of thick hairs which are sometimes branched.
6. The mature sporophyte has a cylindrical capsule, a long seta and a wedge-shaped foot.
7. The capsule opens by 4 valves that remain attached at the apex.
8. The spores are spherical and  $20\mu$  in diameter, and the elaters are bispiral and  $650\mu$  long.

#### ACKNOWLEDGEMENT

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