

EPIDERMAL AND STOMATAL FEATURES IN *PLEOCNEMIA CONJUGATA* (BL.) PRESL.

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ABSTRACT

The development of stomata in *P. conjugata* has been studied in detail and figured. The stoma is raised slightly above the level of the sinuous walled epidermis. The guard cell bears a prominent median papilla. Twinning of the stomata which is quite common has been noted and described in detail.

INTRODUCTION

Pleocnemia conjugata a polypodiaceous fern with characteristic foliar buds is widely distributed in the Eastern and Western ghats of Peninsular India. The foliar buds of this plant have been cultivated *in vitro* and the morphology of this plant has also been studied in detail (JOSHI, 1965, 1969). The stomatal features had not been investigated and the present paper embodies our observations on this aspect.

MATERIAL AND METHODS

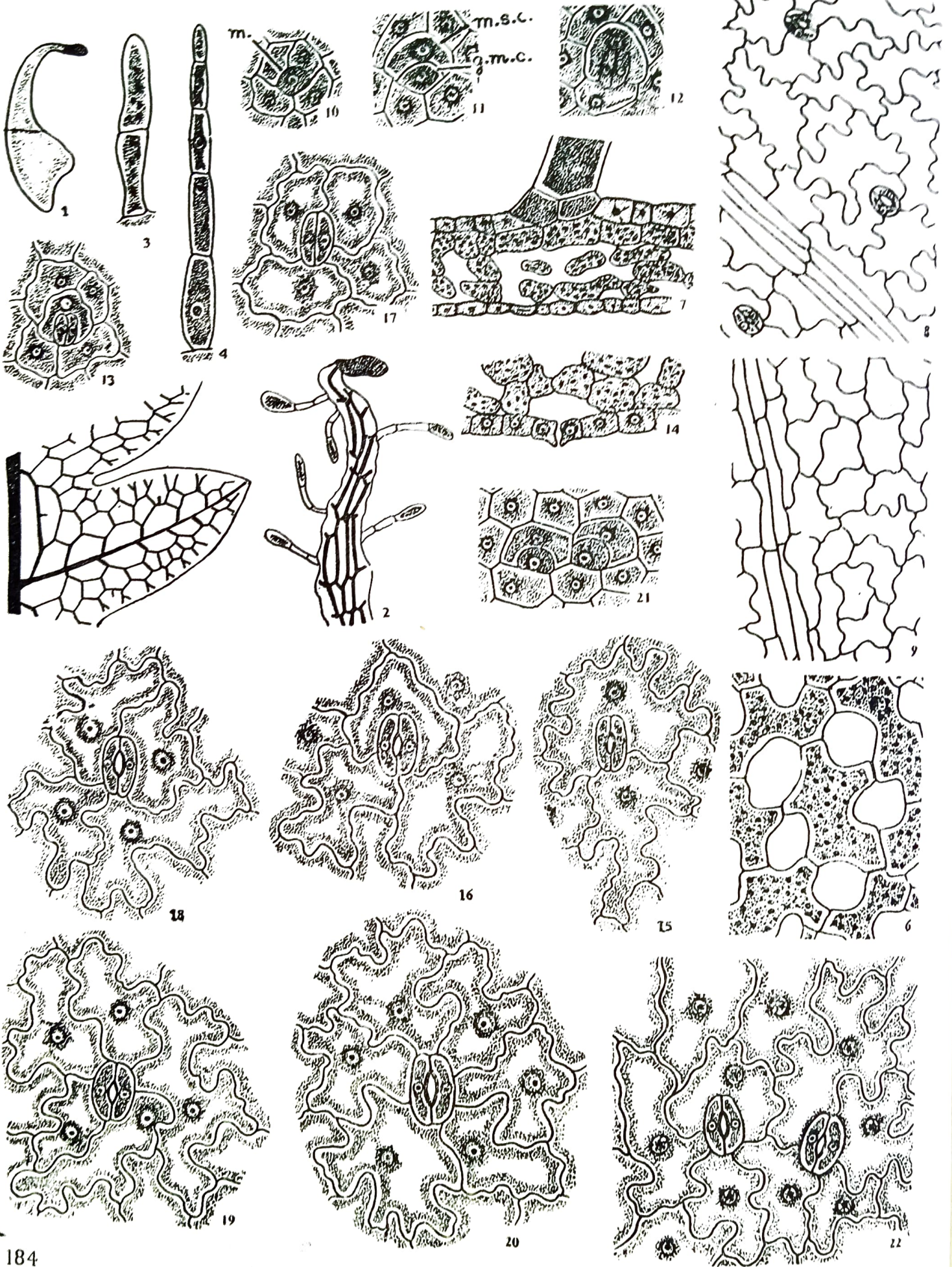
Plants of *P. conjugata* collected from Agumbe (Karnataka), were grown in the botanical garden of the Bangalore University. Epidermal peels were taken from fresh leaves and also from leaves fixed in F.A.A. Peels were stained in 1% aqueous safranin and mounted in dilute canada balsam. Transverse and paradermal sections of the leaves were cut at 10-14 μ after the usual process of dehydration. These were stained in 2% alcoholic safranin.

OBSERVATIONS

The large frond, 90 \times 42 cm, has a grooved stipe which is 35 cm long and is scaly at the base. The triangular subcoriaceous lamina 55 \times 42 cm, bears 3-4 pairs of opposite or sub-opposite pinnae. Each pinna is pinnatisect with a caudate apex. The basiscopic pinna is the largest and is further subdivided. Each pinnule is pinnatisect with a caudate apex. The basiscopic pinnule is the largest and is further sub-divided. Each pinnule is pinnatifid with obtuse segments and is densely hairy at the sinuses.

Numerous shining red-brown sessile scales are adpressed by their broad bases, to the stipe of a young frond (Text-fig. 1). The acuminate tip of a scale has an elliptic gland and the margin has small, 3-celled hairs with terminal ovoid glandular cell (Text-fig. 2). Scattered on both the surfaces of the lamina are 2-celled hairs (Text-fig. 3). In addition to these, 4-5-celled uniseriate hairs, with two-celled bases inserted between the epidermal cells are also found (Text-figs. 4 & 7).

Veins are distinct on both the surfaces of the lamina. The hard shining rachis gives off opposite veins to the pinnae which run up to the tip of each pinna. From the midrib of the pinna lateral veins are given off alternately which run into the pinnule. From these lateral veins, secondary veins are produced at an angle of 45°, which enter each lobe



of the pinnule (Text-fig. 5). Each secondary vein soon after its emergence gives off a tertiary vein which runs parallel to the secondary vein. A costal areole is thus formed. From the secondary vein alternatively, 5-6 pairs of tertiary veins are produced. These branch and the branches fuse at an angle to form secondary areoles on either side of the secondary veins. While the costal areoles are devoid of free included veinlets, most of the other areoles possess simple free included veinlets. Towards the margin of pinnule lobes, veins are free and forked 1-3 times.

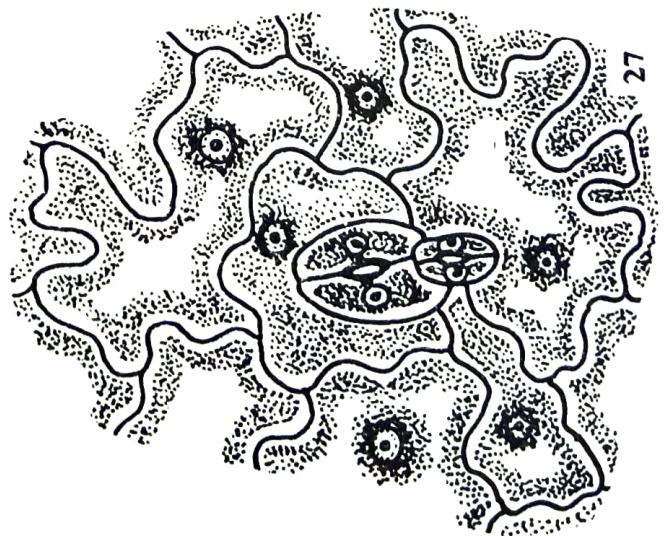
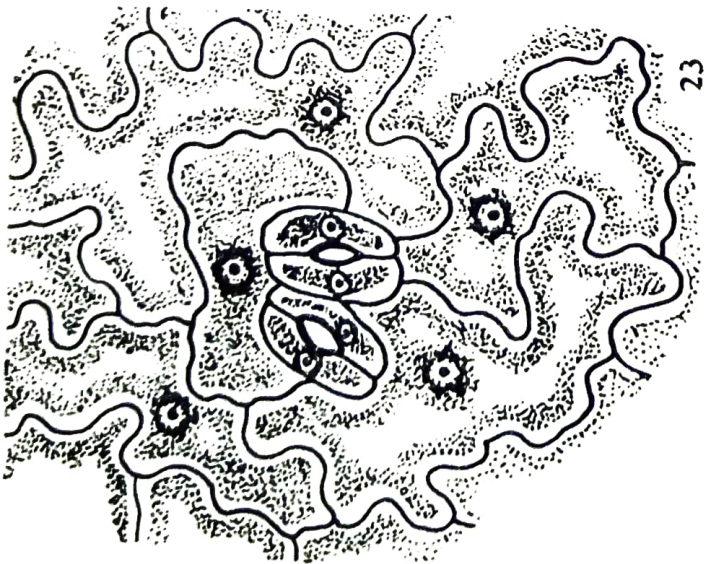
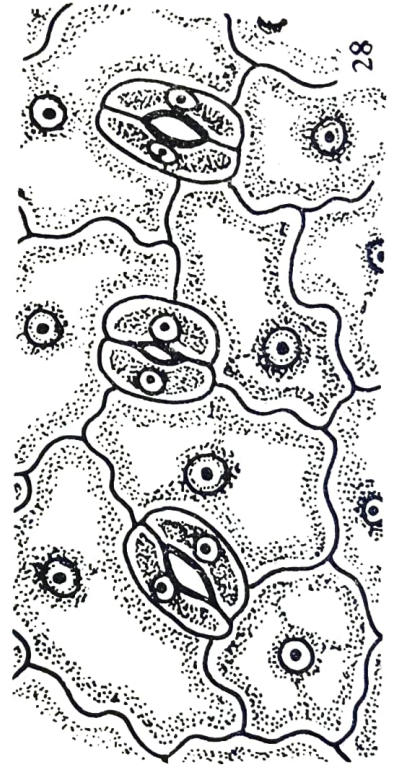
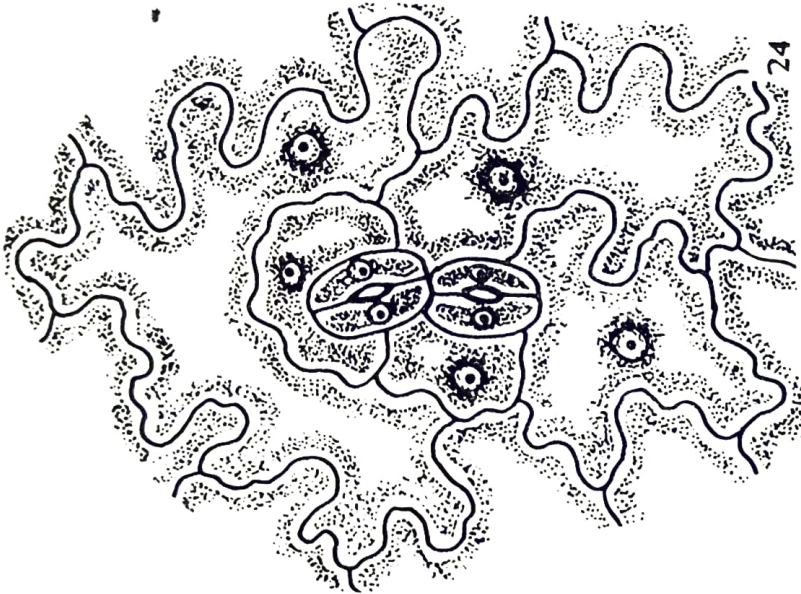
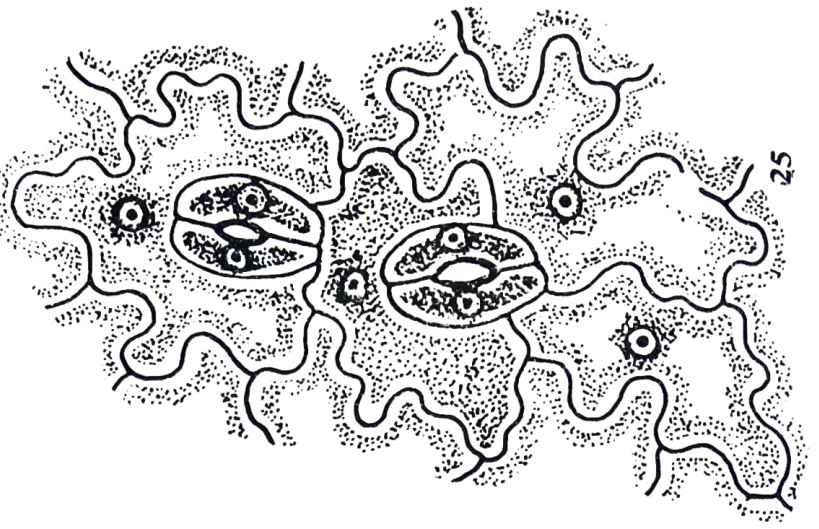
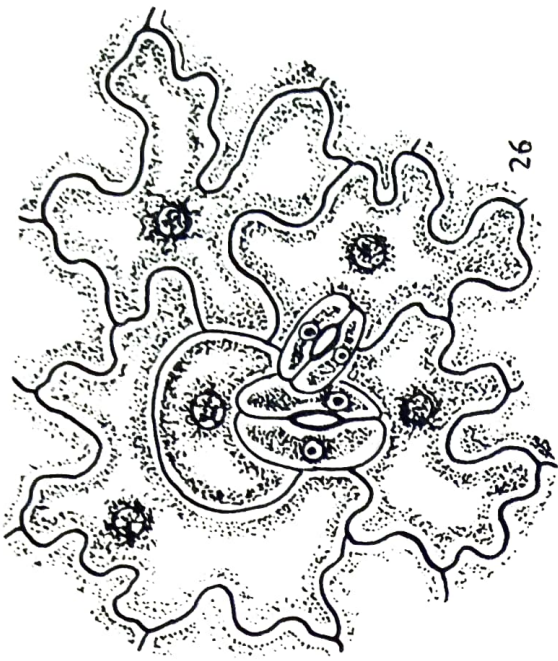
Lamina is composed of 3-4 layers of undifferentiated densely chlorophyllous armed palisade cells with large air spaces (Text-fig. 6). Below the upper epidermis, these cells are compactly arranged (Text-fig. 7).

Epidermal cells are chlorophyllous, irregularly shaped with sinuous walls as seen in a paradermal section. A cell of the lower epidermis $23 \times 10 \mu$, is markedly more sinuous than that of the upper epidermis $20 \times 16 \mu$. Epidermal cells over veins of a leaf are narrow, elongated and have comparatively straight outlines (Text-figs. 8 & 9). A stomatal meristemoid is slightly smaller in size, has denser cytoplasm and larger nucleus than surrounding epidermal cells (Text-fig. 10). This cell divides to produce a larger curved cell—the mesogenous subsidiary cell and a smaller cell—the guard cell mother cell (Text-fig. 11). The latter assumes an oval shape and divides by a vertical wall to produce the two guard cells (Text-fig. 12). The mesogenous subsidiary cell enlarges and its wall also becomes sinuous (Text-fig. 13). The lenticular guard cells are slightly raised above the surface of the epidermal cells. Each guard cell has a prominent beak-like median papilla (Text-fig. 14). In an adult leaf 22 stomata were found per mm^2 of lamina.

An adult stoma $18 \times 8 \mu$, with the opening $80 \times 5 \mu$, is surrounded by the mesogenous subsidiary cell on one side and one or two perigenous cells on the other (Text-figs. 15 & 16). A peculiarity is that even in a young stoma as soon as the guard cells are formed, a vertical wall is laid in the mesogenous subsidiary cell (Text-fig. 17). Subsequent divisions of the mesogenous subsidiary cell followed by the perigenous cell or cells results in a stoma being surrounded by 4, 5 and 6 cells (Text-figs. 18, 19 & 20). All these cells look alike in an adult stoma although their origin may be different.

A few twin stomatal meristemoids (Text-fig. 21) and adult twin stomata are found (Text-fig. 22). Lateral twinning is also seen where both the stomata are surrounded on one side by a common mesogenous subsidiary cell (Text-fig. 23). Lateral twinning has been reported in *Blechnum orientale* Linn. (INAMDAR *et al.*, 1971). End to end twinning has also been observed in our material. In such twinning two stomata lie in a line, their poles touching each other (Text-fig. 24). In some cases two stomata are found to lie very close to one another and the mesogenous subsidiary cell of one appears to form the perigenous cell of the other (Text-fig. 25). It is difficult to categorically trace the ontogeny of such a condition. Apart from these types of twinning, a rather unusual type has been

Text-figs. 1-22, 1. A scale on a young stipe $\times 15$, 2. Tip of a scale enlarged $\times 330$ 3-4, Uni-seriate hair $\times 128$, 5. Venation pattern of a pinnule $\times 10$, 6. Mesophyll in surface view $\times 26$, 7. T. S. of portion of pinna. Note the bi-celled base of a foliar hair $\times 26$, 8-9. Surface view of lower and upper foliar epidermis $\times 26$, 10. A stomatal meristemoid, 11. A meristemoid divided to form the mesogenous subsidiary cell and the guard cell mother cell, 12. Guard cell mother cell divided to form the two guard cells, 13. Young stoma, 14. V. S of a mature stoma showing the median beak-like papilla, 15-16. Adult stomata surrounded by a single mesogenous subsidiary cell on one side and one/two perigenous cells on the other side respectively, 17. Young stoma showing the vertical division of the mesogenous subsidiary cell, 18-20. Adult stomata surrounded by 4, 5 and 6 cells respectively, 21. Twin stomatal meristemoid, 22. Adult twin stomata, 10-22 $\times 330$. *m.*, meristemoid; *m.s.*, mesogenous subsidiary cell; *p.c.*, perigenous cell.



observed in this fern and quite frequently too (5%). Here two stomata of different sizes are placed very closely *one above the other*. In such super-imposed twinning, the smaller stoma is invariably at a higher level and is oriented at different angles to the larger (Text-figs. 26 & 27). So far as we are aware, this kind of twinning has not been reported in ferns. All attempts to trace fully the ontogeny of this type of twinning was not successful. Stomata lying contiguously are rather rare (Text-fig. 28).

CONCLUSIONS

Stomatal development in *Pleocnemia conjugata*, which had not been studied so far, has been investigated in detail. The stomatal development can be referred to the *Plagiogyria* type of PANT (1965) and the eupolo-mesoperigenous type of FRYNS-CLAESSENS AND COTTHEM (1973). Lateral twinning and end to end twinning of the adult stomata are frequently observed. But a more common, intriguing and hitherto unreported, superimposed twinning of stomata has been found in nearly 5 per cent of the stomata observed.

ACKNOWLEDGEMENTS

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Text-figs. 23-28, 23. Lateral twinning, 24. End to end twinning, 25. Two stomata lying close to one another. The mesogenous subsidiary cell of one forms the perigenous cell of the other, 26-27. Super-imposed stomata, 28. Contiguous stomata, 23-28. \times 330.