

EPIDERMAL STUDIES IN SOME SPECIES OF *PTERIS* L.*

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ABSTRACT

Epidermal structure of 18 species and 4 varieties of *Pteris* is described. The anticlinal walls of upper and lower epidermal cells are sinuous. Stomata are of polocytic type; but in some species, anomocytic type has also been recorded. Stomatal frequency is highest in *P. wallichiana* and the largest stomata occur in *P. aspericaulis* and *P. quadriaurita* var. *argentea*. Four species viz., *P. cretica* var. *wilsonii*, *P. insignis*, *P. multifida* and *P. pellucida* are characterised by the presence of 'spicular cell' in the epidermis. The present study lends support to the view that pteroid ferns have schizacaceous ancestry.

INTRODUCTION

Pteris L. is a large genus (ca. 280 spp.) of terrestrial ferns, widely distributed throughout the tropics. From India ca. 27 species and one variety are recorded occurring in wild condition (BEDDOME, 1892). However, in addition to these, there are a large number of green-house varieties (some of which possess highly dissected, fringed or variegated pinna) which constitute an important component of ornamental horticulture. Little attention has been given to the various species and varieties of *Pteris*, especially those which are under cultivation in the Indian gardens and nurseries. The present study is aimed at using the epidermal character, the significance of which is well demonstrated earlier (CHANDRA & HASHIM, 1974; FRYNS-CLAESSENS & VAN COTTHEM, 1973; PANT, 1965; THRUSTON, 1969; VAN COTTHEM, 1970; INAMDAR *et al.*, 1971), for a better understanding of the various species and in assessing the phylogeny and relationship of the genus.

MATERIAL AND METHOD

The following species and varieties were investigated: *Pteris asperula* Hieron., *P. aspericaulis* J. G. Agardh, *P. biaurita* L., *P. crassiuscula* Ching *et. C. H. Wang*, *P. cretica* L., *P. cretica* var. *albolineata* Hook., *P. cretica* var. *wilsonii* Hort., *P. excelsa* Gaud., *P. grevilleana* J. G. Agardh, *P. insignis* Mett., *P. khasiana* (Clark) Hieron., *P. multifida* Poir., *P. longipinnula* J. G. Agardh, *P. mertensioides* Willd., *P. pellucida* Presl., *P. quadriaurita* Retz., *P. quadriaurita* var. *argentea* Bedd., *P. semipinnata* L., *P. vittata* L., *P. wallichiana* J. G. Agardh.

The material of above species was collected by the senior author during the various plant collection tours to the different parts of the country. However, in some cases fresh leaves have also been used from the plants growing in the fernery of the National Botanical Research Institute, Lucknow. Methodology followed in the preparation of slides and recording of observations (as given in Table-1) is the same as described earlier (CHANDRA & HASHIM, 1974.)

*N. B. R. I. Research Publication No. 83 (N.S.)

Table 1. Illustrates in different species, the measurements of various epidermal characters such as epidermal cells size, stomatal size, frequency, etc.

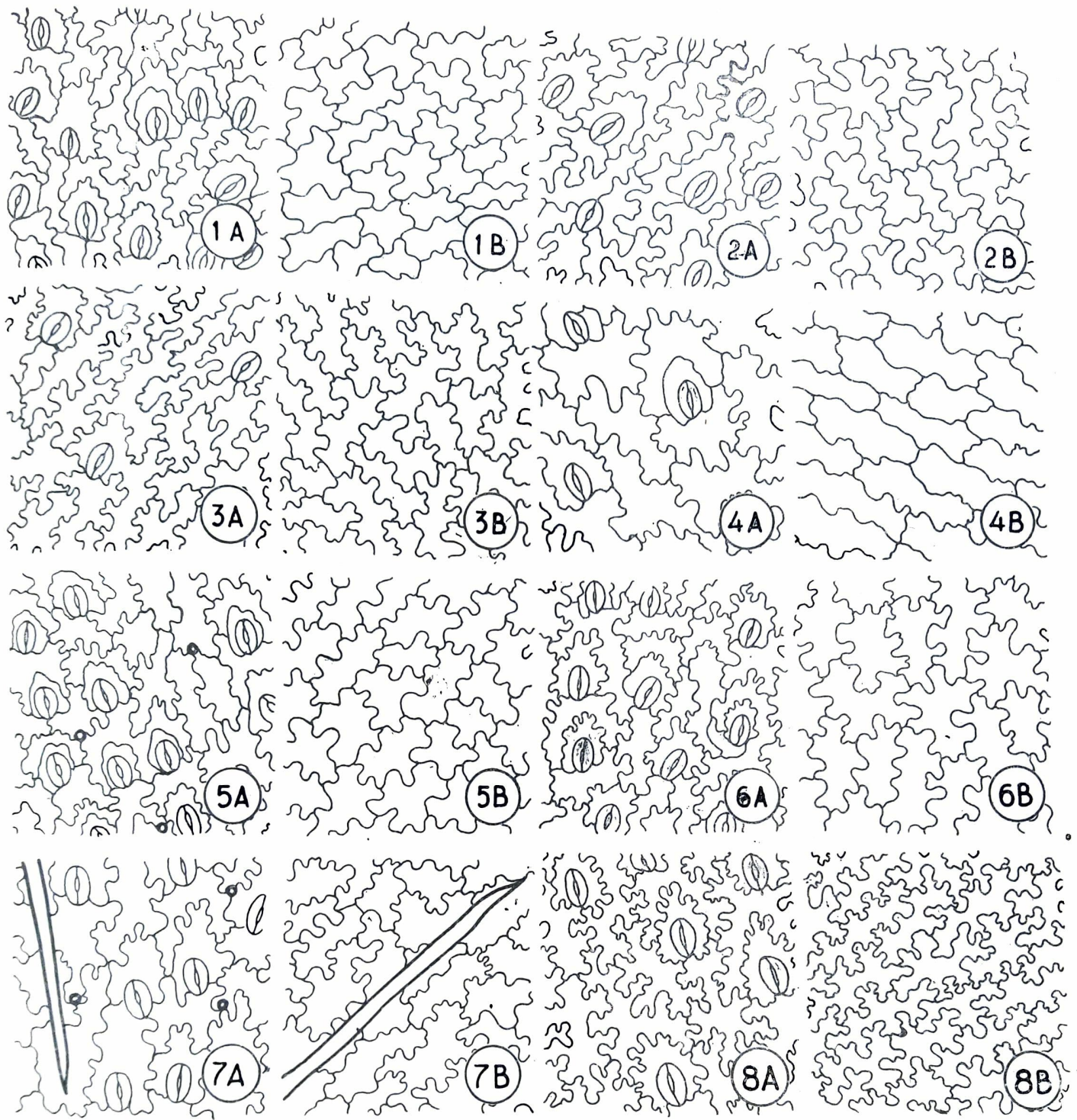
Name of species	Epidermal cell Size in μm		Stomata		Stomatal	Trichomes	
	L	U	No/sq. mm	Size in μm	Index	L	U
<i>Pteris asperula</i>	108 × 31	92 × 43	64	47 × 20	16.67	A	A
<i>P. aspericaulis</i>	126 × 42	110 × 48	52	49 × 28	16.45	A	A
<i>P. biaurita</i>	172 × 55	151 × 52	68	40 × 20	19.1	A	A
<i>P. crassiuscula</i>	180 × 72	152 × 60	16	42 × 25	12.9	A	A
<i>P. cretica</i>	117 × 67	196 × 60	88	36 × 21	22.46	P	A
<i>P. cretica</i> var. <i>albolineata</i>	146 × 58	120 × 65	80	43 × 26	23.53	A	A
<i>P. cretica</i> var. <i>wilsonii</i>	182 × 50	160 × 53	44	40 × 30	23.4	P	A
<i>P. ensiformis</i>	187 × 60	153 × 48	44	45 × 26	22.91	A	A
<i>P. ensiformis</i> var. <i>victorae</i>	103 × 36	86 × 40	110	36 × 23	40.44	P	A
<i>P. excelsa</i>	81 × 32	76 × 30	78	40 × 20	29.58	P	A
<i>P. grevilleana</i>	183 × 55	173 × 55	36	45 × 27	20.45	A	A
<i>P. insignis</i>	176 × 48	122 × 36	48	40 × 20	17.4	A	A
<i>P. khasiana</i>	86 × 46	79 × 53	196	33 × 23	32.00	A	P
<i>P. multifida</i>	178 × 48	171 × 45	72	38 × 24	29.03	P	A
<i>P. longipinnula</i>	126 × 40	93 × 47	108	40 × 20	31.4	P	P
<i>P. mertensioides</i>	90 × 38	81 × 53	72	47 × 20	23.68	P	P
<i>P. pellucida</i>	144 × 72	122 × 78	68	36 × 20	16.2	A	A
<i>P. quadriaurita</i>	140 × 52	130 × 51	49	45 × 19	12.72	A	A
<i>P. quadriaurita</i> var. <i>argentea</i>	144 × 56	133 × 53	52	49 × 20	24.2	P	P
<i>P. semipinnata</i>	114 × 48	110 × 56	60	35 × 19	16.12	P	P
<i>P. vittata</i>	178 × 42	138 × 57	64	41 × 25	17.00	A	A
<i>P. wallichiana</i>	60 × 45	60 × 38	264	36 × 23	33.34	P	P

L, Lower ; U, Upper ; A, Absent ; P, Present.

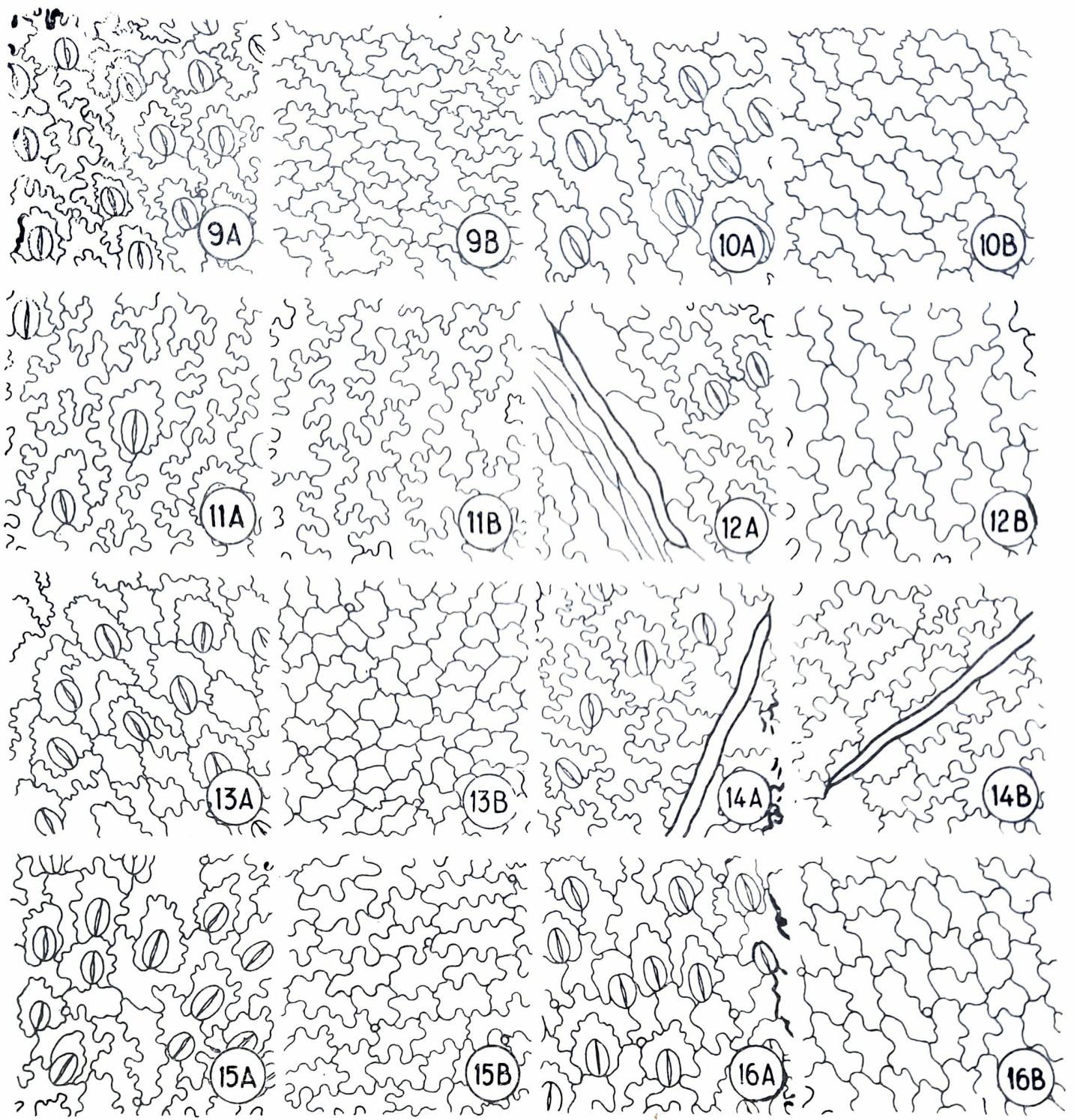
OBSERVATIONS

Epidermal cells—Epidermal cells on both the surfaces are thin-walled and elongated parallel to the midrib. The upper epidermal cells in all the species are irregular in shape. The anticlinal wall of upper epidermal cells are sinuous in all the species (Figs. 1B—22B). The size of upper epidermal cells varies considerably in the different species (Table-1). The smallest cells are recorded in *Pteris wallichiana* ($60 \times 38 \mu\text{m}$) and the largest in *P. grevilleana* ($182 \times 55 \mu\text{m}$). The lower epidermal cells are almost similar to upper ones in their shape. The longest cells occur in *P. ensiformis* ($187 \times 60 \mu\text{m}$) and the smallest in *P. wallichiana* ($60 \times 45 \mu\text{m}$). In all the species the anticlinal walls of lower epidermal cells are deeply sinuous (Figs. 1A—22A). In some species like *Pteris ensiformis* (Fig. 8A), *P. grevilleana* (Fig. 11A), *P. semipinnata* (Fig. 20A) and *P. vittata* (Fig. 21A), the situations are sometimes lobate (terminology after VAN COTTEN, 1968).

Stomata—The leaves are hypostomatic in all the species. Stomata are usually polycytic surrounded by a single large subsidiary cell (VAN COTTEN, 1968). How-



Figs. 1-3 Fig. 1. A-B., *Pteris asperula*. Fig. 2. A-B, *P. aspericaulis*. Fig. 3. A-B, *P. biaurita*. Fig. 4 A-B *P. crassiuscula*. Fig. 5. A-B, *P. cretica*. Fig. 6. A-B, *P. cretica* var. *albolineata*. Fig. 7. A-B, *P. cretica* var. *wilsonii*. Fig. 8. A-B, *P. ensiformis* (A-lower, B-upper epidermal cells, Figs. $\times 100$).



Figs. 9-16. Fig. 9. A-B, *P. ensiformis* var. *victorae*. Fig. 10. A-B, *P. excelsa*. Fig. 11. A-B, *P. grevilleana*. Fig. 12. A-B, *P. insignis*. Fig. 13. A-B, *P. khasiana*. Fig. 14. A-B, *P. multifida*, Fig. 15. A-B, *P. longipinnula*. Fig. 16. A-B, *P. mertensioides*. (A-lower, B-upper epidermal cells. Figs. $\times 100$).

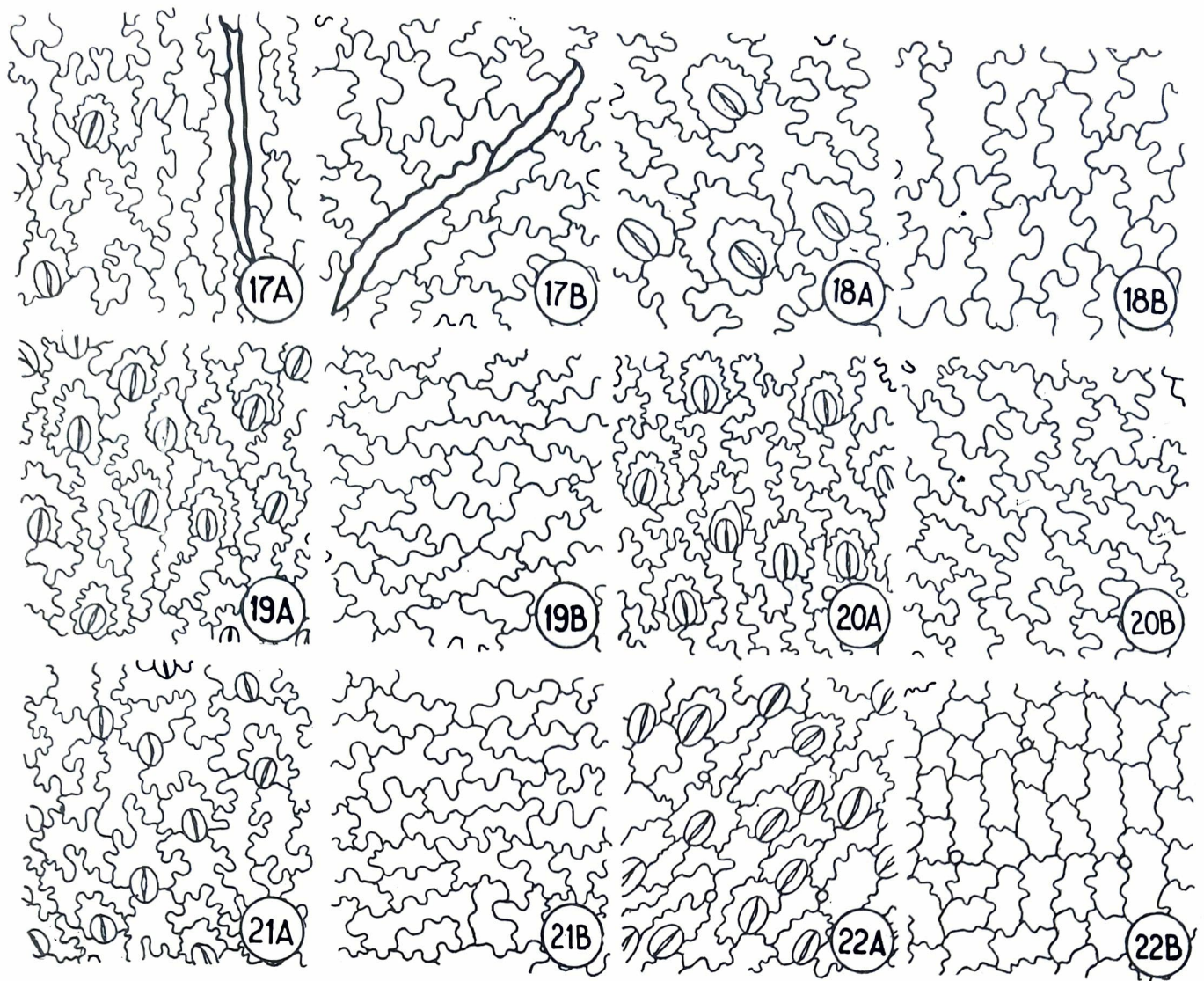


Fig. 17-22. Fig. 17 A-B, *P. pellucida*. Fig. 18. A-D, *P. quadriaurita*. Fig. 19. A-B, *P. quadriaurita* var. *argentea*. Fig. 20. A-B, *P. semipinnata*, Fig. 21. A-B, *P. vittata*. Fig. 22. A-B, *P. wallichiana*. (A-lower, B-upper epidermal cells. Figs. $\times 100$).

ever, in some species like *Pteris asperula* (Fig. 1A), *P. aspericaulis* (Fig. 2A), *P. biaurita* (Fig. 3A), *P. excelsa* (Fig. 10A), *P. insignis* (Fig. 12A), *P. mertensioides* (Fig. 16A), *P. pellucida* (Fig. 17A), *P. quadriaurita* (Fig. 18A), *P. semipinnata* (Fig. 20A), *P. vittata* (Fig. 21A), and *P. wallichiana* (Fig. 22A), mixed with polocytic ones anomocytic type (VAN COTTEN, 1968) of stomata have also been recorded. The stomatal frequency is highest in *P. wallichiana* (264 per sq. mm), whereas in *P. crassiuscula* it is the lowest (16 per sq. mm). The size of stomata ranges between $35 \times 19 \mu\text{m}$ to $47 \times 20 \mu\text{m}$ in a majority of species. The largest stomata occur in *P. aspericaulis* ($49 \times 28 \mu\text{m}$) and *P. quadriaurita* var. *argentea* ($49 \times 20 \mu\text{m}$); in *P. khasiana* the stomata are smallest in size ($33 \times 23 \mu\text{m}$).

Trichomes—Trichomes have been observed in 8 species and 3 varieties, viz. *Pteris cretica*, *P. cretica* var. *wilsonii*, *P. ensiformis* var. *victoriae*, *P. excelsa*, *P. khasiana*, *P. multifida*, *P. longipinnula*, *P. mertensioides*, *P. quadriaurita* var. *argentea*, *P. semipinnata* and *P. wallichiana*. The hairs are uniseriate, multicellular (2-6 celled) with a swollen glandular terminal cell and a short basal cell. These are sparsely distributed, all over, on both the surfaces of the leaf in all the above species except *P. cretica*, *P. cretica* var. *wilsonii*, *P. ensiformis* var. *victoriae*, *P. excelsa* and *P. multifida* where they are confined to the lower and in *P. khasiana* on the upper surface only.

Spicular cells—Narrow, elongate, highly thick-walled cells, having parallel sides and tapering at both the ends, have been observed in four species of *Pteris* viz. *P. cretica* var. *wilsonii*, *P. insignis*, *P. multifida* and *P. pellucida*. These cells ('spicular cells') occur on both the epidermal surfaces in *P. cretica* var. *wilsonii* (Fig. 17A, B), *P. multifida* (Fig. 14A, B) and *P. pellucida* (Fig. 17A, B), and only on the lower surface in *P. insignis* (Fig. 12A).

DISCUSSION

Much controversy exists regarding the circumscription of the family Pteridaceae of COPELAND (1947) and relationship of the various groups of genera included therein (CHING, 1940 ; HOLTUM, 1947, 1949 ; ALSTON, 1956 ; PICHI-SERMOLLI, 1958). COPELAND (1947) included as many as eight phyletic groups in the family, viz. dicksonioid—, dennstaedtioid—, lindsayoid, pteroid, syngamma-coniogramma, cheilanthoid (gymnogrammoid), *Eriosorus* and *Adiantum*. These groups belong either to cyatheoid stock (dicksonioid, dennstaedtioid, lindsayoid) or to schizaeaceous stock (*Syngamma*, *Coniogramma*, cheilanthoid, *Eriosorus*, *Adiantum*) from which the pteroid ferns are supposed to have evolved. COPELAND (1947) suggested dennstaedtioid ancestry of the genus *Pteris*, and its evolution through the chaetopteroid genera (*Paesia*, *Pteridium*, *Histiopteris*, *Lonchitis*, *Anisosorus*) which are intermediate between dennstaedtioid ferns and *Pteris*. The epidermal features in *Pteris* species however, do not indicate any affinity with those of chaetopteroid genera. There is complete absence of polocytic type of stomata in chaetopteroid genera which is so common in *Pteris* species. ALSTON (1956) and PICHI-SERMOLLI (1958) are also of the opinion that chaetopteroid genera are not closely related to *Pteris* and may be separated from the latter. The epidermal features in investigated species of *Pteris* show remarkable similarity with the various groups of schizaeaceous stock (*Syngamma*, *Coniogramma*, *Eriosorus*, *Adiantum*) in the presence of polocytic type of stomata, which commonly occurs in the above genera (VAN COTTHEM, 1968). Therefore, dennstaedtioid ancestry of the genus is not supported from the epidermal features. Characteristic 'spicular cells' which are reported only in vittarioid ferns and *Adiantum* species (BOWER, 1923—28 ; PICHI-SERMOLLI, 1957 ; CHANDRA & HASHIM, 1974) have been observed in *Pteris*. Occurrence of these cells in *Pteris* indicate the close affinity of the genus with the above ferns. Apart from the 'spicular cells' *Pteris* shows resemblance with *Adiantum* in possessing trilete, tetrahedral spores (NAYAR & DEVI, 1968) and polocytic type of stomata (CHANDRA & HASHIM, 1974).

Within the genus *Pteris*, the various species show consistency in the sinuous nature of anticlinal wall of the epidermal cells on both the surfaces, presence of polocytic type of stomata and glandular hairs. *Pteris wallichiana* is characterised by having highest stomatal frequency and *P. aspericaulis* and *P. quadriaurita* var. *argentea* in possessing the largest stomata within the genus. Some of the species like *Pteris cretica* var. *wilsonii*, *P. insignis*, *P. multifida* and *P. pellucida*, stand out on account of the presence of 'spicular cells'.

ACKNOWLEDGEMENTS

Authors are highly indebted to Dr. T. N. Khoshoo, Director, National Botanical Research Institute, Lucknow for his keen interest in this work. Junior author expresses his gratitude to Director, N. B. R. I. for providing necessary facilities for this study.

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