

On foliar sclereids in the tribe *Peniantheae* of the *Menispermaceae*

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Summary : The leaf sclereids of the species of *Penianthus* and *Sphenocentrum* are described. The vegetative features found to be of use in a key to the genera and species are : types and mode of branching of sclereids ; outline midrib and thickness (width) of lamina as seen in transections. These features provide a good diagnostic character and are suggestive of the naturalness of the tribe *Peniantheae*, and at the same time separation into distinct species not so far made apparent by anatomical study.

Résumé : Description des sclérites observées dans les feuilles de *Penianthus* et de *Sphenocentrum*. Les caractères végétatifs qui se sont révélés utiles pour établir la clé des genres et des espèces sont : types et mode de ramification des sclérites ; forme de la nervure médiane et épaisseur du limbe en coupe transversale. Ces caractères fournissent de bons critères de détermination et suggèrent que la tribu des *Peniantheae* constitue un groupe naturel ; ils permettent aussi la distinction d'espèces que l'étude anatomique n'avait pas, jusqu'à maintenant, permis de mettre en évidence.

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Currently the bulk data of leaf sclereids have been mostly retrieved from the old literatures, review articles and plant anatomical texts (SOLEREDER, 1908 ; METCALFE & CHALK, 1956 ; NAPP ZINN, 1973 ; RAO & BHATTACHARYA, 1978 ; RAO & DAS, 1979). Consequent to the advent of clearing techniques, it is often felt that many of the citations from the old literature need to be examined afresh for a clearer picture of the sclereid typology, location and their patterns of distribution. An example to illustrate this point of view is the reported occurrence of lobed sac-like sclereids in leaves of *Heptacyclum zenkeri* Engl. (= *Penianthus zenkeri* (Engl.) Diels) (SOLEREDER, 1908). On reexamination of the leaves of this plant, contrary to the earlier descriptions of leaf sclereids only columnar ramiform sclereids were observed prominently interspersed in the mesophyll. Attention is therefore turned to all the other taxa belonging to the tribe *Peniantheae*, namely *Penianthus* with four species and *Sphenocentrum* with one species to investigate the mesophyll features in respect of sclereids. It was found that columnar sclereids were present in all the below listed specimens which led us to evaluate their role as a safe criterion in the identification of species.

MATERIALS AND METHODS

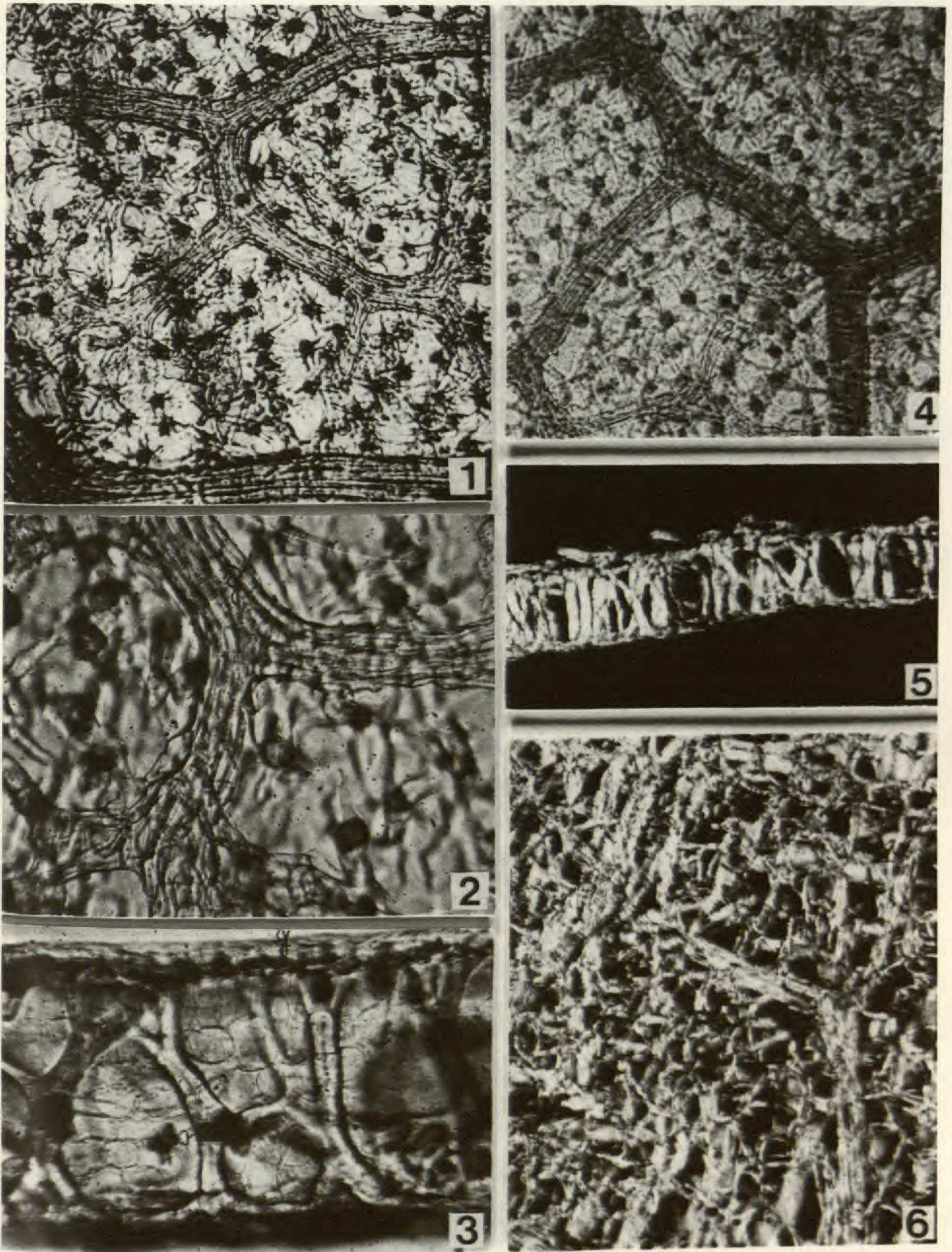
Penianthus camerounensis Dekker : *Keay & Russel 28530*, Cameroun (P). — **P. longifolius** Miers : *Bos 3303*, Cameroun (WAG); *Bos 5200*, Cameroun (WAG); *J. J. E. E. de Wilde 8097 A*, Cameroun (WAG); *Doyle de Key s.n.*, Cameroun, 1982 (P); *Leeuwenberg 6621*, Cameroun (WAG); *Van der Burg 37*, Cameroun (WAG). — **P. patulinervis** Hutch. & Dalz. : *Beentje 208, 215, 417*, Ivory Coast (WAG); *Chevalier 15507*, Ivory Coast (P); *Leeuwenberg 4481*, Ivory Coast (WAG); *Oldeman 119*, Ivory Coast (WAG); *Van der Burg 539, 590*, Ivory Coast (WAG). — **P. zenkeri** (Engl.) Diels : *Breteler 2651* (female), *2663* (male), Cameroun (WAG); *Bos 6893*, Cameroun (WAG); *W. J. J. O. de Wilde & B. E. E. de Wilde 8171c*, Cameroun (WAG); *Zenker 1904*, Cameroun (P). — **Sphenocentrum jollyanum** Pierre : *Chevalier 22743*, Benin (P).

Leaves were cleared by the modified technique of trichloroacetic acid — phenol method as outlined in a recent paper (RAO et al., 1983). Transections were cut near the cuneate base of lamina to depict the midrib outline in the different species. Sclereids were isolated after masceration and categorised according to their morphological features (RAO & BHUPAL, 1973).

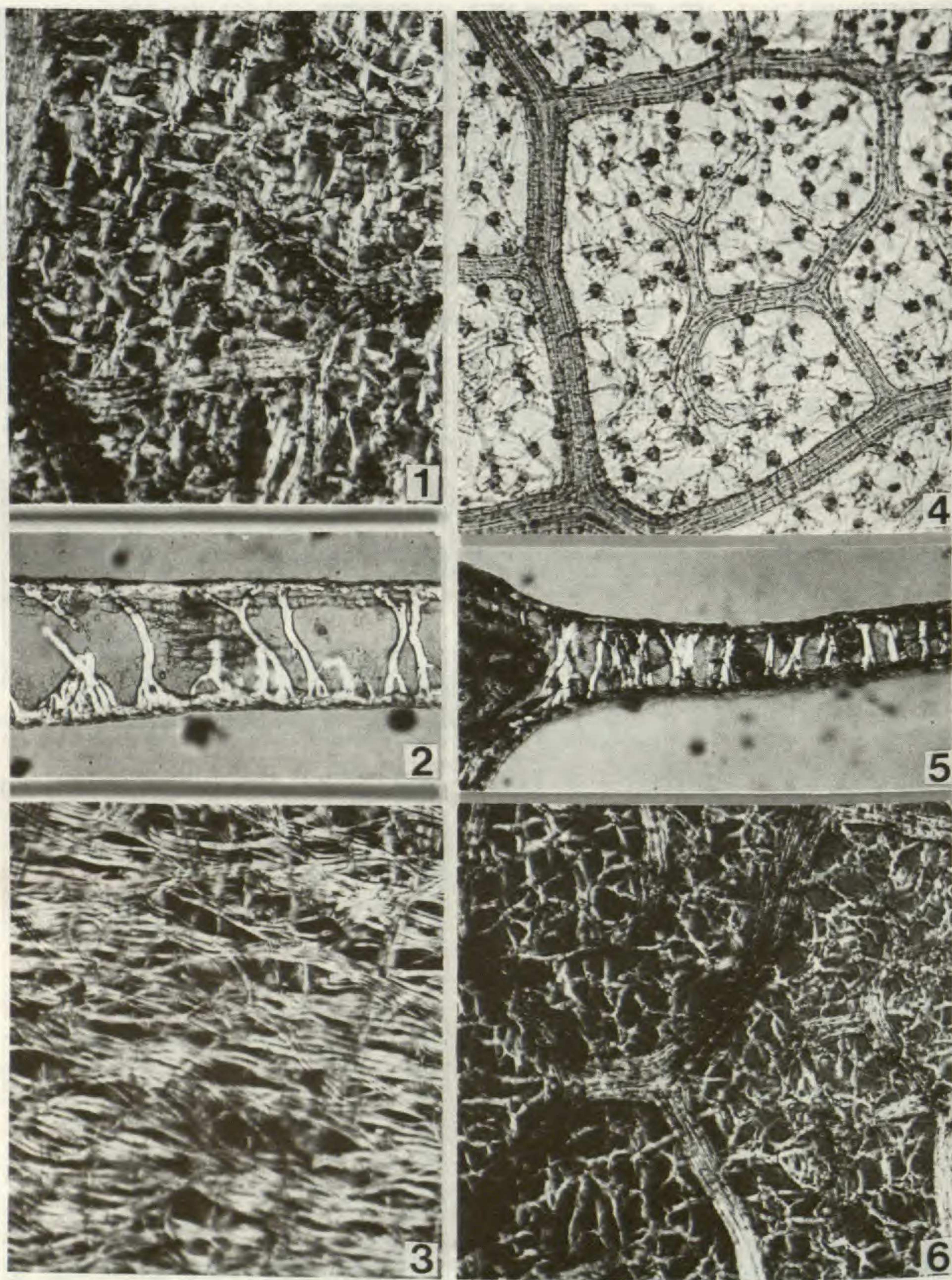
RESULTS

This study of the cleared leaves, hand sections and masceration revealed the constancy of diffuse columnar sclereids of three types : those with columnar ramiform type as in *P. camerounensis* (Pl. 3, 2) and *Sphenocentrum jollyanum* (Pl. 1, 5 ; 3, 5); those with columnar filiform type as in *P. longifolius* (Pl. 2, 2 ; 3, 1), and those with columnar polymorphic type as in *P. patulinervis* (Pl. 2, 5 ; 3, 4) and *P. zenkeri* (Pl. 1, 3 ; 3, 3).

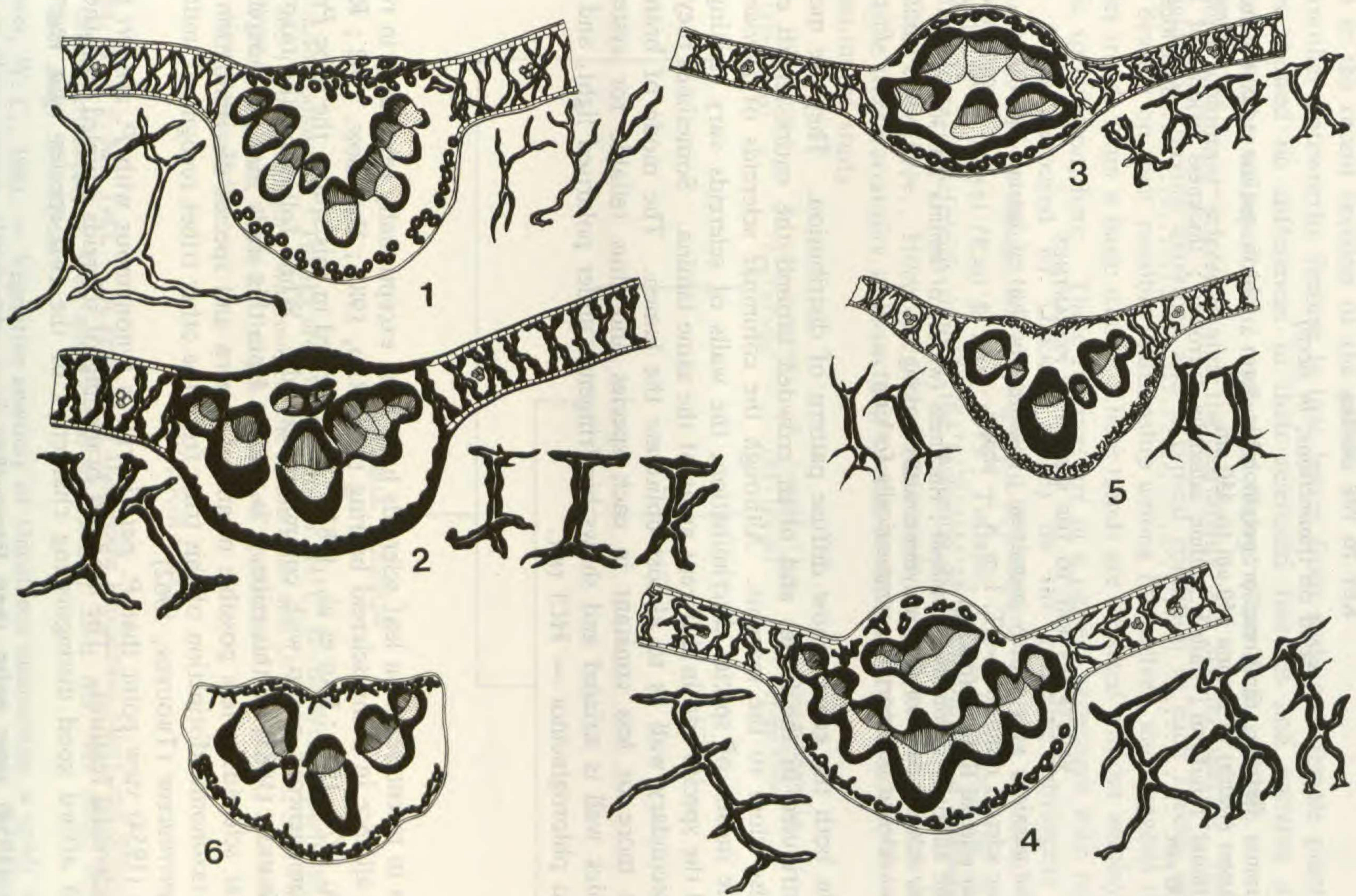
Another striking feature of these columnar sclereids is the differential pattern of their appearance from the adaxial and abaxial surfaces. In cleared leaves observed from adaxial surface the columnar sclereids appear more or less polk dotted with radiating arms of varied length as in *P. camerounensis* (Pl. 2, 4), *P. zenkeri* (Pl. 1, 1, 2), and *Sphenocentrum jollyanum* (Pl. 1, 4). In contrast the abaxial surfaces of *P. camerounensis* (Pl. 2, 6) and *S. jollyanum* (Pl. 1, 6) show stellar to dendric branches of the columnar sclereids beneath the epidermal layers. This differential pattern of appearance of sclereids is very striking in the leaves of *P. longifolius*. As viewed from the adaxial surface the branch system of columnar filiform sclereids collectively resemble a mesh work (Pl. 2, 1). In contrast from the abaxial surface collectively they form a loosely packed strand of filiform or fibre-like branches, and extend horizontally beneath the epidermis (Pl. 2, 3). Thus, the typological features and the ramifications of sclereids seem to follow more or less a fixed pattern to a certain extent and has proved to be of taxonomic value, especially in comparisons. These features are utilised as key characters along with transectional midrib outline at the cuneate base of each species in preparing a vegetative key at generic and species levels.



Pl. 1. — Cleared leaf sectors. *Penianthus zenkeri* (Engl.) Diels : 1, adaxial surface $\times 25$; 2, abaxial surface $\times 50$; 3, transverse section $\times 50$. (*Breteler 2663*, σ , WAG). — *Sphenocentrum jollyanum* Pierre : 4, adaxial surface $\times 25$; 5, transverse section under polarised light $\times 25$; 6, abaxial surface under polarised light $\times 25$. (*Chevalier 22743*, P).



Pl. 2. — Cleared leaf sectors. *Penianthus longifolius* Miers (under polarised light) : 1, adaxial surface $\times 25$; 2, transverse section $\times 50$; 3, abaxial surface $\times 25$. (Bos 5200, WAG). — *P. camerounensis* Dekker : 4, adaxial surface $\times 25$; 6, abaxial surface under polarised light $\times 25$. (Key & Russel 28530, P). — *P. patulinervis* Hutch. & Dalz. : 5, transverse section $\times 25$. (Olderman 119, WAG).



Pl. 3. — Transverse sections of leaves : 1, *Penianthus longifolius* (Bos 5200, WAG) ; 2, *P. camerounensis* (Keay & Rus-
 sel 28530, P) ; 3, *P. zenkeri* (Breteler 2663, WAG) ; 4, *P. patulinervis* (Olderman 119, WAG) ; 5, *Sphenocentrum jollyanum*
 (Chevalier 22743, P). — T.S. of petiole : 6, *S. jollyanum* (Chevalier 22743, P).

KEY TO THE GENERA

(Based on transections, *in sicco*)

- 1. Sclereid columnar filiform, ramiform or polymorphic form ; midrib outline adaxially not furrowed ; thickness (width) of lamina 150 μm to 450 μm *Penianthus*
- 1'. Sclereid columnar ramiform ; midrib outline adaxially furrowed ; thickness (width) of lamina 180 μm to 200 μm *Sphenocentrum*

VEGETATIVE KEY TO THE SPECIES OF PENIANTHUS

- 1. Midrib outline adaxially very slightly prominent ; thickness (width) of lamina 300-450 μm .
 - 2. Columnar sclereid ramiform — T, I or X — shape..... *P. camerounensis*
 - 2'. Columnar sclereid filiform-forking. *P. longifolius*
- 1'. Midrib outline adaxially gradually prominent ; thickness (width) of lamina 200-300 μm .
 - 3. Columnar sclereid polymorphic, unsymmetrically forking..... *P. patulinervis*
 - 3'. Columnar sclereid polymorphic, symmetrically forking..... *P. zenkeri*

Sclereids in both the genera show diffuse pattern of distribution. They are more or less evenly distributed in the leaves and often crowded around the entire length of the midrib, and also close to the margins. Although the columnar sclereids of *Peniantheae* offer a possible means of species discrimination, the walls of sclereids vary strikingly in thickness in all the species and in different areas of the same lamina. Sometimes they have a very thick secondary wall as to almost obliterate the lumen. The mode of branching appears to be more or less constant in each species and thus reliable for systematic study. The thick wall is striated and shows birefringence under polarised light, and positive reaction to phloroglucinol — HCl test.

DISCUSSION

Researches in recent years on leaf sclereids have been exceptionally rewarding in revealing taxonomic alliance in many sclereid bearing taxa (RAO, 1981 ; DICKISON, 1982 ; RAO & BHATTACHARYA, 1977, 1978 ; RAO et al., 1983). As revealed in this study, the tribe *Peniantheae* forms homogeneous group with columnar sclereids. While following the taxonomy presented by DEKKER (1983) on this tribe, it is evident from this study that the morphology of the columnar sclereids offers possible means of genera and species discrimination, and strengthen the taxonomic distinction of this tribe from the other tribes recognised under the African *Menispermaceae* (TROUPIN, 1962).

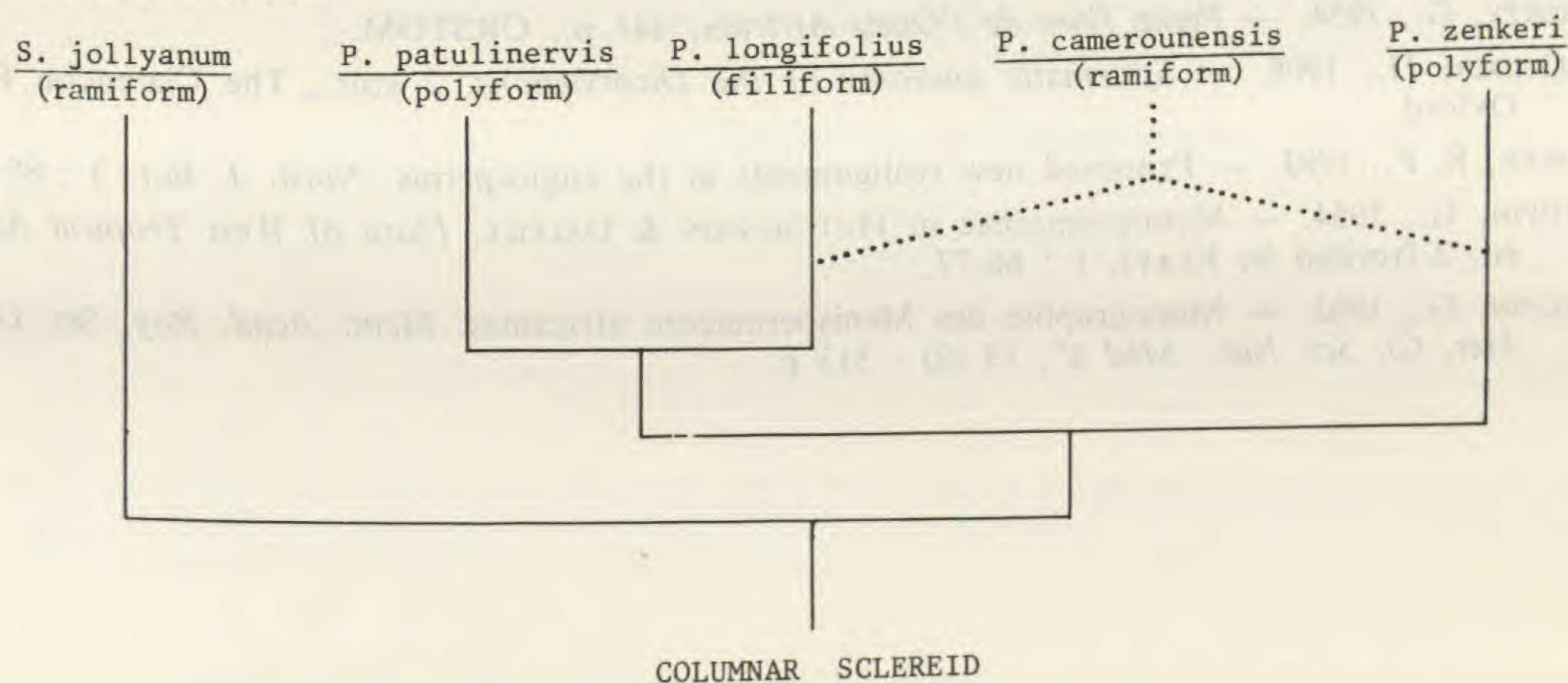
TROUPIN's (1954) view point that *P. patulinervis* is synonymous with *P. zenkeri* is not supported by sclereidal features. The mode of branching of sclereids coupled with the outlines of midrib afford good distinguishing characters of the two species with vegetative material.

ROBERTY's (1954) view point that *Penianthus* is a monotypic genus with a single variable species, namely *P. longifolius* is examined in the light of the sclereid data, obtained

in this study. It is evident that anatomical features especially the sclereids and the midrib outline are sufficiently varied to warrant the species distinction as outlined by DEKKER (1983) in the recent revision of the genus.

Another noteworthy feature is that leaves from male and female plants of the same species showed no differences in their sclereidal features and patterns of distribution. A similar feature is reported in respect of *Garrya* (RAO & DAS, 1980).

Since columnar sclereids and the variability are species specific, their study as a "population" having extremes and a typical condition in each species appears to have some bearing on their possible relationship among themselves, and suggests the existence of parallel trends from a basic stock. These trends are depicted without employing any phylogenetic speculation, here. These findings are in a perfect agreement with respect to cladogram A as favoured by DEKKER (1983) on the probable phylogeny in the tribe *Peniantheae*. Even though any phylogenetic speculation based on sclereidal features do not seem warranted as yet (RAO & DAS, 1979 ; THORNE, 1982), it is tempting to speculate that columnar form of sclereids support the inclusion of *Penianthus* and *Sphenocentrum* under the tribe *Peniantheae*. However, their constancy is suggestive of their close link, and at the same time their variability in branching system to their separation not so far made apparent by anatomical study.



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