

STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA —
38. REMARKS ON *TRIZYGIA SPECIOSA* ROYLE WITH
REFERENCE TO THE GENUS *SPHENOPHYLLUM* KOENIG

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ABSTRACT

On the basis of morphographical, epidermal and palaeogeographical differences it is proposed to separate *Sphenophyllum speciosum* (Royle, 1839) M'Clelland, 1850 from the genus *Sphenophyllum* Koenig and revert to the original nomenclature, i.e. *Trizygia speciosa* Royle, 1839.

INTRODUCTION

THE genus *Sphenophyllum* was proposed by Koenig (1825) for certain plants which Brongniart (1822) had described under the name *Sphenophyllites*. A detailed definition of the genus was later given by Seward (1898, p. 390). This plant is a characteristic member of the Carboniferous and Permian floras of the Northern Hemisphere.

Royle (1839, PL. 2, fig. 8) figured a fossil from the Bardwan Coal Measures of India under the name *Trizygia speciosa* (l.c., p. XXIX*). He (ROYLE, l.c., p. 431) referred this species as well as the genus *Sphenophyllum* to Marsileaceae. According to Arber (1905, p. 34) the fact that the leaves are arranged in three pairs of unequal size led Royle to institute the genus *Trizygia*, while according to Feistmantel (1879, p. 165) *Trizygia* was proposed by Royle on account of arrangement of leaves, always six in three pairs on one side of the nodes. However, Royle in his original description (l.c., p. XXIX* and 431) has given no reason whatsoever for the establishment of this genus.

M'Clelland (1850, p. 54) on the basis of its close resemblance with the species of the genus *Sphenophyllum* renamed it as *Sphenophyllum speciosa*. Feistmantel (1876a) described it as *Sphenophyllum trizygia*. Grand'Eury (1877) remarked that *Trizygia speciosa* resembles *Sphenophyllum oblongifolium*. Feistmantel (1879), however, reverted to Royle's name *Trizygia*. Between *Trizygia* and *Sphenophyllum* he differentiated thus:

A — Leaf whorls complete round the joint; stalk pretty thick; number of leaves

variable; leaves of the same size and shape in the same whorl — *Sphenophyllum*.

B — Whorls incomplete on one side of the joints; stalk comparatively thin; number of leaves six, arranged in three pairs, of which each differs from the other in size and partly also in shape of the leaves — *Trizygia*.

But all the same he believed that *Trizygia* may be considered as representative of the Carboniferous *Sphenophyllum*, though as an independent genus.

In all his later publications he refers this plant as *Trizygia speciosa* (1880, 1882, 1886 etc.). On the basis of discovery of specimens similar to the Indian species by Bosniaski in the Carboniferous beds of Monte Pisano, and by Zeiller in the Coal-Measures and the Permian, Zeiller (1891) included the Indian species in the genus *Sphenophyllum*. Seward (1898) and Arber (1905) supported this view which has since then been followed to this date. This view was further strengthened by the close similarity between the vegetative shoots of the Indian species and *Sphenophyllum sino-coreanum* Yabe, 1920. Halle (1927, p. 49) was so much impressed by resemblances between some specimens of *S. sino-coreanum* and *S. speciosum* that he remarked "It would be very difficult in that case to decide whether the former should be named *S. speciosum* or *S. sino-coreanum*."

Besides India this plant has also been recorded from other Gondwanaland countries under the name *Sphenophyllum speciosum*, e.g., from Lower Bowen Series at Siberia Camp, Mt. Mulligan, Queensland (BALL, 1912; WALKOM, 1922, p. 7); Upper Wankie Sandstones, Wankie District, Southern Rhodesia (WALTON, 1929, p. 64, LACEY, 1961, LACEY & HUARD-MOINE, 1966); Lower Karroo Series, near Chiromo, Lower Shire Region, Nuyasaland (LACEY, 1958, p. 368) and Golondrina Series, Bajo de la Leona, Argentina (ARCHANGELSKY, 1958, p. 27).

DESCRIPTION

- 1839 — *Trizygia speciosa*, Royle, p. XXIX*
pl. 2, fig. 8.
- 1845 — *Trizygia speciosa*, Unger, p. 114.
- 1850 — *Sphenophyllum trizygia*, Unger, p. 71.
- 1850 — *Sphenophyllum speciosa*, M'Clelland,
p. 54.
- 1860 — *Sphenophyllum*, Oldham, p. 326.
- 1865 — *Trizygia*, Blanford, p. 31.
- 1876a — *Sphenophyllum trizygia*, Feistmantel,
p. 70.
- 1876b — *Sphenophyllum trizygia*, Feistmantel,
p. 342, pl. 15, fig. 1. 2.
- 1879 — *Trizygia*, Feistmantel, p. 165.
- 1880 — *Trizygia speciosa*, Feistmantel, p. 69.
- 1882 — *Trizygia speciosa*, Feistmantel, p. 22.
- 1886 — *Trizygia speciosa*, Feistmantel, p. 22.
- 1891 — *Sphenophyllum speciosum*, Zeiller,
p. 673.
- 1898 — *Sphenophyllum speciosum*, Seward,
p. 411, text. fig. 111.
- 1900 — *Sphenophyllum speciosum*, Zeiller,
p. 140.
- 1901 — *Sphenophyllum speciosum*, Arber,
p. 546.
- 1901 — *Trizygia*, Kidston, p. 129.
- 1905 — *Sphenophyllum speciosum*, Arber,
p. 35, pl. 1, fig. 1
- 1912 — *Sphenophyllum speciosum*, Ball,
p. 11.
- 1922 — *Sphenophyllum speciosum*, Walkom,
p. 7.
- 1929 — *Sphenophyllum speciosum*, Walton,
p. 64.
- 1958 — *Sphenophyllum speciosum*, Lacey,
p. 368.
- 1958 — *Sphenophyllum speciosum*, Archangel'sky,
p. 27.
- 1963 — *Sphenophyllum speciosum*, Pant &
Mehra, p. 51.
- 1964 — *Sphenophyllum speciosum*, Boureau,
p. 83.
- 1966 — *Sphenophyllum speciosum*, Surange,
p. 23.
- 1966 — *Sphenophyllum speciosum*, Lacey &
Huard-Moine, p. 15.

The plants belonging to this species show most of the characteristic vegetative features of the genus *Sphenophyllum*. The stems are slender and articulated with the nodes slightly swollen. The internodal region usually shows two ridges which do not alternate from one internode to the next, but are continuous. Leaves are arranged in whorls of six at the nodes; the successive whorls being superposed. A leaf

whorl is complete round the node and not on one side of the node as Feistmantel (1879, p. 166) believed them to be. The leaves are so orientated with reference to the axis that their laminae are extended in a plane parallel to the axis, so that the shoot is dorsiventral and the leaves form a flat or mosaic. The six leaves are arranged in three pairs of different shape and size. The leaves of the upper two pairs are larger, simple, entire, elongate-ovate and spreading while those of the lower pair are smallest simple, entire, ovate and reflexed. A single vein (? or more) enters each leaf, dichotomizes three to five times, but no anastomoses are formed. The number of veins at the apical margin of each leaf varies from 10-18 or sometimes even more. In fossil state the leaves are spread out in a single plane and this led Pant and Mehra (1963) to suggest that the shoots of this species were probably strangling on the ground like those of the genus *Galium* of Rubiaceae. Seward (1898, p. 389) had also made a similar comparison between the appearance of what must have been fresh green shoots of *Sphenophyllum*, and the *Galium* of hedgerows. However, there is little evidence to suggest that the shoots of *Trizygia speciosa* were strangling on the ground. The view that this plant was a creeper which supported itself on the stronger trees seems to be more acceptable.

Pant and Mehra (1963) have described the epidermal structure of this plant. The study of the epidermal preparations made by me confirms most of their observations (see SURANGE, 1966). Pant and Mehra describe the cells of one epidermis as being longitudinally elongated and with less sinuous walls. In my preparation, however, the cells of one epidermal surface have straight-walled cells. But this perhaps is a minor difference. Pant and Mehra thought that they were observing both the epidermal surfaces, while most probably their preparations show only one epidermal layer, because in pull preparations it is not always possible to tell if both layers are present. The stomata are haplocheilic. The number of subsidiary cells is not definite and they are almost indistinguishable from the ordinary epidermal cells. The guard cells are distinctly marked out because of their thickenings. Stomatal pore is elongate oval to lens-shaped. (For figures see PANT & MEHRA, 1963, and SURANGE, 1966).

DISCUSSION

As pointed out earlier this Indian species was originally described as *Trizygia speciosa* but was later included in the genus *Sphenophyllum*. Abbott (1958) has given a chart showing morphographic details of American species of the genus *Sphenophyllum*. The Indian form differs from them all in gross morphographical characters. Unlike the southern form the northern species of the genus *Sphenophyllum* show a dentate, lobed, toothed or crenate margin, except in one or two cases. In most of the northern forms the number of leaves in a whorl is 6-12, sometimes six as in the southern form. In almost all but a few northern species (e.g., *S. oblongifolium* and *S. sino-coreanum*) all the leaves of a whorl are equal. In *S. oblongifolium*, however, the apical margin is toothed and in *S. sino-coreanum* it is notched as against convex smooth margin of *S. speciosum*. The latter form is nearest to the Indian species and can with difficulty be separated from the Indian form (see HALLE, 1927, p. 47, PL. 9, FIGS. 12, 13, 18-20). Some specimens figured as *Sphenophyllum* sp. (HALLE, l.c., PL. 10, FIGS. 10-12) recall the leaf arrangement of the Indian form. But by a detailed study of shape, apical margin and venation these two Chinese species can be separated from the Indian form. Thus though morphologically the Indian form is distinct from all other species of the genus *Sphenophyllum*, yet it can not be taken out of the genus on this ground alone.

The epidermal structure of several species of the genus *Sphenophyllum* is now known (ABBOTT, 1958; RADFORTH & WALTON, 1960, and PANT & MEHRA, 1963). In *S. cuneifolium* (Sternberg, 1823) Zeiller, 1880 the epidermal cells have sinuous walls and the marginal cells in the distal part of the leaf project to form short pointed teeth (RADFORTH & WALTON, l.c., p. 103, PL. 2, FIG. 7a-c). From the description it is not clear whether both the epidermal layers have sinuous-walled cells. If so then this species is probably different on generic level from the Indian form. Stomatal structure has not been described for *S. cuneifolium* by these authors. *Sphenophyllostachys dawsonii* (Williamson, 1876) Seward, 1898 is the strobilus of *S. cuneifolium*. No reproductive structure resembling even remotely *S. dawsonii* are known

from the Southern Hemisphere. In *S. majus* (Bronn, 1828) Bronn, 1835 the subsidiary cells form almost complete ring around the stomata (ABBOTT, 1958) whereas in the Indian form the subsidiary cells are like ordinary epidermal cells and are arranged irregularly. In *S. angustifolium* (Fermar, 1845) Goepfert, 1848 hairs are present while they have not been found so far in the Indian form. *Sphenophyllum emarginatum* (Brongniart, 1822) Koenig, 1825, type species of the genus, possesses 6-9, triangular, \pm equal sized leaves with blunt teeth. The epidermal cells on the abaxial surface are rectangular and sinuous-walled. In *S. oblongifolium* (Germar & Kaulfuss) Unger the leaves of a whorl are dimorphic like those of the southern form but the apices are dentate. The epidermal cells are rectangular and sinuous-walled; stomata not known. From the above Pant and Mehra (1963, p. 55) concluded that "The Gondwana form of the genus, *S. speciosum*, may be specifically distinct but the form of its foliage shoots and epidermis strongly suggest that it belongs in all likelihood to the same natural alliance."

However, to me it seems that morphographically there is enough support for separation of the Indian form from *Sphenophyllum* and on the basis of epidermal studies too, the Indian species can be separated from the northern forms at generic level. This separation further seems desirable because of the incomplete knowledge about the Indian form; of course this point is debatable. Similarity in gross morphological characters of vegetative parts does not necessarily mean that the two individuals belong to the same taxon or rank. This has been amply proved by recent works. A leaf of *Glossopteris* closely resembles a leaflet of *Sagenopteris* but the two have different types of reproductive organs. In the genus *Glossopteris* itself while all the leaves show similar basic morphographical characters, yet they have been found to belong to 4 or more taxonomic groups — probably of generic rank (SURANGE & SRIVASTAVA, 1957). The northern genus *Annularia* is very similar to the southern genus *Stellothecca* but as there is no evidence of the presence of Calamitales in the Southern Hemisphere these two genera have been kept separate (SURANGE & PRAKASH, 1962). Without the knowledge of fructification it is seldom possible to tell whether

a fern-like frond is actually a fern or a Pteridosperm.

So unless we come to know more about our southern member of Sphenophyllales, particularly about its fructification, it seems desirable to separate it from the genus *Sphenophyllum*. And for that we can revert to the original name *Trizygia speciosa* Royle, which will be well in accordance with the views of Kräusel (1928) and Edwards (1955) that the northern forms identified in the Glossopteris flora are possibly different from similar looking elements occurring

in the north with which they have been identified.

Recently Gorelova (1962) described a new species of *Trizygia* — *T. tomiensis* from the Upper Permian of Montagneux district in Altai-Sainsk. Boureau (1964) has transferred this species to the genus *Sphenophyllum*. This change of generic name is justified as in *S. tomiensis* the leaves of a whorl do not differ in size amongst themselves as is the case in *Trizygia* and further more this species is based on a fragmentary specimen.

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