

FOSSIL PLANTS FROM THE JURASSIC ROCKS OF THE MADRAS COAST, INDIA

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INTRODUCTION

FOSSILIFEROUS rocks of Upper Gondwana age occur in numerous patches and small exposures along the eastern coast of the Peninsular India. They are represented by the Athgarah beds near Cuttack in Orissa; Golapilli sandstones, Raghavapuram shales and Tripetty sandstones near Ellore in the Godavari district; Budavada sandstones, Vemavaram shales and Pavulur sandstones in Guntur district; Kandukur group in Nellore district; Sripermatur and Satyavedu sandstones near Madras; Uttatur and Terany beds in the Trichinopoly district; and lastly near Amar-sanpatty in Madura-Ramnad districts.

Of these the beds exposed at Vemavaram (Vammevaram) are the most interesting and noteworthy as they contain a larger number of both animal and vegetable remains than any other beds met with elsewhere. The village of Vemavaram, close to which the plant-bearing marine beds are exposed, lies 14 miles N.E.N. of Ongole in Guntur district and 8 miles inland from the coast. This group constitutes the middle stage of the triple grouping by Bruce Foote of the Upper Gondwana rocks near Ongole and is equivalent to the Kota stage. The fossiliferous rocks are purple to variegated in colour, argillaceous and very hard and can be broken into thin slabs along the bedding planes. These shales are economically important as building and road material due to their hardness. A detailed description of the geology of the area was given by Bruce Foote (1879) in his classical work.

Fossil plants from these rocks were described by Feistmantel as early as 1879. While describing the geology of the area, Bruce Foote recorded some animal and plant fossils obtained from different horizons, but without figures and descriptions. Later, this was revised to some extent by Seward and Sahni (1920) and Sahni (1928, 1931) from the specimens sent by the Geological Survey of India. Spath (1933) examined

some collections of Ammonites from near about Vemavaram and described two new fossils, namely *Pascoeites budavadensis* and *Gymnoplites Simplex*.

The fossil plants described in this paper are among the collection made by me from the exposures near the village Vemavaram in the middle of December 1953 and include a pinnule of *Sphenopteris*, an interesting species of *Pterophyllum* and an impression of Cycadophytean stem.

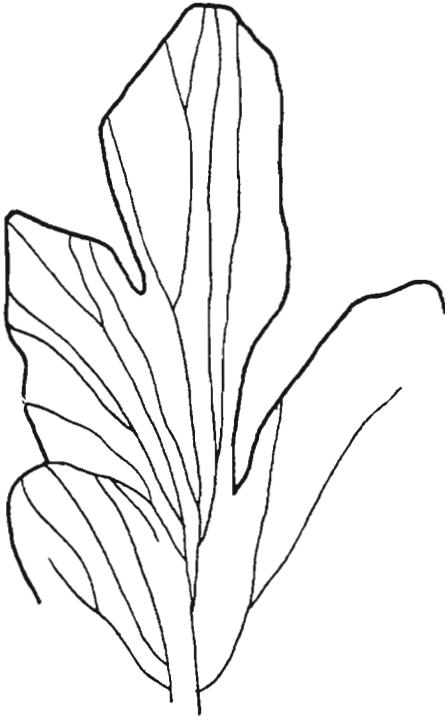
DESCRIPTION

Sphenopteris sp.

Out of the various Upper Gondwana outliers on the east coast of India, the occurrence of *Sphenopteris* has been reported by Bruce Foote from Vemavaram, Sripermatur and Trichinopoly groups, all belonging to the Kota stage. But neither figures nor descriptions of the reported specimens are available.

The present specimen (8107) is an impression of a single pinnule on a hard, variegated, argillaceous, iron-stained shale. It measures about 2 cm. in length and 1 cm. in breadth. The pinnule (PL. 1, FIGS. 1, 2) is cuneate in shape, contracting into a very short foot-stalk. It is elongated and divided unequally into four blunt and slightly pointed lobes. The lobes are obovate in shape, narrow at the base and widening towards the apex. The central one is more prominent and larger than the lateral ones. Margins are entire. The venation is very well defined. There is nothing like a midrib, instead a single stout vein (TEXT-FIG. 1) arises at the base and as a result of repeated dichotomy branches into a number of veinlets which supply the different lobes. The ultimate veins in each lobe are about 7 in number. Fructification is not seen.

Although my specimen is fragmentary, the lobing of the lamina, contraction at the base and the typical dichotomous branching of the veins radiating from the base show



TEXT-FIG. 1

that the pinnule belongs to the genus *Sphenopteris*.

Since variation in individual pinnules as regards size, shape, etc., is so very common, it is not possible to make specific identification on the basis of a single specimen.

Pterophyllum bifurcatum sp. nov.

Diagnosis — Frond with very broad rachis showing longitudinal striations, pinnae obliquely placed, broad at the base and gradually tapering towards the tip, pinnae united at the bases, tip acute, bifurcated, venation parallel, 3-4 in number.

The lower or the middle portion of a frond (PL. 1, FIG. 3) is preserved on a hard white and purple-coloured shale (SPECIMEN No. 8108), showing some complete pinnae on the right half. It measures 6 cm. in length, 4 cm. in width and is traversed by a broad rachis, 1 cm. wide, on which are seen distinctly marked longitudinal striations. The segments or pinnae into which the lamina is divided are opposite, closely arranged

rather uniformly narrow with somewhat expanded bases, which are 3 mm. broad on the average. The attachment of the pinnae to the rachis is oblique, making an average angle of about 70°. The pinnae are nearly parallel-sided, but taper gradually towards the apex. The bases are contiguous and are joined to one another. The margin gently curves upwards to a pointed tip which is bifurcated (PL. 1, FIG. 5). The bifurcation on the tips may be deep or shallow and either symmetrical, leaving two equal pointed halves or irregular, with one predominating over the other. Largest pinna is about 2½ cm. in length. The veins are few, 3-4 in number, faintly marked and widely placed. They are simple and parallel, though in rare cases dichotomous near the base.

Attempts to obtain cuticular preparations from the fossil have failed. The fossil was also studied under strong reflected light, but did not show any structure.

The general shape and form of the frond, the oblique attachment of the pinnae to the rachis, the shape of the pinnae being broad at the base and gradually narrowing down towards the apex suggests at first sight that the fossil belongs to the genus *Ptilophyllum*. But a closer examination of the bases of the pinnae shows that the manner of their attachment to the rachis is not the one characteristic of *Ptilophyllum*, instead they are united perfectly to one another, exactly as in the case of *Pterophyllum* and are attached by the whole width of their bases. The fossil is, therefore, identified as *Pterophyllum*.

Of the different species of *Pterophyllum*, *P. incisum*, described by Sahni and Rao (1933) from the Rajmahal Hills is the nearest to mine, but not identical. In the Rajmahal species the attachment of the pinnae is at right angles to the thin rachis and the margins of the pinnae are perfectly parallel and straight, whereas in the Vemavaram species the pinnae are attached at an acute angle to a broad rachis and taper gradually towards the apical end and invariably curve upwards, giving an entirely different look to the frond.

Another similar species is *P. fissum*, reported by Bruce Foote (1879) from the Vemavaram beds. Neither figures nor the description of this species from Vemavaram are available anywhere. Some fronds belonging to this species were described by Feistmantel (1877). These were later des-

cribed by Seward and Sahni (1920) as *Nilssonia fissa*, because of the veins which emerge obliquely from the rachis and run parallel for some distance before bifurcating. The main resemblance with my specimen is in the division of the apex of the leaflets. However, *N. fissa* differs by its shorter and broader pinnae, frequently dichotomizing of the veins and, on the whole, general form of the frond.

Feistmantel (1879) figured three more specimens from the shales at Vemavaram and described them as *Anomozamites fissum*, indicating the important feature — the incision on the apex of the leaflets. This was transferred by Seward and Sahni to *Nilssonia*, but after examining numerous specimens Sahni and Rao (1933) thought that the former identification may have been correct. All these fronds are wholly unlike the species in question and also are too fragmentary. All the specimens figured by Sahni and Rao as *Nilssonia* (*Anomozamites*) *fissa* differ very much from the present one in the shape and attachment of the pinnae to the rachis.

Among the foreign species, *Pseudoctenis fissa* described by Du Toit (1927) from the Molteno beds of Duart castle, Hlatimbe valley, Natal, shows similar clefting of the apices of the pinnae. But the Natal specimen does not show any resemblance, since the segments are much broader, uniformly wide with a large number of veins and are attached perpendicularly to the rachis.

There are other species of *Pterophyllum*, e.g. *Pterophyllum Thomasi* (HARRIS, 1952); *Pterophyllum* sp. b. (OISHI & HUZIOKA, 1938); *Pterophyllum* sp. (MICHAEL, 1936) and *Pterophyllum platyrachis* (ZIGNO, 1873-85), which have tapering pinnae, attached to the broad rachis at acute angles. But they all differ from *Pterophyllum bifurcatum* in not having bifurcated tips and possessing an altogether different look of the lamina.

Forking of the pinnae in *Pterophyllum bifurcatum* appears to be a normal feature, since all the pinnae which are completely

preserved invariably show this character. In this connection it is interesting to note that the forked pinnae have been recorded as abnormal feature by workers in some living cycads, for example, *Cycas circinalis* (SEWARD, 1917, p. 13); *Cycas Rumphii* var. *bifida* (THEISELTON-DYER, 1802, p. 560); *Cycas revoluta* grown at Allahabad (PANT, 1953); *Encephalartos Lehmanni* E. Caffer (?) (WIELAND, 1906) and *E. horridus* (SCHUSTER, 1932).

CYCADOPHYTEAN STEM

On the rock specimen bearing the *Sphenopteris* pinnule is also seen an impression of a small cycadophyean stem, 1.5 cm. in length and 1 cm. in breadth (PL. 1, FIG. 6). A portion of the fragment shows the armour of the scars of leaf bases which are rhomboidal in shape. It is not possible to determine with certainty whether there are zones of large and small leaf bases, but the leaf bases present are quite large, approximately uniform in size and broader than long, measuring about 2×1 mm. At the centre of each leaf base a transversely elongated line is seen in the form of a raised surface. The leaf bases are arranged most probably in spiral fashion. Neither the vascular bundles nor the leaf traces are preserved.

The morphological features and the general appearance of the stem suggest it to be a cycadean type. There is no record of cycadean stems from the Madras Coast flora, although several of them are known from the Rajmahal Hills, Bihar (BANCROFT, 1913; BOSE, 1953; SAHNI & RAO, 1933; GANJU, 1946) and hence the significance of this specimen. Unfortunately my specimen is too poorly preserved to be identified even generically.

ACKNOWLEDGEMENT

I feel it a pleasure to thank Dr. K. R. Surange under whose guidance the work was carried out.

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EXPLANATION OF PLATE 1

1. *Sphenopteris* pinnule. × 4.
2. *Sphenopteris* pinnule. × 6.
3. *Pterophyllum bifurcatum* sp. nov. Nat. size.
4. *Pterophyllum bifurcatum* sp. nov. × 3.
5. *Pterophyllum bifurcatum* sp. nov. showing the incised tips. × 3.
6. Cycadophytean stem. × 4.

