

MORPHOTAXONOMY OF HETEROPHYLLOUS LYCOPSID SHOOT FROM THE RAJMAHAL HILLS, INDIA

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ABSTRACT

Morphology of the herbaceous lycopsid shoot occurring commonly in several localities of Rajmahal Hills, India has been studied. In earlier records the fossil was figured as *Araucarites*(?) *gracilis*. Later, it was described as *Cheirolepis gracilis* and thereafter as *Lycopodites gracilis*. However, the present study reveals that the form of the shoot is precisely like that of a creeping *Selaginella* having two dorsal and two ventral ranks of microphyllous leaves. Therefore, it is being described here as *Selaginellites gracilis*.

Key-words — Morphotaxonomy, Lycopsida, *Selaginellites*, Rajmahal Hills, Jurassic (India).

सारांश

भारत में राजमहल पहाड़ियों से विषमपर्णी लाइकोप्सिड प्ररोह का बाह्यवर्गीय अध्ययन — पंकज कुमार पाल

भारत में राजमहल पहाड़ियों में कई स्थानों से साधारणतया मिलने वाले शाखीय लाइकोप्सिड प्ररोह का बाह्य-आकारिकीय अध्ययन किया गया है। इससे पहले के अभिलेखों में यह प्ररोह अँराकेराइटिस? ग्रेसिलिस के नाम से विदित था। परन्तु इसके बाद यह चीरोलेपिस ग्रेसिलिस तथा तत्पश्चात् लाइकोपोडाइटिस ग्रेसिलिस के नाम से वर्णित किया गया। तथापि, इस अध्ययन से यह व्यक्त होता है कि यह प्ररोह निश्चित रूप से विमर्षी सिलेजिनेला का है जिसमें कि अपाक्ष एवं अभ्यक्ष की ओर अलग-अलग दो प्रकार की पत्तियाँ विद्यमान हैं। अतएव इस प्ररोह को सिलेजिनेलाइटिस ग्रेसिलिस से नामांकित किया गया है।

INTRODUCTION

THE lycopsid shoots, occurring commonly in several localities of the Rajmahal Hills, were first considered as a conifer (Oldham & Morris, 1863; Feistmantel, 1877). Later, Feistmantel (1880) thought them to be a lycopod and transferred to the genus *Lycopodites* Brongniart. Sharma (1971) described such shoots as *Selaginellites* sp. A and *Selaginellites* sp. B. Later, Sharma (1980) in a review paper considered that the heterophyllous lycopsid shoots from the Rajmahal Hills belong to three distinct taxa, viz., *Lycopodites gracilis*, *Selaginellites* sp. A and *Selaginellites* sp. B.

My observations are based on about 50 specimens collected from Bindaban, Chuna-khali and Balbhadri Hill of the Rajmahal Hills. I have also re-examined the holotype and other specimens figured by Oldham and Morris (1863) and the figured specimens of Bose and Sah (1968).

DESCRIPTION

Selaginellites Zeiller, 1906

Selaginellites gracilis (Oldham & Morris)
Pal comb. nov.

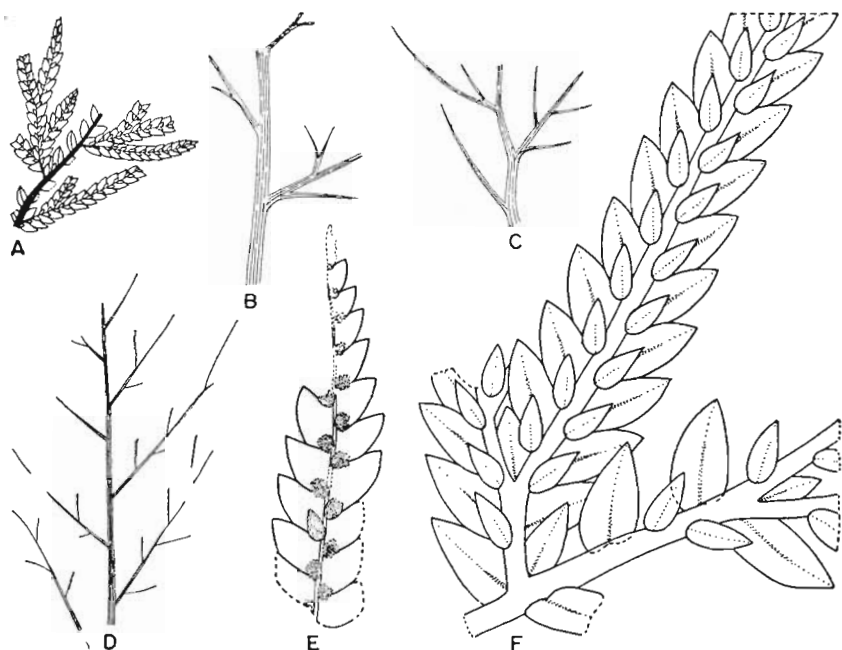
Pl. 1, figs 1-3, 5, 6; Text-fig. 1A-F

Basionym:

Araucarites (?) *gracilis* Oldham & Morris, *Memoir Geological Survey of India Palaeontologica indica, Ser. 2, 1* (1), 1863, pl. 33, figs 1, 2; pl. 35, figs 1, 2 — Bindaban (figs. with explanation).

Synonyms:

- 1877 *Cheirolepis gracilis* (Oldham & Morris) Feistmantel, p. 87 (description, figs of Oldham & Morris, 1863 referred).
1880 *Lycopodites gracilis* Feistmantel, p. XIV (Preface) (name only).
1881 *Lycopodites gracilis* (Oldham & Morris) Feistmantel, p. 150, pl. 2, fig. 2 (new



TEXT-FIG. 1A-F — *Selaginellites gracilis* (Oldham & Morris) Pal comb. nov. A. general habit of the plant, B.S.I.P. no. 35524, $\times 1$; B, C, D, branching pattern of shoots, B.S.I.P. nos. 25575, 35525 and 35526, all $\times 1$; E, apical part of a shoot, note the dorsal leaves not fully exposed, mostly their basal part being exposed appearing as circular scars, B.S.I.P. no. 35524 (a), $\times 4$; F, idealized drawing of leafy shoot based on a part of the specimen in text-fig. 1A, B.S.I.P. no. 35524, $\times 6$.

specimen figured, 'cone-like structure' mentioned).

1920 *Lycopodites gracilis* Morris: Seward & Sahni, p. 18, pl. 7, figs 77, 77a (specimen of Oldham & Morris, 1863 redrawn).

1966 *Lycopodites gracilis* (Oldham & Morris) Seward & Sahni: Surange, p. 16, fig. 7A-C (description, new specimen photographed, text-fig. of Seward & Sahni, 1920 repeated).

1968 *Lycopodites gracilis* (Oldham & Morris) Feistmantel: Bose & Sah, p. 18, pl. 1, figs 7, 8 (description, new specimen figured).

1971 *Selaginellites* sp. A: Sharma, p. 66, pl. 19, fig. 6; pl. 20, fig. 16; text-figs 9-12 (description & new specimens figured).

1971 *Selaginellites* sp. B: Sharma, p. 69, pl. 20, fig. 11; text-figs 13, 14 (description & new specimens figured).

1972 *Selaginellites* sp. B: Sharma, p. 132, pl. 1, fig. 9 (figure of Sharma, 1971 repeated).

1975 *Selaginellites* sp. A: Sharma, p. 83, pl. 1, figs 1, 2 (figures of Sharma, 1971 repeated).

Diagnosis — Shoots dorsiventral, heterophyllous, monopodially branched in one plane. Main stem more or less straight, up to 1 mm thick. Lateral branches alternate, arising at irregular intervals at an angle of 40° - 50° , about 0.5 mm thick. Ultimate branches about 0.25 mm thick. In broad stems upper surface showing two ridges separated by a groove, but no clear ridges visible in narrow stems. Lower surface showing three round ridges separated by grooves in broadest stem, two ridges in medium-sized stems and a single ridge in narrow stems. Leaves in four rows, two ventral rows of larger spreading leaves, two dorsal rows of small, more forward pointing leaves; each ventral leaf lying opposite a dorsal leaf. A single ventral leaf present in the angle of dichotomy and pointing forward. Leaves rather distantly placed in main stem, but more crowded on smaller branches. Ventral leaves on

larger shoots up to 4 mm long but more commonly 2.5 mm long, 1.5 mm on smaller shoots; base contracted (but seldom clearly seen, not suitably exposed to show a ligule); midrib well-marked; margins entire, of unequal length; apex acute. Dorsal leaves appressed to stem below, up to 1 mm long, lanceolate, base constricted.

Holotype — Specimen no. 4487 of the Geological Survey of India, Calcutta.

Occurrence — Bindaban (*Locus typicus*), Chunakhali and Balbhatri Hill of the Rajmahal Hills, Bihar, India.

Age — Upper Jurassic.

DISCUSSION

The generic name *Selaginellites* Zeiller has been preferred to *Lycopodites* Brongniart because the form of the shoots in all the specimens is precisely that of a creeping *Selaginella*. A good many species of *Lycopodium* have flattened shoots and are heterophyllous, but though these show varied arrangement of small leaves above and sometimes below the stem, in not one is the arrangement that of *Selaginella* or the present specimens. The Rajmahal specimens also show a forward pointing leaf in the angle of a dichotomy, a character of *Selaginella*. Some authors, e.g. Lundblad (1950) refrained from using the name *Selaginellites* or *Selaginella* for a fossil with leaf arrangement as in creeping *Selaginella*, when their material fails to show the heterospory. However, though there is no cone, *Selaginellites gracilis* as mentioned above does show another character which is exclusive to *Selaginella*, i.e. the leaf in the angle of dichotomy, and this I take as confirmation. I have also found a cast of megaspore, about 1000 μm in diameter (Pl. 1, fig. 4), in close association, which provides additional evidence for the affinity of the present material with heterosporous *Selaginella*. There is no morphological difference between *Selaginella* Linn. and *Selaginellites* Zeiller, but merely a widely used convention for preferring a distinct name for a Mesozoic plant. The ribs on the stem surface of *Selaginellites gracilis*, which vary in number in branches of different order, probably represent the vascular strands (some authors called them steles).

Feistmantel (1877) thought that *S. gracilis* is a conifer and though he stated that he

could only see a dorsal and two lateral rows of leaves he felt sure there should be a ventral rank concealed below. This idea was accepted by later workers (Surange, 1966; Bose & Sah, 1968). However, several of the present specimens in which the ventral surface is clearly exposed show conclusively that there are no additional small ventral leaves; there are four ranks, as in ordinary *Selaginella*. Nearly all the shoots show their under surface because the rock has split in the plane of the spreading ventral leaves, but in a few specimens the dorsal surface is exposed. Even where the ventral surface is exposed small shoots may show the small dorsal leaves because a small amount of rock above them has broken away and exposed them though not as a rule completely. However, more rocks may be degaged by damaging the ventral leaves. Where just a little of the dorsal leaves is seen the specimen looks exactly like the figure in Sharma, 1971, text-fig. 10 (where they were taken to be sporangia). Until fully degaged they do indeed look like sporangia.

I consider that all the specimens of Sharma (1971, 1972, 1975) are *S. gracilis*. The locality he gives as Dhokuti is the name of a village close to Bindaban Village otherwise Bindaban and Dhokuti are same locality. He divides his specimens in two groups based on the branching pattern and nature of the stem surface. But the individual lateral branches of his 'sp. A' represent the branching pattern of his 'sp. B'. The nature of the stem surface has also been found variable in the branches of different order in the same shoot. Thus it is quite clear that Sharma's *Selaginellites* sp. B is a lateral branch of his *Selaginellites* sp. A.

Rigby (1978) considered a specimen from Queensland Jurassic to be identical with the Rajmahal specimens and described it as *Lycopodites gracilis*. But unlike Indian *Selaginellites gracilis* the Queensland specimen possesses falcate and more spreading ventral leaves. The Queensland specimen (as observed from the photograph) appears more like *Lycopodites falcatus* Lindley & Hutton.

COMPARISON

Selaginellites gracilis resembles *Lycopodites scanicus* Nathorst ex Halle described by Lundblad (1950) from the Rhaetic of

Sweden in having heterophyllous shoots with leaves of similar size and arrangement. But unlike *S. gracilis*, *L. scanicus* has leaves with almost rounded apices and finely denticulate margins. *Selaginella dichotoma* described by Velenovsky and Viniklar (1931) from the Cretaceous of Bohemia differs from *S. gracilis* in being larger in size and having more spreading, somewhat falcate ventral leaves. *L. ghoshii* Bose *et al.* (1984) from the Lower Cretaceous of Gardeshwar, Gujarat is also heterophyllous with two dorsal rows of smaller leaves and two ventral rows of larger leaves, but it differs from *S. gracilis* in having narrower

shoots and shorter ventral leaves having mucronate apices. *L. falcatus* Lindley & Hutton redescribed by Harris (1961) from the Middle Jurassic of Yorkshire has falcate ventral leaves and small leaves both above and below the stem.

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EXPLANATION OF PLATE

- 1-3. *Selaginellites gracilis* (Oldham & Morris) Pal comb. nov.
1. B.S.I.P. specimen no. 35527. $\times 1$.
2. B.S.I.P. specimen no. 35528. $\times 2$.
3. Syntype, specimen G.S.I. no. 4476. $\times 1$.
4. Megaspore, found in close association of the shoot shown in text-fig. 1A, B.S.I.P. specimen no. 35524. $\times 10$.
- 5, 6. *Selaginellites gracilis* (Oldham & Morris) Pal comb. nov.
5. Magnified view of a shoot showing ridges and grooves over the stem surface, note the ventral spreading leaves at places showing distinct mid-vein (v), B.S.I.P. specimen no. 25575. $\times 2.5$.
6. Magnified view of a part of the shoot shown in text-fig. 1A, showing forms and arrangement of leaves (dl—dorsal leaves, vl—ventral leaves), B.S.I.P. specimen no. 35524. $\times 8$.



PLATE 1