

ON TWO NEW SPECIES OF *PHYLLOTHECA* FROM THE SOUTH KARANPURA COALFIELD, BIHAR

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ABSTRACT

Two new species of *Phyllothea* are described from the South Karanpura Coalfield, Bihar. *P. ampla*, is the biggest in size known so far from the Permian of southern hemisphere. The other species *P. angusta* is based on epidermal characters. Stomata simple with cells completely enclosed by two subsidiary cells.

INTRODUCTION

FROM the Permian of the southern hemisphere about ten species of *Phyllothea* have been distinguished so far (BOUREAU, 1964). *Phyllothea etheridgei*, *P. australis* and *P. brookvalensis* are known from Australia; *P. deliquescens* from India (?), Argentina, South Africa, China and U.S.S.R.; *P. greisbachi* from India and Brazil; *P. uluguruana* from S. Africa; *P. sahnii* from India and U.S.S.R.; *P. zeilleri* from Africa; *P. muelleriana* from Brazil; and *P. indica* from India. From India only three species are definitely known. They are *P. indica* Brong. from the Karharbari (MAITHY, 1965) and the Raniganj stages (SURANGE, 1966); *P. sahnii* Saksena from the Karharbari stage (SAKSENA, 1952; MAITHY, 1965); and *P. greisbachi* Zeiller from the Barakar (ZEILLER, 1902) and the Raniganj stages (SURANGE, 1956).

Recently some collections were made from the Argada area of South Karanpura Coalfield (Karharbari stage ?) containing the impressions and compressions of *Phyllothea*. On detailed examination they were found to be entirely different from the known species of *Phyllothea*.

DESCRIPTION

Phyllothea ampla sp. nov.

Pl. 1, Figs. 1-2; Text-figs 1-2

Diagnosis — Stouter stems, strongly ribbed, bearing leafy shoots below and leaf sheaths in upper part, about 15 mm. broad at lower end, tapering to about 5 mm. near top, internodes 16 mm. to 27 mm. in length;

leafy shoots, slender, 3 mm. to 8 mm. in breadth with internodes 4 mm. (near tip) to 11 mm. in length; leaf sheaths large, almost adpressed to stem, cup to saucer-shaped, about 6 mm. to 10 mm. in length, with about 20 free leaflets, one median vein in each leaflet; leaflets 30 mm. to 65 mm. in length and 1 mm. to 2 mm. in breadth.

Holotype — Specimen no. 33795, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — 70 feet above Argada 'S' seam, Argada Sector, South Karanpura, Bihar.

Horizon — ? Karharbari Stage.

Stouter Stem — The type specimen is 27 cm. long and 1.5 cm. broad at the lower end and 5 mm. towards the upper end. The surface is marked by strong ribs and furrows, which are continuous through several internodes (PL. 1, FIG. 1; TEXT-FIG. 1). The length of the internodes varies from 16 mm. to 27 mm. The lateral leafy shoots are borne on the lower part of the stem; they arise from the 2nd, 3rd, 4th and the 7th nodes. The leaf sheaths are borne on the upper part of the stem from the 8th node upwards. The plant appears to be profusely branched.

Leafy Shoots — The lateral leafy shoots bear only leaf sheaths at the nodes (PL. 1, FIG. 1; TEXT-FIG. 1). One of the lateral shoots shows constriction at the point of its attachment with the stouter stem. This shoot is 15 cm. long and 3 mm. to 7 mm. broad. It has 18 nodes, the internodes varying in length from 4 mm. to 11 mm. It bears leaf sheaths from the 4th node upwards; the three successive nodes from the point of its attachment with the main stem are devoid of leaf sheaths. The lower leaf sheaths cover almost the entire length of the internodes, but from the 9th node upwards they cover about 1/2 the length of the internodes (PL. 1, FIG. 1; TEXT-FIG. 1).

Leaf Sheaths — The leaf sheaths are large and form a cup about 6 mm. to 10 mm. in length, almost adpressed to the stem. About 20 long free leaflets radiate from

the margin of the cup and spread out in all directions (PL. 1, FIG. 1; TEXT-FIG. 1). The leaflets are entire, flat, about 1 to 2 mm. broad (mostly 2 mm.), narrowing only near the tip. The length of the leaflets varies from 30 to 65 mm., depending upon the size of the leaf sheath. The midrib is prominent and visible almost for the entire length of the leaflet. A detached leaf sheath (PL. 1, FIG. 2; TEXT-FIG. 2) measures 15 mm. across and appears to be saucer-shaped.

Comparison — A table is given below to show the morphological differences of the new species, *P. ampla*, from the known species of *Phyllothea* from India and also the type species, *P. australis*.

P. ampla sp. nov. appears to be the largest amongst the known species from the Permian of the southern hemisphere.

The Triassic species, *P. brookvalensis* Townrow from New South Wales is also very big in size, but the leaflets are less in number (10-14 per cup) and are narrower (0.76-1.25 mm. at the base) than those of *P. ampla*.

Phyllothea angusta sp. nov.

Pl. 1, Figs. 3-6, Text-figs. 3, 4

Our knowledge regarding the epidermal structure of *Phyllothea* species is meagre. Saksena (1952) described some epidermal characters which he has been able to observe from a peel from a leaf sheath of *Phyllothea sahnii*. Townrow (1954) described epidermal structures of *P. australis*, which he obtained from the main stem. In a few other species of *Phyllothea*, mention is made only of the size of the epidermal cells, but no other details are mentioned.

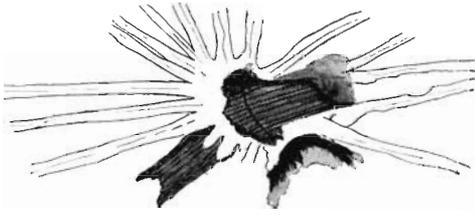
The present specimen of *Phyllothea*, which has yielded some good pieces of cuticle, consists of only broken leaflets, preserved as compressions on two drill cores obtained from the Argada Sector of the South Karanpura Coalfield (PL. 1, FIG. 3). The impressions of leaflets are incomplete but they possess good carbonized crust over them. No leaf sheath is preserved. Each leaflet is linear, flat with a prominent median vein. The width of the leaflet is about 2 mm. Although

TABLE 1 — SHOWING DIFFERENCES BETWEEN FIVE DIFFERENT SPECIES OF PHYLLOTHECA

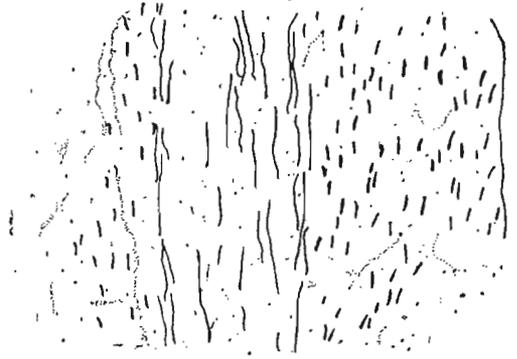
	<i>P. australis</i> BRONG. (1828)	<i>P. indica</i> BRONG. (1828)	<i>P. sahnii</i> SAKSENA (1952)	<i>P. greisbachi</i> ZEILLER (1902)	<i>P. ampla</i> sp. nov.
1. <i>Stem</i>	Stouter stems up to 12 mm. wide	Up to 15 mm. wide	—	—	Up to 15 mm. wide
	Internodes up to 20 mm. in length, without leaves	13-25 mm. without leaves	—	—	Up to 27 mm., bigger stems with branches on the lower side and leaf sheaths on the upper
	Leafy shoot 1-4 mm. wide	2-4 mm. wide	5-7 mm. wide	Up to 15 mm. wide	8 mm. wide
2. <i>Leaf-sheath</i>	2-4 mm. in length	2-7 mm. length	—	—	6-10 mm. in length
	Width not known	—	15 mm. wide	13 mm. wide	15 mm. wide
	Cup-like	Cup-like	Open saucer-like disc.	horizontally spreading disc.	Cup-like, adpressed to the stem; detached leaf-sheath shallow saucer-like
3. <i>Leaflets</i>	3-15 mm. in length 0.5-0.75 mm. in breadth	Up to 30 mm. 0.5-0.75 mm.	Up to 15 mm. 0.75-1.25 mm.	20-25 mm. Not known	30-65 mm. 1-2 mm. broad
	18-23 leaflets per cup	18-22 leaflets	20-23 leaflets	30-40 leaflets	About 20 leaflets



TEXT-FIG. 1 — *Phyllothea ampla* sp. nov., showing strongly ribbed main stem with 5 lateral branches and leaf sheaths towards the upper end, the branch number 2 showing its attachment with the main stem. $\times 1$.



TEXT-FIG. 2 — *Phyllotheca ampla* sp. nov., showing impression of an incomplete leaf-sheath attached with a stem; each leaflet has a prominent midrib in the middle. $\times 1$.



TEXT-FIG. 3 — *Phyllotheca angusta* sp. nov., showing distribution and longitudinal orientation of the stomata on either side of the midrib. $\times 50$.

the specimens are incomplete, the free leaflets appear to be comparable morphologically with *Phyllotheca ampla*. Both the plants occur in the same locality, but *Phyllotheca ampla* is based only on the impressions collected from the surface exposures, whereas *Phyllotheca angusta* has been obtained from the bore cores and the species is mainly based on the epidermal characters.

Diagnosis — Linear leaves about 2 mm. broad with a median vein; cuticle layers differentiated into non-stomatiferous and stomatiferous surfaces; midrib region well marked on both cuticles with narrow elongate cells; non-stomatiferous surface possesses narrow, elongate epidermal cells, arranged end to end; epidermal cells on stomatiferous surface similar to those of non-stomatiferous surface; stomata crowded, occupying entire lamina on either side of midrib; stomata perhaps arranged in incomplete rows and orientated longitudinally, parallel to midrib; each stoma with two slightly thickened guard cells and a long slit in the middle; two subsidiary cells surround guard cells.

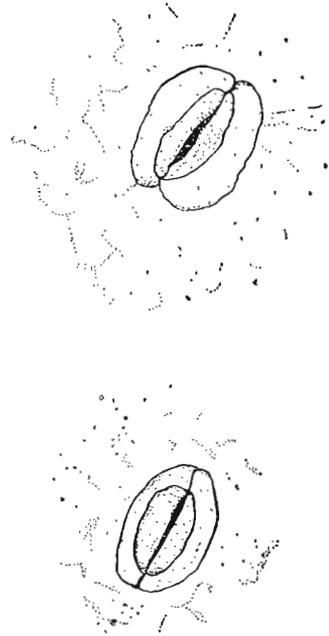
Holotype — Specimen No. 33797, Birbal Sahni Institute of Palaeobotany, Lucknow.

Locality — From a scattered drill core collected in the Argada Sector, South Karanpura, Bihar.

Horizon — ? Karharbari.

Description — The leaflets yielded good cuticles on maceration and the two surfaces could easily be separated out. The cells of the epidermis are not well preserved but the stomata are present only on one surface and are very clearly seen.

Non-stomatiferous surface — The midrib region is rather broad as compared to the breadth of the leaflet (PL. 1, FIG. 4; TEXT-FIG. 3). Although it stands out clearly,



TEXT-FIG. 4 — *Phyllotheca angusta* sp. nov., two stomata enlarged to show the thinly cutinized guard cells completely enclosed by two thin subsidiary cells. $\times 500$.

the cells are not well preserved (PL. 1, FIG. 5). The cells over the midrib appear to be arranged regularly in longitudinal rows, but their outlines are obscure. They are elongated, very narrow and with slightly wavy cell walls; their width is 15-30 μ but the length could not be ascertained.

Stomatiferous surface — The epidermal cells are preserved only at a few places and appear to be of the same type as those on the non-stomatiferous surface. The stomata are crowded and regularly orientated in the longitudinal direction of the leaf (PL. 1, FIG. 6). They cover the entire lamina on either side of the midrib, right upto the margin. The density of the stomata is 130-160 per sq. cm. (TEXT-FIG. 3). A stoma is about 52-70 μ in length and 35-52 μ in breadth (PL. 1, FIG. 6; TEXT-FIG. 4). It consists of two guard cells and two subsidiary cells, which completely surround the former. Guard cells are thinly cutinized, measuring 40-55 μ in length and 6-10 μ in breadth. They enclose an elongated slit in the centre, 30-35 μ in length. Almost all the stomata are closed. The subsidiary cells are very thin and measure about 65 μ in length and 15-25 μ in breadth.

Comparison — In *Phyllothea australis* stomata are unknown but the epidermal cells of the stem are known. They are, however, much larger in size as compared to those on the lamina of *P. angusta*.

In *P. sahnii* the epidermal cells of the leaf sheaths are small and square, whereas those on the leaflets of *P. angusta* are very narrow and appear to be much more elongated with slightly wavy cell walls. In *P. sahnii*, the stomata are smaller in size measuring 32 \times 6 μ and subsidiary cells are not known. In our species the stomata are bigger in size 52 \times 70 μ to 35 \times 52 μ with two lateral subsidiary cells completely surrounding the guard cells.

The stomata of the modern *Equisetum ramosissimum* Desf. (CHATTERJEE, 1964) have characteristic rib-like thickenings on the subsidiary cells which are totally absent in the cuticle of *Phyllothea* species.

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EXPLANATION OF PLATE

(All the specimens and slides are preserved at the Museum of Birbal Sahnii Institute of Palaeobotany, Lucknow, India)

Phyllothea ampla sp. nov.

1. *Holotype* — showing main stem with lateral branches on the lower side and leaf sheaths on the upside. Specimen no. 33795. \times 3/10.
2. *Isotype* — impression of an incomplete leaf sheath. Specimen no. 33796. \times 1.

Phyllothea angusta sp. nov.

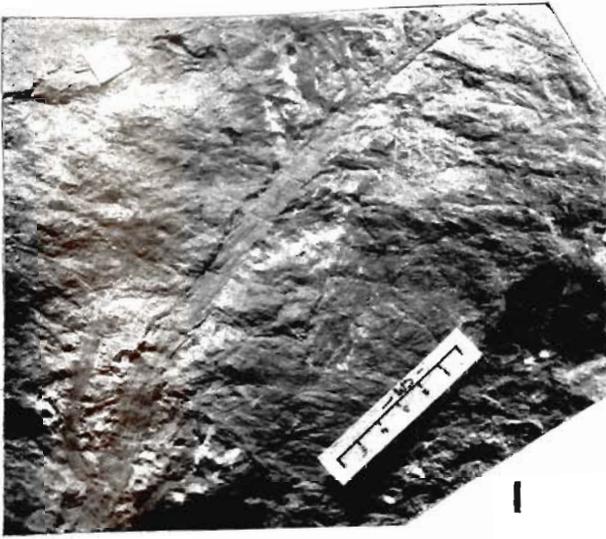
3. *Holotype* — Compression of leaflets on a bore

core. Specimen no. 33797. \times 1.

4. Cuticle showing the broad midrib zone in the lamina. Slide no. 3020. \times 100.

5. Epidermal cells of the non-stomatiferous surface. Slide no. 3021. \times 100.

6. Distribution, orientation and nature of the stomata. (Note the two guard cells and faint outlines of the two subsidiary cells). Slide no. 3021. \times 400.



1



5



3



2



4



6