

ON SOME FOSSIL CYCADEAN STEMS FROM THE RAJMAHAL HILLS, BIHAR

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ABSTRACT

The present work is based on five specimens of fossil Cycadean stems collected from the Rajmahal hills, Bihar. One of the stems is especially interesting because it has got a *Williamsonia* type of flower attached to it at the apex. These stems have been compared with the other fossil Cycadean stems and *Protocyathea rajmahalense* Jacob.

INTRODUCTION

AN account is given in this paper of some fossil Cycadean stems which were collected from two different localities in the Jurassic of the Rajmahal hills, Bihar. The first locality is Chilgojuri, Amrapara. The collection from this locality was made in May 1951 by me. Here petrifications as well as impressions and incrustations of fossil Cycadean stems were found. In addition to this the bed is full of *Ptilophyllum*, *Dictyozamites*, *Williamsonia*, *Homoxylon*, *Brachyphyllum*, *Coniferocaulon* and other coniferous woods and cones. The second locality is Sakrigalighat, about one mile north of Sakrigali railway station. Only a single specimen of a fossil Cycadean stem in the form of an impression was collected by Mr. S. C. D. Sah in December 1950. From this bed Jacob (1937) described a few specimens of *Protocyathea rajmahalense*. Besides this the plant-bearing bed is full of leaf impressions of *Ptilophyllum*, *Pterophyllum*, *Nilssonina*, *Brachyphyllum* and *Elatocladus*.

The internal anatomy of these Cycadean stems could not be studied and on the basis of the external characters alone, no generic or specific identification was possible, for these stems may have belonged to any of the plants bearing such fronds as *Ptilophyllum*, *Pterophyllum* and *Nilssonina*.

I wish to express my gratitude to Professor O. A. Höeg for kindly criticizing the manuscript of this paper and to Dr. K. R. Surange for his general help throughout the work. To Mr. S. C. D. Sah I owe my thanks for the loan of the specimen from Sakrigalighat for investigation.

DESCRIPTION

CYCADEAN STEMS FROM CHILGOJURI

In all ten specimens were collected, of these only three are in the form of petrifications. Internal anatomy of the petrified specimens could not be studied due to bad preservation. Here only four specimens are described.

Specimen 1—The specimen is petrified and measures about 7 cm. in length and 6 cm. in breadth at the basal region, but at the upper region the breadth is 4.5 cm. (PL. 1, FIG. 1). It is covered with conical spirally arranged persistent leaf-bases throughout its length. They are very badly preserved. No leaf-scars and leaf-trace bundles are seen.

The stem is oval in transverse section with a very compact wood encircling a narrow oval pith. The wood shows clear marks of growth rings which are more than 16 in number. The spring and the autumn wood are practically equally developed. The tracheids of the spring wood are thin-walled and are bigger in size than those of the autumn wood. Medullary rays are mostly uniseriate, sometimes biseriate and very rarely triseriate. The pith cells are not preserved. There is a very broad zone of phloem encircling the secondary wood. The cells of the phloem are not well preserved. Next to phloem, bark can be made out. Here, too, the preservation is not good. Nothing can be seen in the tangential and longitudinal sections of the stem.

Specimen 2—The specimen (PL. 1, FIG. 2) is a slender petrified stem measuring about 5.7 cm. in length and 1.5 cm. in breadth. The leaf-bases are variable in shape and size, mostly rhomboidal. The largest leaf-base measures 0.8 cm. in length and 0.6 cm. in breadth, and the smallest measures 0.1 cm. in length and 0.2 cm. in breadth. At the top of each leaf-base is seen the scar of a fallen leaf. In each leaf-scar there are five marks of the leaf-trace bundles. Of these one is dorsal, two are laterals and two ventrals, as shown in Pl. 1, FIG. 3.

Specimen 3 — Pl. 1, Fig. 4 shows a block of rock specimen with a portion of a Cycadean stem (c) protruding out. On splitting this block with a hammer the main stem (c) was obtained (PL. 1, FIG. 5) and on the two counterparts of the rock the impressions of the stem were found (PL. 1, FIG. 6). The stem is 6.2 cm. in length and about 2.6 cm. in breadth at the basal region. At the upper region the stem seemed to have given off a lateral branch (b) and at the point of branching the breadth is 3.8 cm. The stem is covered with persistent leaf-bases of two sizes which are rhomboidal in shape. The high and low leaf-bases occur in alternating zones. The leaf-scars are very crowded and there is very little trace of leaf-cushions between them. In each leaf-scar there are five marks of vascular bundles; sometimes even up to seven are seen. Out of these five bundles one is dorsal, two are laterals and two ventrals. In cross-section the stem is oval.

Specimen 4 — Pl. 2, Fig. 9, shows an impression of a stem with petrified remains of leaf-bases and bracts of the terminal flower. The plasticine cast of the same specimen is shown in Pl. 2, Fig. 10. The specimen is about 19 cm. long, but out of this the main stem is only 12 cm. in length and 3.5 cm. in breadth. At the terminal part of the stem the petrified bracts of a flower are seen; the longest bract measures 7 cm. in length. There are three sets of alternating zones of high and low rhomboidal leaf-bases. The leaf-bases are very variable in shape and size and have wrinkled surface. Scar of the fallen leaf is seen at the top of each leaf-base and in some of these leaf-trace bundles can be seen. The number of leaf-trace bundles is from 5 to 7. The marks of the vascular bundles are also seen at the basal region of the leaf-bases and here, too, the number is from 5 to 7. The smaller (low) leaf-bases are rhomboidal and vary to a less extent in shape. The bracts of the flower are very long and flat. Unlike the leaf-bases and petiole they have constant breadth throughout the length, the breadth being 0.5 cm. At some places signs of hairs are seen on the lateral sides of the bracts.

CYCADEAN STEM FROM SAKRIGALIGHAT

Specimen 5 — The specimen (PL. 1, FIG. 7) measures about 5.5 cm. in length and 5 cm. in breadth. The stem is covered with

armour of spirally arranged leaf-bases which are of two sizes. There are alternating zones of high and low rhomboid leaf-bases. Each large leaf-base measures approximately 1.3 cm. in length and 0.9 cm. in breadth and they have wrinkled surfaces. At the top of each of these leaf-bases is seen the scar of a fallen leaf. The leaf-scars are densely crowded and there is very little trace of leaf-base between them. In some of the scars leaf-trace bundles are seen (PL. 1, FIG. 8); they vary in number from 5 to 7 and their arrangement is not constant. The smaller leaf-cushions are about 0.2 cm. long and 0.8 cm. broad. In these five leaf-trace bundles are seen.

COMPARISON AND DISCUSSION

Very little can be made out of the internal anatomy of these stems and, therefore, we have to rely only on the basis of external characters; on them alone, no generic and specific identification is possible. Chilgojuri specimens can at best be referred to two different species, that is one belonging to the *Ptilophyllum* type of leaf and the other to the *Dictyozamites* type, but at present it is very difficult to separate the two. At Sakrigalighat, the plant-bearing bed consists mainly of three different types of Bennettitalean fronds: *Ptilophyllum*, *Pterophyllum* and *Nilssonia*. Most of the fronds of *Pterophyllum* and *Nilssonia* are more than 1 ft. in length whereas the length of the *Ptilophyllum* fronds is mostly less than 30 cm. Probably the Cycadean stem from Sakrigalighat had the smaller leaves of *Ptilophyllum*.

In external character these specimens resemble very much *Bucklandia indica* Seward and *Bucklandia Sahnii* Bose in having spirally arranged rhomboidal leaf-bases of variable shape and size. In these specimens, like *B. indica*, the alternation of large and small leaf-bases is seen. The number of leaf-trace bundles is also the same as in *B. indica* and *B. Sahnii*. The specimen 4 from Chilgojuri, however, differs greatly from *B. indica* in having the flower at the apex or at the terminal region of the stem, whereas in *B. indica* fertile shoots have been shown to be lateral by Sahni (1932). In this respect this specimen resembles *B. Sahnii*, where, too, the flower is found in the terminal region. These specimens also show resemblance with the Cycadean stems described by Sahni and Rao (1933) and Ganju (1946). The petrified specimens from

Chilgojuri differ from *B. Sahnii* in being oval in cross-section and in having a very narrow oval pith, while *B. Sahnii* is circular in cross-section and have wider pith.

Besides these, the Cycadean stem from Sakrigalighat shows a very close resemblance with *Protocyathea rajmahalense* Jacob, more particularly with his specimen No. 2 (JACOB, 1937, PL. 8, FIGS. 6, 7). On both leaf-bases are spirally arranged and at the top of each leaf-base the scar of the fallen leaf is seen. Leaf-scars are densely crowded and there is very little trace of leaf-base between them. This Cycadean stem, too, like *B. Sahnii* and *B. indica*, has 5 to 7 marks of vascular bundles in some of the leaf-scars but no such marks of vascular bundles are preserved in his specimen No. 2 of *P. rajmahalense*. However, in specimen No. 1 of *P. rajmahalense*, Jacob has found 14 such marks of vascular bundles and the arrangement of these vascular bundles is more like that found in petioles of Cycadean leaves, such as *Ptilophyllum amarjolense* Bose. Only difference *P. rajmahalense* shows is that there are three extra bundles which are placed below and on one side of the main upper arc of bundles. Impressions of ad-

ventitious roots in the specimen No. 2 (JACOB, 1937, PL. 8, FIG. 7, r) of *P. rajmahalense* are also not very convincing. They are rhomboidal in shape and look more like the bands of the smaller leaf-bases of the Cycadean stems than the scars of roots. On the whole leaf-bases of the Cycadean stems here described resemble very much the leaf-bases of *P. rajmahalense*. The similarity is so close that one feels inclined to doubt whether all the specimens of *P. rajmahalense* really belong to *Protocyathea*. Possibility is there of at least some of these specimens of *P. rajmahalense* would belong to some Cycadean plant, and the smaller specimens (2, 3 and 4), where there is no mark of the vascular bundles on the leaf-scars, should be considered as of doubtful affinity. At the same time I leave this question open as my observations are only based on the photographs and not on the actual specimens. I tried to compare my specimens with the type specimens of *Protocyathea rajmahalense* and paid a special visit to the Geological Survey of India in Calcutta, but was informed by Dr. Jacob that the specimens had been misplaced, so that no further comparison could be made.

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EXPLANATION OF PLATES

PLATE 1

- 1-2. Petrified specimen numbers 1 and 2 from Chilgojuri. $\times 1$.
3. Part of the specimen No. 2 magnified to show the marks of the vascular bundles on the leaf-scars. $\times 5$.
4. The block of rock specimen, showing a portion of the Cycadean stem (*c*) from Chilgojuri. $\times \frac{1}{2}$.
5. Petrified specimen No. 3 with a lateral branch (*b*). $\times 1$.
6. Impression of the specimen No. 3. $\times 1$.

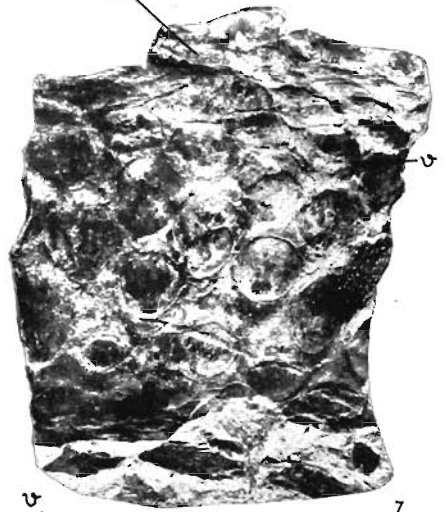
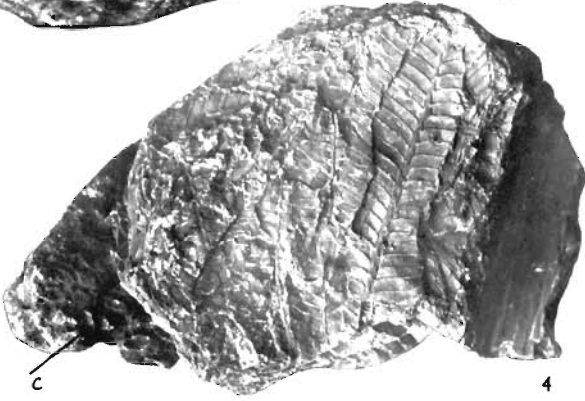
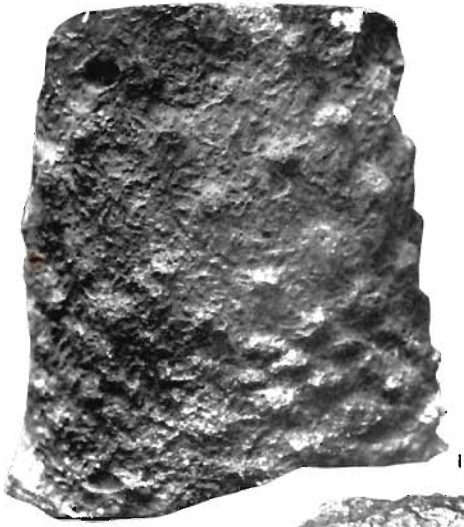
7. Cycadean stem impression (specimen No. 5) from Sakrigalighat showing marks of the vascular bundles (*v*). $\times 1$.

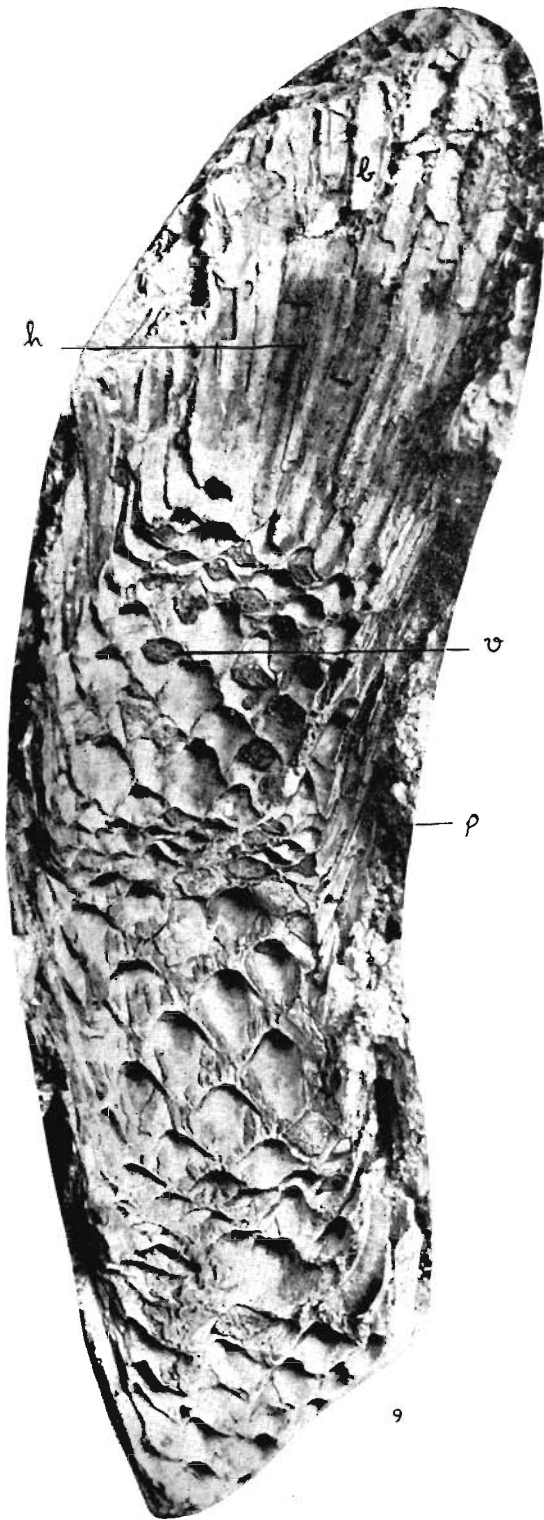
8. Some of the leaf-bases of the above specimen, showing the marks of the vascular bundles (*v*). $\times 6$.

PLATE 2

9. Specimen No. 4 from Chilgojuri, showing the bracts (*b*), hairs (*h*), marks of the vascular bundles (*v*) and petiole (*p*). $\times 1$.

10. Plasticine cast of the above specimen. $\times 1$.





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