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# *Bengalia raniganjensis*, a new sphenopsid from the Raniganj Formation (Upper Permian)

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A new taxon of articulatae, closely resembling the characteristic Barakar form *Lelstotheca* is reported from the shales associated with Nega Coal of Raniganj Formation in Raniganj Coalfield. It comprises linear-lanceolate leaves with mucronate apices, in clusters of about 18 in each whorl. Leaves are free throughout and apparently do not form a sheath or disc.

**Key-words**—Sphenopsida, Equisetales, Raniganj Formation, *Lelstotheca*, *Raniganjia*.

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## सारांश

बंगालिया रानीगंजेन्सिस, रानीगंज शैल-समूह (उपरि परमी) से एक नया स्फीनोप्सिड

हरिकृष्ण माहेश्वरी †विनय कुमार सिंह एवं ऊषा बाजपेयी

रानीगंज कोयला-क्षेत्र में रानीगंज शैल-समूह के नीचा कोयले से सहयुक्त शैलों में आर्टिकुलेटी समूह का एक नया वर्गक अभिलिखित किया गया है जो लार्शार्णक बाराकार प्ररूप लेल्सटोथीका में घनिष्ठ समानता प्रदर्शान करता है। इम वर्गक में प्रन्येक चक्र में गुच्छे के रूप में नोकदार अग्रकों वाली लगभग 18 रेखीय-भालाकार पत्तियाँ हैं। सभी पत्तियाँ लम्बाई में पणरूपेण म्वतंत्र हैं तथा किमी आच्छद अथवा चक्रिका का निमाण नही करती।

THE sphenopsids in the Lower Gondwana of India are represented by the genera *Trizygia* Royle, *Phyllotheca* Brongniart, *Schizoneura* Schimper & Mougeot, *Raniganjia* Rigby and *Lelstotheca* Maheshwari. A few specimens of *Sphenophyllum*-like foliage have also been reported, but more likely these are sports of *Trizygia speciosa* Royle 1839. The genera *Schizoneura*, *Raniganjia* and *Trizygia*, each represented by one species, are normally found in the Raniganj or equivalent formations, except for an occasional report in the Barakar Formation. Of the three species of *Phyllotheca*, one each occurs in Karharbari (*sabnii*), Barakar (*australis*) and Raniganj (*griesbachii*) formations. *Lelstotheca robusta* (Feistmantel) Maheshwari 1972 and *Barakaria dichotoma* (Feistmantel) Seward & Sahni 1920, also a probable sphenopsid, are so far recorded only from the Barakar Formation. Pant and Nautiyal (1967) favoured the inclusion of *Phyllotheca sabnii* Saksena 1952 under *Raniganjia bengalensis*

(Feistmantel) Rigby 1962 on the basis of similarity in microscopic details of leaf architecture in the two species. A somewhat similar microscopic detail is also seen in *Lelstotheca robusta* (Feistmantel) Maheshwari (Surange & Prakash, 1962; Maheshwari & Srivastava, 1987) and *Barakaria neuburgiana* Meyen 1969, but it has not been suggested that these, too, belong to *Raniganjia*. In fact two of the specimens included by Pant and Nautiyal (1967, pl. 10, fig. 5; pl. 11, fig. 10; text-figs 1C, 2D) under *Raniganjia bengalensis* are very much unlike a typical *Raniganjia* in having leaves which are not only free up to their bases but also have apparent difference in insertion levels.

During the 1985-86 field season we collected a somewhat similar specimen from the East Raniganj Coalfield, West Bengal. As this specimen and the two above mentioned specimens from Pant and Nautiyal collection do not answer to diagnostic features of any of the known sphenopsid, a new taxon *Bengalia*

*raniganjensis* is being proposed here to accommodate and classify them.

### MATERIAL AND METHOD

A single hand specimen with counterpart, exhibiting compressions of 3 clusters of leaves in a simulated whorled arrangement, was collected from the shales intercalated with coals of Nega Seam (Raniganj Formation), Upper Permian. Due to natural oxidation, the coalified crust of the compression now remains only as a very thin carbonaceous film which appears brownish in colour in liquid paraffin under incident light. The carbonified film is so delicate that it did not give any cellulose pulls for the study of microscopic details. Except a few leaves, the counterpart is just an impression and replica of the part. A somewhat whitish 'halo' is seen round leaf whorls. Origin of this 'halo' is not known. Probably it resulted by exudation of some compound during natural oxidation of the carbonified leaf compression.

### OBSERVATIONS

Though the three leaf clusters of the specimen are aligned in such a way as if they were part of a single plant, no connecting axis is seen, which is not very unusual for most Lower Gondwana Equisetales. The two more complete clusters, containing 13 and 14 leaves respectively, are compressed dorsiventrally. The leaves radiate from a shallow depression indicating the possibility of their attachment directly at the nodes with little or no adherent leaf-sheath. The actual point and manner of attachment of leaves could not be observed due to overlapping of leaves at base. Although, disposition of leaves is indicated around the point of attachment, yet in the specimen they are more in number, crowded and overlapping in one half which may suggest an asymmetrical arrangement of leaves on the live plant. Alternatively this asymmetry in disposition of leaves may be due to the partial preservation or due to loss of some leaves on the other half during opening of the specimen. In that case the number of leaves per cluster is estimated to be about 18. The leaves overlap at base in such a way as if they enated from the axis at different levels. The

apparent asymmetry of the whorls and overlapping of the leaves in rock could also be due to oblique burial. The third, incomplete cluster shows remains of five leaves on one side of the radiating point. Three partly preserved leaves of opposite side of the same whorl are found on the counterpart. The distance between lower and middle whorls is 7 cm and that between middle and upper whorls is 5 cm.

The leaves are constricted towards the base (cuneate). They are neither joined by their marginal commissures nor seem to be united at or near the base. The nodal plates at the attachment point of leaves as in *Lekstobeca robusta* (Surange & Prakash, 1962; Maithy & Mandal, 1978) and in other stellate articulates, have also not been observed. Individual leaves are linear-lanceolate, 2.8 to 4 cm long and 3 to 5 mm at widest near about the middle of the leaf length. The lamina is flat, inflexed upwards on either side and with entire lateral margins. The prominent median vein extends right up to the apex and continues for a short distance beyond it to form a distinct and sometimes long mucro. The length of mucro averages at about 1 mm. The midvein is flat for most part of the leaf but near the tip it becomes swollen excluding mucro which is marked by the remains of blackish cylinder of carbonaceous substance along it. This indicates a straight spinous tip of the leaves. The leaf lamina shows indistinct and irregular transverse wrinkles.

### DIAGNOSES

#### *Bengalia* gen. nov.

Type species—*Bengalia raniganjensis* gen. et sp. nov.

*Diagnosis*—Linear-lanceolate leaves radiating in clusters of about 18 from an undefined axis in verticillate whorls. Leaf lamina flat, with a single distinct median vein which protrudes as a distinct and long mucro. Leaves free up to cuneate base, probably not forming an addressing sheath. Axis, nodal-disc and nature of leaf attachment unknown. Leaf lamina with irregular, mostly transversely placed wrinkles.

#### *Bengalia raniganjensis* sp. nov.

1967 *Raniganjia bengalensis* (Feistmantei) Rigby;

### PLATE 1

1. *Bengalia raniganjensis* gen. et sp. nov. Holotype. Specimen no. BSIP 35962. × 1.
2. Counterpart of the holotype. Specimen no. BSIP 35963. × 1.
- 3, 4. Leaf whorls in specimen illustrated in figure 1 enlarged to

- show free nature and point of attachment of leaves. × 3.
5. Two of the leaves photographed under glycerine to show the mucro. × 4.

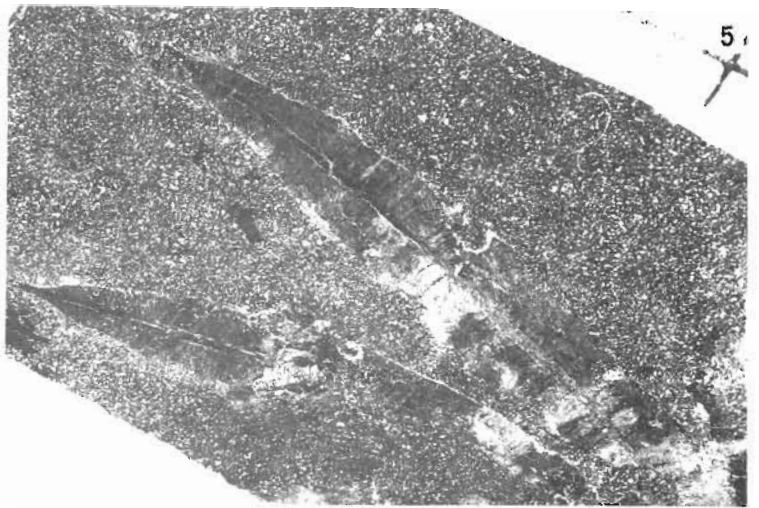
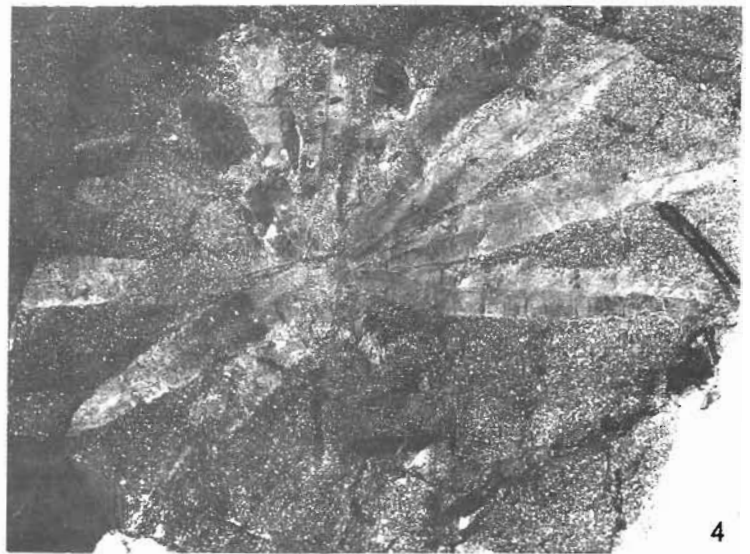
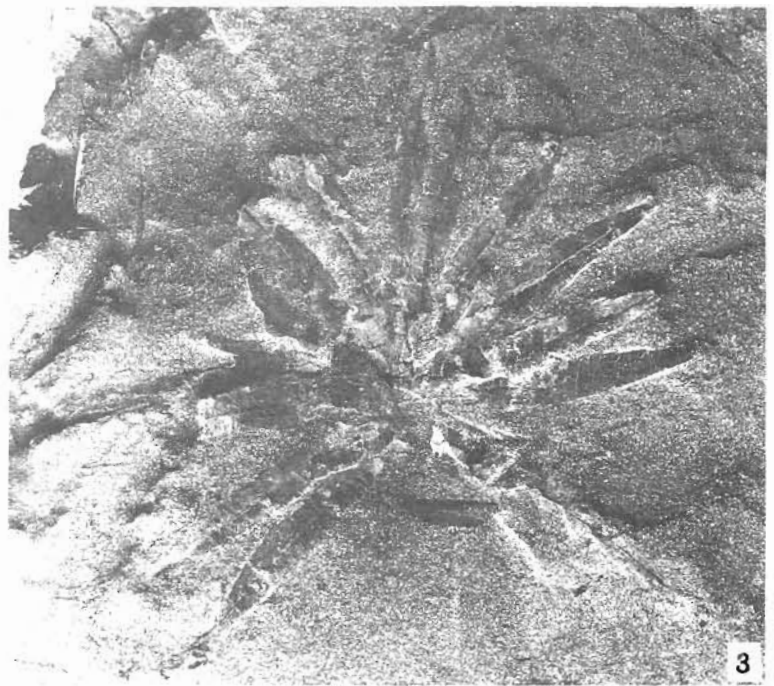


PLATE 1

Pant & Nautiyal (*pars*), pl. 10, fig. 5; pl. 11, fig. 10, Specimen nos 1352a, 1362, *Palaeontographica* **B121** : 1-22.

*Diagnosis*—Verticillate whorls comprising more than 13-14, linear-lanceolate leaves, more crowded in one half and overlapping each other. Leaf base cuncate, leaf length 2.8 to 4 cm, width 3-5 mm around middle part. Midvein prominent from base to apex, depressed for three-fourths of leaf length but becomes swollen near acuminate apex and protrudes for about 1 mm beyond lamina to form a distinct mucro. Leaf lamina entire along the margins and flat or inflexed upwards on both sides of the midvein.

*Holotype*—Specimen no. BSIP 35962, Upper Permian, Raniganj Formation, Nega Seam, Damara Colliery, East Raniganj Coalfield, India.

### REMARKS

The newly established genus *Bengalia* approaches very close to the articulate genera *Raniganjia*, *Lelstobeca* and to some extent to *Annularia*. As compared to *Raniganjia*, the number of leaves in *Bengalia* is much less and they are free from each other up to the node at least. *Raniganjia* shows 50-80 leaves united for most part of their length to form almost flat or saucer-shaped sheaths (Feistmantel, 1881; Srivastava, 1954, Rigby, 1962; Pant & Nautiyal, 1967). Pant and Nautiyal (1967) imputed *Lelstobeca* to *Raniganjia* on the basis of analogy with leaf sheaths of modern *Equisetum* in which the number of leaves is reported to vary according to the position on the axis. They further implied that *Bengalia* type leaf-sheaths illustrated by them "either represent a developmental stage or these sheaths become torn along the commissures during fossilization"

However, they have not put forth any convincing evidence or argument in support of such an implication. Whorls with few free leaves and whorls with numerous united leaves have so far not been found to occur on the same foliage shoot. Although, the size of the leaves may vary, yet the number of segments will remain the same in a leaf-sheath during development. Tearing of leaves along the commissures during fossilization should not be difficult to decipher; some of the segments will still remain united atleast near the base

The genus *Lelstobeca* has smaller leaves, widest at the base where they unite in the form of a disc and overlap in circinate vernation (Surange & Prakash, 1962) or may apparently be free up to the base (Maithy & Mandal, 1978). The genus *Bengalia* has larger leaves, widest near middle of the lamina

but are free up to the base. Due to characteristic overlap the leaves seem to enate at different levels. The leaves show a prominent midvein which protrudes as a distinct mucro unlike *Lelstobeca robusta*.

The true nature of transversely placed striations or wrinkles on the leaf lamina is not known as yet and hence it is premature to ascribe any taxonomic significance to this particular feature. It is reported from taxa as different as Gondwanan *Phyllotheba sahnii*, Angaran *Annularia* and Euramerican *Asterophyllites*.

In spite of having verticils resembling those of most extinct and extant articulates, the exact botanical affinities of *Bengalia* yet remain enigmatic due to lack of knowledge about its leaf attachment, the axis and the nodal disc. The arrangement of leaves in simulated close spirals as indicated by their characteristic overlapping may suggest its exclusion from articulates but the general look of the specimen is that of an equisetaceous sphenopsid.

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