

Diversity of Early Cretaceous megaflora from Hiranubha locality of Rajmahal Basin, Jharkhand

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Megafloral diversity from the Early Cretaceous beds of Hiranubha locality of Rajmahal Basin, Jharkhand has been studied. The megafloral assemblage comprises thirteen genera of pteridophytes and gymnosperms, viz. *Cladophlebis*, *Hausmannia*, *Nipaniophyllum*, *Ptilophyllum*, *Bucklandia*, *Williamsonia*, *Otozamites*, *Dictyozamites*, *Anomozamites*, *Brachyphyllum*, *Elatocladus*, *Coniferoaulon*, detached cone-scale and young female cone of *Araucaria*, belonging to various species. Solitary impression of molluscan shell has also been recovered along with plant fossils. The assemblage is well diversified, showing qualitative and quantitative dominance of cycadophytes in comparison to conifers and pteridophytes. In overall composition, the present assemblage resembles the second intertrappean assemblage of Amarjola locality in the Rajmahal Basin. The abundance of cycadophytic remains indicates tropical to subtropical palaeoclimatic conditions during the Early Cretaceous Period in Rajmahal Basin.

Key-words – Early Cretaceous, Megafloral diversity, Hiranubha, Rajmahal Basin.

INTRODUCTION

PRESENT investigation of fossil assemblage from Hiranubha locality of Rajmahal Basin, Jharkhand has been carried out with the aim to ascertain the lateral extension of bennettitales dominated flora and variation in the floral composition in the southern part of the Rajmahal Basin.

Hiranubha locality is situated in the northwest of Kalkipara village (Map-1). The collection includes impression as well as petrified specimens. Impression fossils were found at the top of the hillock and at the base of the hillock in the cultivated field, whereas petrified cherts were collected from the middle region at one place. These cherty rocks were found embedded along with the traps. The impressions were preserved in whitish buff coloured silty shales and sandstones. Petrified fossils were found in grey siliceous cherts.

Floral Composition

The present assemblage comprises impression of 13 genera belonging to various plant groups and solitary impression of molluscan shell fragment. The taxa are listed and remarks on the taxa marked with asterisks are provided.

PTERIDOPHYTES

Filicales

Osmundaceae

Cladophlebis indica (Pl. 1, Fig. 2)

Dipteridaceae

Hausmannia crenata (Pl. 1, Fig. 1)

GYMNOSPERMS

Pentoxylales

*?*Nipaniophyllum hobsonii* (Pl. 2, Fig. 3)

Bennettitales

**Bucklandia* sp. (Pl. 1, Figs. 3, 4)

Ptilophyllum cutchensis (Pl. 1, Fig. 6)

Ptilophyllum acutifolium

**Williamsonia* sp. (Pl. 1, Fig. 5)

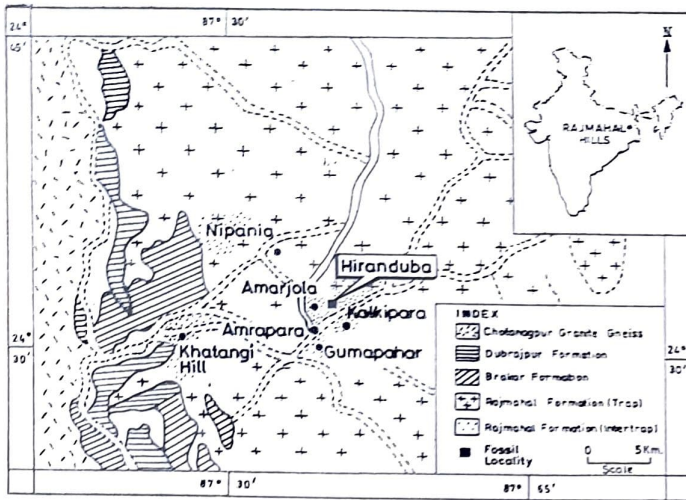
**Otozamites* sp. cf. *O. walkamotaensis* (Pl. 1, Figs. 8, 9)

**Dictyozamites falcatus* (Pl. 1, Fig. 7)

Anomozamites fissus (Pl. 2, Figs. 1, 2)

Coniferales with doubtful affinities (Incertae Sedis)

Coniferoaulon rajmahalense (Pl. 2, Fig. 10)



Map 1. Southern part of Rajmahal Basin showing Hiraniduba fossil locality (After Ball, 1877)

Elatocladus confertus (Pl. 2, Fig. 9)

Elatocladus tenerrimus (Pl. 2, Fig. 4)

**Brachyphyllum* sp. (Pl. 2, Figs. 7, 8)

Araucarites cutchense (Pl. 2, Fig. 5)

Araucarian young female cone (Pl. 2, Fig. 6)

MOLLUSCA

**Bivalvia* (Pl. 2, Fig. 11)

?*Nipaniophyllum hobsonii* (Pl. 2, Fig. 3)

Impression specimens of Taeniopteroid- type leaf are assigned to the taxon *Nipaniophyllum* because from all the nearby localities, i.e. Amarjola and Nipania, pentoxylalean remains are frequently found in the assemblages.

Bucklandia sp. (Pl. 1, Figs. 3, 4)

Specimen showing decorticated stem measuring 6x3.2 cm, surface with spirally arranged oval-oblong leaf bases, leaf scars ob-cuneate with concave apices, number of leaf traces not clearly visible. In external features the present specimen is somewhat similar to *Bucklandia sahnii* described by Bose (1953, Pl. 1, Fig. 4). However, only on the basis of external features it is difficult to identify the specimen up to the species level.

Williamsonia sp. (Pl. 1, Fig. 5)

The specimens showing well developed bracts but

receptacles are not clearly discernible in the impression specimens. In view of this, assignment of the *Williamsonia* 'flower' in any particular species is unjustified.

Table 1. Comparative analysis of the Early Cretaceous megafloal assemblages from three localities in Rajmahal basin

Localities	Hiraniduba	Amarjola	Nipania
Taxa			
<i>Lycoxylon indicum</i>	-	-	+
<i>Cladophlebis indica</i>	+	+	+
<i>Cladophlebis sahnii</i>	-	-	+
<i>Osmundites rajmahalensis</i>	-	+	-
<i>Hausmannia crenata</i>	+	+	+
<i>Thinnfeldia</i> sp. A	-	+	-
<i>Thinnfeldia</i> sp. B	-	+	-
<i>Taeniopteris crenata</i>	-	+	-
<i>Taeniopteris spathulata</i>	+	+	-
<i>Nipaniophyllum hobsonii</i>	-	-	+
<i>Nipaniophyllum raoi</i>	-	+	+
<i>Pentoxylon sahnii</i>	-	+	+
<i>Nipanioxylon guptai</i>	-	+	-
<i>Carnoconites rajmahalensis</i>	-	-	+
<i>Carnoconites compactus</i>	-	-	+
<i>Sahnia nipaniensis</i>	-	-	+
<i>Ptilophyllum cutchense</i>	+	+	+
<i>Ptilophyllum acutifolium</i>	+	+	-
<i>Ptilophyllum sahnii</i>	-	+	-
<i>Ptilophyllum nipanica</i>	-	-	+
<i>Bucklandia sahnii</i>	-	-	+
<i>Bucklandia dichotoma</i>	-	+	-
<i>Bucklandia guptai</i>	-	+	-
<i>Bucklandia</i> sp.	+	-	-

<i>Sahnioxylon andrewsii</i>	-	+	-	<i>Araucarites cutchensis</i>	+	-	-
<i>Williamsonia companulatiformis</i>	-	+	-	<i>Araucarites nipaniensis</i>	-	-	+
<i>Williamsonia guptai</i>	-	+	-	<i>Araucarites</i> sp.	-	+	-
<i>Williamsonia harrisiana</i>	-	+	-	<i>Podocarpoxyton indicum</i>	-	+	-
<i>Williamsonia sewardiana</i>	-	+	-	<i>Podocarpoxyton rajmahalensis</i>	-	+	-
<i>Williamsonia</i> sp. cf. <i>W. scotica</i>	-	+	-	<i>Circoporoxylon amarjolaense</i>	-	+	-
<i>Williamsonia</i> sp.	+	-	-	<i>Indophyllum raoi</i>	-	-	+
<i>Amarjolia dactylota</i>	-	+	-	<i>Indophyllum nipanica</i>	-	-	+
<i>Otozamites</i> sp. cf. <i>O. walkamotaensis</i>	+	-	-	<i>Indophyllum sahnii</i>	-	-	+
<i>Dictyozamites falcatus</i>	+	+	-	<i>Nipanioruha lanceolata</i>	-	-	+
<i>Anomozamites fissus</i>	+	+	-	<i>Nipanioruha granthia</i>	-	-	+
<i>Anomozamites amarjolense</i>	-	+	-	<i>Nipanioruha curvifolia</i>	-	-	+
<i>Brachyphyllum spiroxylon</i>	-	+	-	<i>Podostrobus sahnii</i>	-	-	+
<i>Brachyphyllum florinii</i>	-	-	+	<i>Podostrobus rajmahalensis</i>	-	-	+
<i>Brachyphyllum</i> sp.	+	-	-	<i>Podostrobus podocarpoides</i>	-	-	+
<i>Elatocladus confertus</i>	+	-	-	<i>Sitholeya rajmahalensis</i>	-	-	+
<i>Elatocladus tenerrimus</i>	+	-	-	<i>Mehtaia santalensis</i>	-	-	+
<i>Elatocladus sahnii</i>	-	-	+	<i>Mehtaia rajmahalensis</i>	-	-	+
<i>Coniferoaulon latisulcatum</i>	-	+	-	<i>Nipaniostrobus aciculifolia</i>	-	-	+
<i>Coniferoaulon rajmahalensis</i>	-	+	-	<i>Nipaniostrobus pagiophylloides</i>	-	-	+
<i>Coniferoaulon</i> sp.	+	-	-	<i>Nipaniostrobus sahnii</i>	-	-	+

PLATE 1

1. *Hausmannia crenata*, B.S.I.P. Specimen No. 38999 X 1.
2. *Cladophlebis indica*, B.S.I.P. Specimen No. 39000 X 2.
3. *Bucklandia* sp., B.S.I.P. Specimen No. 39001 X 1.
4. *Bucklandia* sp., B.S.I.P. Specimen No. 39002 X 1.
5. *Williamsonia* sp., B.S.I.P. Specimen No. 39003 X 1.
6. *Ptilophyllum cutchensis*, B.S.I.P. Specimen No. 39004 X 2.
7. *Dictyozamites falcatus*, B.S.I.P. Specimen No. 39005 X 2.
8. *Otozamites* sp. cf. *O. walkamotaensis*, B.S.I.P. Specimen No. 39006 X 15.
9. *Otozamites* sp. cf. *O. walkamotaensis*, B.S.I.P. Specimen No. 39007 X 2.

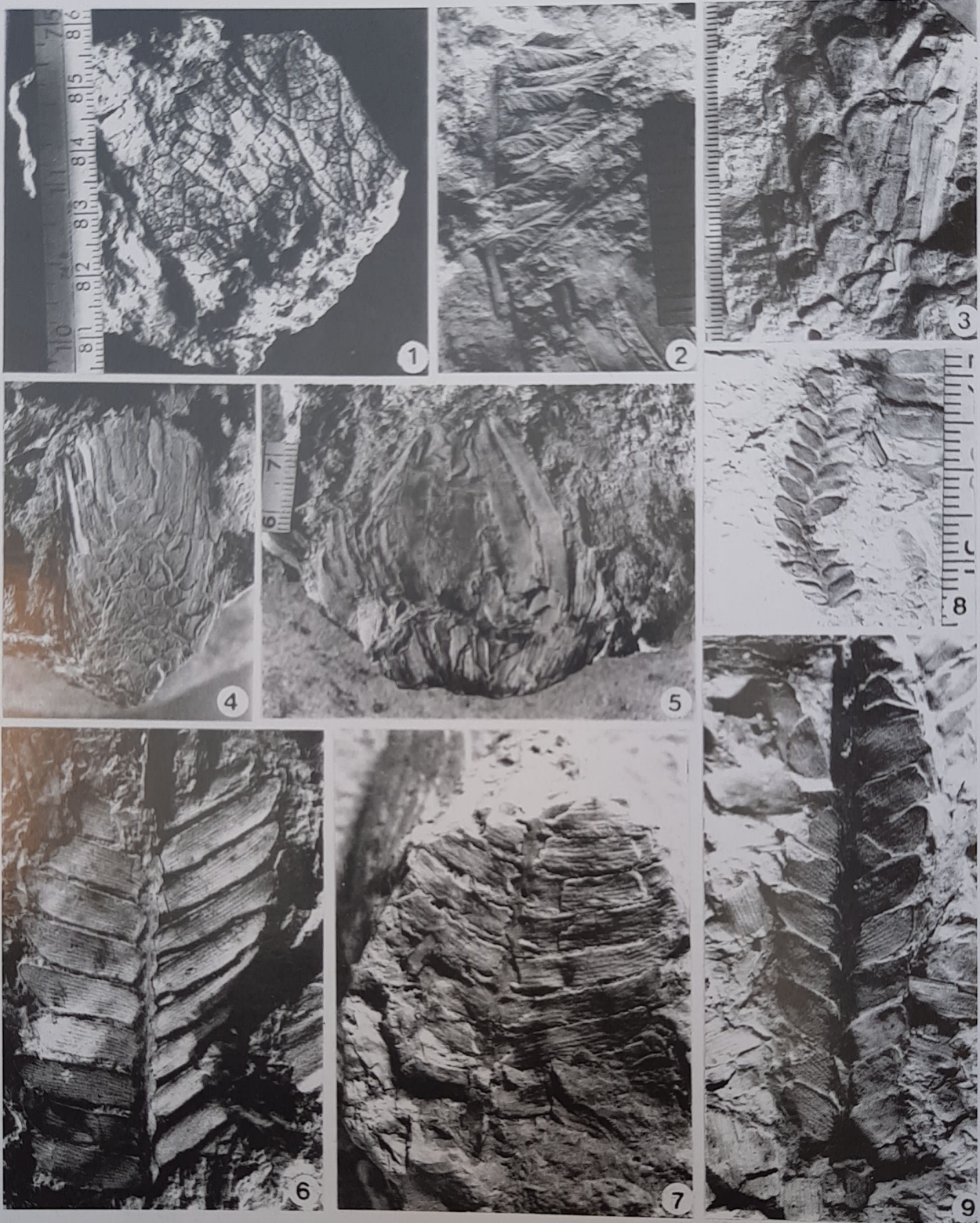
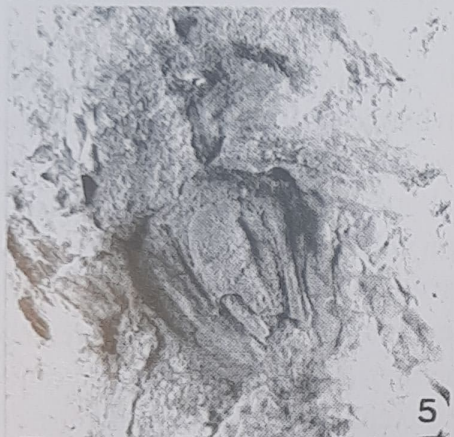
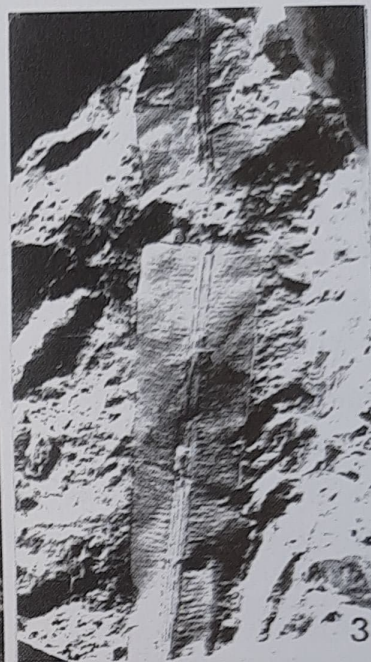
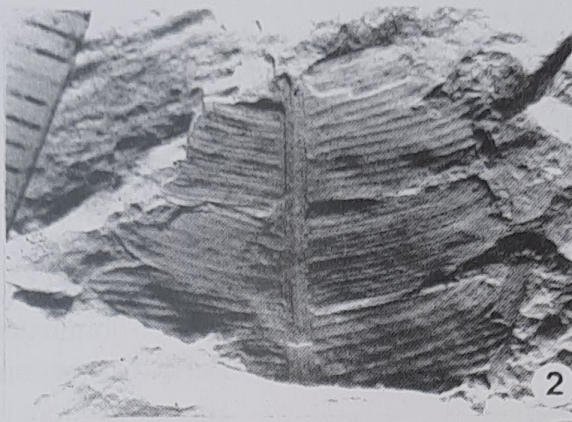
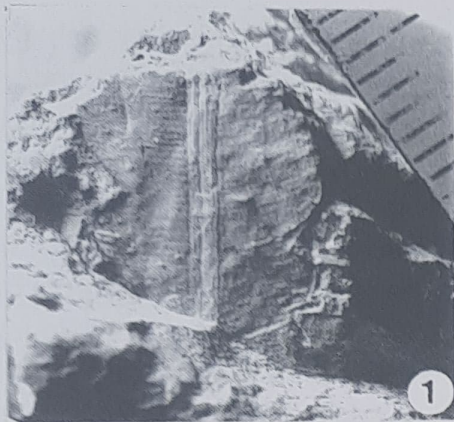


PLATE 2

1. *Anomozamites fissus*, B.S.I.P. Specimen No. 39008 X 2.
2. *Anomozamites fissus*, B.S.I.P. Specimen No. 39009 X 2.
3. ?*Nipaniophyllum hobsonii*, B.S.I.P. Specimen No. 39010 X 1.5
- 4 *Elatocladus tenerrimus*, B.S.I.P. Specimen No. 39011 X 2.
5. *Araucarites cutchense*, B.S.I.P. Specimen No. 39012 X 2.
6. Araucarian young female cone, B.S.I.P. Specimen No. 39013 X 2.
7. *Brachyphyllum* sp., B.S.I.P. Specimen No. 39014(a) X 2.
8. *Brachyphyllum* sp., B.S.I.P. Specimen No. 39014(b) X 1.
9. *Elatocladus confertus*, B.S.I.P. Specimen No. 39015 X 3.
10. *Coniferocaulon rajmahalense*, B.S.I.P. Specimen No. 39016 X 1.
11. *Bivalvia*, B.S.I.P. Specimen No. 39017 X 3.



Otozamites sp. cf. *O. walkamotaensis* (Pl. 1, Figs. 8, 9)

In gross morphology and venation pattern the impression specimens from Hiraniduba locality agree with that of *O. walkamotaensis* Bose & Zeba-Bano. However, due to lack of cuticular features in the present specimens, the Hiraniduba specimens are assigned as *Otozamites* sp. cf. *O. walkamotaensis*.

Brachyphyllum sp. (Pl. 2, Figs. 7, 8)

The impression specimens are incomplete and devoid of cuticles. However, based only on external morphology the present specimens have been tentatively assigned under the genus *Brachyphyllum*.

*Bivalvia (Pl. 2, Fig. 11)

Single specimen of bivalve shell 1.5 x 1 cm shows concentric rings where umbo region is broken. Due to incomplete nature of specimen it is difficult to identify the specimen up to generic level.

Comparison and Discussion

Comparative analysis of the floral assemblages pertaining to three nearby localities in the southern region of Rajmahal Basin has been shown in Table 1. It is evident that qualitatively the *Nipania*, *Amarjola* and *Hiraniduba* megafloreal assemblages of Rajmahal Basin are somewhat similar but differs in their quantitative assessment. Megafloreal assemblage of *Amarjola* locality shows dominance of Bennettitales in comparison to conifers (Bose, 1968; Sharma, 1967, 1968, 1972; Bose *et al.*, 1984). As revealed by the present analysis, the *Hiraniduba* assemblage is also dominated by Bennettitales. However, the *Nipania* assemblage shows dominance and diversity of conifers (Rao, 1943, 1947; Bose, 1953; Vishnu-Mittre, 1953, 1956a, b, 1957a, b, 1958). It can be assumed that variation in the assemblage depends upon time and space. Undoubtedly all the assemblages belong to Rajmahal Formation but the precise stratigraphic position of the fossiliferous intertrappean horizon is unknown due to intercalated nature of traps and intertraps or absence of lateral continuity of these beds. However, the present study reveals that bennettitalean remains were dominant in the *Hiraniduba* and *Amarjola*

assemblages, whereas in the *Nipania* assemblage conifers were dominant. Following the stratigraphy proposed by Sen Gupta (1988) it can be presumed that *Nipania* assemblage is the youngest fossiliferous assemblage in the Rajmahal Basin. Thus, it can be concluded that bennettitales dominated flora of *Amarjola* and *Hiraniduba* was gradually replaced by conifer-dominated flora in the Rajmahal Basin during Early Cretaceous Period. In all probabilities the *Hiraniduba* flora is equivalent to *Amarjola* flora rather than *Nipania* flora.

Dominance of cycadophytes in the *Hiraniduba* flora indicates warm humid tropical-subtropical climatic condition. Moreover, the palaeocommunity flourished during that period shows the cycadophyte dominated open land vegetation with an under storey of ferns and patches of coniferous tree forest inhabited in the upland areas of river or stream margins. The presence of a bivalve (molluscan shell) impression is indicative of deposition near the ephemeral pool or ditches.

REFERENCES

- Ball, V 1877. Geology of Rajmahal Hills. Mem. geol. Surv. India 13(2): 94.
- Bose, MN 1953. *Bucklandia sahnii* sp. nov. from the Jurassic of Rajmahal Hills, Bihar. *Palaeobotanist* 2: 41-50.
- Bose, MN 1968. A new species of *Williamsonia* from the Rajmahal Hills, India. *J. Linn. Soc. (Bot.)* 61(384): 121-127.
- Bose, MN, Banerji, J & Pal, PK 1984. *Amarjolia dactylota* (Bose) comb. nov., a bennettitalean bisexual flower from the Rajmahal Hills, India. *Palaeobotanist* 32: 217-229.
- Bose, MN, & Zeba-Bano 1981. On a new species of *otozamites* from Kachchh, Western India. *Palaeobotanist* 27: 227-231.
- Rao, AR 1943. *Nipaniostrobus*, a new genus of *Dacrydium*-like seed bearing cones and other silicified plants from the Rajmahal Series. *Proc. Indian Acad. Sci.* 13: 113-133
- Rao, AR 1947. *Nipanioruha granthia* gen. et sp. nov., a new petrified coniferous shoot from the Rajmahal Hills, Bihar. *J. Indian Bot. Soc., Iynger Commemoration Volume*: 389-397.
- Sen Gupta, S 1988. Upper Gondwana Stratigraphy and Palaeobotany of Rajmahal Hills, Bihar (India). *Palaeontologia Indica*. Geological Survey of India 68: 1-182.
- Sharma, BD 1967. Investigations on the Jurassic Flora of Rajmahal Hills, India-3. A review of the genus *Ptilophyllum* of Morris, with description of two new species from *Amarjola* in the Rajmahal Hills. *Palaeontographica* 120B: 139-150.
- Sharma, BD 1968. Investigations on the Jurassic flora of Rajmahal Hills, India-5. Epidermal studies on the bracts in two new

- species of *Williamsonia*, *W. guptai* and *W. amarjolense*. *Acta bot. Hung.* **14**: 373-383.
- Sharma, BD 1972. Plant life in the Jurassic of Amarjola, Rajmahal Hills, India. *Acta Pal.* **13**: 123-128.
- Vishnu-Mittre 1953. A male flower of Pentoxyleae with marks on the structure of the female cones of the group. *Palaeobotanist* **2**: 75-84.
- Vishnu-Mittre 1956a. Studies on the fossil flora of Nipania, Rajmahal Series, India- Bennettitales. *Palaeobotanist* **5**: 95-99.
- Vishnu-Mittre 1956b. *Masculostrobus sahnii* sp. nov., a petrified conifer cone producing three winged cone and 4 winged abnormal pollen grains from the Jurassic of the Rajmahal Hills, Bihar. *Grana Palynologia* **1**(2): 99-107.
- Vishnu-Mittre 1957a. Studies on the fossil flora of Nipania (Rajmahal Series) India- Pentoxyleae. *Palaeobotanist* **6**: 31-46.
- Vishnu-Mittre 1957b. Studies on the fossil flora of Nipania (Rajmahal Series), Bihar-Coniferales. *Palaeobotanist* **6**: 82-112.
- Vishnu-Mittre 1958. Studies on the fossil flora of Nipania, Rajmahal Series, India-Pteridophyta and general observation on Nipania fossil flora. *Palaeobotanist* **7**: 47-66.