

# The genus *Araucarites* from Upper Gondwana Succession (Early Cretaceous) of Bairam-Belkher area, district Amravati, Maharashtra and district Betul, Madhya Pradesh

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## ABSTRACT

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The present investigation corroborates with the vegetative counterparts belonging to conifers recovered from the fossiliferous horizons of the Upper Gondwana succession of the Early Cretaceous age. The succession, in addition, to the species of Filicales, Bennettitales, Cycadales and Coniferales, also revealed the rich assemblage of *Araucarites*, viz., *A. cutchensis*, *A. minutus* and *Araucarites* sp.

**Key-words**—Impressions, Mesozoic conifers, Upper Gondwana, India.

महाराष्ट्र के अमरावती जिले तथा मध्य प्रदेश के बैतूल जिले के बैरम-बेलखेर क्षेत्र के उपरि गोंडवाना अनुक्रम (प्रारम्भिक क्रिटेशस) से प्राप्त एरोकेराइटीज़ वंश

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## सारांश

वर्तमान अन्वेषण प्रारम्भिक क्रिटेशस आयु के उपरि गोंडवाना अनुक्रम के जीवाश्म-मय से प्राप्त शंकुवृक्ष से सम्बन्धित वनस्पति प्रतिरूपों के साथ संपुष्टि करता है। इसके अतिरिक्त फिलिकेलीज़, बेनेटाइटेलीज़, साइकेडेलेलीज़ एवं कॉनीफेरेलीज़ की प्रजातियों के अनुक्रम में एरोकेराइटीज़ अर्थात् ए. कच्छेन्सिस, ए. माइन्यूटस एवं एरोकेराइटीज़ प्रजाति के प्रचुर समुच्चय भी प्राप्त हुए हैं।

संकेत शब्द—मुद्राश्म, मीसोजोइक कोनिफर, उपरि गोंडवाना, भारत।

## INTRODUCTION

THE Bairam-Belkher area (21°22' : 77°37'-21°22' : 77°32') exhibits a good exposure of the Upper Gondwana succession in the form of tectonic inliers in vastly exposed basaltic terrain. It rests unconformably on the Archaean

feldspathic gneiss, while overlain by the Lametas, Deccan Traps and Alluvium (Fig. 1). The succession is about 100 m thick in Bairam area, while 90 m in Belkher area, represented by arenaceous argillaceous sediments. The major lithological facies are almost same in both the exposures except slight variations in thickness and are vertically represented by (i) cross and

parallel bedded sandstone lithofacies (ii) sandstone-clay lithofacies (iii) siltstone-clay lithofacies and (iv) conglomerate-grit lithofacies. The sandstone-clay lithofacies encompasses pocketed or lenticular bodies of clay with a dimension of 3-4 m length and 1-2 m width. These clay pockets are highly fossiliferous exhibiting impressions of diversified plant remains of Filicales, Bennettitales, Cycadales and Coniferales exhibiting Early Cretaceous age (Srivastava *et al.*, 1995, 1999, 2001). Apart from the plant remains, records of trace fossils have also been encountered (Srivastava *et al.*, 1996).

The present paper reports the occurrence of six species of *Araucarites*, based on detailed study of sixteen specimens. From the detailed study of these specimens, *A. cutchensis*, *A. minutus* and *Araucarites* sp. A, B, C and D have been reported. An attempt has been made to describe the reported taxa in detail along with its comparison with the known taxa from other Indian Lower Cretaceous localities viz., Kachchh, Jabalpur, Rajmahal, Golapalle, Gangapur and Athgarh formations. All the samples are kept in the museum of the P.G. Department of Geology, Amravati University, Amravati.

## SYSTEMATICS

### GYMNOSPERM

### CONIFERALES

#### Genus—ARAUCARITES Presl. 1838

The genus *Araucarites*, Presl 1838 has been instituted to include the detached cone-scales that show resemblance with the members of Araucariaceae. The genus represents the reproductive unit of family Araucariaceae of Coniferales that has unique evolutionary position in the plant kingdom.

The six species of *Araucarites* are reported which are based on the detailed study of sixteen specimens.

#### ARAUCARITES CUTCHENSIS (Feistmantel) Bose & Maheshwari (1973) (Pl. 1.1, 6, 7, 8)

*Description*—Detached seed-scale variable in size measuring 1.9 to 2.4 cm in length and 1.1 to 1.5 cm in width, wedge-shaped, broader towards distal end, gradually tapering to a truncate base, a tapering tip is distinct at the distal end

measuring 5-9 x 1-5 mm, seed obovate placed in the median position measuring 1-9 mm and 4-9 mm, longitudinal striations, distal projection shows variations.

*Locality and Material*—Bairam-Belkher area, districts Amravati, Maharashtra and Betul, Madhya Pradesh. Seven well preserved specimens including parts and counter parts.

*Comparison*—The specimens closely compares with *A. cutchensis* (Bose & Banerji, 1984) in overall morphographic shape and size, but differs in having a distinct operculum like appendage at the distal end. Also, the seed position is marked obovate in shape, wing narrow. It is well differentiated from *A. minutus* (Bose & Banerji, 1984) in shape and striated surface. It shows clear distinction from *A. janaianus* (Bose & Banerji, 1984) in lacking cuticular characters. Therefore, the present specimens are identified as *A. cutchensis*, Bose and Maheshwari, 1973.

During subsequent visits more specimens have been collected (Pl. 1.4, 7, 8) which shows close resemblance with the *A. cutchensis*. Bose and Maheshwari, 1973. The genus is widely reported from Upper Jurassic to Early Cretaceous Gondwana succession i.e., from Rajmahal Formation (Ramanujam, 1957); from Kachchh and Jabalpur area (Bose & Maheshwari, 1973), from Gangapur Formation (Sukh-Dev & Rajanikanth, 1988; Laxminarayan & Rao, 1988); from Golapalle Formation, (Pandya & Sukh-Dev, 1990); from Athgarh

Age	Formation/Group	Lithology
Quaternary		Soil and alluvium
-----Unconformity-----		
Miocene to Late Cretaceous	Deccan Trap	Nonporphyritic to porphyritic basalt
-----Unconformity-----		
Late Cretaceous	Lameta	Shale, limestone and Sandstone
-----Disconformity-----		
Early Cretaceous	Upper Gondwana	Clay, shale, sandstone and conglomerate
-----Unconformity-----		
Archaean		Quartz-feldspathic gneiss

Fig. 1—Generalised stratigraphy of the area.

## PLATE 1

(Scale = one centimeter)

- 1., 6., 7., 8. *Araucarites cutchensis*: specimens showing details of seed-scales.
2. *Araucarites* sp. C: specimen showing details of seed-scale and appendage.
3. *Araucarites* sp. D: exhibiting overall shape and striation on seed-scale.
4. *Araucarites* sp. A: showing structure of seed-scale
5. *Araucarites* sp. B: exhibiting morphographic features of seed-scale.
- 9., 10. *Araucarites minutus* specimens showing details of morphographic features of seed-scale.

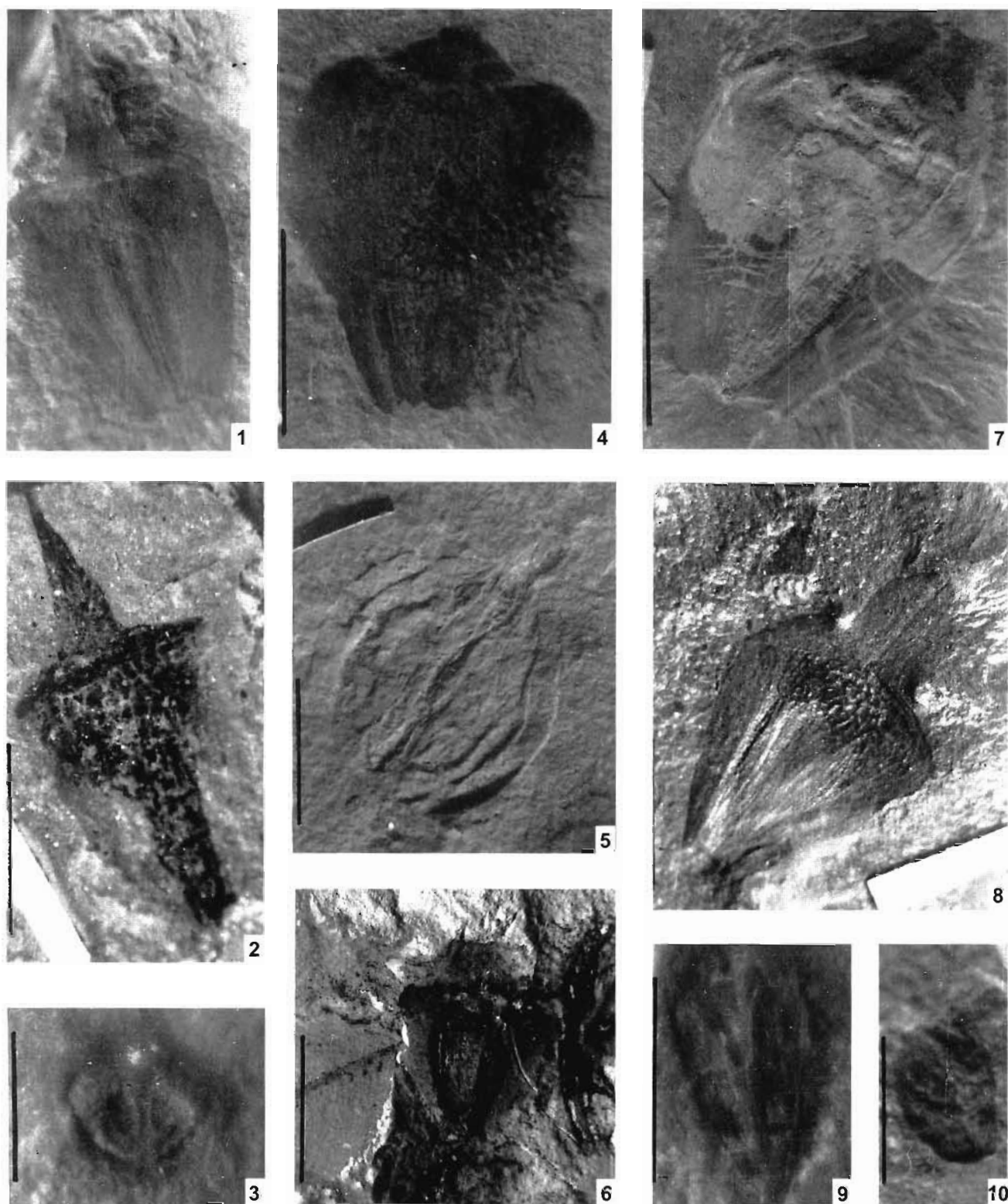


PLATE 1

Formation (Patra & Sahoo, 1992; Prakash & Sukh-Dev, 1995); and from Rajmahal Formation (Banerji, 1995).

**ARAUCARITES MINUTUS** Bose and Maheshwari (1973)  
(Pl. 1.9, 10)

*Description*—Detached seed-scales, variable in shape i.e., wedge-shaped 6 mm long and 7 mm wide to oval, narrowing to a truncate base, tip narrow; short, seed position well-marked, broadly obovate, medianly placed, approximately 3 to 4 mm long and 2 to 4 mm broad.

*Locality and Material*—Belkher area, districts Amravati, Maharashtra and Betul, Madhya Pradesh. Three well preserved specimens including parts and counter parts.

*Comparison*—The specimens recovered from the locality resembles *A. minutus* Bose and Maheshwari 1973 in shape and size but lacks fine longitudinal striations. It also shows resemblance with *A. cutchensis* Bose and Maheshwari 1973 in overall shape, but differs in minute size and non-striated surface. However, in morphographic characters, it resembles with *A. janaianus* Bose and Banerji 1984 identified on the basis of cuticular evidences, but the present specimen is an impression and lacks the epidermal features.

*A. minutus* has also been reported from Gangapur Formation (Sukh-Dev & Rajanikanth, 1988) and Athgarh Formation (Prakash & Sukh-Dev, 1995).

**ARAUCARITES** sp. A

(Pl. 1.4)

*Description*—Detached seed-scales, 2.5 cm long and 1.5 cm broad, wedge-shaped, broader towards distal end expanded into a wing-like extensions, with somewhat rounded shoulders, tapering towards the basal region to form a 5 mm broad base. The distal end bears a well-defined 1 cm long and 5 mm broad appendage with an acute apex.

*Locality & Material*—Bairam area, districts Amravati, Maharashtra and Betul, Madhya Pradesh. Well preserved one specimen part and counter part.

*Comparison*—The specimen shows distinct morphographic characters having expanded into broad wing-like extension and well-marked tip. It shows resemblance with *A. cf. nipaniensis* reported from Kachchh. However, *A. cf. nipaniensis* Singh 1956 (Bose & Banerji, 1984) possesses incomplete base and also distal end forms a minute, in contrast to well-marked tip. In overall shape and size, the specimen is comparable to *Araucarites janaianus* (Bose & Banerji, 1984) but differs in absence of cuticular characters.

**ARAUCARITES** sp. B

(Pl. 1.5)

*Description*—Detached seed-scale, obovate in shape, measuring 1.5 cm in length and 8 mm in width, margin entire, oval shaped seed is attached on one side of the scale measuring 7 mm long and 4 mm wide, distal appendage lacking, distal part of scale and seed surface showing faint longitudinal striations.

*Locality and Material*—Belkher area, districts Amravati, Maharashtra and Betul, Madhya Pradesh. Well preserved two specimens, part and counter part.

*Comparison*—The present specimen is clearly distinguished from *A. cutchensis* Bose and Maheshwari (1973) in having typical obovate shape and seed placed eccentrically on one side, also the appendage at the distal end is lacking. From *A. minutus* (Bose & Maheshwari, 1973) it differs in shape, size and position of seed. From *A. cf. nipaniensis* Singh 1956 reported from Kachchh it lacks trapezoidal shape and distal projection. The other species like *A. janaianus*, *A. pantiana* and *A. sehoraensis* Bose and Maheshwari 1973 (Bose & Banerji, 1984) are characterised by their distinct epidermal features which are absent in present specimen. Also, the position of seed towards one side differentiates it from compression forms. Morphologically, the specimen resembles with *Araucarites* sp. (Laxminarayan & Rao, 1988) reported from Gangapur Formation in shape only. The position of seed and other details are not provided by Laxminarayana and Rao (1988).

On the character of obovate shape, eccentric position of seed and complete absence of epidermal features, a species is named as *Araucarites* sp. B because of the insufficient number of specimens.

**ARAUCARITES** sp. C

(Pl. 1.2)

*Description*—Detached seed-scale measuring 1.5 cm in length and 1 cm in width, broadly triangular, tapering towards base about 4 mm long and 0.6 mm wide, upper appendage triangular in shape bearing centrally an oval seed measuring 0.4 mm in length and 0.6 mm in width.

*Locality and Material*—Belkher area, districts Amravati, Maharashtra and Betul, Madhya Pradesh. Only one specimen.

*Comparison*—The specimen exhibits well-preserved seed-scale with a distinct and broadly triangular appendages. In its gross morphology, it resembles with the *A. janaianus* (Bose & Banerji, 1984) reported from Trambau and Chawad river. However, in the character of narrowing of seed-scale and lacking cuticular details, it can be clearly distinguished from *A. janaianus*. It is also comparable to *A. cutchensis* (Bose & Banerji, 1984) in overall shape but in possession of broadly triangular appendages, it is clearly distinct from *A. cutchensis*. From *A. minutes* (Bose & Banerji, 1984), it is clearly demarcated in shape and distinct morphological features. As the observations are based on limited number of specimens, presently it is described as *Araucarites* sp. C.



**ARAUCARITES** sp. D

(Pl. 1.3)

*Description*—Detached seed-scale about 2 cm long and 2 cm wide, almost circular shaped tapering towards base measuring 5 mm long and 3 mm broad, seed obovate placed in the median position about 2.2 mm in length and 0.6 mm in width. Exposed part of scale and seed surface showing distinct longitudinal striations.

*Locality and Material*—Belkher area, districts Amravati, Maharashtra and Betul, Madhya Pradesh. Well preserved two specimens, part and counter part.

*Comparison*—The seed-scale shows broadly oval outline with distinct longitudinal striations. It is clearly distinguished by its shape and size from *A. cutchensis* (Bose & Banerji, 1984), a most common seed-scale described from various Upper Gondwana localities. The present species is also differentiated from *A. minutus* (Bose & Maheshwari, 1973), owing to its large size and striations on the surface. From *A. nipaniensis* (Bose & Banerji, 1984) reported from Nipania, Rajmahal Hills, it can be distinguished easily by its shape and gross morphological features. As the present specimen shows less similarity with known species of *Araucarites*, it is described here as *Araucarites* sp. D.

**DISCUSSION**

The Upper Gondwana succession belonging to the Early Cretaceous age of Bairam-Belkher locality has been explored for its rich assemblage of Filicales, Unclassified Ferns, Bennettitales, Cycadales and Coniferales (Srivastava *et al.*, 1995, 1999). The detailed investigation of the floristic composition of area revealed the occurrence of diversified detached seed-scales. A total of sixteen specimens of *Araucarites* species have been collected and studied. The assemblage shows the presence of *A. cutchensis*, *A. minutus*, *Araucarites* sp. A, B, C and D. They are quite distinct in shape, size and position of ovule.

The occurrence of *Araucarites* suggest that the Conifers particularly the Araucariaceae was well represented in the area. The fairly good representation of *Araucarites* seed-scales signifies the geographical distribution of *Araucarian* plants. A close perusal of the literature reveals that such seed-scales are often encountered in Upper-Jurassic to Early Cretaceous localities, thus strengthening the age assignment to the present locality. The dominance of Conifers mainly by *Pagiophyllum* sp., *Brachyphyllum* sp., *Elatocladus tenneirrimus*, *E. sp. cf. E. kingianus* and *Elatocladus* sp., *Araucarites cutchensis*, *A. minutus*, *Araucarites* sp. A, B, C and D also supports the prevalence of subtropical climatic

conditions as has been proposed for Dubrajpur Formation by Banerji (1990). In the present day climate, the *Araucarian* members luxuriantly grows in sub-tropical to temperate climatic conditions showing adaptations to xeric conditions (Ramanujam, 1979).

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**REFERENCES**

- Banerji J 1990. Plant fossils from Dubrajpur Formation, Bihar and their significance in stratigraphy. *Palaeobotanist* 38 : 122-130.
- Banerji J 1995. Megafloreal assemblages from two new localities of Rajmahal Formation. *Geophytology* 24 : 205-208.
- Bose MN & Maheshwari HK 1973. Some detached seed-scales belonging to Araucariaceae from the Mesozoic rocks of India. *Geophytology* 3 : 205-214.
- Bose MN & Banerji J 1984. The fossil floras of Kachchh. I-Mesozoic Megafossils. *Palaeobotanist* 33 : 1-189.
- Laxminarayana G & Rao KN 1988. A note on the occurrence of *Ptilophyllum* flora from the Chintalapudi sub-basin, Pranhita-Godavari Valley, Khammam District, Andhra Pradesh. *Journal of Geological Society of India* 32 : 137-142.
- Pandya N & Sukh-Dev 1990. Fossil flora of Golapalle Formation. *Palaeobotanist* 38 : 147-154.
- Prakash N & Sukh-Dev 1995. Fossil flora of Athgarh Formation, Orissa, India. *Geophytology* 24 : 219-227.
- Patra BP & Sahoo NK 1992. Plant megafossils from Athgarh Formation near Bouda, Cuttack District, Orissa. *Geophytology* 22 : 127-132.
- Ramanujam CGK 1957. Cone scales of *Araucarites cutchensis* from the Rajmahal Hills, Bihar. *Current Science* 26 : 87-88.
- Ramanujam CGK 1979. *Indian Gymnosperms in time and space*. Today and Tomorrow Printers and Publishers, New Delhi : 15.
- Singh G 1956. *Araucarites nipaniensis* sp. nov.- A female *Araucarian* cone scale from the Rajmahal series. *Palaeobotanist* 5 : 64-65.
- Srivastava AK, Banubakode PD, Kale VM & Patil GV 1995. Record of Upper Gondwana flora from Bairam-Belkher area of district Amravati, Maharashtra and district Betul, Madhya Pradesh. *Current Science* 69 : 397-400.
- Srivastava AK, Banubakode PD, Kale VM & Patil GV 1996. Record of the trace fossils from Upper Gondwana succession of Bairam and adjoining area, district Amravati, Maharashtra. *Gondwana Geological Magazine* 11 : 33-44.
- Srivastava AK, Banubakode PD, Kale VM, Patil GV & Manik SR 1999. Lower Cretaceous plant fossils from Bairam-Belkher area, district Amravati, Maharashtra and district Betul, Madhya Pradesh and significance in stratigraphy. *Palaeobotanist* 48 : 39-48.
- Srivastava AK, Manik SR & Gawande RR 2001. Record of genus *Hausmannia* Dunker from the upper Gondwana of Bairam-Belkher area, Amravati District, Maharashtra and Betul District, Madhya Pradesh. *Current Science* 81 : 756-757.
- Sukh-Dev & Rajanikanth A 1988. The Gangapur Formation. Fossil flora and Stratigraphy. *Geophytology* 18 : 1-27.