PALYNOLOGY OF THE ATHGARH FORMATION, NEAR CUTTACK, ORISSA

HARI K. MAHESHWARI
Birbal Sahni Institute of Palaeobotany, Lucknow 226007

ABSTRACT

The palynological assemblage of the Athgarh Formation, Cuttack and Puri districts, Orissa comprises 45 species belonging to 29 genera of pollen and spores. The assemblage has a predominance of gymnospermic pollen, particularly *Araucariacites* and *Callialasporites*. Pteridophytic spores are meagrely represented. In its quantitative composition the Athgarh mioflora has overall resemblance with the miofloras of the Vemavaram and Upper Katrol beds.

INTRODUCTION

THE post-Triassic fresh-water strata around Athgarh, near Cuttack, Orissa were first studied by Blanford *et al.* (1859) and were named by them as 'Athgarh Sandstones'. Blanford (1872) referred these strata to a separate stage, 'the Athgarh Stage'. The area was first systematically mapped by Ball (1877) and later by Adyalkar (*see* Adyalkar & Rao, 1973, p. 319). The lower and upper boundaries of the 'Athgarh Stage' are yet not demarcated.

The rocks of the Athgarh Formation comprise conglomerates, grits, sandstones and arenaceous shales. Coal and carbonaceous shales have been reported from the Sidheshwar Hill, about 6·5 km west of Cuttack (Fox, 1931). The type locality for the formation is "the northern slopes of the hill about five furlongs south of the village Ghantidhal* (20°31′00″: 85°44′30″ — Hontikal or Hontikul of Ball) in sheet No. 73H/10" whereas "the town of Athgarh, after which the stage is named, is situated on the khondalites" (Adyalkar & Rao, 1963, pp. 319, 320).

Plant fossils were first collected from the Athgarh Formation by Ball (1877). The collection was described by Feistmantel (1877). Adyalkar's collection of plant fossils from the type locality was described by Adyalkar and Rao in 1963. Jain (1968) described some plant fossils from the same general locality. Recently some more plant fossils have been described from several localities of the Athgarh Formation by Pandya and Patra (1968) and Patra (1973). Following is a list of plant megafossils known from the Athgarh Formation:

Marattiopsis macrocarpa (Oldham & Morris) Seward & Sahni 1920
Gleichenia gleichenoides (Oldham & Morris) Bose & Sah 1968
Cladophlebis indica (Oldham & Morris) Sahni & Rao 1933
Cladophlebis ?srivastavae Gupta 1954
Cladophlebis ?denticulata Brongniart 1849
Cladophlebis sp. cf. *C. longipennis* Seward 1917
Phlebopteris athgarhensis Jain 1968
Sphenopteris ?hislopi Oldham & Morris 1863
?Coniopteris sp.
?Onychiopsis paradoxus Bose & Sukh-Dev 1961
Rhizomopteris ballii Feistmantel 1877
Thinnfeldia sp.
?Dicroidium sp.
Pachypteris indica (Oldham & Morris) Bose & Roy 1968
Ptilophyllum acutifolium Morris 1840
Ptilophyllum cutchense Morris 1840
Ptilophyllum indicum Jacob & Jacob 1954
Ptilophyllum oldhamii Jacob & Jacob 1954
Cycadites sp. cf. *C. conferta* Morris 1863
Taeniopteris spatulata McClelland 1850
Baiera sp.
Araucarites sp. cf. *A. macropterus* Feistmantel 1877
Nilssonia (*Anomozamites?*) *?fissa* (Feistmantel) Seward & Sahni 1920

Reports of the occurrence, in the Athgarh Formation, of the species listed above are by no means all correct, and need rechecking. On the whole the megaflora of the Athgarh Formation shows affinities with that of the Jurassic Floras of India.

In the present paper the palynological composition of the Athgarh Formation

*Misprint from Ghantikhal.

has been discussed and comparisons are drawn with palynological assemblages known from some other Upper Mesozoic formations of India.

MATERIAL AND METHOD

The material for the study comprised grab samples collected from unmeasured sections at the undermentioned localities. The author thanks Dr Sukh-Dev for providing the sampes.

Locality 1. Ghantikhal (Map 1) — pinkish shale — no miospores.

Locality 2. Sidheshwar Hill (Map 1) —
Sample no. E. — carbonaceous shale — sporiferous.
Sample no. E/S3 — grey shale — few miospores.
Sample no. E/S7 — grey shale — few miospores.
Sample no. E/F28 — arenaceous shale — no miospores.
Sample no. $E/\frac{N}{11}-\frac{18/12}{66}$ — black shale — unfossiliferous.

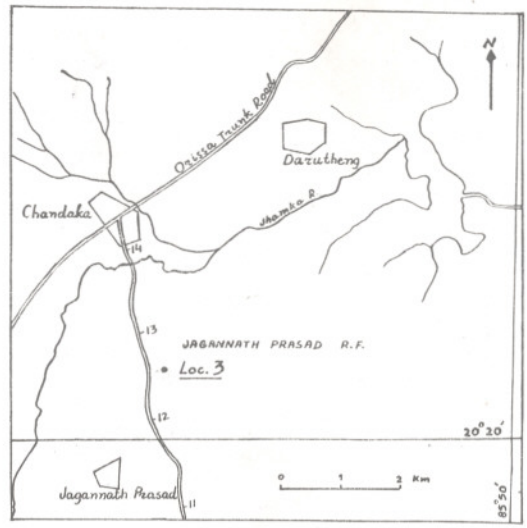
Locality 3. Jagannath Prasad Quarry (Map 2) — Sample no. G — fine-grained sandstone — sporiferous.

Locality 4. Churang Hill — clayey shale — no miospores.

The samples were macerated in concentrated Nitric acid for 3 to 4 days. After thoroughly washing with water the macerate was digested in 5 per cent Potassium hydroxide solution. If any silica remained, it was dissolved in Hydrofluoric acid. Slides were prepared in Polyvenyl alcohol and canada balsam.

Miospore recovery was satisfactory only in two samples, viz., E (Sidheshwar Hill, Cuttack District) and G (Jagannath Prasad Quarry, Puri District). Other samples were either barren of miospores or had only a few specimens.

Map 1 — Showing location of the Ghantikhal (1) and Sidheshwar Hill (2) localities.



Map 2 — Showing location of Jagannath Prasad Quarry (3).

PALYNOLOGICAL COMPOSITION

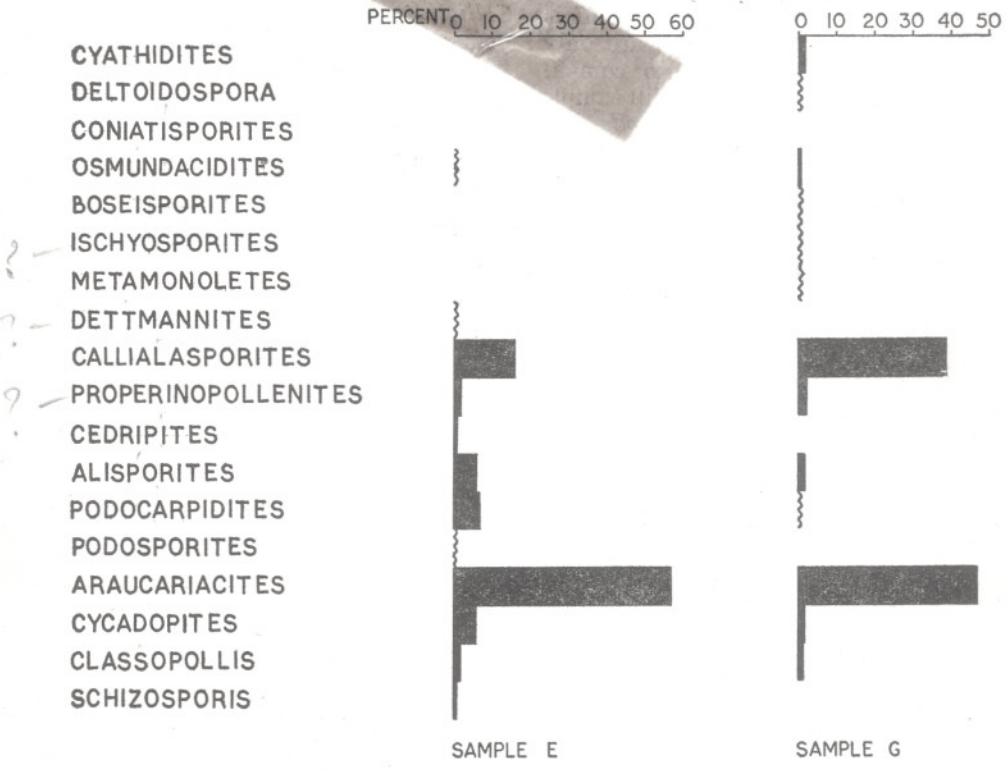
Following pollen and spore types have been recovered from the samples analysed. Some important palynomorphs are illustrated in plate 1.

Cyathidites australis Couper 1953
C. minor Couper 1953
Deltoidospora sp.
Todisporites sp.
Osmundacidites wellmanii Couper 1953
Lycopodiumsporites austroclavidites (Cookson 1953) Potonié 1956
L. circolumenus Dettmann 1963
Lametatriletes indicus Singh & Kumar 1972
Boseisporites praeclarus Sukh-Dev 1961
Ischyosporites sp.
Impardecispora sp. cf. *A. verrucata* (Couper 1958) Venkatachala, Kar & Raza 1969

Gleicheniidites sp.
?*Ornamentifera* sp.
Contignisporites sp.
Monolites indicus Kumar 1972
Crassimonoletes sp.
Dettmannites sp.
Callialasporites baculosus Sukh-Dev 1959 ex Maheshwari 1974
C. dampieri (Balme 1957) Sukh-Dev 1961
C. discoidalis (Döring 1962) Bharadwaj & Kumar 1972
C. doeringii Kumar 1973
C. enigmatus (Singh & Kumar 1969) Kumar 1973
C. lucidus (Pocock 1962) Maheshwari 1974
C. rudisaccus Maheshwari 1974
C. segmentatus (Balme 1957) Sukh-Dev 1961
C. triletes Singh, Srivastava & Roy 1964
C. trilobatus (Balme 1957) Sukh-Dev 1961
Properinopollenites monoalasporus (Sukh-Dev 1961) Maheshwari 1974
?*Sehoripollenites* sp.
Alisporites ovalis Kumar 1973
Alisporites sp.
Podocarpidites ellipticus Cookson 1947
P. magnus Maheshwari 1974
P. novus Sah & Jain 1965
Vitreisporites sp.
Chordasporites sp.
Podosporites tripakshii Rao 1947
Cedripites nudis Kar & Sah 1970
Araucariacites australis Cookson 1947
A. ghuneriensis Singh, Srivastava & Roy 1964
Cycadopites couperi Sukh-Dev 1961
Cycadopites sp.
Classopollis indicus Maheshwari 1974
Schizosporis sp.

QUANTITATIVE ANALYSIS

Of the eight samples studied from four localities, only two samples have yielded abundant miospores. Rest of the samples were either barren or have a very poor



Histogram 1 — Showing per cent miospore frequency of the different genera in the two samples (E-Sidheshwar Hill, and G-Jagannath Prasad Quarry).

miofloral composition. The Sporae dispersae comprises trilete and monolete spores and monosaccate, nonstriate bisaccate, polysaccate, monocolpate and operculate pollen. Quantitative analyses of samples E and G are based on a count of 400 specimens from each sample (Histogram 1).

The pteridophytic spores, though quite varied in species, are meagrely represented quantitatively. In the Sidheshwar Hill sample (E) they hardly amount to 1 per cent, while in the Jagannath Prasad Quarry sample (G) these are slightly more, being about 5.5 per cent.

Araucariacites is the most dominant genus of the assemblage and contributes to more or less 50 per cent of the specimens. The next quantitatively important genus is *Callialasporites*. The frequency of the genus in sample G is more than double than in sample E. The smaller frequency of *Callialasporites* in sample E is, however, compensated by a comparatively high incidence on nonstriate bisaccate genera *Alisporites*, *Cedripites* and *Podocarpidites*, which together amount to about 15 per cent. In the Jagannath Prasad sample on the other hand the bisaccates are only 2.5 per cent. *Cycadopites* is also comparatively more in the Sidheshwar Hill sample (6%). The genera *Properinopollenites*, *Podosporites*, *Classopollis* etc. are 2 per cent or less each. The genera *Cedripites* and *Schizosporis* occur only at the Sidheshwar locality.

COMPARISON AND DISCUSSION

The Jurassic-Lower Cretaceous miofloras are known from the Rajmahal Hills (Sah & Jain, 1965), Madhya Pradesh (Bharadwaj *et al.* 1972; Maheshwari, 1973, 1974), Andhra Pradesh (Kar & Sah, 1970), Gujarat (Venkatachala & Kar, 1970), Rajasthan (Srivastava, 1966; Banerjee, 1972; Lukose, 1972) and the Cauvery Basin (Venkatachala *et al.*, 1972), and others.

The Lower Jurassic miofloras from the Lathi Formation and the Jaisalmer Limestone, Rajasthan are extremely rich in the *Classopollis*-complex (up to 80 per cent). *Callialasporites* is also fairly well represented whereas *Araucariacites* is less than 5 per cent. The Athgarh mioflora on the other hand is rather poor in *Classopollis* but very rich in *Araucariacites* (± 50 per cent).

The Rajmahal plant beds between trap flow nos. 1-4 are supposed to be Lower-Middle Jurassic in age on the basis of megafossils (Shah *et al.*, 1973). Bharadwaj *et al.* (1972), on the hand, think that the Rajmahal plant beds are younger than the Jabalpur 'Stage' which they conclusively date as Upper Jurassic. There is, however, no megafloristic support for the latter view. The Rajmahal mioflora which is very different from that of the Lathi Formation. is known from two localities, Sakrigali Ghat and Basco. According to Sah and Jain (1965) the Sakrigali Ghat assemblage is rich in pteridophytic spores whereas the Basco assemblage has more of gymnospermous pollen. Bharadwaj (1969, p. 89), however, asserts that both assemblages have similar palynological composition. When we compare the miofloras of the Athgarh and the Rajmahal beds, the difference in the frequency of miospore groups is quite noticeable. The Rajmahal beds have up to 40 per cent pteridophytic spores, while in the Athgarh beds they hardly amount to 5 per cent. The genera *Callialasporites* and *Araucariacites* which dominate the Athgarh mioflora, are comparatively low in percentage at Rajmahal.

In the paucity of the pteridophytic spores, the Athgarh mioflora is strikingly similar to the one described from the Vemavaram beds (Kar & Sah, 1970; histogram III in Bharadwaj, 1969). In both miofloras the dominant genera are *Araucariacites* and *Callialasporites*. Megafloristically, however, there is not much similarity. Particularly striking is the absence of the genera *Otozamites* and *Dictyozamites* in the Athgarh Formation. At the same time, *Marattiopsis macrocarpa*, *Gleichenia gleichenoides*, *Phlebopteris athgarhensis*, *Rhizomopteris ballii*, *Ptilophllum indicum*, *P. oldhamii*, *Cycadites* sp. and *Baiera* sp. are so far not known from the Vemavaram beds. Kar and Sah (1970) palynologically date the Vemavaram beds as Upper Jurassic, but on the basis of faunistic evidences, afforded by the ammonites and fish remains, the beds at Vemavaram do not seem to be older than Upper Neocomian. Considering the dissimilarity of the Athgarh and Vemavaram megafloras, the overall similarity in the generic frequency count of the two miofloras is inexplicable.

Another miospore assemblage which is poor in pteridophytic spores is from the Upper Katrol rocks near Bhuj, Gujarat

(Venkatachala *et al.*, 1969). The Upper Katrol shales are dated as Upper Jurassic on the basis of ammonite faunas. Bharadwaj (1969, p. 91) suggests the subdivision of the Katrol miofloral assemblage into three zones. The Athgarh mioflora is more akin to the middle zone but for the lack of the genera *Cedripites* and *Cycadopites* in the frequency count of the latter. The mioflora from Section K of the Bhuj beds near Bhuj (Lower Cretaceous, Venkatachala, 1969) is not, in any way, different from that of the Katrol beds. The miofloras of sections J and L, however, are extremely rich in trilete spore forms and hence do not compare with the Athgarh mioflora.

Bharadwaj *et al.* (1972) discussed the palynostratigraphy of the Jabalpur 'Stage' from three localities. Like the Athgarh mioflora, this mioflora is also dominated by the genera *Araucariacites* and *Callialasporites*, but at the same time has higher per cent frequencies of the pteridophytic spores, and the genera *Cycadopites* and *Classopollis*. The mioflora from the Bansa Formation (Maheshwari, 1974) also has similar overall palynological composition. The Bansa beds are dated as Lower Cretaceous on the basis of the contained megafossils.

Thus, we find that the Jurassic-Lower Cretaceous miofloral assemblages of peninsular India are characterized by the abundance of the pollen belonging to the genera *Araucariacites and Callialasporites*, both belonging to the gymnosperms. The genera *Cyathidites, Alisporites, Podocarpidites, Classopollis, Cycadopites* etc. are subdominant in individual sections of various formations. As far as the present knowledge goes there are no index genera or generic groups for different formations. The, Jurassic palynoflora continues into the Lower Cretaceous without an appreciable change in its overall composition and it is difficult at present to draw a palynological boundary between the two. Palynological distinction even between various groups and formations of the Jurassic System of India is also difficult at present. As such, it is not possible to palynologically date the studied samples of the Athgarh Formation. In the paucity of pteridophytic spores these do show palynological similarity with the Upper Katrol and the Vemavaram beds which are palynologically dated as Upper Jurassic. But the Upper Jurassic age of the Vemavaram beds is not supported by the fossil animals found in these beds, which rather indicate a Lower Cretaceous age. The plant fossils of the Athgarh and Vemavaram beds are not similar, and there are no undoubted Lower Cretaceous plants in the Athgarh beds.

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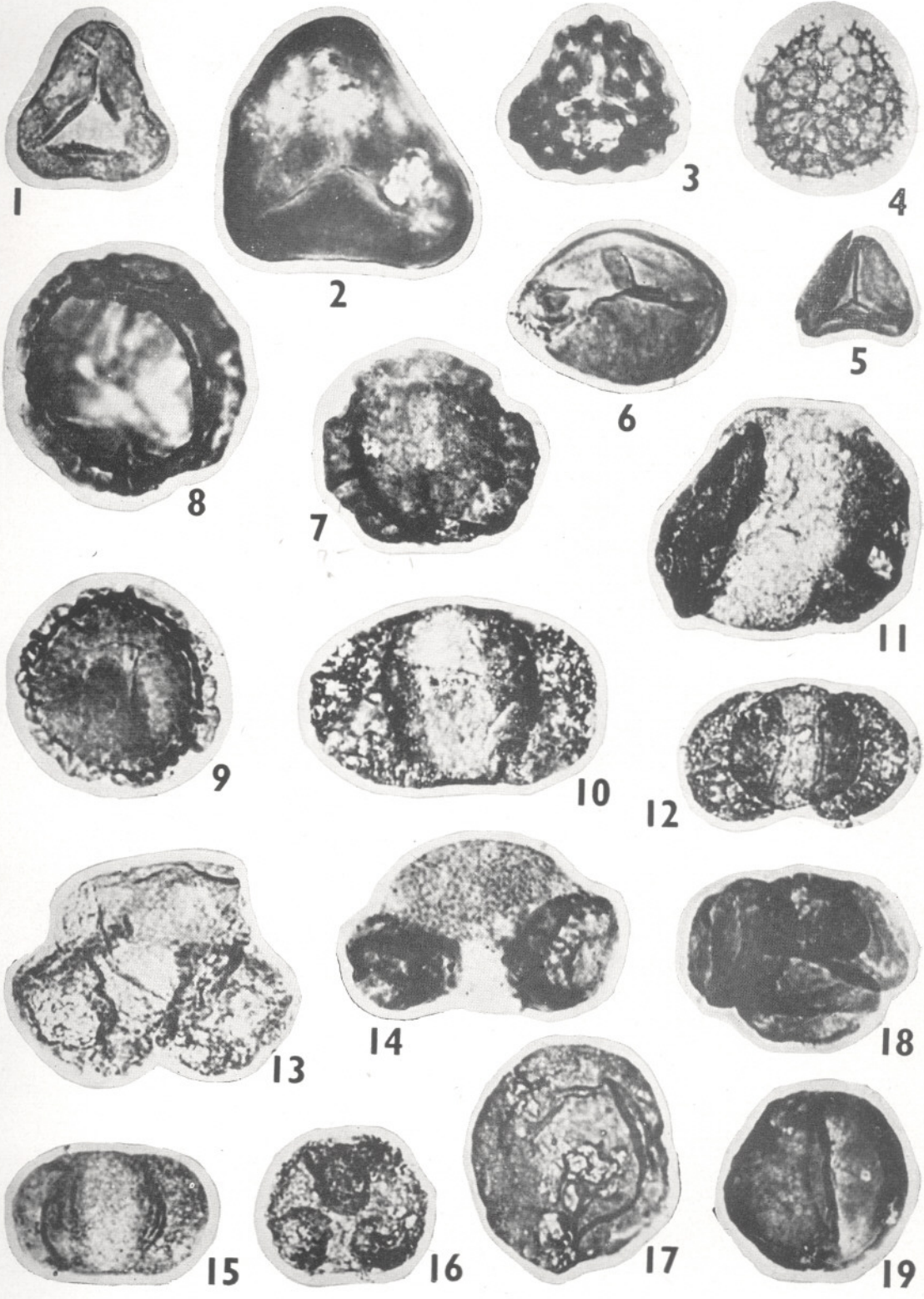
EXPLANATION OF PLATE 1

(All figures are × *Ca.* 500)

1. *Cyathidites australis*
2. *Boseisporites praeclarus*
3. *Ischyosporites* sp.
4. *Lycopodiumsporites austroclavidites*
5. *Gleicheniidites* sp.
6. *Crassimonoletes* sp.
7. *Callialasporites trilobatus*
8. *Callialasporites dampieri*
9. *Callialasporites doeringii*
10. *Alisporites ovalis*
11. *Alisporites* sp.
12. *Podocarpidites novus*
13. *Cedripites nudis*
14. *Cedripites nudis*
15. *Vitreisporites* sp.
16. *Podosporites tripakshii*
17. *Araucariacites australis*
18. *Classopollis indicus*
19. *Schizosporis* sp.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