Palynology of Mesozoic outcrops of Athgarh Formation exposed near Talbast, Orissa

B. N. Jana

Jana, B. N. 1990. Palynology of Mesozoic outcrops of Athgarh Formation exposed near Talbast, Orissa. *In* : Jain, K. P. & Tiwari, R. S. (eds)—*Proc. Symp. 'Vistas in Indian Palaeobotany'*, *Palaeobotanist* **38** : 155-162.

The palyno-assemblage recovered from Athgarh Formation, near Talbast region, Orissa contains 23 genera and 33 species. This assemblage, the first record from southern part of Athgarh outcrops in the region, is characterized by the dominance of the genus *Murospora*, and the palynofloral composition, as a whole, shows its affinity with Upper Jurassic-Lower Cretaceous palynological assemblages.

Key-words—Palynology, Athgarh Formation, Mahanadi Basin, Upper Jurassic-Lower Cretaceous (India)

B. N. Jana, Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226 007, India

सारांश

उड़ीसा में तलबस्त के समीप अनावरित अथगढ़ शैल-समूह के मध्यजीवी दृश्यांशों का परागाणविक अध्ययन

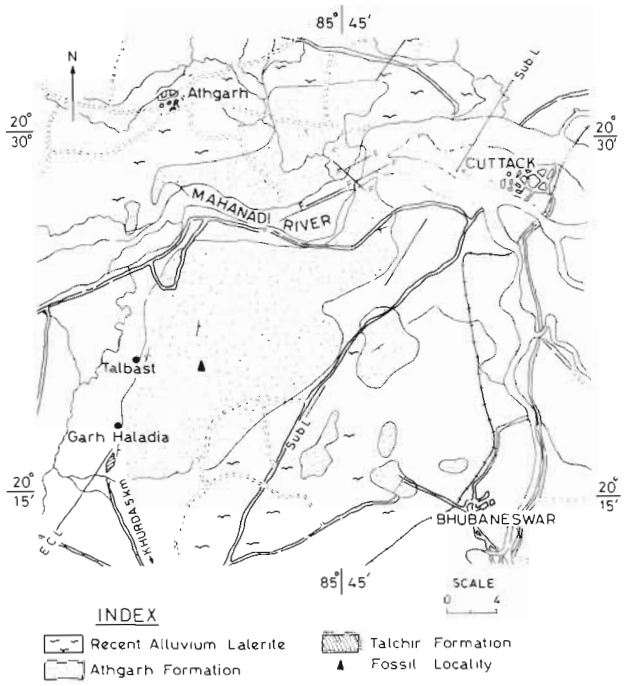
ब्रजेन्द्र नाथ जाना

उड़ीसा में तलबस्त क्षेत्र के समीपस्थ अथगढ़ शैल-समूह से उपलब्ध परागाणविक समुच्चय में 23 प्रजातियाँ एवं 33 जातियाँ विद्यमान हैं। इस क्षेत्र में अथगढ़ दृश्यांशों के दक्षिणी भाग से उक्त समुच्चय का यह पहला अभिलेख है तथा यह **मुरोस्पोरा** नामक प्रजाति की बाहुल्यता से अभिलक्षणित है। कुल मिलाकर यह उपरि जुरेसिक-अधरि क्रीटेशी परागाणविक समुच्चयों से सजातीयता व्यक्त करती है।

THE Athgarh Formation, usually known as "Athgarh Sandstones" constitutes a part of sedimentary sequence of Mahanadi Basin. It is the northernmost exposure of East Coast Gondwana of the Indian peninsula. The outcrops are exposed in the west and southwest of Cuttack city and encompasses an area of about 600 sq km. The sedimentary sequence of this formation is mostly covered by laterite and alluvium. The Athgarh Formation constitutes a part of Upper Gondwana sequence; it was known to lie unconformably over Precambrian basement rocks, but recently the palaeopalynological investigation by Tiwari *et al.* (1987) has revealed the presence of Talchir palynofossils in the olive-green shales which are lying below the Athgarh sandstone exposed near Garh-Haladia Village. Thus, as in other East Coast Gondwana basins, the Mesozoic sediments in Mahanadi Basin also lie unconformably over the Permian sediments.

The main lithological constituents of this formation are conglomerates, grits, sandstones and ferruginous shales (Ball, 1877; Adyalkar & Rao, 1963; Patra, 1980). Also, the occurrence of carbonaceous shales and coal-bands is known from Sidheshwar Hill. The palynological information from this formation is very meagre. So far, the records are known only from Sidheshwar Hill (Maheshwari, 1975; Jana & Tiwari, 1986) and Jagannath Prasad Quarry (Maheshwari, 1975). The paucity of palynological data is mainly because of unfavourable lithology of this formation for the preservation of spores and pollen. Maheshwari (1975) recorded an *Araucariacites*-rich assemblage containing 29 genera and 45 species from Sidheshwar Hill, Cuttack District and Jagannath Prasad Quarry, Puri District. Jana and Tiwari (1986) further made a detailed analysis of the sediments exposed in Sidheshwar Hill and reported the presence of 35 genera and 48 species in which *Araucariacites* is dominant, followed by the genus *Callialasporites*.

It is rather difficult to recover palynofossils from the sediments of Athgarh Formation; yet through



Map 1—The geological map of a part of Athgarh Basin showing the location of Mesozoic outcrops studied (after Ball, 1877; partly revised by P. K. Dutta, 1978, G. S. I. DOCD No. 4/79).

consistent efforts, new palynological information has recently been derived which forms the subject matter of the present paper.

MATERIAL

The samples were collected by the author from Talbast region during a field trip in 1987. In Talbast area, the sediments of Athgarh Formation are mostly covered under dense vegetation; however; they are exposed in the open cast quarry of "Fire Clay".

The productive samples are from Fire Clay Mine which is about 350 m east of Tata's Fire Clay Mine Guest-House (Map 1). In the mine, the top is covered by alluvium and the base is not exposed; the section consists of alternate bands of sandstone and clay. The thickness of rock units and location of samples are as under:

LITHOLOGY	THICKNESS (in m)	SAMPLE NO.
Alluvium cover		
Sandy clay band-IV	0.94	3 (16-18)
Ferruginous fine grained sandstone	3.48	
Sandy clay-band (discontinuous)	0.15	1 (15)
Ferruginous coarse-grained sandstone	2.84	
Clay band	00.63	3 (12-14)
Ferruginous sandstone	1.26	
Clay band -II	0.63	3 (9-11)
Coarse-grained ferruginous sandstone	2.20	
Clay band-I	2.20	8 (1-8)
(Base not exposed)		
Total	14.33	18

CHECK LIST OF SPORE-POLLEN TAXA

The palynological assemblage recovered from Athgarh sediments is listed below:

Genus—*Cyathidites* Couper 1953
C. australis Couper 1953
C. minor Couper 1953
C. concavus (Bolkhovitina) Dettmann 1963
Genus—*Deltoidospora* Miner 1935
Deltoidospora sp.
Genus—*Todisporites* Couper 1958
T. major Couper 1958
Genus—*Dictyophyllidites* Couper emend. Dettmann 1963
Dictyophyllidites sp.
Genus—*Concavisporites* Pflug emend. Delcourt & Sprumont 1955
Concavisporites sp.
Genus—*Osmundacidites* Couper 1953
O. wellmanii Couper 1953
Osmundacidites sp.
Genus—*Lycopodiacidites* Couper emend. Potonie 1956
Lycopodiacidites sp.
Genus—*Concavissimisporites* Delcourt & Sprumont emend. Delcourt, Dettmann & Hughes 1963
Concavissimisporites sp.
Genus—*Impardecispora* Venkatachala, Kar & Raza 1969
I. apiverrucata (Couper) Venkatachala, Kar & Raza 1969
I. indica Venkatachala 1969
Genus—*Klukisporites* Couper 1958
K. scaberis Couper 1958
K. variegatus Couper 1958
Klukisporites sp.
Genus—*Ischyosporites* Balme 1957
I. crateris Balme 1957
Genus—*Murospora* Somers 1952
M. florida Pocock 1961
Murospora sp.

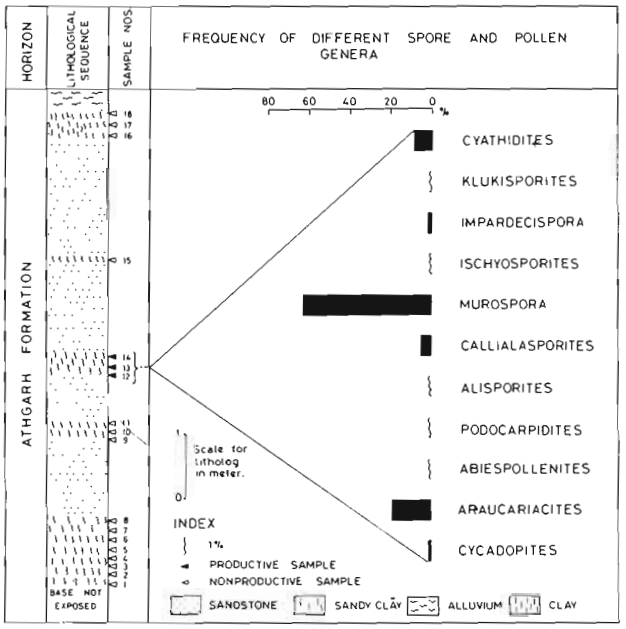
Genus—*Laevigatosporites* Ibrahim 1933
Laevigatosporites sp.
Genus—*Aequitriradites* Delcourt & Sprumont emend. Cookson & Dettmann 1961
Aequitriradites sp.
Genus—*Callialasporites* Dev 1961
C. dampieri (Balme) Dev 1961
C. segmentatus (Balme) Srivastava 1966
Genus—*Alisporites* Daugherty 1941
A. grandis (Cookson) Dettmann 1963
Genus—*Abiespollenites* Thiergart in Raatz 1937
Abiespollenites sp.
Genus—*Podocarpidites* Cookson *ex* Couper 1953
Podocarpidites ellipticus Cookson 1947
Podocarpidites sp.
Genus—*Cycadopites* Wodehouse ex Wilson & Webster 1946
C. couperi Kumar
Cycadopites sp.
Genus—*Ginkgocycadophytus* Samoilovitch 1953
Ginkgocycadophytus sp.
Genus—*Inaperturopollenites* Thomson & Pflug 1953
Inaperturopollenites sp.
Genus—*Araucariacites* Cookson ex Couper 1953
A. australis Cookson 1947
Genus—*Araucariapollenites* Reyre 1970
Araucariapollenites sp.

Some of the important spores and pollen of this assemblage are illustrated in Plate 1 and Plate 2. The genus *Murospora*, being the major component, shows wide morphographical variations in this assemblage.

QUANTITATIVE ANALYSIS AND COMPARISON

In this assemblage 11 genera out of 23 were encountered in counting (Text-fig. 1). The genus *Murospora* is the dominant (61%) spore. The representation of other elements is as follows: *Cyathidites* (9%), *Klukisporites* (0.5%), *Impardecispora* (1.5%), *Ischyosporites* (0.5%), *Callialasporites* (5%), *Alisporites* (0.5%), *Abiespollenites* (0.5%), *Podocarpidites* (0.5%), *Cycadopites* (1%) and *Araucariacites* (20%). The trilete group, as a whole, constitutes 72.5 per cent of the total assemblage.

This assemblage markedly differs from other assemblages described from Athgarh Formation in having the dominance of trilete group. It is important to note that the genus *Murospora* is dominant in the present assemblage but was not recorded earlier (Maheshwari, 1975; Jana & Tiwari, 1986). The alete genus *Araucariacites* is the dominant taxon in the assemblages of Sidheshwar Hill and Jagannath Prasad Quarry. The disaccate



Text-figure 1

group which constitutes 15 per cent of the total assemblage (Maheshwari, 1975) is poorly represented in the present assemblage.

It is obvious that the assemblages from Sidheshwar Hill, Jagannath Prasad Quarry and Talbast do not match with each other. Lithostratigraphically their relative position in a sequence is difficult to assess because the dips are mostly rolling and most of the sediments are concealed. Palynologically the Sidheshwar Hill palynoflora is the richest among the three. The Talbast assemblage shows some indication of its being relatively younger to Sidheshwar Hill assemblage because *Murospora* qualifies for an younger affinity (Filatoff, 1975).

The present palynological assemblage shows resemblance with other known palynological assemblages recovered from Cauvery Basin, Palar Basin and Krishna-Godavari Graben. The palynological assemblages from Cauvery Basin (Venkatachala & Jain, 1970; Venkatachala & Sharma, 1974; Venkatachala, Sharma & Jain, 1972) have many genera in common with the present assemblage but the former is distinguishable from the latter in having *Cicatricosisporites, Contignisporites, Cooksonites, Coptospora, Triporoletes, Microcachrydites*, etc. However, the dominance of *Murospora* marks the difference. Inspite of several common genera with present assemblage, the Palar Basin assemblage (Ramanujam & Varma, 1981) is distinguishable from the present one in having *Cicatricosisporites, Cooksonites, Coptospora* and in

the nature of dominant element. The palynological assemblages from Krishna-Godavari Graben (Sharma, Jain & Venkatachala, 1977) have several elements common with present assemblage but the former has several other genera, such as *Appendicisporites, Crybelosporites, Sestrosporites, Staplinisporites, Coronatispora, Cooksonites, Coptospora*, etc. in the assemblage.

The present assemblage closely resembles the palynological assemblage known from Katrol sediments of Kutch Basin (Venkatachala, Kar & Raza, 1969) but the latter differs in having *Araucariacites* as the dominant element.

The palynological assemblages from Satpura Basin (Kumar, 1973; Maheshwari & Gupta, 1983; Gupta, 1988) also have several common genera but they possess *Cicatricosisporites, Cooksonites*, etc. Moreover, the dominant genus is *Araucariacites* in the assemblage of Satpura Basin.

The present assemblage is also comparable to *Callialasporites dampieri* Super Zone of Upper Jurassic horizon of Australia (Helby *et al.*, 1987). Out of four Oppel Zones under *C. dampieri* Super Zone, the present assemblage resembles most the *Murospora florida* Oppel Zone in having *M. florida* and several species, such as *Klukisporites scaberi, Aequitriradites* sp., *Callialasporites dampieri*. However, the *M. florida* Oppel Zone of Helby differs from the present assemblage in having a variety of trilete spores, such as—*Stereisporites antiquaporites, Rogalskisporites canaliculus, Antulsporites varigranulatus, Staplinisporites telatus, Neoraistrickia densata, Lygodiumsporites circulumenus, Dictyotosporites complex, D. speciosus, Contignisporites cooksonii, Gleicheniidites senonicus, Lycopodiacidites asperatus* which are not recorded in Talbast assemblage.

The Upper Jurassic palynoflora of western Canada (Pocock, 1970) resembles the present assemblage in having several common genera. These are *Deltoidospora, Todisporites, Concavisporites, Concavissimisporites, Klukisporites, Murospora*, etc. But the Canadian palynological assemblage differs in having rich and varied trilete forms and in the nature of dominant element.

In the Talbast palynological assemblage, the stratigraphically important palynotaxa are *Impardecispora apiverrucata, Klukisporites scaberi, Ischyosporites crateris, Murospora florida* and *Aequitriradites* sp. These forms are known from Upper Jurassic as well as Lower Cretaceous horizons of India (Singh *et al.*, 1964; Venkatachala, 1967, 1969 a, b; Venkatachala *et al.*, 1969; Tiwari *et al.*, 1984; Ramanujam & Srisailam, 1974 etc.), Australia (Filatoff, 1975; Helby *et al.*, 1987; Dettmann, 1963), The Netherlands (Herngreen *et al.*, 1980), Canada (Pocock, 1964, 1967). So also the representation of genera like *Impardecispora, Aequitriradites*, etc. started in the Upper Jurassic but their qualitative variations and quantitative richness are seen in Lower Cretaceous horizons.

The present palynological assemblage is also unique in having trilete genus *Murospora* as the dominant element. So far, no playnological assemblage is known from the Upper Jurassic and Lower Cretaceous horizons of the Indian

---

→

PLATE 1

(All photomicrographs are magnified ca × 500. Coordinates refer to Leitz Laborlux Microscope no. 067063)

1, 2. *Cyathidites australis* Couper, Slide nos. BSIP 10276, Coordinates: 49 × 105.6; BSIP 10277, Coordinates: 33 × 98.

3. *Todisporites major* Couper, Slide no. BSIP 10276, Coordinates: 37 × 101.

4. *?Concavisporites* sp., Slide no. BSIP 10277, Coordinates: 30.5 × 102.7.

5, 6, 7 *Osmundacidites wellmanii* Couper, Slide nos. BSIP 10279, Coordinates: 38 × 103.8; BSIP 10276, Coordinates: 71 × 79.5; BSIP 10278, Coordinates: 64 × 101.5.

8. *Murospora florida* Pocock, Slide no. BSIP 10282, Coordinates: 42 × 106.

9, 10. *Klukisporites variegatus* Couper, Slide nos. BSIP 10280, Coordinates: 39 × 93.4; BSIP 10277, Coordinates: 49.6 × 103.7.

11. *Ischyosporites* sp., Slide no. BSIP 10282, Coordinates: 60.8 × 98.8.

12. *Impardecispora* sp., Slide no. BSIP 10278, Coordinates: 50 × 110.4.

13. *Impardecispora apiverrucata* (Couper) Venkatachala, Kar & Raza, Slide no. BSIP 10283, Coordinates: 37.6 × 99.7

14. *Lycopodiacidites* sp., Slide no. BSIP 10284, Coordinates: 66 × 100.5.

15. *Aequitriradites* sp., Slide no. BSIP 10279, Coordinates: 46.5 × 105.5.

16. *Klukisporites scaberis* Couper, Slide no. BSIP. 10281, Coordinates: 60.8 × 98.8.

17, 18. *Murospora florida* Pocock; 17, BSIP 10284, Coordinates: 66 × 100.5; 18, BSIP 10284, Coordinates: 66 × 100.

19. *Impardecispora indica* Venkatachala, Slide no. BSIP 10281, Coordinates: 46 × 104.

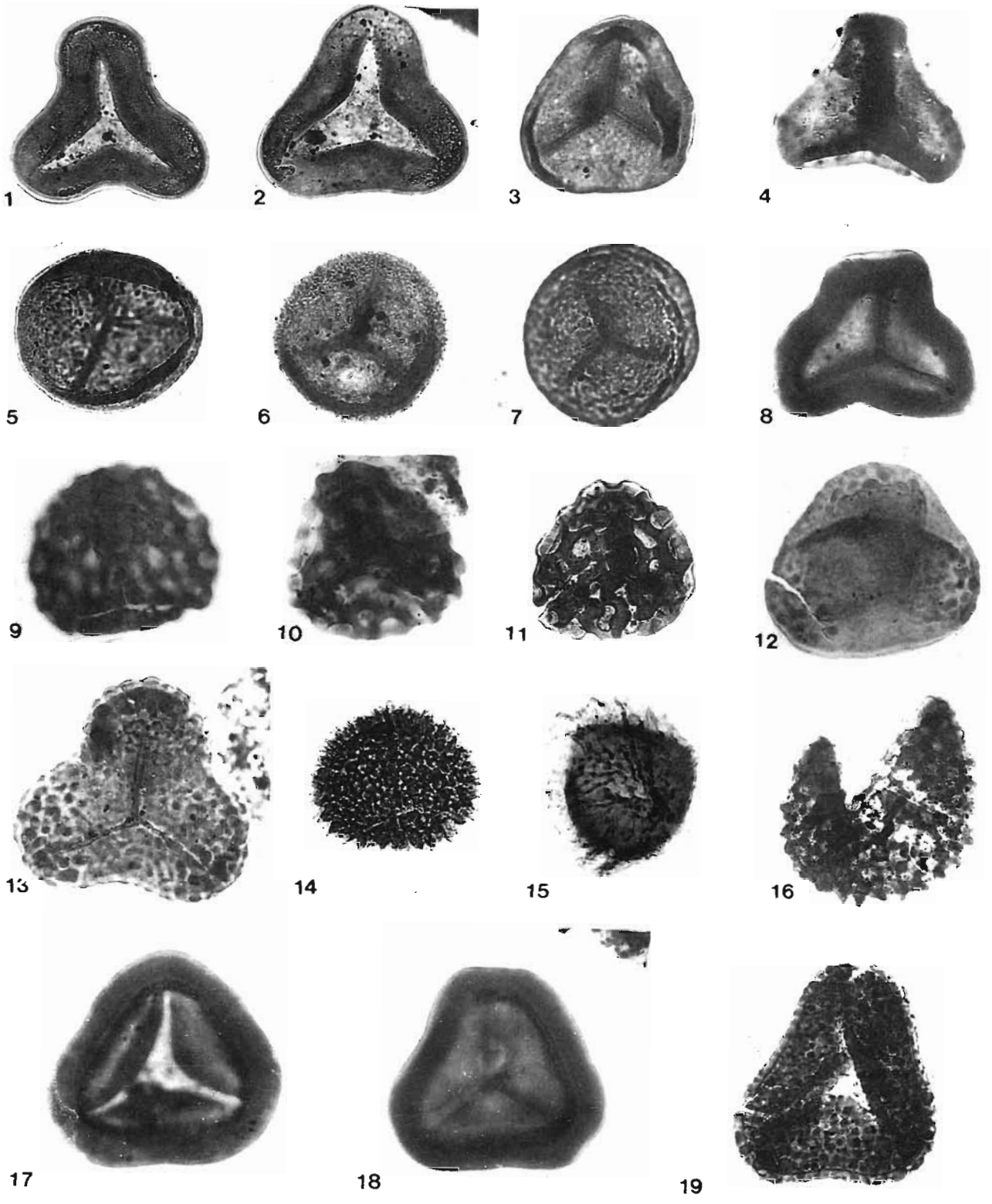


PLATE 1

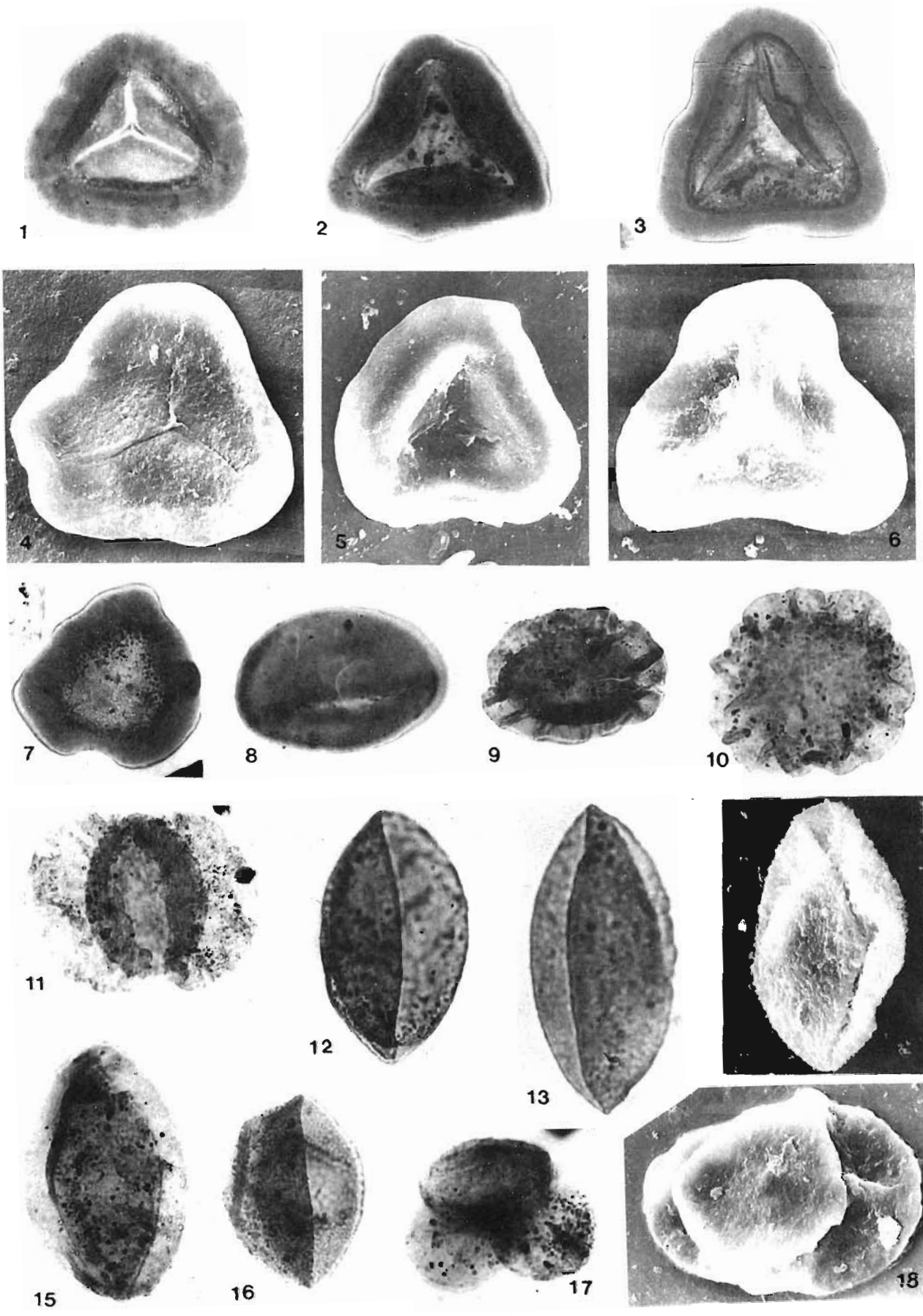


PLATE 2

subcontinent where trilete group of spores constitutes the overall dominance. Analysing the overall composition of the present assemblage it is assumed that the pteridophytes producing *Murospora*-type of spores were growing nearby or at the depositional site.

ACKNOWLEDGEMENT

I am thankful to Dr R. S. Tiwari for showing keen interest, various suggestions and critically going through the manuscript. I am also thankful to Sri B. Misra, Agent, Tata Refractories Ltd., Talbast, Orissa for permitting me to collect samples from the Fire Clay Mine and necessary facilities.

REFERENCES

Adyalkar, P. G. & Rao, C. N. 1963. Some new plant fossils from the Athgarh Stage, Upper Gondwanas, Orissa. *Rec. geol. Surv. India* **92**(2) : 319-322.

Ball, V. 1877. On the 'Athgarh Sandstones' near Cuttack. *Rec. geol. Surv. India* **10**(2) : 63-68.

Dettmann, M. E. 1963. Upper Mesozoic microfloras of south-eastern Australia. *Proc. R. Soc. Vict.* **77**(1) : 1-148.

Filatoff, J. 1975. Jurassic palynology of the Perth Basin, western Australia. *Palaeontographica* **154B** : 1-113.

Gupta, A. 1988. Evidences on the age of Jabalpur Formation exposed at the confluence of Hard and Sakkar rivers, Narsinghpur District, Madhya Pradesh. *Geophytology* **18**(2) : 221-224.

Helby, R., Morgan, R. & Patridge, A. D. 1987 A palynological zonation of the Australian Mesozoic. *Mem. Assoc. Australas. Palaeontols.* **4** : 1-94.

Herngreen, G. F. W., Van Hoecken-Klinkenberg & de Boer, K. F. 1980. Some remarks on selected palynomorphs near the Jurassic-Cretaceous boundary in The Netherlands. *In*: Bharadwaj, D. C. *et al.* (eds)—*Proc. IV int. palynol. Conf., Lucknow (1976-77)* **2** : 357-367, Birbal Sahni Institute of Palaeobotany, Lucknow.

Jana, B. N. & Tiwari, R. S. 1986. Further observations on the palynological assemblage from the Athgarh Formation, Sidheshwar hills, Orissa. *Q. J. geol. Min. metall. Soc. India* **58**(3) : 201-209.

Kumar, P. 1973. The *Sporae dispersae* of Jabalpur Stage, Upper Gondwana, India. *Palaeobotanist* **20**(1) : 91-126.

Maheshwari, H. K. 1975. Palynology of the Athgarh Formation near Cuttack, Orissa. *Palaeobotanist* **22** : 23-28.

Maheshwari, H. K. & Gupta, A. 1983. New palynological evidence on the age of Jabalpur Formation exposed at the confluence of Hard and Sakkar rivers. *V Indian geophytol. Conf., Lucknow (Abstract)*, The Palaeobotanical Society, Lucknow.

Patra, B. P. 1980. some ferns from the east coast Gondwana of Orissa with a note on its age. *Proc. 3rd geol Congr., Poona (1980)*, pp. 57-68.

Pocock, S. A. J. 1964. Pollen and spores of Chlamydospermae and Schizaeaceae from Upper Manville strata of the Saskatoon area Saskatchewan. *Grana Palynol.* **5**(2) : 129-209.

Pocock, S. A. J. 1967 The Jurassic-Cretaceous boundary in northern Canada. *Rev. Palaeobot. Palynol.* **5** : 129-136.

Pocock, S. A. J. 1970. Palynology of the Jurassic sediments of western Canada. *Palaeontographica* **130B** : 12-72.

Ramanujam, C. G. K. & Srisailam, K. 1974. Palynology of the carbonaceous shales from a bore-hole at Kattavakkam near Conjeevaram, Tamil Nadu, India. *Pollen Spores* **16**(1) : 67-102.

Ramanujam, C. G. K. & Varma, Y. N. R. 1981. Hilate spores from the Upper Gondwana deposits of Palar Basin, Tamil Nadu. *Palaeobotanist* **28-29** : 308-315.

Sharma, K. D., Jain, A. K. & Venkatachala, B. S. 1977. Palynology of the Early Cretaceous sediments from the subsurface of Godavari and Krishna basins, Andhra Pradesh, South India. *In*: Venkatachala, B. S. *et al.* (eds)—*Proc. IV Colloq. Indian Micropalaeont. Stratigr.* : 109-121.

Singh, H. P., Srivastava, S. K. & Roy, S. K. 1964. Studies on the Upper Gondwanas of Cutch-I. Miospores and microspores. *Palaeobotanist* **12** 282-306.

Tiwari, R. S., Kumar, P. & Tripathi, A. 1984. Palynodating of Dubrajpur and Intertrappean beds in subsurface strata of north-eastern Rajmahal Basin. *In*: Tiwari, R. S. *et al.* (eds)—*Proc. Symp. & Technical session, 5th Indian geophytol. Conf.* pp. 207-225, The Palaeobotanical Society, Lucknow.

Tiwari, R. S., Tripathi, A., Dutt, A. B. & Mukhopadhyay, A. 1987. Palynological dating of olive green shales underlying the

←

PLATE 2

(All photomicrographs are magnified ca × 500 unless otherwise stated. Coordinates refer to the stage of Leitz Laborlux Microscope no. 067063).

1-3. *Murospora florida* Pocock, Slide nos. 10285, Coordinates: 43 × 95; BSIP 10276, Coordinates: 49.5 × 106; BSIP 10278, Coordinates: 59 × 59.5.

4-6. *Murospora florida* Pocock, SEM photomicrographs, × 600.

7. *Murospora* sp., Slide no. BSIP 10286, Coordinates: 49 × 106.6.

8. *Laevigatosporites* sp., Slide no. BSIP 10278, Coordinates 62 × 96.5.

9, 10. *Callialasporites dampieri* (Balme) Dev, Slide nos. BSIP 10278, Coordinates: 59.5 × 97; BSIP 10287, Coordinates: 47.5 × 107.7

11 *Podocarpidites ellipticus* Cookson, Slide no. BSIP 10286, Coordinates: 67 × 107.

12 14. *Cycadopites couperi* Kumar, Slide nos. BSIP 10281, Coordinates: 53 × 106.4; BSIP 10276, Coordinates: 37 × 101; SEM photomicrograph. × 600.

15. *Cycadopites* sp. A, Slide no. BSIP 10287, Coordinates: 43 × 103.6.

16. *Cycadopites* sp. B, Slide no. BSIP 10283, Coordinates: 39 × 107.7.

17 *Abiespollenites* sp., Slide no. BSIP 10276, Coordinates: 70 × 89.

18. *Podocarpidites* sp., SEM photomicrographs. × 600.

Athgarh sandstone in Mahanadi Basin. *Curr. Sci.* **56**(22) : 1150-1153.

Venkatachala, B. S. 1967. Palynology of the Umia plant beds of Kutch, western India-1. Systematic palynology of the Bhuj exposures near Walkamata, Kutch District, Gujarat State. *Rev. Palaeobot. Palynol.* **5** : 163-177

Venkatachala, B. S. 1969a. Palynology of the Umia plant beds of Kutch, western India-2. Bhuj exposures near Walkamata, Kutch District, Gujarat State—Systematic palynology. *Palaeobotanist* **17** : 1-8.

Venkatachala, B. S. 1969b. Palynology of the Mesozoic sediments of Kutch-4. Spores and pollen from Bhuj exposures near Bhuj, Gujarat District. *Palaeobotanist* **17** : 208-219.

Venkatachala, B. S. & Jain, A. K. 1970. Fossil spores and pollen from Lower Cretaceous subsurface sediments near Karaikal, Cauvery Basin. *Palaeobotanist* **18**(1) : 63-66.

Venkatachala, B. S., Kar, R. K. & Raza, S. K. 1969. Palynology of the Mesozoic sediments of Kutch, western India-5. Spores and pollen from Katrol exposures near Bhuj, Kutch District, Gujarat State. *Palaeobotanist* **17** : 184-207.

Venkatachala, B. S. & Sharma, K. D. 1974. Palynology of the Cretaceous sediments from subsurface of Vridhachalam area, Cauvery Basin. *Geophytology* **4**(2) : 153-183.

Venkatachala, B. S., Sharma, K. D. & Jain, A. K. 1972. Palynological zonations of Jurassic-Lower Cretaceous sediments in the subsurface of Cauvery basin. *In*: Ghosh, A. K. *et al.* (eds)—*Proc. Sem. Palaeopalynol. Indian Stratigr., Calcutta*, pp. 172-187, Botany Department, Calcutta University, Calcutta.