

REWORKED CRETACEOUS SPORES AND POLLEN GRAINS FROM THE MATANOMADH FORMATION (PALAEOCENE), KUTCH, INDIA

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ABSTRACT

The present paper records the occurrence of reworked Cretaceous spores and pollen grains from the Matanomadh Formation, Kutch, India. The Matanomadh palynofloral assemblage is distinctly Palaeocene in age. Altogether seven genera of reworked spores and pollen grains were encountered in this assemblage. These are: *Concavissimisporites* (Delcourt & Sprumont) Delcourt, Dettmann & Hughes (1 species), *Impardecispora* Venkatachala, Kar & Raza (2 species), *Klukisporites* Couper (3 species), *Boseisporites* (Dev) Bharadwaj & Kumar (2 species), *Contignisporites* Dettmann (2 species), *Callialasporites* (Dev) Bharadwaj & Kumar (4 species) and *Schizosporis* Cookson & Dettmann (1 species). These palynomorphs commonly occur in the Cretaceous rocks and do not extend into the Palaeocene. The presence of such palynomorphs in the Matanomadh Formation indicates that part of sediments for Matanomadh sedimentation were provided by the Bhuj Formation (early Cretaceous), which is exposed in close proximity to the area under present study.

Key-words — Palaeopalynology, Palaeocene, Matanomadh Formation (India).

सारांश

मातानीमढ़ शैल-समूह (पेलियोसीन), कच्छ, भारत से पुनः प्रेक्षित क्रीटेशियस बीजाणु एवं परागकण — रमेश कुमार सक्सेना

इस शोध-पत्र में मातानीमढ़ शैल-समूह, कच्छ, भारत से पुनः प्रेक्षित क्रीटेशियस बीजाणु, एवं परागकणों की उपस्थिति अभिलिखित है। मातानीमढ़ परागाणु समुच्चय स्पष्ट रूप से पेलियोसीन कालीन है। इस समुच्चय में पुनः प्रेक्षित बीजाणुओं एवं परागकणों की कुल मिलाकर 7 प्रजातियाँ — कनकेविसी-मिस्पोराइटिस (डेलकॉर्ट, डेटमॉन एवं स्पूमांट) डेलकॉर्ट, डेटमॉन एवं ह्यूजिस (1 जाति), एम्पारडेसिस्पोरा वेंकटाचाला, कर एवं रजा (2 जातियाँ), क्लूकिसिस्पोराइटिस कॉउपर (3 जातियाँ), बोसिस्पोराइटिस (देव) भारद्वाज एवं कुमार (2 जातियाँ), कॉन्टिगनिस्पोराइटिस डेटमॉन (2 जातियाँ), केलियालास्पोराइटिस (देव) भारद्वाज एवं कुमार (4 जातियाँ) तथा शाइजोस्पोरिस कुकसन एवं डेटमॉन (1 जाति), मिली हैं। ये परागाणु साधारणतया क्रीटेशियस कालीन चट्टानों में ही पाये जाते हैं तथा पेलियोसीन काल में प्रवेश नहीं करते। मातानीमढ़ शैल-समूह में ऐसे परागाणुओं की उपस्थिति यह प्रदर्शित करती है कि मातानीमढ़ अवसादन के कुछ अंश भुज शैल-समूह (प्रारंभिक क्रीटेशियस) द्वारा प्रदान किये गये थे जो कि प्रस्तुत अध्ययन के क्षेत्र के बहुत ही निकट विद्यमान हैं।

INTRODUCTION

THE term 'reworked' is said of a sediment, fossil, rock fragment or other geologic material, that has been removed or displaced by natural agents from the place of its origin and incorporated in recognizable form in a younger formation.

Reworking of fossil spores and pollen grains is a phenomenon of common occurrence. A careful study of reworked fossils is considerably significant for the interpretations of palaeoecology, environment of deposition and for determining the source area of the sediments. Nonrecognition of such redeposited fossils is a serious omis-

sion in palynological studies and may result into totally erroneous conclusions. The reworked fossils commonly occur in shale, siltstone, sandstone, marl, limestone, etc. as these rocks contain material derived from pre-existing rocks. Peat, lignite and coal, on the other hand, are mostly *in situ* deposits and therefore are generally devoid of reworked fossils.

Occurrence of reworked palynomorphs in Indian sediments has been reported by a number of workers. Potonié and Sah (1960) instituted *Cannanoropollis*, a new genus, from Cannanore lignite (late Miocene-early Pliocene) of Kerala. *Cannanoropollis* is, in fact, a typical Permian pollen and has been subsequently reported from Talchir Formation by Lele (1964). He named this genus as *Virkkipollenites*. Besides, *Limitisporites* sp. described by Potonié and Sah (1960) from the Cannanore lignite is also a Permian pollen.

Dev (1961) studied the palynoflora of Jabalpur Series (late Jurassic) exposed near Sehora on the Sher River, Narsinghpur District, Madhya Pradesh. The following taxa described by him are typically of Permian age (Venkatachala, 1970). *Sehorisporites indicus* Dev, cf. *Zonalasporites* sp., *Circella splendidus* Dev, *Striatites indicus* Dev, *Striatites* sp., *Protosacculina* sp., *Striatopodocarpites balmei* Dev, *Striatopodocarpites* sp., *Pityosporites* sp. and *Protociferus grandis* Bolkhovtina.

Spores and pollen grains from Katrol sediments (late Jurassic) near Bhuj have been studied in detail by Venkatachala, Kar and Raza (1969b). During the course of this study, Venkatachala (1970) observed the presence of few typically Permian palynomorphs. These are: *Virkkipollenites* Lele (= *Cannanoropollis* Potonié & Sah), *Parasaccites* Bharadwaj & Tiwari, *Limitisporites* Leschik, *Densipollenites* Bharadwaj, *Strotersporites* Wilson, *Striatopiceites* Sedova, *Striatites* (Pant) Bharadwaj and *Sulcatisporites* (Leschik) Bharadwaj. Venkatachala (1970) also mentioned that these fossils were not rare and were encountered frequently. The other spores and pollen grains found in this assemblage are characteristic of late Jurassic.

Sah and Kar (1970) recovered *Callialasporites* (*Applanopsis*) *lenticularis* (Doering) Sah & Kar and *Callialasporites* (*Applanopsis*) *trilobatus* (Balme) Dev from the

Laki Series (early Eocene) of Kutch, Gujarat. *Callialasporites* (Dev) Bharadwaj & Kumar is a Mesozoic genus and frequently occurs in the Jurassic-Cretaceous sediments of India.

Nandi (1972) described a rich miofloral assemblage from Middle Siwalik sediments (late Miocene-early Pliocene) of Mohand (East) field. This assemblage includes a few typically Mesozoic taxa. These are *Concavissimiporites crassatus* Delcourt, Dettmann & Hughes, *Klukisporites* sp. and *Tsugaepollenites* sp. The presence of such forms in Siwalik sediments may be attributed to reworking.

Wilson (1964) mentioned that palynological recycling may be recognized in the following types of assemblages: (i) assemblages consisting of fossils of more than one geological ages, (ii) assemblages consisting of fossils with different biological stain reactions, (iii) assemblages consisting of fossils showing differential preservation, (iv) assemblages consisting only of fossils recognized to be geologically older than the rocks in which they occur, and (v) assemblages of marine fossils preserved in fresh water sediments.

Wilson (1965) used the stain technique to differentiate Mississippian fossils in Pennsylvanian sediments from Ti Valley, Pittsburg County, Oklahoma. Van Gijzel (1967) suggested the use of fluorescence microscopy to detect reworked fossils in sediments.

The palynofloral assemblage of the Matanomadh Formation (Palaeocene) has recently been investigated (Kar & Saxena, 1976; Saxena, 1978, 1979). During the course of this study the author came across certain palynomorphs which are common in the Cretaceous sediments the world over and do not occur in the Tertiary. Moreover, most of these palynomorphs are poorly preserved than those of the original assemblage and hence are considered as reworked. A brief account of these palynomorphs is given ahead.

REWORKED ASSEMBLAGE

- Anteturma — *Proximegerminantes* Potonié, 1970
 Turma — *Triletes* (Reinsch) Dettmann, 1963
 Suprasubturma — *Acavatriletes* Dettmann, 1963

Subturma — *Azonotriletes* (Luber) Dettmann, 1963

Infraturma — *Apiculati* (Bennie & Kidston) Potonié, 1956

Genus — *Concavissimisporites* (Delcourt & Sprumont) Delcourt, Dettmann & Hughes, 1963

Concavissimisporites panolaensis Dettmann, 1963

Pl. 1, fig. 1

Remarks — Only two specimens of this species were encountered.

Genus — *Impardecispora* Venkatachala, Kar & Raza, 1969a

Impardecispora apiverrucata (Couper) Venkatachala, Kar & Raza, 1969a

Pl. 1, fig. 2

Remarks — Only 11 specimens of this species could be recovered in the entire assemblage. The specimens are comparatively well-preserved.

Impardecispora setifera (Verbizkaya) comb. nov.

Pl. 1, fig. 3

1958 *Lygodium setiferum* Verbizkaya, pl. 3, fig. 46a

1961 *Lygodium setiferum* Verbizkaya, in Bolkhovitina, pl. 38, fig. 4.

Remarks — Verbizkaya (1958) described spores having spinose ornamentation under *Lygodium setiferum* in which spines are bigger and denser at the apices. Similar spores have also been described by Bolkhovitina (1961) under the same species. Later, Venkatachala, Kar and Raza (1969a) instituted the genus *Impardecispora* for the fossil spores having denser and bigger ornamentation at apices and sparser and smaller ones at interapical and contact area. Since, *Lygodium setiferum* Verbizkaya (1958) comes under the circumscription of *Impardecispora*, the former has been transferred to the latter.

Representation of this species in the Matanomadh assemblage is very poor. Only eight, poorly preserved specimens were encountered.

Genus — *Klukisporites* Couper, 1958

Klukisporites pseudoreticulatus Couper, 1958

Pl. 1, fig. 4

Remarks — Only four grains of this species are present. The specimens are \pm circular in shape and have indistinct trilete mark while the spores described by Couper (1958) are triangular in shape and have distinct and long trilete rays.

Klukisporites scaberis (Cookson & Dettmann) Dettmann, 1963

Pl. 1, fig. 5

Remarks — Only four well preserved specimens of this species were encountered.

Klukisporites punctatus Venkatachala, 1969b

Pl. 1, fig. 6

Remarks — Only three specimens of this species were recovered. The preservation of the grains is comparatively poor.

Genus — *Boseisporites* (Dev) Bharadwaj & Kumar, 1972

Boseisporites praeclarus (Dev) Bharadwaj & Kumar, 1972

Pl. 1, fig. 7

Remarks — Only three poorly preserved specimens were recorded.

Boseisporites punctatus Venkatachala, 1969b

Pl. 1, fig. 8

Remarks — Only two specimens of this species were recovered. The preservation of these grains is extremely poor.

Genus — *Contignisporites* Dettmann, 1963

Contignisporites fornicatus Dettmann, 1963

Pl. 1, fig. 9

Remarks — Only five well preserved specimens of this species were recovered.

Contignisporites multimuratus Dettmann, 1963

Pl. 1, fig. 10

Remarks — Only two specimens of this species are present in the assemblage.

Contignisporites sp.

Pl. 1, fig. 11

Description — Spores subcircular, 50-80 μ . Trilete, rays ill-developed. Exine 2-3 μ thick, proximally verrucose, varrucae 2-10 μ wide, distal exine sculptured with 6-11 costae, costae raised (2-3 μ), parallel to each other; costae and furrow intrapunctate; cingulum leathery, 5-15 μ wide.

Remarks — Seventeen specimens of this species were recorded from Matanomadh Formation. These specimens differ from all the known species of *Contignisporites* Dettmann (1963) by their characteristic intrapunctate costae and furrows.

Anteturma — *Variagerminantes* Potonié, 1970

Turma — *Saccites* Erdtman, 1947

Subturma — *Monosaccites* (Chitaley) Potonié & Kremp, 1954

Infraturma — *Aletesacciti* Leschik, 1955

Genus — *Callialasporites* (Dev) Bharadwaj & Kumar, 1972

Callialasporites trilobatus (Balme) Bharadwaj & Kumar, 1972

Pl. 1, fig. 12

Remarks — Twenty two specimens of this species were recorded in the assemblage. However, the preservation of the pollen grains is good.

Callialasporites dampieri (Balme) Dev, 1961

Pl. 1, fig. 13

Remarks — Only one poorly preserved specimen of this species was recovered.

Callialasporites granulatus (Venkatachala & Kar) comb. nov.

Pl. 1, fig. 14

1969 *Applanopsis granulatus* Venkatachala & Kar, pl. 2, figs 24-26, 28-30.

Remarks — *Callialasporites* (Dev) Bharadwaj & Kumar (1972) has nomenclatural priority over *Applanopsis* Doering (1961). Therefore, *Applanopsis granulatus* Venkatachala & Kar (1969) has been transferred

to *Callialasporites*. Representation of this species in Matanomadh assemblage is poor, as only five grains could be recovered.

Callialasporites punctatus (Venkatachala & Kar) comb. nov.

Pl. 1, fig. 15

1969 *Applanopsis punctatus* Venkatachala & Kar, pl. 2, fig. 36

Remarks — Only four specimens of this species were encountered.

Turma — *Aletes* Ibrahim, 1933

Subturma — *Azonialetes* (Luber) Potonié & Kremp, 1954

Infraturma — *Reticulonapiti* (Erdtman) Bose & Kar, 1967

Genus — *Schizosporis* Cookson & Dettmann, 1959

Schizosporis reticulatus Cookson & Dettmann, 1959

Pl. 1, fig. 16

Remarks — Only two poorly preserved specimens of this species were recorded from the Matanomadh Formation.

DISCUSSION

The reworked palynofloral assemblage recovered from Matanomadh Formation consists of 7 genera and 15 species. Of these, 5 genera, viz., *Concavissimisporites* (Delcourt & Sprumont) Delcourt, Dettmann & Hughes, *Impardecispora* Venkatachala, Kar & Raza, *Klukisporites* Couper, *Boseisporites* (Dev) Bharadwaj & Kumar and *Contignisporites* Dettmann are trilete and belong to pteridophytes; 1 genus, viz., *Callialasporites* (Dev) Bharadwaj & Kumar is monosaccate and belongs to gymnosperms; and 1 genus, viz., *Schizosporis* Cookson & Dettmann is of uncertain affinity. All these forms commonly occur in the Cretaceous sediments of India and other countries.

The frequency of the reworked palynomorphs is very poor in the Matanomadh assemblage and not even a single species is represented in a count of 200 specimens per sample.

Cretaceous palynoflora of India has been extensively studied by Singh, Srivastava and Roy (1964), Varma and Rawat (1964),

Banerjee (1967, 1972), Venkatachala (1967, 1969a,b, 1972, 1974), Banerjee and Misra (1968), Jain and Subbaraman (1969), Venkatachala and Jain (1970), Bharadwaj (1970), Venkatachala and Rawat (1970, 1971), Venkatachala and Kar (1970, 1972), Kar (1972), Mathur and Mathur (1972), Venkatachala, Sharma and Jain (1972), Singh (1972), Lukose (1972, 1974), Maheshwari (1974) and Venkatachala and Sharma (1974a, b) etc. Reworked palynomorphs from the Matanomadh Formation were compared with those of the original Cretaceous assemblages and it was observed that both are identical. The authenticity and identification of the Cretaceous fossils in the Matanomadh Formation can not therefore be doubted. A perusal of the published literature also shows that these fossils are restricted only in the Mesozoic sediments and do not extend into Palaeocene.

The original Matanomadh assemblage recovered from the same material has already been described by Kar and Saxena (1976) and Saxena (1978, 1979). A comparison of the Matanomadh assemblage with the known Palaeocene-Lower Eocene assemblages from different parts of India suggests that the Matanomadh assemblage is distinctly Palaeocene in age.

The occurrence of Cretaceous palynomorphs in the Matanomadh Formation (Palaeocene) is due to reworking. The source of such fossils can be easily traced. Not far away from the Matanomadh area, from where the material for the present study was collected, are exposed dirty white, medium to coarse-grained, felspathic sandstones belonging to the Bhuj Formation (early Cretaceous). The distance between these exposures and the locality of the present assemblage is about 2.5 km. It may thus be considered that the present reworked assemblage was derived from these Bhuj exposures only. The Jurassic rocks (Jhurio, Jumara & Jhuran formations) are developed at considerably long distances from Matanomadh and therefore chances of reworked fossils being derived from these sediments are almost negligible.

Palynological evidences also support that the present reworked assemblage is derived from Cretaceous sediments and not from Jurassic. Bharadwaj (1970) published

a detailed account of the palynological succession through the Mesozoic Era in India. He (1970, pp. 92-94) distinguished two miofloras among the Jurassic spore assemblages of India, viz., (i) *Classopollis* complex (*Classopollis* & *Gliscopollis*) rich mioflora; and (ii) *Araucariacites* complex (*Araucariacites* & *Laricoidites*) rich mioflora, containing *Araucariacites* (including *Laricoidites*), *Cyathidites*, *Podocarpidites*, *Gleicheniidites* and *Callialasporites*. On the other hand, three sporological zones were distinguished in the Cretaceous deposits, viz., (i) *Araucariacites* (55%) rich assemblage with *Callialasporites* (30%), (ii) *Impardecispora* (52%) rich assemblage with *Araucariacites* (10%), *Schizosporis* (9%) and *Callialasporites* (7%), and (iii) trilete spores rich assemblage with *Appendicisporites*, *Contignisporites*, *Callialasporites* and *Podocarpidites*.

A comparison of the present reworked assemblage with the aforementioned Jurassic and Cretaceous assemblages makes it clear that the palynomorphs recorded here have close affinity with the Cretaceous assemblages while Jurassic mioflora is distinctly different.

Lithostratigraphically, Matanomadh Formation is divisible into two members, viz., (i) Laterite Member, and (ii) Clastic Member (Saxena, 1977). The Laterite Member is unfossiliferous while Clastic Member is rich in palynological fossils. The palynofloral assemblage described earlier by the author (Kar & Saxena, 1976; Saxena, 1978, 1979) and the present reworked assemblage have been recovered from the Clastic Member only. The Clastic Member is made up of ferruginous and gritty sandstones, tuffaceous and carbonaceous shales, alum shales, bentonitic and ferruginous clays, volcanic ash, tuff, lignitic shales, etc. and presents an extremely variable and colourful lithology. The material forming this member was mainly derived from traps and finer pyroclastics volcanic ash, tuff, etc.) ejected during the later phase of Deccan Trap vulcanicity (Biswas, 1965, p. 3). However, the occurrence of reworked Cretaceous palynomorphs in these sediments indicates that considerable amount of material for the sedimentation of the Matanomadh Formation was supplied by the Bhuj Formation which is exposed in the vicinity of the Matanomadh area.

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EXPLANATION OF PLATE

(All photomicrographs are enlarged ca. \times 500)

PLATE I

1. *Concavissimisporites panolaensis* Dettmann; Slide no. 4946/1.
2. *Impardecispora apiverrucata* (Couper) Venkatachala & Kar; Slide no. 4946/5.
3. *Impardecispora setifera* (Verbizkaya) comb. nov.; Slide no. 4947/15.
4. *Klukisporites pseudoreticulatus* Couper; Slide no. 4798/24.
5. *Klukisporites scaberis* (Cookson & Dettmann) Dettmann; Slide no. 4949/18.
6. *Klukisporites punctatus* Venkatachala; Slide no. 4950/11.
7. *Boseisporites praeclarus* (Dev) Bharadwaj & Kumar; Slide no. 4942/7.
8. *Boseisporites punctatus* Venkatachala; Slide no. 4781/31.
9. *Contignisporites fornicatus* Dettmann; Slide no. 4943/33.
10. *Contignisporites multimuratus* Dettmann; Slide no. 4946/2.
11. *Contignisporites* sp.; Slide no. 4946/1.
12. *Callialasporites trilobatus* (Balme) Bharadwaj & Kumar; Slide no. 4946/8.
13. *Callialasporites dampieri* (Balme) Dev; Slide no. 4939/17.
14. *Callialasporites granulatus* (Venkatachala & Kar) comb. nov.; Slide no. 4952/18.
15. *Callialasporites punctatus* (Venkatachala & Kar) comb. nov.; Slide no. 4951/2.
16. *Schizosporis reticulatus* Cookson & Dettmann; Slide no. 4943/34.

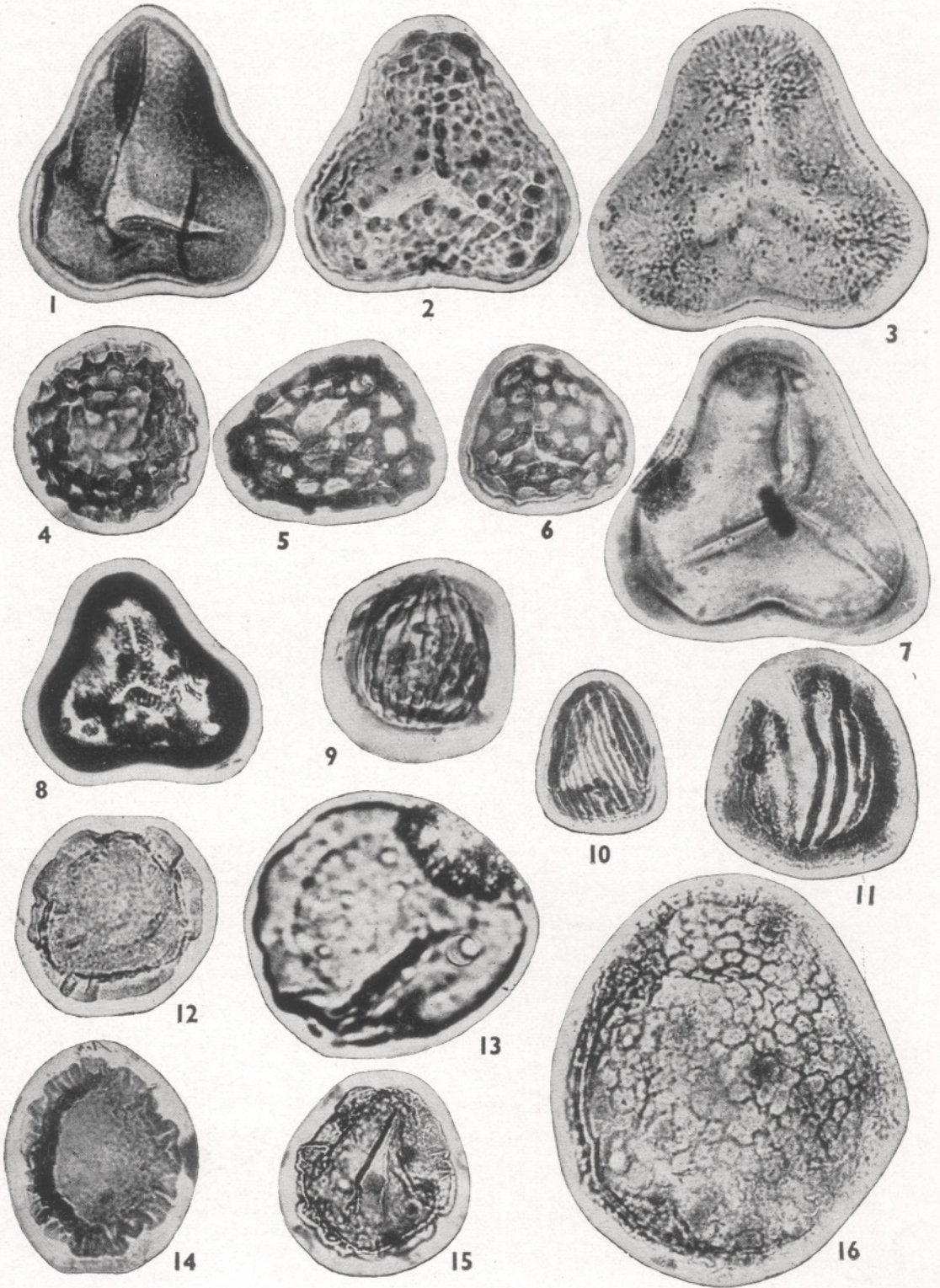


PLATE I