UPPER TRIASSIC SPORAE DISPERSAE FROM THE TIKI FORMATION: MEGASPORES FROM THE JANAR NALA SECTION, SOUTH REWA GONDWANA BASIN

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ABSTRACT

Twentyone different types of megaspores belonging to 10 genera are recorded from the plant-bearing bed in the upper part of the Tiki Formation exposed in a stream section in Bijouri-Harai area, Shahdol District, Madhya Pradesh (South Rewa Gondwana Basin). Five species are new. The genus *Banksisporites* Dettmann has been emended and enlarged. On the basis of megaspore study an Upper Triassic age for the plant-bed of the Tiki Formation is supported.

INTRODUCTION

In the last two decades the taxonomic classification of megaspores has undergone a change. Whereas in the beginning surface study of dry megaspores was carried out by reflected light, later more emphasis was given to the structural studies of wet megaspores in transmitted light. A balanced approach where equal importance is given to surface studies as well as to structural studies has recently found much acceptance with megaspore workers. Of necessity this type of study has resulted in the creation of several new genera of megaspores (Høeg, Bose & Manum, 1955; Pant & Srivastava, 1961, 1962; Bharadwaj & Tiwari, 1970; Maheshwari & Banerji, 1975).

As in the case of dispersed microspores and pollen, in megaspores too, it would be farfetched to suggest that all species referred to a particular genus of megaspores are phylogenetically related. For example, the genus *Biharisporites* is reported right from the Devonian of Arctic Canada (Chaloner, 1958) to at least up to the Upper Triassic of India (present work) but there is no evidence from the megafossil record of the occurrence of a plant which flourished from Devonian to Upper Triassic. Thus, *Biharisporites* presumably includes megaspores of different and may be phylogenetically widely separated plants. This could be true for several other genera too. In the same way it is also likely that megaspores of phylogenetically related plants are placed under different genera.

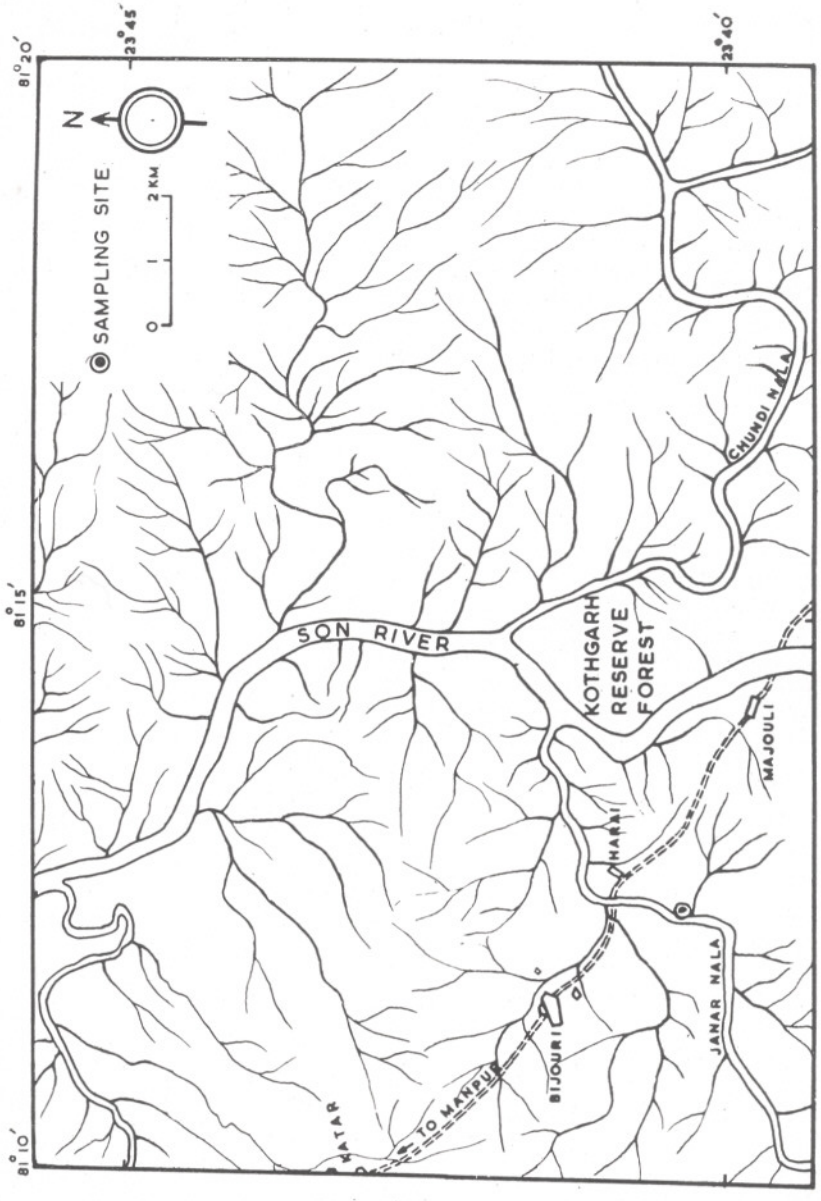
Thus the taxonomic classification of megaspore taxa has so far been arbitrary and no relationship is implied by placing together similar looking megaspores.

MATERIAL AND METHODS

The megaspores described in the present study were obtained from a grey, argillaceous shale and associated micaceous sandy shale collected by one of us (H.K.M.) from a small exposure on the south bank of Janar stream, about 2·5 km south-east of Bijouri Village (Survey of India toposheet no. 64E/2, see Map 1), Shahdol District, Madhya Pradesh (South Rewa Gondwana Basin). Both the shales are fossiliferous and have yielded carbonized compressions of certain fronds which outwardly look like *Dicroidium* but their cuticle is more of *Lepidopteris* type.

Plant fossils from this locality were also reported by C. Nageswara Rao (see Krishnan, 1958, pp. 11, 12) who placed this exposure in the Tiki Group to which he assigned a Lower Triassic age.

The Tiki Formation has been shown by Roy Chowdhury *et al.* (1975, p. 151) as ranging from Anisian to Norian. The Janar Nala plant-bearing bed represents the upper part of the Tiki Formation. A rich vertebrate fauna of Carnian-Norian age has been obtained from beds near Tiki which presumably overlie the plant bearing bed and on that basis Roy Chowdhury *et al.* (1975) date the plant-bearing bed as Late Carnian-Norian in age. The flora of the Parsora Formation is supposed to be an extension



MAP 1 — Map of Bijouri-Harai area showing the sampling site along Janar Nala near Bijouri, Shahdol District, Madhya Pradesh.

of the Tiki flora and the combined Tiki-Parsora flora (Flora IV of Roy Chowdhury *et al.*) is dated as Late Carnian-Rhaetian in age.

Megaspores were processed for study in the same way as outlined in an earlier work by Maheshwari and Banerji (1975, p. 151).

Anteturma — *Sporites* Potonié, 1893
Turma — *Triletes* (Reinsch) Potonié & Kremp, 1954
Subturma — *Azonotriletes* Luber, 1935
Infraturma — *Laevigati* (Bennie & Kidston) Potonié, 1956

Genus — *Trileites* Erdtman ex Potonié, 1956

Type Species — *Trileites spurius* (Dijkstra) Potonié, 1956.

Trileites sp.

Pl. 1, fig. 1

Description — Megaspore spherical, trilete. Trilete laesurae open, rays extend more or less up to half spore radius, inter-radial areas show three distinct subtriangular regions each with a central dense portion; contact area indistinct. Exosporium rough, laevigate, 10 μm thick; mesosporium indistinct.

Dimensions — Equatorial diameter — dry condition: 360 μm; wet condition: 900 μm.

Remarks — The only specimen found from the sandstone sample shows a peculiar thickening in the inter-radial areas which has not been reported so far in any of the megaspore species.

Genus — *Bokarosporites* Bharadwaj & Tiwari, 1970

Type Species — *Bokarosporites psilatus* Bharadwaj & Tiwari, 1970.

Bokarosporites janarensis sp. nov.

Pl. 1, fig. 2; Text-fig. 1

Diagnosis — Megaspores circular to subcircular, trilete. Trilete laesurae distinct, rays extend up to 2/3rd of spore radius, rays broader toward ends, sometimes with funnel-shaped endings; curvaturae indistinct. Exosporium laevigate to rough, 10-15 μm thick; mesosporium distinct, circular, thin, without cushions.

Dimensions — Equatorial diameter — dry condition: 550-700 μm; wet condition: 650-900 μm. Diameter of mesosporium: 500-650 μm.

Comparison — *Bokarosporites janarensis* is easily distinguished from the two known species of the genus *Bokarosporites*, viz., *B. psilatus* Bharadwaj & Tiwari, 1970 and *B. rotundus* (Singh) Bharadwaj & Tiwari, 1970 by its trilete rays which are slightly broader at the ends and in the possession of a well-defined mesosporium, whereas, in both the known species the rays are with tapering, pointed or blunt ends and the mesosporium is not as distinct as in the present species.

Holotype — Pl. 1, fig. 2; Slide no. B.S.I.P. 5300.

Type Locality — Janar Nala near Bijouri, Shahdol District, Madhya Pradesh.

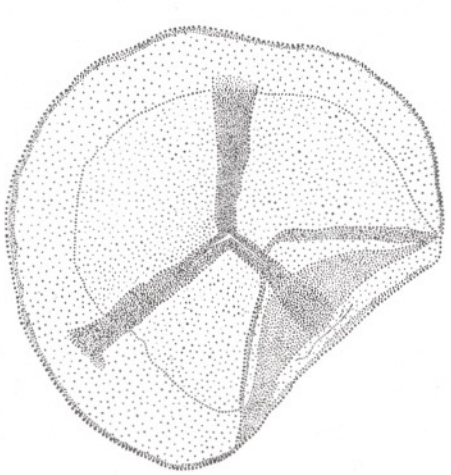
Age & Horizon — Upper Triassic, Tiki Formation.

Genus — *Banksisporites* Dettmann emend.

Type Species — *Banksisporites pinguis* (Haris) Dettmann, 1961.

Emended Diagnosis — Megaspores subcircular to subtriangular, trilete. Trilete laesurae distinct, straight to sinuous with lips; curvaturae ill-defined to distinct. Exosporium smooth to granulose; mesosporium indistinct to well-defined, thin, usually covering more than half radius of spore cavity, without cushions.

Remarks — The genus *Banksisporites* was instituted by Dettmann (1961) from Lower Mesozoic strata of Tasmania for cavate trilete megaspores with smooth to granular nexine and sexine and straight or sinuous laesurae with or without lips. She designated *Triletes pinguis* Harris (1935) as the type species of her genus. Besides describing a new species, *Banksisporites sinuosus* from Tasmania, she also ascribed to this genus another species earlier known as *Triletes tenuis* Dijkstra (1955), from the Permian of Brazil. Bharadwaj and Tiwari (1970) created a new genus *Srivastavaesporites* for cavate trilete megaspores, diagnostic characters of this genus being almost similar to those of the earlier *Banksisporites*



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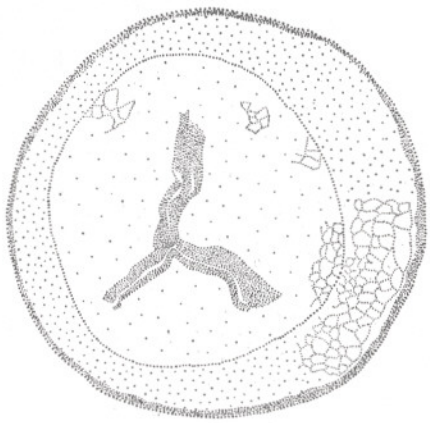

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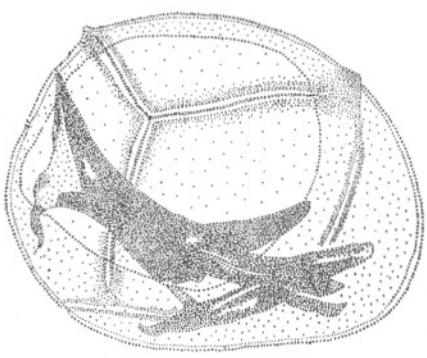

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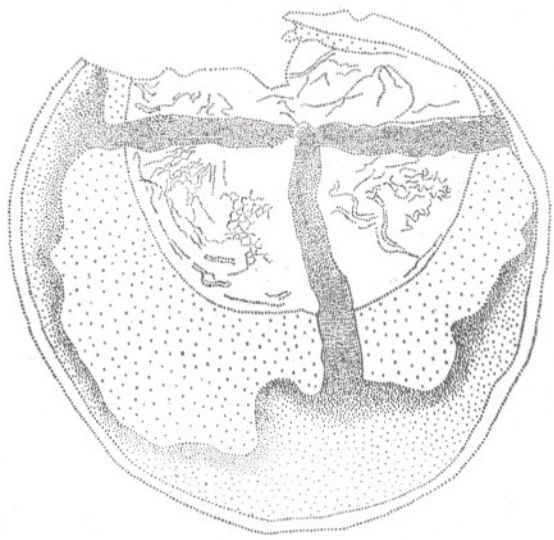

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TEXT-FIGS. 1-4 — **1**, *Bokarosporites janarensis* sp. nov.: holotype in optimum stage of maceration showing trilete rays and distinct subcircular mesosporium × 75. **2**, *Banksisporites dettmannae* sp. nov.: holotype in translucent stage of maceration showing trilete laesurae extending up to contact ridges and a well-defined mesosporium × 100. **3**, *Banksisporites sinuosus* Dettmann.: macerated megaspore showing sinuous laesurae and subcircular mesosporium × 150. **4**, *Banksisporites* sp. cf. *B. gondwanensis* Maheshwari & Banerji: macerated megaspore showing trilete rays up to contact ridges, and a distinct mesosporium with minute folds × 100.

except for well-defined contact areas delimited by prominent curvaturae in *Srivastavaesporites*. However, Dettmann has figured one specimen of *B. sinuosus* (1961, pl. 1, fig. 14) where one could observe the presence of clearly developed arcuate ridges. Probably the previous author did not attach any importance to this character. In the present assemblage megaspores with both indistinct as well as well-defined contact areas delimited by clearly developed arcuate ridges have been found. Therefore, it seems that not much importance can be attached to the prominence of the arcuate ridges. Hence, the diagnosis of the genus *Banksisporites* is

accordingly emended. *Srivastavaesporites* is treated as a junior synonym.

Banksisporites dettmannae sp. nov.

Pl. 1, figs. 3-6; Text-fig. 2

Diagnosis — Megaspores subcircular, trilete. Trilete laesurae distinct, extend nearly up to equator, straight, lips 20-25 μm broad, uniformly thickened, contact area well-defined, delimited by distinct arcuate ridges which almost merge with equator. Exosporium 5-10 μm thick, folded, finely granulose, grana uniformly distributed all over surface; mesosporium distinct, subcircular, large.

Dimensions — Equatorial diameter — dry condition: 300-900 μm; wet condition: 350-600 μm. Diameter of mesosporium: 250-400 μm.

Comparison — *Banksisporites dettmannae* differs from *B. pinguis* (Harris) Dettmann, 1961 in having large contact areas delimited by arcuate ridges which sit almost at the equator. *Banksisporites sinuosus* Dettmann, 1961 can be readily distinguished by its sinuous laesurae. *B. panchetensis* (Maheshwari & Banerji, 1975) resembles the present species in general organization but differs somewhat in ornamentation of exosporium as well as size of the mesosporium. *B. gondwanensis* (Maheshwari & Banerji, 1975) also differs in its ornamentation.

Holotype — Pl. 1, figs. 3-4; Slide no. B.S.I.P. 5301.

Type Locality — Janar Nala near Bijouri, Shahdol District, Madhya Pradesh.

Age & Horizon — Upper Triassic, Tiki Formation.

Banksisporites panchetensis (Maheshwari & Banerji) comb. nov.

Pl. 2, figs. 7-10; Pl. 7, fig. 50

1975 *Srivastavaesporites panchetensis* Maheshwari & Banerji, *Palaeontographica, B152*, pp. 175-176, pl. 9, figs. 116-123; text-fig. 7.

Description — Megaspores subcircular, trilete. Trilete laesurae distinct, raised, straight, equally broad throughout, extend up to 4/5th of spore radius, ray ends sometimes funnel-shaped; contact area well-defined, delimited by mediumly developed arcuate ridges. Exosporium 10-15 μm thick, granulose to finely verrucose; mesosporium generally distinct, half spore diameter to almost filling the whole cavity of spore.

Dimensions — Equatorial diameter — dry condition: 320-420 μm; wet condition: 340-620 μm. Diameter of mesosporium: 330-410 μm.

Remarks — Restudy of *Srivastavaesporites panchetensis* Maheshwari & Banerji, 1975 along with some more specimens from the present assemblage clearly shows that these specimens conform to the diagnosis of the genus *Banksisporites* and hence the species is transferred to the latter genus.

Banksisporites pinguis (Harris) Dettmann, 1961

Pl. 2, figs. 11-14

1935 *Triletes pinguis* Harris, *Meddr. Grønland, 112*, p. 166, pl. 25, fig. 3.

1935 *Triletes persimilis* Harris, *Meddr. Grønland, 112*, p. 165, pl. 25, fig. 4.

1950 Megaspore of *Selaginellites hallei* Lundblad, *K. svenska VetenskAkad. Handl., 4*, p. 9, pl. 1, figs. 6-15.

1950 Megaspore of *Selaginella hallei* Lundblad, *Svensk bot. Tidskr., 44*, p. 484, pl. 2, figs. 1-4.

1956 *Trileites pinguis* (Harris) Potonié, *Beih. geol. Jb., 23*, p. 24.

1960 *Trileites pinguis* (Harris) Potonié: Jung, *Palaeontographica, B107*, p. 133, pl. 36, figs. 6-8.

1961 *Banksisporites pinguis* (Harris) Dettmann, *Micropaleontology*, 7, p. 74, pl. 1, figs. 1-8.

1962 *Trileites pinguis* (Harris) Marcinkiewicz, *Pr. Inst. geol., 30*, pl. 1, figs. 5-7.

1963 *Banksisporites pinguis* (Harris) Reinhardt, *Freiberger Forsch Hft, 164*, pl. 2, figs. 9, 11.

1971 *Trileites pinguis* (Harris) Potonié: Marcinkiewicz, *Pr. Inst. geol., 65*, pp. 30-31, pl. 1, figs. 1-5.

Description — Megaspores subtriangular, trilete. Laesurae extend up to 3/4th of spore radius, lips broad, 30-40 μm thick, straight to slightly wavy; contact area indistinct. Exosporium finely granulose, 10-20 μm thick, mesosporium well-defined, subtriangular in shape, without cushions.

Dimensions — Equatorial diameter — dry condition: 280-300 μm; wet condition: 340-400 μm. Diameter of mesosporium: 200-250 μm.

Remarks — *Banksisporites pinguis* is a characteristic megaspore species widely known from almost all Rhaetic or Rhaeto-Liassic beds of the world. It was first described by Harris (1935) from Rhaetic (*Lepidopteris* zone) of East Greenland. Later on Lundblad (1950) reported similar megaspores from *Selaginella hallei* type of fructification. Some of our specimens differ slightly in the nature of trilete laesurae from those figured by Harris (1935) and Dettmann (1961). However, specimens included by Marcinkiewicz (1971, pl. 1, figs. 4-5) under this species are quite similar.

Banksisporites sinuosus Dettmann, 1961

Pl. 2, figs. 15-18; Text-fig. 3

1961 *Banksisporites sinuosus* Dettmann, *Micropaleontology*, 7(1), p. 74, pl. 1, figs. 9-14.

1970 *Srivastavaesporites karanpuraensis* Bharadwaj & Tiwari, *Palaeontographica, B129*, p. 23, pl. 2, figs. 1-12.

Description — Megaspore subcircular, trilete. Trilete laesurae distinct, rays extend up to 2/3rd of spore radius, lips raised, sinuous, 8-20 μm broad, tapering towards the ends; contact area indistinct, arcuate ridges not seen. Exosporium granulose to finely verrucose, grana uniformly distributed throughout; mesosporium thin, without cushions, filling almost 3/4th of spore cavity.

Dimensions — Equatorial diameter — dry condition: 190 μm; wet condition: 260 μm. Diameter of mesosporium: 150 μm.

Comparison — The specimen resembles *Banksisporites sinuosus* Dettmann (1961) from the Rhaetic of Tasmania. However, the present specimen shows rather rough exine ornamentation as compared to the Tasmanian specimen.

Srivastavaesporites karanpuraensis Bharadwaj & Tiwari (1970) seems to be similar to *Banksisporites sinuosus* Dettmann and is therefore placed as synonym of *B. sinuosus*.

Trileites sinuosus (Dettmann) Fuglewicz, 1973 from Polish Bundsandstein has been merged with *Trileites polonicus* Fuglewicz by Marcinkiewicz (1976).

Banksisporites tenuis (Dijkstra) Dettmann, 1961

Pl. 3, figs. 22, 23

1955 *Triletes tenuis* Dijkstra, *Meded geol. Sticht., 9*, p. 6, pl. 1, figs. 5-8.

1961 *Banksisporites tenuis* (Dijkstra) Dettmann, *Micropaleontology*, 7 (1), p. 74.

1962 *Triletes tenuis* Dijkstra: Pant & Srivastava, *Palaeontographica, B111*, p. 105, pl. 18, figs. 34-36.

1970 *Srivastavaesporites tenuis* (Dijkstra) Bharadwaj & Tiwari, *Palaeontographica, B129*, p. 27.

Description — Megaspore subcircular, trilete. Trilete laesurae distinct, extend for about 2/3rd of spore radius, slightly wavy, lips 20-50 μm broad; contact areas provided with a few apical folds. Exosporium scabrate-granulose, mesosporium indistinct.

Dimensions — Equatorial diameter — dry condition: 430 μm; wet condition: 500 μm.

Remarks — Similar forms were first described as *Triletes tenuis* by Dijkstra (1955) from Permian of Brazil. Later, Dettmann (1961) renamed the forms as *Banksisporites tenuis*, but she did not give any illustration. Pant and Srivastava (1962) restudied the material of Dijkstra and observed that the megaspores increase in size after alkali treatment and that the exosporium is scabrate. Bharadwaj and Tiwari (1970) transferred previously recorded *Triletes tenuis* to their new genus *Srivastavaesporites* but they did not make any reference to *Banksisporites tenuis* which was already existing. As observed in previous pages *Srivastavaesporites* is hardly distinguishable from *Banksisporites* and hence the species *tenuis* should be referred to the genus *Banksisporites*.

Solitary specimen of *Banksisporites tenuis* observed in the present assemblage is rather more comparable to the specimens figured by Dijkstra (1955, pl. 1, figs. 6-8). All the specimens show granulose exine and contact areas with distinct apical folds.

Banksisporites sp. cf. *B. gondwanensis* Maheshwari & Banerji, 1975

Pl. 3, figs. 19, 20; Text-fig. 4

Description — Megaspore subcircular, trilete. Trilete laesurae distinct, extend up to 3/4th of spore radius, rays straight, 30-40

μm broad, slightly broader towards ends; arcuate ridges not very distinct. Exosporium granulose, 10-15 μm thick; mesosporium well-defined, circular, with minute folds, without cushions.

Dimensions — Equatorial diameter — dry condition: 510 μm; wet condition: 660 μm. Diameter of mesosporium: 430 μm.

Comparison — The specimen is closely comparable with *Banksisporites gondwanensis* Maheshwari & Banerji (1975) in size, shape etc., but differs in having granulate ornamentation, whereas, the earlier specimens show closely set low verrucae.

Banksisporites sp.

Pl. 3, fig. 21

Description — Megaspore subtriangular, trilete. Trilete laesurae extend nearly up to margin, narrow, uniformly 10-15 μm high, straight. Exosporium finely granulose, peripheral folds present; mesosporium faintly perceptible.

Dimensions — Equatorial diameter — dry condition: 380 μm; wet condition: 410 μm.

Comparison — The specimen differs from all the known species of *Banksisporites* by its uniformly developed narrow trilete rays which reach nearly up to the margin.

Infraturma — *Apiculati* (Bennie & Kidston, 1886) Potonié, 1956

Genus — *Biharisporites* Potonié 1956 emend. Bharadwaj & Tiwari, 1970

Type Species — *Biharisporites spinosus* (Singh, in Surange, Singh & Srivastava) Potonié, 1956.

Biharisporites sparsus sp. nov.

Pl. 3, figs. 24, 25; Text-fig. 5

Description — Megaspores subcircular to subtriangular, trilete. Rays extend nearly up to equator, 10-20 μm broad, 20-60 μm high, tectum possessing small spinate projections at its margin. Commissures indistinct probably due to well-developed tectum. Exosporium conate, coni ± 10-20 μm high as well as broad, sparsely distributed all over surface, surface scabrate to granulate; mesosporium generally indistinct, sometimes faintly visible, filling almost whole spore cavity.

Dimensions — Equatorial diameter — dry condition: 500-600 μm; wet condition: 600-700 μm.

Comparison — *Biharisporites sparsus* differs from *B. spinosus* (Singh) Potonié, 1956 emend. Bharadwaj & Tiwari, 1970 in having sparsely placed sculpture elements and a large mesosporium. *B. distinctus* Bharadwaj & Tiwari, 1970 can be distinguished by its differentially developed ornamentation of low coni. *B. arcuatus* Bharadwaj & Tiwari, 1970 resembles the present species in shape, size and indistinctly seen mesosporium but differs by its highly developed arcuate ridges, well-defined contact areas and closely placed setae. *B. scaber* Marcinkiewicz (1960) differs in having well-defined coni, distinct mesosporium and is smaller in size.

Holotype — Pl. 3, figs. 24, 25; Slide no. B.S.I.P. 5313.

Type Locality — Janar Nala near Bijouri, Shahdol District, Madhya Pradesh.

Age & Horizon — Upper Triassic, Tiki Formation.

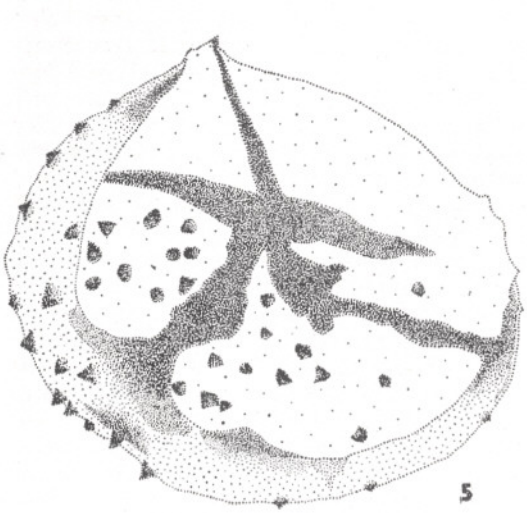
Biharisporites sp.

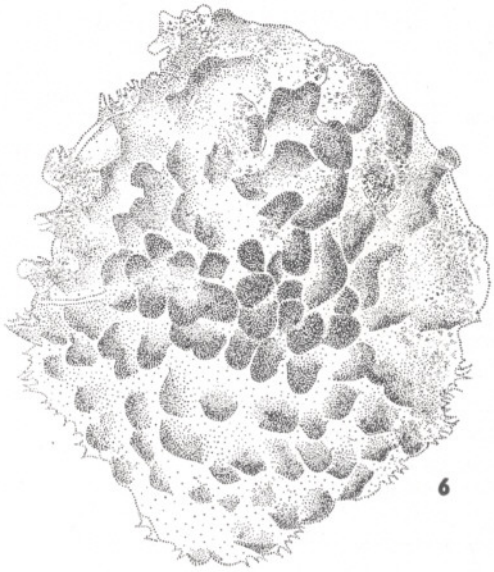
Pl. 4, figs. 26, 27

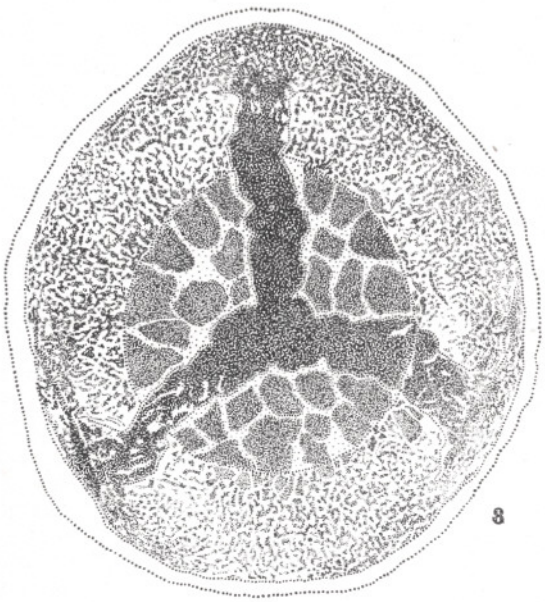
Description — Megaspores circular to subcircular, trilete. Trilete rays extend nearly up to margin, ± straight, 20-25 μm broad, contact areas well-defined by low, 15-20 μm broad arcuate ridges. Exosporium covered with small spines or setae, 10-20 μm thick, 10-20 μm broad at base, apices of spines slightly curved, pointed or rounded, by gradual disappearance of ornamentation exosporium seems to be laevigate-verrucate; at optimum stage of maceration mesosporium faintly visible, almost filling whole of spore cavity.

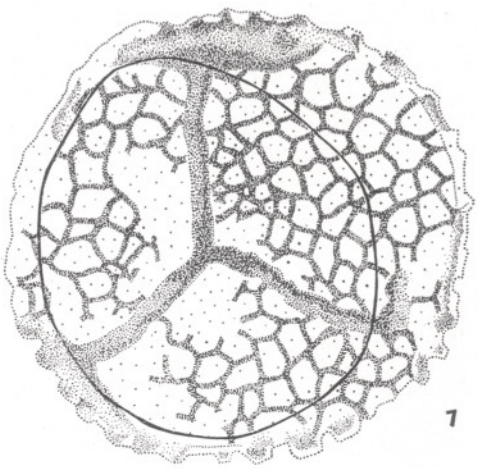
Dimensions — Equatorial diameter — dry condition: 500-600 μm; wet condition: 600-700 μm.

Comparison — The specimens are closely comparable with *Biharisporites arcuatus* Bharadwaj & Tiwari, 1970 in size, shape and ornamentation but the latter species differs in having sinuous trilete laesurae. *B. spinosus* (Singh) Potonié, 1956 and *B.*









TEXT-FIGS. 5-8 — **5**, *Biharisporites sparsus* sp. nov.: holotype in macerated condition showing exosporium with sparsely distributed coni ×75. **6**, *Bacutriletes* sp.: megaspore in macerated condition showing baculate exosporium × 100. **7**, *Horstisporites areolatus* (Harris) Potonié: megaspore showing reticulate exosporium and a subcircular mesosporium × 100. **8**, *Hughesisporites variabilis* Dettmann: translucent specimen showing granulate exosporium and with prominent verrucae in the inter-radial areas × 200.

distinctus Bharadwaj & Tiwari, 1970 are distinguished by a distinct inner body. *B. echinatus* (Miner) Potonié, 1956 differs in having well-developed conate-spinate sculpture. *B. scaber* Marcinkiewicz, 1960 differs by its smaller size.

?Biharisporites sp.

Pl. 4, figs. 28, 29

Description — Megaspore subcircular, trilete. Trilete laesurae small and indistinct. Exosporium conate-spinate, 5 μm thick, spines distantly placed, 10-20 μm long, after maceration it gives a pseudoreticulate appearance; mesosporium indistinct.

Dimensions — Equatorial diameter — dry condition: 350 μm; wet condition: 380 μm.

Comparison — The present specimen can well be compared with *Biharisporites* sp. described by Maheshwari and Banerji (1975) in its exine ornamentation but the trilete laesurae, and the mesosporium are not discernible in the present specimen.

Genus — *Verrutriletes* van der Hammen ex Potonié, 1956

Type Species — *Verrutriletes compositipunctatus* (Dijkstra) Potonié, 1956.

Verrutriletes distinctus (Maheshwari & Banerji) comb. nov.

1975 *Jhariatriletes distinctus* Maheshwari & Banerji, *Palaeontographica, B152*, p. 171, pl. 7, figs. 97-100.

Description (after Maheshwari & Banerji) — Trilete megaspore, amb subtriangular, laesurae strongly developed, straight, almost uniformly broad throughout, about two-thirds of spore radius long, contact area not marked, arcuate ridges absent. Exine cavate, exosporium 10-20 μm thick, ornamented with closely placed verrucate elements with broad bases and gradually narrowing towards rounded or blunt apices. In wet specimens verrucae 10-25 μm high and 10-20 μm broad; mesosporium distinct, large and subtriangular.

Dimensions — Equatorial diameter — dry condition: 280 μm; wet condition: 320-380 μm. Diameter of mesosporium: 250-280 μm.

Comparison — Some of the megaspore types from the Lower Triassic earlier reported under the genus *Jhariatriletes* are now considered to be representative of the genus *Verrutriletes* as these have a verrucate exosporium instead of a baculate exosporium which is characteristic of the former genus. In shape and ornamental elements *Verrutriletes distinctus* comes closest to *V. dubius* (Dijkstra) Potonié. However, the ornamentation elements are not so sparsely distributed as in the latter species and the mesosporium is distinct.

Verrutriletes minuticorpus sp. nov.

Pl. 4, figs. 31, 32; Pl. 5, fig. 33

Description — Megaspore subspherical, trilete. Trilete laesurae extend up to 3/4th of spore radius, uniformly 20-25 μm broad, ± straight, arcuate ridges not well-defined. Exosporium with well-developed, about 20-30 μm long and equally broad verrucae, ends slightly conate, surface in between verrucae finely granulate, after prolonged maceration verrucae dissolve to give granulate surface; mesosporium subcircular to oval, small, darker in colour, granulate.

Dimensions — Equatorial diameter — dry condition: 600-700 μm; wet condition: 700-800 μm; diameter of mesosporium: 450-500 μm.

Comparison — *Verrutriletes minuticorpus* is comparable with *Verrutriletes litchi* (Harris) Potonié described by Marcinkiewicz (1971) from Rhaeto-Liassic beds of Poland in size and exospore ornamentation. However, it differs in possessing a smaller mesosporium as compared to that of the Polish specimens. In the Greenland specimens a mesosporium has not been found (Harris, 1935, p. 159).

Holotype — Pl. 4, figs. 31, 32; Pl. 5, fig. 33; Slide no. B.S.I.P. 5316.

Type Locality — Janar Nala near Bijouri, Shahdol District, Madhya Pradesh.

Age & Horizon — Upper Triassic, Tiki Formation.

Verrutriletes obscurus (Maheshwari & Banerji) comb. nov.

Pl. 5, figs. 34,35

1975 *Jhariatriletes obscurus* Maheshwari & Banerji, *Palaeontographica, B152*, p. 171, pl. 7, figs. 101-102; pl. 8, figs. 103-107; text-fig. 4.

Description — Megaspores subcircular, trilete. Laesurae distinct, extend up to 3/4th of spore radius, straight or slightly sinuous,

20-30 μm broad, occasionally broader at trijunction, gradually tapering towards ends, sometimes laesurae open, with distinct lips; contact area clearly demarcated, but arcuate ridges not prominent. Exine cavate, exosporium ornamented with hemispherical warts or verrucae, 15-35 μm broad, 25-35 μm high, closely distributed except in contact area, surface in between verrucae finely granulate; mesosporium hardly perceptible, subcircular, almost filling the whole cavity.

Dimensions — Equatorial diameter — dry condition: 350-680 μm; wet condition: 450-800 μm; equatorial diameter of mesosporium: 380-600 μm.

Reamrks & Comparison — A detailed study of a number of megaspores suggested that the specimens previously referred as *Jhariatriletes obscurus* Maheshwari & Banerji (1975) from the Maitur Formation of West Bengal are better accommodated under the genus *Verrutriletes* rather than under *Jhariatriletes* as they possess warts or verrucae instead of bacula.

Verrutriletes obscurus resembles *V. utilis* described by Marcinkiewicz (1971) from Rhaeto-Liassic beds of Poland in size and ornamental elements. The latter species is, however, clearly distinguishable by its very prominent arcuate ridges and by the presence of 6-8 oblique folds in the contact areas. Moreover, both laevigate and warty forms have been included under this species.

Genus — *Bacutriletes* (van der Hammen) Potonié, 1956

Type Species — Bacutriletes (*Triletes*) *tylotus* (Harris) Potonié, 1956.

Bacutriletes sp.

Pl. 5, fig. 37; Pl. 6, fig. 38; Text-fig. 6

Description — Megaspores subcircular to oval, trilete. Trilete laesurae indistinct, less than spore radius, contact area indistinct. Exine baculate, bacula 30-50 μm long, 15-25 μm broad, placed about 10-30 μm apart, apex truncated to rounded, surface in between bacula finely granulate, on maceration bacula gradually dissolve and sometimes aquire an appearance of spinules. Mesosporium not noticed.

Dimensions — Equatorial diameter — dry condition: 400-600 μm; wet condition: 600-800 μm.

Comparison & Remarks — The present specimens largely agree with *Bacutriletes tylotus* described from the *Lepidopteris* bed of East Greenland (Harris, 1935). The Greenland specimens, however, characteristically have cylindrical bacula with transversely truncate ends.

The species *tylotus* has also been reported from Rhaeto-Lias boundary of Franconia (Jung, 1960), Rhaeto-Lias beds of Poland (Marcinkiewicz, 1962, 1971), and from Upper Cretaceous of Alberta (Gunther & Hills, 1972). It is, however, extremely doubtful if any of these specimens actually belongs to the species *tylotus*.

Infraturma — *Murornati* Potonié & Kremp, 1954

Genus — *Horstisporites* Potonié, 1956

Type Species — Horstisporites (*Triletes*) *reticuliferus* (Dijkstra) Potonié, 1956.

Horstisporites areolatus (Harris) Potonié, 1956

Pl. 6, figs. 39, 40; Text-fig. 7

1935 *Triletes areolatus* Harris, *Meddr. Grønland, 112*, p. 158, pl. 26, figs. 3, 10.
1956 *Horstisporites areolatus* (Harris) Potonié, *Beih. geol. Jb., 23*, p. 45.
1960 *Horstisporites areolatus* (Harris) Potonié: Jung, *Palaeontographica, B107*, p. 141, pl. 37, figs. 28-30.
1961 *Triletes areolatus* Harris: Harris, *Yorkshire Jurassic Flora, 1*, text-fig. 19 E.
1962 *Horstisporites areolatus* (Harris) Potonié: Marcinkiewicz, *Pr. Inst. Geol., Warszawa, 30*, pl. 4, figs. 1, 2.

Description — Megaspores spherical, trilete. Trilete laesurae distinct, extend up to 3/4th of spore radius, straight, 20-25 μm broad, contact area ill-defined. Exosporium 15-20 μm broad, reticulate, reticulation irregular-polygonal in shape, muri of reticulum 15-20 μm broad, lumina 30-60 μm broad, surface of exosporium finely granulate; mesosporium faintly visible, thin, almost filling two-thirds of spore cavity.

On prolonged maceration the exosporium gradually dissolves and the muri of the reticulation stand out very clearly and look like bacula.

Dimensions — Equatorial diameter — dry condition: 350-500 μm; wet condition: 500-700 μm. Equatorial diameter of mesosporium: 425-450 μm.

Comparison — The present specimens are closely comparable to *Horstisporites areolatus* described from Rhaetic beds of Greenland (Harris, 1935) in having more or less regular development of reticulate pattern on the exosporium. *H. reticuliferus* (Dijkstra) Potonié can be distinguished from the present one in having smaller trilete laesurae and larger areolae. *H. rexargenteus* (Harris) Potonié and *H. harrisii* (Murray) Potonié differ in possessing smaller and irregular meshes of the reticulation. *H. semireticulatus* Jung, 1960 is distinguished by larger meshes of the reticulum. *H. cavernatus* Marcinkiewicz, 1971 is distinguished by its triangular to subtriangular shape. *H. planatus* (Marcinkiewicz) Marcinkiewicz, 1971 and *H. foveotus* Marcinkiewicz, 1971 differ in having a fine and delicate reticulum.

This species is widely known from Rhaeto-Liassic beds of the world and has been recorded by Harris (1935) from Rhaeto-Liassic Bed of East Greenland, Harris (1961) from Jurassic of Yorkshire, Jung (1960) from Rhaeto-Liassic of Franconia and Marcinkiewicz (1962, 1971) from Liassic of Poland.

Genus — *Erlansonisporites* Potonié, 1956

Type Species — *Erlansonisporites erlansonii* (Miner) Potonié, 1956.

Erlansonisporites triassicus sp. nov.

Pl. 6, figs. 42-47; Text-fig. 9

Description — Megaspores subcircular, trilete. Trilete rays raised, reaching nearly up to equatorial margin, 20-30 μm broad; contact areas indistinct. Exine proximally having appendages which form imperfect reticulum on a finely granulate surface, which generally forms 20-25 μm broad equatorial flange; distally exine without appendages.

Dimensions — Equatorial diameter — dry condition: 200-400 μm; wet condition: 300-500 μm.

Comparison — *Erlansonisporites triassicus* differs from the well-known species of the genus, viz., *E. erlansonii* (Miner) Potonié (1956), *E. sparassis* (Murray) Potonié (1956), *E. reticulatus* (Zerndt) Marcinkiewicz (1960), *E. mineri* Dev (1961) and *E. excavatus* Marcinkiewicz (1962) by its smaller size and a smooth distal surface.

Holotype — Pl. 6, figs. 46, 47; Slide no. B.S.I.P. 5325.

Type Locality — Janar Nala near Bijouri, Shahdol District, Madhya Pradesh.

Age & Horizon — Upper Triassic, Tiki Formation.

Erlansonisporites singhii nom. nov.

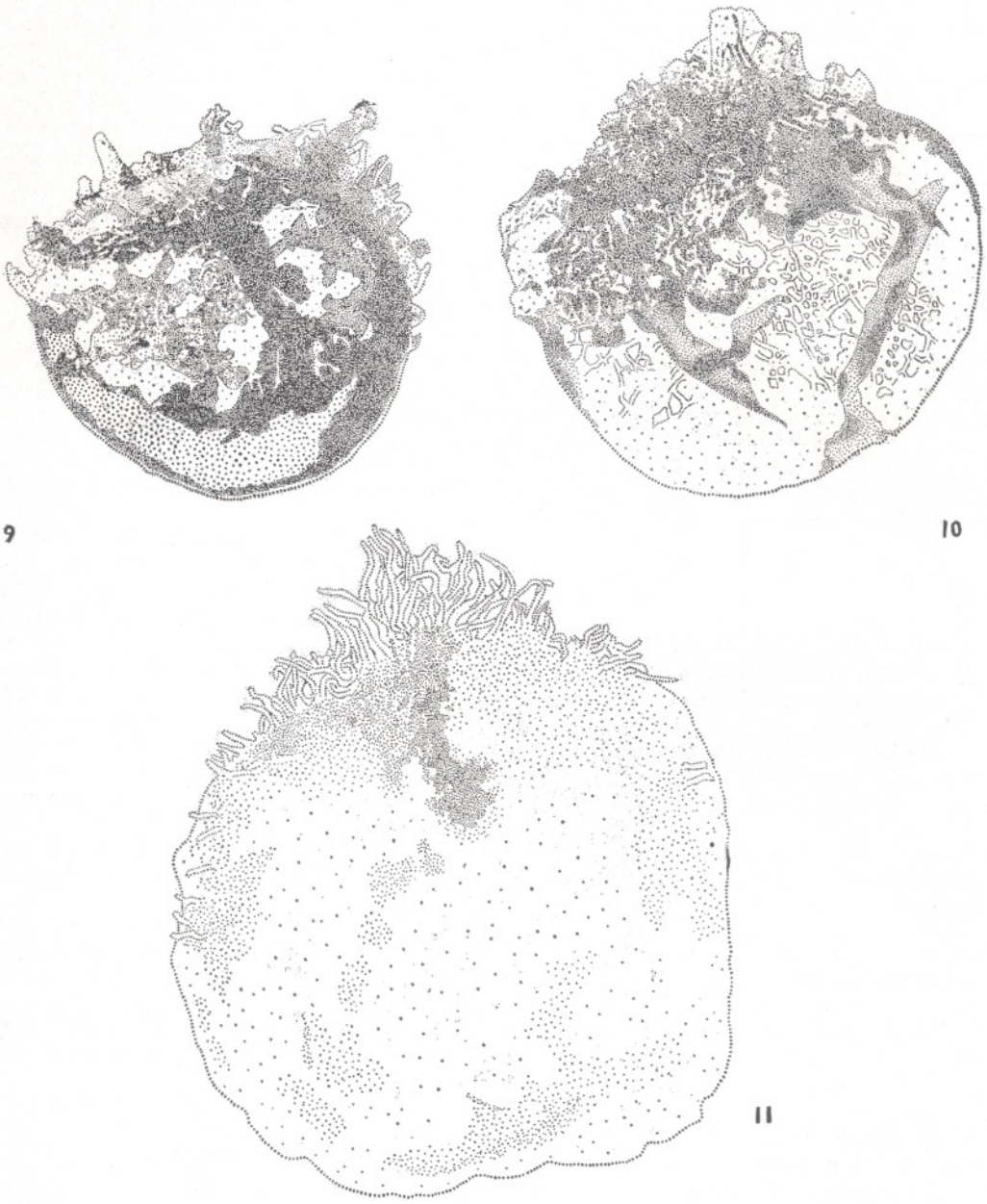
1964 *E. reticulatus* Singh, *Res. Coun. Alberta, Bull., 15*, p. 152, pl. 22, figs. 1, 2.

Description (after Singh, 1964) — Trilete megaspore, outline of the spore completely circular; in some specimens trilete mark entirely covered by strong reticulation and partially or not at all visible; faint trilete crack about 1/3rd the length of the spore radius visible where the high membraneous lamellae on the muri of the reticulum destroyed by oxidative maceration; arcuate lamellae absent; contact faces not distinguishable; a coarse network of muri 4 to 7 micron wide, forming circular to elongate lumina, 34 to 60 micron in diameter, present all over the spore surface, muri of the reticulum transformed into thin and membraneous lamillae about 60 micron high, equally well developed all over the exine, but better preserved around the periphery due to flattening of the spherical body.

Dimensions — Equatorial diameter — including the lamillae; 580-660 μm; excluding the lamillae: 480-550 μm.

Remarks — *Erlansonisporites reticulatus* described by Singh, 1964 is an invalid species as the name was pre-occupied having been used by Marcinkiewicz (1960) for *Triletes reticulatus* Zerndt, 1938. Therefore, a new specific name has been given by us for *E. reticulatus* described by Singh, 1964.

E. reticulatus (Zerndt) Marcinkiewicz can be distinguished from the present species



TEXT-FIGS. 9-11 — **9**, *Erlansonisporites triassicus* sp.nov.: holotype showing laevigate distal exosporium and proximal exosporium with imperfect reticulum comprising thick muri × 200. **10**, *Nathorstisporites* sp.: specimen showing high appendages in inter-radial areas. × 200. **11** *Nathorstisporites hopliticus* Jung: specimen showing branched and unbranched capilli-like exoexinous projections × 150.

by its well-defined contact areas and less-developed muri of the reticulum.

Holotype — Singh, C., 1964, pl. 22, fig. 1.

Type Locality — Fort Augustus no. 1 Well, East-Central Alberta, Canada.

Horizon & Age — Grand Rapids Formation, Lower Cretaceous.

? *Erlansonisporites* sp.

Pl. 6, fig. 41

Description — Megaspore oval, ?trilete. Exosporium reticulate, reticulum irregular comprising high muri, surface finely granulate; mesosporium indistinct.

Dimensions — Equatorial diameter — dry condition: 525 μm; wet condition: 590 μm.

Comparison — The specimen is doubtfully referred to *Erlansonisporites* as the trilete mark has not been seen. The specimen is somewhat comparable with *Erlansonisporites sparassis* (Murray) Potonié emend. Harris (1961) in its coarsely developed reticulate pattern but does not show such high ridges as are characteristic of *E. sparassis*.

Turma — *Barbates* Mädler, 1954

Genus — *Hughesisporites* Potonié, 1956

Type Species—Hughesisporites galericulatus (Dijkstra) Potonié, 1956.

Hughesisporites variabilis Dettmann, 1961

Pl. 7, figs. 48-49; Text-fig. 8

Description — Megaspores subtriangular to subcircular in shape, cavate, trilete. Trilete laesurae wavy, extend up to three-fourths of spore radius, lips about 40 μm broad, contact area well-defined, delimited by mediumly developed arcuate ridges. Exosporium 10 μm thick, granulate, inter-radial areas with prominent verrucae; mesosporium distinct, small, subtriangular to subcircular in shape, without cushions.

Dimensions — Equatorial diameter — dry condition: 275-350 μm; wet condition: 360-400 μm. Diameter of mesosporium: 180-200 μm.

Comparison — In all the characteristic features the present specimens resemble *Hughesisporites variabilis* Dettmann, 1961 reported from the Lower Mesozoic beds of Tasmania. The species differs from *H. galericulatus* and *H. ionthus* (Harris) Potonié, 1956 by its cavate nature and well-defined contact areas. *H. novus* Sah & Jain, 1968 probably represents the genus *Verrutriletes* as the exosporium is verrucate all over. *H. pustulatus* Marcinkiewicz (1962) from the Liassic of Poland is distinguishable by the rugulate exine sculpture in the inter-ray areas. *H. tumulosus* Marcinkiewicz (1976) from the Middle Bundsandstein of Poland differs in having characteristic folds and swellings in the contact areas.

Genus — *Nathorstisporites* Jung, 1958

Type Species—Nathorstisporites hopliticus Jung, 1958.

Nathorstisporites hopliticus Jung, 1958

Pl. 7, figs. 51-54; Text-fig. 11

Description — Megaspores subcircular, trilete. Trilete laesurae with raised lips associated with 20-50 μm long branched or unbranched capilli-like exoexinous projections, inter-ray areas also show prominent spine-like outgrowths. Exine granulate-spinate, after maceration it gives spongy texture due to gradual disappearance of ornamentation.

Dimensions — Equatorial diameter — dry condition: 400-650 μm; wet condition: 500-700 μm.

Remarks — The specimens compare rather well with those described and figured by Marcinkiewicz (1971, p. 40, pl. 22, figs. 5-9) from the Hettangian (Liassic) of Poland.

The species is of wide occurrence in Rhaeto-Liassic sediments of Greenland (Harris, 1935), Sweden (Lundblad, 1956), Germany (Jung, 1960), Poland (Marcinkiewicz, 1960, 1971), Australia (Dettmann, 1961) and Salt Range (Sah & Jain, 1968). Recently Maheshwari and Banerji (1975) have also reported a doubtful specimen from Lower Triassic of India. But, the present record of *N. hopliticus* gives a sufficient ground to show its definite occurrence in the Upper Triassic sediments of India.

Nathorstisporites sp.

Pl. 7, figs. 55-56; Text-fig. 10

Description — Megaspore subcircular, trilete. Trilete laesurae indistinct due to folds. Exine laevigate, infragranulate, proximally with 20-50 μm high appendages in inter-ray areas.

Dimensions — Diameter — dry condition: 330 μm; wet condition: 350 μm.

Comparison — The solitary specimen recovered can best be placed in the genus *Nathorstisporites* Jung. However, it differs from all the known species, viz., *Nathorstisporites hopliticus* Jung, 1958; *N. peltasticus* Jung, 1958; *N. reticulatus* Dettmann, 1961; *N. flagellatus* Dettmann, 1961; *N. pulcherrima* Helby, 1966; *N. nammalensis* Sah & Jain, 1968; and *N. imprimus* Reinhardt & Fricke, 1969 in having smooth, infragranulate exine and leaf-like appendages in proximal interray areas.

PLANTAE INCERTAE SEDIS

Genus — *Spermatites* Miner, 1935

Spermatites sp. cf. *S. indicus* Srivastava, 1955

Pl. 4, fig. 30; Text-fig. 13

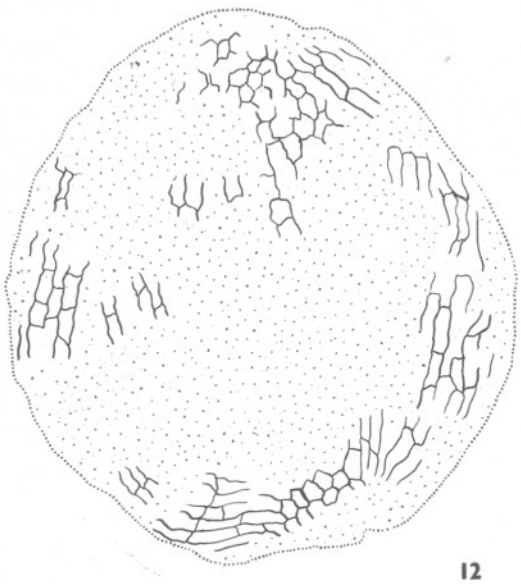
Description — Probably a seed-coat, oval-elliptical in shape, sessile, apex obtuse, size 1·9×0·9 mm. Cellular structure seen only at few places comprising square to rectangular, straight-walled cells. Prominent rib-like structures seen at two extremities.

Comparison — The overall appearance of the specimen is like that of a seed. In its shape and size the specimen compares somewhat with *Spermatites indicus* Srivastava, 1955 known from the Barakar Formation of West Bokaro Coalfield, India. However, in the species a dense and more or less circular nucellus is reported whereas in the present specimen it has not been observed.

Spermatites sp. cf. *S. orbicularis* Miner, 1935

Pl. 5, fig. 36; Text-fig. 12

Description — Seed-coat, sub-circular in shape, sessile, apex obtuse, base broadly rounded, 2 mm long, 1·8 mm wide, cells usually rectangular, near apical region



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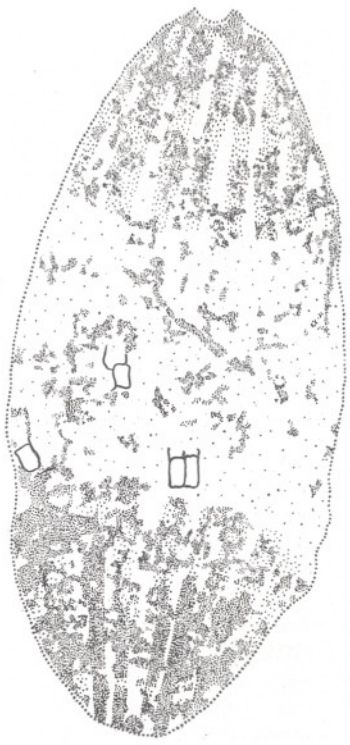

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TEXT-FIGS. 12-13 — **12**, *Spermatites* sp. cf. *S. orbicularis* Miner: subcircular seed-coat showing rectangular polygonal cells × ca. 35. **13**, *Spermatites* sp. cf. *S. indicus* Srivastava: oval-elliptical seed-coat showing rectangular cells and rib-like structures at two extremities × 50.

somewhat polygonal, at base comparatively elongated than elsewhere.

Remarks — Though in this specimen, too, a nucellus has not been observed, it has the looks of a seed. Due to insufficient information available about its structure, it is referred to the non-commital genus *Spermatites*. The nearest comparable species is *S. orbicularis* Miner, 1935 reported from the Upper Cretaceous of Greenland.

DISCUSSION

The megaspores reported in the paper have been recovered both from the fine-grained grey shale and the associated micaceous coarse-grained sandy shale. The proportion of megaspore recovery is, however, comparatively more in the fine-grained shale. A detailed taxonomic study of the specimens recovered has revealed the presence of at least 21 different types of megaspores, probably representing as many species. These have been grouped under 10 genera. The total list of megaspore types described in the present paper is:

Trileites sp.
Bokarosporites janarensis sp. nov.
Banksisporites dettmannae sp. nov.
Banksisporites sp. cf. *B. gondwanensis* Maheshwari & Banerji
Banksisporites panchetensis (Maheshwari & Banerji) comb. nov.
Banksisporites pinguis (Harris) Dettmann
Banksisporites sinuosus Dettmann
Banksisporites tenuis (Dijkstra) Dettmann
Banksisporites sp.
Biharisporites sparsus sp. nov.
Biharisporites sp.
? *Biharisporites* sp.
Verrutriletes minuticorpus sp. nov.
Verrutriletes obscurus (Maheshwari & Banerji) comb. nov.
Bacutriletes sp.
Horstisporites areolatus (Harris) Potonié
Erlansonisporites triassicus sp. nov.
? *Erlansonisporites* sp.
Hughesisporites variabilis
Nathorstisporites hopliticus Jung
Nathorstisporites sp.

A per cent frequency count of the occurrence of megaspores has not been attempted but a general survey shows that the megaspores referable to the genus *Banksisporites* dominate the assemblage. *Horstisporites*, *Nathorstisporites* and *Verrutriletes* are the other genera which are frequency-wise important in that order. The genera *Horstisporites*, *Erlansonisporites*, *Hughesisporites* and *Nathorstisporites* have not been found in the sandy shale samples.

Comparison with Gondwana Megaspore assemblages — From the Gondwanaland provinces though the megaspores have been worked out from the Permian, Triassic, Jurassic and Cretaceous sediments, a proper biostratigraphical sequence built on them has not been worked out so far. This is probably due to scanty information available.

The Permian megaspore assemblages are known from India, Brazil, and Central Africa (see Hœg & Bose, 1960; Pant & Srivastava, 1961, 1962; Trindade, 1967; Bharadwaj & Tiwari, 1970). Most of these assemblages are characterized by the presence of trilete cavate megaspores in which the mesosporium has variously aligned 'cushions', e.g., the genera *Duosporites*, *Talchirella*, *Dijkstraea*, *Gulatriletes* and *Surangeaesporites*. Out of these forms only *Talchirella* extends into the Lower Triassic (Maheshwari & Banerji, 1975). This genus is also reported from the Lower Triassic of Romania (Antonescu & Lantz, 1973) and Poland (Marcinkiewicz, 1976). However, none of these 'cushioned' forms is present in our assemblages.

The only well known Lower Triassic megaspore assemblage is from the Nonia Nala section in the West Raniganj Coalfield, India (Maheshwari & Banerji, 1975). This assemblage, besides having continuation of Permian forms such as *Biharisporites* and *Talchirella*, has several new elements, viz., *Banksisporites*, *Pantiella*, *Maiturisporites*, and *Verrutriletes*. Of these, only *Banksisporites* and *Verrutriletes* are common with our assemblage.

Only a few Middle-Upper Triassic megaspores are known, e.g. *Nathorstisporites pulcherrima* from New South Wales (Helby, 1966), ?*Nathorstisporites* and *Horstisporites* from western Australia (Dolby & Balme, 1976) and *Talchirella*, *Trileites* and *Zeillerisporites* from Salt Range (Pant & Srivastava, 1964).

Dettmann (1961) has described a few Rhaetic-Liassic megaspores from Australia. The following species are common with the present assemblage: *Banksisporites pinguis*,

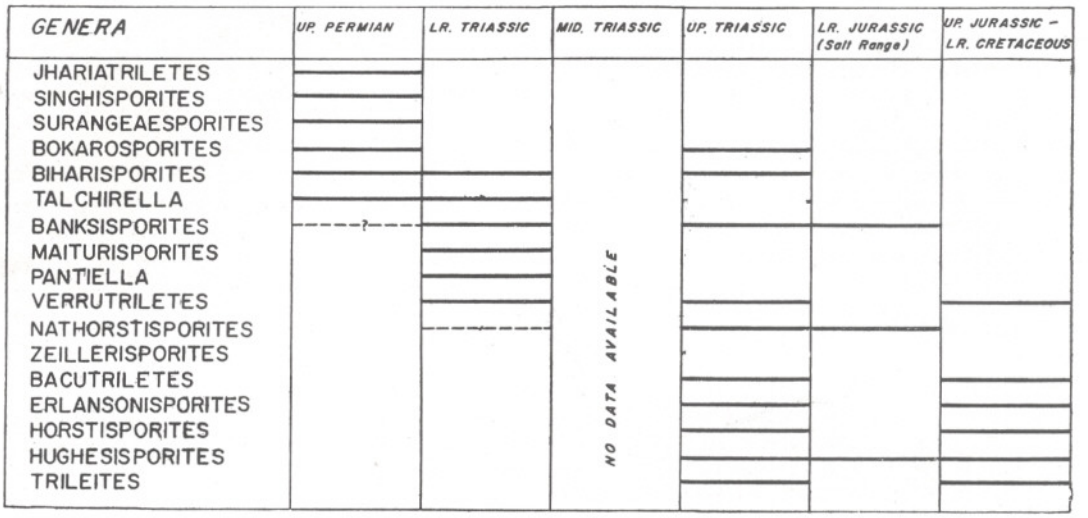

CHART 1 — Distribution of megaspore genera in India during Upper Permian to Lower Cretaceous times.

B. sinuosus, *Hughesisporites variabilis* and *Nathorstisporites hopliticus*. Besides, the genera *Horstisporites* and *Bacutriletes* are also present in both.

The only probable Liassic megaspore assemblage known is from the Salt R nge (Sah & Jain, 1968). From this assemblage only *Banksisporites sinuosus* and *Nathorstisporites hopliticus* are common with our assemblage. The Salt Range assemblage probably also has the genus *Verrutriletes* (*Hughesisporites novus* of Sah & Jain, 1968).

The Jurassic-Cretaceous megaspore assemblages known from India (Dev, 1961; Singh, Srivastava & Roy, 1964) are characterized by the presence of the genera *Dijkstraisporites*, *Erlansonisporites*, *Saccarisporites*, *Verrutriletes*, *Bacutriletes*, *Horstisporites*, *Valvisporites*, *Umiaspora*, *Minerisporites*, *Auriculozonosporites* and *Thomsonia*. Out of these, the genera *Erlansonisporites*, *Bacutriletes*, *Horstisporites* and *Verrutriletes* are also known from our assemblage. *Hughesisporites* and *Horstisporites* are also known from the Cretaceous of Argentina (Gamerro, 1975).

Thus it is evident that our megaspore assemblage is more akin to the Rhaetic-Liassic assemblages rather than to the Permian-Lower Triassic ones. A comparative distribution in Indian sediments of the megaspore genera found in the present assemblage is shown in chart 1.

Comparison with European Rhaetic-Liassic Megaspore assemblages — The Rhaetic-Liassic megaspores in Europe have been extensively worked out from Poland (Marcinkiewicz, 1960, 1961, 1962, 1971), Germany (Jung, 1960), Greenland (Harris, 1935).

The common elements between the Indian and Greenland megaspore assemblages are *Banksisporites pinguis*, *Bacutriletes*, *Horstisporites areolatus* and *Nathorstisporites hopliticus*. The same species are also known from Germany. Reinhardt and Fricke (1969) have reported the presence of *Banksisporites pinguis*, *Verrutriletes*, *Biharisporites*, *Horstisporites* and *Nathorstisporites* in the Keuper of Germany.

The Rhaeto-Liassic of Poland has the following genera common with our assemblage: *Banksisporites*, *Biharisporites*, *Verrutriletes*, *Bacutriletes*, *Horstisporites*, *Erlansonisporites*, *Hughesisporites* and *Nathorstisporites*. The Polish assemblage, however, also has *Maexisporites*, *Minerisporites*, *Thomsonia*, *Aneuletes* and *Dictyothylakos* which are not present in our assemblage.

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EXPLANATION OF PLATES

(*All figures.* × 100, *unless otherwise mentioned*)

PLATE 1

1. *Trileites* sp.– Translucent megaspore showing three subtriangular dense portions. Slide no. B.S.I.P. 5299.

2. *Bokarosporites janarensis* sp. nov.– Holotype in macerated condition showing a well-defined and thin mesosporium. Slide no. B.S.I.P. 5300.

3-6. *Banksisporites dettmannae* sp. nov.– 3, Holotype in dry condition showing trilete rays which extend almost up to the equator; 4, The same megaspore macerated showing distinct mesosporium and finely granulate exosporium. Slide no. B.S.I.P. 5301; 5, Another megaspore in dry condition showing distinct trilete rays; 6, Same in macerated condition. Slide no. B.S.I.P. 5302.

PLATE 2

7-10. *Banksisporites panchetensis* (Maheshwari & Banerji) comb. nov.– 7, Specimen in dry condition showing trilete rays which reach up to the contact ridges; 8, The same megaspore macerated, showing a distinct mesosporium. Slide no. B.S.I.P. 5303; 9, Another specimen in dry condition showing thick and raised trilete rays; 10, Same in macerated condition. Slide no. B.S.I.P. 5304. (An unfigured specimen on Slide No. B.S.I.P. 5307).

11-14. *Banksisporites pinguis* (Harris) Dettmann – 11, Megaspore in dry condition; 12, Macerated megaspore showing the mesosporium. Slide no. B.S.I.P. 5305; 13, Another specimen of the same species. Slide no. B.S.I.P. 5306; 14, A specimen of the same species showing a distinct mesosporium and trilete rays (Specimen dissolved during further maceration).

15-18. *Banksisporites sinuosus* Dettmann – 15, A macerated megaspore showing sinuous trilete rays and the mesosporium. Slide no. B.S.I.P. 5308; 16, A megaspore in dry condition; 17, The same specimen macerated to show the granulate exosporium and the mesosporium; 18, Specimen further macerated. Slide no. B.S.I.P. 5309.

PLATE 3

19-20. *Banksisporites* sp. cf. *B. gondwanensis* Maheshwari & Banerji – 19, A megaspore in dry condition showing granulate exine; 20, Same specimen in macerated condition showing a well-defined subcircular mesosporium. Slide no. B.S.I.P. 5310.

21. *Banksisporites* sp.– The specimen in macerated condition showing narrow trilete laesurae which extend almost up to the spore equator. Slide no. B.S.I.P. 5312.

22-23. *Banksisporites tenuis* (Dijkstra) Dettmann – 22, Megaspore in dry condition; 23, Specimen macerated to show the contact area with apical folds. Slide no. B.S.I.P. 5311.

24-25. *Biharisporites sparsus* sp. nov.– 24, Holotype in dry condition showing highly developed trilete laesurae; 25, The type specimen macerated to show exosporium with sparsely developed coni. Slide no. B.S.I.P. 5313. (Another specimen, unfigured, on Slide no. B.S.I.P. 5318).

PLATE 4

26-27. *Biharisporites* sp.– 26, Megaspore in dry condition showing exine ornamented with spines and setae; 27, Same in macerated condition. Slide no. B.S.I.P. 5314.

28-29. *?Biharisporites* sp.– 28, Megaspore in dry condition showing conate-spinate exine; 29, specimen in macerated condition. Slide no. B.S.I.P. 5315.

30. *Spermatites* sp. cf. *S. indicus* Srivastava – Oval-elliptical seed-coat showing square-rectangular cells. Slide no. B.S.I.P. 5317. × 25.

31-32. *Verrutriletes minuticorpus* sp. nov.– 31, Holotype in dry condition showing verrucate exine; 32, Granulate mesosporium isolated from the exosporium of the holotype by maceration. Slide no. B.S.I.P. 5316.

PLATE 5

33. *Verrutriletes minuticorpus* sp. nov.– Megaspore in Pl. 4, fig. 31, in translucent condition showing verrucate exosporium and a distinct and dense mesosporium. Slide no. 5316 (Mesosporium later isolated and mounted on same slide).

34-35. *Verrutriletes obscurus* (Maheshwari & Banerji) comb. nov.– 34, Megaspore in dry condition showing exine ornamented with closely placed verrucae except in the contact areas; 35, Macerated megaspore showing well-developed verrucae. (Lost during maceration in an attempt to isolate the mesosporium).

36. *Spermatites* sp. cf. *S. orbicularis* Miner – Seed-coat with rectangular-polygonal cells. Slide no. B.S.I.P. 5319. × 25.

37. *Bacutriletes* sp.– Megaspore in dry condition showing baculate exine.

PLATE 6

38. *Bacutriletes* sp.— Specimen in pl. 5, fig. 37 macerated to show well-developed baculate ornamentation of the exosporium. Slide no. B.S.I.P. 5320.

39-40. *Horstisporites areolatus* (Harris) Potonié — 39, Megaspore in dry condition; 40, same specimen in translucent condition showing reticulate exosporium and faintly visible mesosporium. Slide No. B.S.I.P. 5321.

41. *?Erlansonisporites* sp.— Translucent megaspore showing reticulate exosporium. Slide no. B.S.I.P. 5322.

42-47. *Erlansonisporites triassicus* sp. nov.— 42, Megaspore in dry condition; 43, Same specimen in macerated condition showing equatorial flange. Slide no. B.S.I.P. 5323; 44, Another specimen in dry condition; 45, The same spore macerated showing well-developed equatorial flange. Slide no. B.S.I.P. 5324; 46, Holotype in dry condition; 47, Same in macerated condition showing proximal imperfect reticulum and distal laevigate exosporium. Slide no. B.S.I.P. 5325.

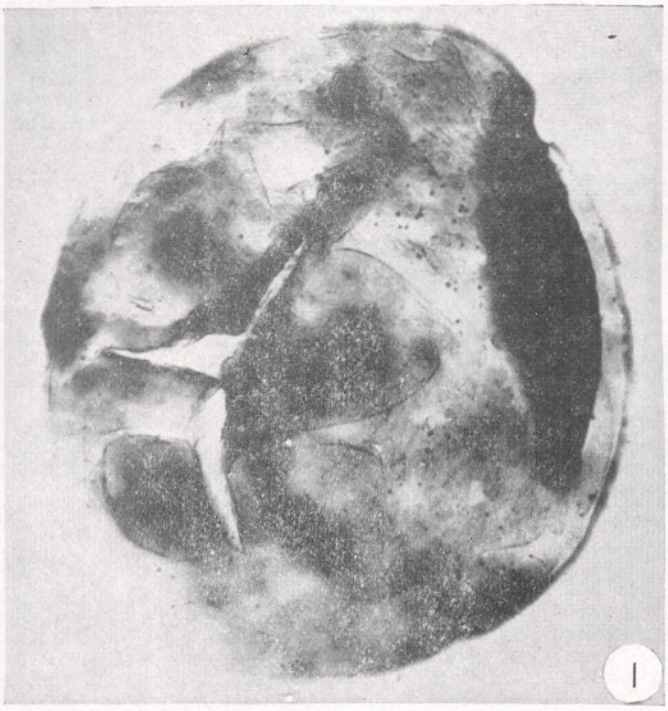
PLATE 7

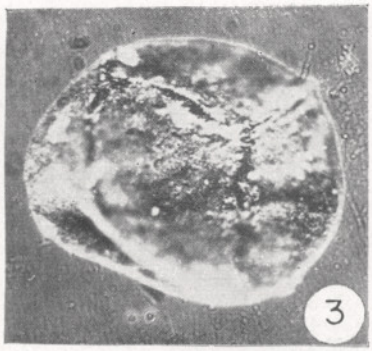
48-49. *Hughesisporites variabilis* Dettmann — 48, Megaspore in dry condition showing well-developed trilete rays reaching almost up to equator; 49, The same megaspore macerated showing granulate exosporium and well-developed verrucae in the inter-radial areas just over the small mesosporium. Slide no. B.S.I.P. 5326.

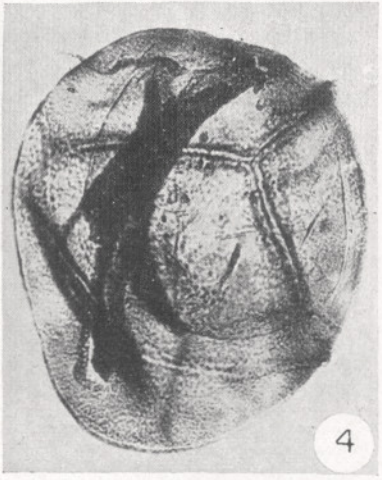
50. *Banksisporites panchetensis* (Maheshwari & Banerji) comb. nov. Megaspore in dry condition. Slide no. B.S.I.P. 5327.

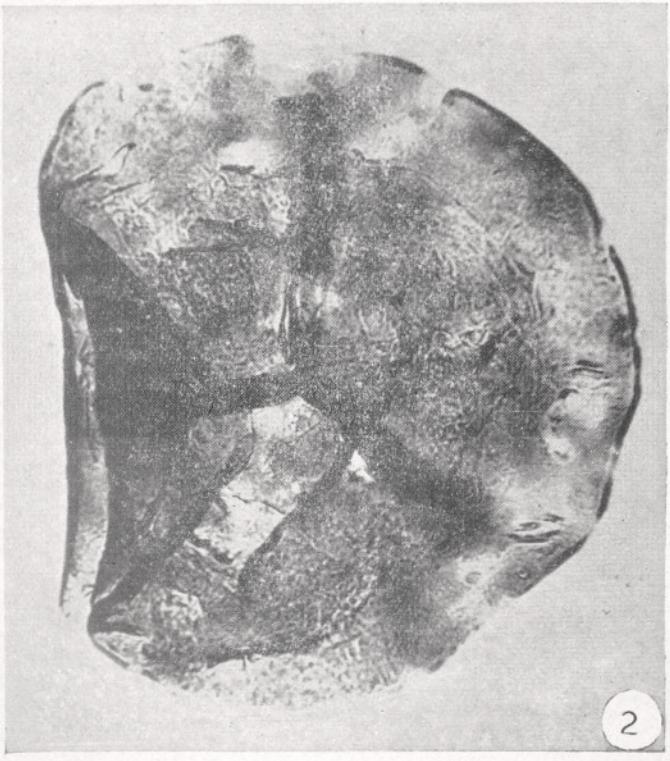
51-54. *Nathorstisporites hopliticus* Jung — 51, Megaspore in dry condition showing branched or unbranched capilli-like exoexinous projections associated with trilete lips; 52, Same in macerated condition. Slide no. B.S.I.P. 5328; 53, Another specimen in dry condition; 54, Same in macerated condition; Slide no. B.S.I.P. 5329.

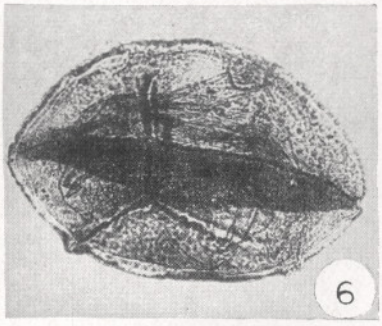
55-56. *Nathorstisporites* sp.— 55, Specimen in dry condition, 56, Macerated spore showing high appendages in inter-ray areas. Slide no. B.S.I.P. 5330.











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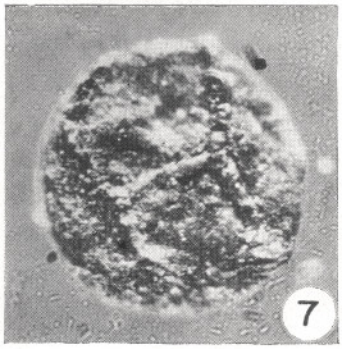

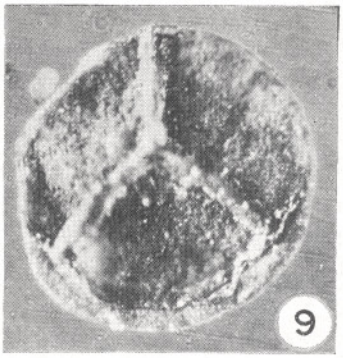

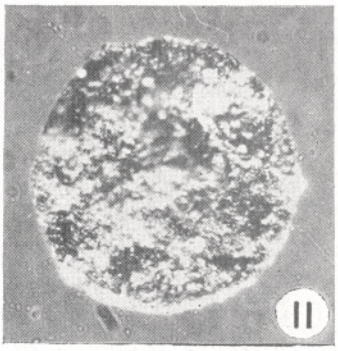

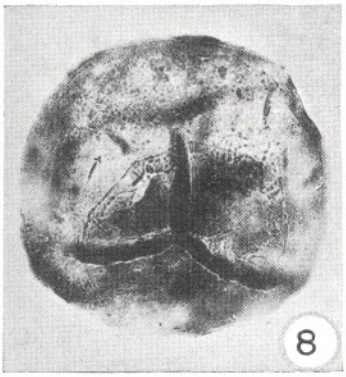

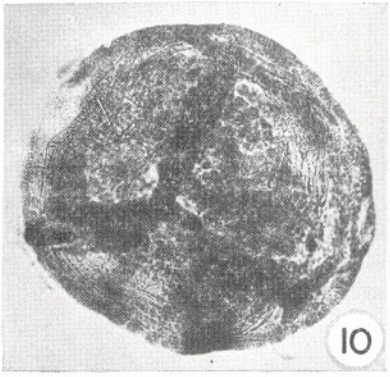

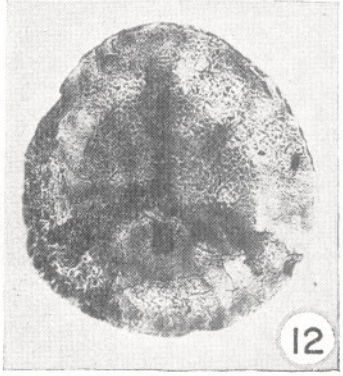

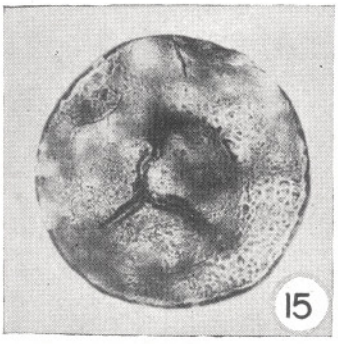

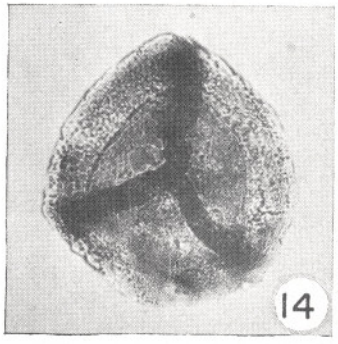

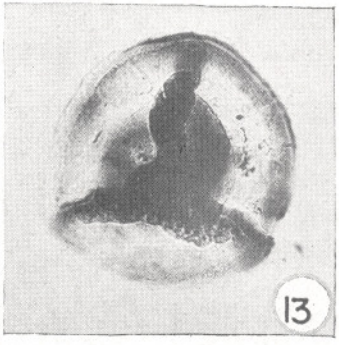

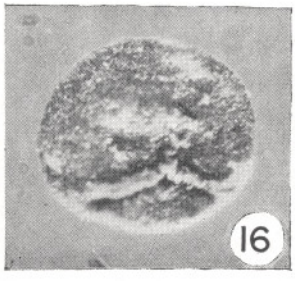

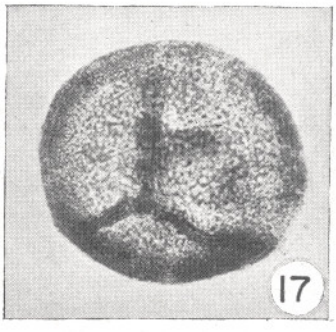

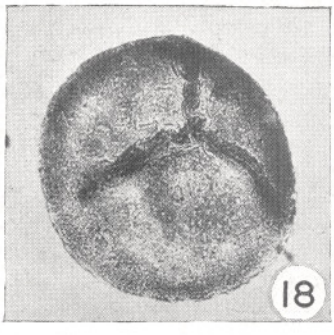

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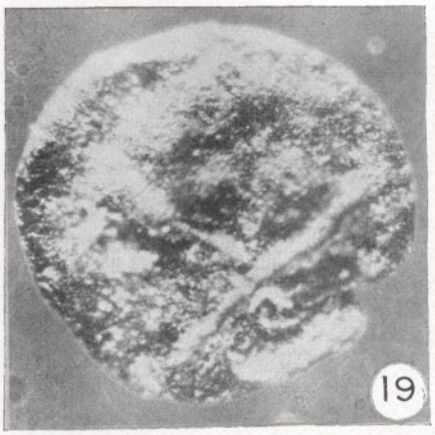

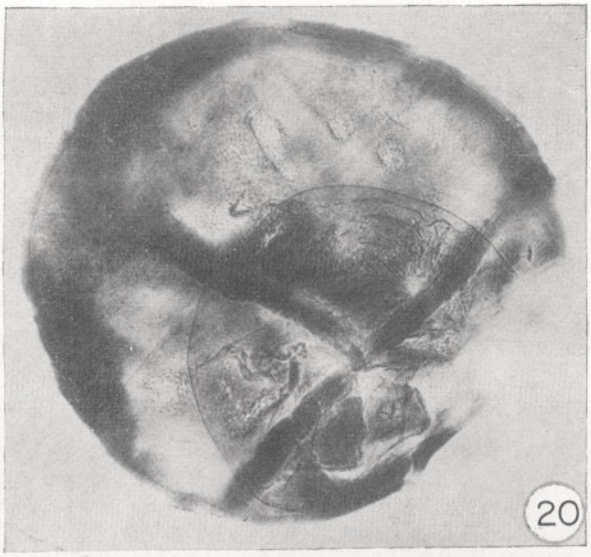

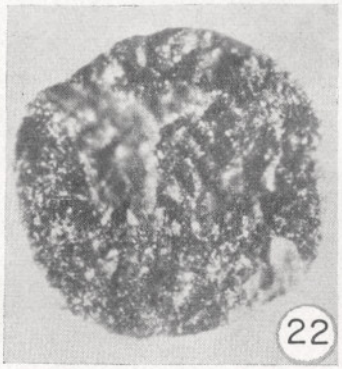

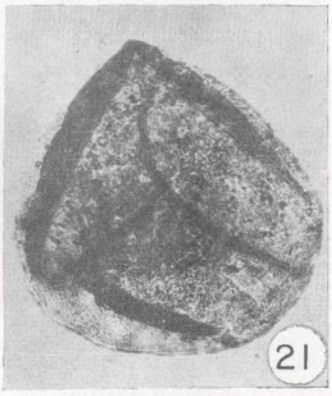

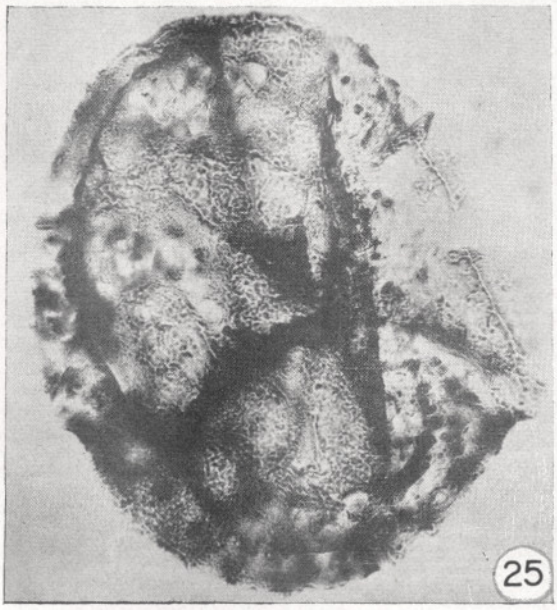

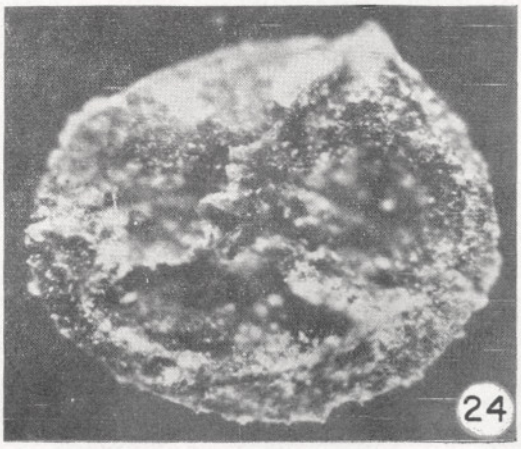

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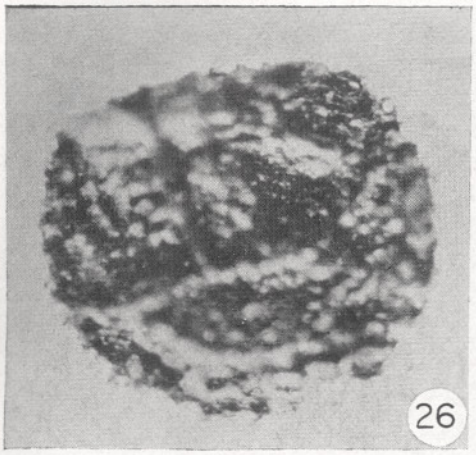

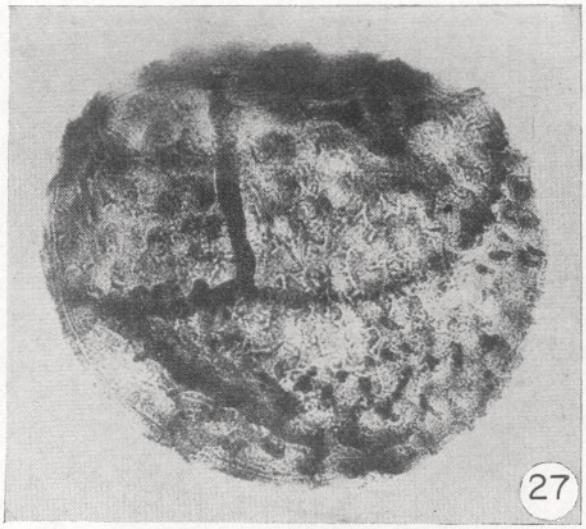

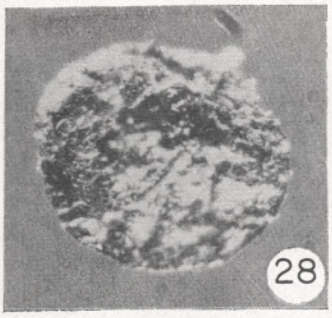

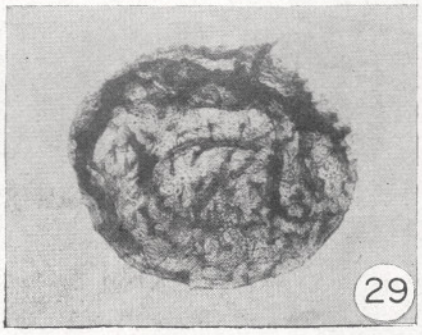

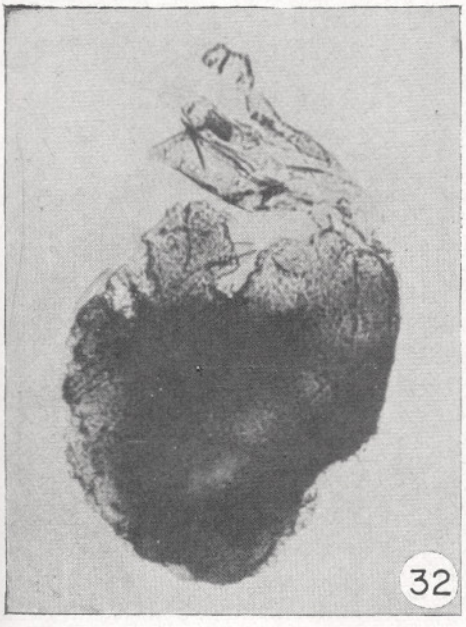

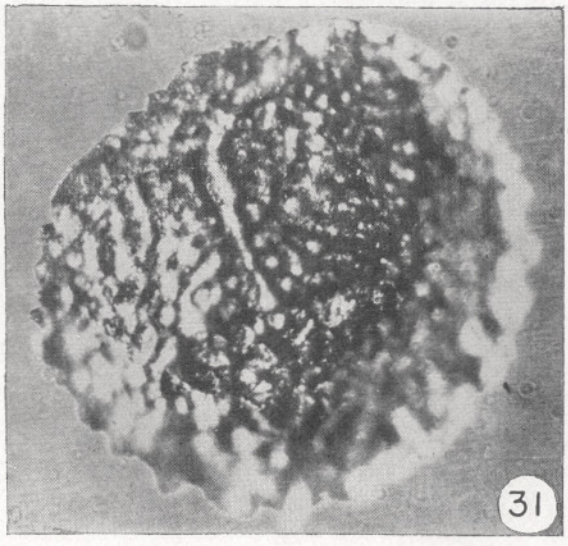

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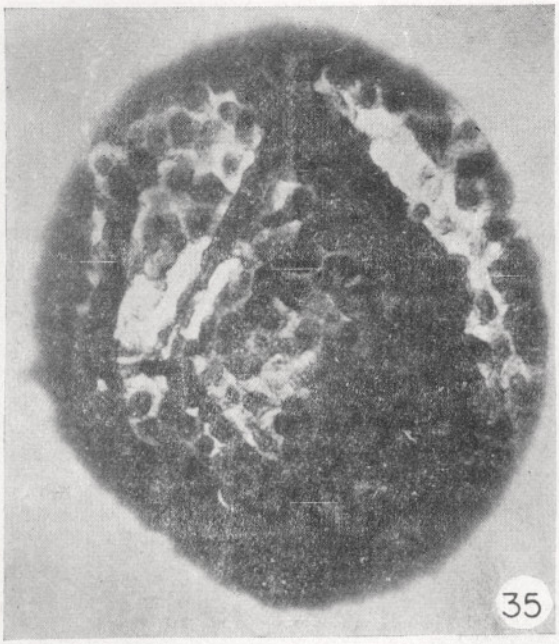

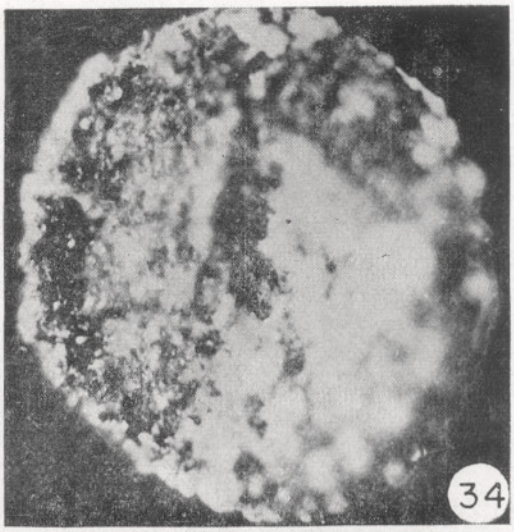

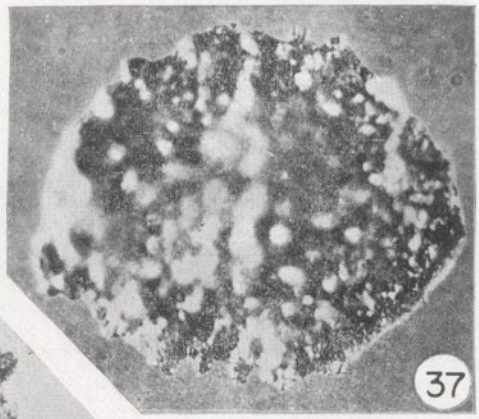

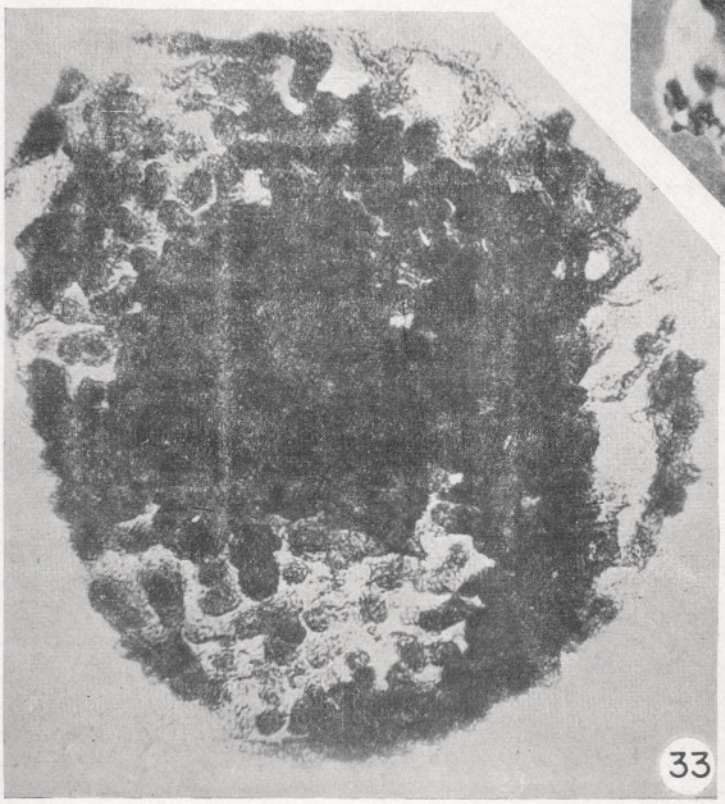

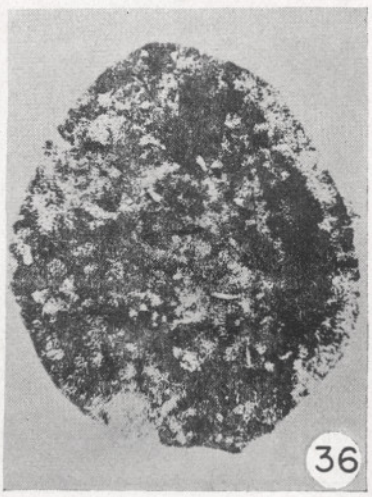

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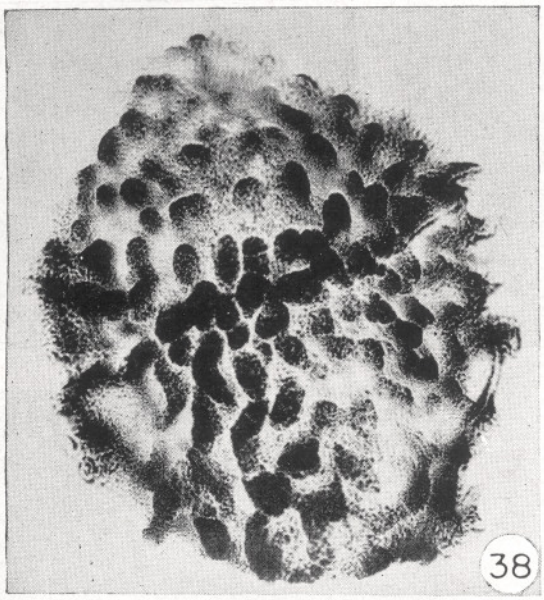
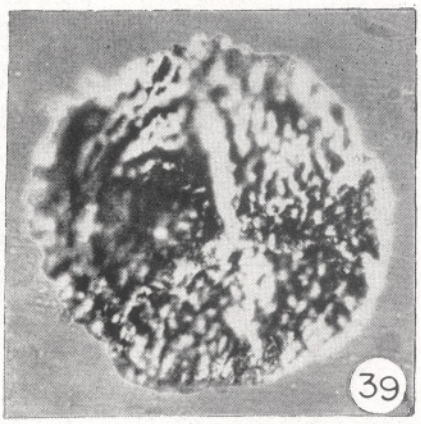
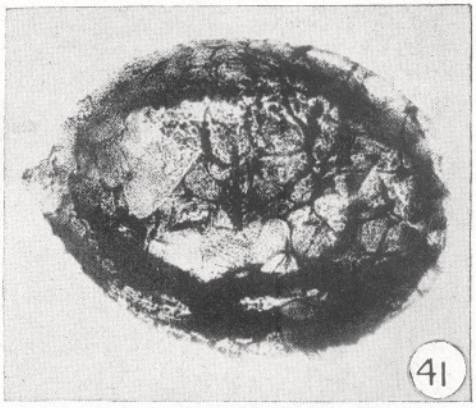
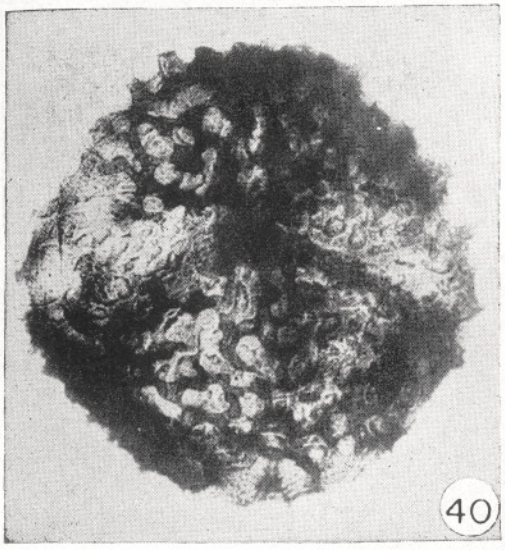
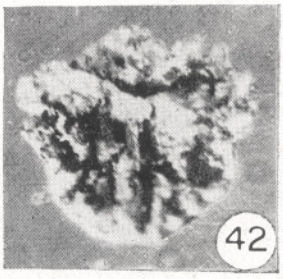
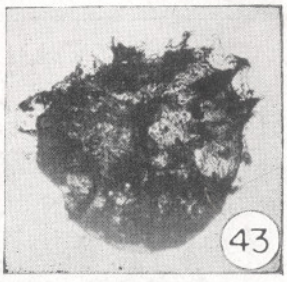


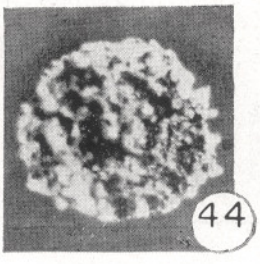


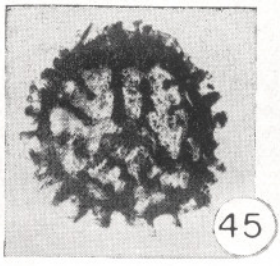


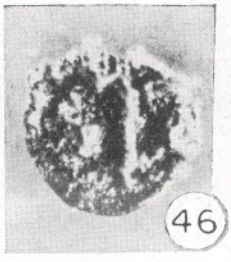












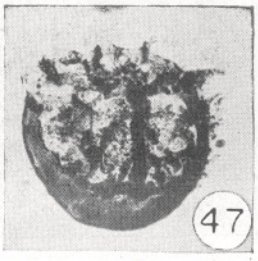
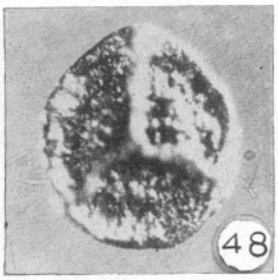
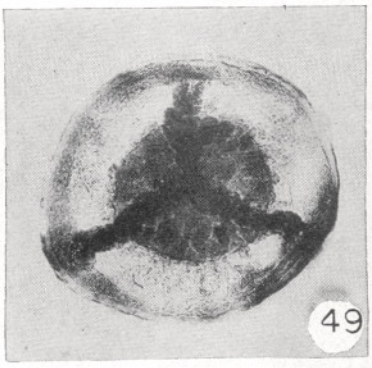
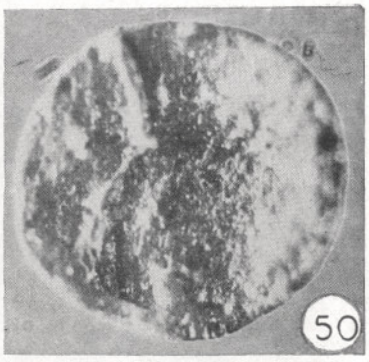
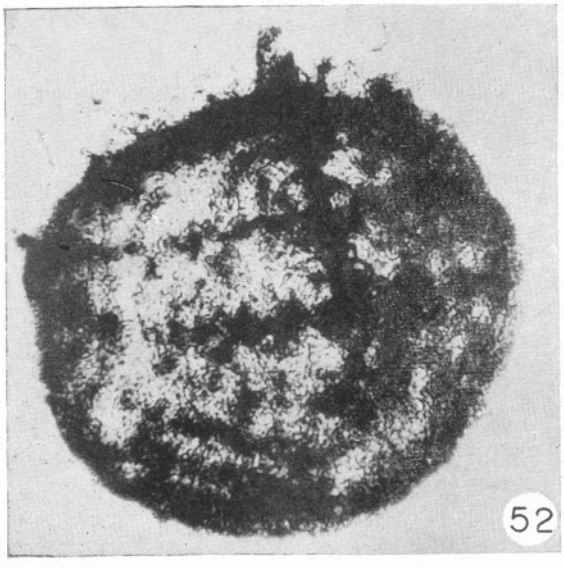


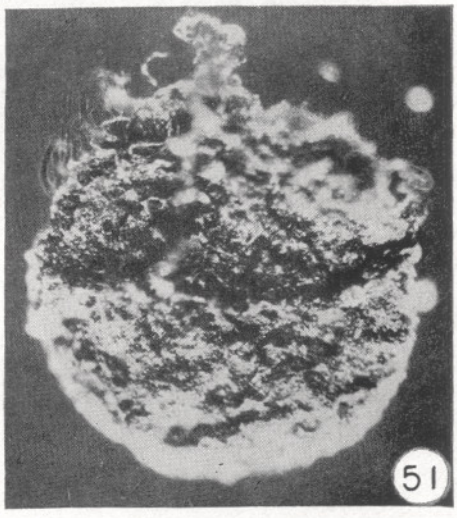
PLATE 6

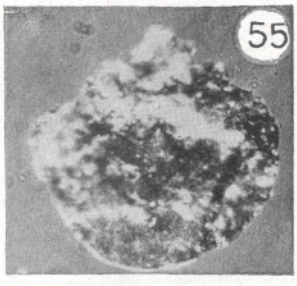


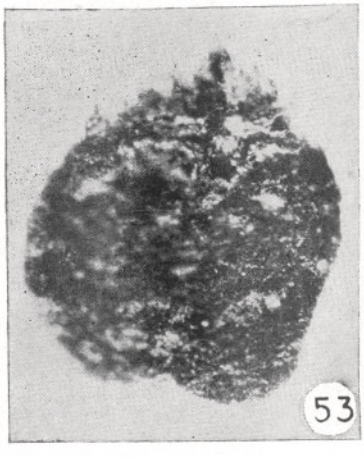


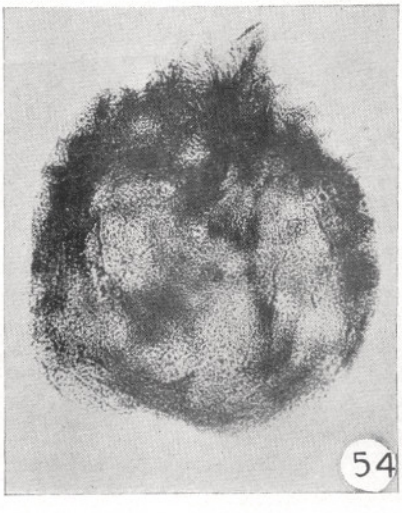












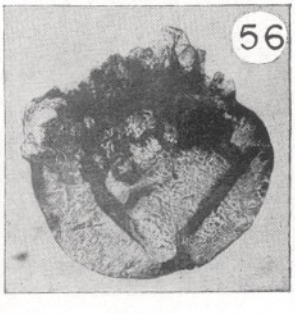


PLATE 7