PALYNOMORPHS FROM THE PANCHET GROUP EXPOSED IN SUKRI RIVER, AURANGA COALFIELD, BIHAR

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ABSTRACT

Palynomorphs obtained from a Panchet Group Exposure in the Sukri River, near Kaima, Auranga Coalfield, Bihar are assignable to 31 species and 22 genera. One genus and five species are newly instituted. On the whole the palynological assemblage is dominated by striate bisaccate pollen. Non-striate bisaccate pollen and the pteridophytic spores share nearly equal percentage. The assemblage is quite similar to the Lower Triassic palynological assemblage reported earlier from the Maitur Formation exposed in the Nonia Nala, near Asansol, West Bengal. The Panchet beds near Kaima are therefore believed to represent the Maitur Formation.

INTRODUCTION

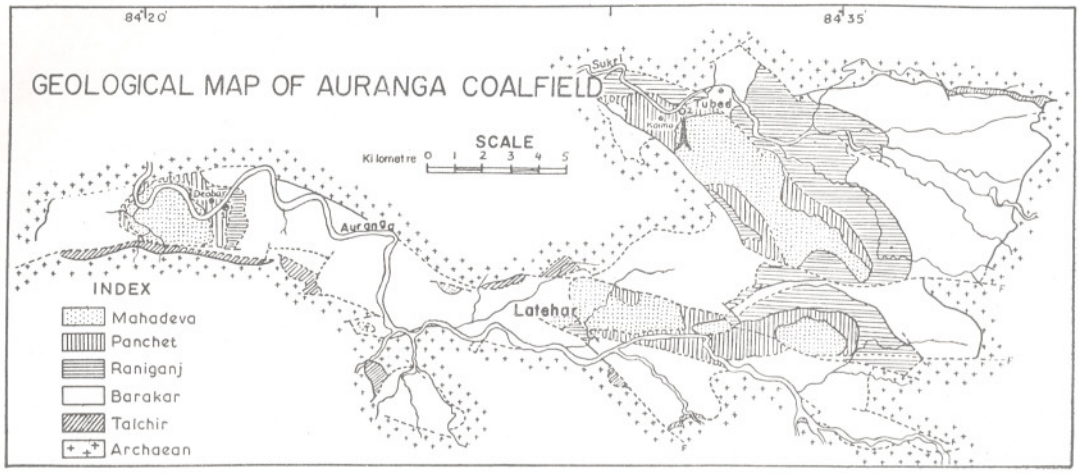
THE Auranga Coalfield is the largest and most complicated coalfield in the Palamau group of coalfields. Its total area is about 250 sq km. The coalfield was first surveyed by Ball (1878) who also delineated the stratigraphical units in the area. The coalfield was remapped by Rizvi (1972). The sedimentary rocks in the Auranga Coalfield belong to the Talchir, Damuda, Panchet and Mahadeva groups.

The total area occupied by the Panchet rocks in the coalfield amounts to about 26 sq km, and the estimated thickness of these rocks is about 213 metres (Ball, 1878). The group is particularly well-developed in the central and eastern part of the coalfield. The strata comprise alternating bands of sandstone and shales with rare calcareous and ferruginous lenses. The sandstones are mostly medium- to coarse-grained and highly felspathic. The shales are white and yellowish-green and are sometimes sandy. According to Ball (1878), some of the thin micaceous shaly sandstones resemble the *Estheria* beds of the Raniganj Coalfield.

The relationship of the Panchet rocks exposed in the different parts of the coalfield is not very clear. No plant fossils were known till recently from the Panchet Group of the coalfield. Ball (1878, p. 89), however, did report some plant fossils from rocks occurring on the northern face of the Latehar Hill. Feistmantel (1886) revisited the locality and was inclined to believe that it represented his 'Transitional beds', probably homotaxial with the 'Parsora Stage' of the South Rewa Gondwana Basin. He lists following taxa: *Schizoneura gondwanensis* Feistmantel, *Vertebraria indica* Royle, *Glossopteris communis* Feistmantel, *G. damudica* Feistmantel, *G. indica* Schimper, *Gangamopteris* sp., scales and winged seeds. In the absence of the genus *Dicroidium* it is extremely difficult to differentiate this assemblage from the Damuda megaflora. Bhattacharyya (1963) has reported plant megafossils from the Panchet Group near Deobar. This assemblage is quite different from the Panchet Group megafossil assemblages known from other areas, in having some characteristically Permian species, e.g., *Gangamopteris cyclopteroides* Feistmantel, *Rhipidopsis densinervis* Feistmantel and *Trizygia speciosa* Royle along with the Triassic *Dicroidium sahnii* Lele. The taxonomy of the Deobar megafossils needs a thorough revision. Except for *Trizygia speciosa* (which is so far not known from the Triassic of India), presence of the other two Permian species is extremely doubtful. No plant mega- or micro-fossils are known so far from the Panchet beds of the Kaima-Subanu area. Therefore the find of pollen and spores in the Sukri River Panchet beds in the area is of great interest as it helps fixing the age of these beds.

MATERIAL AND METHOD

The material studied was obtained from a Panchet Group outcrop on the southern bank of the Sukri River, 0·8 km from Kaima and 1·6 km south-west of Tubed (Loc. 2, Text-fig. 1). The basal beds of the Panchet Group exposed in the Sukri River, north of Kaima overlap the older Raniganj beds. The group starts with a coarse and gritty, white sandstone and a thin conglomerate



TEXT-FIG. 1

band at the base. The associated shales are slightly greenish, whitish and sometimes slightly ferruginous. The rocks trend in the East-West direction with a southerly dip. The same beds are again exposed in the vicinity of Subanu (Rizvi, 1972).

The material was processed in the same way as outlined in an earlier paper (Maheshwari & Banerji, 1975). All the figured slides have been registered with, and deposited in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

DESCRIPTIVE PALYNOLOGY

Anteturma — *Sporites* H. Potonié 1893

Turma — *Triletes* Reinsch emend. Dettmann 1963

Suprasubturma — *Acavatitriletes* Dettmann 1963

Subturma — *Azonotriletes* Luber emend. Dettmann 1963

Infraturma — *Laevigati* Bennie & Kidston emend. Potonié 1956

Genus — *Cyathidites* Couper 1958

Type species — *Cyathidites australis* Couper 1958.

Cyathidites sp.

Pl. 1, fig. 1

Description — Spores 55-65 μ in size, triangular to subtriangular in shape, apices broadly rounded, inter-apical margin convex. Exine 1 μ thick, intrapunctate, puncta more distinct in inter-ray areas. Trilete rays distinct, three-fourths of spore radius long, laesurae thick, commissures distinct, rays seem to bifurcate at ends. Exinal folds frequently present.

Comparison — *Cyathidites* sp. differs from other known species of the genus in the nature of the trilete mark and the differentially punctate exine. Differentially punctate exine is found in the genus *Callumispora* Bharadwaj & Srivastava 1969, which, however, differs in having almost circular shape and comparatively thick exine.

Genus — *Punctatisporites* (Ibrahim) Potonié & Kremp 1954

Type species — *Punctatisporites punctatus* Ibrahim 1933.

Punctatisporites sp.

Pl. 1, fig. 2

Description — Spores circular to subcircular in shape, 50-80 μ in diameter. Exine 1-1·5 μ thick, intrapunctate. Trilete generally distinct, folds usually associated with trilete rays, rays about two-thirds of spore radius long.

Comparison — *Punctatisporites* sp. differs from *P. gretensis* Balme & Hennelly 1956 by its smaller size range. *P. fungosus* Balme 1963 is distinguished by its thick exine.

Genus — *Divaripunctites* Kar 1970

Type species — *Divaripunctites globosus* Kar 1970.

Divaripunctites globosus Kar 1970

Pl. 1, fig. 3

Description — Spores circular to subcircular in shape, 45-80 μ in diameter. Exine 1-1·5 μ thick, sometimes infolded at equatorial margin, proximally punctate, distally laevigate, puncta more distinct in the inter-ray areas. Trilete distinct, rays two-thirds to three-fourths of spore radius long, commissure distinct.

Distribution — The species is so far known only from the Triassic of Raniganj Coalfield, West Bengal (Kar, 1970).

Divaripunctites bifurcatus sp. nov.

Pl. 1, figs. 4-5

Holotype — Pl. 1, fig. 4, size 70 μ. Slide no. B.S.I.P. 4700-6.

Type locality — South bank of Sukri River, 0·8 km from Kaima, Auranga Coalfield, Bihar.

Horizon & Age — Panchet Group, Lower Triassic.

Diagnosis — Spores trilete, circular to subcircular, exine thin, proximally punctate, distally laevigate, generally folded, trilete distinct, rays bifurcate at the ends.

Description — Subcircular spores, 55-75 μ in size. Exine thin, 1 μ, proximally punctate, distally laevigate, usually with many microfolds. Trilete distinct, rays extending up to half radius, bifurcate at the ends, laesurae thick and slightly wavy.

Comparison — The new species differs from the type species, *D. globosus* Kar 1970 by its bifurcating trilete ray ends and in the exine thickness. *D. plicatus* Kar 1970 while resembling in shape and exine thickness differs in having a highly infolded exine.

Infraturma — *Apiculati* Bennie & Kidston emend. Potonié 1956

Genus — *Verrucosisporites* Ibrahim emend. Smith 1971

Type species — *Verrucosisporites verrucosus* Ibrahim 1933.

Verrucosisporites sp. cf. *V. contactus* Clarke 1965

Pl. 1, fig. 6

Description — Spore subcircular, trilete, 68 μ. Exine 2·5 μ thick, verrucose, verrucae of unequal size and shape, in surface view appear like pseudoreticulum. Trilete distinct, rays two-thirds of spore radius long.

Remarks — The solitary spore does not have well-defined verrucae in the proximal inter-ray areas as in *V. contactus*. It is therefore provisionally placed under the species *V. contactus* Clarke 1965.

Distribution — Keuper of Worcestershire (Clarke, 1965).

Verrucosisporites morulae Klaus 1960

Pl. 1, fig. 7

Description — Circular to subcircular, trilete spores, 75-80 μ in diameter. Exine 1·5-2 μ thick, densely verrucose, verrucae of irregular shape, sometimes with blunt tips. Trilete distinct, rays straight, extend up to one half of spore radius.

Distribution — Carnian of the Eastern Alps (Klaus, 1960) and Keuper of Worcestershire, England (Clarke, 1965).

Genus — *Convertubisporites* gen. nov.

Type species — *Convertubisporites contactus* sp. nov.

Generic diagnosis — Subcircular to subtriangular, trilete, spores. Trilete distinct, rays extending up to two-thirds of spore radius. Exine proximally tuberculate, contact area having distinct verrucae, equatorial margin having tubercles and coni; distal ornamentation usually weakly developed, comprises tubercles, coni and verrucae.

Description — The spores are generally subcircular in shape. The trilete is always distinct, generally open, sometimes displaced because of oblique preservation, commissure not seen. The exine is variously ornamented both proximally and distally, proximal inter-ray areas usually having strongly developed verrucae; tubercles, coni or sometimes verrucae are seen at the *extrema lineamenta*. The distal ornamentation is only feebly developed and comprises tubercles, coni or warts. Sometimes the distal ornamentation is also very well-

developed. Exinal infolds may sometimes be present.

Comparison — The genus superficially resembles *Verrucosisporites* Ibrahim 1933 emend. Smith 1971. In the latter, however, the exine is predominantly verrucate whereas in the new genus the exine is predominantly tuberculate, with only a small proportion of verrucae. In *Verrucosisporites* the sculpture elements may be reduced in the contact areas while in *Convertubisporites* the contact areas usually have comparatively strong ornamentation. *Converrucosisporites* Potonié & Kremp 1954 is distinguished by its triangular shape and verrucose exine. *Baculatisporites* Thomson & Pflug 1953 differs in being a circular spore with baculate exine. *Conbaculatisporites* Klaus 1960 is triangular in shape with baculate exine. *Lunzisporites* Bharadwaj & Singh 1964 is a triangular spore with ornamentation elements comprising verrucae, bacula and coni.

Convertubisporites contactus sp. nov.

Pl. 1, figs. 11-12

Holotype — Pl. 1, fig. 11, size 67×75 μ. Slide no. B.S.I.P. 4703-7.

Type locality — South bank of Sukri River, 0·8 km from Kaima, Auranga Coalfield, Bihar.

Horizon & Age — Panchet Group, Lower Triassic.

Diagnosis — Spores subcircular, trilete. Rays generally open, up to two-thirds of spore radius long. Proximal exine sculpture predominantly tuberculate, coni and verrucae also present but in lesser proportion; well-developed verrucae present in the contact area. Distally ornamentation elements sparsely placed.

Description — The spores are 60-80 μ in diameter. Due to oblique preservation of the spores the trilete is sometimes displaced. The rays are straight and open. Commissures have not been seen. The characteristic feature of the species is the presence of well-developed verrucae in the proximal inter-ray areas. The number of ornament elements at the *extrema lineamenta* varies from 45-55. The tubercles are slender, with broad bases, rounded to blunt apices, 2-3 μ long, width is usually less than one half of the length. The verrucae are broader than long and usually flat-topped. The coni are as high as are broad at the base. The proportion of verrucae and coni is comparatively much less.

Convertubisporites densus sp. nov.

Pl. 1, figs. 8-10

Holotype — Pl. 1, fig. 8, size 70 μ. Slide no. B.S.I.P. 4691-15.

Type locality — South bank of Sukri River, 0·8 km from Kaima, Auranga Coalfield, Bihar.

Horizon & Age — Panchet Group, Lower Triassic.

Diagnosis — Subtriangular to subcircular spores, trilete. Rays extending for two-thirds to three-fourths of the spore radius. Exine proximally ornamented with tubercles, verrucae and coni, inter-ray elements comparatively strong. Distally ornamentation elements closely placed and equally strong.

Description — The spores are 70-88 μ in diameter. The exine is 1·5-2 μ thick with characteristic sculpture predominantly comprising tubercles. The individualistic feature of this species is the similar density of the elements on both the proximal and the distal surfaces.

Comparison — *Convertubisporites densus* is distinguished from *C. contactus* in having equally dense ornamentation elements on both the distal and proximal surfaces of the spore.

Convertubisporites sp.

Pl. 1, figs. 13-14

Description — Circular to subcircular spores, 52-65 μ in diameter. Trilete distinct, rays open, extend up to three-fourths of spore radius. Exine 1 μ thick, proximally verrucae are confined only in the inter-ray areas, distally rugose-verrucose pattern is seen.

Comparison — *Convertubisporites* sp. is distinguished from the other two species by its much reduced ornamentation, both proximally as well as distally.

Genus — *Decisporis* Kar 1970

Type species — *Decisporis variabilis* Kar 1970.

Decisporis sp. cf. *D. variabilis* Kar 1970

Pl. 2, figs. 17-18

Description — Trilete spores, usually occur in tetrahedral tetrads. Exine 2-4 μ thick, ornamented with distinct coni and grana, coni regularly arranged, verrucae also frequently present. Trilete rays usually three-fourths of spore radius long.

Comparison — *Decisporis variabilis* Kar 1970 differs from the present species in having granulose-microverrucose sculptural elements on the distal side. *Decisporis rudis* Kar 1970 is distinguished by the distal infoldings which appear as rugae and by the presence of an incipient flange.

Remarks — The observations are based on a number of specimens in tetrad condition. The tetrads are usually tetrahedral, but cross tetrad have also been found (Pl. 2, fig. 18). Not a single spore has been found detached and hence the identification of the species is only a tentative one.

Distribution — The species is known from the Triassic Panchet beds of the Raniganj Coalfield (Kar, 1970a).

Turma — *Monoletes* Ibrahim 1933
Suprasubturma — *Acavatomonoletes* Dettmann 1963
Subturma — *Azonomonoletes* Luber 1935

Genus — *Punctatosporites* Ibrahim 1933

Type species — *Punctatosporites minutus* Ibrahim 1933.

Punctatosporites sp.

Pl. 1, fig. 15

Description — Oval, monolete spores, 20-25 μ long; monolete mark distinct, laesura extending about two-thirds of spore long axis. Exine 1 μ thick, usually folded, faint granulose sculptural pattern present.

Comparison — The spores generally occur in groups. They are closely comparable to *Punctatosporites walkomii* de Jersey 1962 in size and shape but differ in having only a faint sculptural pattern. *Punctatosporites* sp. cf. *P. minutus* Ibrahim described by Balme (1970) from Salt Range is also comparable but for the difference in the thickness of the exine.

Subturma — *Zonotriletes* Waltz 1935
Infraturma — *Cingulati* Potonié & Klaus emend. Dettmann 1963

Genus — *Kraeuselisporites* Leschik emend. Jansonius 1962

Type species — *Kraeuselisporites dentatus* Leschik 1955.

Kraeuselisporites sp.

Pl. 2, fig. 16

Description — Solitary spore trilete, zonate, 60 μ, subtriangular, interapical sides strongly convex. Trilete distinct, rays extend up to the margin of central body. Exine proximally laevigate, distally granulose-coniate. Zona thin, extremely narrow, hardly 2·5 μ.

Comparison — In having low sculpture elements, the specimen differs from *Kraeuselisporites apiculatus* Jansonius 1962, *K. spinosus* Jansonius 1962, *K. cuspidus* Balme 1963, *K. rallus* Balme 1970 and *K. differens* Helby 1966, all of which have large spines intermixed with grana or coni on the distal surface of the central body. *K. verrucifer* de Jersey & Hamilton (1967) has mostly verrucate distal sculpture.

Anteturma — *Pollenites* Potonié 1931
Turma — *Saccites* Erdtman 1947
Subturma — *Monosaccites* Chitaley emend. Potonié & Kremp 1954
Infraturma — *Apertacorpiti* Lele 1964

Genus — *Cannanoropollis* Potonié & Sah 1960

Type species — *Cannanoropollis janakii* Potonié & Sah 1960.

Cannanoropollis densus (Lele) Bose & Maheshwari 1968

Pl. 2, fig. 19

Description — Monosaccate pollen, subcircular, 110 μ in diameter. Central body subcircular, 76 μ in diameter, distinct, exine intramicroreticulate. Trilete indistinct. Saccus offlap 20 μ broad, attachment proximally equatorial, distally subequatorial, distal overlap about 5 μ; saccus fine intrareticulate.

Remarks — The pollen grain resembles *Cannanoropollis densus* (Lele) Bose & Maheshwari 1968 but for having an imperceptible trilete. The genus *Cannanoropollis*

is characteristic of the Talchir and lower part of the Damuda series. Its occurrence above the Barakar Formation is extremely rare. It has, however, been reported from the Tertiary beds of southern India (Potonié & Sah, 1960). The trilete-bearing radial monosaccate pollen are characteristically found in the Lower—Middle Permian horizons of the Gondwanaland. Their occurrence in the Upper Permian as well as in the Lower Triassic sediments is very sporadic.

Cannanoropollis sp. cf. *C. mehtae* (Lele) Bose & Maheshwari, 1968

Pl. 3, fig. 40

Description — Pollen monosaccate, subcircular, 77 μ in size. Central body distinct, 50 μ in diameter, exine scabrate. Trilete not seen. Saccus 12·5 μ broad, thicker than the central body, proximally equatorial, distally subequatorial, fine intrareticulate.

Comparison — The specimen closely compares with *Cannanoropollis mehtae* (Lele) Bose & Maheshwari (1968).

Infraturma — *Saccizonati* Bharadwaj 1957

Genus — *Playfordiaspora* Maheshwari & Banerji 1975

Type species — *Playfordiaspora cancellosa* (Playford & Dettmann) Maheshwari & Banerji 1975.

Playfordiaspora cancellosa (Playford & Dettmann) Maheshwari & Banerji 1975

Pl. 2, fig. 20

Description — Circular to subcircular, monosaccoid miospores, 85-108 μ in diameter. Central body dense, 37-46 μ in diameter, circular to subtriangular, scabrate. Trilete mark distinct or indistinct, rays extend up to two-thirds radius of central body. 'Saccus' filmy, exine 1 μ thick, fine intrareticulate, offlap 28-32 μ.

Distribution — The species has been reported from the Rhaeto-Liassic beds of the Leigh Creek Coal Measures, South Australia (Playford & Dettmann, 1965), Upper Permian — Lower Triassic of the Salt Range (Balme, 1970) and the Maitur Formation, Raniganj Coalfield, West Bengal (Maheshwari & Banerji, 1975).

Infraturma — *Striasacciti* Bharadwaj 1962

Genus — *Striomonosaccites* Bharadwaj 1962

Type species — *Striomonosaccites ovatus* Bharadwaj 1962.

Striomonosaccites sp.

Pl. 2, fig. 21

Description — Monosaccate, oval pollen grain, 105×135 μ in size. Central body subcircular, exine thin, proximally showing about 7, simple or once-forked striations, exine in between the striations fine intrareticulate. Saccus offlap broader along the axis parallel to striations, attachment zones indistinct, intrareticulation fine.

Remarks — The genus is also known from the Maitur Formation section exposed in the Nonia Nala, East of Kumarpur, but mostly it is confined to the Damuda Series.

Subturma — *Disaccites* Cookson 1947
Infraturma — *Pinosacciti* Erdtman emend. Potonié 1958

Genus — *Alisporites* Daugherty 1941 emend. Jansonius 1971

Type species — *Alisporites opii* Daugherty 1941.

Alisporites asansoliensis Maheshwari & Banerji 1975

Pl. 2, figs. 22-23

Description — Bisaccate pollen, slightly diploxylonoid, 85-112 μ long; central body distinct, vertically oval to subcircular, thin, 48-68 μ long, 55-75 μ high, intrareticulate. Sacci hemispherical, 55-87 μ high, proximally equatorially attached, distally subequatorially attached, saccus offlap and overlap almost equal, slit-like distal saccus-free area, sacci finely intrareticulate.

Remarks — The specimens are similar to those recorded from the Maitur Formation exposed in the Nonia Nala (Maheshwari & Banerji, 1975).

Infraturma — *Disacciatrileti* Leschik emend. Potonié 1958

Genus — *Klausipollenites* Jansonius 1962

Type species — *Klausipollenites schaubergeri* (Potonié & Klaus).

Klausipollenites sulcatus Kar, Kieser & Jain 1972

Pl. 2, fig. 24

Description — Bisaccate pollen, 65-70 μ long; central body 32-57 μ long, 55-60 μ high, vertically oval, intramicroreticulate, thin; sacci crescent-shaped, 52-58 μ high, overlap and offlap almost equal, distal saccus-free area broad, biconvex.

Distribution — The species has been recorded from the 'Lower Triassic' of Libya (Kar, Kieser & Jain, 1972).

Klausipollenites sp.

Pl. 2, fig. 25

Description — Solitary bisaccate, haploxylonoid pollen, 78 μ long. Central body distinct, subcircular, 62 μ in diameter, exine intramicroreticulate. Sacci crescent-shaped, sacci height slightly less than central body height, offlap equal to overlap, 7 μ, distally leaving a very broad, subcircular, saccus-free area, intrareticulation fine-meshed.

Comparison — *Klausipollenites sulcatus* Kar, Kieser & Jain 1972 is the nearest comparable species which, however, can be distinguished by its vertically oval central body. *K. staplinii* Jansonius 1962 is also quite comparable but for its smaller size and the presence of infolds in association with the distal saccus roots.

Genus — *Falcisporites* Leschik emend. Klaus 1963

Type species — *Falcisporites zapfei* (Potonié & Klaus) Leschik 1956.

Falcisporites stabilis Balme 1970

Pl. 3, figs. 27-28

Description — Pollen bisaccate, haploxylonoid or slightly diploxylonoid, 80-95 μ long. Central body subcircular to vertically oval, 42-52 μ long, 45-55 μ high, exine intramicroreticulate. Sacci 45-55 μ high, hemispherical, proximally equatorially attached, distally subequatorially attached, offlap almost double of overlap, distal saccus-free area rectangular-oval, 10-17 μ wide.

Remarks — Balme (1970, p. 389) remarks that *Falcisporites stabilis* can not be easily distinguished from *Alisporites australis* de Jersey, except arbitrarily, in a mixed assemblage. Our specimens have both subcircular and vertically oval central bodies. These we have tentatively included as *Falcisporites stabilis* due to a small number of specimens available for study.

Distribution — The species is so far known from the Permian and Triassic beds of the Salt Range (Balme, 1970) and Maitur Farmation of West Bengal (Maheshwari & Banerji, 1975).

Infraturma — *Striatiti* Pant 1954
Genus — *Protohaploxypinus* Samoilovich 1953 emend. Hart 1964

Type species — *Protohaploxypinus latissimus* (Luber & Waltz 1941) Samoilovich 1953.

Protohaploxypinus microcorpus (Schaarschmidt) Balme 1970

Pl. 3, fig. 29

Description — Pollen bisaccate, haploxylonoid or slightly diploxylonoid, 87-112 μ long. Central body vertically oval, outline often indistinct or sometimes marked by irregularly thickened equatorial rim, proximally with 10-15, ill-defined irregularly spaced striations, exine in between striations fine intrareticulate. Sacci semicircular or crescent-shaped, laterally coming close together, sometimes joined, distal zones of attachment not well marked, intrareticulation fine.

Remarks — The species is so far known only from the Permian sediments of Europe, and the Salt Range (Schaarschmidt, 1963; Balme, 1970). The genus is also known from the Lower Triassic Maitur Formation beds, East of Kumarpur, and the Panchet beds of bore-core no. RE9, Raniganj Coalfield (Kar, 1970a — *Striatopiceites clarus; Striatopiceites* Sedova 1956 is a junior synonym of *Protohaploxypinus*).

Genus — *Gondwanipollenites* Bose & Maheshwari 1968

Type species — *Gondwanipollenites congoensis* Bose & Maheshwari 1968.

Gondwanipollenites multistriatus sp. nov.

Pl. 3, figs. 30-31

Holotype — Pl 3, fig. 31; size 110 μ. Slide no. B.S.I.P. 4693-5.

Type locality — South bank of Sukri River, 0·8 km from Kaima, Auranga Coalfield, Bihar.

Horizon & Age — Panchet Group, Lower Triassic.

Diagnosis — Pollen bisaccate, diploxylonoid, 100-114 μ long. Central body outline distinct, subcircular to vertically oval, 42-50 μ long, 52-62 μ high, proximally with 10-15 simple or branched, horizontal striations, usually with several vertical cross-connections, exine in between the striations fine intrareticulate. Sacci subspherical, 64-80 μ high, distal attachment subequatorial, associated with infolds of central body, distal saccus-free zone biconvex, 17-22 μ broad at the widest, saccus intrareticulation fine.

Comparison — *Gondwanipollenites fuscus* (Bharadwaj) compares well except for the comparatively small number of striations on the central body which is vertically oval with both the ends pointed. *G. santalensis* (Maheshwari) differs in having crescent-shaped sacci. G. *gondwanensis* (Maheshwari) has a broader sulcus, and does not possess vertical connecting striations.

Genus — *Lunatisporites* Leschik 1955 emend. Scheuring 1970

Type species — *Lunatisporites acutus* Leschik 1955.

Lunatisporites sp.

Pl. 3, fig. 35

Description — Pollen haploxylonoid or slightly diploxylonoid, bisaccate, 60-66 μ long. Central body subcircular, 45 μ in diameter, with 4-7 taeniae, exine punctate. Sacci hemispherical, intramicroreticulation medium.

Comparison — The species is characterized by ill-developed taeniae, and a comparatively small size. Infact in some of the specimens the taeniae are so badly preserved that they almost look like striations.

?*Lunatisporites* sp.

Pl. 3, fig. 34

Description — Pollen grain tetrasaccate, 80×87·5 μ. Central body subcircular, distinct, with a few taeniae, taeniae exine punctate, exine in between taeniae laevigate. Sacci offlap crescent-shaped, laterally approaching one another, intrareticulation medium, lumen diameter equal to or less than muri width.

Remarks — This is probably an abnormal specimen of the genus *Lunatisporites*.

Genus — *Striatites* Pant emend. Bharadwaj 1962

Type species — *Striatites sewardii* (Virkki) Pant, 1955.

Striatites solitus Bharadwaj & Salujha 1964

Pl. 3, fig. 36

Description — Bisaccate pollen, 75-110 μ long. Central body vertically oval to subcircular, 37-62 μ long and 52-62 μ high, exine 1 μ thick, microverrucose, marginal ridge present, proximally 5-10 horizontal striations. Sacci hemispherical, 60-75 μ high, intrareticulation medium to fine, distal saccus free area 10-30 μ broad.

Distribution — Bharadwaj and Salujha (1964) have recorded the species from the Upper Permian (Raniganj Stage) of Raniganj Coalfield, West Bengal.

Genus — *Striapollenites* Bharadwaj 1962

Type species — *Striapollenites saccatus* Bharadwaj 1962.

?*Striapollenites* sp.

Pl. 2, fig. 26

Description — Diploxylonoid bisaccate pollen, 92 μ along longer axis. Central body distinct, vertically oval, 43 μ long, 58 μ high, proximally with horizontal as well as oblique striations, exine in between the striations granulose. Sacci more than hemispherical, 58 μ high, offlap 30 μ, distal zones of attachment not clearly demarcated, intrareticulation fine.

Remarks — As the solitary specimen shows a few faintly marked horizontal striations besides the vertical-oblique striations, it has been doubtfully referred to the genus *Striapollenites* Bharadwaj 1962. The genus has also been reported from the Panchet beds of bore-core no. RE9, Raniganj Coalfield.

Infraturma — *Striareticuloiditi* Tiwari 1964

Genus — *Rhizomaspora* Wilson 1962

Type species — *Rhizomaspora radiata* Wilson 1962.

Rhizomaspora divaricata Wilson 1962

Pl. 3, fig. 37

Description — Bisaccate diploxylonoid pollen, 95-115 μ long. Central body circular-subcircular, small, 30-37 μ in diameter, dense, reticuloid grooves present. Sacci subspherical, proximally equatorially attached, distal attachment indistinct, saccus-free area narrow.

Distribution — The species is known from the Permian Flowerpot Formation (Wilson, 1962).

Rhizomaspora biharia sp. nov.

Pl. 3, fig. 39

Holotype — Pl. 3, fig. 39, size 84 μ. Slide no. B.S.I.P. 4699-1.

Type locality — South bank of Sukri River, 0·8 km from Kaima, Auranga Coalfield, Bihar.

Horizon & Age — Panchet Group, Lower Triassic.

Diagnosis — Diploxylonoid bisaccate pollen, 80-98 μ long. Central body distinct, vertically oval, 36-42 μ in size, proximally with warty projections of irregular shape and size. Sacci reniform, 35-66 μ high, proximally equatorially attached, distal attachment subequatorial, leaving a biconvex saccus-free area, generally folds associated with distal attachment zones, saccus intra-reticulation medium to fine.

Comparison — The present species differs from all the species described till now by its biconvex and distinct distal saccus-free area and association of vertical infolds with the saccus roots. *Rhizomaspora divaricata* Wilson 1962 differs in having an obscure sulcus.

Rhizomaspora sp.

Pl. 3, fig. 33

Description — Bisaccate pollen, diploxylonoid, 77-80 μ long. Central body circular, 37·5-42·5 μ, proximally with dense wart-like structures which form a sort of reticuloid pattern. Sacci subspherical, 37-42 μ high, proximally equatorially attached, distally subequatorially attached, sometimes folds associated with the distal attachment. Saccus exine fine intrareticulate.

Comparison — *Rhizomaspora* sp. is closely comparable to *Rhizomaspora radiata* Wilson 1962 from the Flowerpot Formation except for the radiating proximal ornamentation. *R. singula* Tiwari 1965 is distinguished by its big, dense central body. *R. monosulcata* Tiwari 1968 has a sub-circular distal saccus-free area.

Subturma — *Monocolpates* Iverson & Troels-Smith 1950

Genus — *Cycadopites* Wodehouse ex Wilson & Webster 1946

Type species — *Cycadopites follicularis* Wilson & Webster 1946.

Cycadopites sp.

Pl. 3, fig. 32

Description — Oval, monocolpate pollen, 37·5×82·5 μ, exine 2 μ thick, psilate to weakly intrastructured, colpus distinct, extending whole length of the pollen, broader at the lateral ends.

Turma — *Aletes* Ibrahim 1933
Subturma — *Azonaletes* (Luber) Potonié & Kremp 1954
Infraturma — *Psilonapiti* Erdtman 1947

Genus — *Laricoidites* Potonié, Thomson & Thiergart 1950

Type species — *Laricoidites magnus* Potonié, Thomson & Thiergart 1950.

Laricoidites intragranulosus Bharadwaj & Singh 1964

Pl. 3, fig. 38

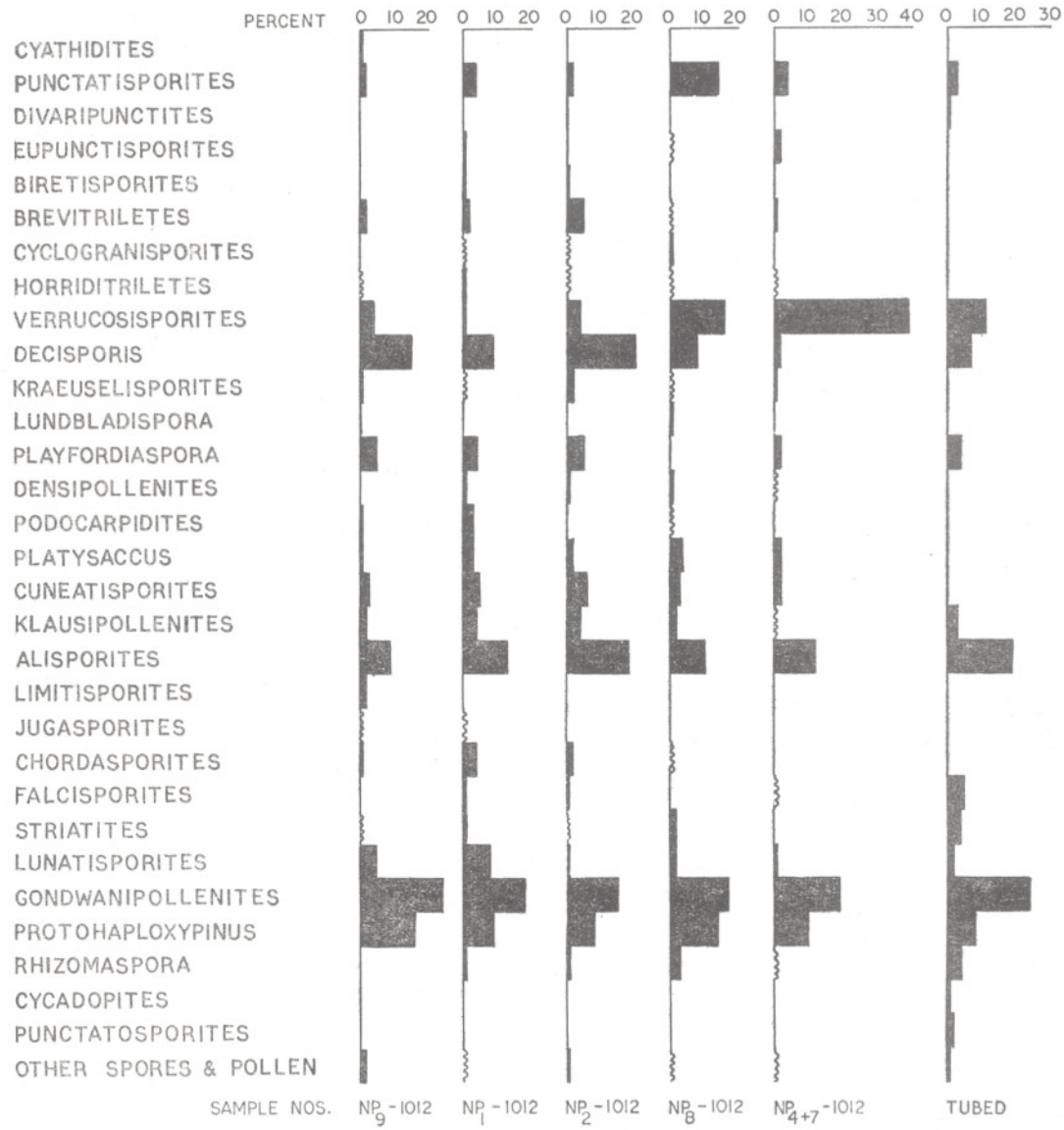
Description — Circular pollen, 72 μ in diameter, alete. Exine 1 μ thick, laevigate-intragranulose, infolds present along the equatorial margin.

Distribution — The species is known from the Upper Triassic of Lunz, Austria (Bharadwaj & Singh, 1964).

DISCUSSION

The mioflora obtained from the Triassic rock exposure in the Sukri River, about

1·5 km south-south-west of Tubed, Auranga Coalfield, Bihar comprises 23 genera and 33 species. The triletes are represented by 7 genera, non-striate bisaccates by 4, striate bisaccates by 6 and the monosaccates and others by 5 genera. The frequencies of important miospore genera are as follows: Triletes—*Punctatisporites* 3·2%, *Divaripunctites* 1·2%, *Verrucosisporites* 4·8%, *Convertubisporites* 6·4%, *Decisporis* 7·2%; Monoletes-one genus *Punctatosporites* 1·6%; Plicates-one genus *Cycadopites* 0·8%; Saccizonates — *Playfordiaspora* 4·0%; non-striate bisaccates — *Alisporites* 19·2%, *Klausipollenites* 3·2%, *Falcisporites* 4·8%; striate bisaccates — *Striapollenites* 0·8%, *Gondwanipollenites* 23·6%, *Protohaploxypinus* 8·4%, *Lunatisporites* 2 %, *Striatites* 4·4%, *Rhizomaspora* 4·4%. Certain genera such as *Lunatisporites, Laricoidites, Striamonosaccites, Cannanoropollis* and *Cyathidites* have not been encountered in the counting. On the



TEXT-FIG. 2

whole the palynological assemblage is dominated by striate bisaccate pollen. Non-striate bisaccate pollen and trilete spores share nearly equal percentage.

During recent years a number of workers has studied the palynology of the Panchet Group in the Raniganj Coalfield, West Bengal. Shrivastava and Pawde (1962) observed that the Panchet Group mioflora of the bore-core R.O.I. (B), near Ondal, West Bengal is dominated by pteridophytic spores. The Tubed mioflora on the other hand is dominated by striate bisaccate pollen, a condition similar to that found in the Upper Raniganj Formation (Venkatachala, 1972, p. 289). The Ondal mioflora is, therefore, definitely younger than the Tubed mioflora. The Triassic spore assemblage described by Kar (1970a, b) from the bore-core RE9 of the East Raniganj Coalfield, West Bengal is also dominated by trilete spores, such as *Divaripunctites* and *Decisporis*. Sarbadhikari (1972) also reports a trilete dominated Panchet mioflora from bore-core RE1 near Lauduha, Raniganj Coalfield, West Bengal. A comparison with the older Raniganj mioflora shows that the Panchet Group in the three bore-cores mentioned above does not represent the basal Panchets.

The palynological assemblage described by Bharadwaj and Srivastava (1969) from the Triassic beds of Nidhpuri, Madhya Pradesh is dominated by non-striate bisaccate pollen of the *Alisporites* complex and a striate colpate pollen, i.e. *Weylandites*. This assemblage is lacking in the typical Lower Triassic miospore genera such as *Decisporis, Verrucosisporites, Playfordiaspora, Kraeuselisporites, Lundbladispora, Chordasporites, Falcisporites* and *Lunatisporites*. It is, therefore, likely that the Nidhpuri beds studied by Bharadwaj and Srivastava do not belong to Lower Triassic at all.

The mioflora of Nidhpuri described by Trivedi and Misra (1970) is striate bisaccate dominated with very few triletes and is, therefore, probably older than the Tubed mioflora.

The present assemblage is very much similar to the palynological assemblage recovered from the Nonia Nala (Maitur Formation), near Asansol, West Bengal (Banerji & Maheshwari, 1974). A comparison of the Tubed mioflora with that obtained from the Maitur samples (NP-1012 series) is shown in text-figure 2. Both the assemblages show certain characteristically similar forms, e.g. *Punctatisporites, Decisporis, Verrucosisporites, Playfordiaspora, Gondwanipollenites, Protohaploxypinus, Lunatisporites, Striatites, Rhizomaspora, Alisporites, Klausipollenites* and *Falcisporites*. Both the assemblages show the dominance of striate bisaccates in the lower beds; triletes and non-striate bisaccates gradually increase in frequency. The Tubed mioflora is particularly very near to that obtained from sample nos. NP2-1012 and NP8-1012 of the Maitur Formation. As the Tubed bed has a palynological composition which is similar to that of the Maitur Formation of Lower Triassic age, we suggest a Lower Triassic age to this bed also. The Maitur assemblage differs from the Upper Permian assemblage by the presence of certain significant forms such as *Decisporis, Playfordiaspora* etc. which are absent in the Upper Permian formations.

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EXPLANATION OF PLATES

(All photographs are × *ca* 500)

PLATE 1

1. *Cyathidites* sp. Slide no. B.S.I.P. 4703-4.
2. *Punctatisporites* sp. Slide no. B.S.I.P. 4709-5.
3. *Divaripunctites globosus* Kar 1970. Slide no. B.S.I.P. 4694-9.
4. *Divaripunctites bifurcatus* sp. nov. Holotype — Slide no. B.S.I.P. 4700-6.
5. *Divaripunctites bifurcatus* Slide no. B.S.I.P. 4693-7.
6. *Verrucosisporites* sp. cf. *V. contactus* Clarke 1965. Slide no. B.S.I.P. 4705-3.
7. *Verrucosisporites morulae* Klaus 1960. Slide no. B.S.I.P. 4691-9.
8. *Convertubisporites densus* sp. nov. Holotype — Slide no. B.S.I.P. 4691-15.
9-10. *Convertubisporites densus* Slide nos. B.S.I.P. 4700-2, 4702-1.
11. *Convertubisporites contactus* sp. nov. Holotype — Slide no. B.S.I.P. 4703-7.
12. *Convertubisporites contactus* Slide no. B.S.I.P. 4696-6.
13-14. *Convertubisporites* sp. Slide nos. B.S.I.P. 4691-8, 4697-5.

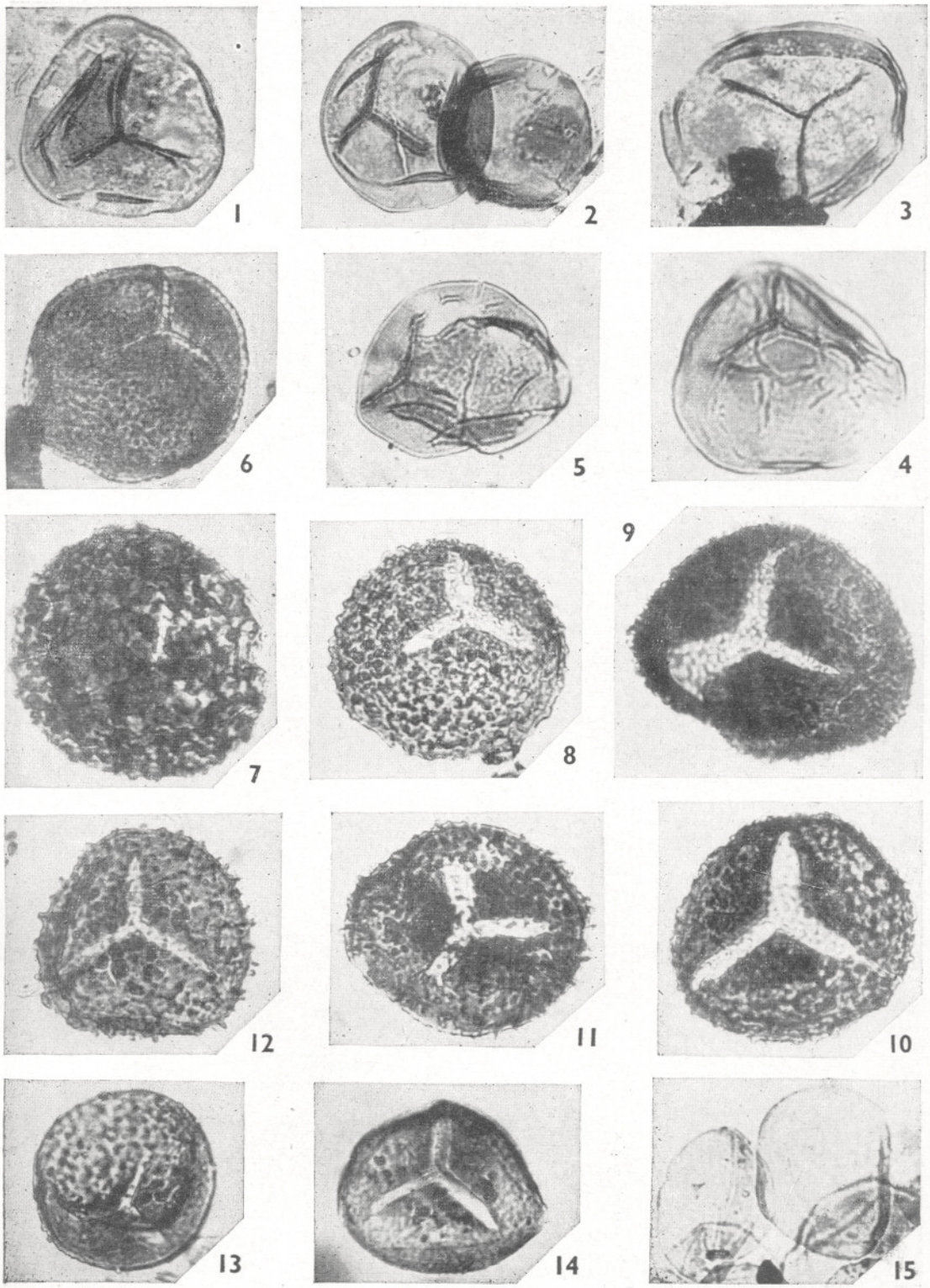
15. *Punctatosporites* sp. Slide no. B.S.I.P. 4688-12. × 1000.

PLATE 2

16. *Kraeuselisporites* sp. Slide no. B.S.I.P. 4696-3.
17-18. *Decisporis* sp. cf. *D. variabilis* Kar 1970. Slide nos. B.S.I.P. 4695-1, 4701-1.
19. *Cannanoropollis densus* (Lele) Bose & Maheshwari 1968. Slide no. B.S.I.P. 4705-1.
20. *Playfordiaspora cancellosa* (Playford & Dettmann) Maheshwari & Banerji 1975. Slide no. B.S.I.P. 4698-1.
21. *Striomonosaccites* sp. Slide no. B.S.I.P. 4703-4.
22-23. *Alisporites asansoliensis* Maheshwari & Banerji 1975. Slide nos. B.S.I.P. 4688-9, 4694-7.
24. *Klausipollenites sulcatus* Kar, Kieser & Jain 1972. Slide no. B.S.I.P. 4706-3.
25. *Klausipollenites* sp. Slide no. B.S.I.P. 4696-7.
26. ?*Striapollenites* sp. Slide no. B.S.I.P. 4698-4.

PLATE 3

27-28. *Falcisporites stabilis* Balme 1970. Slide no. B.S.I.P. 4689-8, 7.
29. *Protohaploxypinus microcorpus* (Schaarschmidt) Balme 1970. Slide no. B.S.I.P. 4696-5.
30. *Gondwanipollenites multistriatus*. sp. nov. Holotype — Slide no. B.S.I.P. 4704-3.
31. *Gondwanipollenites multistriatus*. Slide no. B.S.I.P. 4693-5.
32. *Cycadopites* sp. Slide no. B.S.I.P. 4690-1.
33. *Rhizomaspora* sp. Slide no. B.S.I.P. 4708-3.
34. ?*Lunatisporites* sp. Side no. 4692-4.
35. *Lunatisporites* sp. Slide no. B.S.I.P. 4694-4.
36. *Striatites solitus* Bharadwaj & Salujha 1964. Slide no. B.S.I.P. 4702-8.
37. *Rhizomaspora divaricata* Wilson 1962. Slide no. B.S.I.P. 4705-2.
38. *Laricoidites intragranulosus* Bharadwaj & Singh 1964. Slide no. B.S.I.P. 4707-2.
39. *Rhizomaspora biharia* sp. nov. Holotype — Slide no. B.S.I.P. 4699-1.
40. *Cannanoropollis* sp. cf. *C. mehtae* (Lele) Bose & Maheshwari 1968. Slide no. B.S.I.P. 4700-1.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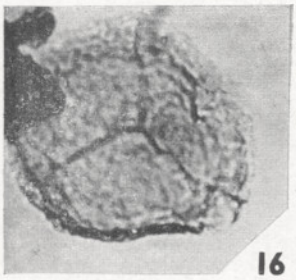
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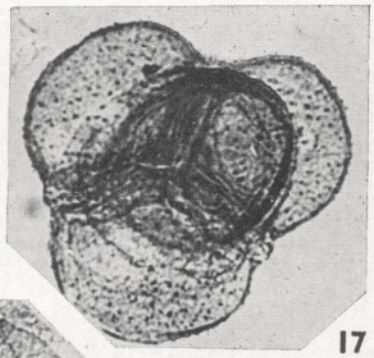
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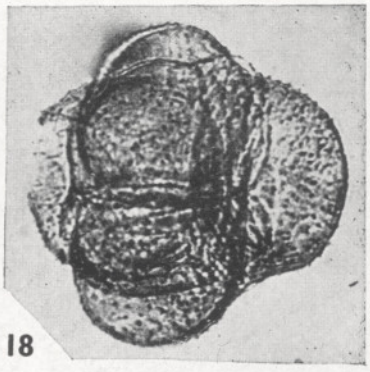
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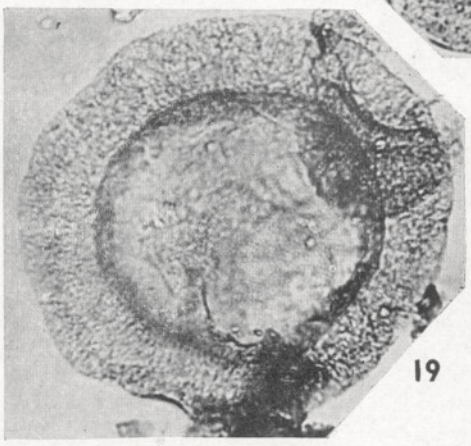
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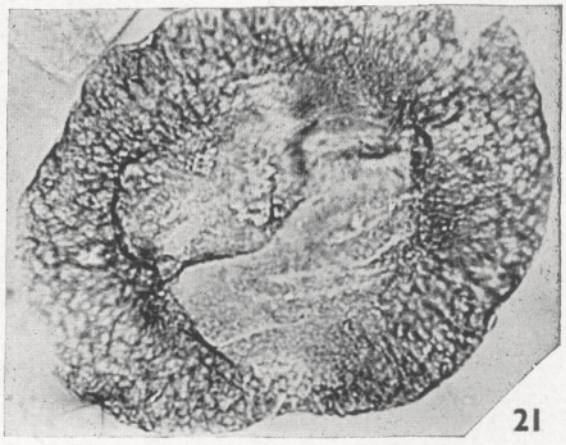
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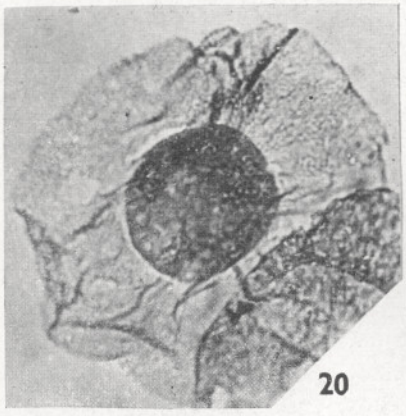
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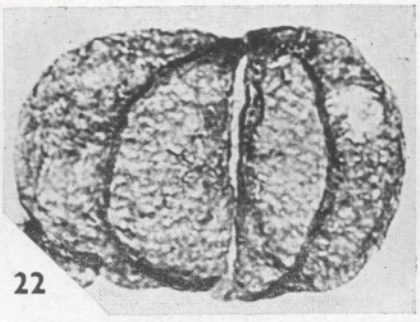
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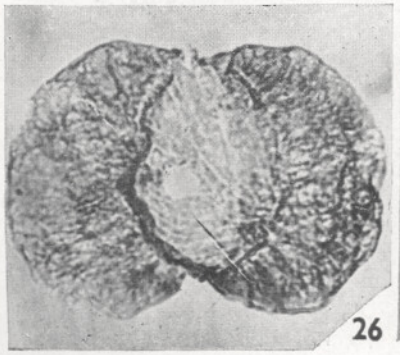
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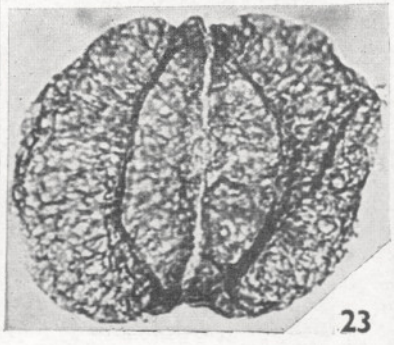
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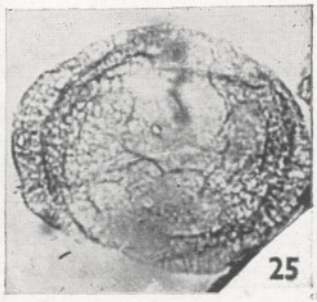
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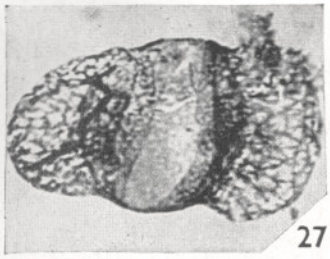
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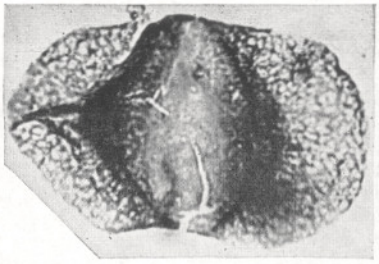
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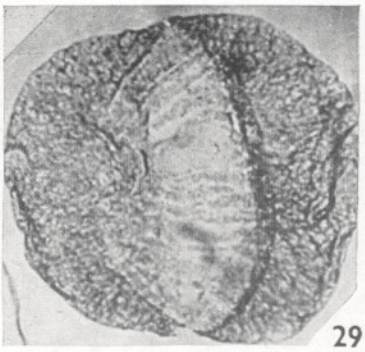
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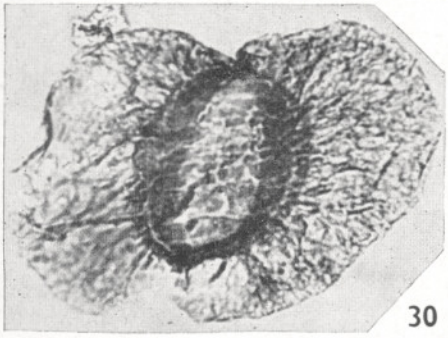
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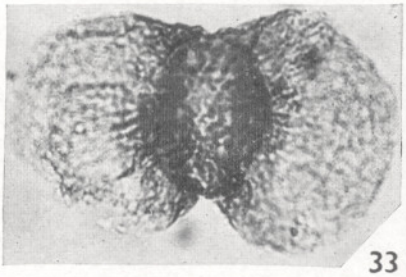
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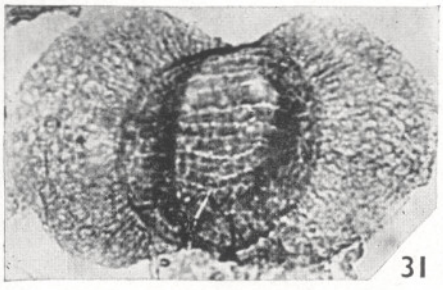
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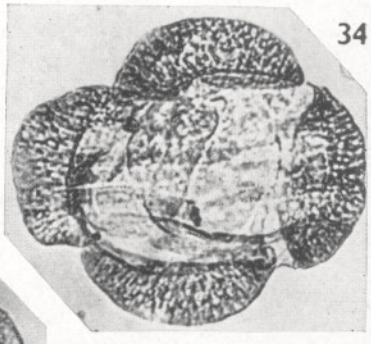
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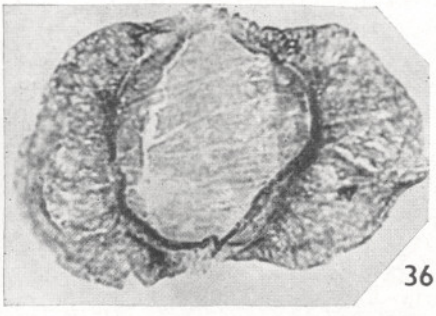
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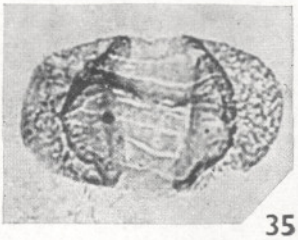
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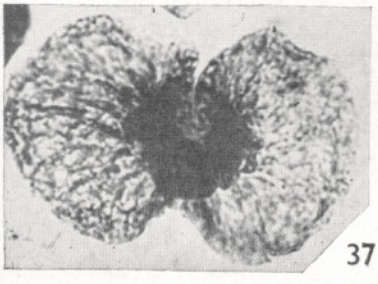
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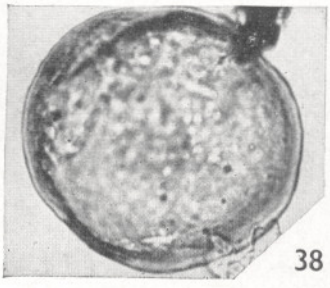
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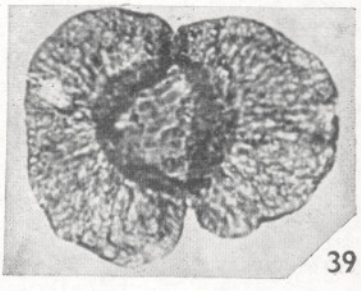
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