STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA—29
MIOSPORE ASSEMBLAGE FROM THE LOWER GONDWANA
EXPOSURES ALONG BANSLOI RIVER IN RAJMAHAL
HILLS, BIHAR

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ABSTRACT

The present paper contains a description of miospore assemblage recovered from the Lower Gondwana rocks of the Bansloi valley, Rajmahal hills, Santhal Parganas, Bihar. The miospore assemblage comprises 34 genera and 64 species out of which one genus and 23 species are new. One new Infraturma has been established.

INTRODUCTION

In recent years fossil microspores, megaspores and pollen grains have assumed great importance because of their application in stratigraphy. Palynological researches have been successfully employed in correlating and horizoning various sedimentary deposits, including those in the coalfields and oilfields.

Till recently studies on the miospore assemblages from the Gondwanaland have been rather few. Much of the work on Gondwana miospores has been done in India. Some of the important contributions are those of Virkki (1937, 1939, 1945), Mehta (1944), Sen (1948), Ghosh & Sen (1948), Surange, Singh & Srivastava (1953), Potonié & Lele (1961), Bharadwaj (1962), Bharadwaj & Saluja (1964), Tiwari (1965), Maithy (1965) and Kar (1966).

Bharadwaj (1966) studied the distribution of dispersed spores and pollen in various stages of the Lower Gondwana India. He also discussed the characteristic miospore groups for each stage specifying index generic associations for each stage.

A number of schemes, based on morphographical characters, have been put forward for classifying dispersed spores (Naumova, 1937; Schoff, Wilson & Bentall, 1944; Erdtman, 1947; Pant, 1954; Potonié & Kremp, 1954). In the following pages the classification on morphographical characters used by Potonié (1956, 1958, 1960) and latter by Bharadwaj (1962) has been mainly followed.

The miospore assemblage described in the present paper was obtained from the Lower Gondwana Exposures of Bansloi valley. Details about the geology of the area and the localities of collection have been given in an earlier paper (Maheshwari & Prakash, 1965). The miospore assemblage comprises trilete, monolete, monocolpate, saccate and alete spores. A classified list of various spore genera is given below.

CLASSIFIED LIST OF MIOSPORE GENERA

Anteturma — Sporites H. Pot.
Turma — Trilletes (Reinsch) Pot. & Kr.
Subturma — Azonotriletes Luber
Genus — Punctatisporites (Ibrah.) Pot. & Kr.

Genus — Indeterminate.

Genus — Cyclogranisporites Pot. & Kr.
Genus — Lophotriletes (Naum.) Pot. & Kr.
Genus — Granulatisporites (Ibrah.) Pot. & Kr.
Genus — Verrucosisporites (Ibrah.) Pot. & Kr.
Genus — Horriditriletes Bharad. & Sal.

Subturma — Zonotriletes Waltz
Genus — Indeterminate.

Turma — Monolletes Ibrah.
Subturma — Azonomonolletes Luber
Infraturma — Psilomonoleti Hamm.
Genus — Latosporites Pot. & Kr.

Infraturma — Ornati Pot.
Genus — Thymospora Wils. & Venkatach.
Anteturma — Pollenites Pot.
Turma — Saccites Erdtm.
**TAXONOMIC DESCRIPTION**

**Anteturma — Sporites H. Pot. 1893**

**Turma — Triletes (Reinsch) Pot. & Kr. 1954**

**Subturma — Azonvtriletes Luber 1935**

**Infraturma — Laevigoti (B. & K.) Pot. 1956**

**Punctatisporites (Ibrah.) Pot. & Kr. 1954**

*Genotype — Punctatisporites punctatus Ibrah. 1933*

? *Punctatisporites* sp.

*Pl. 1, Fig. 1*

The spore is ± circular, small and 44 μ in diameter. The exine is thick and the rays have prominent labra. The rays extend for more than 3/4 radius of the spore. The spore suggests a general resemblance with *Punctatisporites*, but differs from that genus in having characteristically raised labra and thick exine.

**Infraturma — Apiculati (B. & K.) Pot. 1956**

*Genotype — Cyclogranisporites leopoldii (Kr.) Pot. & Kr. 1954*

*Cylogranisporites* sp. *Pl. 1, Fig. 2*

There are only two spores belonging to this form. The spores are circular, 23-39 μ in diameter with granulate exine. Trilete extends to ± 1/2 radius of the spore. About 30 grana are observed along the equator. In size the spores resemble *Cylogranisporites pressoides* Pot. & Kr. but due to lack of sufficient number of specimens a detailed comparison could not be made.

**Lophotriletes (Naum.) Pot. & Kr. 1954**

*Genotype — Lophotriletes gibbosus (Ibrah.) Pot. & Kr. 1954*

*Lophotriletes* cf. *L. rectus* Bharad. & Sal. *Pl. 1, Fig. 3*

*Holotype — Bharadwaj & Salujha, 1964, pl. 2, fig. 26.*

The spores are small, triangular with straight sides and rounded corners. They
measure 23-31 µ in diameter. Trilete when distinct extends to ± 2/3 radius of the spore. Exine ornamented with sparsely distributed blunt coni, numbering ± 15 at the margin.

**Granulatisporites** (Ibrah.) Pot. & Kr. 1954

*Genotype* — *Granulatisporites granulatus* (Ibrah.) Pot. & Kr. 1954

*Granulatisporites* sp.

Pl. 1, Fig. 4

The spores are triangular to subtriangular, 20-35 µ in diameter with a distinct trilete; trilete rays 3/4 radius of the spore or longer. Exine granulate, grana irregularly distributed and not always regular in shape.

The spores show a general resemblance with *Granulatisporites minutus* Pot. & Kr. (Potonié & Kremp, 1955; Pl. 12, Fig. 147) but a detailed comparison is not possible because of insufficient number of spores.

**Verrucosisporites** (Ibrah.) Pot. & Kr. 1954

*Genotype* — *Verrucosisporites verrucosus* (Ibrah.) Pot. & Kr. 1954

Bharadwaj (1955) defining the genus *Verrucosisporites* mentions that the base of the ornament is broader than its bluntly conical or flat apex in this genus. Forms having ornament with basal diameter equal to the apical diameter or truncate apex were separated by him and put in a new genus *Cyclobaculisporites*. Potonié (1960) and Butterworth et al. (1961) think that this distinction is difficult to make in practice and hence the latter have suggested the combination of the two genera. In specimens described below the exine ornamentation varies very much and combines features of both the above genera.

*Verrucosisporites varius* sp. nov.

*Holotype* — Pl. 1, Figs. 5, 6

*Locus typicus*— About 3/4 mile south-east of Alubera, Bansloi valley, Santhal Pargana, Bihar.

*Diagnosis* — Spores circular to subcircular, occasionally folded, 45-70 µ in diameter. Trilete ± 1/2 or more of spore radius long, one ray usually longer than the other two. Exine verrucose, verrucae uniformly and closely distributed, of varying height and shape, 2-3 µ at the base and 1-2 µ high. Number of projections at the spore equator 50-70.

*Comparison* — The genotype while resembling in the extent of the trilete differs in being comparatively larger in size and in having rather broad, semicircular protruberances. *Verrucosisporites trisecatus* Balm. & Henn., *V. bullatus* Balm. & Henn. and *V. parvus* Balm. & Henn. differ in exine ornamentation.

? *Verrucosisporites* sp.

Pl. 1, Fig. 7

The only spore is circular, 18 µ in diameter; trilete or other mark is not seen. Exine covered with uniformly and sparsely distributed verrucae, numbering about 15 at the spore equator.

As there is no definite evidence of a tetrad mark, it is difficult to assign it to *Verrucosisporites* with certainty.

**Horriditriletes** Bharad. & Sal. 1964

*Genotype* — *Horriditriletes curvibaculosus* Bharad. & Sal. 1964

*Horriditriletes curvibaculosus* Bharad. & Sal.

Pl. 1, Figs. 8, 9

*Holotype* — Bharadwaj & Salujha, 1964, pl. 2, fig. 34.

The spores are triangular, 23-39 µ in size with straight to slightly convex sides and rounded angles. Trilete is usually distinct, rays 1/2 to 2/3 spore radius long with blunt ends. Exine is baculate, bacula cylindrical, usually curved, much longer than broad, with ± blunt apices. The bacula are ± 1·5 µ broad at the base and 2-4 µ long, and number 10-18 at the margins.

**Horriditriletes novus** Tiwari

Pl. 1, Figs. 10, 11

*Holotype* — Tiwari, 1965, pl. 1, fig. 23.

Spores triangular to roundly triangular, with ± straight to convex sides, 42 to 50 µ in size. Trilete faintly discernible, rays ± 2/3 spore radius long. Exine thick with scattered bacula, 1·5-2 µ broad and equally long, remainder of the exine finely granulate.
Comparison — *Horriditriletes curvibaculosus* is smaller in size with very few, sparsely arranged, slender, much longer than broad bacula. *H. brevis* Bharad. & Sal. differs in overall size and shape as well as in exine ornamentation. *H. sp. B* of Bharadwaj & Salujha (1964, pl. 2, fig. 44) compares favourably and probably belongs to this species.

**Turma — Zonales (B. & K.) Pot. 1956**

**Subturma — Zonotriletes Waltz 1935**

*Indeterminare*

Pl. 1, Fig. 13

The only spore is ± subtriangular; along the equator of the central body, which is microverrucose, a thin, 8 μ broad zona-like structure is present. Body outline has a rimmed effect and trilete is not seen.

The spore has a superficial resemblance to *Cirratiradites* Wils. & Coe but cannot be assigned to that genus because of the apparent absence of the trilete.

**Turma — Monoletes Ibrah. 1933**

**Subturma — Azonomonoletes Luber 1935**

**Infraturma — *Psilamonoleteri Hamm. 1955***

*Latosporites* Pot. & Kr. 1954

*Genotype* — *Latosporites latus* (Kos.) Pot. & Kr. 1954

*Latosporites colliehensis* (B. & H.) Bharad.

Pl. 1, Fig. 14

*Holotype* — Balme & Hennelly, 1956a, pl. 1, fig. 1.

The spores are oval, longitudinal axis being 78-97 μ, with a distinct monolete extending for about 2/3 of the long axis. Exine is laevigate, thin and usually folded. In general the present forms show same features as those described from the Rani-ganj coalfield by Bharadwaj (1962; pl. 4, Figs. 72, 73).

*Latosporites* sp.

Pl. 1, Fig. 15

The spores are ± oval in shape, 48-58 μ long with a distinct monolete which is ± 2/3 of the long axis. Exine is thin, laevigate and sometimes folded. *Latosporites* sp. differs from *L. latus* and *L. colliehensis* in its smaller size. *Laevigatosporites ovalis* Kos. (which is referable to *Latosporites*) is comparable in size, but differs in having a thick, rarely folded exine and a shorter monolete.

**Infraturma — Ornati Pot. 1956**

*Thymospora* Wils. & Venkatach. 1963

*Genotype* — *Thymospora thiessenii* (Kos.) Wils. & Venkatach. 1963

*Thymospora* sp.

Pl. 1, Fig. 16

The spores are ± oval, 23-46 μ in long axis with a distinct monolete extending to ± 2/3 of the long axis. Exine is verrucose, verrucae are of variable height and densely packed.

Due to insufficient number of spores a detailed comparison could not be made.

**Anteturma — Pollenites Pot. 1931**

**Turma — Saccites Erdtm. 1947**

**Subturma — Monosaccites (Chital.) Pot. & Kr. 1954**

Most of the Lower Gondwana miospores recently included in the two series Apertacorpi and Amphiascacci were formerly included in a single series, viz. Triletisaccacites, and a single genus, viz. *Nuskoisporites*. Recently Lele (1964, 1965) made a critical study of the forms of *Nuskoisporites* from the northern hemisphere and found that these forms are quite different from those of the southern hemisphere *Nuskoisporites*-complex. Hence he separated the southern monosaccate trilete forms from *Nuskoisporites* and created three new genera, viz. *Plicatipollenites*, *Verkkipollenites* and *Stellapollenites*. Bharadwaj & Tiwari (1964) created two more genera, viz. *Barakarites* and *Parasaccites* for certain other grains formerly included in the genus *Nuskoisporites*. Presently it has been found that some similar forms can be differentiated from the above genera on the basis of organizational and structural dissimilarities. These have, therefore, been segregated here under a new name *Parastriopollenites*, placed under a new series ‘*Parasacciti*’.

**Infraturma — Parasacciti ser. nov.**

*Diagnosis* — Trilete, monosaccate miospores showing double-sided saccus attachment, leaving equal and overlapping saccus-free areas both proximally as well as distally.

*Discussion* — The double-sided saccus attachment, from the Gondwanaland, was first reported by Bharadwaj & Tiwari (1964)
in *Parasaccites*. In such condition the saccus is attached subequatorially, both on proximal as well as distal surfaces of the central body, leaving equal bladder-free areas on both the faces. This double-sided saccus-attachment has been reported for two more forms, viz. *Crucisaccites* (Lele & Maity, 1964) and *Stellapollenites* (Lele, 1965). This form of saccus attachment was called as ‘Para-condition of saccus attachment’ by Bharadwaj & Tiwari and as ‘Amphilateral saccus attachment’ by Lele, who used it in a broad sense so as to encompass equal to unequal, overlapping to crossed encroachment of the saccus on the two faces of the central body. He believed that ‘para-condition of saccus’ was only a particular pattern of ‘Amphilateral saccus attachment’. However, it would seem advisable to distinguish between the two. In one case the saccus encroachment is equal on both sides and is overlapping, as well as conforms to overall outline of the miospore. In the other case the saccus encroachment is mostly unequal, never conforms to body outline and the encroachment on two surfaces is usually ‘crossed’. Hence a new series is proposed to include *Parasaccites* and *Parastriopollenites* where saccus encroachment is equal and overlapping.

**Parastriopollenites** gen. nov.

*Genotype* — *Parastriopollenites rajmahalensis* gen. et sp. nov.

*Diagnosis* — Miospores monosaccate; circular, subcircular, triangular or subtriangular; central body circular, subcircular, triangular or subtriangular, usually conforming to the overall shape of the grain, distinct to indistinct, intramicroreticulate; trilete distinct to obscure, rays equal or unequal, from 1/3 body radius to almost equal to body radius in length; body sometimes showing two zones — an outer lighter one and an inner denser one, the inner denser zone traversed by cross-connected channels forming irregular to regular areas (areoles) on both proximal and distal surfaces; saccus attached subequatorially both on proximal as well as on distal surfaces of central body, fine intrareticulate, sometimes with a distinct marginal thickening — a limbus, saccus outline regular to sinuous.

*Description* — One of the chief distinguishing features of the genus is the para-condition of sac-attachment which is produced by the subequatorial attachment of the saccus both on the proximal and distal surfaces of the central body. This condition is not easy to make out unless the material is exceptionally well-preserved like the present one. A careful l-o analysis shows first the reticulum of the saccus on one side, next the body outline and lastly the reticulum of the saccus of the other side. In cases where the central body is diffused this condition is made out only after a careful l-o analysis. In some cases it seems that the saccus fully covers the central body on the distal surface but this condition is rather imperceptible as the intrareticulation of the saccus is almost as fine as that of the central body. The saccus mostly appears denser than the central body but in a few cases the central body is comparatively much darker than the saccus. The extent of the saccus from the body equator was found to be almost consistent and thus obviously becomes an important feature. In certain cases the saccus is distinctly two-zoned — the outer denser zone being comparatively much narrower with coarser and radially elongated meshes. This zone may be a limbus. This character again was found to be consistent within certain type of miospores and hence it evidently is an important character.

The central body varies in shape usually conforming with the overall outline of the miospore and may be distinct to diffused. The structure of the central body is mostly intramicroreticulate with very fine meshes having complete to broken muri and a small lumina. However, in some cases the body becomes corroded and there it is difficult to decipher the ornamentation. Occasionally the central body is two-zoned — an inner denser and an outer lighter zone. The inner zone gives the appearance of an inner body but it does not possess a distinct outline to show that it is distinct from the central body. Infact in most cases the inner zone gradually and imperceptibly passes into the outer lighter zone. The central body is traversed by irregularly orientated channels which are cross-connected and in some cases form a perfect reticulum. In the genus *Barakarites* Bharad. & Tiw. such structures have been
called as reticulate striations which term, however, does not seem to fit to the presently described miospores since here they are mostly irregular and discontinuous. It is probably better to call them just as striations or channels. These grooves or channels are found on both the proximal as well as the distal faces of the central body but the extent of their development varies from specimen to specimen and as such is a valuable help in grouping of these miospores. In some cases the central body shows irregular fold-like structures—mostly along the channels—but these have been found usually to occur only in one type of miospores. In still another type, the exine of the 'areoles' swells out forming probably better to call them just as channels are found on both the proximal and distal sides, uniformly fine intrareticulate. Besides having a similar saccus reticulum, both possess channels on the central body and some forms of both genera show a limbus-like structure. The chief distinguishing feature of the present genus is the para-condition of sac attachment. Further in Barakarites the central body is intramicropunctate whereas in Parasaccites but differs from it in the presence of the channel-system on the central body. The closest resemblance to the present genus is shown by Barakarites. From the photographs these two genera can never be told apart. Besides having a similar saccus reticulum, both possess channels on the central body and some forms of both genera show a limbus-like structure. The chief distinguishing feature of the present genus is the para-condition of sac attachment. Further in Barakarites the central body is intramicropunctate whereas in Parasaccites the central body is intramicrotetrate.

Some other trilete monosaccate genera are: Nuskoisporites (Pot. & Kl.) Kl., Microsporites Dijkt. and Endosporites Wils. & Coe. These are all distinguished from the present genus by a saccus which completely envelops the central body. Florinites Schöpf et al. is distinguished by the enclosure of proximal pole of the central body by the saccus. Peppers (1964) figures a monosaccate miospore, from the late Pennsylvanian Cyclothems in the Illinois basin, in which the distal surface of the body shows polygonal areas (areolae). However, as details are not known a satisfactory comparison could not be made.

**Parastriopollenites rajmahalensis** sp. nov.

*Holotype* — Pl. 1, Figs. 17, 18

*Locus typicus* — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

*Diagnosis* — Miospores circular to subcircular, measure 117-195 μ × 109-183 μ, holotype 148 μ × 140 μ. Central body distinct, circular to subcircular, conforms to overall outline of the miospores, with a denser central region, measures 105-160 μ × 94-148 μ, in holotype 120 μ × 124 μ. Body exine intramicrotetrate, proximally as well as distally uneven narrow channels form polygonal areolae. Trilete distinct, rays equal or unequal, 1/2-2/3 of body radius in length. Saccus narrow, extends for 6-18 μ from body equator, attached subequatorially both on proximal as well as distal sides, uniformly fine intrareticulate.

**Parastriopollenites gondwanensis** sp. nov.

*Holotype* — Pl. 2, Fig. 19

*Locus typicus* — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.
Diagnosis — Miospores subcircular to oval, measure 133-206 µ x 129-160 µ, holotype 164 µ x 146 µ. Central body obscure to distinct, subcircular to oval, sometimes with slightly thicker central region, conforms to overall outline of the miospore, measures 101-187 µ x 70-144 µ, in holotype 142 µ x 128 µ. Exine intramicro reticulate, proximally as well as distally uneven narrow channels crisscross the central body forming an irregular pattern, usually body exine folds along the channels but a true fold rim is never formed. Trilete obscure to distinct, rays either all equal or one longer than the rest two, 1/2-2/3 of body radius in extent. Saccus narrow, extending for 6-15 µ from body equator, attached subequatorially both on the proximal as well as distal surfaces, uniformly fine intrareticulate.

Comparison — It differs from the genotype in overall shape and in less regular rather irregularly disposed channels.

Parastriopollenites triangularis sp. nov.

Pl. 2, Fig. 20

Holotype — Pl. 2, Fig. 20.

Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Miospores subtriangular to roundly triangular, measure 121-195 µ x 117-175 µ, holotype 121 µ x 128 µ. Central body distinct, subtriangular to roundly triangular, conforms to overall shape of the miospore, measures 94-152 µ x 104-160 µ, in holotype 100 µ x 110 µ, usually with a thicker central zone. Exine intramicroreticulate, proximally as well as distally uneven narrow channels form irregular patterns. Trilete obscure to clear, rays all equal or one larger than the other two, 1/2-2/3 of body radius in extent. Saccus narrow, extending for 6-20 µ from the body equator, subequatorially attached both on the proximal as well as distal surfaces, uniformly fine intrareticulate, muri thick, lumina small.

Comparison — It differs from the genotype in the shape of the miospores as well as in irregular arrangement of the channels. Parastriopollenites gondwanensis has a different shape.

Parastriopollenites sinuosus sp. nov.

Pl. 2, Fig. 21

Holotype — Pl. 2, Fig. 21.

Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Subcircular to roundly triangular miospores, measure 120-150 µ x 140-164 µ, holotype 144 µ x 158 µ. Central body usually obscure, circular to subcircular, measures 110-120 µ x 110-130 µ, in holotype 120 µ x 130 µ. Body exine intramicroreticulate, shows both proximally as well as distally narrow, uneven channels which cross-connect to form irregular areas, on which the exine sometimes swells out giving protuberances. Trilete obscure. Saccus usually narrow, undulated or ± lobate in outline due to the formation of thick radial folds or frills along the periphery, fine intrareticulate, muri thick, lumina small.

Comparison — It differs from all species of the genus in having thick frills on the saccus.

Parastriopollenites limbatus sp. nov.

Pl. 2, Fig. 22

Holotype — Pl. 2, Fig. 22.

Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Miospores subtriangular to roundly triangular, measure 124-126 µ x 146-158 µ, holotype 132 µ x 158 µ. Central body ill-defined. Body exine intramicroreticulate, shows both proximally as well as distally narrow, uneven channels which cross-connect to form broad irregular areas, sometimes minor folds develop along the channels. Trilete obscure. Saccus narrow, subequatorially attached both on the proximal as well as the distal sides, two-zoned, the outer zone thicker, comparatively narrow-looking sort of a limbus, fine intrareticulate, muri thick, lumina small.

Comparison — From the genotype this species differs in its shape, ill-defined body, irregular areas on the central body, obscure trilete and limbus-like structure. From other species of the genus too it differs in the presence of a limbus-like structure besides other differences.

Parastriopollenites giganteus sp. nov.

Pl. 3, Fig. 25

Holotype — Pl. 3, Fig. 25.

Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.
Diagnosis — Miospores subcircular, measure 164-180 μ x 176-204 μ, holotype 164 μ x 178 μ. Central body obscure to perceptible, subcircular conforming to overall outline, measures 150-152 μ x 150-154 μ, in holotype 152 μ x 154 μ. Body exine intramicroreticulate, both proximally as well as distally irregular and cross-connecting channels present, in the centre exine ruptures forming a slit which looks like a monolete. Tetrad mark not seen.

Saccus narrow, subequatorially attached both on proximal as well as distal sides of central body, extends for 8-20 μ from body equator, fine intrareticulate.

Comparison — This species differs from all other species of this genus in its much larger size.

Parasaccites Bharad. & Tiw. 1964

Genotype — Parasaccites korbaensis Bharad. & Tiw. 1964

Parasaccites densus sp. nov.

Holotype — Pl. 2, Fig. 23.

Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Miospores subcircular, holotype measures 109 μ x 117 μ. Central body subcircular, thick, denser than the saccus, measures 94 μ x 101 μ in holotype. Body exine intramicroreticulate. Trilete distinct, rays ± 1/3 of body radius in length. Saccus narrow, extends for 8 μ from body equator in holotype, subequatorially attached both proximally as well as distally, fine intrareticulate, muri thick, lumina small.

Comparison — It differs from the genotype in having an uniformly thick, denser than the saccus, central body.

Infraurma — Apertacorpiti Lele, 1964

Plicatipollenites Lele 1964

Genotype — Plicatipollenites indicus Lele 1964

Plicatipollenites gondwanensis (B. & H.) Lele

Holotype — Pl. 3, Figs. 26, 27

The miospores are circular to subcircular and measure 116-164 μ x 129-195 μ. The body is more or less distinct, almost circular and measures 74-113 μ in diameter. The exine ornamentation is usually corroded but in few cases an intramicroreticulate structure is seen. The trilete is faint to distinct with almost uniformly broad rays extending to about 1/2 the radius of the central body. Near the zone of distal attachment of the saccus a dark rim is seen which is the result of the infolding of the central body. The infold system is usually polygonal but in some cases it tends to become triangular. The infold system tends to lie well away from the body periphery. The saccus is usually wide, ± 1/2 the body radius in width, sometimes being as wide as or more than the body radius. The saccus is coarsely reticulate, meshes tending to be radially disposed, outline of the saccus undulated.

Remarks — Most of the grains agree well with the diagnosis of this species. There are certain grains which show some variations but as they are not supported by enough evidence, they have been for the present put under Plicatipollenites gondwanensis. These grains show an infold system which tends to become ± triangular and is almost flat without showing any noticeable angularity and overlap. If this character is found to persist in a large number of specimens, then such specimens may need placing under a separate species. Some other specimens show a polygonal or trapezoidal body but in the lack of enough evidence, these too have been provisionally included in P. gondwanensis.

Virkkipollenites Lele 1964

Genotype — Virkkipollenites triangularis (Mehta) Lele 1964

Virkkipollenites triangularis (Mehta) Lele

Holotype — Mehta, 1944, pl. 1, fig. 1.

The miospores are rounded triangular, 117-139 μ x 101-129 μ in size; central body ± circular to rounded triangular, 78-113 μ in size; trilete mark obscure to invisible, exine intramicroreticulate. Saccus proximally equatorial, distally subequatorial, 10-27 μ wide, intrareticulation coarse, meshes radially orientated.

Remarks — The miospores while agreeing with Lele's specimens in overall description show greater range in overall size of the spore as well as that of the central body.
This character being of no importance, the present miospores are, therefore, placed under *Virkkipollenites triangularis*.

*Virkkipollenites mehtae* Lele  
Pl. 2, Fig. 24

*Holotype* — Lele, 1964, pl. 2, fig. 19.  
Miospores circular to subcircular or oval, 90-121 μ × 86-117 μ in size, a central body circular to oval, conforming to overall shape of spore, 66-98 μ in diameter, thin but discernible, exine intramicroreticulate; trilete obscure to distinct, 1/2-2/3 body radius. Saccus proximally equatorial, distally subequatorial, 8-20 μ broad (mean 12 μ), coarsely reticulate, meshes radially orientated.

*Remarks* — The present miospores have besides a greater size, a trilete mark which is faint to distinct unlike in the specimens of Lele (1964) where it is obscure. However, as this may be due to preservation in the latter case, the present specimens are well placed in *Virkkipollenites mehtae*.

*Virkkipollenites obscurus* Lele  
Pl. 3, Fig. 29

*Holotype* — Lele, 1964, pl. 2, fig. 17.  
Miospores subcircular, 125-187 μ × 125-183 μ; Central body obscure, thin, circular to subcircular, 86-105 μ × 62-105 μ, exine intramicroreticulate; trilete obscure. Saccus proximally equatorial, distally subequatorial, 24-35 μ broad, coarsely intrareticulate.

*Remarks* — Lele (1964) described *Virkkipollenites obscurus* as having fine intrareticulation of the saccus. I have re-examined some of his specimens and found that the saccus is coarsely intrareticulate as in the present specimens.

There are certain grains which show a circular to subcircular, diffuse to faint central body and a distinct trilete mark. The central body is comparatively denser. But as these characters have not been found consistently such specimens have been included in *V. obscurus*.

*Infraturma* — *Vesiculomonoradites* (Pant) Bhard. 1954  
*Potoniesporites* Bhard. emend. Bharad. 1964  
*Genotype* — *Potoniesporites novicus* Bhard. 1964

This genus was established by Bhardwaj (1954) for certain monosaccate miospores showing a proximal monolete and a distal fold system, on the central body. The organization in the miospores of *Potoniesporites* is found in the in situ pollen grains of Lebachia, Ernestiodendron and Walschianthus (Bharadwaj, 1964a). Organizationally the pollen grains of these genera Bharadwaj (1964b) redefined the genus *Potoniesporites*. He now includes *Sahnites* Pant and *Vestigisporites* (B. & H.) Hart in *Potoniesporites*. The monolete and the vertical twinfolds individually or collectively, with the monosaccate nature and other characteristics distinguish *Potoniesporites* from other miospore genera. Hoffmeisterites Wilson has earlier been shown to be a junior synonym of *Potoniesporites* (Wilson & Venkatachala, 1964).

The miospores belonging to this genus in the present assemblage are invariably bilateral and oval. The central body is circular, rhomboidal or trapezoid in polar view and on the proximal face bears a monolete which is occasionally bent and sometimes gives off a small side branch and thus simulates a trilete. On the distal side the central body is usually infolded forming a fold-system usually consisting of a single series of folds — rarely two series as in the genotype. Sometimes the folds form a complete ring while at other times there are two vertical folds joined by two horizontal folds. The body infold system shows a gradual change from distinct two series of folds to no folds whatsoever which supports the merger of *Sahnites* and *Vestigisporites* with *Potoniesporites* (Text-Figs. 1-19). The shape of the central body is, to a large extent, controlled by the nature of the infold system. Organizationally these grains are so similar to *Plicatipollenites* that in cases where the tetrad mark is not seen or is bent with a side branch, it is very difficult to differentiate between them. In such cases the only criterion to distinguish between them is the radial symmetry in *Plicatipollenites* and a bilateral symmetry in *Potoniesporites*. But *Potoniesporites* grains are not always bilateral as Bharadwaj (1964b) describes circular grains also under this genus. Visualizing such a condition where the grain is circular with a single series of infold system and an obscure tetrad mark, the only criterion which could serve
to differentiate between them is the percentage of the grains in overall assemblage. That is, if the assemblage is dominated by typical *Plicatipollenites* then such grains may be referred to it and if typical *Potonieisporites* is in greater proportions then the ill-defined grains may be referred to this genus. The central body usually shows an intramicroreticulate structure. In some cases, however, the ornamentation becomes corroded and sometimes 4-6 μ wide polygonal areas appear on the central body. The saccus is equatorially attached to the central body on the proximal side. Distally the saccus is subequatorially attached and the zone of attachment may lie near to or far away from the equator of the central body. The breadth of the girdling saccus is relatively lesser along the shorter axis than along the longer axis of the entire grain.

The characters used to delimit the species of this genus in the present assemblage are the presence or absence and nature of the body infold system, extent of distal zone of saccus attachment from body equator and the shape of the central body.

*Potonieisporites* cf. *P. novicus* Bhard.

Pl. 4, Fig. 30

*Holotype* — Bhardwaj, 1955, pl. 2, fig. 13.

In the present assemblage there are only two microspores which answer the description of this species. The microspores are monosaccate, bilateral and oval-circular. They measure 160-180 μ × 140-150 μ. The central body is rhomboid and measures ± 100 μ × 95 μ. Monolete is distinct but bent. Body exine is intramicroreticulate. The distal infold system comprises two series of folds as in the holotype. Saccus is coarsely intrareticulate and distal zone of attachment is removed from the body equator.
TEXT-FIGS. 6-10 — Potonieisporites, showing variations in the body infold system and in the nature of the monolete. (× Ca.500). Slides 2330, 2341, 2317, 2341 and 2342 respectively.

Potonieisporites lelei sp. nov.
Pl. 4, Fig. 31

Holotype — Pl. 4, Fig. 31.
Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Miospores monosaccate, bilaterial, oval to oval-elliptical, 152-190 μ × 115-130 μ in size, holotype 190 μ × 130 μ. Central body circular to subcircular, 68-84 μ × 68-88 μ in size, in holotype 84 μ × 88 μ, exine intramicroreticulate, structure sometimes corroded, rarely with small, 4-6 μ broad reticuloid areas on the central body. Monolete distinct to obscure, usually bent, sometimes with a small side branch and thus simulating a trilete. Saccus attachment proximally equatorial, distally subequatorial, broader along the long axis than along the short axis of the miospore. Distal zone of saccus attachment close to body equator; a ± regular and circular body infold system develops along the distal zone of attachment. Saccus coarsely intrareticulate.

Comparison — This species differs from the genotype in having only one series of folds forming a ± regular circular infold system as against the double series of folds in the latter.

Potonieisporites densus sp. nov.
Pl. 4, Fig. 32

Holotype — Pl. 4, Fig. 32.
Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Miospores monosaccate, bilaterial, oval to oval circular, 148-160 μ × 110-120 μ, holotype 160 μ × 120 μ.
Central body irregularly and variously shaped, rectangular, trapezoid or rhomboid, 80-90 μ × 78-94 μ, in holotype 90 μ × 94 μ, exine intramicroreticulate. Monolete distinct to obscure, straight or bent, sometimes simulates a trilete. Saccus attachment proximally equatorial, distally subequatorial, distal zone of attachment far removed from the body equator and ± bilateral. Body infold system develops along this distal attachment, usually consisting of four components of which the two vertical folds are larger. Saccus broader along the long axis than along the shorter axis of the miospore. Saccus coarsely intrareticulate.

**Comparison** — From the genotype it differs in having only one series of folds. From *Potonieisporites lelei* it differs in the shape of the body infold system and also in far removed distal zone of saccus attachment.

*Potonieisporites diffusus* (Maithy) Bharad.

**Pl. 5, Fig. 39**

**Holotype** — Maithy, 1965, pl. 5, fig. 30.

The miospores are monosaccate, bilateral, oval to suboval, and measure 86-121 μ × 129-172 μ. Central body outline is ill-defined and diffuse, the body is thinner than the saccus. The monolete is distinct to obscure. Body ornamentation is intramicroreticulate. Distal zone of saccus attachment is diffuse and the body infold system is absent. The saccus reticulation is coarse.

**Remarks** — Maithy (1962) in his Ph.D. thesis described this miospore as *Vestigisporites diffusus*. Bharadhaj (1964b) included *Vestigisporites* in *Potonieisporites* but Maithy (1965) probably disagreeing with his view kept *Vestigisporites diffusus* separate from *Potonieisporites*. As explained
elsewhere there is a gradual change from *Potonieisporites* to *Vestigisporites* and as such I am convinced that *V. diffusus* should be placed in *Potonieisporites*. This species differs from *P. novicus*, *P. lelei* and *P. densus* in the absence of body infold system. *P. rudis* (B. & H.) Bharad. has fine meshed saccus intrareticulation and *P. methoris* (Hart) Bharad. is smaller in size and has a distinct central body.

**Infraturma — Amphisaccitii** Lele 1965

*Crucisaccites* Lele & Maithy 1964

Genotype — *Crucisaccites latisulcatus* Lele & Maithy 1964

cf. *Crucisaccites latisulcatus* Lele & Maithy

**Holotype** — Lele & Maithy, 1964, pl. 1, fig. 1.

In the present assemblage there are some miospores resembling *Crucisaccites* but as the number is not sufficient and the preservation is not very good, these are provisionally referred to *C. latisulcatus*. The miospores are oval in overall shape with a well to ill-defined subcircular central body. The miospores measure 164-180 \( \mu \times 125-150 \mu \). No definite ornament is visible on the surface of the body and there is no evidence of a tetrad mark. The saccus is attached bilaterally on both the proximal and distal sides of the central body and the two zones of attachment are at right angles to each other.

**Infraturma — Aletesaccitii** Leschik

*Denispollenites* Bharad. 1962

Genotype — *Denispollenites indicus* Bharad. 1962

**Holotype** — Bharadwaj, 1962, pl. 6, fig. 103.

Circular to subcircular irregularly preserved miospores, 117-156 \( \mu \) in longest dia-
meter with a circular to subcircular central body, usually transparent and well defined. Central body 78-89 μ x 82-89 μ in size, without any mark or striations, exine ornamentation corroded or indistinct. Saccus is finely intrareticulate on one side and coarsely reticulate on the other side, usually with a number of folds.

Remarks — These specimens have a larger central body as compared to the genotype and some of the specimens show a slight thickening along the equator of the central body. Sometimes the body is light brown and ill-defined or may be lost.

Infraturma — Striasonosaccites Bharad. 1962

Genotype — Striasonosaccites ovatus Bharad. 1962

Holotype — Bharadwaj, 1962, pl. 7, figs. 107, 108.

Almost circular spores, 82-126 μ in size with an oval central body measuring 78-97 μ in the longest diameter. The central body bears 7-8 simple or forked striations on its proximal face, the area between the striations being intramicroreticulate. The saccus reticulation has fine to medium sized meshes.

The specimens while showing close resemblance with Striasonosaccites ovatus differ in having an oval body as compared to the circular to subcircular central body in the genotype.

Striasonosaccites invisus sp. nov.

Holotype — Pl. 5, Fig. 43.

Locus typicus — 3/4 mile SE of Alubera, Bansloi valley, Rajmahal Hills.

Diagnosis — Circular to subcircular monosporic spores with an indistinct to faintly discernible central body bearing 5-7 striations on its proximal face, area in between the striations being intramicroreticulate.

Description — Holotype almost circular, 145 μ in size with a faintly discernible central body. Miospores range in size from 145 to 245 μ. The central body is thin and bears 5-7 striations on its proximal face, the area in between the striations being microreticulate ornamented. Saccus reticulation has medium sized meshes.

Comparison — The present species differs from the genotype in its much larger size, indistinct central body and saccus intrareticulation.

Subturma — Disaccites Cookson 1947

Genotype — Disaccites papilionis Pot. & Kl. 1954

Platyacatec (Naum.) Pot. & Kl. 1954

Platyacatec sp.

Pl. 6, Fig. 46

The pollen grains are bilateral, disaccate, diploxyllonoid and measure 57-121 μ x 75-171 μ. The central body is ± circular, 31-66 μ in diameter, and devoid of tri-radiate mark or the striations. The exine is microverrucose ornamented. The sacci are subspherical, laterally and distally coming close to each other leaving a narrow saccus-free distal area. Saccus intrareticulation comprises small to medium sized meshes.

Cuneatisporites Leschik 1955

Genotype — Cuneatisporites radialis Leschik 1955

Cuneatisporites sp.

Pl. 6, Fig. 47

The specimens are bilateral, disaccate, diploxyllonoid, 86-132 μ x 105-195 μ in size with a vertically oval, light to dense central body. The central body is intramicroreticulate ornamented and measures 37-97 μ x 32-86 μ. The sacci are ± subspherical, coarsely intrareticulate with thin muri, meshes are up to 8 μ broad. The distal zone of saccus attachment is straight and the distal sulcus is narrow.

Infraturma — Striatiitie Pant emend. Bharad. 1962

Striatiitie Pant emend. Bharad. 1962

Genotype — Striatiitie sevardii (Virkki) Pant 1955

Striatiitie cancellatus (B. & H.) Pot.

Pl. 4, Fig. 33

Holotype — Balme & Hennelly, 1955, pl. 2, fig. 11.

The pollen grains are bilateral, disaccate, 39-74 μ x 70-94 μ in size. Central body
is circular to subcircular, 31-58 µ in diameter and bears 5-9 simple or forked striations on the proximal face, the exine in between the striations being microverrucose ornamented. The sacci are subspherical, usually larger than the body, distally inclined, laterally and distally coming close together leaving a narrow saccus-free distal area. Saccus intrareticulation consists of fine to medium-sized meshes.

**Striatites obtusus** Bharad. & Sal.

**Holotype** — Bharadwaj, & Salujha, 1964, pl. 6, fig. 98

The pollen grains are bilateral, disaccate, diploxylonoid and 75-125 µ x 125-195 µ in size. The central body is circular to subcircular, 51-74 µ in diameter with 5-9 striations on the proximal face. The interconnections between the striations are few and the exine is microverrucose ornamented. The sacci are close laterally, distally leaving a 4-15 µ wide saccus-free area.

**Remarks** — The present grains while agreeing with the holotype differ in having a larger size range.

**Striatites sp.**

**Pl. 4, Fig. 34; Pl. 5, Fig. 44**

The pollen grains are bilateral, disaccate, diploxylonoid, 72-75 µ x 101-133 µ in size with a ± trapezoid central body, 39-51 µ x 39-47 µ in size and having 5-7 simple striations on the proximal face. The exine in between the striations is intramicropunctate. The sacci are close laterally, distally leaving a 4-15 µ wide saccus-free area.

**Remarks** — Striatites sp. differs from *S. sewardii* and *S. cancellatus* in being comparatively larger in size. *S. majus* is a larger form with vertically oval to circular central body as compared to trapezoid central body of *Striatites sp.* *Striatites sp.* (Hq, E & Bose, 1960; Pl. 35, Fig. 7) shows a close resemblance with the present specimens.

**Lahirites Bharad. 1962**

**Genotype** — *Lahirites raniganjensis* Bharad. 1962

**Holotype** — Bharadwaj, 1962, pl. 12, fig. 172

The pollen grains are bilateral, disaccate, diploxylonoid, 136-164 µ long with a circular to subcircular central body, 55-86 µ in diameter. On the proximal face of the central body 5-8 simple or forked striations are present which are cross-connected by many vertical striations. The exine in between the striations is intramicropunctate. The sacci are subspherical, laterally as well as distally separated leaving a 12-30 µ wide saccus-free area. Saccus intrareticulation of medium to coarse sized meshes.

**Lahirites communis** sp. nov.

**Pl. 4, Figs. 35, 36**

**Holotype** — Pl. 4, Fig. 35.

**Locus typicus** — 3/4 mile S.E. of Alubera, Bansloi valley, Santhal Parganas, Bihar.

**Diagnosis** — Pollen grains small, disaccate, bilateral, 66-90 µ in size, holotype measures 90 µ. Central body subcircular, dense brown, 25-43 µ in size, with 5-9 horizontal striations on the proximal face without interconnections, exine in between the striations intramicropunctate. Distal attachment of the sacci full length, straight, leaving a narrow, 4 µ wide saccus-free area. Saccus intrareticulation of fine to medium sized-meshes.

**Comparison** — *Lahirites communis* differs from the genotype in its smaller size, appa-
rent lack of any vertical connecting striations
and the narrow saccus-free distal area.
From other species of the genus too it differs
in having a dense central body.

Lahirites sp. cf. L. incertus Bharad. & Sal.
Pl. 6, Fig. 50

Holotype — Bharadwaj & Salujha, 1964
pl. 8, fig. 122.
The specimens are disaccate, bilateral
and diploxylonoid having a size range of
122-199 μ. The central body is subcircular,
51-62 μ in diameter, with 5-10 horizontal
striations with few to many interconnec-
tions. The exine in between the striations
is intramicropunctate. The sacci are sub-
spherical, distally forming a narrow, 4 μ
wide, and straight saccus-free area. Saccus
intrareticulation consists of medium to big
sized meshes.
Remarks — The nearest approach to the
present specimens is in Lahirites incertus
Bharad. & Sal. but the Raniganj specimens
are comparatively smaller in size.

Hindipollenites Bharad. 1962
Genotype — Hindipollenites indicus Bharad. 1962

Hindipollenites rajmahalensis sp. nov.
Pl. 6, Fig. 51

Holotype — Pl. 6, Fig. 51.
Locus typicus — Near Bargo, Bansloi
valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains bilateral, di-
saccate, diploxylonoid, holotype 156 μ
long. Central body circular with a pro-
minent marginal rim and 6 horizontal stria-
tions on the proximal face with a few and
sparse interconnections. Exine in between
the striations intramicropunctate. Sacci
more than hemispherical, distally and
laterally close, distal saccus attachment
partial length, distal sulcus 1-2 μ wide.
Saccus pitcher-shaped with a broad neck,
intrareticulation mediumly coarse.
Comparison — Hindipollenites rajmahalen-
sis differs from the genotype in a number
of characters, the chief diagnostic characters
being its bigger size, circular central body
and mediumly coarse saccus intrareticula-
tion. From H. oblongus (Bharadwaj & Salujha, 1964) it differs in having finely
intrapunctate structure of the body exine
and lesser number of vertical connecting
striations.

Hindipollenites sp.
Pl. 6, Fig. 52

The pollen grain is 152 μ long, disaccate,
bilateral with a circular central body, 70 μ
in diameter. On the proximal face of the
central body there are about 9 horizontal
striations with many interconnections.
Exine is intramicropunctate in between
the striations. The sacci are laterally
separated but distally come close together
leaving a very narrow distal sulcus. Sacci
are almost twice the height of the central
body, pitcher-shaped with a broad neck.
Saccus intrareticulation is coarse with thick
and broken muri.
Remarks — As there is only one specimen,
a detailed study of variations has not been
possible. From the three known species
of the genus it seems to differ in the saccus
intrareticulation.

Lunatisporites Leschik emend. Bharad. 1962
Genotype — Lunatisparites acutus Leschik 1955

Lunatisporites fuscus Bharad.
Pl. 4, Fig. 37

Holotype — Bharadwaj, 1962, pl. 14, figs.
189, 190

The pollen grains are bilateral, disaccate,
distinctly diploxylonoid and 90-117 μ long.
The central body is vertically oval with
both ends bluntly pointed and measures
55-56 μ X 39-47 μ. Central body bears
6-7 horizontal striations on its proximal
face, the exine in between the striations is
intramicrocristulate. The sacci are slightly
more than hemispherical, finely intrareti-
culate, laterally coming close together. Zones
of distal attachment convex, distal saccus-
free area biconvex.

Lunatisporites gonawakensis sp. nov.
Pl. 7, Fig. 55

Holotype — Pl. 7, Fig. 55.
Locus typicus — Near Bargo, Bansloi
valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains bilateral, di-
saccate, diploxylonoid, holotype 144-170 μ long,
holotype 145 μ, Central body circular to
subcircular, largest central body 86 μ X 94 μ,
in holotype 78 μ, with 6-8 simple or forked
striations on the proximal face, exine in
between the striations intramicrocristulate.
Sacci slightly hemispherical, 97-105 μ high,
latterly close together and coarsely intrareticulate, reticulum sometimes incomplete with thick muri. Distal zone of saccus attachment convex, distal sulcus biconvex, 31-41 μ at its widest.

Comparison — Lunatisporites fuscus differs in having a vertically oval central body and fine intrareticulation of the saccus.

Lunatisporites santalensis sp. nov.
Pl. 7, Fig. 56

Holotype — Pl. 7, Fig. 56.
Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains bilateral, disaccate, holotype 152 μ long. Central body vertically oval, in holotype 74 μ × 99 μ, with 4-8 simple or forked horizontal striations on the proximal face, exine in between the striations intramicroreticulate, central body wall folded inwards forming two characteristic vertical semilunar infolds. Sacci 113-116 μ high with fine intrareticulation, thick muri, and small lumina. Distal zone of saccus attachment convex, distal sulcus biconvex, 29-98 μ at its widest.

Comparison — In Lunatisporites fuscus the central body is smaller and the distal sulcus is comparatively narrow. In L. gondwanensis the saccus intrareticulation is coarse.

Strotersporites Wilson 1962 (sensu Venkatachala & Kar, 1964)

Genotype — Strotersporites communis Wilson 1962

Strotersporites fusus (B. & H.) comb. nov.
Pl. 5, Fig. 45

Holotype — Balme & Hennelly, pl. 1, fig. 7.
The pollen grains are bilateral, disaccate and diploxylonoid measuring 95-148 μ. The central body is subcircular to circular, 45-66 μ in diameter with 6-9 simple or forked striations without any interconnections, the exine in between the striations intramicroreticulate. Sacci are subspherical, larger than the body, laterally and distally slightly separated, leaving a 8-15 μ wide saccus-free distal area. Saccus intrareticulation consists of small sized meshes.

Strotersporites rotundus sp. nov.
Pl. 7, Fig. 57

Holotype — Pl. 7, Fig. 57.
Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains roundly bilateral, disaccate, 130-195 μ long, holotype 152 μ. Central body subcircular to vertically oval, 105-156 μ in size, 7-12 simple or forked striations on the proximal face without interconnections; exine in between the striations intramicroreticulate. Sacci hemispherical, narrow as compared with the central body, laterally and distally coming close together leaving a narrow saccus-free distal area; saccus intrareticulation coarse, muri thick and often broken.

Comparison — In its roundly bilateral form Strotersporites rotundus is distinct from the other species of the genus. S. fusus is smaller in size with a circular to subcircular central body and a fine meshed saccus intrareticulation. S. octistriatus (Hart, 1960) comb. nov. besides being much smaller in size has a wider saccus-free distal area. The holotype of Lunatisporites goraensis (Potonié & Léle, 1961) shows features comparable with those of Strotersporites in general and approaches to a certain extent nearer S. rotundus.

Strotersporites ovatus sp. nov.
Pl. 7, Fig. 58

Holotype — Pl. 7, Fig. 58.
Locus typicus — 3/4 mile S.E. of Alubera, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains bilateral, disaccate, diploxylonoid, 125-183 μ long, holotype 183 μ. Central body subcircular to vertically oval, 66-117 μ × 55-94 μ, with 4-8 simple or forked striations on the proximal face without any interconnections, exine in between the striations intramicroreticulate. Sacci subspherical, distally inclined, distally and laterally close, leaving a 2-8 μ wide straight saccus-free distal area. Saccus intrareticulation double, i.e. fine meshes inside the coarser ones, meshes near the margins often radially directed.

Comparison — Strotersporites rotundus differs from the present species in being roundly bilateral. The closely allied pollen grain is Strotersporites diffusus (Bharad. & Sal.) Venkatach. & Kar (1964) but that too differs in having a hexagonal central body and a wide saccus-free distal area.

Strotersporites globosus sp. nov.
Pl. 7, Fig. 59

Holotype — Pl. 7, Fig. 59.
Locus typicus — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.
Diagnosis — Pollen grains disaccate, diploxylonoid, 117-144 μ long with a horizontal oval to circular central body, sometimes exhibiting a marginal thickening. Central body 62-78 μ in diameter, with 6-10 horizontal striations with few to many interconnections; exine in between the striations intramicroreticulate. Sacci subspherical, higher than the central body, distally inclined leaving a 12-15 μ broad saccus-free distal area. Saccus intrareticulation of medium-sized meshes with thick and broken muri.

Comparison — Strotersporites rotundus has a roundly bilateral shape as compared to distinctly bilateral form of S. globosus. Further the central body in S. rotundus is subcircular to vertically oval as compared to horizontally oval central body in S. globosus. S. ovatus has a different saccus intrareticulation.

Strotersporites perfectus sp. nov.

*Holotype* — Pl. 7, Fig. 60

*Locus typicus* — Near Baragaon, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains bilateral, disaccate, 133-174 μ in size, holotype 172 μ. Central body circular to horizontally oval, 62-117 μ in diameter, with 5-8 horizontal striations, exine in between the striations intramicroreticulate. Sacci as high as or slightly higher than the central body, subspherical, laterally and distally separated, leaving 20-43 μ wide saccus-free distal area. Saccus intrareticulation of medium to big sized meshes.

Comparison — Strotersporites globosus while resembling in size and shape differs in having a narrow saccus-free distal area and medium coarse saccus intrareticulation with thick muri. S. ovatus has double intrareticulation of the saccus and a narrow saccus-free distal area. S. rotundus besides being of different shape has a vertically oval central body. Other species of the genus also do not compare.

Kosankeisporites Bharad. 1954

*Genotype* — Kosankeisporites elegans (Kos.) Bharad. 1955

? Kosankeisporites sp.

*Holotype* — Pl. 7, Fig. 61

The pollen grains are distinctly bilateral and disaccate and measure 128-183 μ in length. Central body is rhomboid or vertically oval, 55-105 μ × 58-94 μ, with 6-11 horizontal striations, which are forked but without any vertical cross connections. Exine in between the striations intramicroreticulate. Sulcus deep, slightly wider in the middle, floor unspecialized.

Remarks — Kosankeisporites as described originally by Bhardwaj (1955) from the Saar and recently recorded from the Raniganj stage (Bharadwaj, 1962) has a microverrucose body and a few zigzag regulate regulae on the proximal face. None of the southern spores assigned to this genus show the zigzag regulate — a character much emphasized in connection with the Saar specimens. On the contrary the Indian grains possess distinct horizontal striations as in the other striate disaccate genera of the Southern Hemisphere. Of the few specimens found in the present material, the presence of a well-defined deep sulcus is very evident. Besides this solitary common feature, the grains do not agree with Kosankeisporites as they possess an intramicroreticulate body and clear horizontal striations. The assignment of the few specimens to Kosankeisporites is thus open to doubt.

Faunipollenites Bharad, 1962

*Genotype* — Faunipollenites varius Bharad. 1962

*Faunipollenites varius* Bharad.

*Holotype* — Bharadwaj, 1962, pl. 18, fig. 230

The pollen grains are disaccate, bilateral and haploxylonoid. They are 124-168 μ long and 82-94 μ high. Central body outline is well-defined with proximal face bearing 7-8 horizontal, simple or forked striations; exine in between the striations is intramicroreticulate. The sacci are hemispherical, coarsely intrareticulate; distal zone of saccus attachment is ill-defined.

Remarks — The grains described here are slightly bigger in size than those originally included in the species.

Faunipollenites bharadwaji sp. nov.

*Holotype* — Pl. 8, Fig. 63

*Locus typicus* — 3/4 mile S.E. of Alubera, Bansloi valley, Santhal Parganas, Bihar.
**Diagnosis** — Pollen grains disaccate, bilateral, haploxylonoid, 152-180 μ long, holotype 179 μ. Central body ill-defined, proximally bearing 7-10 simple or forked striations, exine in between the striations intramicroreticulate. Sacci hemispherical, distally inclined leaving a narrow, ill-defined distal sulcus; saccus intrareticulation coarse.

**Comparison** — The genotype is longish bilateral, smaller in size with fewer proximal striations and a wider sulcus. *Faunipollenites* sp. A (Bharadwaj & SaluJha, 1964; p. 210, pl. 11, fig. 151) compares favourably with the present specimens and probably belongs to this new species.

*Faunipollenites* sp.

Pl. 8, Fig. 64

The pollen grains are disaccate, roundly bilateral with longer axis measuring 145-242 μ. The central body is ill-defined and is intramicroreticulate. It bears 4-10 simple or forked striations on its proximal face. Saccus intrareticulation is coarse.

**Remarks** — In its body structure and roundly bilateral shape the pollen resembles *Strotersporites rotundus* sp. nov. (p. 274). But the body outline and the distal saccus attachment of the present specimens are ill-defined which characters are more consistent with the genus *Faunipollenites*. In view of the lack of more satisfactorily preserved specimens, the few grains are perhaps at best referable to *Faunipollenites*.

**Infraturma — Rectistriatiti** Bharad. 1962

**Genotype — Distriatites bilateris** Bharad. 1962

**Distriatites bilateris** Bharad.

Pl. 9, Fig. 69

**Holotype** — Bharadwaj, 1962, pl. 22, figs. 281, 282

The pollen grains are bilateral, disaccate, 146-195 μ long with a subcircular to rhomboidal central body, 77-109 μ in diameter. On one face the central body bears 8-9 horizontal striations while on the other face 4-8 vertical striations occur. The saccus attachment is ill-defined and the saccus intrareticulation consists of medium-sized meshes.

**Remarks** — Bharadwaj (1962) has included under *Distriatites bilateris* some abnormal pollen in which case each of the two sacci have an additional lobe. At first sight these grains may thus appear to possess four sacci attached to a central body. In the present material there is a single pollen grain (pl. 8, fig. 65) which shows similar features. It is provisionally compared with *D. bilateris* although it is evident that the shape of the body is different from that found in *D. bilateris*.

**Infraturma — Disaccatrilletei** (Leschik) Pot. 1958

**Limitisporites** Leschik, 1956

**Genotype — Limitisporites rectus** Leschik 1957

**Limitisporites latus** Leschik

Pl. 8, Fig. 66

**Holotype** — Leschik, 1956, pl. 21, fig. 16. The pollen grains are bilateral, disaccate, diploxylonoid and 156-164 μ long. The central body is ± hexagonal, 62-70 μ in diameter, with a ± bent monolete on the proximal face and two biconvex, secondary folds running along the lateral axis of the spore on the distal side. The sacci are subspherical, distal zone of saccus attachment convex leaving a biconvex saccus-free distal area. Saccus intrareticulation consist of large meshes.

**Fimbriaesporites** Leschik 1959

**Genotype — Fimbriaesporites globsus** Leschik 1959

**Fimbriaesporites major** Høeg & Bose

Pl. 9, Fig. 70

**Holotype** — Høeg & Bose, 1960, pl. 28, fig. 5. The pollen grains are bilateral disaccate, diploxylonoid with a horizontally oval to circular central body, sometimes with a marginal thickening. Size range of the grains is 121-140 μ × 175-210 μ and that of the central body 58-74 μ × 66-82 μ. The central body proximally bears polygonal to irregular areas forming a frilled ring of projections. Central body exine is microverrucose. Sacci are subspherical, laterally and distally coming close together leaving a narrow saccus-free distal zone. Saccus intrareticulation of medium sized meshes.
? *Fimbriaesporites* sp.

Pl. 8, Fig. 67

The grains are bilateral, 90-117 \( \mu \times 113-140 \mu \) in size with a vertically oval to circular central body, 50-58 \( \mu \times 39-58 \mu \), showing irregular areas marked by faint grooves on the proximal face, exine microverrucose. Saccus condition difficult to determine, whether mono- or disaccate. Saccus intrareticulation of medium-sized meshes.

*Sulcatisporites* Leschik emend. Bharad. 1962

Genotype — *Sulcatisporites interpositus* Leschik 1955

*Sulcatisporites* sp.

Pl. 8, Fig. 68

Pollen grains ± sub circular, disaccate, with an indistinct, nonstriated central body; size range 121-175 \( \mu \times 101-136 \mu \). Sacci hemispherical, placed close to each other, leaving a 4-10 \( \mu \) wide, ill-defined saccus-free distal area. Saccus intrareticulation coarse.

Remarks — These specimens compare favourably with *Sulcatisporites* sp. B. of Bharadwaj & Salujha (1964, p. 212; pl. 12, Fig. 161).

Subturma — *Polysaccites* Cookson 1947

Infuratroma — *Trisacciti* Leschik

*Trochosporites* Wilson 1962

Genotype — *Trochosporites reniformis* Wils. 1962

*Trochosporites* sp.

Pl. 9, Fig. 71

The solitary grain is asymmetrical, tri-saccate, 132 \( \mu \) in size with an oval central body, 62 \( \mu \times 55 \mu \). Sacci subequatorially attached leaving a ± oval saccus-free distal area. Saccus intra-reticulation of medium-sized meshes.

Remark — The genotype is smaller in size with lesser extent of sacci.

*Turma* — *Polyplacites* Erdtm. 1952

Gnetaceae pollenites Thierg. 1938

Genotype — *Gnetaceae pollenites ellipticus* Thierg. 1938

*Gnetaceae pollenites grandis* sp. nov.

Pl. 9, Fig. 72

Holotype — Pl. 9, Fig. 72.

*Locus typicus* — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains elliptical with rounded or broadly pointed and curved margins, 78-101 \( \mu \times 100-210 \mu \) in size. Two to four prominent folds present on the exine, exine \( \pm 1.5 \mu \) thick and intrabaculate.

Comparison — *Gnetaceae pollenites ellipticus* is smaller in size and is known from the Tertiary horizon. *G. sinuosus* (B. & H.) Bharad. is smaller in size with only two folds and has a smooth exine. Cf. *Gnetaceae pollenites* sp. (Bharadwaj & Salujha, 1964) is smaller in size with only two folds.

cf. *Gnetaceae pollenites* sp.

Pl. 9, Fig. 73

The solitary grain is oblong with bluntly pointed ends and is 148 \( \mu \times 114 \mu \) in size. The prominent folds are present on the exine running almost the full length of the grain. Exine \( \pm 2 \mu \) thick, microverrucose.

*Vittatina* Luber 1940

Genotype — *Vittatina subsaccata* Samoilow. 1953

*Vittatina globosa* sp. nov.

Pl. 6, Fig. 53

Holotype — Pl. 6, Fig. 53.

*Locus typicus* — Near Bargo, Bansloi valley, Santhal Parganas, Bihar.

Diagnosis — Pollen grains subcircular, sometimes with one or two folds at right angles to the plane of striations, 86-121 \( \mu \) in diameter. Exine thick bearing 8-15 striations, intramicropunctate.

Comparison — *Vittatina globosa* differs from the genotype in its subcircular shape and larger size range. Other species of the genus also do not compare.

*Turma* — *Monocolpates* Ivers. & T-Smith 1950

Infuratroma — *Intortes* (Naum.) Pot. & Kr.

*Ginkgocycadophytus* Samoilow.

Genotype — *Ginkgocycadophytus eaperatus* (Luber) Samoilow. 1953

*Ginkgocycadophytus cymbatus* (B. & H.) Pot. & Lele

Pl. 4, Fig. 38, Pl. 9, Fig. 74

Holotype — Balme & Hennelly, 1956a, pl. 3, fig. 55.

The pollen grains are ± spindle-shaped, 54-64 \( \mu \) long, ends tapering or ± rounded, exine granulose, colpus not distinct.
Spore subcircular, $\pm 120 \mu$ in diameter, margin undulated; exine thick, muri irregular, membranous forming broadly reticulate pattern, lumina distinct, exine laevigate.

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REFERENCES

*Raniganj Coalfield is in Bengal and not in Bihar as the authors have mentioned.


### PLATE 1

1. ? *Punctatisporites* sp., Slide No. 2327, Photo No. 1401.
2. *Cyclogranisporites* sp., Slide No. 2327, Photo No. 1402.
5. *Verrucosisporites varius* sp. nov., Slide No. 2326, Photo No. 1405.
7. ? *Verrucosisporites* sp., Slide No. 2309, Photo No. 1474.
10. *Horriditriletes gondwanensis* sp. nov., Slide No. 2340, Photo No. 1409.
11. *Horriditriletes gondwanensis* sp. nov., Slide No. 2339, Photo No. 1410.
12. *Greinervillites undulatus* Bose & Kar, Slide No. 2306, Photo No. 1411.
13. Indeterminate, Slide No. 2340, Photo No. 1412.
15. *Latosporites* sp., Slide No. 2308, Photo No. 1414.
17. *Parastriopollenites rajmahalensis* gen. et sp. nov., Slide No. 2312, Photo No. 1416.
19. *Parastriopollenites gondwanensis* sp. nov., Slide No. 2311, Photo No. 1418.
20. *Parastriopollenites triangularis* sp. nov., Slide No. 2312, Photo No. 1419.
21. *Parastriopollenites sinusus* sp. nov., Slide No. 2313, Photo No. 1420.

### EXPLANATION OF PLATES

(All magnifications × 500)

All slides and photo-negatives are registered with and deposited at the repository of Birbal Sahni Institute of Palaeobotany, Lucknow.

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22. Parastriopollenites limbatus sp. nov., Slide No. 2317, Photo No. 1421.
23. Parasaccites densus sp. nov., Slide No. 2332, Photo No. 1422.
24. Virkkipollenites mehtae Lele, Slide No. 2311, Photo No. 1423.

**PLATE 3**
25. Parastriopollenites giganteus sp. nov., Slide No. 2318, Photo No. 1424.
28. Virkkipollenites triangularis (Mehta) Lele, Slide No. 2313, Photo No. 1427.
29. Virkkipollenites obscurus Lele, Slide No. 2327, Photo No. 1428.

**PLATE 4**
31. Potonieisporites lelei sp. nov., Slide No. 2330, Photo No. 1430.
32. Potonieisporites densus sp. nov., Slide No. 2330, Photo No. 1430.
34. Striatites sp., Slide No. 2302, Photo No. 1433.
35. Lahirites communis sp. nov., Slide No. 2325, Photo No. 1434.
36. Lahirites communis sp. nov., Slide No. 2309, Photo No. 1435.
37. Lunatisporites fuscus Bharad., Slide No. 2323, Photo No. 1436.

**PLATE 5**
40. cf. Crucisaccites latisculatus Lele & Maithy, Slide No. 2312, Photo No. 1439.
41. Densipollenites indicus Bharad., Slide No. 2305, Photo No. 1440.
42. Striomonosaccites ovatus Bharad., Slide No. 2332, Photo No. 1441.
43. Striomonosaccites invisus sp. nov., Slide No. 2336, Photo No. 1442.
44. Striatites sp., Slide No. 2303, Photo No. 1443.
45. Strotersporites fusus (B. & H.) comb. nov., Slide No. 2310, Photo No. 1444.

**PLATE 6**
46. Platy saccus sp., Slide No. 2334, Photo No. 1445.
47. Cuneatisporites sp., Slide No. 2301, Photo No. 1446.
48. Striatites obtusus Bharad. & Sal., Slide No. 2312, Photo No. 1447.
49. Lahirites raniganjensis Bharad., Slide No. 2311, Photo No. 1448.
50. Lahirites sp. cf. L. incertus Bharad. & Sal., Slide No. 2314, Photo No. 1449.
51. Hindipollenites rajmahalensis sp. nov., Slide No. 2319, Photo No. 1450.
52. Hindipollenites sp., Slide No. 2312, Photo No. 1451.
53. Vittatina globosa sp. nov., Slide No. 2325, Photo No. 1452.

**PLATE 7**
54. Lahirites parvus Bharad. & Sal., Slide No. 2313, Photo No. 1453.
55. Lunatisporites gondwanensis sp. nov., Slide No. 2316, Photo No. 1454.
56. Lunatisporites santalensis sp. nov., Slide No. 2318, Photo No. 1455.
57. Strotersporites rotundus sp. nov., Slide No. 2313, Photo No. 1456.
58. Strotersporites ovatus sp. nov., Slide No. 2318, Photo No. 1457.
59. Strotersporites globosus sp. nov., Slide No. 2312, Photo No. 1458.
60. Strotersporites perfectus sp. nov., Slide No. 2320, Photo No. 1459.
61. ?, Kosankheisporites sp., Slide No. 2315, Photo No. 1460.

**PLATE 8**
63. Faunipollenites bharadwajii sp. nov., Slide No. 2337, Photo No. 1462.
64. Faunipollenites sp., Slide No. 2335, Photo No. 1463.
65. ?, Distriatites bilateris Bharad., Slide No. 2332, Photo No. 1464.
66. Limitatisporites latus Leschik, Slide No. 2312, Photo No. 1465.
67. ?, Fimbriaesporites sp., Slide No. 2336, Photo No. 1466.
68. Sulcatisporites sp., Slide No. 2333, Photo No. 1467.

**PLATE 9**
69. Distriatites bilateris Bharad., Slide No. 2312, Photo No. 1468.
70. Fimbriaesporites major Høeg & Bose, Slide No. 2311, Photo No. 1469.
71. Trochosporites sp., Slide No. 2304, Photo No. 1470.
72. Gnetaceae pollenites grandis sp. nov., Slide No. 2334, Photo No. 1471.
73. cf. Gnetaceae pollenites sp., Slide No. 2315, Photo No. 1472.
74. cf. Ginkgocycadophytus cymbatus (B. & H.) Pot. & Lele, Slide No. 2308, Photo No. 1474.