

# PALYNOLOGICAL STUDY OF LOWER GONDWANA (PERMIAN) COALS FROM GODAVARI BASIN, INDIA. I—ON SOME NEW MIOSPORE GENERA

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## ABSTRACT

While analysing the palynological contents of some coals from Godavari Coal Basin (Lower Gondwana), five new miospore genera have been found to bear hitherto undescribed associations of morphographic characters. In the present communication, these new sporomorphs have been described; among them *Godavarisporites* and *Lobatisporites* are triletes, *Kingiacolpites* is a monocolpate and *Gondisphaeridium* and *Globulae-sphaeridium* are alete forms.

## INTRODUCTION

THE Barakar mioflora contains highly diversified spores and pollen grains.

During the last decade a number of new morphographic characters as well as organizations have been established for various generic groups of sporae dispersae (see Bharadwaj, 1966). During the course of palynological analysis of Godavari Basin coals, two trilete bearing, one monocolpate and two alete miospore genera have been found which exhibit the presence of new combinations of morphographic characters. Although, some of the similar specimens have been illustrated and described earlier by Balme and Hennelly (1956), Potonié and Lele (1961), Bharadwaj (1962), Thiergart and Frantz (1962), Bharadwaj and Salujha (1964), Tiwari (1965) and Ghosh (1963, 1968), the important characters were not high lighted by these authors and consequently no attempt was made to segregate them from the already known genera. The present study has revealed marked differences from the latter and hence, the separation for such miospore groups at the generic level has been done on the basis of morphology.

Coal deposits of Barakar Stage (Lower Gondwana) are found along a linear tract in the north-west south-east direction in Godavari Valley of Andhra Pradesh. The

present study is based upon coal samples from the major coalseams in Ramagundum, Mandamari — Somagundum and Ramkrishnapuram Coalfield (details given in Tiwari & Moiz, MSS). The samples were treated with commercial Nitric acid for three days followed by the treatment with five per cent Potassium hydroxide. The material has been mounted in glycerine jelly. The slides have been deposited in the Department of Geology, Osmania University, Hyderabad (A.P.) India.

## MORPHOGRAPHY

In the trilete bearing microspores, the presence of arcuate markings delimiting the contact area is an important as well as an easily distinguishable character. In the Lower Gondwana miospore assemblages *Hennellysporites* Tiwari (1967) — a solitary example which bears these arcuate rims — is laevigate in nature. *Godavarisporites*, a new name is given here for the microspores which possess, apart from such contact markings, coni as the sculptural elements.

Among the apiculate, triangular, trilete miospore genera, the concavity or convexity of inter-radial sides provide a wide range of variation. During the course of the present analysis, a group of microspores has been discovered which show a marked concavity in the triangle sides so as to impart a lobate appearance to the arms; this condition is mostly associated with the telescoping of one of the three arms on flattening. Such an organization has not been reported so far, and hence these spores are described here under *Lobatisporites* gen. nov. Another genus, *Kingiacolpites*, has been instituted to accommodate oval to suboval monocolpate pollen grains wherein the lines of colpus delimitations are associated with covering folds. These

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grains though apparently approximate to *Ginkgocycadophytus* Samoil. (1953), and mostly assigned to it so far, differ in the nature of the colpus from the latter. In *Ginkgocycadophytus* the colpus is simple, without any associated folds along the margin of attachment, narrow in the centre and gradually widening apart at the two ends (Text-fig. 4); on the contrary in *Kingiacolpites* gen. nov. the colpus is wider in the centre, zones of colpus delimitations associated with covering folds which in their turn are widest in the centre and narrow out at the ends (Text-fig. 3). As far as is understood, the nature of these folds is not secondary and probably they represent the inwardly projecting exinal structures for giving protection to the thinner area of the colpus.

Two alete miospore genera described here as *Gondisphaeridium* and *Globulaesphaeridium* exhibit hystrichosphere-like morphology.

#### SYSTEMATICS

- Anteturma** — *Sporites* H. Pot. 1893  
**Turma** — *Triletes* (Reinsch) Pot. & Kr., 1954  
**Subturma** — *Azonotrilete* Lubert, 1935  
**Infraturma** — *Apiculati* (Benn. & Kinds.) Pot. 1956  
**Subinfraturma** — *Nodati* Dyb. & Jacho. 1957

**Genus** — *Godavarisporites* gen. nov.

**Genotype** — *Godavarisporites indicus* sp. nov.

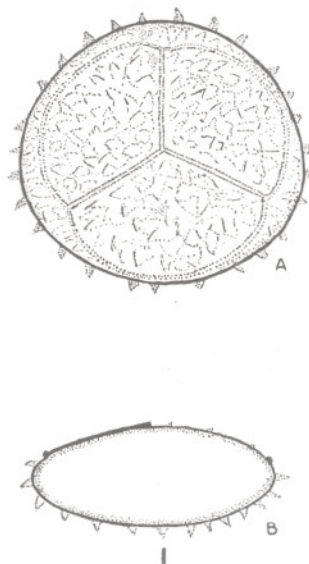
**Generic Diagnosis** — Radially symmetrical trilete bearing miospores. Trilete mark well defined, contact area delimited by arcuate rims. Exine ornamented with pointed or round-ended, conical processes. Ornamentation on contact area reduced or absent.

**Generic Description** — Miospores are small, circular, sub-circular or roundly triangular with convex sides and broadly round angles. The trilete mark is strongly developed and rays reach across more than  $3/4$  of the spores radius in specimens studied here. The rays are simple with thin or thick lips but not elevated unusually; they are straight showing variation in their width. The contact area is distinct and demarcated by moderately to fairly curved arcuate rims. The curvature are either distinct or particularly so only at the ray ends and sometimes subdued by the ornamental processes. In certain cases, on flattening of the spore

the trilete rays rupture and the curvature are coincide with the equatorial margin (Pl. 1, Fig. 2). The exine ornamentation is conate; coni are usually uniformly distributed all over the exine on distal as well as equatorial regions, but a trend of reduction in the size and number of coni on the contact area has been observed.

**Reconstruction** — The spores are proximodistally flattened with a limited shift in the trilete mark suggesting thereby a sub-oval organization in meridional plane as given in Text-fig. 1.

**Comparison** — Not many apiculate miospore specimens with a clear arcuate rim delimiting contact area have been reported from the Lower Gondwana horizons. *Hennellysporites* Tiwari (1967) resembles the present genus in general organization and in the presence of arcuate rims but differs in having an inter-radial, triangular thickening around the trilete junction as well as in the absence of ornamentation. *Apiculatisporis* Pot., though resembles in shape, nature of trilete mark and ornamentation but differentiates itself from the present genus in the absence of contact area and arcuate markings. *Brevitriletes* Bharad. and Sriv. (1969) also differs from the present genus in possessing spines rather than coni, and in the absence of arcuate rims. *Retusotriletes* (Naumova) Strel (1964), a closely



TEXT-FIG. 1 — *Godavarisporites* gen. nov. A. Polar view, B. meridional section along one of the trilete rays.



comparable genus, however, differs from *Godavarisporites* gen. nov. in having unornamented exine; all the more *Retusotriletes* is found in Devonian of the northern hemisphere and includes heterogenous morphographic units (Numova 1953; Potonié 1956). *Apiculiretusispora* Streeb (1964) although compares closely with the present genus, differs in having bigger size with raised trilete rays, bearing mostly short spines (as seen in the genotype) and prominent arcuate ridges rather than faint rims. All the more, this genus has been reported from the Devonian (Lower Givetian) starta of Belgium, and hence is considered different from *Godavarisporites* gen. nov.

*Derivation of name* — After Godavari Basin.

*Godavarisporites indicus* sp. nov.

Pl. 1, Figs. 1-5

*Holotype* — Pl. 1, Fig. 1.

*Locus Typicus* — Mandamari-Somagudum Coalfield, Godavari Basin, A.P. India.

*Stratum Typicum* — Barakar Stage, Lower Gondwana (Lower Permian).

*Diagnosis* — Sub-circular miospores; holotype 32  $\mu$  in size. Trilete mark 4/5 of the spore radius long,  $\pm$  straight, labra thin, vertex low, width  $\pm$  uniform. Contact area distinct arcuate rims complete, moderately bent approaching to the equator of the spore. Coni 2  $\times$  2  $\mu$ , pointed to round tipped, closely set all over the exine, except on the contact area where reduced.

*Description* — Miospores range from 32 to 38  $\mu$  in size. They are usually sub-circular but at times broadly sub-triangular shape is also met with. The contact area is distinct as in the holotype or the arcuate rims may be subdued at places by the ornamentation. The conia are adjacent to each other except on the contact area where they are smaller and sparser.

*Remarks* — Other specimens referable to this species are — *Apiculatisporis levis* Balme & Henn., in Ghosh 1968, Figs. 20, 23.

*Godavarisporites tentulus* sp. nov.

Pl. 1, Figs. 6-8

*Holotype* — Pl. 1, Fig. 6.

*Locus Typicus* — Mandamari-Somagudum Coalfield, Godavari Basin, A.P., India.

*Stratum Typicum* — Barakar Stage, Lower Gondwana (Lower Permian).

*Diagnosis* — Small sub-triangular spores, holotype 26  $\mu$ . Trilete rays thin but distinct, 4/5 radius long, arcuate rims clear particularly so at the ray ends. Contact area covering most of the proximal face. Coni  $\pm$  1  $\times$  1  $\mu$ , closely set.

*Description* — Size of the miospores is 20-26  $\mu$ . Trilete rays are clearly visible, straight and uniformly wide, labrum is thin and vertex is low. *Area contagionis* is delimited by moderately bent curvatureae; sometimes the latter are hidden by the ornamentation in the central region but sharply defined at the ray ends.

*Comparison* — *Godavarisporites indicus* is bigger in size and possesses bigger conia, hence differs from the present species.

*Derivation of Name* — Lat. *Tentulus* meaning small.

*Remarks* — *Verrucosisporites parmatus* Balme & Henn. (1956, Pl. 5, Figs. 51, 52) and *Apiculatisporis jamottei* Kar & Bose (1967, Pl. 1, Figs. 11-12) also show distinct arcuate rims and the contact areas hence they are transferred to *Godavarisporites* gen. nov.

*Godavarisporites parmatus* (Balme & Henn.) comb. nov.

*Synonym* — *Verrucosisporites parmatus* Balme & Hennell 1956, Pl. 5, Figs. 51-52.

*Lectoholotype* — Balme and Hennelly, 1956, Pl. 5, Figs. 51, 52.

*Type Locality* — Main Greta Seam, Cessnock No. 1 Colliery, Greta Coal Measures, N.S.W.

*Godavarisporites jamottei* (Kar & Bose) Comb. nov.

*Synonym* — *Apiculatisporis jamottei* Kar & Bose, 1967, Pl. 1, Figs. 11, 12.

*Holotype* — Kar and Bose, 1967; Pl. 1, Fig. 2.

*Type Locality* — Assise des schistes noirs de la Lukuga, Sondage 10.

*Remarks* — The presence of the contact area has not been described by the authors (Kar & Bose 1961) but it is obvious in the photographs given by them.

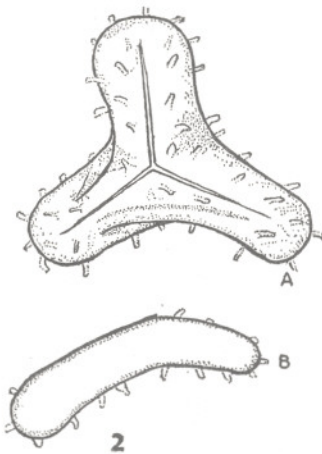
**Genus — *Lobatisporites* gen. nov.**

*Genotype* — *Lobatisporites gondwanensis* sp. nov.

*Generic Diagnosis* — Trilete, triangular miospores with concave inter-radial sides and lobular arms. The three arms of the triangle obliquely pendent distally. Exine bearing mostly bacula, rarely intermixed with short coni.

*Generic Description* — Microspores are triangular with concave inter-radial sides. The corners are broadly rounded and usually appear like lobes. The trilete mark is distinct in most of the specimens studied and the rays are level with the proximal surface. Exine is covered with short pointed to round-apexed coni to elongated blunt bacula both on proximal as well as distal side. The processes are rarer and smaller on the contact area than on the equatorial region and distal side. In the proximodistally flattened specimens one of the three arms of the triangle usually telescopes with the central region of the spore, thus resulting into the formation of short pleats at the inter-radial line (Text-fig. 2). In other specimens where such micropleats are not prominent, a definite fold running  $\pm$  parallel to one of the inter-radial sides is present. Such a telescoping of a triangle-arm, or an inter radial fold, clearly indicates a distally slanting, pendent disposition of three arms in unflattened condition. On flattening, to adjust the distal curvature, one of the arms is driven into the central region causing marginal pleats or a peripheral fold.

*Reconstruction* — Text-fig. 2.



TEXT-FIG. 2 — *Lobatisporites* gen. nov. A. Polar view, B. meridional section along one of the trilete rays depicting the pendent nature of the lobe.

*Comparison* — *Lophotriletes* (Naum.) Pot. & Kr. (1954) is a closely comparable genus but differs from *Lobatisporites* gen. nov., in the absence of deeply concave sides and telescoping tendency of arms in inter radial sides, as well as in having horizontal plane of the angles; no accommodating folds or pleats at margin are found in the former genus. So far, spores having concave to convex inter-radial sides have been described under the genus *Lophotriletes*, although the genoholotype of the latter is of convexly triangular type. However, no sharp line of demarcation can be drawn between concave, straight or convex conditions of the inter-radial sides, in normal conditions, but the "deeply concave" nature of inter-radial sides associated with the in-pushing of one lobe on flattening in *Lobatisporites* is definitely a different line in organization. *Horriditriletes* Bharad. & Salujha (1964) also differs in having slightly concave to convex sides and non-lobular arms without any folds indicating a horizontal plane of triangle arms. The genera *Acanthotriletes*, *Apiculatisporis*, *Neorai-strickia*, and similar other members of infraturma Apiculati, differ in organization, shape and ornamentation.

*Derivation of name* — After lobate nature of triangle arms.

*Lobatisporites gondwanensis* sp. nov.

Pl. 1, Figs. 9-14

*Holotype* — Pl. 1, Fig. 9.

*Locus Typicus* — Ramagundum Coalfield, Godavari Basin, A.P., India.

*Stratum Typicum* — Barakar Stage, Lower Gondwana (Lower Permian).

*Diagnosis* — Miospores concavotriangular with distinct, round lobes at the angles. Holotype 30  $\mu$ . Trilete rays  $\pm$  2/3 radius long, distinct, labra thin, vertex low. Processes 1-2  $\mu$  wide, 2-4  $\mu$  long, straight to conical with blunt-round apex, sparsely arranged; 27 processes counted on *extrema lineamenta* of the holotype.

*Description* — The size ranges from 24  $\mu$  to 34  $\mu$ . The lobes are distinct and the inter-radial curves are prominent. One arm shows small folds at the two radial sides (Pl. 1, Fig. 11) resulted by telescoping of the lobes on flattening; this usually results into the shortening of one of the arms (Pl. 1, Fig. 9). Exine is thin and beset with 2-4  $\mu$



apart, uniformly wide and blunt-tipped bacula and few eoni. The distribution of the ornaments is almost uniform on the proximal and distal surfaces.

*Remarks* — Other specimens referable to this species are:

- *Acanthotriletes* sp. A., Hart, 1963; Pl. 1, Fig. 13.
- *Triquitrites priscus* Kosanke, in Thiery & Frantz 1962; Pl. 2, Figs. 3, 9.
- *Lophotriletes* in Bharad. & Tiwari, 1964, Pl. 1, Fig. 12.

*Lobatisporites brevivaculosus* sp. nov.

Pl. 1, Figs. 15, 16

*Holotype* — Pl. 1, Fig. 16.

*Locus Typicus* — Ramagundum Coalfield, Godavari Basin, A.P., India.

*Stratum Typicum* — Barakar Stage Lower Gondwana (Lower Permian).

*Diagnosis* — Triangular with moderately curved interradian sides and broad, round angles. Holotype  $\pm 34 \mu$ . Trilete rays  $2/3$  radius long. Bacula  $1-2 \mu \times 1-2 \mu$  in size, scanty but uniformly disposed all over the body, except the proximo-polar region where bacula are shorter and sparser; 30 bacula counted on the outline of the holotype.

*Description* — The size of the miospores ranges from 28 to 44  $\mu$ . The lobes of the angles are not sharply delimited but represented by broad, round corners. Usually one of the lobes is driven into the central area or the curvature is adjusted one of the sides to cause a linear fold along it (Pl. 1, Fig. 15).

*Comparison* — *Lobatisporites gondwanensis* sp. nov., differs from the present species in having more defined angle-lobes and in bearing bigger bacula. *Lophotriletes* sp. Tiwari (1965; Pl. 1, fig. 15, 16) resembles the present species.

*Derivation of name* — *Brevivaculosus* meaning with short bacula.

*Lobatisporites* sp. A.

Pl. 1, Fig. 17

*Remarks* — A specimen measuring 18  $\mu$ , showing bulbous, well marked lobes at the angles and bearing a thick-lipped trilete mark shows characteristic differences from the above species.

*Lobatisporites* sp. B.

Pl. 1, Fig. 18

*Remarks* — Another solitary specimen unique in its nature of processes has been encountered. This spore measures 30  $\mu$  (without processes) and possesses well defined lobes at the angles. The trilete mark is very well developed, rays being 1-2  $\mu$  thick and reaching up to the margin. The bacula are 3-7  $\mu$  long, cylindrical and mostly crowded at the three lobes.

The rarity of specimens does not allow a study of variation in these two species.

*Anteturma* — *Pollenites* Pot. 1931

*Turma* — *Plicates* (Naum.) Pot. 1960

*Subturma* — *Monocolpates* Ivers. & Troels.

*Infraturma* — *Intortes* (Naum.) Pot. 1958

*Genus* — *Kingiacolpites* gen. nov.

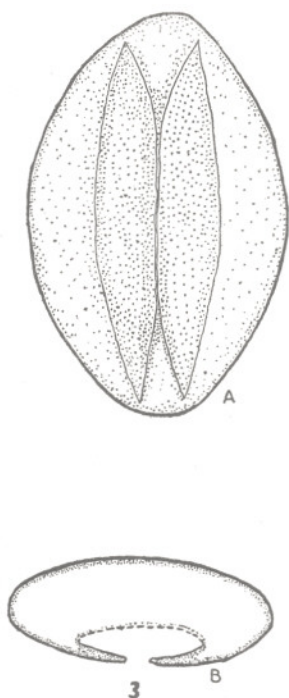
*Genotype* — *Kingiacolpites barakarensis* sp. nov.

*Generic Diagnosis* — Monocolpate miospores with elongate oval to subcircular shape. Colpus  $\pm$  full length along the longer axis, usually straight to convex with delimiting lines associated with exinal infolds; the latter being widest in their centre almost covering the colpus in various degrees except at the terminal regions. Exine distinctly intrapunctate to indistinctly structured; *extrema lineamenta* smooth.

*Generic Description* — Miospores are mostly elongate oval or ellipsoid with flat, round or acute terminal ends; roundly oval to sub oval forms — similar to the elongate oval forms in the nature of colpus and exine intrapunctation — have also been found in the same preparation and hence included in the same circumscription. The colpus usually thinner, is well defined with straight to biconvex sides in normal conditions of flattening. The lines of colpus delimitation are accompanied by  $\pm$  lanceolate exinal folds which in their turn are widest in the centre and narrowing out at the ends, thus almost meeting with each other to cover the median region of the colpus and gradually getting apart terminally to leave  $\pm$  key-hole-like areas uncovered. Exine is thin or thick without any sculptural elements, but with intrapunctate structure.

*Reconstruction* — Text-fig. 3.

*Comparison* — *Bennettitaceacuminella* Malawkina (1953) although resembles with



TEXT-FIG. 3 — *Kingiacolpites* gen. nov. A. showing the nature of colpus and the folds. B. median meridional section of unflattened grain showing the exinal protuberances covering the colpus.

*Kingiacolpites* gen. nov. in the nature of exine structure, differs in having a wider convex colpus in which the exinal folds do not form the keyhole like areas at the terminal regions, but leave a broad  $\pm$  convex area uncovered. *Cycadopites* (Woodeh.) ex Wils. & Webst. (1946), includes  $\pm$  spindle-form pollen with leathery, smooth exine and no exinal folds along the colpus outlines, thus differentiates from the present genus. *Ginkgocycadophytus* (*Entylissa* Naum., 1937) Samoilov. (1953), a closely resembling genus, differs from the present genus in the nature of colpus and exine ornamentation; in the former the colpus lines are not associated with covering exine-infolds while in the latter they are the important features and probably represent the protacting envelop edges (see Text-fig. 3); thus the colpus is narrow in the middle and wider at the terminal regions in *Ginkgocycadophytus* but straight to convex-sided and  $\pm$  wider in the middle in *Kingiacolpites*. The exine in the former genus is granulose to spinose

while in the latter it is psilate and intrapunctate in structure. *Cycadaccaelagella* Malawkina (1953) and *Gynkgaletes* Lubert (1955) also differ from the present genus in the nature of colpus and the exine structure.

*Derivation of name* — After W. King who first discovered the Godavari Coal basin.

*Kingiacolpites barakarensis* sp. nov.

Pl. 1, Figs. 19-21

*Holotype* — Pl. 1, Fig. 20.

*Locus Typicum* — Mandamari-Somagudum Coalfield, Godavari Basin, A.P., India.

*Stratum Typicum* — Barakar Stage, Lower Gondwana (Lower Permian).

*Diagnosis* — Mispores oval with somewhat flat to broadly round ends. Holotype  $42 \times 62 \mu$ . Colpus  $12-16 \mu$  wide in the centre,  $8-12 \mu$  wide at the ends. Zone of colpus demarcation clear, associated with  $6-10 \mu$  wide terminally narrowing folds. Intrapunctation fine, uniform all over; *extrema lineamenta* smooth.

*Description* — Mispores range in size from  $34-44 \times 44-66 \mu$  and are usually oval with somewhat broad flat ends. The colpus is characteristically straight to convex-sided, thinner and covered with exinal fold in the central region. Terminally the folds narrow out to become pointed and to leave wider colpus-area uncovered. The exine is  $1 \mu$  thick in optical section and uniformly intrapunctate.

*Kingiacolpites subcircularis* sp. nov.

Pl. 1, Figs. 22-26

*Holotype* — Pl. 1, Fig. 22.

*Diagnosis* — Mostly subcircular rarely sub oval mispores; holotype  $\pm 68 \mu$ . Colpus  $\pm$  straight,  $10-14 \mu$  wide in the centre, exinal-folds  $4-7 \mu$  wide in centre terminally narrowing and pointed at the ends. Exine  $1.5-2 \mu$  thick, coarsely intrapunctate. *Extrema lineamenta* smooth.

*Description* — Mispores are subcircular in overall shape; sometimes sub-oval shape with round ends is also met with. The colpus is thin and  $\pm$  straight sided with narrow, mostly plano-convex folds meeting in the central region. The exine is distinctly intrapunctate; puncta are  $\pm 1 \mu$  in size and adjacent with each other.



*Comparison* — *Kingiacolpites barakarensis* differs in being oval in shape and having finer intrapunctation on the exine.

*Kingiacolpites elongatus* sp. nov.

Pl. 2, Figs. 27-30

*Holotype* — Pl. 2, Fig. 27.

*Locus Typicus* — Ramagundum Coalfield, Godavari Basin, A.P., India.

*Stratum Typicum* — Barakar Stage, Lower Gondwana (Lower Permian).

*Diagnosis* — Miospores are narrowly elongate oval with narrow round ends in normally flattened conditions; holotype  $32 \times 80 \mu$ . Colpus straight to slightly convex,  $18 \mu$  wide in holotype; folds prominent,  $8 \mu$  wide in holotype,  $\pm$  uniformly broad along most of its length and pointed at ends. Exine finely intrapunctate. *Extrema lineamenta* smooth.

*Description* — The miospores are elongate narrow with round ends, when normally flattened; mostly they are folded and rotated so that the colpus shifts to the marginal region and the ends of the specimens become pointed. The size recorded ranges  $70-100 \mu \times 24-40 \mu$ ; the folds along

the colpus-line are distinct and uniformly wide along their length so the terminal opening regions of colpus are very small. Exine is  $1-1.5 \mu$  thick and finely intrapunctate, the puncta being  $\pm 0.5 \mu$ .

*Comparison* — *K. barakarensis* differs in being oval with round-flat terminal ends, having wider folds and distinct puncta. *K. subcircularis* is subcircular in overall shape with coarser puncta in the exine.

*Kingiacolpites vetus* (Balme & Henn.) comb. nov.

Pl. 2, Figs. 34, 35

*Synonym* — *Entylissa vetus* Balme & Hennelly, 1956.

*Lectoholotype* — Balme & Hennelly, Pl. 3, Fig. 49.

*Type Locality* — Homeville seam, Lower Split, Hebburn No. 1 Colliery, N.S.W.

*Description* — Miospores are oval with narrow round ends and measuring  $32-40 \mu \times 18-26 \mu$  in size. Distal furrow is narrow and extends full length along the longer axis in the median region. Exine is thin and laevigate with fine structure.

*Remarks* — This species in all essential characters of exine and colpus, answers to the circumscription of the genus *Kingiacolpites* gen. nov.

*Kingiacolpites cymbatus* (Balme & Henn.) comb. nov.

Pl. 2, Figs. 31-33

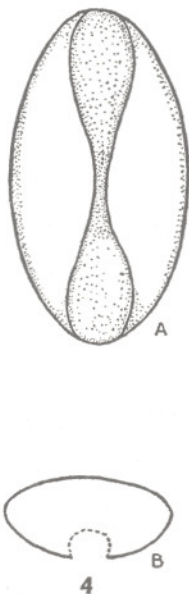
*Synonym* — *Entylissa cymbatus* Balme & Hennelly, 1956.

*Lectoholotype* — Balme & Henn., 1956, Pl. 3, Fig. 55.

*Type Locality* — Homeville seam, Lower Split, Hebburn No. 1 Colliery, N.S.W.

*Remarks* — Colpate oval miospore with a full length colpus with exinal folds along the outline and laevigate exine have been referred to this species. The size recorded for this species varies from  $58-62 \mu$  along the longer axis. The colpus is wider at two ends but is usually obscure due to folding of the specimen. The exine is mostly thin, smooth and indistinctly to distinctly intrapunctate (see also Pot. & Lele; 1961).

This species differs from *K. elongatus* in being smaller in size.



TEXT-FIG. 4 — *Ginkgocycadophytus* Samoil. A. Showing the nature of colpus, B. median meridional section showing the simple nature of colpus.

Other specimen referable to this species are:

— *Ginkgocycadophytus* in Bharad. & Tiwari, 1964.

— *Ginkgocycadophytus* sp. Tiwari 1968, Pl. 8, Fig. 91.

**Turma** — *Aletes* Ibr. 1933

**Subturma** — *Azonoletes* (Lub.) Pot. & Kr. 1954

**Infraturma** — *Granulonapiti* Cooks. 1947

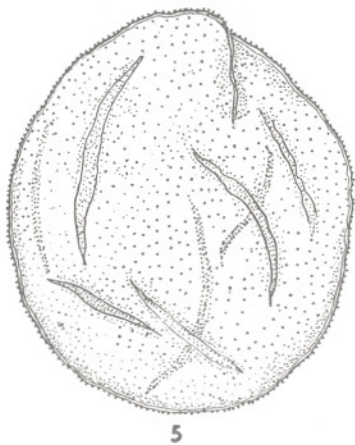
**Genus** — *Gondisphaeridium* gen. nov.

**Genotype** — *Gondisphaeridium levis* sp. nov.

**Generic Diagnosis** — Circular, subcircular to ovoidal, alelete miospores with granulose to verrucose ornamentation.

**Generic Description** — Miospores are radially symmetrical with spheroidal shape, and do not possess any germinal mark, striations or a weak zone. The exine, in the species studied here, is thin and variously folded along irregular directions; the plicates are narrow or short lanceolate to lunar on both the surfaces. The ornamentation is mainly constituted by small grana or microverrucae evenly spaced all over the exine. *Extrema lineamenta* shows microprojections of the ornamentation.

**Reconstruction** — The indeterminate plane of flattening suggests a spherical shape of the unflattened miospore. The details of folds and ornamentation have been shown in Text-fig. 5.



TEXT-FIG. 5 — *Gondisphaeridium* gen. nov. Showing the thin nature of exine, folds and the ornamentation.

**Comparison** — Among the comparable alelete genera *Zonosphaeridium* Timof. (1959) differs from the present genus in having reticuloid pattern on the body and a zonal appearance at the equator. *Protoleiosphaeridium* Timf. (1959) though resembles in the nature of exine folds, differs in lacking grana-verrucae type of ornamentation. *Leiosphaeridia* (Eisenack) Downie & Sarjeant (1963) possesses punctate unornamented exine and also differs in having fewer, folds in the body and thicker exine.

**Derivation of Name** — After *Gond* — an aboriginal tribe in India, from which the name Gondwanaland had been derived.

*Gondisphaeridium levis* sp. nov.

Pl. 2, Figs. 36-39

**Holotype** — Pl. 2, Fig. 38.

**Locus Typicus** — Ramkrishnapuram Coalfield, Godavari Basin, A.P. (India).

**Stratum Typicum** — Barakar Stage, Lower Gondwana (Lower Permian).

**Diagnosis** — Circular to subcircular, holotype 80-104  $\mu$ . Exine thin ornamented with fine, less than 1  $\mu$  grana and verrucae.

**Description** — The size of miospores ranges from 80-110  $\mu$ . The exine is light yellow, variously folded with thin, long folds and closely ornamented. *Extrema lineamenta* is irregular due to grana and verrucae.

**Infraturma** — *Baculonapiti* inf. nov.

**Diagnosis** — Infraturma to include alelete miospore genera with bacula, pila or globular processes for their ornamentation.

**Genus** — *Globulaesphaeridium* gen. nov.

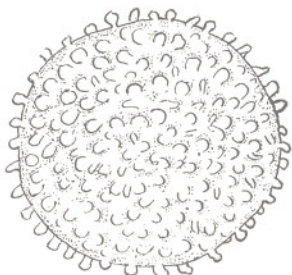
**Genotype** — *Globulaesphaeridium densus* sp. nov.

**Generic Diagnosis** —  $\pm$  Circular, alelete miospores ornamented with bacula, pila or small globular bodies, processes being of various shapes and sizes.

**Generic Description** — Miospores are basically circular in outline. No germinal mark, striations or weak zone of splitting is present. Exine is beset all over with usually broad, round headed pila, elongated round-tipped bacula or even sessile round bodies; these processes project out prominently at the *extrema lineamenta*.

**Reconstruction** — Indeterminate plane of flattening suggests a spherical shape for





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TEXT-FIG. 6 — *Globulaesphaeridium* gen. nov. Showing the nature of ornamentation.

this genus. The details of ornamentation are given in Text-fig. 6.

*Comparison* — *Orygmatosphaeridium* Timof. (1959) although resembles in having globular type of pattern on the exine, does not possess the sculpture as is evident from the psilate outline; the globular look is due to the elevations and depression as well as folding-reticulations on the exine, thus it is morphologically, different from the present genus. *Protoleiosphaeridium* also lacks pilate-baculate ornament and *Zonosphaeridium* shows a zone like structure at the equatorial region, thus are different from the present genus. *Lophosphaeridium* possesses conic and not bacula-pila like bodies as sculpture thus differs from the present genus. *Pilasporites* (Balme & Henn.) Tiwari & Navale (1967) is smooth with a weak zone of rupture.

*Derivation of name* — After round headed, globular ornament.

*Globulaesphaeridium densus* sp. nov.

Pl. 2, Figs. 40-43

*Holotype* — Pl. 2, Fig. 43.

*Locus Typicus* — Ramkrishnapuram Coalfield, Godavari Basin, A.P., India.

*Stratum Typicum* — Barakar Stage, Lower Gondwana (Lower Permian).

*Diagnosis* —  $\pm$  Circular; holotype 56  $\mu$  including processes. Bacula rounded tip, bulbous or finger shaped 4-8  $\mu$  long, 2-4  $\mu$  wide; pila 3-6  $\mu$  long globular bodies few, small; processes closely packed.

*Description* — The size of miospores varies from 56-70  $\mu$ . The exine is beset with crowded bacula of various shapes which are in majority; pila and round bodies are rare and irregularly intermixed. The inter-process spaces usually appear as reticuloid.

*Globulaesphaeridium* sp.

Pl. 2, Fig. 44

*Description* — A solitary specimen measuring 44  $\mu$  bears 2-4  $\mu$  bulbous bacula all over the exine, intermixed with small circular round bodies. As the size of ornament is relatively smaller in this specimen, it has been kept separate from *G. densus*.

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## EXPLANATION OF PLATES

## PLATE 1

(All Photomicrographs are  $\times 500$ )

- 1-5. *Godavarisporites indicus* gen. et sp. nov. Regd. Photo Nos. K/70 (Holotype), R/70, R/84, G/652, R/72.
- 6-8. *Godavarisporites tentulus* sp. nov. Regd. Ph. Nos. K/72 (Holotype), K/66, K/79.
- 9-14. *Lobatisporites gondwanensis* gen. et sp. nov. Regd. Ph. Nos. G/23 (Holotype), G/651, G/619, G/521, G/77, G/623.
- 15-16. *Lobatisporites brevibaculosus* sp. nov. Regd. Ph. Nos. G/618, G/86 (Holotype).
17. *Lobatisporites* sp. A. Regd. Ph. No. G/632.
18. *Lobatisporites* sp. B. Regd. Ph. No. G/613.
- 19, 20. *Kingiacolpites barakarensis* gen. et sp. nov. Regd. Ph. Nos. G/626, K/75 (Holotype).
21. *Kingiacolpites barakarensis* (contd.). Regd. Ph. No. G/52.

- 22-26. *Kingiacolpites subcircularis* sp. nov. Regd. Ph. Nos. K/69 (Holotype), G/626, K/54, K/76, B/37.

## PLATE 2

- 27-30. *Kingiacolpites elongatus* sp. nov. Regd. Ph. Nos. G/488 (Holotype), G/512, G/566, G/514.
- 31-33. *Kingiacolpites cymbatus* (Balme & Henn.) Comb. nov. Regd. Ph. Nos. G/502, G/250, G/137.
- 34-35. *Kingiacolpites vetus* (B. & H.) Comb. nov. Regd. Ph. Nos. G/570, B/101.
- 36-39. *Gondisphaeridium levis* gen. et sp. nov. Regd. Ph. Nos. R/29, B/18, R/39 (Holotype), R/22.
- 40-43. *Globulaesphaeridium densus* gen. et sp. nov. Regd. Ph. Nos. G/492, G/668, G/410, G/667 (Holotype).
44. *Globulaesphaeridium* sp. Regd. Ph. No. G/472.





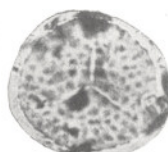
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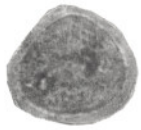
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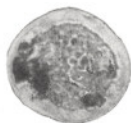
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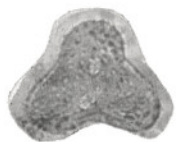
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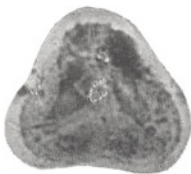
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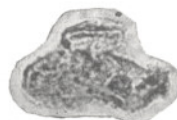
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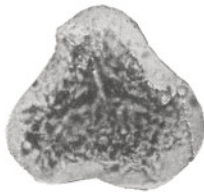
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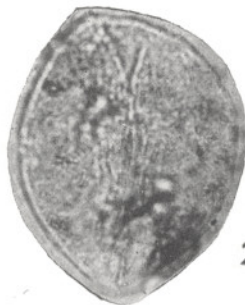
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