

Some new pollen grains from Late Permian sediments of Godavari Graben and their stratigraphic significance

Neerja Jha

Birbal Sahni Institute of Palaeobotany, Lucknow-226007

Jha, Neerja 1996. Some new pollen grains from Late Permian sediments of Godavari Graben and their stratigraphic significance. *Geophytology* 25: 67-75.

Seven new pollen species have been identified on the basis of finer morphographic characters during the palynological investigation of Late Permian sediments in seven bore cores from Ramakrishnapuram, Ramagundam, Chelpur and Bhopalpalli areas of Godavari Graben. These species have not been recorded earlier from the Godavari Graben or any other basin and their presence in Late Permian palynoassemblages here is considered to be stratigraphically significant.

Key-words- Pollen grains, Morphology, Permian, Godavari, India.

INTRODUCTION

THE Godavari Graben is one of the biggest sedimentary basins in India, where almost a complete sequence from Permian to Early Cretaceous is preserved. The Pre-Kamthi succession in this graben is represented by Talchir, Barakar, Barren Measures (Kulti), Raniganj formations (*sensu* Ramanamurty, & Rao, 1987; Jha & Srivastava, 1994). Palynological work on Lower Gondwana sediments in Godavari Graben started as early as 1962 when Thiergart and Frantz reported some pollen and spores from Kothagudem area. Ghosh (1968) provided some information on the miospore contents alongwith their vertical and lateral distribution in Salarjung and Ross seams of Tandur area. Moiz and Ramana Rao (1968), Tiwari and Moiz (1971) described the presence of monolete, trilete, monosaccate, disaccate and alete genera. Whatever work was done during this time was mainly on the Barakar coals which were being mined at that time. With the discovery of coal in Kamthi Formation (*sensu* Raja Rao, 1982) palynology as an aid to the exploration of coal became a necessity in order to date and correlate the sediments. Therefore, the work was undertaken in association with the Geological Survey of India in order to fulfil the gap in the knowledge of the stratigraphic sequence. Ramanamurty (1979) reported some pteridophytic spores and disaccate pollen grains in Kamthi Formation of Ramagundam area but the detailed palynological investigations have been carried out at the Birbal Sahni Institute of Palaeobotany, Luck-

now. Sediments from Ramagundam (Bharadwaj, Srivastava, Ramanamurty & Jha, 1984), Ramakrishnapuram (Srivastava, & Jha, 1992), Mailaram (Srivastava & Jha, 1990), Budharam (Srivastava & Jha, 1995) and Manuguru (Srivastava & Jha, 1992) from the main Godavari sub-basin and Chintalpudi sub-basin (Srivastava & Jha, 1993, 1984) have been studied and as a sequel to it a standard palynological succession has been established. In addition to these occurrence of megaspores (Jha & Srivastava, 1994) and a new taeniate monosaccate pollen genus *Kamthisaccites* (Srivastava & Jha, 1986) have also been described from the Late Permian sediments. The detailed morphographic studies of spore dispersae in Late Permian sediments of Godavari Graben have revealed the presence of some new species which are being described here.

The material for the present study includes bore cores GRK-1, GRK-24 & 25 (Ramakrishnapuram area), GGK-20 & 27 (Ramagundam area), GJ-3 (Chelpur area) and GJ-6 (Bhopalpalli area), the details of which are already published.

DESCRIPTION

The palynofossils recovered from Late Permian (=Raniganj) sediments of Godavari Graben are rich in trilete, monolete, monosaccate and disaccate pollen grains. A list of spore-pollen species identified in these sediments is shown in table-1. The taxa marked with an

asterisk have been commented upon in the text for their morphologic and nomenclatural aspects.

Table -1 : Showing spore-pollen species in Late Permian (=Raniganj) sediments of Ramagundam, Ramakrishnapuram, Chelpur and Bhopalpalli areas, Godavari Graben.

- Leiotriletes* sp.
Lophotriletes rectus Bharadwaj & Salujha, 1964
Gondisporites raniganjensis Bharadwaj, 1962
Indotriradites sparsus Tiwari, 1965
Jayantisporites sp.
Horriditriletes ramosus (Balme & Hennelly) Bharadwaj & Salujha, 1964
H. rampurensis Tiwari, 1968
Lundbladispora willmotti Balme, 1963
L. microconata Bharadwaj & Tiwari, 1977
L. raniganjensis Tiwari & Rana, 1981
Lobatisporites gondwanensis Tiwari & Moiz, 1971
Brevitriletes communis Bharadwaj & Srivastava emend Tiwari & Singh, 1981
B. unicus (Tiwari) Bharadwaj & Srivastava emend Tiwari & Singh, 1981
Microbaculispora tentula Tiwari, 1965
M. gondwanensis Bharadwaj, 1962
Microfoveolatispora foveolata Tiwari emend Tiwari & Singh, 1981
Plicatisporites distinctus & Makada, 1972
Verrucosisporites surangei Maheshwari & Banerji, 1975
Osmundacidites pilatus Tiwari & Rana, 1981
O. senectus Balme, 1963
Laevigatosporites colliensis (Balme & Hennelly, 1956) Venkatachala & Kar, 1968
Polypodiidites perverrucatus Couper 1953
Praecolpatites sinuosus (Balme & Hennelly) Bharadwaj & Srivastava, 1969
* *Densipollenites indicus* Bharadwaj, 1962
D. invisus Bharadwaj & Salujha, 1964
* *D. densus* Bharadwaj & Srivastava 1969
D. minimus Venkatachala & Kar, 1968
D. brevis Lele & Srivastava, 1977
D. magnicarpus Tiwari & Rana, 1981
* *D. annulatus* sp. nov.
* *D. kamthiensis* sp. nov.
* *D. marginalis* sp. nov.
Callumispora gretensis Bharadwaj & Srivastava, emend Tiwari, Srivastava, Tripathi & Vijaya, 1989
C. barakarensis Bharadwaj & Salujha, 1964
Calamospora exila Bharadwaj & Salujha, 1964
Hennellysporites diversiformis (Balme & Hennelly) Tiwari, 1968
Tiwariasporis simplex (Tiwari) Maheshwari & Kar, 1967
T. novus Bharadwaj & Dwivedi, 1981
Weylandites obscurus (Tiwari) Bharadwaj & Dwivedi, 1981
W. minutus Bharadwaj & Srivastava, 1969
W. circularis Bharadwaj & Srivastava, 1969
Vesicaspora luteus Salujha, 1965
Parasaccites korbaensis Bharadwaj & Tiwari, 1964
P. obscurus Tiwari, 1965
P. distinctus Tiwari, 1965
P. diffusus Tiwari, 1965
P. bilateralis Tiwari, 1965
P. densus Maheshwari, 1967
Plicatipollenites ganjraensis Saxena, 1971
P. gondwanensis (Balme & Hennelly) Lele, 1964
Virkkipollenites orientalis Tiwari, 1968
Kamthisaccites kamthiensis Srivastava & Jha, 1986
Lueckisporites crassus Sinha, 1972
Lueckisporties sp.
Guttulapollenites hannonicus Goubin, 1965
Lunatisporites diffusus Bharadwaj & Tiwari, 1977
L. ovatus(Goubin) Maheshwari & Banerji, 1966
Lunatisporites sp.
Corisaccites alutas Venkatachala & Kar, 1966
C. distinctus Venkatachala & Kar, 1968
C. vanus Venkatachala & Kar, 1966.
**Hamiapollenites minimus* sp. nov.
Striatites communis Bharadwaj & Salujha, 1964
S. solitus Bharadwaj & Salujha, 1964
S. tentulus Tiwari, 1965

- S. obliquus* Srivastava, 1979
S. sp. cf. S. parvus Tiwari, 1965
Lahirites rarus Bharadwaj & Salujha, 1964
L. incertus Bharadwaj & Salujha, 1964
L. singularis Bharadwaj & Salujha, 1964
L. karanpuraensis Bharadwaj & Dwivedi, 1981
L. levicorpus Tiwari, 1968
L. rhombicus Maithy, 1965
Verticypollenites secretus Bharadwaj, 1962
V. debilis Venkatachala & kar, 1968
V. finitimus Bharadwaj & Salujha, 1964
V. crassus Bharadwaj & Salujha, 1964
Hindipollenites indicus Bharadwaj, 1962
H. globosus Kar, 1968
H. sp. cf. H. rajmahalensis Maheshwari, 1967
Striatopodocarpites tiwari Bharadwaj & Dwivedi, 1981
S. globosus (Maheshwari) Bharadwaj & Dwivedi, 1981
S. brevis Sinha, 1972
S. diffusus Bharadwaj & Salujha, 1964.
S. rotundus (Maheshwari) Bharadwaj & Dwivedi, 1981
S. decorus Bharadwaj & Salujha, 1964
S. labrus Tiwari, 1965
S. subcircularis Sinha, 1972
 * *S. multistriatus* sp. nov.
Faunipollenites parvus Tiwari, 1965
F. goraiensis (Potonié & Lele) Maithy, 1965
F. copiosus Bharadwaj & Salujha, 1965
F. varius Bharadwaj 1965
F. bharadwajii Maheshwari, 1967
F. singrauliensis Sinha, 1972
F. gopadensis Bharadwaj & Srivastava, 1969
 * *Strotersporites crassiletus* sp. nov.
Strotersporites monosacoides Tiwari & Rana, 1981
Distriatites insolitus Bharadwaj & Salujha, 1964
D. distinctus Sinha, 1972
Rhizomaspora indica Tiwari, 1964
R. monosulcata Tiwari, 1968
Primuspollenites levis Tiwari, 1964
Schizopollis extremus Venkatachala & Kar, 1964
Striasulcites rectus Venkatachala & Kar, 1968
Distriamonocolpites globosus (Maithy) comb. nov.
 * *Crescentipollenites globosus* (Maithy) comb. nov.
 * *C. barakarensis* (Sinha) comb. nov.
 * *C. cephalus* (Kar & Bose) comb. nov.
C. fusus (Bharadwaj) Bharadwaj, Tiwari & Kar, 1974
 * *C. densus* sp. nov.
C. brevis (Bose & Kar) Bharadwaj, Tiwari & Kar, 1974
C. gondwanensis (Maheshwari) Bharadwaj, Tiwari & Kar, 1974
 * *Circumstriatites circumstriatus* Lele & Makada, 1972
C. obscurus Lele & Makada, 1972
Marsupipollenites fasciolatus Balme & Hennelly, 1956
Pretricolpipollenites bharadwajii Balme, 1970
Potonieisporites crassus Lele & Chandra, 1973
P. neglectus Potonié & Lele, 1961
Scheuringipollentites maximus (Hart) Tiwari, 1973
S. minutus (Sinha) Bharadwaj & Dwivedi, 1981
S. barakarensis (Tiwari), Tiwari, 1973
S. tentulus (Tiwari) Tiwari, 1973
Ibisporites jhingurdahiensis Sinha, 1972
Platysaccus papilionis Potonié & Klaus 1954
P. plicatus Bharadwaj & Dwivedi, 1981
Alisporites indarraensis Segroves, 1969
A. landianus Balme, 1970
Chordasporites australiensis de Jersey, 1962
Cuneatisporites royaliensis Saxena, 1970
Falcisporites nuthallensis (Clark) Balme, 1970
Paravesicaspora ovata (Balme & Hennelly) Bharadwaj & Dwivedi, 1981
P. brevis (Sinha) Bharadwaj & Dwivedi, 1981
Aurangapollenites gurturiensis Srivastava 1977
 * *A. minimus* sp. nov.
Vitreisporites pallidus (Reissinger) Balme, 1970
Limitisporites rectus Leschik, 1956
Barakarites indicus Bharadwaj & Tiwari, 1964
Singraulipollenites indicus Sinha, 1965
S. finitimus Sinha, 1969
Maculatasporites gondwanensis Tiwari, 1965
M. irregularis Tiwari, 1965

Genus - *Densipollenites* Bharadwaj, 1962

Type species - *Densipollenites indicus* Bharadwaj, 1962

Densipollenites indicus Bharadwaj, 1962

Holotype - Bharadwaj, 1962; Pl. 6, fig. 103

Remarks - Segroves (1969) has emended *Densipollenites invisus* Bharadwaj & Sahujha (1964) as a synonym of *Densipollenites indicus* Bharadwaj (1962). According to him the latter encompasses "grains in which the intexine is transparent but for its margin in flattened specimens and *D. invisus* Bharadwaj & Salujha (1964) accommodates forms with an intexine which is presumably very thin so hardly discernible". According to him the two species are separated only by slight difference in the discernibility of the intexine. However, the two species are distinctly distinguishable as the central body in *D. indicus* Bharadwaj (1962) is thin, transparent but distinctly visible whereas the central body in *D. invisus* is indistinct, hence both the species are considered here to be different taxa.

Densipollenites densus Bharadwaj & Srivastava, 1969

Synonym - *Densipollenites pullus* Segroves, 1969, *Grana palynologica* 9(1-3): 174-227; Pl.4, figs A,B.

Holotype - Bharadwaj & Srivastava, 1969; Pl. 24, fig. 5.

Remarks - Segroves (1969) described *D. pullus* as the sub-circular to oval monosaccate pollen grains having dark circular to oval central body with irregularly arranged folds in saccus and distinct limboid zone. In the same year (April, 1969) Bharadwaj and Srivastava have described *D. densus* as monosaccate with circular to subcircular, thick, dense, central body covered by saccus. As both the species have been described concurrently in the same year, they have not been compared. Both the species have similar morphographic characters and general organisation, hence *D. densus* Bharadwaj &

Srivastava (1969) is considered to be a valid taxon since *D. pullus* Segroves (1969) was published later.

Densipollenites annulatus sp. nov.

Pl. 1, fig.1

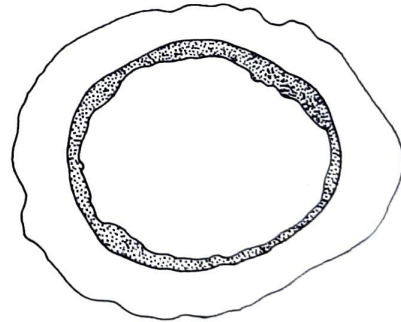
Holotype: Pl.1, fig. 1; B.S.I.P. Slide No. 9341; Size 150 x 122.5 μ m

Locus typicus - Bore hole GKG-27, depth 73m, Ramagundam Area, Godavari Graben, India.

Horizon & age - Raniganj Formation, Late Permian.

Diagnosis - Subcircular, monosaccate pollen grains; \pm 136 to 160.00 μ m in size. Central body large, subcircular, \pm 99 μ m to 196.0 μ m in size, occupying 2/3 of the total saccus area with an equatorial thickening (Text-fig.1). Central body completely covered by saccus. Saccus finely intramicroreticulate. Folds and marginal thickening in the saccus (limbus) present.

Comparison - These pollen grains resemble *D. magnicarpus* Tiwari & Rana (1981) in having large central body approximately 2/3 of the total pollen area but differ from *D. magnicarpus* in having a comparatively thinner central body along with an equatorial thickening.



Text-fig.1 *Densipollenites annulatus* sp. nov. - Holotype showing large central body with an equatorial rim. 500 x

Plate 1

- | | |
|---|---|
| 1. <i>Densipollenites annulatus</i> sp. nov. Holotype, B.S.I.P. slide no. 9341 | 7. <i>Densipollenites kamthiensis</i> sp. nov. Holotype, B.S.I.P. slide no. 9324 |
| 2. <i>Densipollenites marginalis</i> sp. nov. Holotype, B.S.I.P. slide no. 9324 | 8. <i>Aurangapollenites minimus</i> sp. nov. Holotype, B.S.I.P. slide no. 9526 |
| 3. <i>Crescentipollenites densus</i> sp. nov. Holotype, B.S.I.P. slide no. 9525 | 9. <i>Crescentipollenites densus</i> sp. nov. Holotype, B.S.I.P. slide no. 9523 |
| 4. <i>Hamiapollenites minimus</i> sp. nov. B.S.I.P. slide no. 9522 | 10. <i>Strotersporites crassiletus</i> sp. nov. B.S.I.P. slide no. 9341 |
| 5. <i>Strotersporites crassiletus</i> sp. nov. Holotype B.S.I.P. slide no. 9525 | 11. <i>Aurangapollenites minimus</i> sp. nov., B.S.I.P. slide no. 9524 |
| 6. <i>Hamiapollenites minimus</i> sp. nov. Holotype B.S.I.P. slide no. 9524 | 12. <i>Striatopodocarpites multistriatus</i> sp. nov. Holotype, B.S.I.P. slide no. 9340 |

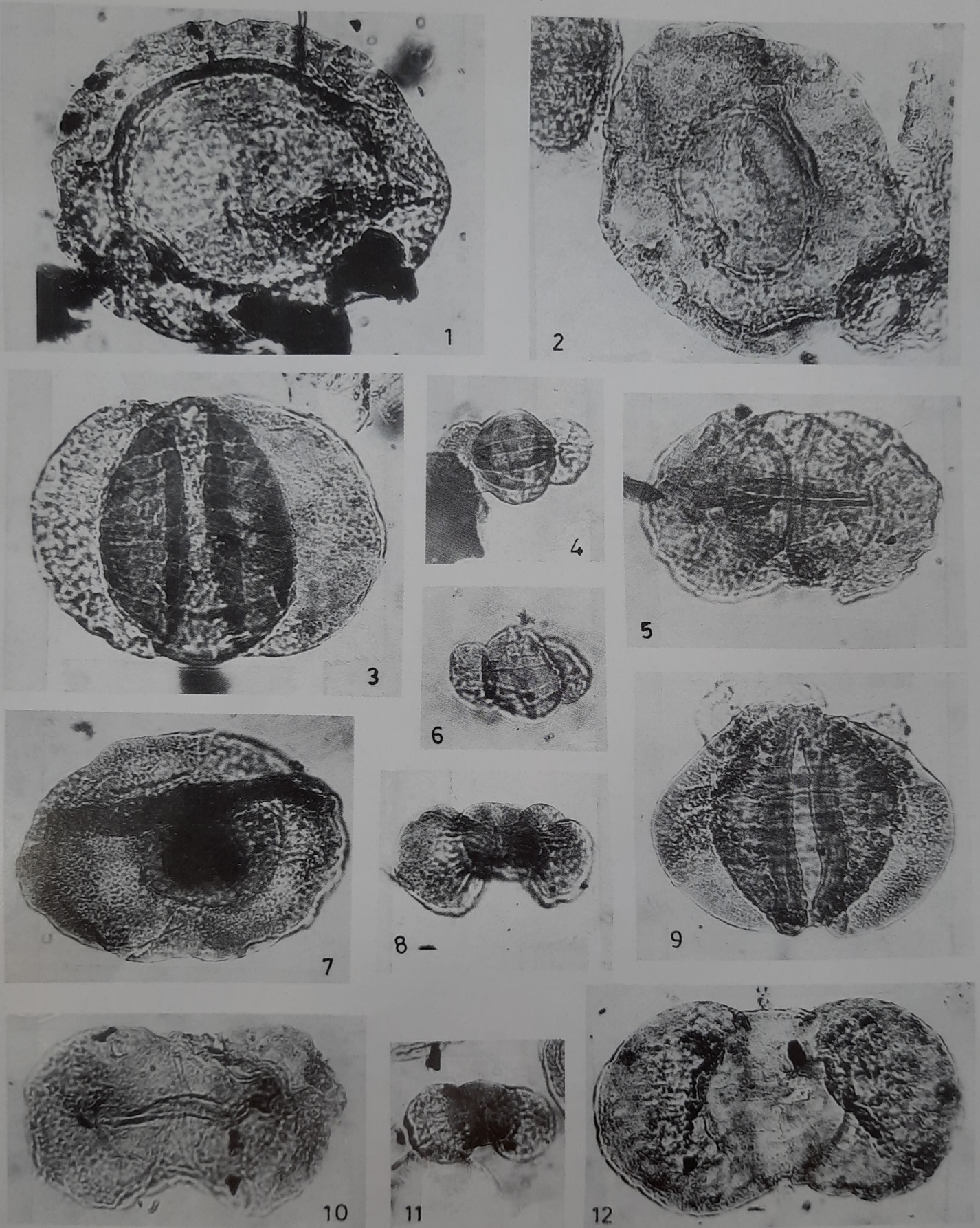


Plate 1

***Densipollenites kamthiensis* sp. nov.**

Pl.1, figs 7

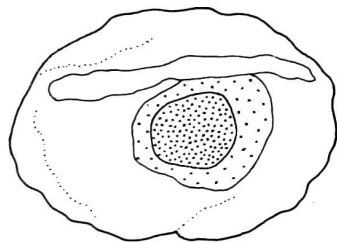
Holotype - Pl. 1, fig. 7; BSIP Slide No. 9324; Size 87.5 x 125.0 μm .

Locus typicus - Bore hole GGK-27, depth 188 m, Ramagundam area, Godavari Graben, India.

Horizon & Age - Raniganj Formation, Late Permian.

Diagnosis - Monosaccate, circular to subcircular, oval or of other derived shape. Overall size range 91 μm to 135 μm . Central body well defined, circular to subcircular, 44 μm to 67 μm in size with an inner body (Text-fig.2), 13 μm to 37 μm in size, without any haptotypic mark. Saccus completely covers the central body. Saccus with few folds and fine to medium intrareticulations. Marginal region in saccus is thicker.

Comparison - *D. indicus* Bharadwaj (1962), *D. densus* Bharadwaj & Srivastava (1969), *D. brevis* Lele & Srivastava (1977), *D. magnicarpus* Tiwari & Rana (1981) and *D. annulatus* sp. nov. all these species have a well defined central body but differ from *D. kamthiensis* sp. nov. in the absence of a well defined inner body. Other species of the genus *D. minimus* Venkatachala & Kar (1968) and *D. invisus* Bharadwaj & Salujha (1964) have ill defined to indistinct central body without an inner body and hence different.



Text-fig. 2 *Densipollenites kamthiensis* sp. nov. Holotype showing central body with an inner body 500 X

***Densipollenites marginalis* sp. nov.**

Pl.1, fig.2

Holotype - Pl.1, fig. 2; B.S.I.P. Slide No. 9521; Size 146x108 μm .

Locus typicus - Bore hole GGK-27; depth 73 m, Ramagundam Area, Godavari Graben, India.

Horizon & Age - Raniganj Formation, Late Permian.

Diagnosis - Monosaccate, circular to subcircular pollen grains, size range from 91 μm to 120 μm , with a distinct light brown to dark brown central body, 42 to 69 μm in size. Marginal rim present all around the central body (Text-fig.3). Saccus intrareticulations fine to medium.

Comparison - The specimens described here differ from other known species of *Densipollenites* in having a

marginal rim around the central body. *D. annulatus* sp. nov. though bears a thickening around central body differs in having a larger central body.

Genus - *Hamiapollenites* Wilson, 1962

Type species - *Hamiapollenites saccatus* Wilson, 1962

Hamiapollenites minimus sp. nov.

Pl.1, figs 4,6

Holotype - Pl. 1, fig. 6; B.S.I.P. Slide No. 9524; Size 35x54.5 μm

Locus typicus - Bore hole GJ-6, depth 258m, Bhopal-palli area, Godavari Graben, India.

Horizon & Age: Barren Measures Formation, Late Permian.

Diagnosis - Disaccate, diploxytonoid, small bilateral pollen grains, size range 35-45 x 50-82 μm . Central body larger than sacci, circular to subcircular, 35-45 x 30-37 μm in size, with 5-6 horizontal taeniae on proximal side and 3 vertical taeniae on distal side (Text-fig. 4). Exine scabrate. Saccus subspherical, smaller than central body, attachment equatorial on proximal side, subequatorial on distal side. Saccus intrareticulations fine.

Comparison: The specimens described above differ from other known species of *Hamiapollenites* in being much smaller in size.

Genus - *Striatopodocarpites* Soritsch & Sedova emend Bharadwaj, 1962

Type species - *Striatopodocarpites tojmensis* Sedova, 1956

***Striatopodocarpites multistriatus* sp. nov.**

Pl.1, fig. 12

Holotype - Pl.1, fig. 12; B.S.I.P. Slide No. 9340; Size 142.5 x 85 μm

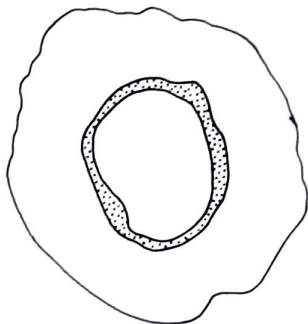
Locus typicus - Bore hole GGK-27, depth 114 m, Ramagundam Area, Godavari Graben, India.

Horizon & Age - Raniganj Formation, Late Permian.

Diagnosis - Disaccate, diploxytonoid, bilateral pollen grains, overall size range 80-105x100-157 μm , vertically oval to subcircular central body with an equatorial rim, and 12-23 horizontal striations (Text-fig. 5) with few to many vertical partitions on proximal side. Exine intramicroreticulate. Saccus attachment equatorial on proximal side and subequatorial on distal side with a broad distal sulcus, 12.5 to 20 μm straight to \pm biconvex.

Comparison - The specimens described here are different from other described species of *Striatopodocarpites*

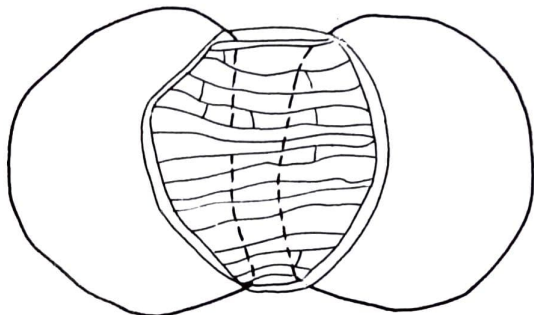
in having distinctly greater number (19-23) of horizontal striations. Bharadwaj and Dwivedi (1981) proposed a new combination *Striatopodocarpites multistriatus* from *Gondwanipollenites multistriatus* but these pollen grains have folds along the distal saccus attachment besides having a number of striations. Hence, these specimens should be placed under the genus *Crescentipollenites*.



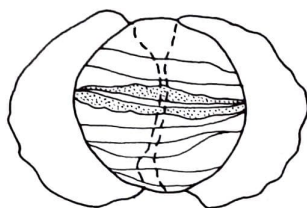
Text-fig 3. *Densipollenites marginalis* sp. nov. Holotype showing body with an equatorial rim. 500 x



Text-fig. 4. *Hamiapollenites minimus* sp. nov. Holotype showing taeniae on the central body, 500x



Text-fig 5. *Striatopodocarpites multistriatus* sp. nov., Holotype showing number of striations on central body. 500x



Text-fig 6. *Strotersporites crassiletus* sp. nov. Holotype showing central body with striations and a monoete mark having thick lip. 500x

Genus - *Strotersporites* Wilson, 1962

Type Species - *Strotersporites communis* Wilson, 1962

Strotersporites crassiletus sp. nov.

Pl.1, figs. 5,10

Holotype - Pl.1, fig. 5; B.S.I.P. Slide No. 9525; Size 70x110 μ m.

Locus typicus - Bore hole GGK-27, depth 73m, Ramagundam Area, Godavari Graben, India.

Horion & Age - Raniganj Formation, Late Permian

Diagnosis - Disaccate, diploxytonoid, bilateral pollen grains, 70- 80 x 107.5 - 145 μ m in size. Central body subcircular to rhomboidal with 5 to 12 horizontal striations and a prominent monoete mark having thick lips in between the median striations on proximal side (Text-fig. 6). Sacci \pm hemispherical attached equatorially on proximal side and subequatorially on distal side. Sulcus narrow, sometimes obscure. Saccus intrareticulations fine to medium.

Comparison - The present species differ from the type species *S. communis* Wilson (1962) in having subcircular to rhomboidal central body, thick lips along the monoete mark and narrow sulcus. *S. richteri* Klaus (1963) has horizontally oval, dense central body, vertical partitions in between the horizontal striations and broad biconvex sulcus. *S. jansonii* Klaus (1963) and *S. wilsonii* Klaus (1963) have \pm circular central body, broad sulcus and folds along the distal saccus attachment. *S. indicus* Tiwari (1965) and *S. rhombicus* Lele & Karim (1971) differs from the new species in having vertically oval to rhomboidal central body, comparatively broad sulcus and folds along the distal saccus attachment. Thus, the present species differs from all other species in having narrow sulcus, long monoete mark having thick lips.

Genus - *Crescentipollenites* Bharadwaj, Tiwari & Kar (1974)

Type species - *Crescentipollenites fusus* (Bharadwaj), Tiwari & Kar, 1974

Remarks - *Crescentipollenites* Bharadwaj, Tiwari & Kar (1974) accommodates disaccate pollen grains with horizontal striations on proximal side and folds along the distal saccus attachment, while *Lunatisporites* Leschik emend Bharadwaj (1974) comprises proximally taeniate pollen grains. Some nontaeniate species of *Lunatisporites* have characters of genus *Crescentipollenites*, hence these species have been transferred here to the genus *Crescentipollenites*.

Crescentipollenites korbaensis (Tiwari) comb. nov.

Synonym - *Lunatisporites korbaensis* Tiwari, 1965; *Palaeobotanist* 13(2): 168-214; Pl.7, fig. 145

Holotype - Tiwari, 1965, Pl.7, fig. 145

Locus typicus - Bore hole, R.341, Korba Coalfield, M.P., India.

Horizon & Age - Barakar Formation, Lower Permian.

***Crescentipollenites cephalis* (Kar & Bose) comb. nov.**

Synonym - *Lunatisporites cephalis* (Kar & Bose) *Annl.*
Mus. R. Afr. Cent., Sci géol., in-8o, 77: 73; pl. 9, figs 5-6.

Holotype - Kar & Bose, 1976, Pl. 9, fig. 5.

Locus typicus - Puits Christine, 2nd seam, Assise
a' Couches de houille

Horizon & Age - Lower Permian.

***Crescentipollenites globosus* (Maithy) comb. nov.**

Synonym - *Lunatisporites globosus* Maithy 1965;
Palaeobotanist 13(1): 299; Pl. 6, fig. 38

Holotype - Maithy, 1965; Pl. 6, fig. 38

Locus typicus - Giridih Coalfield, Bihar, India

Horizon & Age - Karharbari Formation, Lower Per-
mian.

***Crescentipollenites karharbarensis* (Maithy) comb.
nov.**

Synonym - *Striatites karharbarensis* Maithy, 1965;
Palaeobotanist 13(1): 297, Pl.5, fig. 32.

Holotype - Maithy, 1965; Pl.5, fig. 32

Locus typicus - Giridih Coalfield, Bihar, India

Horizon & Age - Karharbari Formation, Lower Per-
mian.

***Crescentipollenites multistriatus* (Banerji
& Maheshwari) comb. nov.**

Synonym - *Gondwanipollenites multistriatus* Banerji,
& Maheshwari, 1975, *Palaeobotanist* Vol. 22: 164; Pl. 3,
fig.s 30- 31.

- *Striatopodocarpites multistriatus* (Banerji & Mahesh-
wari 1975) Bharadwaj & Dwivedi, 1981, *Palaeobotanist*
Vol. 27: 1-54.

Holotype - Banerji & Maheshwari, 1975, Pl. 3, fig. 31

Locus typicus - South bank of Sukri River, 0.8 Km.
from Kaima, Auranga Coalfield, Bihar.

Horizon & Age - Panchet Group, Lower Triassic.

Remarks - Bharadwaj and Dwivedi (1981) made a
new combination *Striatopodocarpites multistriatus* from
Gondwanipollenites multistriatus. These pollen grains
have folds along the distal saccus attachment, a feature
characteristic of *Crescentipollenites*. Hence, a new com-
bination has been proposed here to transfer
Gondwanipollenites multistriatus Banerji & Maheshwari
(1975).

***Crescentipollenites densus* sp. nov.**

Pl. 1, fig. 3,9

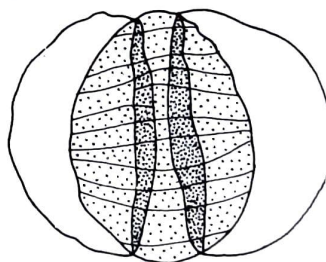
Holotype - Pl. 1, fig. 3; B.S.I.P. Slide No. 9522, Size
145x90 μ m.

Locus typicus - Bore hole GJ-3, Chelpur Area,
Godavari Graben, India.

Horizon & Age - Raniganj Formation, Late Permian.

Diagnosis - Disaccate, diploxylonoid pollen grains
with 70-106 x 105- 170.0 μ m in size range. Central body
 \pm vertically oval, 50-76 x 62-84 μ m in size, dark brown
having 11 to 14 horizontal striations on proximal side.
(Text-fig. 7). Sacci more than a hemisphere, attached
equatorially on proximal side and subequatorially on
distal side. Distal saccus attachment associated with
folds.

Comparison - The comparable species are - *C. mag-
nificus* Bharadwaj & Salujha (1964), *C. gondwanensis* and
C. brazilensis Bharadwaj, Kar & Navale (1976). *C.
brazilensis* approximates the present species in size
range and number of striations but differs in having thin
central body. The present species also resembles *C.
magnificus* and *C. gondwanensis* in size range but differs
in having thick, dark brown central body.



Text-fig. 7. *Crescentipollenites densus* sp. nov. Holotype showing dense
central body. 500x



Text-fig 8. *Aurangapollenites minimus* -Holotype showing pitcher
shaped sacci. 500x

Genus - *Aurangapollenites* Srivastava, 1977

**Type Species - *Aurangapollenites gurturiensis*
Srivastava, 1977**

***Aurangapollenites minimus* sp. nov.**

Pl.1, figs 8,11

Holotype - Pl. 1, fig. 8; B.S.I.P. Slide No. 9526, Size
42.5 x 77.5 μ m

Locus typicus - Bore hole GJ-6, depth 258 m, Bhopal-
palli area, Godavari Graben, India.

Horizon & Age - Raniganj Formation, Late Permian,

Diagnosis - Disaccate, diploxytonoid, bilateral pollen grains, overall size range 24-52.5 x 48-75 µm, with a circular mediumly thick central body, 22-48 x 22.5-40 µm in size, without any striation or mark (Text-fig. 8). Exine microverrucose. Sacchi pithcer shaped, attached equatorially on proximal side and subequatorially on distal side. Sulcus ± straight to biconcave.

Comparison - The specimens described here have the characters of the genus *Aurangapollenites* Srivastava (1977). Only two known species, *A. gurturiensis* Srivastava (1977) and *A. brevizonatus* (Tiwari) Bharadwaj & Dwivedi (1981), are bigger in size than the specimens described here.

Stratigraphic occurrence

After a careful study of the palynoflora of Talchir to Raniganj formations in Godavari Graben it has been observed that the above described species have restricted stratigraphic occurrence. The dominance of disaccate pollen grains begin from upper part of Barakar Formation and continue to occur upto Raniganj Formation. At this level some new taxa make their first appearance and become stratigraphically more significant viz. *Strotersporites crassiletus*, *Hamiapollenites minimus*, *Aurangapollenites minimus*, *Crescentipollenites densus*, *Densipollenites annulatus*, *D. marginalis*, and *D. kamthiensis*.

The association of *Densipollenites* with striate disaccates is recorded from Barren Measures as well as from younger sediments Raniganj Formation. On the basis of qualitative analysis it has been observed that all the species of the genus recorded in Barren Measures palynoflora continue to occur in Raniganj Formation. but the new species mentioned above have evolved only during Raniganj Formation.

All the new species described here are the first record from Godavari Graben and their presence in other basins have been observed but they are yet to be reported.

ACKNOWLEDGEMENT

The author is thankful to the authorities of Geological Survey of India for providing material for present study. Thanks are due to Dr. Suresh C. Srivastava, for going through the manuscript and giving useful suggestions.

REFERENCES

- Bhardwaj, D.C., & Dwivedi, A. (1981). Spores dispersae of the Barakar sediments from South Karanpura Coalfield, Bihar, India. *Palaeobotanist* 27(1): 21-94.
- Bhardwaj, D.C., Srivastava, Suresh C., Ramamnamurty, B.V. & Jha, Neerja (1984). Palynology of Kamthi Formation from Ramagundam-Mantheni area, Godavari Graben, Andhra Pradesh, India. *Palaeobotanist* 35(3): 318-330.
- Bharadwaj, D.C. & Srivastava, Shyam C. 1969. A Triassic mioflora from India. *Palaeontographica*, B125 (4-6): 119-149.
- Ghosh, T.K. (1968). Distribution of miospores in Tandur coal, Godavari Valley, Andhra Pradesh, South India. *Q. Jl geol. Min. metall. Soc. India* 40 (1) : 7-24.
- Jha, Neerja & Srivastava, Suresh C. (1984). Occurrence of megaspores in Kamthi Formation, Godavari Valley Coalfield, Andhra Pradesh *Geophytology* 14(1) : 121-122.
- Jha, Neerja & Srivastava, Suresh C. (1994). Kamthi Formation-Palynofloral diversity. (Abs.) *9th Int. Gond. Symp., Hyderabad*, 1994; 23-24.
- Moiz, A.A., Rama Rao, N.R. (1968). A preliminary study of spores dispersae in Ramagundam Coalfield, Godavari Coal Basin, A.P. *Curr. Sci.* 37(13) : 376.
- Ramanamurty, B.V. (1979). Report on the occurrence of coal seam in Kamthi Formation from Ramagundam area of Godavari Valley Coalfields, and its stratigraphic significance. *Geol. Surv. India Misc. Publ.* 45: 89-93.
- Ramanamurty, B.V. & Madhusudan Rao, C. (1987). A new classification of Lower Gondwana (Permian) lithostratigraphy of Ramagundam area, Godavari Valley Coalfield, Andhra Pradesh. *Proc. Nat. Sem. Coal Res. India.* (ed. R.M. Singh): 112-120.
- Raja Rao, C.S. (1982). Coal resources of Tamil Nadu, Andhra Pradesh, Orissa and Maharashtra. *Bull. geol. Surv. India Ser. A (45) Coalfields of India* vol. 2 : 9-40.
- Segroves, K.L. (1969). Saccate plant microfossils from the Permian of Western Australia. *Grana Palynol.* 9(1-3): 174-227.
- Srivastava, Suresh C. & Jha, Neerja (1986). A new monosaccate pollen genus from Kamthi Formation of Godavari Graben, Andhra Pradesh, India. *Geophytology* 16: (1) : 258-260.
- Srivastava, Suresh C. & Jha, Neerja (1990). Permian-Triassic palynofloral transition in Godavari Graben, Andhra Pradesh. *Palaeobotanist* 38: 92-97.
- Srivastava, Suresh C. & Jha, Neerja (1992). Permian palynostratigraphy in Ramakrishnapuram area, Godavari Graben, Andhra Pradesh, India. *Geophytology* 20 (2) : 83-95.
- Srivastava, Suresh C. & Jha, Neerja (1992). Palynostratigraphy of the Permian sediments in Manuguru area, Godavari Graben, Andhra Pradesh. *Geophytology* 22: 103-110.
- Srivastava, Suresh C. & Jha, Neerja (1993). Palynostratigraphy of Lower Gondwana sediments in Chintalpudi sub-basin, Godavari Graben, Andhra Pradesh. *India. Geophytology*, 23 (1) : 93-98.
- Srivastava, Suresh C. & Jha, Neerja (1994). Palynological dating of Lower Gondwana sediments in Sattupalli area, Chintalpudi sub-basin, Andhra Pradesh, India. *Palaeobotanist* 42(2) : 169-173.
- Srivastava, Suresh C. & Jha, Neerja (1995). Palynostratigraphy and correlation of Permian-Triassic sediments in Budharam area, Godavari Graben, India. *J. geol. Soc. India* 46: 647-653.
- Thiergart, G. & Frantz, U. (1962). Pollen and spores einer Kohlenprobe von Kothagudem, India. *Berich. Deutsch. Botanik. Gessells* IXXV (3) : 71-77.
- Tiwari, R.S. & Moiz, A.A. (1971). Palynological study of Lower Gondwana (Permian) Coals from Godavari Basin, India - 1. On some new miospore genera. *Palaeobotanist* 19 (1) : 95-104.
- Tiwari, R.S. & Rana, Vijaya (1981). *Spores dispersae* of some Lower and Middle Triassic sediments from Damodar Basin, India. *Palaeobotanist* 27(2): 190-220.