

PALYNOLOGY OF LOWER GONDWANA SEDIMENTS IN THE BHOPALPALLI AREA, GODAVARI GRABEN

SURESH C. SRIVASTAVA and NEERJA JHA

BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW-226007

ABSTRACT

Palynoflora recovered from 360 m thick sequence of bore core GJ-6 from Bhopalpalli area of Mulug coal belt is divided into three distinct palynoassemblages. Assemblage-I dominated by *Scheuringipollenites* shows Lower Barakar (Early Permian) affinity. Occurrence of some taxa viz. *Vitreisporites*, *Falcisporites*, *Lunatisporites*, *Corisaccites*, *Guttulapollenites*, *Gondisporites*, *Verticopollenites*, *Hindipollenites*, *Densipollenites* and *Weylandites* along with dominance of striate disaccates in Assemblages II and III indicate Raniganj (Late Permian) affinity. High incidence of *Parasaccites* alongwith striate disaccates in Assemblage III suggests that the climate towards the end of the Permian time tended to become colder. This evidence supports the contention of a third glacial phase during the Late Permian/Early Triassic (Panchet Stage).

Key words : Palynology, Lower Gondwana, Bhopalpalli area, Godavari graben.

INTRODUCTION

Bhopalpalli is a part of Mulug coal belt along south-eastern margin of Godavari sub-basin and is situated between the two active mining centres, Ramagundam in the north and Kothagudem in the south. In order to prove the continuity of the coal-bearing sediments of the Ramagundam area further south, the drilling operations in this area were conducted by Geological Survey of India. Bore core GJ-6 was drilled near Gopiapalli village in Bhopalpalli Block and is located in the north of bore core GJ-3. The details of the samples have been given in table - 1. The bore hole was closed at 470m in

Barakar Formation. The lithological succession from bottom to top consists of alternating sequence of medium to coarse-grained whitish feldspathic sandstone and thin coal bands in lower part of bore

Table 1: List of samples investigated in bore hole no. GJ-6 from Bhopalpalli area, Godavari Graben, Andhra Pradesh. *indicates fossil-yielding samples.

Sample No.	Depth in meters	Lithology
* 1	20	Laminated shale within coarse grained greenish sandstone.
2	58	Coarse grained greenish sandstone.
* 3	68	Current bedded sandstone
3A	69.3	Carbonaceous shale
* 4	77	Shaly micaceous sandstone
* 5	82-83	Sandy shale
6	120	Carbonaceous shale
7	136	Sandy black shale
* 8	160	Sandy shale
* 9	168	Carbonaceous shale
10	182	Greyish green shale
11	192	Greyish to greenish clay
* 12	211	Carbonaceous shale
* 13	223	Carbonaceous shale
* 14	244	Sandy shale
* 15	258	Carbonaceous shale
* 16	268	Carbonaceous shale
* 17	301-302	Sandy carb shale
* 18	310-311	Carbonaceous shale
* 19	322-323	Carbonaceous shale
* 20	357-360	Carbonaceous shale

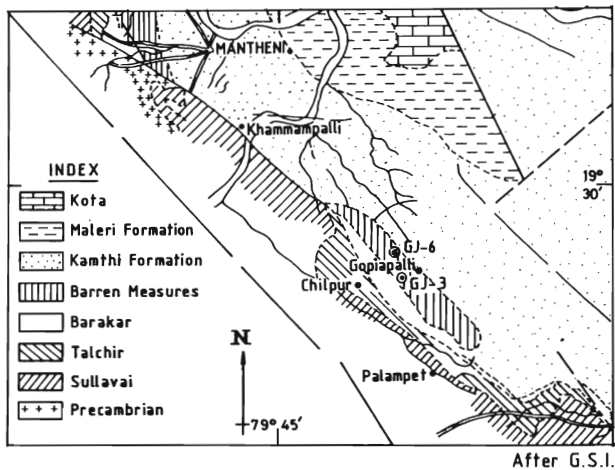


Fig. 1. Geological map of the Bhopalpalli area showing location of bore core GJ-6 (after G.S.I.).

core and greenish sandstone, grey to greyish white sandstone/siltstone/clay sequence and black shale, medium to coarse grained ferruginous brownish sandstone and clay at top. In all seven coal seams have been recorded in the bore core.

PALYNOLOGY

Palynoflora recovered from the subsurface sediments in bore core GJ-6 consists of 52 genera. A list of species has been given in table-2 and some important Late Permian taxa are presented in Pl. I. Three distinct palyno-assemblages have been recognised on the basis of quantitative and qualitative distribution of various palynotaxa (fig. 2).

Table 2: List of species recorded in bore core GJ-6 from Bhopalpalli area, Godavari Graben, A.P.

Name of Species	Barakar	Raniganj		
<i>Callumispora tenuis</i> Bharadwaj & Srivastava, 1969	+			
<i>Leiotriletes</i> sp.	+	+		
<i>Indotriradites korbaensis</i> Tiwari, 1964	+	+		
<i>Gondisporites raniganjensis</i> Bharadwaj, 1962		+		
<i>Lundbladispora willmotti</i> Balme, 1963		+		
<i>L. microconata</i> Bharadwaj & Tiwari, 1977		+		
<i>Lophotriletes rectus</i> Bharadwaj & Salujha, 1964	+	+		
<i>Verrucosisporites trisectus</i> Balme & Hennely, 1956		+		
<i>Horriditriletes rampurensis</i> Tiwari, 1968	+	+		
<i>H. ramosus</i> (Balme & Hennely) Bharadwaj & Salujha, 1964	+	+		
<i>Lobatissporites gondwanensis</i> Tiwari & Moiz, 1971		+		
<i>Brevitriletes communis</i> Bharadwaj & Srivastava emend. Tiwari & Singh, 1981	+	+		
<i>B. unicus</i> (Tiwari) Bharadwaj & Srivastava emend. Tiwari & Singh, 1981	+	+		
<i>Hennelysporites diversiformis</i> (Balme & Hennely) Tiwari, 1968		+		
<i>Microbaculispora tentula</i> Tiwari, 1965		+		
<i>Microfoveolatispora foveolata</i> Tiwari emend. Tiwari & Singh, 1981	+	+		
<i>Pseudoreticulatispora barakarensis</i> Bharadwaj & Srivastava, 1969	+			
<i>Osmundacidites pilatus</i> Tiwari & Rana, 1981		+		
<i>O. sennectus</i> Balme, 1963		+		
<i>Laevigatosporites colliensis</i> (Balme & Hennely) Venkatachala & Kar, 1968	+	+		
<i>Densipollenites invisus</i> Bharadwaj & Salujha, 1964		+		
<i>D. indicus</i> Bharadwaj, 1962				+
<i>D. magnicarpus</i> Tiwari & Rana, 1981				+
<i>Tiwariasporis simplex</i> (Tiwari) Maheshwari & Kar, 1967			+	+
<i>T. novus</i> Bharadwaj & Dwivedi, 1981				+
<i>Weylandites obscurus</i> (Tiwari) Bharadwaj & Dwivedi, 1981				+
<i>W. minutus</i> Bharadwaj & Srivastava, 1969				+
<i>W. circularis</i> Bharadwaj & Srivastava, 1969				+
<i>Parasaccites korbaensis</i> Bharadwaj & Tiwari, 1964			+	+
<i>P. obscurus</i> Tiwari, 1965			+	+
<i>P. distinctus</i> Tiwari, 1965			+	+
<i>P. diffusus</i> Tiwari, 1965			+	+
<i>P. talchirensis</i> Lele & Makada, 1972			+	
<i>Plicatipollenites ganjraensis</i> Saxena, 1971			+	
<i>Trochosporites</i> sp.			+	
<i>Kamthisaccites kamthiensis</i> Srivastava & Jha, 1986				+
<i>Lueckisporites crassus</i> Sinha, 1972				+
<i>L. sp.</i>				+
<i>Guttulapollenites hannonicus</i> Goubin, 1965				+
<i>Lunatisporites ovatus</i> (Goubin) Maheshwari & Banerji, 1975				+
<i>Lunatisporites</i> sp.				+
<i>Corisaccites alutus</i> Venkatachala & Kar, 1966				+
<i>Corisaccites vanus</i> Venkatachala & Kar, 1966				+
<i>Hamiapollenites minimus</i> Jha, 1996				+
<i>Striatites communis</i> Bharadwaj & Salujha, 1964			+	+
<i>S. solitus</i> Bharadwaj & Salujha, 1964			+	+
<i>S. tentulus</i> Tiwari, 1965			+	+
<i>Lahirites rarus</i> Bharadwaj & Salujha, 1964				+
<i>L. laevis</i> Tiwari, 1968				+
<i>L. rhombicus</i> Maithy, 1965			+	+
<i>Verticypollenites debilis</i> Venkatachala & Kar, 1968			+	+
<i>V. secretus</i> Bharadwaj, 1962				+
<i>V. finitimus</i> Bharadwaj, 1962				+
<i>Hindipollenites indicus</i> Bharadwaj, 1962				+
<i>Striatopodocarpites labrus</i> Tiwari, 1965			+	+
<i>S. decorus</i> Bharadwaj & Salujha, 1964			+	+
<i>S. brevis</i> Singh, 1972				+
<i>S. globosus</i> (Maheshwari) Bharadwaj & Dwivedi, 1981				+
<i>S. rotundus</i> (Maheshwari) Bharadwaj & Dwivedi, 1981			+	+
<i>S. subcircularis</i> Sinha, 1972			+	+
<i>S. multistriatus</i> Jha, 1996				+
<i>Faunipollenites parvus</i> Tiwari, 1965				+
<i>F. goraiensis</i> (Potonie & Lele) Maithy, 1965			+	+
<i>F. varius</i> Bharadwaj, 1962			+	+

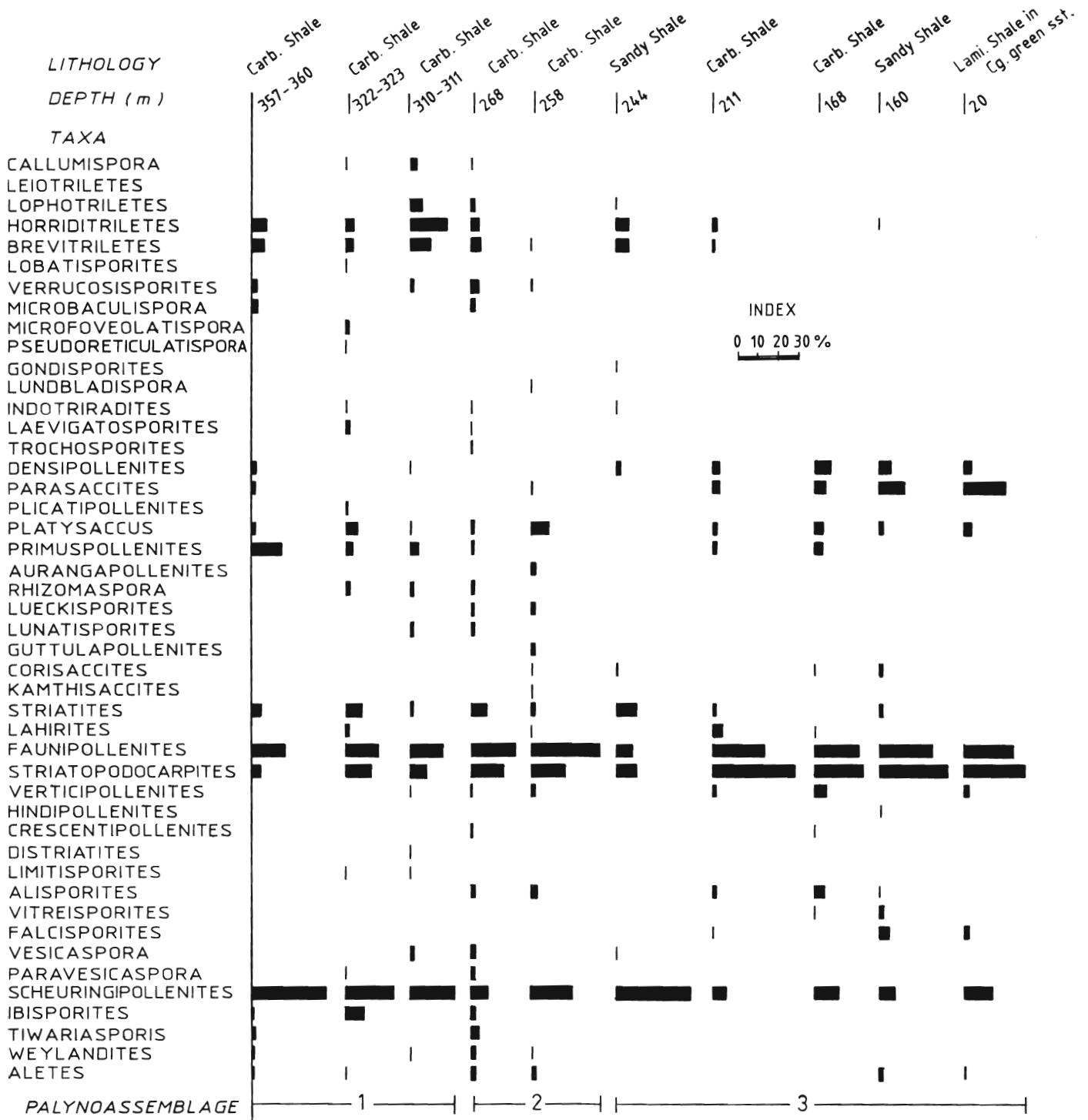


Fig. 2. Percentage distribution of various palynotaxa in bore core GJ-6.

<i>F. bharadwajii</i> Maheshwari, 1967		+
<i>F. singrauliensis</i> Sinha, 1972	+	
<i>F. gopadensis</i> Bharadwaj & Srivastava, 1969	+	+
<i>Strotersporites crassiletus</i> Jha, 1996		+
<i>Distriatites insolitus</i> Bharadwaj & Salujha, 1964	+	+
<i>Rhizomaspora indica</i> , Tiwari, 1965	+	+
<i>Primuspollenites levis</i> Tiwari, 1964	+	+
<i>Crescentipollenites globosus</i> (Maithy) Jha, 1996	+	+
<i>C. densus</i> Jha, 1996		+
<i>C. gondwanensis</i> (Maheshwari)		+
Bharadwaj, Tiwari & Kar, 1964		
<i>C. talchirensis</i> Lele, 1975	+	+
<i>Scheuringipollenites maximus</i> (Hart)	+	+
Tiwari, 1973		
<i>S. barakarensis</i> (Tiwari) Tiwari, 1973	+	+
<i>S. tentulus</i> (Tiwari) Tiwari, 1973	+	+
<i>Ibisporites diplosaccus</i> Tiwari, 1968	+	
<i>I. jhingurdahiensis</i> Sinha, 1972	+	+
<i>Platysaccus plicatus</i> Bharadwaj & Dwivedi, 1981	+	+
<i>P. papilionis</i> Potonie & Klaus, 1954	+	+
<i>Alisporites indarraensis</i> Segroves, 1969		+
<i>A. landianus</i> Balme, 1970		+
<i>Falcisporites nuthaliensis</i> (Clark) Balme, 1970		+
<i>Paravesicaspora ovata</i> (Balme & Hennelly)		+
Bharadwaj & Dwivedi, 1981		
<i>P. brevis</i> (Sinha) Bharadwaj & Dwivedi, 1981		+
<i>Vesicaspora luteus</i> Salujha, 1965		+
<i>Aurangapollenites minimus</i> Jha, 1996		+
<i>Vitreisporites pallidus</i> (Reissinger) Balme, 1970		+
<i>Chordasporites australiensis</i> de Jersey, 1962		+
<i>Limitisporites rectus</i> Leschik, 1956	+	
<i>Barakarites indicus</i> Bharadwaj & Tiwari, 1964	+	
<i>Inaperturopollenites</i> spp.	+	+

PALYNO-ASSEMBLAGE I

This assemblage has been recognised at 310-360m depth and is dominated by non-striate disaccates chiefly *Scheuringipollenites* (upto 36%). *Primuspollenites* (3-14%), *Platysaccus* (1-7%), *Ibisporites* (1-9%) and *Alisporites* (1%) are also present. The striate disaccates comprising *Faunipollenites* (15%), *Striatopodocarpites* (4-8%) and *Striatites* (2-8%) are sub dominant. Triletes are fairly well represented in this assemblage both quantitatively as well as qualitatively. These include *Leiotriletes*, *Lophotriletes*, *Callumispora*, *Lobatisporites*, *Verrucosisporites*, *Microbaculispora*, *Micr- ofoveolatispora*, *Pseudoreticulatispora*, *Horriditriletes*, *Brevitriletes*, *Indotriradites*. Aletes,

monoletes and monosaccates are rare. *Primuspollenites* is 14% at 357-360m.

PALYNO-ASSEMBLAGE II

This assemblage has been recognised at 258-268m depth. It shows dominance of striate disaccates chiefly *Faunipollenites* (up to 34%) and *Striatopodocarpites* (up to 17%). Qualitatively significant taxa recorded in this assemblage are *Lundbladispota*, *Lunatisporites*, *Verticypollenites*, *Gondisporites*, *Weylandites*, *Guttulapollenites*, *Corisaccites* and *Crescentipollenites*.

PALYNO-ASSEMBLAGE III

This assemblage has been demarcated at 244-20m depth. It also shows dominance of striate disaccates chiefly *Striatopodocarpites* (upto 40%) and *Faunipollenites* (up to 25%). The radial monosaccate taxa *Parasaccites* is upto 20% at 20m depth. *Densipollenites* is 1-7%. Triletes are poorly represented by *Horriditriletes* (2%) and *Brevitriletes* (1%). Some of the taxa viz., *Falcisporites*, *Vitreisporites*, *Gondisporites*, *Corisaccites*, and *Hindipollenites* are rare in percentage.

DISCUSSION

The presence of *Scheuringipollenites* in high percentages in association with striate disaccates in Assemblage-1 (depth 310-360m) suggests Lower Barakar affinity (Early Permian). This palynoflora compares well with the Lower Barakar palynoflora of Godavari as well as other basins in India (Bharadwaj and Srivastava, 1973; Tiwari, 1973; Srivastava, 1973; Bharadwaj, Navale and Anand-Prakash, 1974; Tiwari *et al.*, 1981; Srivastava and Anand-Prakash, 1984; Anand-Prakash and Srivastava, 1984; Sarate, 1986; Srivastava and Jha, 1992a, 1992b, 1995, 1996). All these assemblages are accommodated under *Scheuringipollenites barakarensis* Assemblage Zone (Tiwari and Tripathi, 1992). *Primuspollenites* is high (14%) in this assemblage at 357-360m depth (seam II_B). High incidence of *Primuspollenites* (14%) has also been observed in Queen Seam of Koyagudem area (Srivastava and Jha, 1996). Subdominance of *Primuspollenites* in association with

Scheuringipollenites has also been observed in bore core GGK-20 in Lower Barakar assemblage and in association with *Parasaccites* in Upper Karharbari assemblage (Srivastava and Jha, 1989). Queen Seam of Polampalli Incline in Yellandu Area is also characterised by association of *Primuspollenites* and *Scheuringipollenites* (Srivastava, 1987). *Primuspollenites* in high percentage in association with *Scheuringipollenites* has also been recorded from Bhadua, Khandia, Bali and Jatkuti coal seams of Giridih Coalfield (Srivastava, 1973) and in Unit-2 of Garu Formation, West Siang District (Srivastava and Bhattacharya, 1996).

Dominance of striate disaccates and appearance of taxa like *Lundbladispora*, *Lunatisporites*, *Corisaccites*, *Guttulapollenites*, *Gondisporites* and *Weylandites* in low percentage indicates Late Permian age. Assemblage II of the present investigation compares with the Assemblage I of GGK-27 and GGK-20 from Ramagundam area (Bharadwaj *et al.*, 1987), Assemblage-A of Chelpur area (Srivastava and Jha, 1987), Palynozone 6 of Ramakrishnapuram area (Srivastava and Jha, 1992b), Palynozone 7 of Budharam area (Srivastava and Jha, 1995) and Palynoassemblage 5 of Manuguru area (Srivastava and Jha, 1992a). The present Assemblage-II is also comparable with *Striatopodocarpites-Faunipollenites* Assemblage-Zone described by Tiwari and Tripathi (1992).

Dominance of striate disaccates and fairly well representation of *Parasaccites* (up to 20%) along with *Densipollenites* (up to 7%) is the characteristic association in Assemblage III of the bore core. *Densipollenites* along with striate disaccates is characteristic of Barren Measures palynoflora. However, this genus almost disappears in lower part of Raniganj Formation but appears again in upper part of Raniganj Formation and is differentiated by the restricted occurrence of the *D. magnicarpus*. Further, the presence of some younger taxa like *Falcisporites*, *Vitreisporites*, *Gondisporites*, *Verticipollenites*, *Hindipollenites*, *Corisaccites* also distinguishes it from the Barren Measures palynoflora. Hence the palynoassembl-

ages II and III represent Raniganj equivalent palynoassemblages in bore core GJ-6 in Bhopalpalli area.

The percentage of *Parasaccites* gradually increases from 3 to 20% between 211m to 20m depth. The high incidence of *Parasaccites* in association with dominance of striate disaccates is also observed in bore core GRK-25 from Ramakrishnapuram area, in bore core GJP-I from Jaipuram area (Srivastava and Jha, 1992b) of Godavari Graben. In South Rewa Basin Assemblage 5 of bore cores JHL-24, JHL-25 (Tiwari and Ram-Awatar, 1989), and Assemblage I of bore core UKD-8 (Tiwari and Ram-Awatar, 1987) also shows high incidence of *Parasaccites*. However, in the Raniganj Formation of Damodar Valley *Parasaccites* is present in *Striatopodocarpites-Densipollenites* Assemblage in low percentage. Occurrence of *Parasaccites* in high percentages is known in the Talchir Formation and also the Upper Karharbari sediments. Lithologically, the sediments in bore core GJ-6 which have yielded high percentage of *Parasaccites* shows greenish tinge. Hence, it is possible that towards the end of the Raniganj Formation (Late Permian) the climate of the region tended to become colder. However, the other spore genera, e.g., *Plicatipollenites*, *Callumisporea* which suggest cold climate in association with *Parasaccites*, not being present, could only mean a weak cool oscillation. Nevertheless, this evidence tends to extend support to the contention of Bharadwaj (1975) for the third glacial phase during Panchet Stage. However, the lithological evidence for this glaciation in India, is not available till now but it is necessary to search and think over in this direction, particularly in the Godavari Graben due to its close proximity to south pole during that time. Talchir-like climate has also been suggested during Upper Raniganj and Lower Panchet by Tiwari and Tripathi (1987). Late Permian/Triassic (?) plant microfossils have been reported from the sediments being considered to be of glacial origin, i.e. varve-like rhythmites, deposited on Sri Lankan fragment of the Gondwana and (Dahanayake *et al.*, 1989).

ACKNOWLEDGEMENT

The authors are thankful to the authorities of Geological Survey of India for providing the samples and necessary details.

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EXPLANATION OF PLATE

Plate I

(All magnifications x500)

Showing some significant palynotaxa from Late Permian palyno-assemblages.

1. *Crescentipollenites globosus* B.S.I.P. Slide No. 9481, Coordinates 113.1 x8.0.
2. *Weylandites circularis* B.S.I.P. Slide No. 9529, Coordinates 15.84x5.0.
3. *Osmundacidites pilatus* B.S.I.P. Slide No. 9339, Coordinates 112.2 x15.7.
4. *Brevitriletes unicus* B.S.I.P. Slide No. 9332, Coordinates 111.2 x10.2.
5. *Aurangapollenites minimus* B.S.I.P. Slide No. 9526, Coordinates 85.7 x18.1.
6. *Vitreisporites pallidus* B.S.I.P. Slide No. 9324, Coordinates 95.7 x19.8.
7. *Corisaccites alutus* B.S.I.P. Slide No. 9324, Coordinates 104.0 x12.6.
8. *Hamiapollenites minimus* B.S.I.P. Slide No. 9522, Coordinates 98.8 x7.2.
9. *Verrucosiporites surangei* B.S.I.P. Slide No. 9339a, Coordinates 96.5 x5.3.
10. *Strotersporites crassiletus* B.S.I.P. Slide No. 9341, Coordinates 96.0 x5.0.
11. *Paravesicaspora nilssoni* B.S.I.P. Slide No. 9336, Coordinates 12.6 x90.0.
12. *Kamthisaccites kanthiensis* B.S.I.P. Slide No. 9480, Coordinates 101.7 x19.1.

