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Palynological expression about Permian-Triassic transition in the Talcher Coalfield, Orissa, India

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ABSTRACT

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A Permian-Triassic palynofloral transition is recorded in Borehole TP-8, Talcher Coalfield, Orissa, India. The change of palynoflora from Late Permian to Early Triassic is gradual and not abrupt. The variation in the pattern of changeover of the palynomorph distribution at P/Tr transition in Talcher Coalfield, Mahanadi Basin and Raniganj Coalfield, Damodar Basin is discussed.

Key-words—Palynology, Permian-Triassic transition, Talcher Coalfield, Orissa.

भारत के उड़ीसा प्रान्त के तालचेर कोयला क्षेत्र में परमियन-ट्रायसिक संक्रमण का परागाणविक विवेचन

अर्चना त्रिपाठी

सारांश

भारत के उड़ीसा प्रान्त के तालचेर कोयला क्षेत्र के वेध छिद्र टी.पी.-8 में एक परमियन-ट्रायसिक परागाणुवनस्पतिजातीय अनुक्रम अंकित किया गया है। अन्तिम परमियन से प्रारंभिक ट्रायसिक के मध्य परागाणुवनस्पतिजात में परिवर्तन शनैः - शनैः है तथा यह आकस्मिक नहीं है। प्रस्तुत शोध पत्र में तालचेर कोयला क्षेत्र, महानदी द्रोणी तथा रानीगंज कोयला क्षेत्र, दामोदर द्रोणी में पी./टी. संक्रमण पर परागाणु रूप वितरण के परिवर्तन विन्यास में वैविध्य की चर्चा की गयी है।

संकेत शब्द—परागाणुविज्ञान, परमियन-ट्रायसिक संक्रमण, तालचेर कोयला क्षेत्र, उड़ीसा.

INTRODUCTION

EARLIER palynological analyses of sediments in the Talcher Coalfield have shown the presence of equivalent Late Permian palynofloras (Tiwari *et al.*, 1991; Tripathi, 1996a; Tripathi & Bhattacharyya, 2001). The palynodata corroborate the observation made by Subramanium (1959-1960) of the presence of Upper Permian strata in the Talcher Coalfield on the basis of plant megafossils. The recovery of Early Triassic palynoassemblages in the sediments of Borehole TP-8, Chendipada (Tripathi, 1996a, Fig. 1) overlying the Late Permian palynoassemblage bearing levels prompted the present analysis of the Permian-Triassic boundary in the Talcher Coalfield. Thus the data from closely spaced borecore samples were analysed critically to delineate, if possible, the Permian-Triassic boundary, in this coalfield.

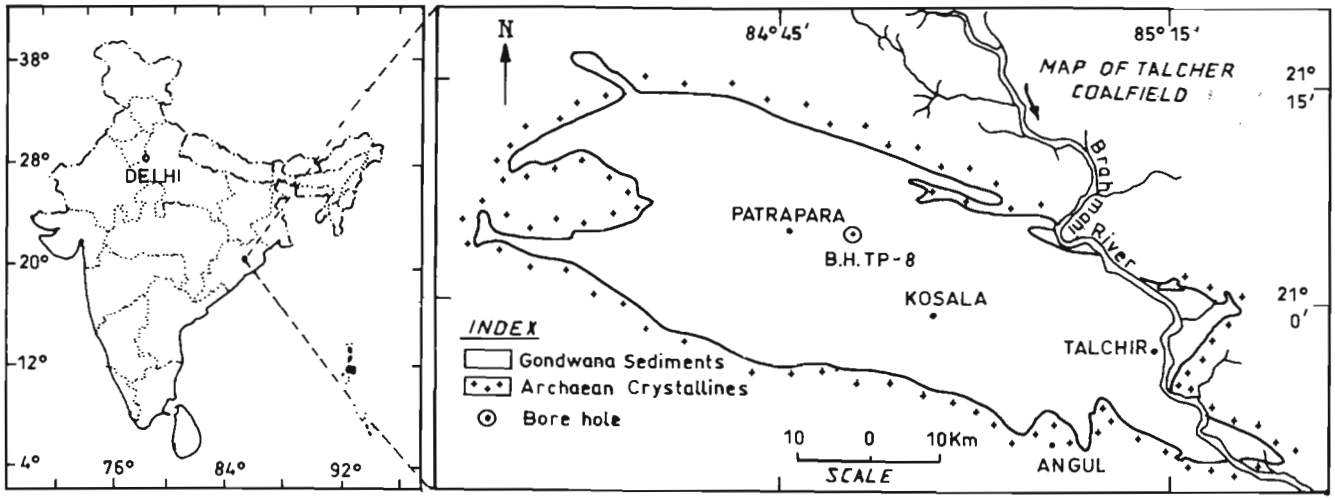


Fig. 1—Map of India with enlarged portion showing location of Borehole TP-8, Talcher Coalfield

PALYNOLOGICAL OBSERVATIONS

The Borehole TP-8 provided palynoflora considered transitional from Late Permian to Early Triassic. Palynologically, the top-most coal-bearing horizon (374.00-404.00 m depth) is dated as Late Permian while overlying strata at 367.50 m and above are dated as Early Triassic (Tripathi & Bhattacharyy 2001). Detailed analyses of samples between 392.00 and 361.00 m depths (Fig. 2) are plotted in Fig. 3 and Fig. 4. Quantitatively the assemblage (up to 367.50 m) is dominated by striate bisaccate pollen grains while at 361.00 m it is dominated by non-striate bisaccates *Satsangisaccites* Bharadwaj & Srivastava and *Falcisporites* Leschik emend. Klaus. The composition of the palynoflora permits identification of two assemblages (Fig. 6; Pl. 1.1-16) The Assemblage I recorded at depth interval 404-371.50 m has the presence of marker taxa *Navalesporites spinosus, Gondisporites raniganjensis, Densipollenites magnicorpus, Praecolpatites sinuosus* and

S.No.	Depth in m	Lithology	Yield	Preservation	Remarks
1	361.00	Shale band in run of sandstone	Rich	Good	Very rich in other plant tissues
2	367.50	Sandstone with carbonaceous layer	Rich	Good	Very rich in other plant tissues
3	371.50	Grey shale	Common	Poor	Rich in black wood fragments
4	*374.00	Grey shale	Rare	Poor	Rich in black wood fragments
5	*377.00	Grey shale	Rare	Poor	Rich in other plant tissues
6	383.00	Grey shale	Rich	Good	Rich in other plant tissues
7	386.00	Carbonaceous shale	Rich	Good	Rich in other plant tissues
8	*392.00	Coal	Rich	Poor	Other plant tissues rare
9	*404.00	Grey shale	Rare	Poor	Organic matter rare

Fig. 2—List of samples from Borehole TP-8, Talcher Coalfield detailing the lithology, together with yield and preservation of palynomorphs and other plant material. The samples marked with an asterisk are analysed qualitatively only, while others qualitatively as well as quantitatively.

PLATE 1

(Scale bar in figure 6 is 10 μm and for all the figures)

1. *Gondisporites raniganjensis*
2. *Callumispora gretensis*
3. *Navalesporites spinosus*
4. *Weylandites indicus*
5. *Playfordiaspora cancellosa*
6. *Densipollenites densus*
7. *Osmundacidites senectus*
8. *Arcuatipollenites pellucidus*
9. *Densipollenites magnicorpus*
10. *Guttulapollenites hannonicus*
11. *Satsangisaccites nidpurensis*
12. *Krempipollenites indicus*
13. *Falcisporites stabilis*
14. *Striatopodocarpites magnificus*
15. *Quadrisporites* sp.
16. *Leiosphaeridia* sp.

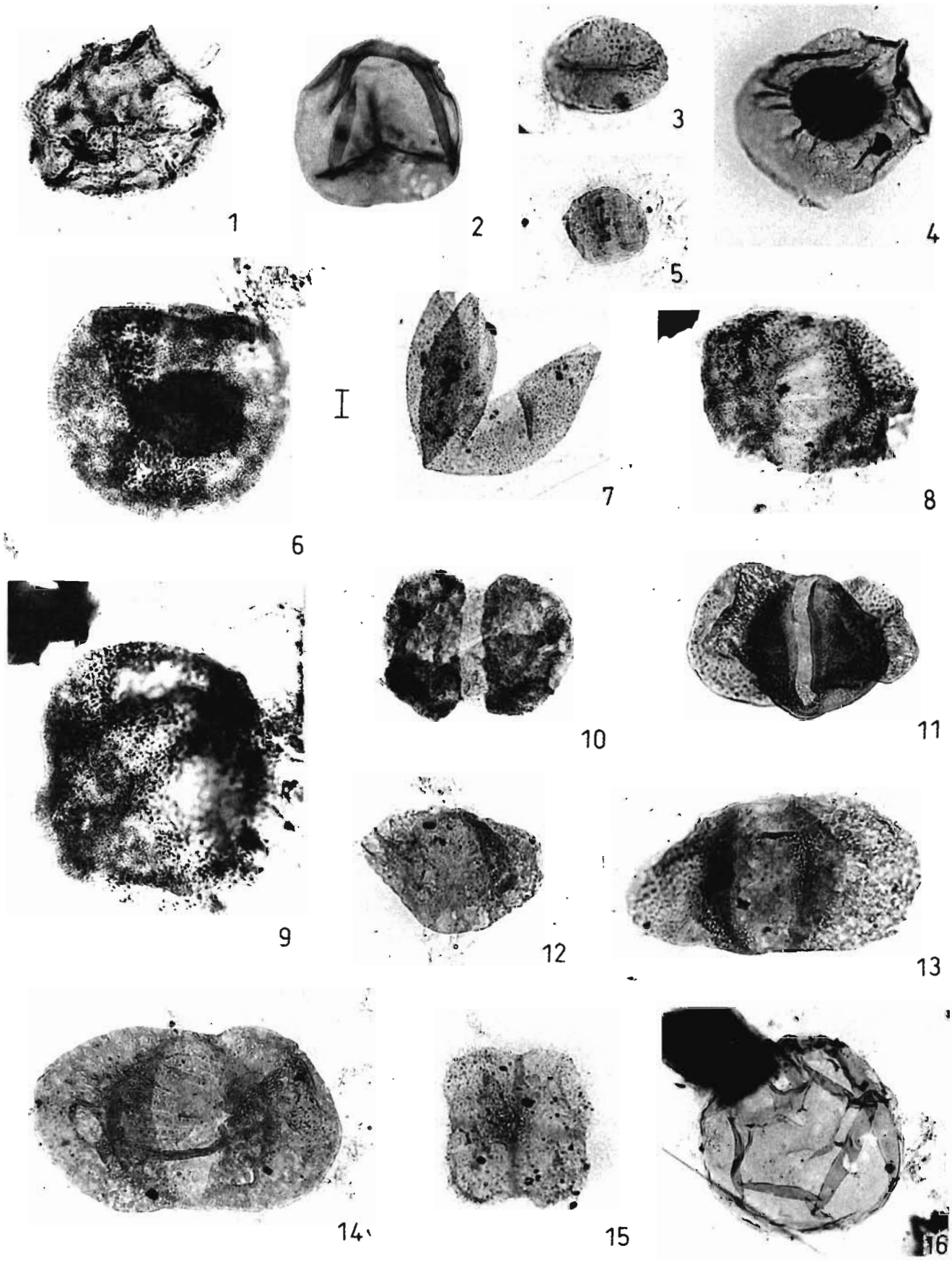


PLATE 1

	← Permian →						← Triassic →		
Palynotaxa\Depth of Sample	**404.00**	**392.00**	**386.00**	**383.00**	**377.00**	**374.00**	**371.50**	**367.50**	**361.00**
Striatopodocarpites	+	+	50.0	35.2	+	+	47.0	44.0	11.2
Faunipollenites	+	+	12.0	10.6	+	+	13.0	8.0	1.6
Scheuringipollenites	+	+	9.0	6.0	+	+	3.0	2.0	3.2
Crescentipollenites	+	+	2.0	3.6	+	+	7.0	3.0	
Verticipollenites + Striatites	+	+	3.0	+	+	+	4.0		
Densipollenites	+	+	6.0	8.1	+	+	19.0	7.0	
Horriditriletes	+	+	1.0			+			
Cyclogranisporites + Cyclobaculisporites	+	+	3.0				3.0		
Satsangisaccites			4.0	10	+	+		2.0	28.0
Falcisporites	+	+	4.0	13.1	+	+		3.0	17.6
Parasaccites + Plicatipollenites				0.5		+	1.0		0.8
Weylandites				0.5	+			1.0	11.2
Parasaccites					+	+		6.0	
Callumispora				1.5	+				0.8
Platysaccus + Cuneatisporites					+			3.0	1.6
Lophotriletes + Camptotriletes			1.0						3.3
Leiosphaeridia	+		2.0		+	+	1.0	1.0	1.0
Quadrisporites	+		3.0	2.5	+	+	1.0	2.0	
Krempipollenites				2.5	+			3.0	3.2
Arcuatipollenites				.05	+		1.0	3.0	1.6
Guttulapollenites								1.0	3.2
Osmundacidites								5.0	4.0
Alisporites								3.0	1.6
Calamospora									0.8
Densoisporites									0.8
Playfordiaspora									4.0
Thymospora				0.5					0.8

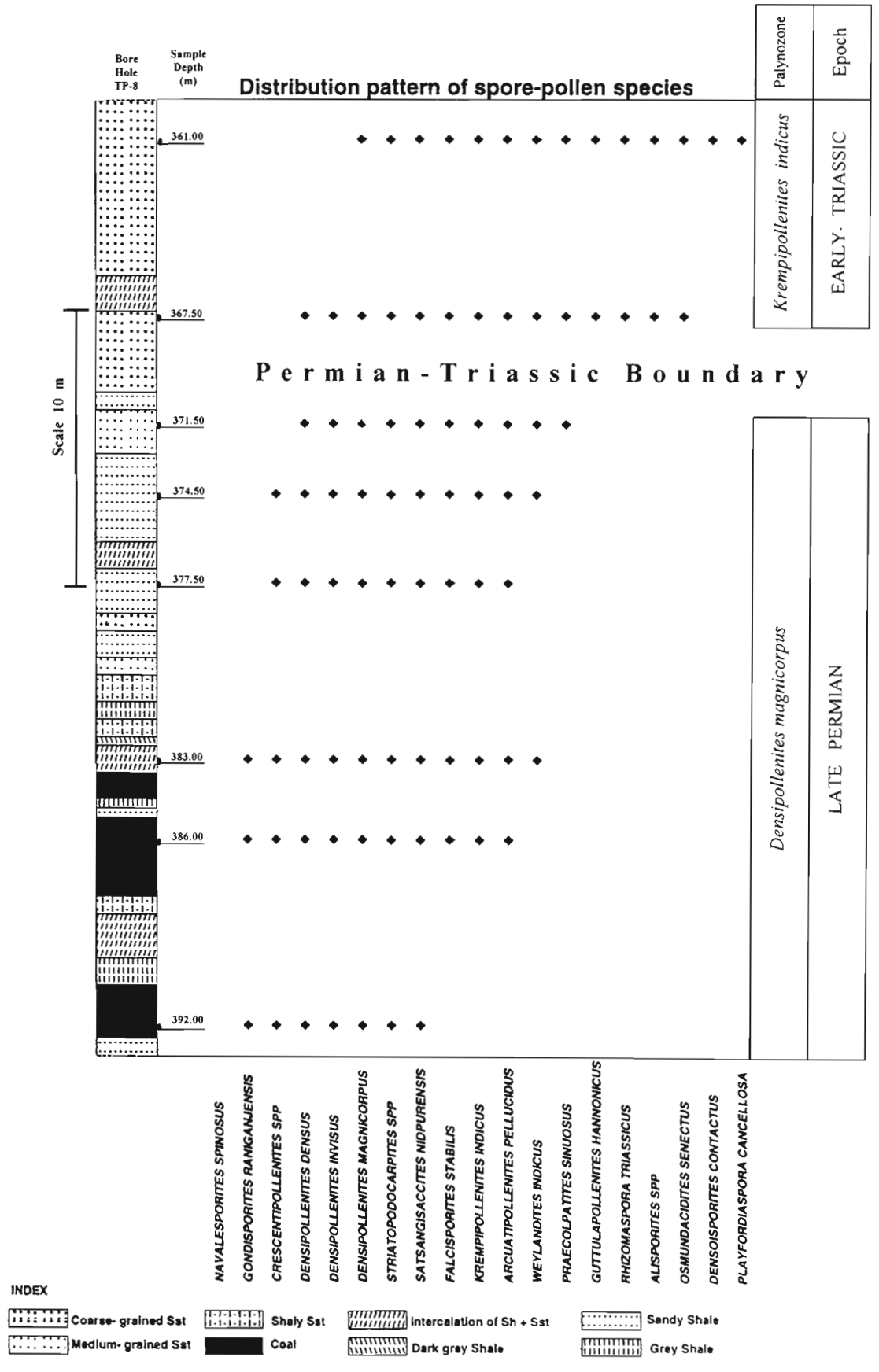
Fig. 3—Relative percentage frequency of spores-pollen in the samples of Borehole TP-8, Talcher Coalfield, Orissa. Counts are based on a total of more than 200 palynomorphs.

Weylandites indicus in striate bisaccate (*Striatopodocarpites*) dominating palynoflora. It is correlatable with the *Densipollenites magnicorpus* Assemblage Zone of Tiwari and Tripathi (1992). The Assemblage I recorded at depth interval 367.50-361.00 m has the Early Triassic marker taxa – *Osmundacidites senectus, Rhizomospora triassica, Arcuatipollenites* spp., *Alisporites* spp., *Playfordiaspora cancellosa* and *Densoisporites contactus* along with abundance/dominance of the nonstriate bisaccate (*Satsangisaccites nidpurensis, Falcisporites stabilis* & *Krempipollenites indicus*). This assemblage is comparable with the *Krempipollenites indicus* Assemblage Zone of Tiwari and Tripathi (1992).

The taxa *Satsangisaccites* and *Falcisporites* make their appearance at 392.00 m and show increased frequencies at 383.00 m with a short decline and rise again to dominance at 361.00 m. A marked change in the palynoflora heralds in the last phase of the coal sequence. Beside these two taxa, other stratigraphically significant forms (*Arcuatipollenites* Tiwari & Vijaya and *Krempipollenites* Tiwari & Vijaya) appear and impart qualitative distinction at 386.00 m. The samples at 367.50 m and 361.00 m contain additional Early Triassic marker forms (*Alisporites* Daugherty emend. Jansonius, *Osmundacidites* Couper); and at 361.00 m *Densoisporites* Weyland & Krieger emend. Dettmann and *Playfordiaspora* Maheshwari & Banerji emend. Vijaya also are introduced. The observed presence of

→

Fig. 4—Composite figure showing the lithocolumn of Borehole TP-8 with sample depth analysed, distribution pattern of stratigraphically important spore-pollen species and the palynozones recorded in the sequence. Palynozone after Tiwari & Tripathi 1992.


Bore Hole TP-8
Sample Depth (m)
Distribution pattern of spore-pollen species
Palynozone
Epoch
361.00
367.50
371.50
374.50
377.50
383.00
386.00
392.00
Scale 10 m
Permian-Triassic Boundary
Krempipollenites indicus
EARLY TRIASSIC
Densipollenites magnicorpus
LATE PERMIAN
NAVALESPORITES SPINOSUS
GONDISPORITES RANGANJENSIS
CRESCENTIPOLLENITES SPP
DENSIPOLLENITES DENSUS
DENSIPOLLENITES INVISUS
DENSIPOLLENITES MAGNICORPUS
STRIATOPODOCARPITES SPP
SATSANGISACCITES NIDPURENSIS
FALCISPORITES STABILIS
KREMPIPOLLENITES INDICUS
ARCUATIPOLLENITES PELLUCIDUS
WEYLANDITES INDICUS
PRAECOLPATITES SINUOSUS
GUTTULAPOLLENITES HANNONICUS
RHIZOMASPORA TRIASSICUS
ALISPORITES SPP
OSMUNDACIDITES SENECTUS
DENSOISPORITES CONTACTUS
PLAYFORDIASPORA CANCELLOSA
INDEX
Coarse- grained Sst
Medium- grained Sst
Shaly Sst
Coal
Intercalation of Sh + Sst
Dark grey Shale
Sandy Shale
Grey Shale

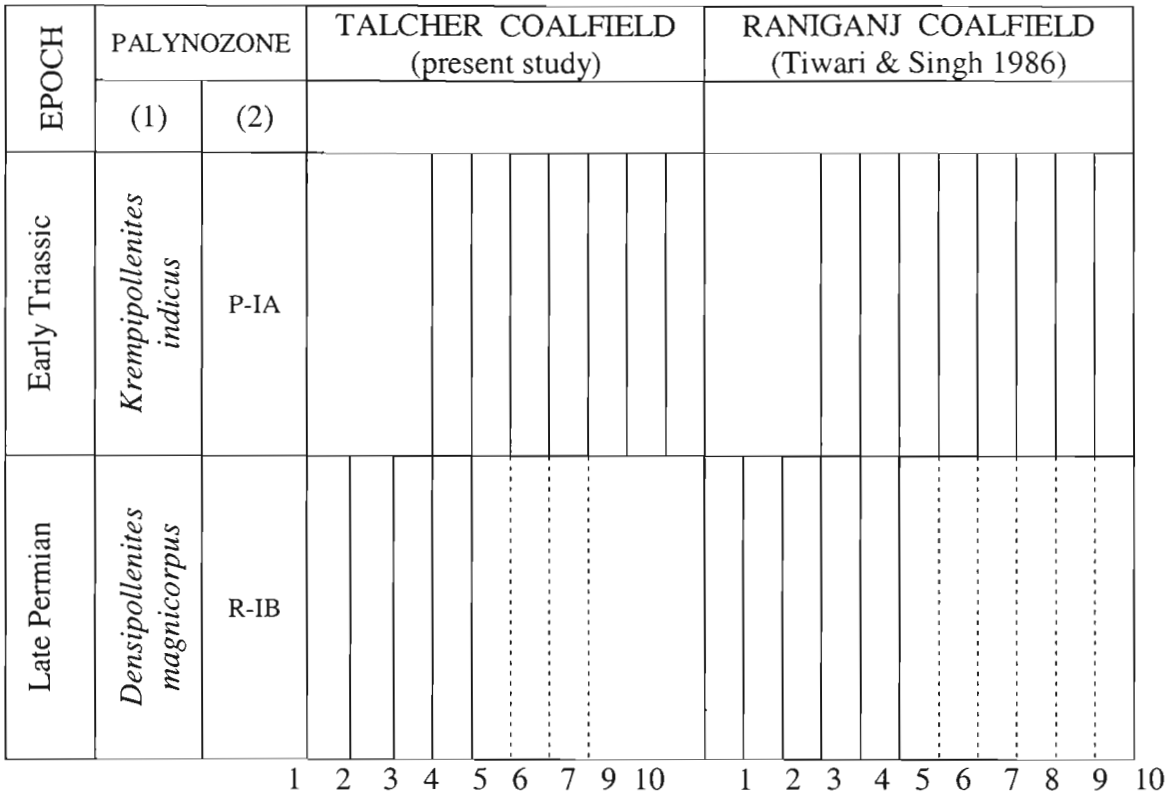


Fig. 5— Pattern of occurrence of marker spore-pollen taxa in Talcher and Raniganj Coalfields across Permian-Triassic boundary. Palynozone (1) after Tiwari & Tripathi 1992; (2) after Tiwari & Singh 1986. Key to numbered genera: 1- *Gondisporites*, 2- *Navalesporites*, 3- *Densipollenites*, 4- *Striatopodocarpites*, 5- *Krempipollenites*, 6- *Satsangisaccites* + *Falcisporites*, 7- *Arcuatipollenites*, 8- *Lundbladispora*, 9- *Densoisporites*, 10- *Playfordiaspora*.

acritarchs throughout the sequence (Fig. 3), though in small quantities, is significant and indicates continuity of the palynoflora and palaeoenvironment. Thus, the palynofloral change from typical Late Permian to Early Triassic is gradual and distinct.

DISCUSSION

The palynological results from Borehole TP-8 indicate that the studied interval represents a transition from Late Permian to Early Triassic (Fig. 4). The change is recorded well within the last phase of the coal-bearing sequence. Palynologically the Permian-Triassic boundary is drawn between the depth interval 371.50-367.50 m. A comparison of the pattern of palynofloral change at the Permian-Triassic boundary in the Talcher and Raniganj coalfields exhibits few differences (Fig. 5). The absence of cavate spores *Lundbladispora* Balme emend. Playford and *Densoisporites* Weyland & Krieger emend. Dettmann in the studied latest Permian palynoflora is striking. These forms reportedly appear in the end-Permian palynoassemblage of the Raniganj Coalfield (Vijaya & Tiwari, 1986). Also, the Early Triassic palynoflora in the Talcher Coalfield has abundant of *Satsangisaccites* to the extent of dominance, instead of *Krempipollenites* Tiwari & Vijaya as reported in the Raniganj Coalfield (Tiwari & Singh, 1983, 1986). These quantitative differences of spores and pollen may reflect climatic differences between the two regions under discussion. A regional provincialism has already been interpreted in the Upper Permian palynoassemblages of various Indian Gondwana basins (Tripathi, 1996b).

Information regarding the yield and preservation of spores-pollen and other plant material from the samples studied here in is presented in Fig. 2. An assessment of this figure shows that the sequence has a good yield of organic matter. The samples from 392.00-383.00 m and 371.50-361.00 m are rich in palynomorphs whereas these are rare in samples at 377.00-374.00 m. The samples from 374.00 and 371.50 m are rich in woody fragments, the remaining samples are rich in other plant tissues. The abundance of other plant tissues has been interpreted to indicate a near shore environment (Pocock *et al.*, 1988; Traverse, 1988). However, no lithological evidence is available for inferring such an environment in Talcher Coalfield. The palynological preservation is poor in the depth interval of 371.50-377.00 m depth, but the other samples (above

Alisporites asansoliensis Maheshwari & Banerji 1975
Alisporites landianus Balme 1970
Arcuatipollenites ovatus Tiwari & Vijaya 1995
Arcuatipollenites pellucidus Tiwari & Vijaya 1995
Crescentipollenites fuscus Bharadwaj, Tiwari & Kar 1974
Crescentipollenites gondwanensis Bharadwaj, Tiwari & Kar 1974
Densipollenites densus Bharadwaj & Srivastava 1969
Densipollenites invisus Bharadwaj & Salujha 1964
Densipollenites magnicorpus Tiwari & Rana 1981
Densoisporites contactus Bharadwaj & Tiwari 1977
Falcisporites stabilis Balme 1970
Gondisporites raniganjensis Bharadwaj 1962
Guttulapollenites hannonicus Goubin 1965
Krempipollenites indicus Tiwari & Vijaya 1995
Navalesporites spinosus Sarate & Ram-Awatar 1984
Osmundacidites senectus Balme 1963
Playfordiaspora cancellosa (Playford & Dettmann) Maheshwari & Banerji emend. Vijaya 1995
Praecolpatites sinuosus (Balme & Hennelly) Bharadwaj & Srivastava 1969
Rhizomaspora triassica Tiwari & Rana 1981
Satsangisaccites nidpurensis Bharadwaj & Srivastava 1969
Striatopodocarpites decorus Bharadwaj & Salujha 1964
Striatopodocarpites diffusus Bharadwaj & Salujha 1964
Striatopodocarpites magnificus Bharadwaj & Salujha 1964
Weylandites indicus Bharadwaj & Srivastava 1969

Fig. 6—Alphabetical list of spore-pollen species referred in the paper.

and below these depths) show good preservation. This points to a perturbation in the conditions prevailing during deposition of these sediments. Thus palynologically the transitional period from Permian to Triassic evidences a short span of changing palaeoenviromental conditions.

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