Early Permian palynoassemblage from Ajay River Section, Damodar Basin, India

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The first record of spore-pollen assemblage from the khaki-green silty shale and mudstone lithounits exposed along the right bank of Ajay River section in Raniganj Coalfield, West Bengal has been documented. Compositionally, the assemblage is diversified, represented by 20 genera; however, quantitative determination of the palynomorphs could not be made because of their scanty recovery. On comparison a close similarity between the present assemblage and some of the Upper Talchir palynoassemblages known from Indian peninsula has been revealed by the frequent occurrence of genera *Jayantisporites*, *Plicatipollenites*, *Caheniasaccites*, *Striatopodocarpites*, *Crescentipollenites* and *Sahnites*. The other significant taxa, although rare, in association are — *Microbaculispora*, *Microfoveolatispora*, *Verrucosisporites*, *Scheuringipollenites* and *Potonieisporites*. The biostratigraphical significance of the present palynological finding is that it supports the presence of the upper sedimentary cyclic phase of Talchir deposits in this section and dates it as Sakmarian. The vegetation was not impoverished as it is reflected by palyno-diversity although taphonomic factors have distorted the organic remains.

Key-words— Palynology, Early Permian, Talchir Formation, Damodar Basin.

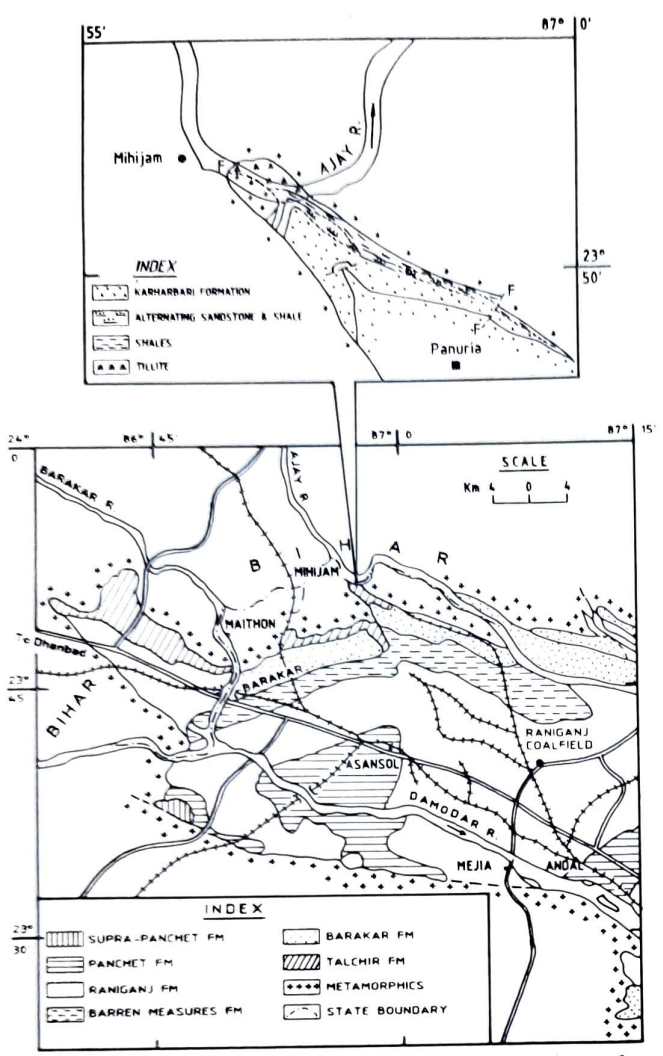
INTRODUCTION

THE Raniganj Coalfield covers an extensive area in West Bengal and constitutes the most easterly part of the Damodar graben. It is bounded on north, west and south by Archaeans; and to the east, the alluvium and laterite cover the Gondwana sediments (Map 1).

The study of Talchir Formation, comprising the basalmost lithounit of the Gondwana Sequence on Indian peninsula, continues to be facinating because this lithounit encompasses the evidence of great glaciation and beginning of *Glossopteris* emergence. The Damodar Valley coalfields are the ideal areas for the study of Talchir sediments because of the long strech of their occurrences. The Talchirs directly rests on metamophic rocks of Precambrian age. They are predominantly dull-green, silty sediments and boulder beds laid down on uneven denuded land surface, and exhibit considerable variation in their thickness in lateral extent. The Talchirs comprise fluvio-glacial sediments distinguishable by their characteristic lithological features, and consitute a mappable unit.

In Raniganj Coalfield, Talchirs are exposed as a tract of variable width adjoining northern edge to the north-east, pitching in a triangular-shaped area between Mihijam and Panuria along the Ajay river (Map-1). The complete cyclic deposition of Talchir Formation in the Raniganj Coalfied is described by Ghosh and Mitra (1975) who divided the succession into nine units. From their description (p. 42-43), it is clear that the lower sedimentary cyclic deposits are not present in the Ajay River section. In the succession, streched along the loop of the Ajay River, the characteristic Talchir lithology, i.e., needle shales, varves and fine grained siltstone, are not observable. The progressive thinning of Talchir Formation in north-eastern part seems to have resulted from the non-deposition of lower cycle of sediments.

The collection of the material for the present study was made from a little distance from the Basal Tillite (Map 1). Ghosh and Mitra (1975) have described that the basement at the tillite contact bears very finely developed striations in Ajay River section. The lithounit investigated for palynological contents is correlated with the younger unit, i.e.



Map 1 Diagrammatic sketch of the riverloop to show the nature of Talchir sediments exposed in Ajay River section (based on present field observations and description by Ghosh & Mitra 1975), Raniganj Coalfield, Damodar Basin.

Unit Seven, overlying the Basal Boulder Bed (Table 1). Because of the repetitive strike faults, the Talchir sediments reoccur after a short stretch, as is shown in Map 1.

In total, 25 samples were collected from the outcrop of Talchir sediments exposed along the river-loop (Map 1). Based on lithological characters of the rock samples, and the approximate stretch of each rock-unit, a lithocolumn is drawn (Figure 1). Only eleven samples have proved to be productive (marked with an asterisk). The recovery of spores and pollen in general is fair to scanty in these samples (Table 2). Yet the thorough search of the palynological slides has revealed significant qualitative diversity of the spores and pollen taxa (Table 3).

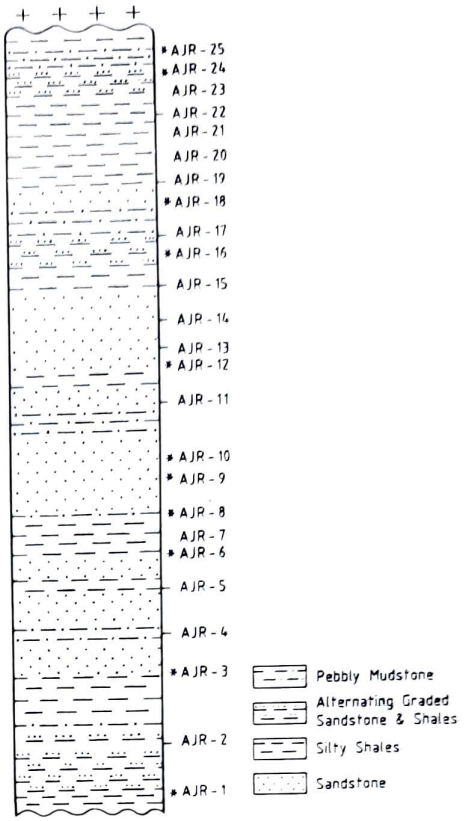


Figure 1. Lithocolumn of Talchir sediments in Ajay River.

Palyno-composition

Qualitative assessment of the total composition reveals the presence of many characteristic taxa, documented in Table 3. Reason for the paucity of palynmorhs is attributed to the taphonomy of or-

Table 1: Generalized lithostratigraphy of Talchir Formation exposed in Ajay River section, Raniganj Basin (after Ghosh & Mitra, 1975)

Karharbari Formation		
	Units	**Lithology**
TALCHIR FORMATION	9.	Upper Current bedded sandstones (27 m)
	8.	Shales (15 m)
	7.	Alternation of graded sandstones and shales (35 m)
	6.	
	5.	Shales (10 m)
	4.	
	3.	
	2.	
	1.	Basal Tillite (3.5 m)
Precambrian		

Table 2: Details and yield of palynomorphs in samples collected from the Ajay River Section

Sample Nos.	Lithology	Occurrence	Taphonomic Remarks
*AJR-1	Khaki green shaly Sst.	Rare	Black organic matter including woody pieces of varied shapes and sizes; exine-structures translucent, body-surface studded with fine black particles
*AJR-2	Khaki green shaly Sst.		
*AJR-3	Khaki green shaly Sst.		
AJR-4	Mudstone	Frequent	
AJR-5	Needle shale		
*AJR-6	Needle shale	Fair	Black organic matter including woody pieces of varied shapes and sizes; exine-structures translucent, body-surface studded with fine black particles
AJR-7	Khaki green shales		
*AJR-8	Mudstone	Fair	Black organic matter including woody pieces of varied shapes and sizes; exine-sturctures translucent, body-surface studded with fine black particles
*AJR-9	Silstone	Fair	Fair representation of palynofossils for taphonomic reasons, all kinds found in distorted and hyaline state of state of preservation
*AJR-10	Siltstone	Frequent	
AJR-11	Siltstone		
*AJR-12	Siltstone	Very Rare	Scanty occurrence of distorted blackish forms
AJR-13	Siltstone		
AJR-14	Siltstone		
AJR-15	Khaki green Sst.		
*AJR-16	Shaly Sst.	Frequent	Mostly the specimens broken, distorted, few hyaline forms present, blackish-brown, exine character indistinct, bodysurface smothered
*AJR-17	Siltstone	Very rare	Scanty record of distorted hyaline specimens
*AJR-18	Siltstone	Frequent	Mostly the specimens intact, exine characters distinct, dark brown to yellowish, distorted forms also present, frequent occurrence of alete forms
AJR-19	Khaki green shales		
AJR-20	Khaki green shales		
AJR-21	Khaki green shales		
AJR-22	Khaki green shales	Very rare	In general palynomorphs distor-ted, broken, blackish brown
*AJR-24	Siltstone	Rare	In general palynomorphs distorted, broken, blackish brown

ganic matter because of fluvio-glacial environment during the Talchir sedimentation.

Samples have been processed chemically by usual method using HF acid and HCL. In the palynological preparations, the black organic matter is quite frequent, including small, irregular woody pieces with angular margins. Granular amorphous matter is also present. Exine characters in most of the specimens are not distinct, being impregnated with small black particles on body surfaces. In saccate pollen, body is abruptly placed out of the saccus. The saccus structure is translucent and the exine has been peeled-off at places. Such state of preservation of the palynomorphs reflects the impact of transportation and oxidative mode of preservation of the organic material.

In the total composition, representation of apiculate trilete spores i.e., *Apiculatisporis, Cyclogranisporites, Microbaculispora, Brevitriletes,* etc., is good in kind, and the genus *Jayantisporites* is frequent in the sample No. AJR - 3, 6, 9, 18. Among the monosaccate pollen taxa *Plicatipollenites, Caheniasaccites* are significant elements. The bisaccate pollen comprise a group of both, non-striate and striate genera (*Scheuringipollenites, Vesicaspora, Crescentipollenites, Striatopodocarpites, Faunipollenites*).

The alete morphos (*Leiosphaeridia, Maculatasporites, Dictyotidium*) are also observed in the assemblage representing the group OMIDOs in particular (Tiwari *et al.*, 1995). The relative occurrences of all these palynofossils are given in Table 3, and their species diversity is also mentioned in Table 4 which determines the status of evolution of the present palynocomposition and its placement within the succession of Talchir palynofloras. A uniform pattern of the occurrence of palynomorphs is recorded in the whole sequence.

Comparison - On peninsular India, Early Permian Talchir palynoflora is recognized by the dominance of radial monosaccate pollen genera - *Plicatipollenites* and *Parasaccites*. The relative abundance of these two taxa determines the older and younger aspect respectively, of the palynoassemblages within the Talchir palynoflora (Tiwari & Tripathi, 1992).

Recently, a critical review of all the published data about Talchir palynoflora, representing almost the complete palyno-succession in Talchir

Table 3: Relative qualitative diversity of the spore-pollen taxa in Ajay River section

Palynotaxa	Sample Numbers							
	AJR-1	AJR-3	AJR-6	AJR-8	AJR-9	AJR-10	AJR-16	AJR-18
Callumispora		+						
Apiculatisporis		+					+	+
Cycloqranisporites						+		
Verrucosisporites				+				
Microbaculispora		+	+					+
Microfoveolatispora	+	+	+			+	+	+
Lacinitriletes		+	+		+			+
Brevitriletes							+	
Jayantisporites		+			+			+
Parasaccites		+	++++		++++	+		
Plicatipollenites	+	+	+	+++	+		+	+
Potonieisoprites		+++	+	+	+			+
Caheniasaccites	+				+		+	+
Sahnites		+	+	+	+			+
Scheurinogipollenites		+	+	+			+	
Vesicaspora		+	+	+	+			+
Faunipollenites		+	+	+				+++
Striatopodocarpites		+	+	+				+
Crescentipollenites		+++	+	+++	+	+		+
Rhizomaspora		+	+			+		+
Leiosphaeridia					+			+
Maculatasporites		+		+				
						+	+	+
								+

(+ = scanty, ++ = frequent, +++ = common)

deposits of Lower Gondwana basins on Indian peninsula, has been made to understand the evolving patterns of morphos during the time of Talchir sedimentaion (Vijaya & Tiwari, 1992; Vijaya, 1996; Venkatachala *et al.*, 1993). This analysis has revealed that the oldest palynoassemblage found to occur in the basal boulder bed matrix and associated khaki-green mudstone lithounits, is not impoverished; its organic material is destroyed due to various taphonomic factors (Tiwari *et al*, 1994). And the innovation as well as diversificaion of morphos had been a steady and progressive pattern in the course of evolution of Early Permian palynoflora. Such sequential diversity is recognised in terms of the innovation levels of new morphologies, which have been defined as Biohorizons. In Talchir palynoflora, three such Biohorizons (I, II & III) are identified (Vijaya & Tiwari, 1992; Vijaya, 1996).

The palynocomposition of the Ajay River section exhibit fair diversity in the kind of morphos (Tables 3, 4). Hence, miofloristically it compares closely to the palynofloral composition of Biohorizon III (Vijaya, 1996) that makes it a part of the Upper Talchir palynoassemblages. The biostratigraphic significance of the present palynocomposition lies in the dating as it is a supportive evidence for the upper sedimentary cycle of Talchir deposits in this particular sector of Ajay River section, which level has also been assigned by Ghosh and Mitra (1995, p. 42-43).

CONCLUSION

The Talchir deposits in Damodar Valley coalfields - North Karanpura, Bokaro, Ramgarh, Jharia and Raniganj, are distributed in widely separated areas and occur in patches (Ghosh & Mitra, 1975). The interpretations given for uneven thickness of

Plate 1

1. cf. *Auroraspora*, X 500
2. Taphonomically distorted specimen of trilete spore x 750
3. *Jayantisporites* tetrad, X 500
4. *Jayantisporites pseudozonatus*, X 500
5. *Callumispora gretensis*, X 750
7. *Dictyotidium* sp., X 750
8. *Botryococcus* sp., X 750
9. *Plicatipollenites indicus*, X 500
10. *Faunipollenites perexiguus*, X 500
11. *Potonieisporites mutabilis*, X 500
12. Chitinous body, X 750
13. *Leiosphaeridia indica*, X 500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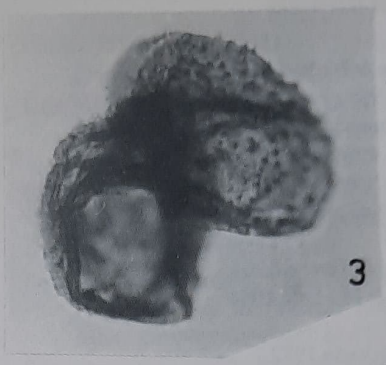
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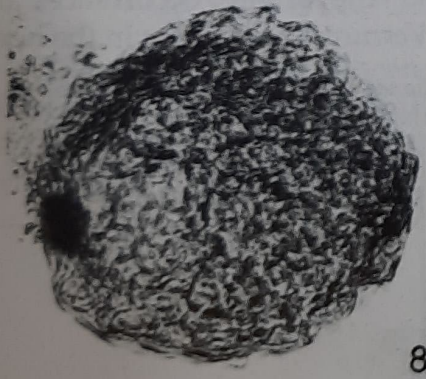
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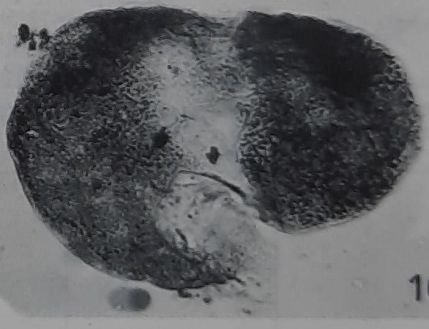
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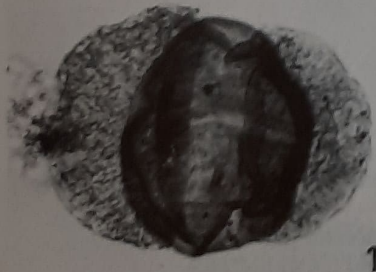
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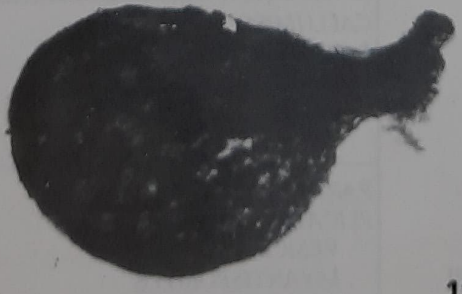
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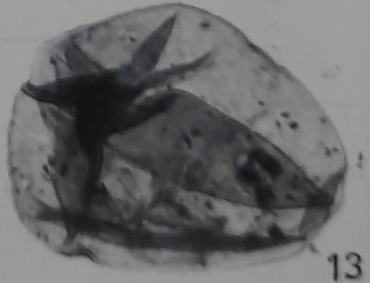
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Plate 1

Table 4: List of species recognised in the productive samples of Ajay River section

Callumispora gretensis (B. & H.) Bharad. & Sriv. emend. Tiwari *et al.* 1989
Verrucosisporites sp.
Cyclogranisporites sp.
Apiculatisporis sp.
Jayantisporites pseudozonatus Lele & Makada 1972
Microbaculispora tentula Tiwari 1965
Microbaculispora indica Tiwari emend. Tiwari & Singh 1981
Microfoveolatispora foveolata Tiw. emend. Tiwari & Singh 1981
Brevitriletes communis Bharad. & Sriv. emend. Tiwari & Singh 1981
Lacinitriletes minutus Venkat. & Kar emend. Tiwari & Singh 1981
Parasaccites obscurus Tiwari 1965
Parasaccites korbaensis Bharadwaj & Tiwari 1964
Plicatipollenites gondwanensis (B. & H.) Lele 1964
Plicatipollenites indicus Lele 1964
Potonicisporites magnus Lele & Makada 1972
Caheniasaccites distinctus Lele & Makada 1972
Vesicaspora crassa Lele & Makada 1972
Sahnites jayantiensis (Lele & Karim) Tiwari & Singh 1984
Sahnites barrelis (Tiw.) Tiwari & Singh 1984
Scheuringipollenites maximus Tiwari 1973
Faunipollenites perexiguus Bharadwaj & Salujha 1965
Striatopodocarpites crassus Tiwari 1965
Circumstriatites obscurus Lele & Madakda 1972
Crescentipollenites talchirensis Lele 1977
Rhizomaspora sp.
Leiosphaeridia indica Lele & Chandra 1972
Leiosphaeridia talchirensis Lele & Karim 1971
Dictyotidium sp. in Lele & Chandra 1972
Maculatasporites gondwanensis Tiwari 1965

Talchir sedimentation in Damodar Basin indicate that northerly hill ranges in the basin had provided important relief features which exercised a hold on ice radiation and supply of detritus to the peripheral embryonic depressions in Damodar Valley coalfields, at their northern fringes on denuded surface.

Not much palynological data is on record from the Talchir sediments in Damodar Valley coalfields, i.e. only in Jamunia River section, Jharia Coalfield (Tiwari *et al.*, 1981) and Dudhi River section, West Bokaro Coalfield (Lele, 1975). Besides, the other data known is from Jayanti and Giridih coalfields, the areas in close vicinity of Raniganj Coalfield in the north (Lele & Karim, 1971; Lele & Makada, 1972; Srivastava, 1973).

The palynoflora recovered from the presently analysed Talchir sediments exhibit a gradational complexity of spore-pollen taxa, representing the uppermost palynosequence of the Talchir Formation.The less diversified nature of the early Talchir assemblage is reflected by limited number and variety of taxa - mainly *Parasaccites, Plicatipollenites, Potonieisporites,* and the scanty occurrences of *Cyclogranisporites, Verrucosisporites.* But in the next

Table 5: Relative position of the palynoassemblage recovered from Ajay River section, in the sequence of Early Permian Talchir palynoflora on Indian peninsula (After Vijaya & Tiwari 1992; Vijaya 1996)

FORMATION	AGE	BIOHO.	PALYNOLOGICAL ASSEMBLAGES	SIGNIFICANT PALYNOTAXA In Ajay River Section
KARHARBARI	ARTINSKIAN	IV	*PARASACCITES* *CALLUMISPORA* *STRIATOPODOCARPITES* *SCHEURINGIPOLLENITES* *HORRIDITRILETES*	
	SAKMARIAN		*CALLUMISPORA* *PARASACCITES* *CRUCISACCITES* *FAUNIPOLLENITES* *DENTATISPORA*	
TALCHIR		III	*PARASACCITES* *PLICATIPOLLENITES* *VESICASPORA* *JAYANTISPORITES* *MICROBACULISPORA*	* PRESENT PALYNOASSEMBLAGE *JAYANTISPORITES* *PLICATIPOLLENITES* *CAHENIASACCITES* *VESICASPORA* *SCHEURINGIPOLLENITES* *FAUNIPOLLENITES* *STRIATOPODOCARPITES*
	ASSELIAN	II	*PLICATIPOLLENITES* *PARASACCITES* *POTONIEISPORITES* *VESTIGISPORITES* *VERRUCOSISPORITES*	
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subsequent palynossemblage of Lower Talchir Formation increased diversity prevails beside the stronghold of radial monosaccate pollen taxa, and several morphos make new appearance, such as *Jayantisporites*, *Sahnites*, and many striate bisaccate pollen - *Crescentipollenites*, *Faunipollenites* and *Striatopodocarpites*. Such kind of evolving pattern of morphos had been identified in a distinct and sequential miofloral change on Indian peninsula (Table-5).

On comparison, it is derived that the Talchir palynoflora in the northern fringes of Damodar Basin is well represented in kind and number of morphos.

Taphonomic observations of the palynological preparations from Talchir deposits had provided evidence towards the fair representation of the morphos at the advent level of Talchir sedimentation on Indian peninsula (Tiwari *et al.*, 1994; Vijaya, 1996), and the present result further adds to the established diversity by the end-phase of the Talchir Formation.

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REFERENCES

Ghosh P.K. & Mitra N.D. 1975. History of Talchir sedimentation in Damodar Valley basins. *Mem. geol. Surv. India* **105**: 1-117

Lele K.M. 1975. Studies in the Talchir flora of India - 10. Early and Late Talchir microfloras from the West Bokaro Coalfield, Bihar. *Palaeobotanist* **22**(3): 219-233.

Lele K.M. & Karim R. 1971. Studies in the Talchir Flora of India - 6. Palynology of the Talchir Boulder Beds in Jayanti Coalfield, Bihar. *Palaeobotanist* **19**(1) : 52-69.

Lele K.M. & Makada R. 1972. Studies in the Talchir Flora of India - 7. Palynology of the Talchir Formation in the Jayanti Coalfield, Bihar. *Geophytology* **2**(1): 41-73.

Srivastava S.C. 1973. Palynostratigraphy of the Giridih Coalfield. *Geophytology* **3**(3): 184-194.

Tiwari R.S., Srivastava S.C., Tripathi, A. & Singh, V. 1981. Palynostratigraphy of Lower Godwana sediments in Jharia Coalfield, Bihar. *Geophytology* **11**(2) : 220-237.

Tiwari R.S. & Tripathi A. 1992. Marker Assemblage-Zones of spore and pollen species through Gondwana Palaeozoic and Mesozoic Sequence in India. *Palaeobotanist* **40**: 194-236.

Tiwari R.S., Tripathi A. & Vijaya 1995. Organic-walled microfossils of doubtful origin in Permian and Triassic sequences on peninsular India. *Palaeobotanist* **43**(1) : 1-38.

Venkatachala B.S., Tiwari R.S. & Vijaya 1993. Diversity of spore pollen "character states" in Indian Permian. *Rev. Palaeobot. Palynol.* **85** : 319-340.

Vijaya 1996. Advent of Gondwana deposition on Indian peninsula : A palynological reflection and relationship. *Gondwana Nine : Proc. 9th Int. gond. Symp.*, Hyderabad, India, 10-14 January 1994. Oxford & IBH Publ. Co. Ltd. New Delhi **1**: 283-298.

Vijaya & Tiwari R.S. 1992. Morpho-evolutionary biohorizon stratigraphy and relation cladistics in saccate pollen through Gondwana Sequence of India. *Palaeobotanist* **40**: 157-193.