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Palynological studies of Coal Measures in South Rewa Gondwana Basin and their biostratigraphical significance

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ABSTRACT

Chandra, A. & Srivastava, A. K. (1986). Miofloral studies of Coal Measures in South Rewa Gondwana Basin and their biostratigraphical significance. *Palaeobotanist*, **35**(1) : 85-92.

Palynological assemblages from Coal Measures (Lower Permian) of four areas, namely Umaria, Birsinghpur Pali, Anuppur and Chirimiri of South Rewa Gondwana Basin, Madhya Pradesh are described. A brief description of the stratigraphy and geology of the relevant sections is given. Available information on some other significant Coal Measures (Barakars) has been taken into consideration for bringing out their palynological characteristics with reference to stratigraphy. Qualitative and quantitative distribution of palynotaxa in various areas reveal that the miofloral assemblages reported here are closer to the Karharbari mioflora. A rich palynofloral assemblage is reported for the first time from Coal Measures of Anuppur.

Key-words—Palynology, Mioflora, Coal Measures, South Rewa Gondwana Basin, Lower Permian (India).

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सारांश

दक्षिण रीवा गोंडवाना द्रोणी के कोयला-मेज़र्स से उपलब्ध सूक्ष्मवनस्पतिजात का अध्ययन तथा इसका जैवस्तरिकीय महत्व

अनिल चन्द्रा एवं अश्विनी कुमार श्रीवास्तव

मध्य प्रदेश में दक्षिण रीवा गोंडवाना द्रोणी के उमरिया, बीरसिंहपुरपाली, अनूपपुर एवं चिरीमिरी नामक चार क्षेत्रों के कोयला-मेज़र्स से उपलब्ध परागाणविक समुच्चय का वर्णन किया गया है। सम्बद्ध अनुखंडों का स्तरिकीय एवं भूवैज्ञानिक अध्ययन संक्षिप्त रूप में दिया गया है। कुछ अन्य विशिष्ट कोयला-मेज़र्स (बराकार) के सूक्ष्मवनस्पतिजातों से सम्बन्धित उपलब्ध जानकारी का उपयोग स्तरविन्यास के सन्दर्भ सहित उनकी परागाणविक विशेषताओं को प्रकाश में लाने के लिए किया गया है। विभिन्न क्षेत्रों में परागाणविक वर्गकों के परिमाणात्मक एवं गुणात्मक वितरण से यह व्यक्त होता है कि सूक्ष्मवनस्पतिजातीय समुच्चय करहरबारी वनस्पतिजात के काफी अनुरूप है। अनूपपुर के कोयला-मेज़र्स से पहली बार एक प्रभावी सूक्ष्मवनस्पतिजातीय समुच्चय का भी उल्लेख किया गया है।

INTRODUCTION

ANY stratigraphical, palaeobotanical or palynological study of the Lower Gondwana Formations of India appears to be incomplete without the consideration of rock formations exposed in South Rewa Gondwana Basin in Madhya Pradesh. The huge outcrops of Talchir and Barakar Formation (Lower Permian) are exposed from one end to the other in this basin. The eurydesmids at the base of the Talchir in Manendragarh and the productids at the top of Talchir Formation in Umaria add further geological importance to this basin.

Feistmantel (1879, 1882) considered the coal beds of South Rewa Gondwana Basin (now described as Son Valley Basin) as equivalent to Karharbari 'Stage' on the basis of the floral comparison. Fermor (1914) reported *Glossopteris*, *Vertebraria* and *Schizoneura* from Barakar of Kurasia Coalfield. Biswas (1955) suggested Karharbari correlation of at least a part of Chirimiri Coal Measures on the basis of Fermor's collection. Datta (1957) observed that the Barakar flora in Jhagrakhund area is comparable to the lower section of the Lower Gondwana flora. Plant fossils from Coal Measures of Chirimiri were described by Ganguly (1959). Lele and Maithy (1964) described two new species of *Noeggerathiopsis* from the Karharbari beds of Ganjra Nala, Birsinghpur Pali. Pant and Varma (1964) recognised three species of *Noeggerathiopsis* from the Lower Gondwana sequence of Manendragarh. Maithy (1966) considered the coal bearing beds at Umaria as equivalent to the Karharbari beds of Giridih. Maithy (1968) reported two new fossil plants from the Karharbari beds of Ganjra nala, Birsinghpur Pali Coalfield. Recently, Chandra and Srivastava (1982) have suggested that Coal Measures (so-

called Barakar) of Umaria, Birsinghpur Pali, Anuppur and Chirimiri are equivalent to Karharbari Formation of the Peninsular India on the basis of plant fossils

Because of the controversy about stratigraphical position of the karharbari Formation, South Rewa Gondwana Basin was selected for palaeobotanical and stratigraphical studies. The well-developed nature of Talchir sediments was an equally important factor favouring the selection of this basin. Consequently, detailed field excursions to study the Lower Gondwana formations were undertaken in Umaria, Birsinghpur Pali, Anuppur, Manendragarh and Chirimiri areas of this basin. The results of the microfossil studies including acritarchs and megaspores from the Talchir Formation (Lele & Chandra, 1967, 1969, 1972, 1973, 1974; Chandra & Lele, 1979), megafossil studies from Talchir and Coal Measures (Chandra & Srivastava, 1982; Srivastava & Chandra, 1982) and a new species of *Arberia* from the Coal Measures (Chandra & Srivastava, 1981) have been already published.

The remaining portion, i.e. the microfossil study of the Coal Measures of selected areas of this basin is presented in this paper. Some well preserved and fairly rich palynofloras from Coal Measures of the four areas, viz., Umaria, Birsinghpur Pali, Anuppur and Chirimiri (Text-figs 1-4) have been described here. These assemblages have been compared with the equivalent palynofloral assemblages. Palynological work in some of the areas of this basin has also been carried out by Saksena (1969), Bharadwaj & Srivastava (1969), Srivastava (1980) and Srivastava and Anand Prakash (1984).

GEOLOGY

South Rewa Gondwana Basin (included in Son Basin) forms a small part of the great central basin of the Gondwana rocks, occupying a large part of the Central India. According to Hughes (1884) the general geological succession of this basin is as follows :

Surface deposits
Deccan Traps and Lametas
Gondwana System:

Supra Barakar
Barakars with Karharbaris
Talchirs

The geology of Umaria, Birsinghpur Pali, Anuppur and Chirimiri alongwith various traverses undertaken in the field has earlier been described by Chandra and Lele (1979) and Chandra and Srivastava (1982). We are, therefore, giving only those sections (Coal Measures) from where miospores have been recovered.

UMARIA

Under the Umaria Railway Station—Kirintal-Umaria traverse rock samples belonging to Coal Measures were collected from the following two sections (about 2.4 km south east of the Umaria Railway Station) :

1. Section below and north of the railway bridge

Lithology	*Thickness in m*	*Field nos.*
Coal	1.22	KU 5
Greyish sandstone	5.49	KU 6
Carbonaceous shale (rich in miospores)	3.05	KU 7

2. Section beneath and slightly south of the railway bridge

Lithology	*Thickness in m*	*Field nos.*
Whitish greyish sandstone	9.15	RB 1
Coal	1.24	RB 2
Carbonaceous shale	2.48	RB 3
Shaly sandstone	2.17	RB 4
Coarse whitish sandstone	1.55	RB 5

BIRSINGHPUR PALI

1. Along the Patpara-Marjada Nala traverse, in a section about 3.2 km east of the village Khodargaon (after crossing the road bridge) the succession is as follows :

Lithology	*Thickness in m*	*Field nos.*
Massive yellowish sandstone	3.05	K 7
Carbonaceous shaly sandstone	1.22	K 6
Yellowish sandstone	0.61	K 5
Carbonaceous shaly sandstone (rich in miospores)	0.31	K 4
Carbonaceous shale	0.31	K 3
Coal	1.22	K 2

These beds dip gently (4-8°) due north.

2. Under the Ganjra Nala-Johilla River traverse, miospores have been recovered in the following sections :

(i) Section about 0.27 km east of the Ganjra Nala-Johilla River confluence along the Ganjra nala.

Lithology	*Thickness in m*	*Field nos.*
Sandstone	—	GN 3
Carbonaceous shale (rich in miospores)	1.83	GN 2
Grey micaceous sandstone	1.53	GN 1F
Carbonaceous shale	2.14	GN 1
Coal	—	

(ii) Section exposed near the Ganjra Nala-Johilla River confluence

Lithology	*Thickness in m*	*Field nos.*
Carbonaceous shale and sandstone intercalations (rich in miospores)	—	GN 10
Carbonaceous shale (containing miospores)	2.76	GN 9

ANUPPUR

Under the Bakan Nala railway bridge-Son River traverse, the succession of different beds exposed about 0.8 km south west of the Bakan nala-Son River confluence is as follows :

Lithology	*Thickness in m*	*Field nos.*
Coarse sandstone	6.10	BN 27
Carbonaceous shale	0.31	BN 26
Coal	0.31	BN 25
Carbonaceous shale (rich in miospores)	0.31	BN 24
Coal	0.93	
Carbonaceous shale	0.31	BN 23
Whitish-bluish sandstone	4.22	BN 21

CHIRIMIRI

Under Chirimiri-Paradol railway cutting traverse samples from following two sections have yielded miospores.

1. Section exposed about 0.8 km north-west of the Chirimiri Railway Station along Chirimiri-Paradol railway line :

Lithology	*Thickness in m*	*Field nos.*
Yellowish-white coarse sandstone (current bedded)	9.15	CP_7
Coal	0.15	CP_6
Carbonaceous shale and sandstone intercalations	3.65	CP_5
Carbonaceous shale	0.92	CP_4
Sandstone	3.05	CP_3
Carbonaceous shale (rich in miospores)	0.25	CP_2
Fine grained sandstone	9.15	CP_1

The beds dip 10° due north.

2. Section exposed about 8 km north-west of Chirimiri Railway Station along the northern side of railway line.

Lithology	*Thickness in m*	*Field nos.*
Massive greyish white sandstone	15.25	CP_{24}
Coal, sandstone and shale	0.31	CP_{23}
Sandstone (poor in miospores)	0.15	CP_{22}
Sandstone shale intercalation (poor in miospores)	0.31	CP_{21}
Bluish sandstone (poor in miospore)	0.31	CP_{20}
Carbonaceous shale (poor in miospores)	0.15	CP_{19}
Bluish sandstone (rich in miospores)	0.15	CP_{18}

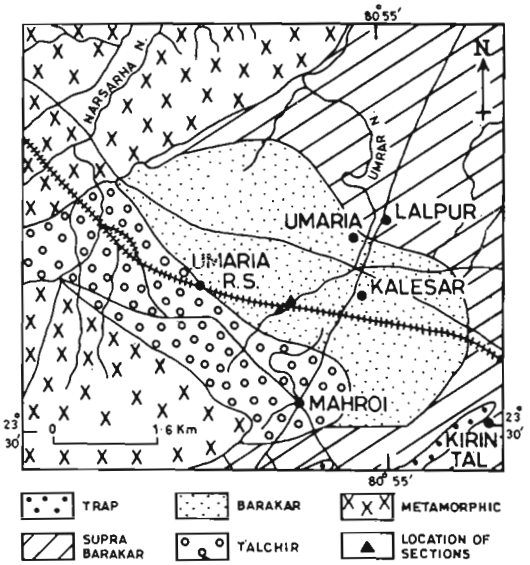
PALYNOFLORAL CHARACTERISTICS OF INDIVIDUAL AREA

UMARIA

Following two palynological assemblages have been recovered from Coal Measures of Umaria.

Assemblage A—It has been recovered from the carbonaceous shales (Field no. KU 7) under the Umaria Railway Station—Kirintal-Umaria traverse in which *Plicatipollenites* Lele (22.5%), *Parasaccites* Bharadwaj & Tiwari (18.5%), *Callumispora* Bharadwaj & Srivastava (14.5%) and *Caheniasaccites* Bose & Kar (12.5%) are the dominant genera. Next in frequency order are *Stellapollenites* Lele (7.5%), *Crucisaccites* Lele & Maithy (7.5%), *Potonieisporites* Bharadwaj emend. Bharadwaj (5%), *Faunipollenites* Bharadwaj (5%), *Strotersporites* Wilson emend. Klaus (5%) and *Tiwariasporis* Maheshwari & Kar (2%). Monosaccates form the dominant group constituting 73.5 per cent of the total assemblage.

Assemblage B—This has been recovered from the carbonaceous shale bed (Field no. RB 3) of section no. 3



Text-figure 1—Geological map of Umaria, Madhya Pradesh (after Hughes, 1884).

under Umaria R. S.—Kirintal-Umaria traverse. It is dominated by the genera *Parasaccites* Bharadwaj & Tiwari (28%), *Jayantisporites* Lele & Makada (22.5%) and *Plicatipollenites* Lele (12.5%). The other quantitatively important genera are *Callumispora* Bharadwaj & Srivastava (7.0%), *Potonieisporites* Bharadwaj emend. Bharadwaj (5%) and *Indotriradites* Tiwari (5%). And next in frequency are *Latosporites* Potonié & Kremp (2.5%), *Pachysaccus* Lele & Maithy (2.5%), *Cahenіasaccites* Bose & Kar (2.5%), *Limitisporites* Leschik emend. Potonie (2.5%), *Scheuringipollenites* Tiwari (2.5%) and *Faunipollenites* Bharadwaj (4.5%).

Obviously, in this assemblage the monosaccate genera form the dominant elements (50.5%). The trilete forms are significantly high contributing to 34.5 per cent of the assemblage.

Both the palynological assemblages A and B from Umaria show the dominance of the radial monosaccate and trilete forms.

BIRSINGHPUR PALI

Three palynological assemblages have been obtained from the Coal Measures of Birsinghpur Pali.

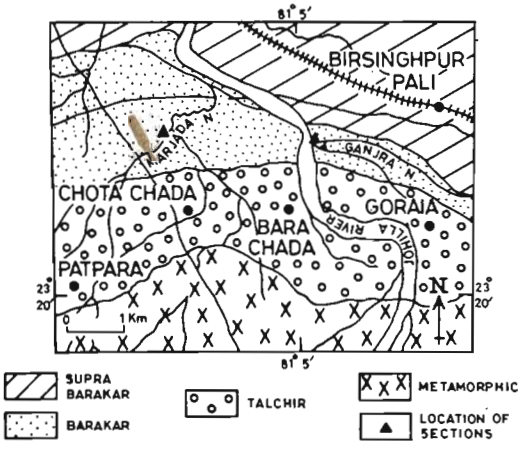
Assemblage A—It has been recovered from the carbonaceous shaly sandstone (Field no. K4) of a section exposed about 3.2 km east of the village Khodargaon under Patpara-Marjada Nala traverse. *Parasaccites* Bharadwaj & Tiwari (38.5%), *Cahenіasaccites* Bose & Kar (12.5%) and *Pachysaccus* Lele & Maithy (10%) are the dominant forms. These are followed by *Callumispora* Bharadwaj & Srivastava (16.5%), *Plicatipollenites* Lele (7.5%), *Crucisaccites* Lele & Maithy (5%), *Stellapollenites* Lele (7.5%), *Scheuringipollenites* Tiwari (2.5%) and *Faunipollenites* Bharadwaj (2.5%) and *Strotersporites* Wilson emend. Klaus (2.5%). This assemblage is also characterized by the dominance of monosaccate group constituting 76 per cent of the total assemblage.

Assemblage B—This has been recovered from the carbonaceous shale bed (Field no. GN 2) of a section exposed about 0.27 km east of the Ganjra Nala-Johilla confluence along Ganjra Nala. The significant elements are *Plicatipollenites*, Lele (29%), *Parasaccites* Bharadwaj & Tiwari (28%) and *Potonieisporites* Bharadwaj emend. Bharadwaj (11.0%) which are followed by *Striatites* Pant emend. Bharadwaj (8%), *Cahenіasaccites* Bose & Kar (6%), *Limitisporites* Leschik emend. Potonié (5%), *Pachysaccus* Lele & Maithy (5%), *Labirites* Bharadwaj (2%), *Scheuringipollenites* Tiwari (2%), *Converrucosisporites* Potonié & Kremp (1%), *Jayantisporites* Lele & Makada (1%), *Vesicaspora* Schemel emend. Venkatachala & Wilson (1%), *Gondwanopollis* Lele & Maithy (0.5%) and *Crucisaccites* Lele & Maithy (0.5%). The monosaccate group forms the characteristic element of the assemblage.

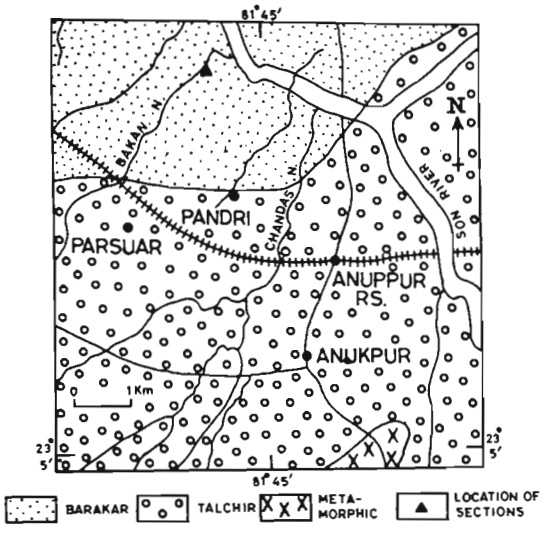
Assemblage C—This assemblage has been found in a bed of carbonaceous shale and sandstone intercalation (Field no. GN 10) exposed near the Ganjra nala-Johilla River confluence. *Parasaccites* Bharadwaj & Tiwari (28%), *Pachysaccus* Lele & Maithy (22.5%) and *Cahenіasaccites* Bose & Kar (8.5%) are the significant elements followed by *Callumispora* Bharadwaj & Srivastava (13.5%), *Crucisaccites* Lele & Maithy (5%), *Striatites* Pant emend. Bharadwaj (5%), *Plicatipollenites* Lele (5%), *Stellapollenites* Lele (5%), *Faunipollenites* Bharadwaj (2.5%), *Scheuringipollenites* Tiwari (2%), *Latosporites* Potonié & Kremp (1.5%) and *Jayantisporites* Lele & Makada (1.5%). The assemblage is dominated by the monosaccate grains which contribute 74 per cent of the total assemblage.

ANUPPUR

Assemblage A—It has been recovered from the carbonaceous shale bed (Field no. BN24) exposed about



Text-figure 2—Geological map of Birsinghpur Pali, Madhya Pradesh (after Hughes, 1884).

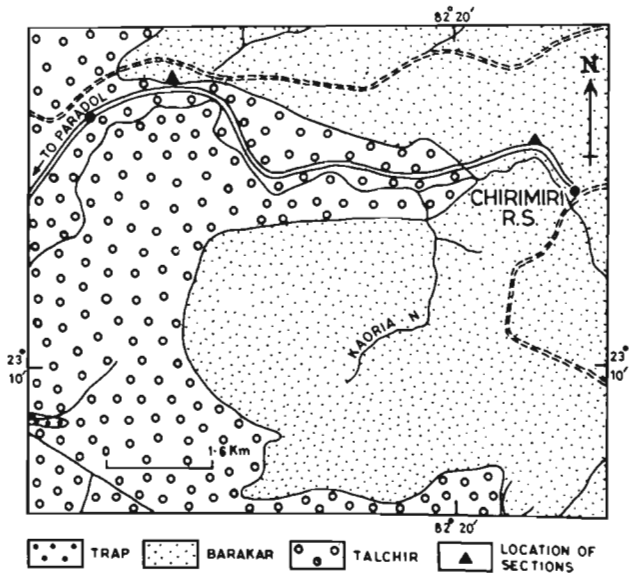


Text-figure 3—Geological map of Anuppur, Madhya Pradesh (after Hughes, 1884).

0.8 km south-west of the Bakan Nala-Son River confluence along Bakan Nala. *Parasaccites* Bharadwaj & Tiwari (36.5%), *Cabeniasaccites* Bose & Kar (12.5%), *Callumispora* Bharadwaj & Srivastava (14.5%) and *Pachysaccus* Lele & Maithy (11.5%) are significant genera in the assemblage. These are followed by *Plicatipollenites* Lele (9%), *Strotersporites* Wilson emend. Klaus (6%), *Stellapollenites* Lele (3.5%), *Scheuringipollenites* Tiwari (2.5%), *Divarisaccus* Venkatachala & Kar (2%), *Latosporites* Potonié & Kremp (1%), *Leiotriletes* Naumova ex. Potonié & Kremp (0.5%) and *Striatites* Pant emend. Bharadwaj (0.5%). Thus this assemblage is dominated by the monosaccate forms contributing to 75 per cent of the total assemblage.

CHIRIMIRI

Two palynological assemblages were obtained from this area.



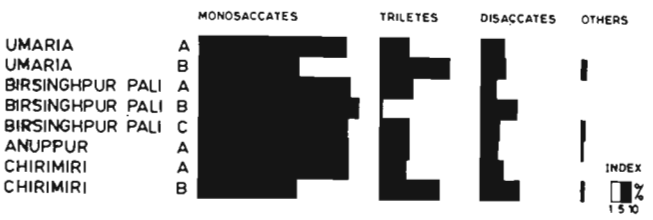
Text-figure 4—Geological map of Chirimiri, Madhya Pradesh (after Hughes, 1884 with certain modifications).

Assemblage A—It was recovered from carbonaceous shale bed (Field no. CP2) of a section exposed about 0.8 km north-west of the Chirimiri Railway Station along the Chirimiri-Paradol railway line. *Parasaccites* Bharadwaj & Tiwari (45.5%) and *Cabeniasaccites* Bose & Kar (14%) are the significant genera in this assemblage. Other genera in order of their frequency are *Callumispora* Bharadwaj & Srivastava (14%), *Crucisaccites* Lele & Maithy (3.5%), *Stellapollenites* Lele (3%), *Strotersporites* Wilson emend. Klaus (3%), *Leiotriletes* Naumova ex. Potonié & Kremp (2.5%), *Tiwariasporis* Maheshwari & Kar (3%), *Gondwanopollis* Lele & Maithy (1%) and *Limitisporites* Leschik emend. Potonié (0.5%). The monosaccate group forms 66 per cent of the total assemblage.

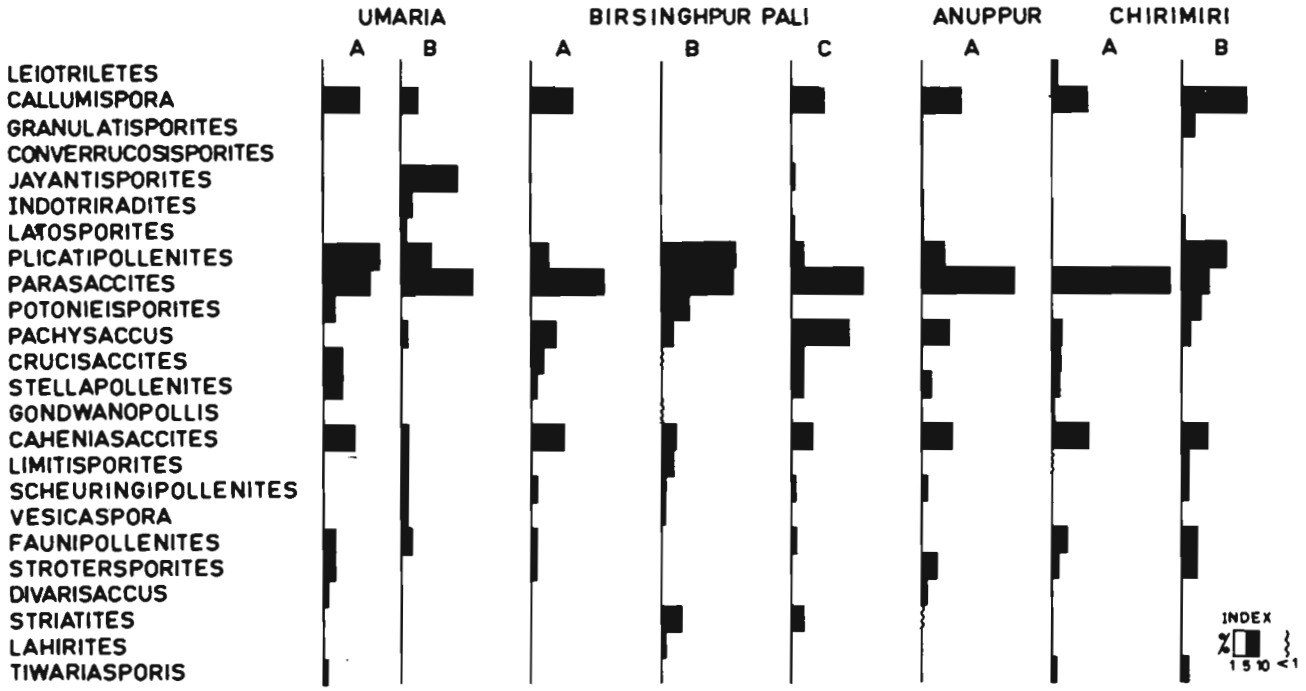
Assemblage B—It has been obtained from the bluish sandstone bed (Field no. CP 15) of a section exposed about 0.8 km north-west of Chirimiri Railway Station along the northern side of the railway line. In this assemblage *Callumispora* Bharadwaj & Srivastava (25%), *Plicatipollenites* Lele (17.5%), *Parasaccites* Bharadwaj & Tiwari (10.5%) and *Cabeniasaccites* Bose & Kar (10%) are the important genera. Next in order are *Potonieisporites* Bharadwaj emend. Bharadwaj (7.5%), *Strotersporites* Wilson emend. Klaus (6%), *Faunipollenites* Bharadwaj (6%), *Granulatisporites* Ibrahim emend. Potonié & Kremp (5%), *Pachysaccus* Lele & Maithy (3.5%), *Tiwariasporis* Maheshwari & Kar (2.5%), *Scheuringipollenites* Tiwari (2.5%), *Limitisporites* Leschik emend. Potonié (2.5%) and *Latosporites* Potonié & Kremp (1.5%). Thus the assemblage is dominated by the monosaccate (49 per cent) and trilete forms (30 per cent).

PALYNOFLORISTIC COMPARISON AND BIOSTRATIGRAPHICAL SIGNIFICANCE

Well-represented Karharbari palynological assemblage has been described by Maithy (1966) from the carbonaceous shale of Umaria. Maithy (1969) has given the distribution and frequency of the characteristic Karharbari taxa in different localities of the Lower Gondwana formations of India, which has provided a reliable basis for the recognition of the Karharbari Formation. Srivastava (1973) studied the Karharbari palynological assemblage from the type area—the Giridih Coalfield—and has recognized two zones. The Lower Karharbari mioflora (younger part in Zone 1) of the Giridih Coalfield is dominated by *Callumispora* and *Parasaccites*. Similar assemblage has been described from the North Karanpura Basin (Zone II of Kar, 1973), bore-core from Korba Coalfield (Upper subzone in Zone 1 of Bharadwaj & Srivastava, 1973), Umrer Quarry, Nagpur (Zone 1 of Bharadwaj & Anand Prakash, 1974), Jayanti Coalfield (Flora of the sample nos. D_{18} & D_{19}, Lele & Makada, 1974), Auranga Coalfield (Lele & Srivastava, 1977), West Bokaro Coalfield (Anand Prakash, Srivastava & Tiwari, 1979) and Zone 1 of the Hutar Coalfield (Shukla, 1983).



Histogram 1—Showing the percentage distribution of different groups of palynotaxa.



Histogram 2—Showing the percentage distribution of the different genera.

TABLE 1—SHOWING PERCENTAGE DISTRIBUTION OF DIFFERENT GROUPS OF THE PALYNOTAXA

Groups	*Umaria*		*Birsinghpur Pali*			*Anuppur*	*Chirimiri*	
	A	B	A	B	C	A	A	B
Monosaccates	73.5	50.5	76.0	80.0	74.0	75.0	75.0	49.0
Triletes	14.5	34.5	16.5	2.0	15.0	15.0	13.5	30.0
Disaccates	12.0	12.5	7.5	18.0	9.5	9.0	11.5	19.5
Others	—	2.5	—	—	1.5	1.0	—	1.5

The palynofloral assemblages from the Coal Measures of Umaria, Birsinghpur Pali, Anuppur and Chirimiri, in general, are dominated by the monosaccate and trilete forms. The disaccate and others have comparatively low representation (Tables 1 & 2 and Histograms 1 & 2). These eight palynological assemblages are not comparable with the known Barakar assemblages (Tiwari, 1973, 1974). On the other hand, these assemblages (A & B from Umaria, A & C from Birsinghpur Pali, A from Anuppur, and A & B from Chirimiri) are comparable to the known Karharbari assemblages. Significant proportion of the disaccate forms in B assemblage of Birsinghpur Pali may be because of some local variation in the flora (Tiwari, 1974). Some of the genera, such as *Granulatisporites, Plicatipollenites, Crucisaccites, Parasaccites, Potonieisporites, Caheniasaccites, Pachyasaccus, Gondwanopollis* and *Stellapollenites* of the Karharbari assemblage have also been found in our assemblage (Table 3).

Parasaccites/Plicatipollenites/Caheniasaccites and *Callumispora/Jayantisporites* complex forms the most significant constituent of the eight palynological assemblages (Table 2 & Histogram 2). The general dominance of radial monosaccate and trilete grains in the Coal Measures of Umaria, Birsinghpur Pali, Anuppur and Chirimiri brings these assemblages more closer to the Lower Karharbari assemblages.

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Table 3—Showing the miospore genera from Umaria, Birsinghpur Pali, Anuppur and Chirimiri and their comparison with the known Karharbari assemblages.

TABLE 2—SHOWING PERCENTAGE DISTRIBUTION OF VARIOUS GENERA

Genera	*Umaria*		*Birsinghpur Pali*			*Anuppur*	*Chirimiri*	
	A	B	A	B	C	A	A	B
Leiotriletes						0.5	2.5	
Callumispora	14.5	7.0	16.5		13.5	14.5	9.0	25.0
Granulatisporites								5.0
Converrucosisporites			1.0					
Jayantisporites		22.5		1.0	1.5			
Indotriradites		5.0				1.0		
Latosporites		2.5			1.5	1.0		1.5
Plicatipollenites	22.5	12.5	7.5	29.0	5.0	9.0		17.5
Parasaccites	18.5	28.0	38.5	28.0	28.0	36.5	45.5	10.5
Potonieisporites	5.0	5.0		10.0				7.5
Pachysaccus		2.5	10.0	5.0	22.5	11.5	4.0	3.5
Crucisaccites	7.5		5.0	8.5	5.0		3.5	
Stellapollenites	7.5		2.5		5.0	3.5	3.0	
Gondwanopollis				0.5			1.0	
Caheniasaccites	12.5	2.5	13.5	6.0	8.5	12.5	14.0	10.0
Limitisporites		2.5		5.0			0.5	2.5
Scheuringipollenites		2.5	2.5	2.0	2.0	2.5		2.5
Vesicaspora		2.5		1.0				
Faunipollenites	5.0	4.5	2.5		2.5		6.0	6.0
Strotersporites	5.0		2.5			6.0	3.0	6.0
Striatites				8.0	5.0	0.5		
Labirites				2.0				
Tiwariasporis	2.0						2.0	2.5
Divarisaccus						2.0		

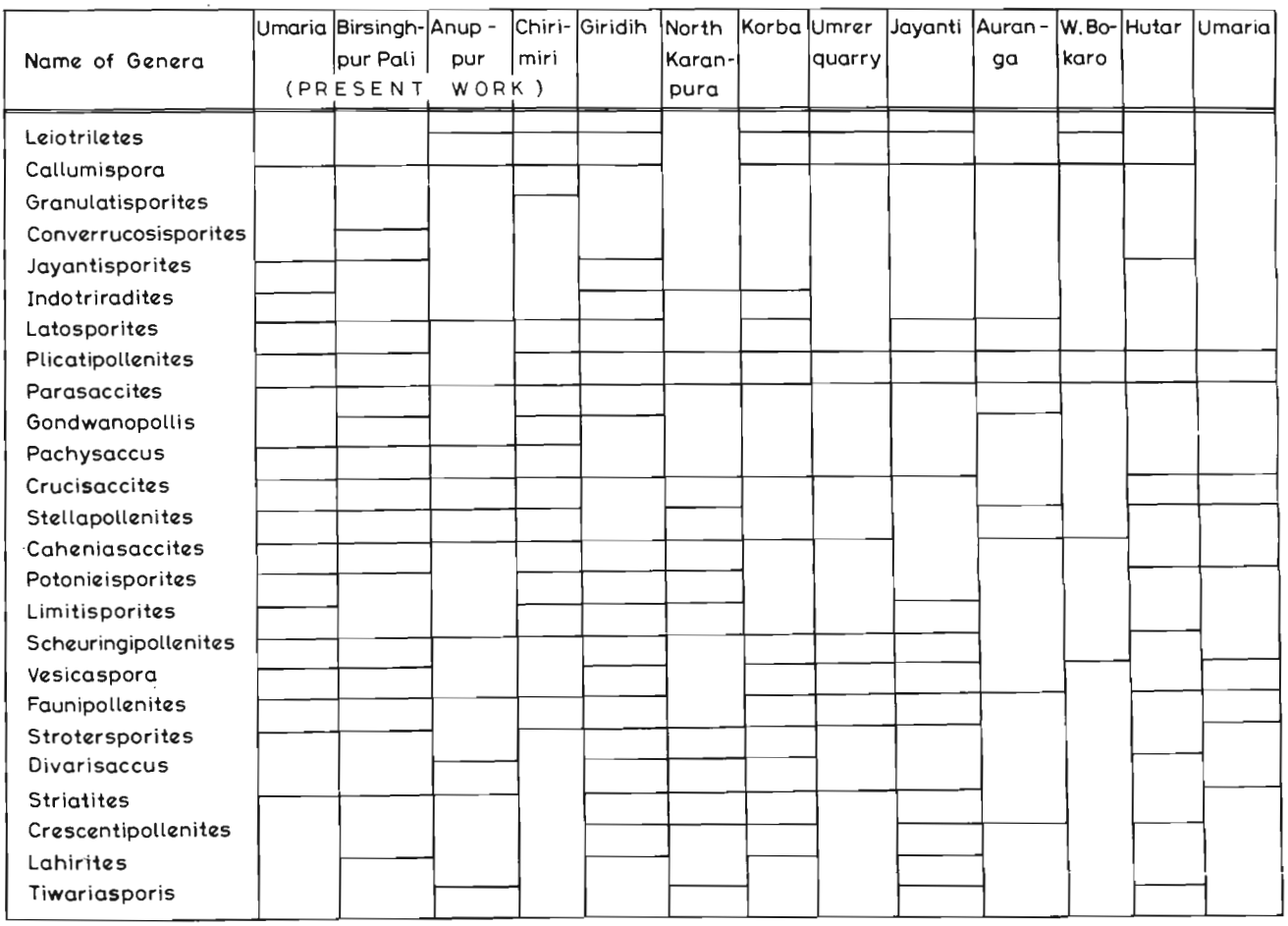

TABLE 3

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