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PALYNOLOGICAL SUCCESSION OF THE LOWER GONDWANA SEDIMENTS IN UMARIA COALFIELD, MADHYA PRADESH, INDIA

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ABSTRACT

Palynological investigation of the Lower Gondwana sediments from Umrar River section and Umaria Coal Mine, Umaria Coalfield has been described. Four miofloral zones have been recognized. The first zone is characterized by the dominance of *Callumispora*+*Jayantisporites* and the second zone is marked by the dominance of *Parasaccites* and belongs to Lower and Upper Karharbari miofloras respectively. Miofloral Zone-3 has the dominance of *Scheuringipollenites*, whereas Miofloral Zone-4 shows the overall dominance of striate-disaccate pollen grains representing the Lower and Upper Barakar miofloras in succession.

Key-words — Palynology, *Callumispora*, *Jayantisporites*, *Parasaccites*, *Scheuringipollenites*, Umaria Coalfield, Lower Gondwana (India).

सारांश

मध्य प्रदेश (भारत) के उमरिया कोयला-क्षेत्र में अधरि गोंडवाना अवसादों का परागाणविक अनुक्रम – सुरेश चन्द्र श्रीवास्तव एवं आनन्द-प्रकाश

उमरिया कोयला-क्षेत्र की उमरिया कोयला-खान एवं उमरार नदी खंड के गोंडवाना अवसादों का परागाणविक अन्वेषण प्रस्तुत किया गया है। अन्वेषण के आधार पर चार सूक्ष्मवनस्पतिजातीय मंडल बनाये गये हैं। प्रथम मंडल कैल्युमिस्पोरा + जयन्तिस्पोराइटिस की बाहुल्यता से अभिलक्षणित है, दूसरा मंडल पेॅरासैक्काइटिस की बाहुल्यता व्यक्त करता है तथा क्रमशः अधरि एवं उपरि करहरबारी सूक्ष्मवनस्पतिजातों से सम्बन्धित है। सूक्ष्मवनस्पतिजातीय मंडल – 3 श्यौरिंगीपॉलिनाइटिस से प्रभावी है, जबकि मंडल – 4 रेखित-द्विकोष्ठीय परागकणों की बाहुल्यता के साथ-साथ अनुक्रम में अधरि एवं उपरि बराकर सूक्ष्मवनस्पतिजातों का निरूपण करता है।

INTRODUCTION

THE Umaria Coalfield is situated in South Rewa Gondwana Basin between longitudes 80°47′-80°56′ and latitudes 23°29′-23°38′. Feistmantel (1882) and Hughes (1885) first described the plant fossils from the coal-bearing beds. Maithy (1966) recorded *Gangamopteris cyclopteroides* Feistmantel, *Glossopteris indica* Schimper, *Noeggerathiopsis* sp., *Cordaicarpus zeilleri* Maithy, cf. *Gondwanidium* sp. and few equisetalean stems. He also recorded 15 miospore genera, majority of monosaccate pollen grains, and thus snggested a Karharbari age for the coal-bearing beds of Umaria Coalfield conforming to the earlier dating by Feistmantel (1882) and Hughes (1885). Chandra and Srivastava (1982) have also described three species of *Gangamopteris*, four species of *Glossopteris*, and few equisetalean stems from Umaria, and equated their assemblage with the known Karharbari assemblages. However, Fox (1931) considered them to be Barakar in age and thus the age of the coal-bearing beds remained a controversial subject. In addition to these, Tripathi (1952) discovered some megaspores from the coal horizon of Umaria Coalfield. The Talchir Formation including the marine intercalations were studied by Lele and Chandra (1969, 1972) and Chandra and Lele (1979). The miofloral records were rather poor but

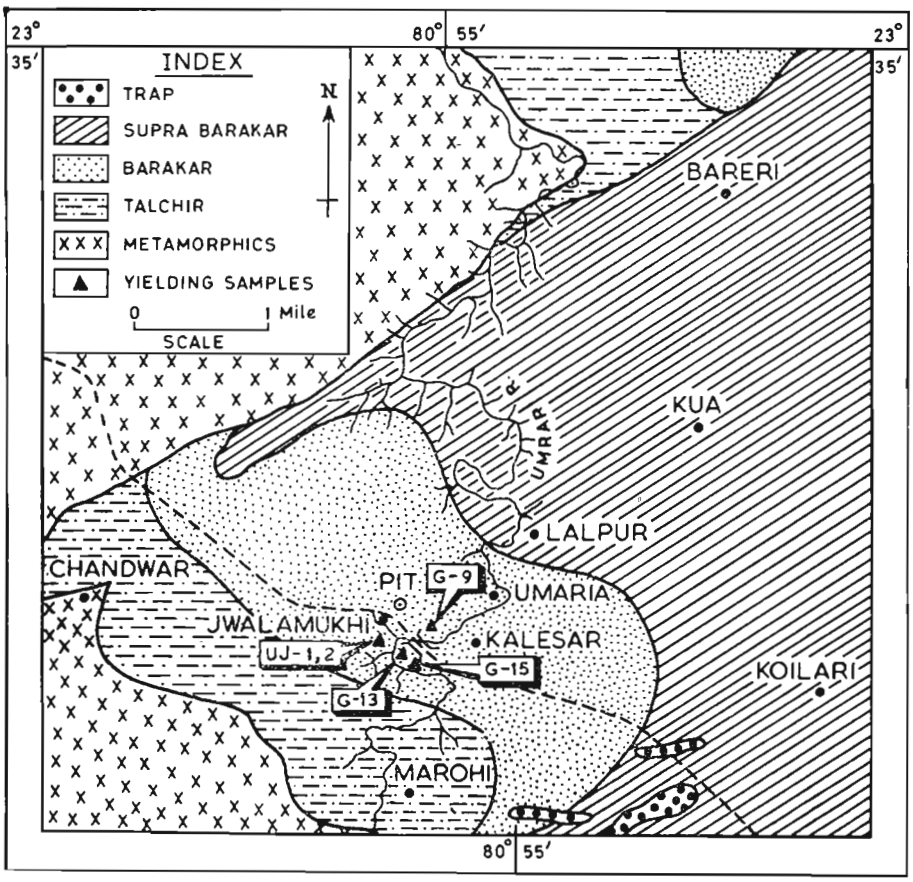
the marine bed yielded considerably rich acritarchs. Thus, obviously, the knowledge regarding palynological fossils of the Lower Gondwana sediments of Umaria Coalfield remains incomplete and hence to fill the lacunae an attempt has been made here to work out a palynostratigraphic succession of sediments.

GEOLOGY

The geology of the area was first studied by Medlicott (1860) and later by Hughes (1879-81). Gee in 1928 proved the existence of workable coal seams. Later, Venkatappayya, Deshmukh and Srivastava (1960) mapped the area in detail. The known geological formations in the Umaria Coalfield are as follows (Map 1):

Supra Barakar	Massive, conglomeratic, pebbly and gritty, white sandstone with intercalations of red clay
Barakar	Massive, medium to coarse grained sandstone, shale and coal seams
Talchir	Marine bed, greenish pebbly sandstone, clay and shales
.....	.....
Metamorphics	Gneisses and schists

The Lower Gondwana sediments are deposited over the Archeans which are exposed towards west, north and southern part of the coalfield. The oldest formation, i.e. Talchir Formation, rests over the metamorphics and is exposed along Umrar River and a few tributaries south and south-west of Umaria. The marine fossiliferous beds



MAP 1 — Geological map of the Umaria Coalfield, Madhya Pradesh (after Hughes, 1884).

are exposed in the railway cutting near Narsarha nala north-west of Umaria railway station. The Barakar Formation overlies the Talchir Formation and is the principal coal-bearing horizon in this coalfield and includes massive, medium to coarse-grained sandstones, shale and six coal seams. The succession of these sediments is exposed along Umrar River which ultimately traverses into Supra Barakar sediments in the northern part of the Umaria Coalfield.

The general succession of coal seams in this area is as follows:

Seam I	1.2-1.5 m
Parting	12.1 m
Seam II	1.5-2.4 m
Parting	24.3-27.4 m
Seam III	1.5-3.9 m
Parting	2.7-7.0 m
Seam IV	1.5-2.1 m
Parting	12.1 m
Seam V	1.0 m (Exposed near the railway bridge)
Parting	24.3 m
Seam VI	1.2 m (Exposed near the Jwalamukhi temple)

TABLE 1 — SHOWING DETAILS OF SAMPLES COLLECTED FROM THE UMARIA COALFIELD

Sample No.	Locality	Lithotype	Age	Miospore occurrence
		Umrar River Section		
G1		Sandstone	Supra Barakar?	−
G2		Fine grained sandstone	Barakar?	−
G3		Coarse grained sandstone	Barakar	−
G4		Sandy Shale	Barakar	++
G5		Sandstone	Barakar	−
G6	Near Kalesar Ghat	Sandstone	Barakar	−
G7	,, ,,	Sandstone	Barakar	−
G8	,, ,,	Medium grained sandstone	Barakar	−
G9	Below railway bridge	Carbonaceous shale	Barakar	++
G10	,, ,,	Sandstone	Barakar	−
G11	,, ,,	Sandstone	Barakar	Spicules?
G12	,, ,,	Sandstone	Barakar	−
G13	South of railway bridge	Top sandy shale (2 m)	Barakar	++
G14	,, ,,	Carbonaceous shale	Barakar	++
G15	,, ,,	Carbonaceous shale (2 m)	Barakar	++
G16	,, ,,	Sandstone		−
G17	,, ,,	Sandstone		
G18	,, ,,	Sandstone	Talchir	+
		Railway Cutting		
G19		Sandstone	Talchir	−
G20		Boulder bed	Talchir	−
G21		Sandstone	Talchir	−
G22		Needle shale	Talchir	−
G23		Needle shale	Talchir	−
G24		Basement rock	Archean	−
		Jwalamukhi Temple		
UJ1	Tributary of Umrar River	Coal	Barakar	++
UJ2	On the bank facing the temple	Coal	Barakar	++
		Umaria Coal Mine		
1		Bottom coal+underlying shale — III seam	Barakar	+
2		Top Coal III Seam		+
3		Carbonaceous shale overlying III seam		+
4		Coal — IV Seam		+
5		Coal — V Seam		+

Note: ++, rich in miospores; +, miospores rare; −, miospores absent.

TABLE 2 — SHOWING PERCENTAGE COMPOSITION OF MIOSPORE GENERA IN THE YIELDING SAMPLES UNDER STUDY, UMARIA COALFIELD

Genera/Sample No.	Jwala-Mukhi Temple	Umrar River Section					Umaria Coal Mine
		South of Rly. bridge			Rly. bridge		
	UJ/1+2	G15	G14	G13	G9	G4	5
Leiotriletes	3.0	—	1.0	0.5	—	—	—
Callumispora	30.0	21.0	7.0	4.0	4.0	1.0	—
Hennellysporites	1.0	1.0	2.0	1.0	1.0	—	—
Cyclogranisporites	—	—	—	1.0	—	—	—
Verrucosisporites	—	—	—	—	0.5	—	—
Lophotriletes	—	—	1.0	—	—	2.0	1.0
Brevitriletes	5.0	1.5	1.0	1.0	7.0	12.0	2.0
Pseudoreticulatispora	—	—	—	—	—	1.0	—
Horriditriletes	—	—	—	—	3.0	—	1.0
Microbaculispora	5.0	16.0	23.0	6.0	2.0	—	—
Indotriradites	—	—	—	—	—	—	9.0
Potonieitriradites	—	—	—	—	11.0	2.0	—
Jayantisporites	31.5	47.0	56.0	40.0	—	—	—
Parasaccites	2.5	5.0	2.0	24.0	33.0	6.0	5.0
Caheniasaccites	—	—	—	2.0	—	—	0.5
Potonieisporites	—	—	—	—	2.0	—	—
Vestigisporites	1.0	1.0	—	2.0	5.0	1.0	1.0
Plicatipollenites	1.0	—	—	9.0	9.0	2.0	1.0
Crucisaccites	—	—	—	—	1.0	—	—
Virkkipollenites	—	—	1.0	0.5	4.0	—	1.0
Platysaccus	1.0	—	—	1.0	2.0	11.0	3.0
Striatites	—	—	—	—	—	14.0	4.0
Primuspollenites	—	—	—	—	—	—	5.0
Rhizomaspora	—	—	—	—	—	—	0.5
Lahirites	—	—	—	—	—	8.0	—
Striatopodocarpites	1.0	—	—	—	1.5	8.0	7.0
Hindipollenites	—	—	—	—	—	1.0	—
Faunipollenites	1.0	—	—	0.5	1.5	11.0	8.5
Illinites	—	—	1.0	—	—	2.0	2.5
Vesicaspora	5.5	1.0	1.0	4.0	5.0	9.0	17.5
Scheuringipollenites	0.5	—	—	—	2.5	3.0	24.0
Ibisporites	—	—	—	—	—	1.0	1.0
Tiwariasporis	—	—	—	—	—	4.0	2.0
Ginkgocycadophytus	7.0	1.0	2.0	1.0	—	—	3.0
Pilasporites	1.0	2.0	1.0	2.5	3.5	2.0	0.5
Maculatasporites	—	0.5	—	—	—	—	—
Leiosphaeridia	3.0	1.0	1.0	—	1.0	2.0	—

PALYNOLOGICAL SUCCESSION

The palynofossils recovered consist of following 38 genera:

Leiotriletes, *Callumispora*, *Hennellysporites*, *Cyclogranisporites*, *Lophotriletes*, *Verrucosisporites*, *Brevitriletes*, *Pseudoreticulatispora*, *Horriditriletes*, *Microbaculispora*, *Microfoveolatispora*, *Potonieitriradites*, *Indotriradites*, *Jayantisporites*, *Parasaccites*, *Caheniasaccites*, *Potonieisporites*, *Vestigisporites*, *Plicatipollenites*, *Crucisaccites*, *Virkkipollenites*, *Platysaccus*, *Striatites*, *Primuspollenites*, *Rhizomaspora*, *Lahirites*, *Striatopodocarpites*, *Hindipollenites*, *Faunipollenites*, *Illinites*, *Vesicaspora*, *Scheuringipollenites*, *Ibisporites*, *Tiwariasporis*, *Ginkgocycadophytus*, *Pilasporites*, *Maculatasporites* and *Leiosphaeridia*

Of all the above genera *Callumispora*, *Jayantisporites*, *Parasaccites* and *Scheuringipollenites* play an important role being the dominant ones. The other genera in order of dominance are — *Brevitriletes*, *Microbaculispora*, *Potonieitriradites*, *Indotriradites*, *Plicatipollenites*, *Striatites*, *Striatopodocarpites* and *Faunipollenites*. On the basis of the quantitative distribution four miofloral zones have been distinguished.

Miofloral Zone 1 — This is characterised by the dominance of the genus *Jayantisporites*. This taxon is present up to 31 per

cent in Sample no. UJ/1+2, increases to 56 per cent in Sample no. G14, declines to 40 per cent in Sample no. G13 and finally disappears in the younger sediments. *Callumispora* shows its maximum frequency in Sample no. UJ/1+2 (30%) and then declines gradually in the younger sediments. The third taxon in significance is *Microbaculipsora* which marks an increasing tendency from Sample no. UJ/1+2 (5%) to G15 (16%) and attains maximum in G14 (23%) and then declines gradually in further younger samples. *Vesicaspora* and *Ginkgocycadophytus* although present consistently are in decreasing order from older to younger sediments.

Miofloral Zone 2 — This assemblage zone is marked by the dominance of *Parasaccites* (33% in Sample no. G9) which was subdominantly present in G13. The monosaccates are further increased by the representation of *Plicatipollenites* (9%), *Crucisaccites* (1%), *Virkkipollenites* (4%), *Vestigisporites* (5%) and *Potonieisporites* (2%) and thus bringing a total average of 54 per cent. Among the zonate triletes, *Jayantisporites* is absent and *Potonieitriradites* is present up to 11 per cent. Apiculate triletes also increase to 10 per cent.

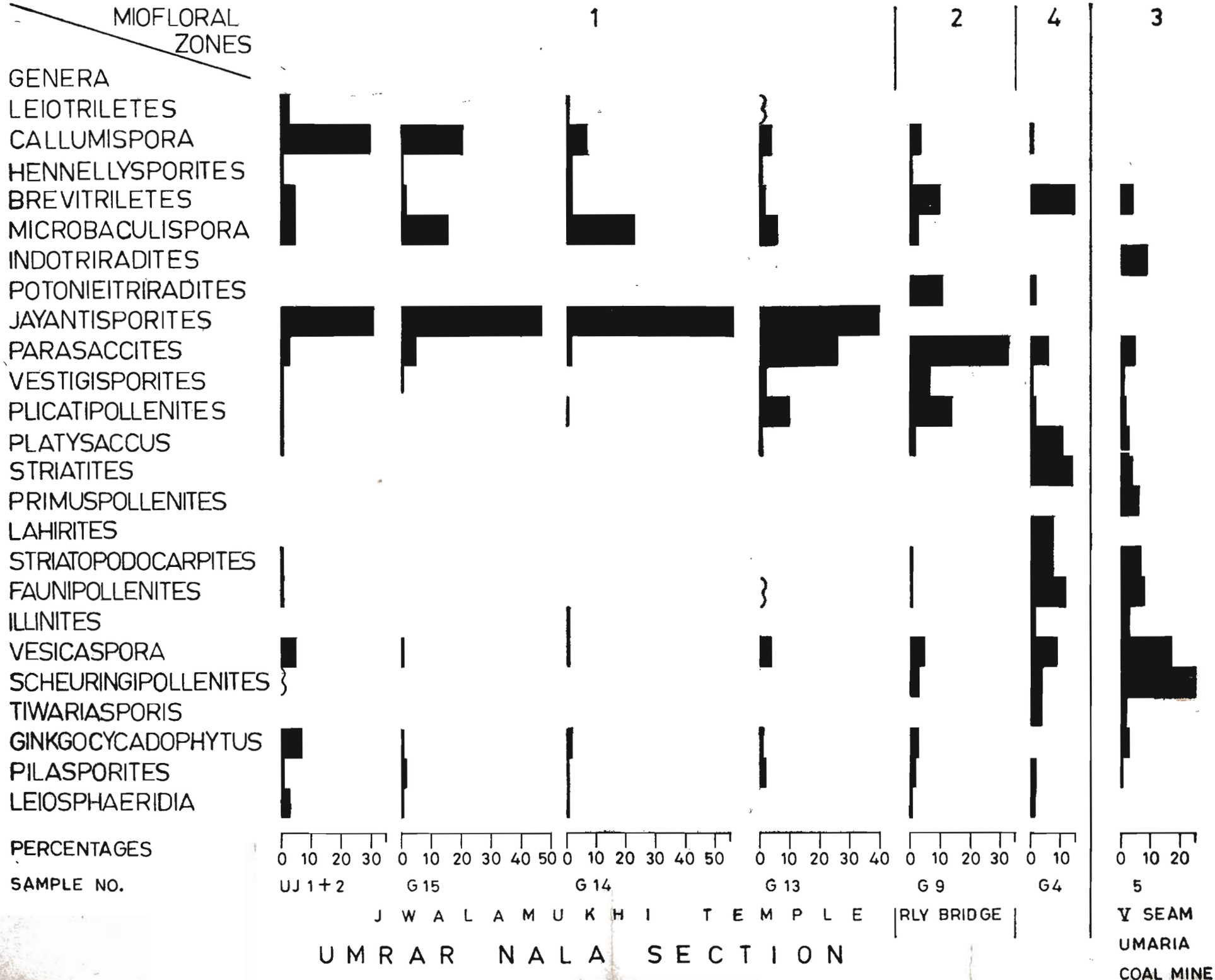
Miofloral Zone 3 — The miofloral of the coal samples (Sample no. 5) from Umaria Coal Mine shows an overall dominance of nonstriated-disaccate pollen grains (58%), maximum being represented by *Scheuringipollenites* (24%). *Vesicaspora* shows its maximum (17%). *Primuspollenites* (5%) and *Indotriradites* (9%) are present only in this sample. Apiculate triletes are, however, reduced to 4 per cent and so are the monosaccate pollen grains (8%). Striated-disaccates increase to 18 per cent.

Miofloral Zone 4 — Sample no. G4 of the Umrar River Section shows maximum development of striated-disaccate pollen grains (46%), being represented by *Striatites* (14%) and *Faunipollenites* (11%). *Tiwariaporis* rises to 4 per cent. On the other hand, *Vesicaspora* and *Scheuringipollenites* decline to subdominance in the present sample.

COMPARISON

The Talchir sediments of the railway cutting have not yielded sufficient miospores and hence a quantitative estimation of the mioflora could not be made. However, the genera identified among them resemble qualitatively with the known Talchir miofloras. Lele and Chandra (1972) also made similar observation from the marine beds of the Umaria Coalfield.

The coal seam (sample UJ/1+2) exposed in the tributary of Umrar River near Jwalamukhi Temple shows a combined dominance of *Callumispora* + *Jayantisporites*. The dominance of *Callumispora* is known from the Lower Karharbari seam of the Giridih Coalfield (Srivastava, 1973) but the percentage of *Parasaccites* and *Brevitriletes* are higher in the latter. *Jayantisporites* was first recorded from the Talchir Formation of the Jayanti Coalfield by Lele and Makada (1972) but quantitatively it was rare in the Talchir and Karharbari formations of the Jayanti Coalfield. Later on its presence in association with *Callumispora* was recorded in the Chirimiri Coalfield (Srivastava, 1980b; Lower Karharbari; Paradol-Chirimiri railway cutting, Sample no. CR/15) and also the Lower Karharbari mioflora of North Karanpura Coalfield (Srivastava, 1980a; Honhe area; Sample no. B/5). However, the dominance of *Jayantisporites* is the first record from Umaria Coalfield and its maximum development has been recorded in the sediments exposed in Umrar River (Sample nos. G15-G13) where *Callumispora* shows a declining phase. Instead the genus *Microbaculispora* attains significance. In the Lower Karharbari miofloras of Chirimiri (Srivastava, 1980b) and North Karanpura (Srivastava, 1980a) coalfields *Microbaculispora* also forms the subdominance. In Korba Coalfield (Bharadwaj & Srivastava, 1973, younger phase of Zone 1), however, *Callumispora* is associated with *Parasaccites* and *Brevitriletes*. The above comparison shows that the coal seam exposed near Jwalamukhi temple and the Sample nos. G15-G13 of Umrar River belong to the same group, the Lower Karharbari, the former being the oldest. The coal seam exposed near Jwalamukhi temple also represents the oldest coal seam (Seam VI) of the Umaria Coalfield. In this respect the carbonaceous shale (Sample no. G9) associated with a coal seam exposed below the railway bridge shows maximum development of radial monosaccates and is associated with a zonate trilete genus


MIOFLORAL ZONES
1
2
4
3
GENERA
LEIOTRILETES
CALLUMISPORA
HENNELLYSPORITES
BREVITRILETES
MICROBACULISPORA
INDOTRIRADITES
POTONIEITRIRADITES
JAYANTISPORITES
PARASACCITES
VESTIGISPORITES
PLICATIPOLLENITES
PLATYSACCUS
STRIATITES
PRIMUSPOLLENITES
LAHIRITES
STRIATOPODOCARPITES
FAUNIPOLLENITES
ILLINITES
VESICASPORA
SCHEURINGIPOLLENITES
TIWARIASPORIS
GINKGOCYCADOPHYTUS
PILASPORITES
LEIOSPHAERIDIA
PERCENTAGES
0 10 20 30
0 10 20 30 40 50
0 10 20 30 40 50
0 10 20 30 40
0 10 20 30
0 10
0 10 20
SAMPLE NO.
UJ 1+2
G 15
G 14
G 13
G 9
G4
5
J W A L A M U K H I T E M P L E
RLY BRIDGE
V SEAM
UMARIA
COAL MINE
UMRAR NALA SECTION

HISTOGRAM 1

Potonieitriradites. The apiculate triletes also increase in their percentages. The older subzone of Zone 2 in the Korba Coalfield, (Bharadwaj & Srivastava, 1973), the Kauakoh Nala Section of the Chirimiri Coalfield (Srivastava, 1980b) shows similar dominance of *Parasaccites* but do not contain zonate triletes similar to Sample no. G9 of Umrar River. The Upper Karharbari seam of the Giridih Coalfield is dominant in *Illinites* + *Vesicaspora* and is different from the present mioflora. Thus, the coal seam exposed below the railway bridge, i.e. Coal seam V of the general sequence, represents the Upper Karharbari seam of the Umaria Coalfield.

The mioflora of the coal seam (Sample no. 5) being worked out in Umaria Coal Mine shows a significant variation from the above miofloras rich in nonstriated-disaccates, chiefly *Scheuringipollenites* and *Vesicaspora*, and striate-disaccates in general follow the subdominance. Among the zonate trilete, *Indotriradites* is significant. Although the Upper Karharbari seam of the Giridih Coalfield contains a significant amount of *Vesicaspora* and thus bears a close affinity with the coal seam of Umaria Coal Mine, yet it differs in having larger percentages of monosaccates. Similar association of *Scheuringipollenites* is also described by Bharadwaj and Tripathi (1978) from South Karanpura Coalfield (Table 4, Roof Shale, Argada 'S' Seam, Assemblage Zone A). In the Barakar type area, i.e. Giridih (Srivastava, 1973; Zone 1), and Pench-Kanhan coalfields (Bharadwaj, Navale & Anand-Prakash, 1974). All these assemblages are dominated by nonstriated-disaccates (*Scheuringipollenites*) and the striated-disaccates come next to them. Monosaccates are rare. Maithy (1966) described a mioflora from the shales of New Umaria Colliery showing the dominance of monosaccate pollen grains. The present mioflora being dominant in nonstriated-disaccates does not compare at all.

The youngest assemblage in the present investigation has been recorded in Umrar River Section (Sample no. G4) which shows the dominance of striated-disaccate pollen grains (*Striatites* + *Faunipollenites*). Non-striated-disaccates form the subdominance. The apiculate triletes are chiefly represented by *Brevitriletes*. Striated-disaccate mioflora is characteristic of the Upper Barakars (Tiwari, 1973, Zone V) and similar mioflora is also reported from North Karanpura Coalfield (Kar, 1973, Zone VI). In South Karanpura Coalfield the striated-disaccate rich assemblage is present in Argada A and Argada B seams of Saunda Block, (Bharadwaj & Tripathi, 1978; Assemblage Zone B) which compares closely with those of sample no. G4 in Umrar River Section of Umaria Coalfield representing the Upper Barakar mioflora.

The palynological succession of the Umaria Coalfield in the present investigation may be summarised as follows:

BARAKAR	UPPER ZONE-4	G4 Umrar River	*Striatites*	Dominant
			Faunipollenites	Subdominant
	LOWER ZONE-3	Umaria Coal Mine (sample no. 5)	*Scheuringipollenites*	Dominant
			Vesicaspora	Subdominant
KARHARBARI	UPPER ZONE-2	G9 Umrar River	*Parasaccites*	Dominant
			Potonieitriradites	Subdominant
	LOWER ZONE-1	G15-G13 Umrar River	*Jayantisporites*	Dominant
			Microbaculispora	Subdominant
		Jwalamukhi Temple	*Jayantisporites* + *Callumispora*	Dominant
			Microbaculispora	Subdominant

the Raniganj Coalfield, *Scheuringipollenites* is present in Zone 4 (Tiwari, 1973) and thus compares with the present mioflora. Similar dominance is also known from Korba, (Bharadwaj & Srivastava, 1973; Zone 3),

CONCLUSION

The present investigation has revealed that almost a complete sequence from Talchir to Barakar (Upper) formations is developed

in Umaria Coalfield, indicating the presence of a considerably reduced thickness of Barakar sediments in the area as compared to the other Lower Gondwana coalfields. The coal-bearing horizon extends from Lower Karharbari to Upper Barakar. The coal seam (youngest) being worked at Umaria coal mine compares with known Lower Barakar miofloras. Further, Supra-Barakars in the northern part of the coalfield may have concealed even younger sediments and also a good reserve of coal of economic value.

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