A PALYNOSTRATIGRAPHIC STUDY OF LOWER GONDWANA SEDIMENTS FROM SOUTH KARANPURA COALFIELD, BIHAR, INDIA

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ABSTRACT

South Karanpura Coalfield is one of the important coalfields in Damodar Valley. The coal bearing strata are dated to be Barakar (Lower Permian) in age. In the present work a comprehensive palynological investigation of these carbonaceous sediments has been done. The mioflora recovered is either dominated by the nonstriate-disaccate or striate-disaccate genera. On the basis of statistical analysis three Assemblage zones are recognized. The basal most ' Assemblage Zone A ' is characterized by the dominance of *Scheuringipollenites* associated with *Brevitriletes*. The middle ' Assemblage Zone B ' shows the increasing tendency of *Faunipollenites* and decline of *Scheuringipollenites*. The youngest ' Assemblage Zone C ' shows the increase in the percentage of *Scheuringipollenites* and corresponding decline of *Faunipollenites* associated with *Horriditriletes* and *Cyclogranisporites*.

The ' Assemblage Zone A' shows broad similarities with the Lower Barakar mioflora of Pench-Kanhan, Korba and Giridih coalfields and the Zone IV of Barakar mioflora of the type area and the mioflora of bore core KB21 (at 405·6 m depth) from North Karanpura Coalfield. The ' Assemblage Zone B ' shows broad similarities with the Zone V of the Barakar Type area and the assemblage of bore core KBM19 (at 48 m depth) of North Karanpura Coalfield.

INTRODUCTION

ALTHOUGH, palynological data are not unknown from the carbonaceous sediments of South Karanpura Coalfield, Bihar (Datta, 1957, 1964; De, 1960; Khan, 1962, 1964; Bandyopadhyay, 1967; Bharadwaj & Tiwari, 1968; Lele & Kulkarni, 1969; Bharadwaj & Anand-Prakash, 1972) a detailed and systematic study of palynostratigraphy has not been on record. In the present work a more or less complete miofloral succession has been built up in order to know the incidence pattern of different groups of miospores. In view of the accumulating data from other areas regarding the miofloral succession through Barakar deposits, the results presented here further provide an understanding in the lateral variation and basinal characters of miofloras.

GEOLOGY OF THE COALFIELD

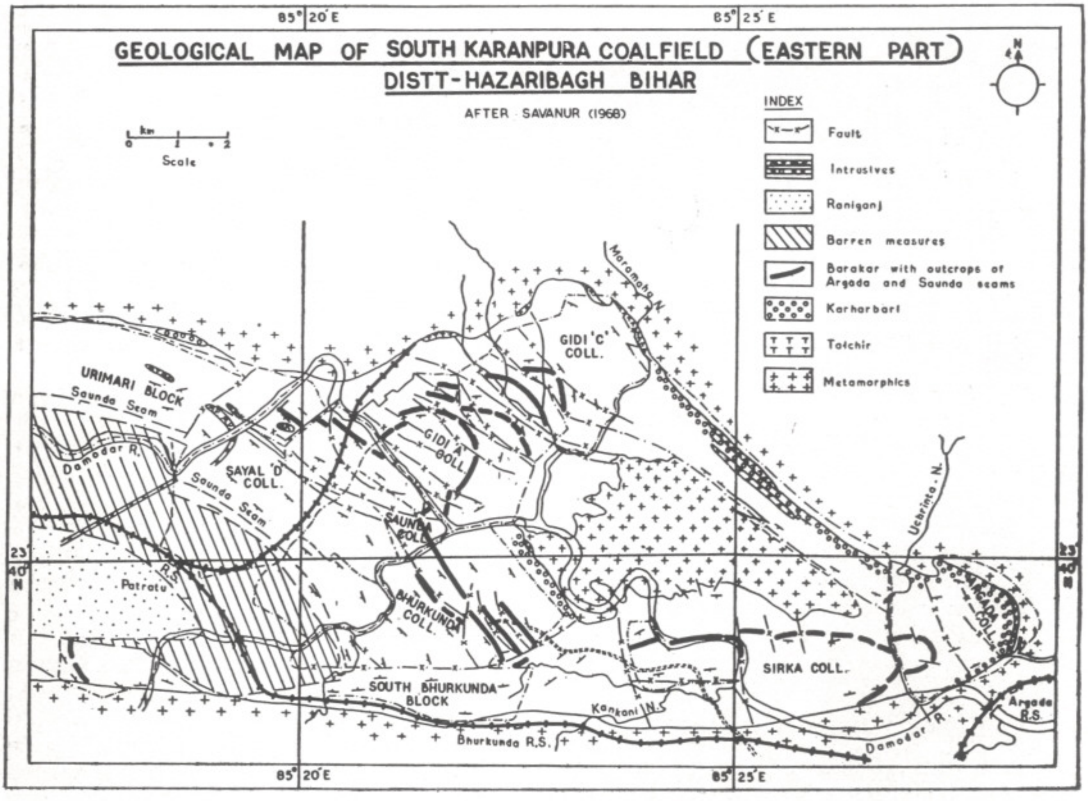
The Karanpura Coalfield lies between 84° 46′ and 85° 28′ E longitude and 23° 38′ and 23° 50′ N latitude. The total area of the coalfield is roughly 885·115 sq km of which 120·697 sq km belong to the southern area (Fox, 1934). Hughes (1869) named this southern area (85° 7′ & 85° 28′ E longitudes and 23° 38′ & 23° 43′ N latitudes, Hazaribagh District of Bihar) as the South Karanpura Coalfield and the larger area in the north as the North Karanpura Coalfield.

Damodar is the principal river and its only tributary of any importance is the Jainagar stream. The coalfield occupies the low ground of the valley of Damodar extending along its bank forming a narrow and elongated trough. On the eastern and northern fringes of the coalfield the Talchir rocks are thin and sporadic in occurrence (Map 1; after Savanur, 1968). The southern boundary of the coalfield is faulted throughout but the northern boundary is faulted only in some parts of Urimari block.

The geological succession of South Karanpura Coalfield is as follows (after Savanur, 1968):

		Alluvium and Laterite	Recent
....		UNCONFORMITY	....
LOWER GONDWANA		Intrusives (Dolerite and Micaperidotite)	Cretaceous to Jurassic
		Raniganj Series	Upper Permian
	Damuda System (Permian)	Barren Measures Series (304·8 to 457·2 m)	Middle Permian
		Barakar Series (127·76 m)	Lower Permian
		Talchir Series (15·24 m)	Upper Carboniferous
....		GREAT UNCONFORMITY	....
		Metamorphics (Gneisses and Schists)	Pre-Cambrian

The above classification proposed by Savanur is, however, not acceptable here, in view of the provisions in Code of Stratigraphic Nomenclature. He (Savanur, *loc. cit.*) has suggested Gondwana to be called as 'Group' but a group is a unit in the



MAP 1

TABLE 1 – DETAILS OF THE SAMPLES STUDIED IN THE PRESENT WORK. THE COAL SEAMS HAVE BEEN ARRANGED IN ASCENDING ORDER FROM BOTTOM TO TOP.

SL. No.	COAL SEAM/BED	COLLIERY	SECTOR/INCLINE	LITHOLOGY AND POSITION	THICKNESS OF THE SEAM	REGISTERED LOCALITY NUMBER	LAB. SAMPLE NUMBER	MIOSPORES PRESENT (+), OR ABSENT (–)
1	Talchir Sandstone	Exposed in Marmara Nala Section	—	Sandstone		1231	27	–
2.	Argada 'S' Seam	Argada	Argada Sector	Floor shale		1234	4	–
3.	,,	,,	,,	Inter-bedded shale	10·06 m	,,	3	+
4.	,,	,,	,,	Coal		,,	2	+
5.	,,	,,	,,	Roof shale		,,	1	+
6.	Naditoli Seam	Beside Marmara Nala near Gidi 'C' Private Colliery	—	Coal	12·19 m exposed thickness	1229	5	+
7	Seam above Naditoli	Sahu	Hislong Sector on the bank of Marmara Nala	Coal	0·61 m	1235	6	+
8.	Argada 'B' Seam	Saunda	Argada Incline	Floor shale		1232B	8	+
9.	Argada 'B' Seam	,,	,, ,,	Coal	9·14 m	,,	7	+
10.	Argada 'A' Seam	,,	,,	Coal	7·92 m	1232A	9	+
11.	Argada Seam	Gidi 'A'	,,	Floor shale	21·34 m	1240	11	+
12.	,,	,,	,,	Coal		,,	10	+
13.	Lower Sirka Seam	Saunda	Sirka Incline	Floor shale	3·05 m	1233	18	+
14.	,,	,,	,,	Coal		,,	17	+
15.	Middle Sirka Seam	,,	,,	Floor shale		,,	16	+
16.	,,	,,	,,	Coal	4·88 m	,,	15	+
17.	,,	,,	,,	Roof shale		,,	14	+
18.	Upper Sirka Seam	,,	,,	Coal		,,	13	+
19.	,,	,,	,,	Roof shale	2·74 m	,,	12	+
20.	Hathidari Seam	Bhurkunda	Hathidari Incline	Coal	3·66 m	1238	19	+
21.	Lower Semana Seam	,,	Lower Semana Incline	Coal	3·66 m	1239	20	+
22.	Lower Nakari Seam	Saunda	Nakari Incline	Floor shale		1216	23	+
23.	,,	Saunda	Nakari Incline	Coal	4·88 m	,,	22	+
24.	,,	,,	,,	Roof shale		,,	21	+
25.	Upper Nakari Seam	Sayal 'D'	Sayal No. 4 Incline	Coal	2·44 m	1236	25	+
26.	,,	,,	,,	Roof shale		,,	24	+
27.	Kurse Seam	,,	,,	Coal	5·48	1237	26	+

hierarchy of rock stratigraphic units (group, formation, member) and hence, can not be designated so. Savanur (1968, p. 326) suggests to consider the Talchir, Barakar, Barren Measures and Raniganj as ' series ' and not as stages' . . . in keeping with their great thickness of strata . . . ". As such, however, series is a time stratigraphic unit next in rank below system and therefore cannot be based upon the thickness of the strata. The series generally constitutes a major unit in time correlation. The stage is a time stratigraphic unit next in rank below series. Commonly, it is based on a succession of biostratigraphic zones. In view of these facts, the Talchir, Barakar, Barren Measure and Raniganj have been considered here as stages and not as series.

A geological account of different horizons in this coalfield is as given below:

Archaeans — Archaean rocks form the boundary of the South Karanpura Coalfield. The main rock types present are gneisses, hornblende schist, mica schist and limestones. The limestones are present near the southern boundary of the coalfield.

Talchir Stage — The Talchir rocks are not well-developed and occur in restricted and thin exposures along the fringes of eastern and northern boundary of this coalfield. It overlies the Archaeans with an unconformity and forms the lowest Formation of the Gondwana Sequence. The Talchir deposits are mostly greenish, yellowish and buff-coloured, thinly laminated shales. The occurrence of Talchir boulder bed at the base has not been reported so far.

Barakar Stage — This is the most important coal bearing stage of the Damuda Series. 129·49 sq km out of 181·29 sq km, are occupied by the sediments of the Barakar Stage (Savanur, *loc. cit.*). It directly overlies the Archaeans and is found only in patches. The basal Barakar deposits do not form a constant horizon in the strata of the Barakar Stage indicating thereby the irregularity in the archean floor (Jowett, 1925; Mehta *et al.*, 1963). It is probably due to this reason that the thickness of the Barakars differs in different parts of the field (Mehta *et al.*, 1963). The Barakar Formation is conformably overlain by the rocks of Barren Measure and Raniganj formations in the central part of the coalfield, over the remaining 51·79 sq km. The most important rock types of the Barakar Stage are sandstone, grey shale, carbonaceous shale and coal. It has a persistent basal conglomerate which thickens considerably towards the east (Banerjee, 1960). The younger sequence of this stage is best developed in Bhurkunda Colliery and the older sequence in Argada block. The total number of coal seams developed in this coalfield is 41 (Savanur, *loc. cit.*). The total thickness of Barakar sediments is about 1699·26 m according to Banerjee (1960) but Savanur (*loc. cit.*) has reported it to be 1127·76 m. The entire sequence of Barakar strata has been divided into seven stages by Savanur (*loc. cit.*) on the basis of group of coal seams containing good quality coal seams and inferior quality coal seams. According to him, each of such group of coal seams represents one of the stages of the Barakar Series. However, as discussed above, the groups of seams based on quality differences can not represent the ' stage '. Thus, ' Barakar Series in its special meaning has been taken here to be the true ' Stage '.

Barren Measure Stage — The strata of Barren Measure Stage occur as a lenticular unit being thickest at Kirigarha and tapering out both eastwards and westwards. The thickness of Barren Measure sediments is 73·76-168·24 m. Lithologically, in general it contains brown, ferruginous siltstones, black carbonaceous shales, fine grained brown sandstones, conglomerates, and ironstones. It is homogeneous from bottom to top.

Raniganj Stage — The Raniganj sediments are more than 190·80 m thick (Banerjee, 1960). They are lithologically similar to Barakar sediments having basal sandstone, middle shale and upper siltstone. This stage is almost without coal. However, only one coal seam (0·60 m thick) has been reported near the Nakari River (Mehta *et al.*, 1963).

Panchet Stage — No sediments belonging to the Panchet Stage are found in the South Karanpura Coalfield (Jowett, 1925).

MATERIAL AND METHODS

The material, on which the present study is based, was collected from the working faces of various coal seams. The coal and shale samples were collected from freshly cut channels, initially foot-wise, by chipping the cut surface and then making representative overall samples by mixing almost equal quantity from foot-samples. The details of these samples are given in Table 1.

All the samples were first powdered in order to obtain about 2-3 mm size pieces. From each sample 10 gm of powdered material was taken. The coal samples were digested in commercial nitric acid for 3-4 days, thereafter treated with 10% potassium hydroxide. The shale samples were first subjected to cold hydrofluoric acid treatment and then kept in nitric acid. Slides were prepared in glycerine jelly and were sealed with paraffin wax. Two hundred specimens have been counted at random from each sample to determine the generic frequency percentage.

MIOFLORAL DISTRIBUTION

Twenty seven samples have been examined palynologically, out of which 25 samples yielded spores and two samples (Talchir sandstone & floor shale of Argada 'S' seam) proved barren. Out of these 25 samples, 2 samples collected from Naditoli and Seam-above-Naditoli have not been included in the quantitative considerations because of incomplete sampling.

The miospore assemblage of the present succession consists of 43 genera. It includes many trilete, monolete, monosaccate, disaccate and monosulcate genera. The analysis has suggested that the following genera are important either individually or by forming characteristic association with other miospore genera in various samples.

Horriditriletes Bharad. & Sal., 1964; *Brevitriletes* Bharad. & Sriv., 1969; *Microbaculispora* Bharad., 1962; *Lacinitriletes* Venkat. & Kar, 1965; *Cyclogranisporites* Pot. & Kr., 1954; *Verrucosisporites* Ibr. emend. Smith, 1971; *Laevigatosporites* Ibr., 1933; *Weylandites* Bharad. & Sriv., 1969; *Lueckisporites* Pot. & Kl. emend. Bharad., 1974; *Striatites* Pant emend. Bharad., 1962; *Striatopodocarpites* Bose & Maheshw., 1968; *Lahirites* Bharad., 1962; *Faunipollenites* Bharad., 1962; *Primuspollenites* Tiw., 1964; *Paravesicaspora* Kl., 1963; *Scheuringipollenites* Tiw., 1973.

In addition to the above important genera, a number of others have also been recorded, but they are either meagre in representation or sporadic and inconsistent in occurrence and, hence, presumably do not play any important role in the group consideration. Their presence, however, is qualitatively important. These genera are:

Indotriradites Tiw., 1964; *Potonieitriradites* Bharad. & Sinha, 1969; *Indospora* Bharad. emend. de Jersey, 1968; *Microfoveolatispora* Bharad., 1962; *Insignisporites* Bharad. & Dwivedi, 1977; *Praecolpatites* Bharad. & Sriv., 1969; *Densipollenites* Bharad., 1962; *Tiwariasporis* Maheshw. & Kar, 1967; *Parasaccites* Bharad. & Tiw., 1964; *Crescentipollenites* Bharad., Tiw. & Kar, 1974; *Verticipollenites* Bharad., 1962; *Distriatites* Bharad., 1962; *Ginkgocycadophytus* Samoil., 1953; *Cuneatisporites* Lesch., 1955; *Barakarites* Bharad. & Tiw., 1964.

Alongwith the above mentioned genera, few others are also present which are very rare, such as:

Divarisaccus Venkat. & Kar, 1966; *Tuberisaccites* Lele & Makada, 1972; *Rhizomaspora* Wils., 1962; *Schizopollis* Venkat. & Kar, 1964; *Ibisporites* Tiw., 1968; *Illinites* Kos., 1950.

Apart from the miospores mentioned above, some phytoplanktons have also been recorded. They are inconsistent in incidence and are present in very feeble percentages. Such alete forms are: *Pilasporites, Leiosphaeridia, Hemisphaerium, Hindisporis, Botryococcus.*

Quantitative Composition of Coal seams — The quantitative analysis of the mioflora is based on a count of 200 specimens per sample. The criterion for marking the relative quantitative abundance of various miospore genera is as follows:

Prominent	25% or $<25\%$
Abundant	11% — 24%
Common	1% — 10%
Rare	$>1\%$

The relative abundance of important genera is given in Table 2.

In Histogram 1, the quantitative as well as qualitative miofloristic composition of all the coal seams has been given (Table 3). The samples are arranged in successional order, the oldest being the first on the left.

A critical examination of this histogram clearly shows that the following miospore genera are most characteristic in the whole miofloral spectrum as they are present regularly in fair to high percentage frequency in all the samples.

Horriditriletes, Brevitriletes, Microbaculispora, Lacinitriletes, Cyclogranisporites, Striatites, Striatopodocarpites, Faunipollenites, Scheuringipollenites.

TABLE 2 — RELATIVE FREQUENCY OF IMPORTANT MIOSPORE GENERA IN VARIOUS SAMPLES STUDIED. THE SEQUENCE OF THE SAMPLES IS FROM BOTTOM TO TOP IN SERIAL ORDER.

* — Common 1%-10%, ** — Abundant 11%-24%, *** — Prominent 25% or >25%

SAMPLES/MIOSPORE GENERA	*Indotriradites*	*Potonieitriradites*	*Horriditriletes*	*Brevitriletes*	*Microbaculispora*	*Microfoveolatispora*	*Lacinitriletes*	*Cyclogranisporites*	*Verrucosisporites*	*Laevigatosporites*	*Praecolpatites*	*Weylandites*	*Lueckisporites*	*Crescentipollenites*	*Striatites*	*Striatopodocarpites*	*Lahirites*	*Faunipollenites*	*Distriatites*	*Primuspollenites*	*Ginkgocycadophytus*	*Platysaccus*	*Cuneatisporites*	*Paravesicaspora*	*Scheuringipollenites*	*Barakarites*
1. Coal of Argada 's' seam				*			*		*	***					*	*	*	**		*			*		***	
2. Interbedded shale of Argada 'S' seam			*	***	*		*	*										*		*	*	*		*	***	
3. Roof shale of Argada 'S' seam			*	*	*		*	*				*			*	*	*	*					*	*	***	*
4. Floor shale of Argada 'B' seam			*		*		*	*				*	*		*	*	*	***		*		*	*		**	
5. Coal of Argada 'B' seam	*		*	**	*		*	**		*			*		*	*	*	***		*	*		*		*	
6. Coal of Argada 'A' seam	*	*	**	*	*	*	*	*					*		*	*		**		*					*	
7. Floor shale of Argada seam			**	*	**		*	**	*	*					*	*	*	**		*			*		**	
8. Coal of Argada seam	*	*	**	*	**		*	*				*			*	*	*	*		*		*			*	
9. Floor shale of Lr. Sirka seam	*		*	*	**		*	**		*					*	*		**		*					**	
10. Coal of Lr. Sirka seam			**	*	**	*	*	**	*						*	*		***		*		*			*	
11. Floor shale Mid. Sirka seam			*	*	*		*	*			*				*	*	*	**		*					***	
12. Coal of Mid. Sirka seam			**	*	*		*	***	*						*	*		***		*					**	
13. Roof shale of Mid. Sirka seam			*				*	*	*	*	*	*			*	**	*	*	*	*					**	
14. Coal of Upper Sirka seam			**	*	*		*	*	*			*			*	*		***		*	*			*	**	
15. Roof shale of Upper Sirka seam			*		*				*			*	*		*	*	*	**		*					**	
16. Coal of Hathidari seam	*		**	*	*		*	**	*			*			*	*		***		*					*	
17. Coal of Lr. Semana seam			***	*	*		**	**	*			*			*	*		**		*					*	
18. Floor shale of Lr. Nakari seam			**	*	*		*	*	*						*	*	*	**		*	*			*	**	*
19. Coal of Lr. Nakari seam	*		**	*	*		*	*	*	*		*			*	*	*	**	*						*	
20. Roof shale of Lr. Nakari seam			*				*	*	*	*	*	*		*	*	**	*	**	*	*		*		**	**	
21. Coal of Upper Nakari seam	*		**	*	*		*	**	*	*					*	*		**		*		*			*	
22. Roof shale of Upper Nakari seam			**	*	*		*	*	*		*	*	*		*	**	*	**					*	*	**	*
23. Coal of Kurse seam			**	*	*		*	***	*						*	*		***		*					**	

HISTOGRAM 1 — Showing the percentage frequency of important miospore genera encountered in different seams studied here.

SEQUENTIAL DISTRIBUTION OF MIOSPORE GENERA

A perusal of Histogram 1 shows that the trilete spores belonging to ferns are very inconsistent in their percentage frequency. No definite pattern has been observed in the distribution of these spores in floor shale, coal or roof shale. Sometimes they are represented in high percentage in the floor shale, sometimes in the coal, but in none of the roof shales they have been recorded in high percentage. For example, *Cyclogranisporites* is in high percentage in the coal of seams — Argada 'B', Middle Sirka, Hathidari, Lower Semana, Upper Nakari and Kurse, while the floor shales in which its percentage is higher than coal are of Argada seam and Lower Sirka seam. Similarly the percentage of *Brevitriletes* is high in the interbedded shale rather than coal of Argada 'S' seam while its percentage frequency is high in the coal of Argada 'B' seam. The genus *Horriditriletes*, on one hand occurs in high percentage in coal of Argada 'A', Sirka, Lower and Upper Nakari and Kurse seams but on the other hand its frequency is high in floor shale of Argada seam. The genus *Microbaculispora* is in high percentage in the coal of Argada seam. In none of the roof shale samples the fern spores attain high percentage frequency.

Such a great inconsistency in the percentage frequency of the fern spores seems to be due to the reason that the ferns are moisture and shade loving plants. Their luxuriant growth tends to be restricted to moist places, sheltered from light. Hence, these are of local significance rather than regional importance (Bharadwaj, 1975). Therefore, to mark the various assemblages it is not possible to rely upon the fern spores. On the other hand, the gymnospermous plants which form a more persistent vegetation within a region and hence, are of regional significance, do not exhibit marked distributional fluctuations. Evidently, the gymnospermous pollen grains give relevant information and can be relied upon for marking the different assemblages in a particular miofloral succession. Therefore, restricting the distributional consideration to gymnospermous pollen grains the percentage for the gymnospermous pollen genera have been re-calculated excluding the percentage of the pteridophytic spores from the total count, (Table 4) and the same have been plotted in Histogram 2. In this Histogram also, the samples have been arranged in the successional order as given by Savanur (1968), the oldest being the first on the left.

GYMNOSPERMOUS POLLEN GENERA IN DIFFERENT LITHO-FACIES — COAL AND SHALE

In Histogram 2 the following gymnospermous pollen genera have been represented:

Praecolpatites, *Weylandites*, *Lueckisporites*, *Crescentipollenites*, *Striatites*, *Striatopodocarpites*, *Lahirites*, *Faunipollenites*, *Distriatites*, *Primuspollenites*, *Ginkgocycadophytus*, *Platysaccus*, *Cuneatisporites*, *Paravesicaspora*, *Scheuringipollenites*.

This Histogram exhibits the comparative incidence of the various gymnospermous genera more instructively as compared to what one sees in Histogram 1. An overall view of Histogram 2 elucidates the consistent occurrence of *Faunipollenites*, *Scheuringipollenites*, *Striatites*, *Striatopodocarpites*, *Primuspollenites* and *Lahirites*, and the dominance of either *Scheuringipollenites* or *Faunipollenites*. Excepting the former four genera, rest of the miospore genera are present comparatively in low percentage. All other disaccate genera — *Lueckisporites*, *Distriatites*, *Crescentipollenites*, *Platysaccus*, *Cuneatisporites* and *Paravesicaspora* and monosulcate genera *Praecolpatites*, *Weylandites* and *Ginkgocycadophytus* are inconsistent in occurrence. These miospore genera which are present irregularly or, are present in low percentage have not been considered significant.

Argada 'S' Seam — In this seam three samples (coal, interbedded shale, and roof shale) have been studied. In the coal sample, the nonstriate-disaccate genus *Scheuringipollenites* is dominant and the striate-disaccate genus *Faunipollenites* is subdominant. Same is the case in the interbedded shale. However, in the roof shale, the nonstriate-disaccate genus *Scheuringipollenites*, though still dominant, is comparatively lower in percentage frequency than in the coal or the interbedded shale. In this seam the highest percentage of *Scheuringipollenites* is in the interbedded shale and that of *Faunipollenites* in the coal.

Argada 'B' Seam — The over all dominance is of striate-disaccates in the floor shale and the coal sample. In both the samples, the genus *Faunipollenites* is dominant being present in highest percentage while *Scheuringipollenites* is a subdominant genus. The percentage of the former genus is higher in the floor shale than in the coal and that of the latter genus is higher in the coal than in the floor shale. The other genera *Striatopodocarpites* and *Striatites* are represented by almost equal percentage in the two samples. The palynological composition of the floor shale and the coal litho-facies of Argada 'B' seam is almost the same.

Argada 'A' Seam — In this seam the dominance of striate-disaccates is maintained by high percentage frequency of *Faunipollenites*, being the prominent genus. However, the subdominant genus is also a striate-disaccate miospore genus *Striatites*. The percentage of *Striatopodocarpites* is slightly lower than *Striatites*. The nonstriate-disaccate genus *Scheuringipollenites* is represented in lower percentage.

Argada Seam — In the coal sample of this seam an almost similar pattern of miospore distribution has been observed as is the case in the coal of Argada 'A' Seam. *Faunipollenites*, the striate-disaccate genus, is dominant while the subdominant genus is *Striatopodocarpites*. *Striatites* is next to *Striatopodocarpites* in order of relative abundance. The nonstriate-disaccate genus *Scheuringipollenites* is present in low percentage. However, in the floor shale a reverse pattern to that of the composition in the coal facies, is observed. The nonstriate-disaccate genus *Scheuringipollenites* occurs as the dominant genus, being present in high frequency and *Faunipollenites* the striate-disaccate genus is subdominant. *Striatites* and *Striatopodocarpites* show a low percentage frequency.

In this seam a marked difference has been recorded in the palynological composition of the coal and the floor shale. The percentage of striate-disaccates is higher in the coal than in the floor shale whereas the nonstriate-disaccates show strikingly high percentage in the floor shale than in the coal.

Lower Sirka Seam — In this seam, the over all composition of the coal and the shale facies is very much similar in having striate-disaccates (*Faunipollenites* in highest percentage) in dominance and nonstriate-disaccate (chiefly *Scheuringipollenites*) in subdominance. However, the percentage frequency of various miospore genera slightly varies in the two facies. The percentage of *Scheuringipollenites*, *Faunipollenites* and *Striatopodocarpites* is greater in the floor shale than in the coal while that of *Striatites* is greater in the coal than in the floor shale.

Middle Sirka Seam — In this seam the dominant miospore genus is *Scheuringipollenites* in the floor shale and the coal sample while it is subdominant in the roof shale, showing a decline in its percentage frequency from the floor shale to the coal and to the roof shale. The striate-disaccate genus *Faunipollenites* is subdominant in the coal and in the floor shale while dominant in the roof shale but its highest percentage frequency is in the floor shale. The genus *Striatites* occurs in highest frequency in the coal than in the floor and roof shales. The percentage of *Striatopodocarpites* increases from the floor shale to the coal and to the roof shale.

The composition of coal and floor shale is very much similar while that of roof shale is different with respect to the frequency of *Scheuringipollenites* and *Faunipollenites*.

Upper Sirka Seam — In the coal sample of this seam the dominant miospore genus is *Scheuringipollenites* while the striate genus *Faunipollenites* is subdominant. In the roof shale, *Faunipollenites* occurs as a dominant genus whereas the nonstriate-disaccate genus is subdominant. *Striatites* and *Striatopodocarpites* show slight variation in their percentage in the two facies.

Here, in the composition of coal and roof shale facies, the dominant and subdominant genera — *Faunipollenites* and *Scheuringipollenites* are reversed.

Hathidari Seam — In this seam, *Faunipollenites* is dominant and the subdominant genus is *Scheuringipollenites*. The miospore genera *Striatites* and *Striatopodocarpites* acquire third place, with slight difference in their percentage in order of relative abundance.

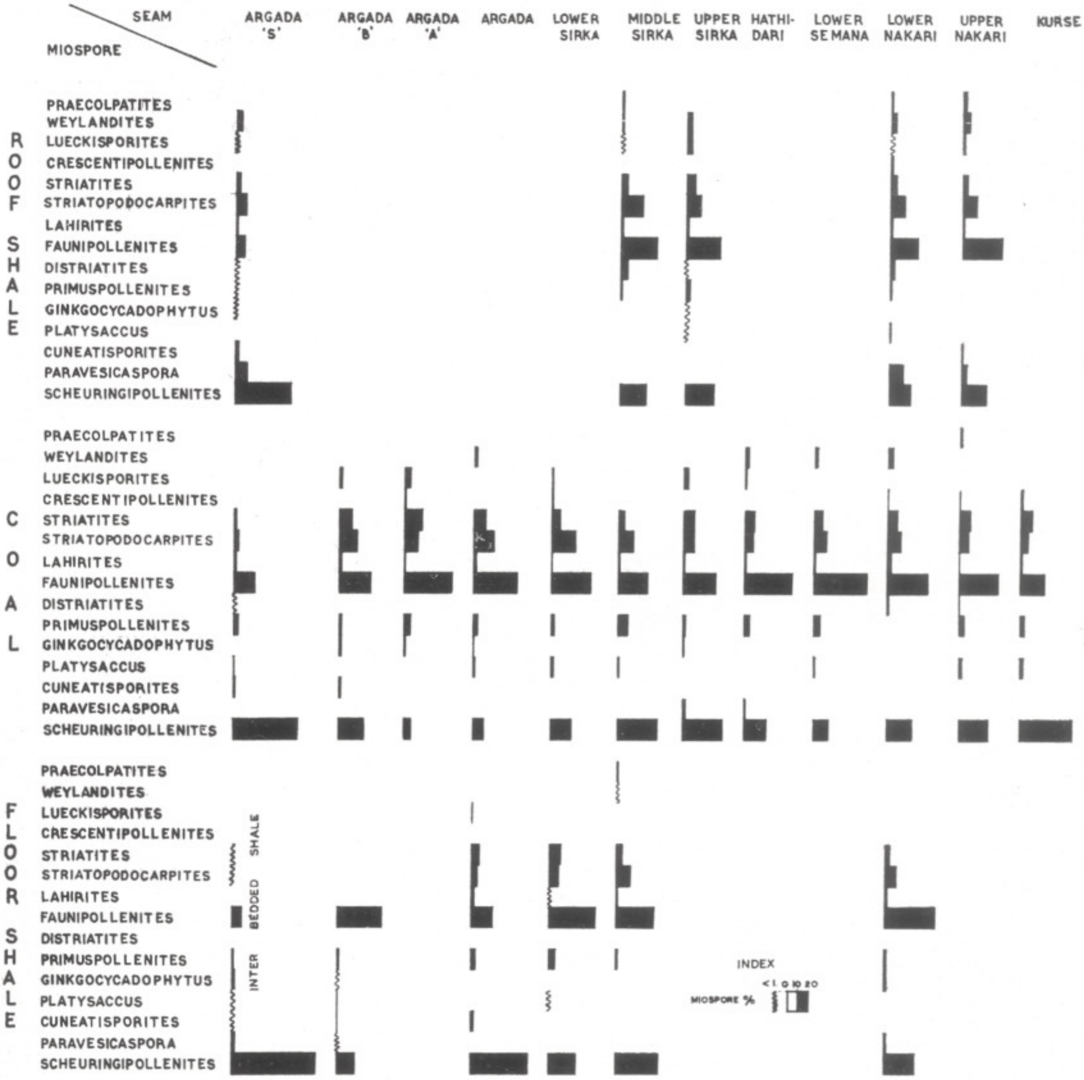
Lower Semana Seam — The over all composition of the seam as well as the percentage of various genera is very similar to that of Hathidari seam. The genus

TABLE 3 — PERCENTAGE FREQUENCY OF IMPORTANT MIOSPORE GENERA ENCOUNTERED IN THE SAMPLES

Seam	Argada 'S'			Argada 'B'		Argada 'A'	Argada		Lr. Sirka		Mid. Sirka			Upp. Sirka		Hathidari	Lr. Semana	Lr. Nakari			Upp. Nakari		Kurse
Miospores / Lithofacies	Coal	Inter-bedded Shale	Roof Shale	Floor Shale	Coal	Coal	Floor Shale	Coal	Floor Shale	Coal	Floor Shale	Coal	Roof Shale	Coal	Roof Shale	Coal	Coal	Floor Shale	Coal	Roof Shale	Coal	Roof Shale	Coal
Indotriradites					1·0	2·0	0·5	2·0	2·0							1·5			1·5		1·5		
Potonieitriradites						1·5		3·0	0·5														
Indospora						1·0		0·5		0·5													
Horriditriletes		6·0	3·5	6·5	5·5	20·5	24·5	13·0	10·0	21·0	9·5	11·5	6·0	11·0	6·0	22·0	25·5	19·0	24·0	1·5	21·5	11·0	23·0
Brevitriletes	4·5	27·5	10·5		20·5	9·5	9·0	4·0	2·0	3·0	6·5	8·5		6·0		5·5	2·0	9·0	7·0		5·0	4·0	8·5
Microbaculispora		2·5	4·5	2·5	7·0	15·5	11·0	17·5	5·0	3·5	3·5	7·0		6·0	1·0	1·5	2·5	4·0	6·0		2·5	1·0	4·5
Microfoveolatispora		0·5			0·5	1·0			0·5	2·5					0·5		0·5		0·5		1·5		2·5
Lacinitriletes	2·0	1·5	6·0	2·0	3·5	5·5	2·5	6·0	2·5	8·0	1·0	2·5	1·0	6·0		7·5	12·0	5·0	9·0	1·0	9·0	4·0	2·0
Cyclogranisporites	0·5	4·5	6·5	9·5	19·0	7·5	15·5	10·0	15·5	14·0	2·0	29·5	1·0	3·5	0·5	14·5	19·5	9·0	10·5	1·5	21·0	7·0	25·5
Verrucosisporites	1·5						1·0			6·0		3·0	3·0	3·0	1·0	1·5	1·5	3·0	2·0	1·5	1·5	1·0	6·0
Insignisporites										0·5						0·5					0·5	1·0	
Laevigatosporites	26·0	0·5			2·0	0·5	1·0		1·0		0·5		1·0						1·5	1·0	1·5		0·5
Praecolpatites											1·0		1·5			0·5				1·5	0·5	2·0	
Tiwariasporis		0·5														0·5				0·5	0·5		
Weylandites			3·5	2·0				1·5			0·5		1·5	2·5	4·0	1·5	1·0		2·0	4·5		4·0	
Parasaccites			0·5						0·5		0·5			0·5				1·0		0·5		1·0	
Lueckisporites			0·5	3·0	1·0	2·0	0·5			0·5			0·5	0·5	4·0	0·5				0·5		1·0	
Crescentipollenites						0·5				0·5						0·5			0·5	2·0	0·5		0·5
Striatites	2·0	0·5	2·5	6·5	5·0	6·0	2·5	5·0	6·0	3·5	4·0	2·5	5·0	6·0	6·0	4·0	3·0	2·0	3·5	4·5	3·5	3·0	3·0
Striatopodocarpites	3·0	0·5	6·0	10·0	7·0	4·5	2·0	8·5	5·5	9·5	9·5	5·5	18·5	6·0	10·0	3·5	4·5	5·0	5·0	13·5	3·0	9·0	2·0
Lahirites	1·5		1·0	2·5	1·5	0·5	1·0	1·5	0·5	0·5	1·0	0·5	1·0	0·5	2·0	0·5	0·5	1·0	2·0	2·0	0·5	1·0	0·5
Verticipollenites								0·5	0·5							0·5	0·5		·	0·5	0·5		
Faunipollenites	13·0	5·0	5·5	30·5	12·5	16·0	7·0	18·0	27·0	15·5	27·0	10·5	30·5	18·0	25·0	19·5	18·5	23·0	15·0	23·0	12·5	25·0	6·0
Distriatites			0·5										6·0		0·5				1·0	3·5	0·5		
Primuspollenites	3·0	1·0	0·5	1·5	1·5	2·0	1·5	2·0	4·0	1·5	1·5	3·5	1·0	1·5	3·0	2·0	2·5	1·0		1·5	1·5		1·0
Ginkgocycadophytus		1·5	0·5	0·5	1·0	0·5		0·5						1·0	0·5			1·0					
Platysaccus	1·0	0·5		1·0				1·0		1·0		0·5			0·5		0·5			1·0	1·0		
Cuneatisporites	1·0	0·5	2·0	1·0		1·0		0·5														1·0	
Paravesicaspora		1·5	7·0	0·5							0·5			2·5		0·5		1·0		13·5		3·0	
Scheuringipollenites	40·0	44·5	38·5	12·0	10·0	2·5	18·5	4·5	16·0	8·0	31·0	14·5	21·5	22·5	21·5	9·0	5·5	14·0	9·0	18·0	9·5	16·0	13·0
Barakarites			1·0					0·5			0·5			0·5				1·0		0·5		2·0	
Pilasporites		1·0	2·0											1·0		0·5				0·5			0·5
Leiosphaeridia			0·5				0·5	0·5		0·5												1·0	
Hemisphaerium			0·5											1·5		0·5		1·0					1·0
Hindisporis	0·5															1·0							
Botryococcus				6·5									0·5		12·5								

TABLE 4 — ABSOLUTE PERCENTAGE OF GYMNOSPERMOUS POLLEN GENERA IN VARIOUS SAMPLES INVESTIGATED HERE

Seam	Argada 'S'			Argada 'B'		Argada 'A'	Argada		Lr. Sirka		Mid. Sirka		Upp. Sirka			Hathi-dari	Lr. Semana	Lr. Nakari			Upp. Nakari		Kurse
Miospores / Lithofacies	Coal	Inter Bedded Shale	Roof Shale	Floor Shale	Coal	Coal	Floor Shale	Coal	Floor Shale	Coal	Floor Shale	Coal	Roof Shale	Coal	Roof Shale	Coal	Coal	Floor Shale	Coal	Roof Shale	Coal	Roof Shale	Coal
Praecolpatites	—	—	—	—	—	—	—	—	—	—	1·3	—	1·7	—	—	—	—	—	—	1·7	1·5	3·0	—
Weylandites	—	—	5·5	2·8	—	—	—	3·4	—	—	0·6	—	1·7	4·0	5·1	3·5	2·8	—	5·2	5·0	—	6·1	—
Lueckisporites	—	—	0·8	4·2	2·4	5·8	1·4	—	—	1·2	—	—	0·5	0·8	5·1	1·1	—	—	—	0·5	—	1·5	—
Crescentipollenites	—	—	—	—	—	1·4	—	—	—	1·2	—	—	—	—	—	—	—	—	1·3	2·2	1·5	—	1·9
Striatites	3·0	0·9	3·9	9·2	12·1	17·4	7·3	11·6	10·7	8·6	5·2	6·6	5·7	9·8	7·8	9·5	8·3	4·3	9·2	5·0	10·6	4·6	11·5
Striatopodocarpites	4·6	0·9	9·5	14·1	17·0	13·0	5·8	19·7	9·0	23·4	12·8	14·6	20·8	9·8	12·9	8·3	12·5	10·4	13·1	13·4	9·1	13·8	7·6
Lahirites	2·3	—	1·6	3·5	3·6	1·4	2·9	3·4	0·8	1·2	1·3	1·3	1·1	1·6	2·5	1·1	1·3	2·0	5·2	2·2	1·5	1·5	1·9
Faunipollenites	20·0	9·0	8·7	42·5	30·4	46·3	20·5	41·8	44·6	38·2	35·7	28·0	34·6	29·5	32·4	46·4	51·3	47·9	39·5	25·8	37·8	38·4	23·0
Distriatites	0·7	—	0·8	—	—	—	—	—	—	—	—	—	6·9	—	0·6	—	—	—	2·6	3·9	1·5	—	—
Primuspollenites	4·6	1·8	0·8	2·1	3·6	5·8	4·4	4·6	6·6	3·7	1·9	9·3	1·1	2·4	3·8	4·7	6·9	2·0	—	1·7	4·5	—	3·8
Ginkgocycadophytus	—	2·7	0·8	0·7	2·4	1·4	—	1·1	—	—	—	—	—	1·6	0·6	—	—	2·0	—	—	—	—	—
Platysaccus	1·5	0·9	—	1·4	—	—	—	2·3	0·8	2·4	—	1·3	—	—	0·6	—	1·3	—	—	1·1	3·0	—	3·0
Cuneatisporites	1·5	0·9	3·1	1·4	2·4	—	2·9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5	—
Paravesicaspora	—	2·7	11·1	0·7	—	—	—	—	—	—	—	—	—	3·2	—	1·1	—	2·0	—	13·4	—	4·6	—
Scheuringipollenites	61·5	80·1	53·1	17·0	24·3	7·2	54·4	10·4	26·4	19·7	41·0	38·6	24·8	36·8	27·5	21·4	15·2	29·1	23·7	20·2	28·8	24·6	50·0



HISTOGRAM 2 — Showing the percentage of gymnospermous pollen genera in various samples under investigation.

Faunipollenites is dominant and *Scheuringipollenites* is subdominant. *Striatopodocarpites* occupies the third place.

Lower Nakari Seam — In this seam, the three samples — the floor shale, the coal and the roof shale, have been studied. The genus *Faunipollenites* shows its dominance in all the three samples while the subdominant genus is *Scheuringipollenites*. Both the genera show decline in their percentage from the floor shale to the coal and the roof shale. The third genus *Striatopodocarpites* shows an increase in its percentage from the floor shale to the coal and the roof shale while *Striatites* is in higher percentage in the coal sample than in the roof and the floor shales.

Upper Nakari Seam — In the roof shale and coal sample of this seam, the dominance is of striate-disaccate genus *Faunipollenites* and the subdominant genus is nonstriate *Scheuringipollenites*, with slight difference in their percentage in the two facies. The genera *Striatopodocarpites* and *Striatites* are present in almost equal percentage in coal while in roof shale *Striatopodocarpites* is more than *Striatites*.

Kurse Seam — In this topmost seam, the nonstriate-disaccate genus *Scheuringipollenites* shows recurrence in high percentage and is present as a dominant genus. The striate-disaccate *Faunipollenites* is subdominant. The associated genera *Striatites* and *Striatopodocarpites* are relatively low in percentage. In this seam, the over all percentage of striate-disaccates is equal to that of the nonstriate-disaccates.

It is evident from Histogram 2 that the palynological composition of the floor shale pertaining to different seams shows in general the same distributional pattern of striate-disaccates being dominant and the nonstriate-disaccate miospores being subdominant as in the coal facies. This normal pattern, however, is not maintained in the case of Argada seam.

In the case of coal samples, the palynological composition, after the change in the dominant genus between Argada 'S' and Argada 'B' seams, shows a uniform trend in the distribution of disaccate genera — the striates being dominant and the nonstriates subdominant in most of the seams with a slight variation in the percentage frequencies of the different genera. However, in the Middle and Upper Sirka and Kurse seams the over all dominance changes to *Scheuringipollenites* instead of *Faunipollenites*.

The interbedded shale has been investigated in only one seam — Argada 'S', which shows variation from the coal as well as the roof shale, the dominant genus being more numerous than in the coal or roof shale.

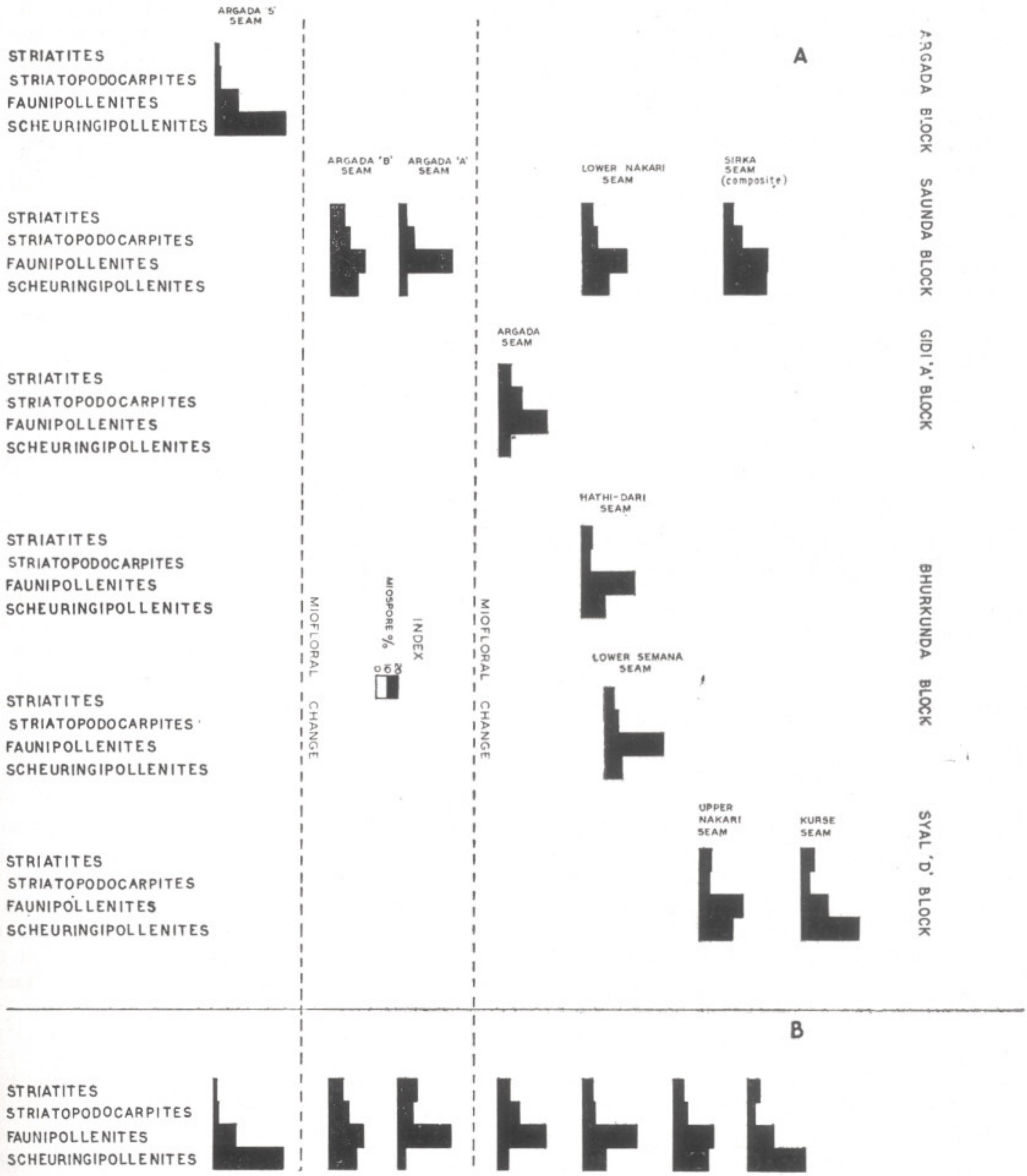
The roof shale of Argada 'S' seam agrees with the coal facies in the dominant genus but differs in the subdominant genus. However, the palynological composition of the three roof shales, viz., Upper Sirka, Lower and Upper Nakari seams agree with the coal facies in the dominant as well as the subdominant genera. But in the roof shale of Middle Sirka seam as compared to the coal facies, the dominant and the subdominant places for the two genera are reversed. It is clear from the above discussion that the palynological compositions of various litho-facies resemble each other in general trends for the dominant and subdominant genera with only occasional exception.

Miospore Genera in the Coal Facies

Restricting to the palynological composition of coal facies only, the disparity in the frequencies of the numerically important miospore genera (Histogram 2) in the various coal seams of different blocks has been analysed. The change of dominance by *Scheuringipollenites* in Argada 'S' seam to that of *Faunipollenites* in Argada 'B' seam appears to be due to a floristic change which, though appearing to be sudden, might have been really gradual as quite thick strata containing seams C-R intervene between the two. Subsequently, from Argada 'B' seam onwards, through the younger seams, the dominance of striate-disaccate genus appears to be persistent but for the level of the younger Middle and Upper Sirka seams and the youngest Kurse seam where the percentage of the non-striate-disaccate miospore genus becomes greater than the striate-disaccate one. Evidently, *Scheuringipollenites* regains dominance in the younger levels. Between these two maxima, in Argada 'S' and Kurse seams respectively, lies the minimum in Argada 'A' seam. Correspondingly, the two minima for *Faunipollenites* lie in Argada 'S' and Kurse seams and the maximum in Argada 'A' seam. With these evident trends of dominance the position of various seams in stratigraphical sequence in different blocks of the coalfield has been given in Histogram 3A.

STRATIGRAPHICAL ASSIGNMENT OF MIOSPORE ASSEMBLAGES IN COALS

In Histogram 3A the palynological compositions restricted to the four numerically important genera in the coal facies only have been plotted. The various seams investigated here from different blocks in South Karanpura Coalfield have been arranged in stratigraphical sequence as suggested by palynological analysis. In the present discussion only two genera — *Scheuringipollenites* and *Faunipollenites* which are dominant and subdominant in



HISTOGRAM 3A — Showing the rearranged position of coal seams under investigation in stratigraphical sequence as suggested by palynological analysis.

HISTOGRAM 3B — Showing the palynological sequence on the basis of mean representation of four significant genera.

various seams, have been considered as they are presumed to control the placement of various palynological assemblages of coal seams at different stratigraphic levels.

A synthesis of Histogram 3A has been plotted in Histogram 3B showing the two maxima of *Scheuringipollenites* at the bottom and top levels respectively. In between these two maxima of *Scheuringipollenites*, the maximum of *Faunipollenites* has also been indicated. On the basis of the reversal of the tendencies in the occurrence of *Scheuringipollenites* and *Faunipollenites* depicted in Histograms 3A and 3B two miofloral changes have been interpreted. The line of floral change has been drawn at the level of culmination of the phase of increasing dominance by one genus and the commencement of a similar phase by another genus. The first palynological change lies at some level after Argada 'S' seam and before Argada 'B' seam, where the reversal in the increasing trend of *Scheuringipollenites* starts and accordingly a hypothetical line for the change has been drawn. The actual line of change could not be plotted because there are a number of seams between Argada 'S' and 'B' seams which have not been studied here. The second miofloral change occurs after Argada 'A' seam where from the reversal in the increasing tendency of *Faunipollenites* is observed. Hence, the second line of change is drawn between Argada 'A' seam and Argada seam. Evidently, this histogram depicts clearly the presence of three assemblage zones — Assemblage Zone A, Assemblage Zone B and Assemblage Zone C.

Assemblage Zone A — The oldest assemblage, ' Assemblage Zone A ' (*Scheuringipollenites* assemblage) is dominated by the non-striate-disaccate *Scheuringipollenites*. The striate-disaccate genus *Faunipollenites* is subdominant. This assemblage is represented in the oldest seam — Argada 'S' seam of Argada block.

Assemblage Zone B — The middle placed ' Assemblage Zone B ' (*Faunipollenites* assemblage) shows the increasing tendency of *Faunipollenites* and decline of *Scheuringipollenites*. This assemblage is recorded from Argada 'B' and Argada 'A' seams of Saunda Block.

Assemblage Zone C — The youngest assemblage, ' Assemblage Zone C ' is again the assemblage of *Scheuringipollenites*. It shows the increasing tendency of *Scheuringipollenites* and corresponding decline of *Faunipollenites*. This assemblage zone shows similarity with ' Assemblage Zone A ' with respect to the increase in the percentage of *Scheuringipollenites*. This youngest assemblage is observed in Argada seam of Gidi 'A' Block, Lower Nakari, Lower Middle and Upper Sirka seams of Saunda Block, Hathidari and Lower Semana seams of Bhurkunda Block, and Upper Nakari and Kurse seams of Syal 'D' Block.

PLACEMENT OF ASSEMBLAGE ZONES A — C IN THE PALYNOSTRATIGRAPHIC SEQUENCE OF LOWER GONDWANA

According to Bharadwaj (1975), succeeding the radial monosaccates-rich Upper Karharbari Formation, the Barakar Formation is palynologically divisible in two parts. The older part is dominated by *Scheuringipollenites* with prominent association of striate-disaccates although in its basal most part, a zonate and azonate trilete rich assemblage is often reported to occur. In the younger part, striate-disaccate mostly *Faunipollenites*, dominated spore assemblage is normally met with. The present investigation has revealed that the sequence of Assemblage Zones A to C happen to be zones of ascending dominance for *Scheuringipollenites*, *Faunipollenites* and once again *Scheuringipollenites*. All these assemblages being associated with fair percentage of triletes, seem to be older to the scarce-trilete associated *Faunipollenites* dominating assemblage of Upper Barakar Formation reported by Kar (1969) from North Karanpura Coalfield, which continues further into Barren Measures with an overwhelming dominance of striate-disaccates along with the addition of a monosaccate genus *Densipollenites*. It seems that within the Barakar Formation there is an alternation of *Scheuringipollenites* and *Faunipollenites* dominating horizons, one each in the Lower and the Upper parts. The difference between the Lower and Upper *Scheuringipollenites* zones lies in the association of high percentage of *Brevitriletes* in the former and that of *Cyclogranisporites* and *Horriditriletes* in the latter. Likewise, between the two *Faunipollenites* zones, the older is trilete rich while the younger is trilete poor.

Evidently, in the Barakar Formation there are four palynological zones as summarized below:

B	U	*Faunipollenites*	Kar, 1969, Bore
A	P	Assemblage	hole no. K5, North
R	P	Zone	Karanpura Basin
A	E		

K A R F O R	R L O W	*Scheuringipollenites* Assemblage Zone	Argada seam of Gidi 'A' Block; Lr. Nakari; Lr. Mid. and Upper Sirka seams of Saunda Block; Hathidari and Lr. Semana seams of Bhurkunda Block, and Upper. Nakari and Kurse seams of Syal 'D' Block.
M A T	E R	*Faunipollenites* Assemblage Zone	Argada 'A' and Argada 'B' seams of Saunda Block.
I O N		*Scheuringipollenites* Assemblage Zone	Argada 'S' seam of Argada Block.

COMPARISON OF PRESENT ASSEMBLAGES WITH OTHER BARAKAR ASSEMBLAGES

The palynostratigraphical study of the Barakar deposits from Lower Gondwana of India has been extensively studied in the last decade (Bharadwaj & Tiwari, 1964; Bharadwaj & Srivastava, 1973; Bharadwaj & Anand-Prakash, 1972; Bharadwaj, Navale & Anand-Prakash, 1974; Tiwari, 1965, 1968, 1971, 1973; Kar, 1969, 1973; Navale & Tiwari, 1968; Venkatachala & Kar, 1968a, 1968b; Srivastava, 1973; Srivastava & Anand-Prakash, 1973). Out of these data the well-dated and complete successions are those reported by Tiwari, 1973; Bharadwaj, Navale & Anand-Prakash, 1974; Bharadwaj & Srivastava, 1973; Srivastava, 1973; and Kar, 1969, 1973.

In the mioflora of the Barakar type area, three zones have been reported by Tiwari (1973) in the Barakar Stage. Zone III representing the Lower Barakar is *Parasaccites*/zonate-cingulate rich in which the nonstriate-disaccates are subdominant. Zone IV which represents the Middle Barakar is dominated by the nonstriate-disaccates (*Sulcatisporites* = *Scheuringipollenites*/*Ibisporites*) while the striate-disaccates are significantly represented, and the monosaccates are rare. In the upper most zone — Zone V representing the Upper Barakar the striate-disaccates (*Faunipollenites*/*Striatopodocarpites*) dominate the assemblage while the nonstriates are subdominant.

The lowermost 'Assemblage Zone A' of the assemblage zones encountered in the present investigation differs from the Zone III of the Barakar type area in the absence of radial monosaccates and zonates/cingulates. The 'Assemblage Zone A' and 'B' are comparable to the mioflora of Zone IV and Zone V of the type area respectively in respect to the nonstriate and striate-disaccates.

From the Barakar sediments of North Karanpura Coalfield, Kar (1973) reported three zones — IV, V and VI representing the Lower, Middle and Upper Barakar within the Barakar Stage. The lower zone (Zone IV) is dominated by striate-disaccates (*Strotersporites* = *Striatopodocarpites*, *Striatopiceites* = *Faunipollenites*, *Striatites*) and the monosaccates and triletes are common. The middle zone (Zone V) shows the dominance of triletes (*Lophotriletes*, *Lacinitriletes*, *Microbaculispora*, *Didecitriletes* and *Apiculatisporis*) and the striate-disaccates are subdominant. The upper zone (Zone VI) is again dominated by the striate-disaccates (*Striatopiceites*, *Strotersporites* and *Striatites*) whereas the triletes, monoletes and monosaccates are few. The detailed analysis of the available data of bore cores representing these assemblages (Kar, 1973, pp. 311, 314) show that the mioflora of bore core KB21 at 405·6 m depth is dominated by *Scheuringipollenites* while *Faunipollenites* is subdominant. In KBM19 at 48 m depth the mioflora is dominated by *Faunipollenites*, but *Scheuringipollenites* is not reported. In the assemblages of bore core K5 which continues further into Barren Measures, *Faunipollenites* shows the phase of increasing dominance. It increases from 32 per cent (at 320·0 m depth) to 49 per cent (at 309 m depth) and *Scheuringipollenites* shows corresponding decline from 16 to 24 per cent. With reference to present findings the assemblages of KB21 and KBM19 represent the *Scheuringipollenites* and *Faunipollenites* Assemblage zones of Lower Barakar and the two assemblages of K5 represent the other *Faunipollenites* Assemblage Zone of the Upper Barakar. With this view the 'Assemblage Zone A' of South Karanpura Coalfield resembles the mioflora of KB21 (at 405·6 m depth) and 'Assemblage Zone B' resembles the assemblage known from KBM19 (at 48 m depth). The comparison of 'Assemblage Zone C' has not been possible as the data of Middle Barakar from these bore cores is not given separately.

The mioflora of the Lower Barakar is known from Korba, Giridih and Pench-Kanhan coalfields (Bharadwaj & Srivastava, 1973; Srivastava, 1973; Bharadwaj, Navale & Anand-Prakash, 1974). All the three assemblages are dominated by nonstriate-disaccates (*Sulcatisporites* = *Scheuringipollenites*) and the striate-disaccates are subdominant. The monosaccates are rare in Pench-Kanhan and Korba Coalfields. The 'Assemblage Zone A' of present study is comparable to the assemblage known from Pench-Kanhan Coalfield with respect to the nonstriate-disaccate genera whereas the radial monosaccates which are rare in Pench-Kanhan Coalfield are absent in the 'Assemblage Zone A'. The other two assemblages known from Korba and Giridih coalfields resemble the 'Assemblage Zone A' with respect to the dominance of nonstriate-disaccates.

The above discussion reveals that the 'Assemblage Zone A—C' encountered in the present investigation from South Karanpura Coalfield show some similarity with other known assemblages of the Barakar Stage. The 'Assemblage Zone A' resembles the Lower Barakar mioflora of Pench-Kanhan, Korba and Giridih coalfields, and the mioflora of Zone IV of the Barakar type area and bore core KB21 (at 405·6 m depth) from North Karanpura Coalfield. The 'Assemblage Zone B' resembles the mioflora of Zone V of the Barakar type area and the palynoflora of bore core KBM19 (at 48 m depth) from North Karanpura Coalfield. The 'Assemblage Zone C' is not comparable with any of the well dated Barakar miofloras known so far.

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