ASSOCIATIONS OF MIO- AND MEGAFLORAS IN THE ROOF SHALES OF SOME BARAKAR COAL SEAMS, SOUTH KARANPURA COALFIELD, BIHAR

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ABSTRACT

Miofloral assemblages recovered from the roof shales of the Argada Seam, Lower Nakari Seam, Upper Nakari Seam and Kurse Seam are recorded under 40 spore-pollen genera and 51 species. *Scheuringipollenites*, *Striatopiceites* and *Strotersporites* are characteristically dominant.

By comparison with the Barakar palynozones of the type area, the Argada mioflora approaches the 'Nonstriate-disaccate zone' characterized by *Scheuringipollenites*. The younger roof shales of the Nakari-Kurse Group have miofloras referable to the "Striate-disaccate zone" characterized by *Striatopiceites* and *Strotersporites*. The 4 roof-shale miofloras seem to fall within the Middle to Upper Barakar interval which is in agreement with their geological position. Certain peculiarities between the shale and coal miofloras are given in view of their probable bearing on facies differences.

The South Karanpura material provides an interesting situation where mio- and megafloral counterparts are found in fair abundance. Both evidences support the distinction of the Argada roof shale from the younger shales of the Nakari-Kurse Group. However, within the latter group, the megafloral composition of individual roof shales is apparently more critical than that of the miofloras. A wide study of mio- and megafloral associations and the factors fafluencing their distribution is needed to resolve these problems.

INTRODUCTION

THE South Karanpura Coalfield is a large basin (195 sq km) stretching between the latitudes 23°38′ to 23°45′ and longitudes 85°05′ to 85°28′. A thick succession of Lower Gondwana rocks, encompassing Talchir to Raniganj Formations, is developed in the basin. A narrow fringe of Archaeans separates the South Karanpura Coalfield from the North Karanpura Coalfield, the latter also representing a parallel development of Lower Gondwana sediments.

The Barakar Formation is best developed in the South Karanpura Coalfield and contains all the good quality coal. Drilling data indicate a thickness between 790 to 915 m for the Barakar. Lithologically the Barakar rocks consist of coarse grained pebbly sandstone, medium to fine grained sandstone, shales, carbonaceous shales and coal seams.

There are about 40 coal seams in the Barakar succession. According to Deekshitulu and Gokul (1971) the Argada Seam is the 18th seam in ascending order. It occurs roughly at the middle of the Barakar and constitutes an important horizon. The Argada Seam is separated from the younger Lower Nakari Seam by an intervening succession of 13 different seams. The Lower Nakari Seam is followed up consecutively by the Upper Nakari Seam and the Kurse seam — the three seams together constituting the Nakari-Kurse Group which apparently occupies a position within the middle to late Barakar interval.

From the roof shales of the Argada Seam, Lower Nakari and Upper Nakari seams, a considerable amount of fossil megaflora dominated by *Glossopteris* was described some years ago by Kulkarni (1970, 1971). The same material was investigated for the recovery of palynological fossils. All the samples of different roof shales yielded well preserved miofloras. In view of the palaeobotanical implications of such mio - and megafloral association in the same sediment we consider it worthwhile to record the palynological findings in some detail and discuss their stratigraphical value in conjunction with the megafossil evidences. The present study would further advance our knowledge of the South Karanpura Barakar miofloras (De, 1960; Bhattacharya et al., 1957; Bharadwaj & Anand - Prakash, 1972; Bharadwaj & Tiwari, 1968; Lele & Kulkarni, 1969), which are still relatively less well-known as compared to those from the neighbouring North Karanpura Coalfield (Bharadwaj & Tiwari, 1966; Venkatachala & Kar, 1964, 1965, 1968a, 1968b; Kar, 1969, 1973) and from other Barakar formations of India (Bharadwaj & Tiwari, 1964;

Bharadwaj & Sinha, 1969; Bharadwaj & Srivastava, 1969, 1971, 1973; Tiwari, 1965, 1968, 1971, 1973, 1974; Navale & Srivastava, 1971; Navale & Tiwari, 1968).

MATERIAL AND METHOD

Following samples were macerated for miofloral studies. They are arranged in stratigraphically ascending order.

Sample No. 793 — Carbonaceous shale, representing roof of the Kurse Seam, Khas Karanpura Colliery, South Karanpura Coalfield.

Age — Middle to Upper Barakar.

Sample No. 795 — Carbonaceous shale, representing roof of the Upper Nakari Seam, Sayal D Colliery, South Karanpura Coalfield.

Age — Middle to Upper Barakar.

Sample No. 794 — Carbonaceous shale, representing roof of the Lower Nakari Seam, Saunda Colliery, South Karanpura Coalfield.

Age — Middle to Upper Barakar.

Sample No. 789 — Carbonaceous shale, representing roof of the Argada Seam, Bhurkunda Colliery, South Karanpura Coalfield.

Age — Middle Barakar.

The extraction of miospores from the shale samples and the preparation of permanent slides were done by conventional palynological methods.

MIOFLORAL RECORD

Following 62 palynomorphs have been identified in the four roof-shale assemblages as a whole. Some characteristic palynomorphs have been figured.

Punctatisporites gretensis Balme & Henn., 1956; *Calamospora* sp.; *Apiculatisporis secretus* Venk. & Kar, 1967; *Lophotriletes* sp.; *Cyclogranisporites gondwanensis* Bharad. & Sal., 1964; *Altitriletes densus* Venk. & Kar.; 1968; *Microbaculispora minutus* Venk. & Kar, 1968; *Didecitriletes* sp.; *Lacinitriletes badamensis* Venk. & Kar, 1965; *Dentatispora gondwanensis* Tiw., 1964; *Indotriradites sparsus* Tiw., 1964, *Gondisporites* sp., *Laevigatosporites* sp.; *Plicatipollenites indicus* Lele, 1964; *P. gondwanensis* (Balm. & Henn.) Lele, 1964; *Virkkipollenites obscurus* Lele; *V. congoensis* Bose & Kar; *Virkkipollenites* sp.; *Parasaccites korbaensis* Bharad. & Tiw., 1964; *P. bilateralis* Tiw., 1965; *P. rimosus* Venk. & Kar, 1968; *Caheniasaccites ovatus* Bose & Kar, 1966; *Barakarites indicus* Bharad. & Tiw., 1964; *Divarisaccus lelei* Venk. & Kar, 1966; *Densipollenites indicus* Bharad., 1962; *Potonieisporites concinnus* Tiw., 1965; *P. barrelis* Tiw., 1965; *P. congoensis* Bose & Mahesh., 1968; *Striomonosaccites ovatus* Bharad., 1962; *Platysaccus papilionis* pot. & Kl., 1954; *Platysaccus* sp.; *Cuneatisporites flavatus* Bose & Kar, 1965; *Cuneatisporites* sp.; *Raniganjiasaccites ovatus* Kar, 1969; *Limitisporites* sp.; *Striatites communis* Bharad. & Sal., 1964; *S. ornatus* Venk. & Kar, 1968; *S. alius* Venk. & Kar, 1968; *Lahirites raniganjiensis* Bharad., 1962; *L. naviculus* Venk. & Kar, 1968; *L. alutas* Venk. & Kar, 1968; *Verticipollenites debilis* Venk. & Kar, 1968; *Hindipollenites indicus* Bharad., 1962; *Striatopiceites digredus* Kar, 1968; *Striatopiceites rimosus* Venk. & Kar, 1968; *Strotersporites decorus* (Bharad. & Sal.) Venk. & Kar, 1964; *S. diffusus* (Bharad. & Sal.) Venk. & Kar, 1964; *S. lentisaccatus* Kar, 1967; *Schizopollis disaccoidis* Venk. & Kar, 1964; *S. extremus* Venk. & Kar, 1964; *S. rugosus* Venk. & Kar, 1964; *Rhizomaspora costa* Venk. & Kar, 1962; *Hamiapollenites saccatus* Wil., 1962; *H. incestus* Wil., 1972; *Corisaccites alutas* Venk. & Kar, 1966; *Scheuringipollenites maximus* (Hart) Tiw., 1975; *S. tentulus* (Tiw.) Tiw., 1973; *Guttulapollenites hannonicus* Goub., 1965; *Gondwanaeaplicates bharadwajii* Kar, 1969; *Ginkgocycadopytus cymbatus* Pot. & Lele, 1961; *Striasulcites tectus* Venk. & Kar, 1978; *Decussatisporites* sp.

COMPARISON AND DISCUSSION

Miofloral Evidence

The miofloral assemblages of the four roof shales are generally dominated by nonstriate-disaccate miospores (*Scheuringipollenites*) and striate-disaccates (*Striatopiceites* and *Strotersporites*). *Hamiapollenites* also shows significant incidence in certain roof shales (Table 1 & Histogram 1). Monosaccate miospores are subordinate in representation, more notable being *Parasaccites* and *Potonieisporites*. The meagre forms belong to triletes, monoletes, polysaccates and polyplicates.

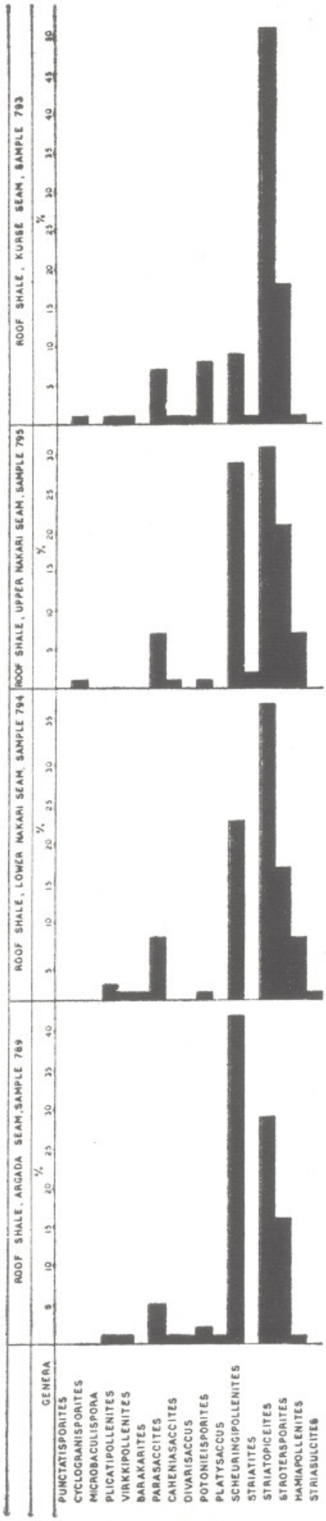
TABLE 1 – PERCENTAGE DISTRIBUTION OF PRINCIPAL GENERA IN ROOF-SHALES OF THE FOUR BARAKAR SEAMS

(Stratigraphically ascending order of samples from left to right. Presence of genus indicated by +)

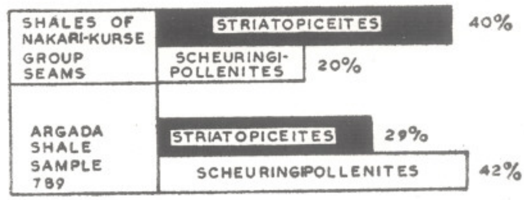
	Argada Seam Roof shale Sample 789		Lower Nakari Seam Roof shale Sample 794	Upper Nakari Seam Roof shale Sample 795	Kurse Seam Roof shale Sample 793
Punctatisporites			+		
Cyclogranisporites				1	1
Microbaculispora			+		
Plicatipollenites	1		2		1
Virkkipollenites	1		1		1
Barakarites			1		
Parasaccites	5		8	7	7
Caheniasaccites	1	(13 Intervening	+		1
Divarisaccus	1	seams)	+		1
Potonieisporites	2		1	1	8
Platysaccus	1		+		
Scheuringipollenites	42		23	29	9
Striatites			+	2	1
Striatopiceites	29		38	31	51
Strotersporites	16		17	21	18
Hamiapollenites	1		8	7	1
Striasulcites			1	+	+

The Barakar Formation of the type area has been divided into five palynological zones by Tiwari (1973), viz., Laevigate trilete Zone, 2. Monosaccate Zone, 3. Monosaccate-Zonate-Cingulate Zone, 4. Nonstriate-disaccate Zone and 5. Striate-disaccate Zone (in ascending order). According to this zonation scheme, the South Karanpura miofloras would fall within the range of 'Nonstriate-disaccate' to the 'Striate-disaccate Zone'. This is also in agreement with a middle to Upper Barakar position of the four roof-shale samples in the geological sequence (Deekshitulu & Gokul, 1971).

The Argada roof shale is much older in position than those of the Nakari-Kurse Group because of the intervening sequence of 13 seams. There is also a correspondingly sharp difference between the shale mioflora of the Argada Seam and that of the younger seams (Lower Nakari, Upper Nakari and Kurse) forming the Nakari-Kurse group. This difference is particularly notable in the relative proportion of certain nonstriate-disaccate and striate-disaccate miospores (Histograms 2 & 3). In the Argada shale (sample no. 789) the non-striate-disaccate genus *Scheuringipollenites* (42%) dominates over the striate-disaccate genus *Striatopiceites* (29%) and almost equals *Striatopiceites* plus *Strotersporites* (=45%). Perhaps this aspect of miofloral composition suggests closeness of the Argada assemblage to the 'non-striate-disaccate zone' of Tiwari that approximates the Middle Barakar. However, other important members of the 'Nonstriate-disaccate zone, like *Ibisporites* and *Rhizomaspora*, are not prominent in Argada Shale. In the three younger seams (Nakari-Kurse Group) the miofloral composition shows a distinct reversal trend. *Scheuringipollenites* (29%-9%, mean 20%) declines upward in time while *Striatopiceites* (31%-51%; mean 40%) rises to dominance. Taken together, *Striatopiceites* and *Strotersporites* (mean 55%) further accentuates the predominance of striate-disaccates over the nonstriate-disaccates (Histograms 2 & 3). This aspect of miofloral composition in the Nakari (Lower & Upper) and Kurse Seam shales is more compatible with the 'striate-disaccate zone' of Tiwari that approaches the Upper Barakar. Within the three younger seam shales, the miofloral composition is more or less homogeneous



HISTOGRAM 1



HISTOGRAM 2. Quantitative relationship between *Sheuringipollenites* and *Striatopiceites* in roof shal e mioflora of different seams.

HISTOGRAM 3. Quantitative relationship between *Sheuringipollenites* and *Striatopodocarpites* and *Strotersporites* in roof shale mioflora of different seams.

which supports their recognition as the 'Nakari-Kurse Group' (Deekshitulu & Gokul, 1971).

The study of Kar (1973) in the North Karanpura basin indicates that the Lower Barakar miofloras are dominated by striate -disaccates and some subordinate mono-saccates. The next higher zone is dominated by triletes where there are thick coal seams. In the Upper Barakar, triletes dwindle and striate-disaccates predominate. It is evident that the lower biozones proposed by Kar do not apparently conform to those of Tiwari in the Baraker type area. However, the upper Barakar miofloral assemblages of these areas are agreeable with each other and also with those of the South Karanpura assemblages, recovered from the roof-shale of Nakari-Kurse Group of seams.

A few other peculiarities of the South Karanpura shale miofloras may also be

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HISTOGRAM 1. Percentage frequency distribution of palynomorphs in the roof shale of different seams.

mentioned. For example, the monosaccate taxa like *Potonieisporites* and *Parasaccites* not only persist in all the samples but that *Potonieisporites* shows a rising trend in successively younger samples. The other striking feature of the shale miofloras of South Karanpura is that *Hamiapollenites* is significantly represented while trilete taxa are very rare. In other Barakar miofloras, which are recovered from coal, the picture is contrary to this (e.g. in South Karanpura coals studied by Bharadwaj & Tiwari, 1968). Some of these peculiarities in the coal and shale miofloral association may well be due to facies difference and other environmental factors. This is indeed, an interesting field of inquiry (Bharadwaj & Srivastava, 1973) for which detailed miofloral analysis of coal and associated shale miospore populations is warranted on a wide scale.

Megafloral Evidence

Although the present material is rather limited for making any detailed biostratigraphic deductions, the evidence serves well in providing support to the major biozonation of the Barakar proposed by Tiwari (1973) in the type area. Based on these tenets, the roof shale mioflora of the Argada Seam appears to be distinguishable from those of the three younger seam shales, viz., Lower Nakari, Upper Nakari and Kurse. It is important to note that a similar distinguishable feature is provided by the megafossil associations found in the roof shale material of the various seams (Table 2).

The megaflora (Kulkarni, 1970, 1971) of the older Argada shale is poor in the number of species (only 3) and is chiefly characterized by the abundance of *Glossopteris karanpurensis*. This species does not occur in the younger shale floras of the Nakari-Kurse Group (Table 2). On the other hand there are as many as 7 species of *Glossopteris* in the roof shales of the Nakari-Kurse Group, of which six are not found in the Argada shales. This difference is further accentuated by the presence of the fern *Sphenopteris polymorpha* (now *Neomariopteris hughesi*) in the shales of the Nakari-Kurse Group seams and its absence in the Argada Seam roof shale.

TABLE 2 – DISTRIBUTION OF MEGAFLORA IN THE ROOF SHALES OF THE FOUR BARAKAR SEAMS

Roof Shale of Seam	Megaflora
Kurse Seam	Present authors have observed *Glossopteris*, *Vertebraria* and *Neomariopteris*.
Upper Nakari Seam	*Glossopteris decipiens* *G. barakarensis* *G. stricta* *G. damudica*
Lower Nakari Seam	*G. timearus* *G. indica* *G. fusa*
Argada Seam	*G. indica* *G. communis* *G. karanpurensis*

From the above comparisons, it is clear that the mio- and megafloral evidences both agree in as much as the demarcation of the Argada roof-shale from the Kurse-Nakari Group is concerned. But there are also some contradictory features between the two kinds of evidences. For instance, in the megafloras of the Lower Nakari, Upper Nakari and Kurse Seam shales, which are in consecutive order, there are significant differences. *Glossopteris* species of one seam shale do not appear in the other. On the other hand, the differences in the associated miofloras are not as significant.

It is seldom that the mio- and megafossil counterparts of a flora are found together in fair abundance in the same sediments. The Karanpura material thus provides an interesting situation for a comparative study of such evidences. It is, however, felt that more wider studies are needed on the mio- and megafloral associations of the roof shales and the factors that might have influenced their distribution in these sediments. In this manner, it may be possible to build up a more coherent synthesis of the Glossopteris flora for stratigraphical determinations.

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EXPLANATION OF PLATES

(All illustrations are. × 500)

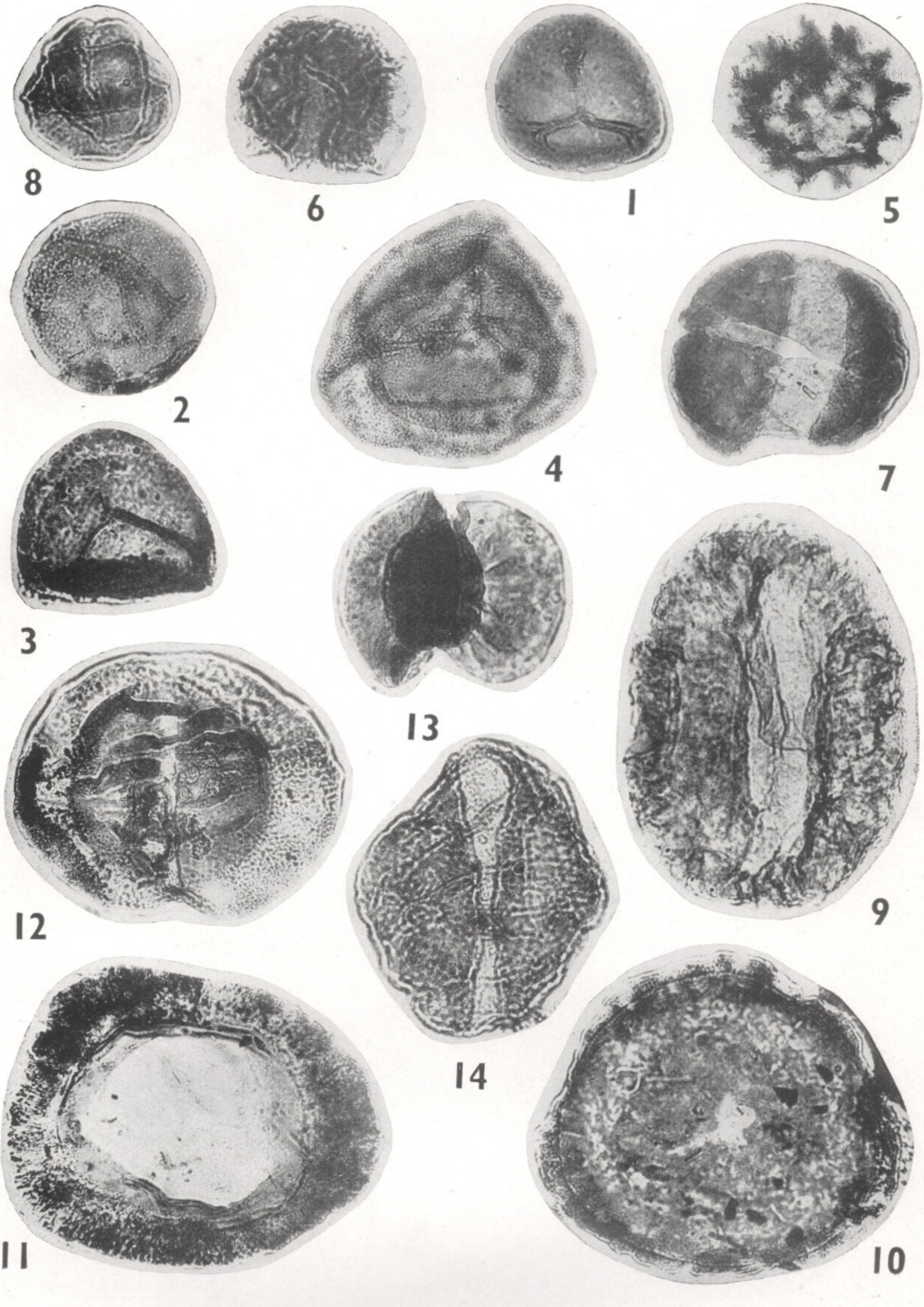
PLATE 1

1. *Altitriletes densus* Venk. & Kar. Slide no. 795/7/14.
2. *Apiculatisporis secretus* Venk. & Kar. Slide no. 793/4/51.
3. *Indotriradites sparsus* Tiw. Slide no. 793/3/2.
4. *Gondisporites* sp. Slide no. 793/3/3.
5. *Greinervillites undulatus* Bose & Kar. Slide no. 793/3/13.
6. *Greinervillites* cf. *undulatus* Bose & Kar. Slide no. 793/3/6.
7. *Corisaccites alutas* Venk. & Kar. Slide no. 795/6/4.
8. *Guttulapollenites hannonicus* Goub. Slide no. 795/6/7.
9. *Divarisaccus lelei* Venk. & Kar. Slide no. 795/6/12.
10. *Barakarites indicus* Bharad. & Tiw. Slide no. 793/2/18.

11. *Plicatipollenites gondwanensis*. Slide no. 794/3/8.
12. *Strotersporites decorus* (Bharad. & Sal.) Venk. & Kar. Slide no. 40/789/1/12.
13. *Lahirites alius* Venk. & Kar. Slide no. 795/7/7.
14. *Striasulcites tectus* Venk. & Kar. Slide no. 793/2/11.

PLATE 2

15. *Hamiapollenites incestus* Wil. Slide no. 795/7/6.
16. *Platysaccus papilionis* Pot. & Kl. Slide no. 793/2/16.
17. *Striatopiceites rimosus* Venk. & Kar. Slide no. 793/3/12.
18, 23. *Lahirites naviculus* Venk. & Kar. Slide nos. 795/3/5, 40/789/1/111.
19. *Schizopollis rugosus* Venk. & Kar. Slide no. 795/5/5.
20. *Striatopiceites digredius* Kar. Slide no. 795/7/8.
21. *Striatites communis* Bharad. & Sal. Slide no. 795/6/14.
22. *Gondwanaeaplicates bharadwajii* Kar. Slide no. 794/3/13.
24. *Cuneatisporites* sp. Slide no. 794/2/11.
25. *Strotersporites decorus* (Bharad. & Sal.) Venk. & Kar. Slide no. 19/789/5/3.
26. *Platysaccus* sp. Slide no. 19/789/3/3.
27. *Potonieisporites congoensis* Bose & Maheshw. Slide no. 793/3/4.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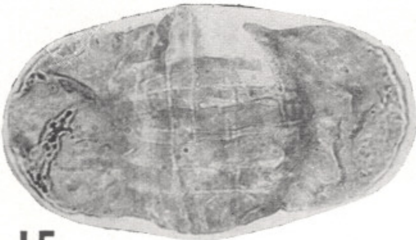
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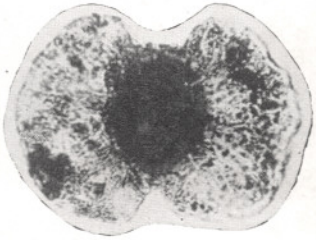
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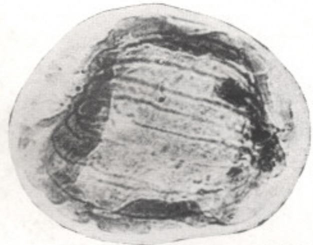
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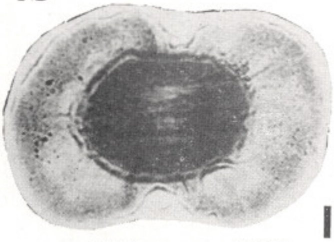
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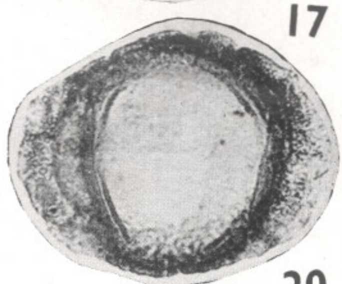
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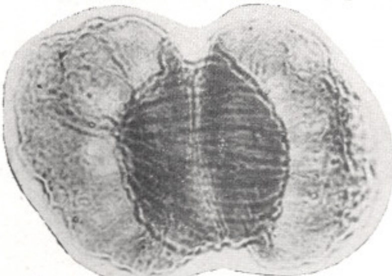
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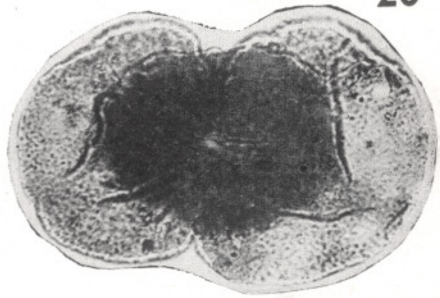
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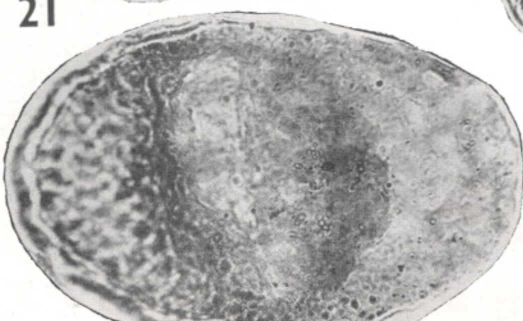
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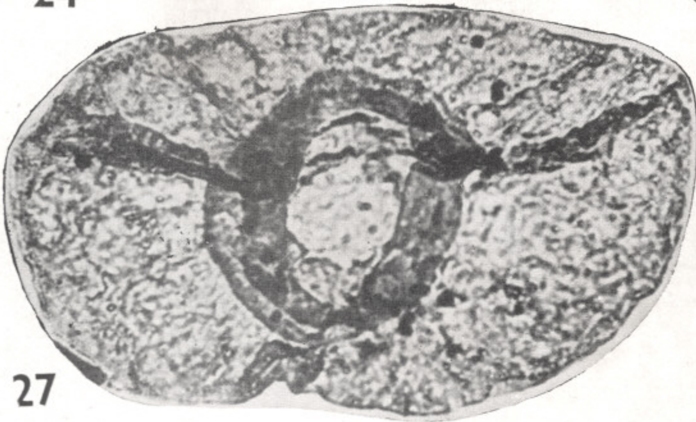
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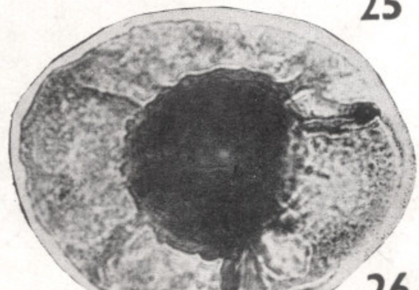
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