

SPOROLOGICAL ANALYSIS OF SOME COAL AND CARBONACEOUS SHALES FROM BARREN MEASURE STAGE (LOWER GONDWANA) OF INDIA

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ABSTRACT

Sporological analysis of some coal and carbonaceous shales from Sibbabudih and Katri nalas in Jharia Coalfield has been done and the *Sporae dispersae* have been referred to 32 genera. A generic quantitative analysis has shown that the genus *Striatopodocarpites* is dominating while *Lophotriletes*, *Densipollenites*, *Striatites*, *Faunipollenites* and *Sulcatisporites* are fairly well represented. This miospore assemblage has been compared with those from the younger and the older beds in Damuda Series of Lower Gondwana of India.

INTRODUCTION

THE study of *Sporae dispersae* in the Lower Gondwana formations of India has received much attention during the last decade. The spore and pollen contents of various sediments pertaining to most of the different stages in Lower Gondwanas have been studied in detail. Thus the studies of Talchir Stage by Potonié & Lele (1961), Karharbari Stage by Maithy (1965), Barakar Stage by Bharadwaj & Tiwari (1964) and Tiwari (1965) and Raniganj Stage by Bharadwaj (1962) and Bharadwaj & Salujha (1964, 1965) have provided detailed sporological data for these stages. The mioflora of the Barren Measure (Ironstone Shales) Stage so far not known, is being given in the present preliminary study.

Geology—The Damuda Series in the Jharia Coalfield has been subdivided into three groups of strata—

Damuda Series	{	Raniganj Stage Barren Measures (Ironstone Shales) Barakar Stage
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The name Ironstone Shales was originally given to the strata, overlying the Barakars and underlying the Raniganj Stage, which were rich in clay ironstones. These were also separated from the underlying Barakars in the type area by an uncon-

formity. The name Barren Measures was substituted for Ironstone Shales by Fox (1930, p. 77; 1934, p. 15) because he found that the unconformity was only a local one and that in fact the Ironstone Shales are really an "upward succession of the Barakars but barren of coal-seams." However, he (1931, p. 35) expressed that the term Barren Measures should be restricted to the Jharia Coalfield. The Barren Measures are characterized by strata predominated by carbonaceous shales at the base, overlying the Barakars and followed by a thick series of sandstones. The sandstones are followed higher up by another conspicuous series of carbonaceous shales and finally sandstones once again become prominent at the top. These alternations form the basis of the stratigraphic classification of Barren Measures into the following four sub-stages (FOX 1930, p. 77):

Barren Measures (2,000 ft.)	{	(d) Mahuda ridge sandstone — 650'
		(c) Hariharpur carbonaceous shales — 150'
		(b) Petia and Patrakuli sandstones — 600'
		(a) Sibbabudih and Bhelataur carbonaceous shales — 600'

The material for the present study was collected from the carbonaceous shale outcrops exposed along the Katri and the Sibbabudih nalas in the Jharia coalfield. The Katri nala expoures east of Bhelataur village are composed of black shales alternating with medium-grained, highly feruginous and micaceous sandstones. Far downwards along the nala the carbonaceous shales were found alternating with pebbly sandstones. The beds dip at about 18° towards South.

The Sibbabudih nala exposes a very good section of the Barren Measures. Here also, a number of carbonaceous shales as well as thin coalseams are seen alternating

with sandstones. The beds in this section also dip towards South at an angle of 17°-20°.

MATERIAL AND METHODS

The material for the present palynological study came from the surface exposures of thin coalseams in Sibbabudih nala and shales in Katri nala (Barren Measurre) of the Jharia Coalfield, Bihar, India, collected by D. C. Bharadwaj and S. C. D. Sah in 1957. The samples investigated are B. S. I. P. 354/31048-31050, 31052-31054 from Katri nala and B. S. I. P. 355/31055-31063 from Sibbabudih nala.

For maceration about 50 gms. of material was taken from each sample and treated with HNO₃ (Comm.) for 4 days. After washing with water, it was heated to 90° C. in 10 per cent KOH and then washed with water. Some samples required an initial treatment with Hydrofluoric acid to remove the fine silt which otherwise interfered in the study of spores. The slides were prepared in Glycerine Jelly following the usual procedure and for all samples, one thousand specimens were counted from a number of slides.

MIOFLORA

The mioflora found in the coals and shales consists of diversified forms of spores and pollen grains. These miospores have been assigned to 32 genera (after BHARADWAJ, 1962, BHARADWAJ & TIWARI 1964 and TIWARI, 1964) out of which the following are significant ones:

Lophotriletes
Horriditriletes
Microbaculispora
Cyclobaculisporites
Gondisporites
Densipollenites
Barakarites
Striomonosaccites
Striatites
Rhizomaspora
Lahirites
Lunatisporites
Striatopodocarpites
Verticypollenites
Hindipollenites
Faunipollenites
Vesicaspora
Sulcatisporites

The following genera although rare are also found and are qualitatively significant:

Punctatisporites
Indotriradites
Reticulatisporites
Potonicisporites
Parasaccites
Illinites

The remaining miospore genera given below are sporadic:

Leiotriletes
Cyclogranisporites
Verrucosisporites
Apiculatisporis
Latosporites
Platysaccus
Welwitschiapites
Vittatina

Representatives of some of the important genera are illustrated on Plates 1-3.

Quantitative Analysis—The quantitative analysis of this assemblage reveals that *Striatopodocarpites* is the most dominating genus of all, being 29.4 per cent in the samples from Sibbabudih nala and 35.3 per cent in those from Katri nala. Other miospore genera characteristically prominent in their average frequency (Histogram I) are:

	Sibbabudih Nala (SBB) per cent	Katri Nala (KTR) per cent
<i>Lophotriletes</i>	6.5	3.4
<i>Densipollenites</i>	4.1	12.0
<i>Striatites</i>	3.3	4.7
<i>Faunipollenites</i>	27.0	23.6
<i>Sulcatisporites</i>	14.1	12.7

The following genera are mostly rarely represented as revealed by their average frequency:

	SBB per cent	KTR per cent
<i>Punctatisporites</i>	1	-
<i>Horriditriletes</i>	0.5	0.8
<i>Microbaculispora</i>	0.5	0.1
<i>Cyclobaculisporites</i>	1.0	0.2
<i>Gondisporites</i>	0.07	1.7
<i>Barakarites</i>	2.2	0.5
<i>Striomonosaccites</i>	0.8	-
<i>Rhizomaspora</i>	2.0	1.2
<i>Lahirites</i>	1.1	0.6
<i>Lunatisporites</i>	0.7	-
<i>Vesicaspora</i>	1.9	0.9
<i>Verticypollenites</i>	0.1	0.1
<i>Hindipollenites</i>	-	0.2

Some of the qualitatively significant rare genera show the following percentage frequency:

	SBB per cent	KTR per cent
<i>Indotriradites</i>	0.3	0.2
<i>Reticulatisporites</i>	0.15	-
<i>Potonieisporites</i>	0.2	0.1
<i>Parasaccites</i>	0.5	-
<i>Illinites</i>	-	0.1

the former while it is less than 1.0 per cent in the latter. The remaining genera show more or less similar incidences in the samples from both the localities, and the overall pattern of the miospore distribution is very much similar.

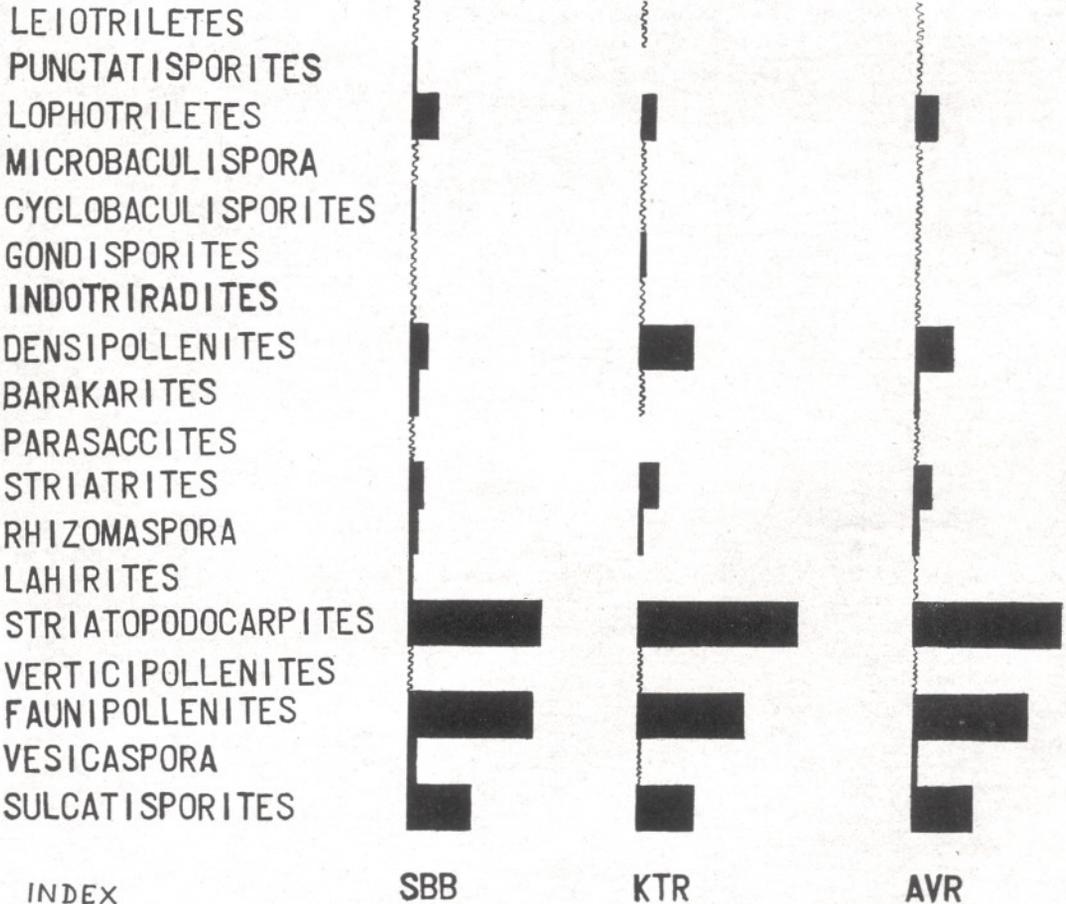
MIOFLORISTIC COMPARISONS

The remaining ones are in traces and not consistent in their occurrence.

The samples from two localities show some differences in the frequency of some of the miospore genera, e. g. genus *Densipollenites* is 4.1 per cent in the samples from Sibbabudih nala (HISTOGRAM 1, SBB) while it is 12 per cent in those from Katri nala (HISTOGRAM 1, KTR). On the other hand, genus *Barakarites* is 2.2 per cent in

The mioflora of Raniganj Stage is well understood from the works of Bharadwaj (1962), Bharadwaj & Salujha (1964, 1965) and Salujha (1965).

Most of the genera found in the present assemblage are reported from the Raniganj Stage. However, the following genera though only rarely present in these samples from Barren Measures are significant in so



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HISTOGRAM 1 — Percentage frequency of miospore genera in the samples from Sibbabudih and Katri nalas, Jharia Coalfield, Bihar (India). SBB — Sibbabudih nala; KTR — Katri nala; AVR — Average miospore frequency of both.

far as they are not known from the Raniganj Stage:

Indotrivradites
Potonieisporites
Illinites
Rhizomaspora

The meagre occurrence of these genera in the Barren Measures (the present assemblage), their absence in the overlying Raniganj beds but their prominence in one or all of the underlying strata, i.e. in Barakar, Karharbari and Talchir sediments, suggest that in the Barren Measures, these particular genera reach their end-points.

The following genera though found in the Raniganj Stage (although rarely) are absent from the present assemblage.

Eupunctisporites
Anapiculatisporites
Lycopodiumsporites
Gravisporites
Punctatosporites
Verrucososporites
Distriomonosaccites

The sediments of Barakar Stage have been sporologically worked out by many workers. However, the studies by Bharadwaj & Tiwari (1964) and Tiwari (1964, 1965) provide detailed information for comparison.

Between the miofloras of Barren Measures and Barakar Stage, most of the spore genera are common, excepting the genus *Gondisporites* which is present in the assemblage of the former but has so far not been reported from the assemblages of the latter. On the other hand there are also some Barakar genera, such as *Primuspollenites*, *Korbapollenites*, *Maculatasporites*, *Dentatispora* and few others which are absent from the present assemblage. Within the Barakar Stage, the mioflora of Upper Barakar (TIWARI 1965) with the genus *Barakarites*, shows greater resemblance with that of Barren Measures than the mioflora of Lower Barakar.

CONCLUSIONS

Comparisons of the present miospore assemblage with those from the Raniganj and Barakar Stages of Lower Gondwana of India have revealed that the former resembles the both up to a certain extent yet has its own identity. Some of the important genera show a very interesting range of distribution in these three assemblages. Thus the genera *Indotrivradites*, *Potonieisporites*, *Illinites* and *Rhizomaspora*, whose prominent presence in Barakars (BHARADWAJ & TIWARI, 1964, TIWARI, 1965) is of significance, are found only in traces in the assemblage from Barren Measure Stage, and are practically absent in Raniganj Stage. The genus *Barakarites* is quite characteristically present in the West Bokaro Coals of Upper Barakar age as well as in the present assemblage and its extreme rarity in the Raniganj Coals is also noteworthy. *Gondisporites* appears for the first time in the Barren Measures and is well represented in Raniganj Stage.

It is concluded that the mioflora in the Barren Measures is characterized by the association of the following prominent genera:

Striatopodocarpites
Faunipollenites
Sulcatisporites
Densipollenites
Striatites
Lophotriletes

Along with this the following genera are qualitatively characteristic:

Gondisporites
Barakarites
Rhizomaspora

ACKNOWLEDGEMENTS

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EXPLANATION OF PLATES

(All figures are magnified 500 ×)

PLATE 1

- 1-2. *Lophotriletes*, Ph. Nos. 384/26, 384/29.
- 3-5. *Microbaculispora*, Ph. Nos. 385/34, 384/16, 385/41.
6. *Punctatisporites*, Ph. No. 385/18.
- 7-8. *Indotriradites*, Ph. Nos. 384/10, 385/30.
9. *Reticulatisporites*, Ph. No. 383/20.
10. *Gondisporites*, Ph. No. 385/29.

PLATE 2

- 11-12. *Denispollenites*, Ph. Nos. 385/24, 385/22.
- 13-14. *Parasaccites*, Ph. Nos. 385/19, 384/31.

- 15-16. *Barakarites*, Ph. Nos. 385/4, 385/12.
17. *Striomonosaccites*, Ph. No. 385/40.

PLATE 3

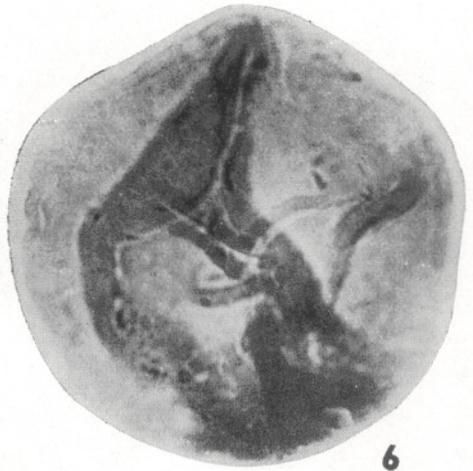
18. *Potonieisporites*, Ph. No. 385/15.
- 19, 21. *Striatopodocarpites*, Ph. Nos. 384/21, 385/14.
20. *Rhizomaspora*, Ph. No. 384/2.
22. *Lahirites*, Ph. No. 384/6.
23. *Lunatisporites*, Ph. No. 384/4.
24. *Faunipollenites*, Ph. No. 385/7.
- 25, 26. *Sulcatisporites*, Ph. Nos. 385/28, 385/6.



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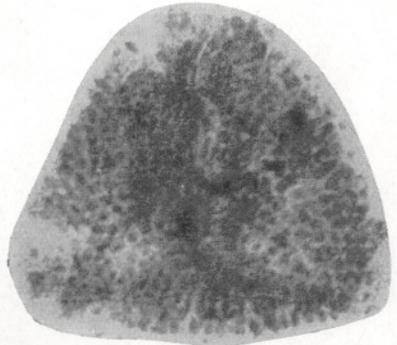
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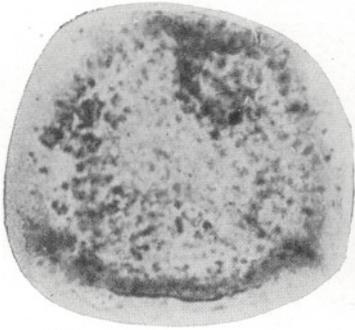
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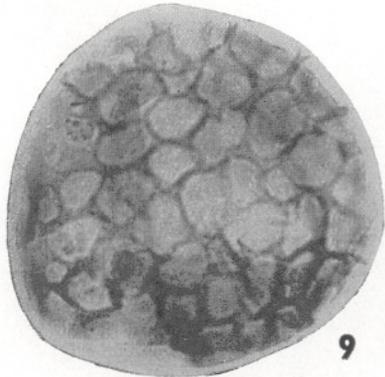
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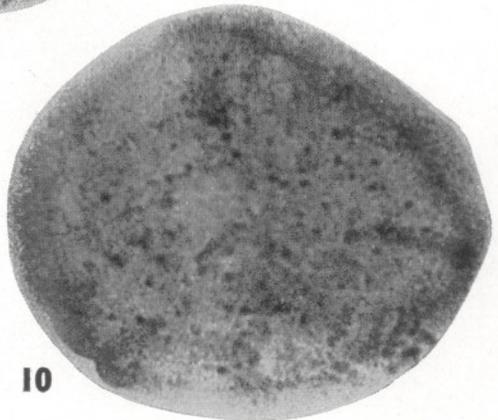
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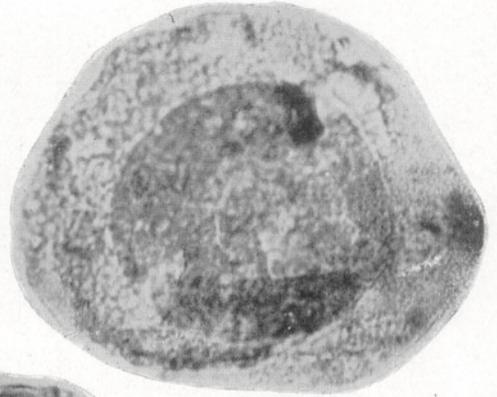
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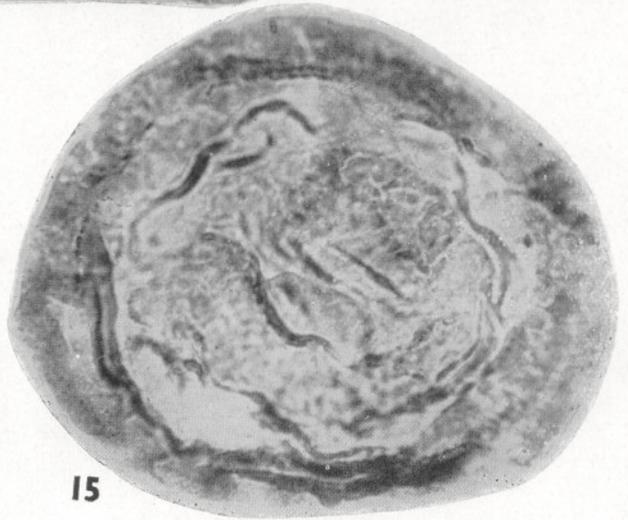
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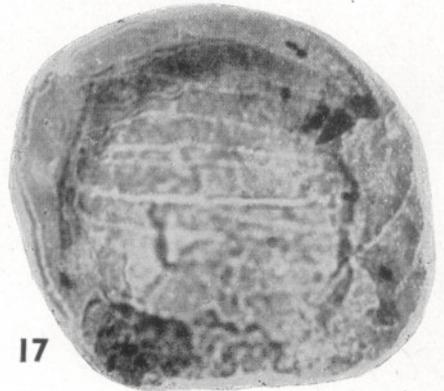
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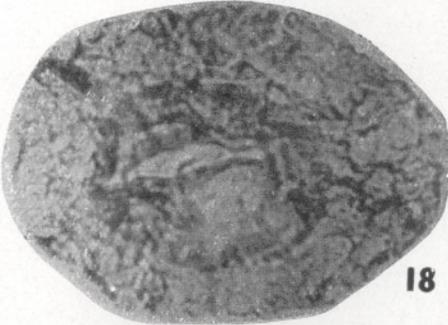
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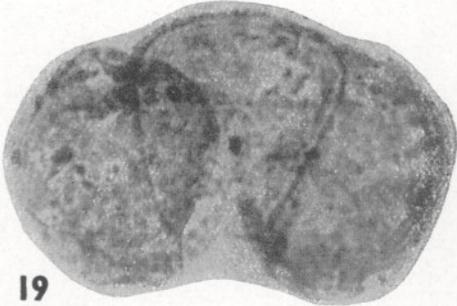
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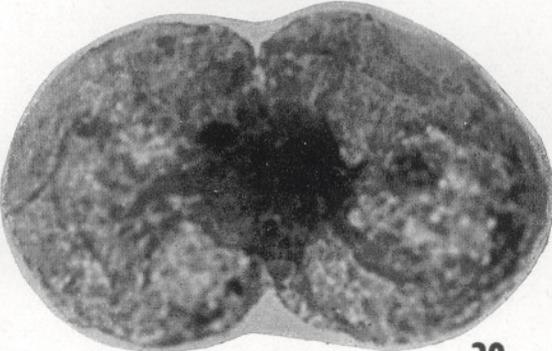
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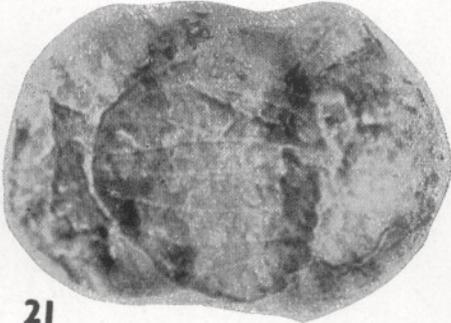
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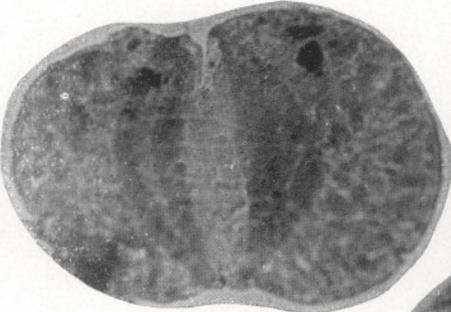
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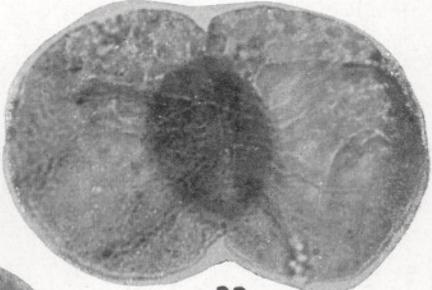
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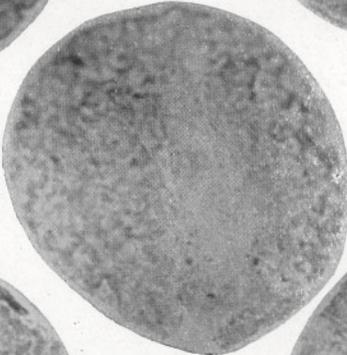
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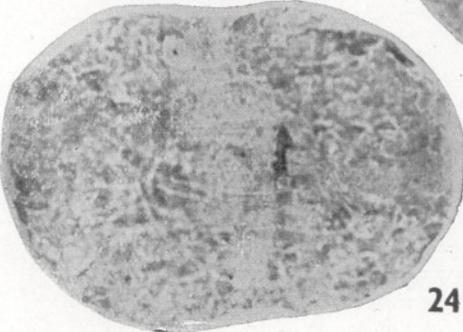
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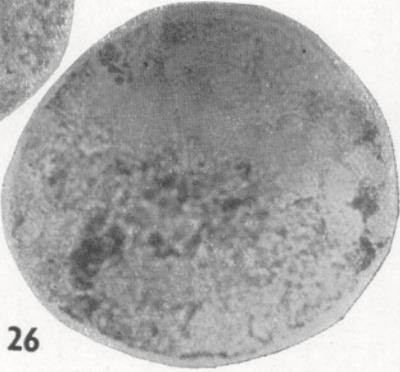
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