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PALYNOLOGICAL DATING OF JHINGURDAH SEAM, SINGRAULI COALFIELD: A REAPPRAISAL

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ABSTRACT

A re-examination of the mioflora of the thickest coal seam of India, the Jhingurdah seam in Singrauli coalfield, Madhya Pradesh, has shown the presence of the genera *Indospora*, *Gondisporites*, *Densoisporites*, *Kendosporites*, *Thymospora*, *Corisaccites*, *Guttulapollenites*, *Lunatisporites* and *Falcisporites* associated with a striated-disaccate-rich assemblage. The mioflora is closely comparable with the known Raniganj miofloras. The presence of the genera *Lophotriletes*, *Brevitriletes*, *Latosporites*, *Barakarites*, *Parastriopollenites* and *Scheuringipollenites* indicates a partial continuity of the older biozones into the younger one.

Key-words — Palynology, Mioflora, Jhingurdah Seam, Singrauli Coalfield (India).

सारांश

सिंगरौली कोयला-क्षेत्र के झिंगुरदाह स्तर का परागाणविक कालनिर्धारण : एक समालोचना – राम शंकर तिवारी एव सुरेश चन्द्र श्रीवास्तव

मध्य प्रदेश के सिंगरौली कोयला-क्षेत्र में विद्यमान भारत के सबसे मोटे कोयले के झिंगुरदाह स्तर के सूक्ष्मवनस्पतिजात के पुन: अध्ययन से रेखीय-द्विकोष्ठीय तत्वों से भरपूर एक समुच्चय से सहयुक्त इन्डोस्पोरा, गोन्डिस्पोराइटिस, डेन्सोस्पोराइटिस, कैन्डोस्पोराइटिस, थाइमोस्पोरा, कोरिसेक्काइटिस, गुटुलापोलिनाइटिस, ल्यूनाटिस्पोराइटिस एवं फालसीस्पोराइटिस नामक वंशों की उपस्थिति व्यक्त हुई है। यह सूक्ष्मवनस्पतिजात रानीगंज से विदित सूक्ष्मवनस्पतिजातों से घनिष्ठ तुलनीय है। लोफ़ोट्राइलिटीज़, ब्रेविट्राइलिटीज़, लाटोस्पोराइटिस, बराकाराइटिस, पैरास्ट्रिओपोलिनाइटिस एवं श्यौरिन्गिपोलिनाइटिस नामक वंशों की उपस्थिति से अधिक आयु वाले जैवमंडलों की कम आयु वाले जैवमंडलों में आंशिक निरन्तरता व्यक्त होती है।

INTRODUCTION

THE Lower Gondwana sediments representing Talchir, Barakar, Barren Measures and Raniganj formations are well developed in the Singrauli Coalfield (Latitude 23° 47′ to 24° 12′N & longitude 81° 45′ to 82° 48′E). The Barakar Formation is overlain by the Barren Measure Formation which is about 125 m in thickness having coarse-grained to gritty ferruginous, yellow sandstones. Above the latter, the 400 m thick Raniganj Formation contains fine to coarse-grained felspathic sandstones, white and grey clays with ferruginous bands, carbonaceous shale and coal seams. The Jhingurdah seam (164 m) belongs to the last formation (late Permian; for detailed geological information see Ahmad, 1955; Basu, 1965). However, Bharadwaj and Sinha (1969a) reported that the Jhingurdah coal deposit contains a more or less uniform mioflora having a closer resemblance with the Upper Barakar miofloras. Their conclusion is based upon the prominence of the following genera:

Non-striate disaccate — *Scheuringipollenites*, *Ibisporites*, *Vesicaspora*.

Striate-disaccate — *Faunipollenites*, *Striatopodocarpites*.

Apiculate trilete— *Cyclogranisporites*, *Lophotriletes*, *Brevitriletes*, *Horriditriletes*.

Quantitatively, the above three groups of spores and pollen grains range from 20-30 per cent each (Tiwari, 1971; histogram 2). All the more, certain miospore taxa, characteristic of the Raniganj Formation, e.g. *Indospora*, *Gondisporites*, *Thymospora* and *Densipollenites* were reported to be absent (or rarely present) in the Jhingurdah seam

by Bharadwaj and Sinha (1969a) which further supported their contention that this seam contains a mioflora closely comparable to the Barakar miofloras.

Does this palynoflora really belongs to the Barakar age ? Recent data on palynology of the Indian Lower Gondwana have provided a wider basis for understanding the lateral and vertical variations of palynofloras. A synthesis of Barakar palynofloras (Tiwari, 1974) has further brought out some new trends of variations in different basins. In view of these data, *vis-a-vis* the existing discrepancy in geological and palynological observations, Dr Bharadwaj (personal communication) suggested a reinvestigation of the Jhingurdah seam pollen-spore assemblage and the present work is a sequel to the same.

INVESTIGATIONS

In all, 15 compound samples were prepared from Bore-hole NCSJ-4, out of which each sample represents the coaly and shaly zones separately. The following list gives the present sample numbers as JH-1 to JH-15 and the corresponding sample numbers given by Bharadwaj and Sinha (1969a; text-fig. 1; histogram 1).

Present Sample no.	Corresponding Sample nos. of Bharadwaj and Sinha (1969a)	Depth from the surface in meters	Lithology
JH-1	1 to 12	9.15-22.46	Coal
JH-2	13 to 14	22.46-24.30	Coaly shale and coal
JH-3	15 to 57	24.80-63.95	Coal
JH-4	58 to 66	63.95-75.80	Shale
JH-5	67	73.80-75.34	Coal and thin shale band
JH-6	68 to 70	75.34-78.22	Shaly coal and coal
JH-7	71 to 73	78.22-81.80	Coal
JH-8	74	81.80-83.35	Coaly shale
JH-9	75 to 83	83.35-92.75	Coal
JH-10	84 to 92	92.75-98.45	Mainly shale with thin coal
JH-11	93 to 112	138.50-147.56	Thin coal and shale bands
JH-12	113 to 121	147.56-154.62	Mainly coal with thin shale
JH-13	122	161.48-161.98	Coal
JH-14	123 to 125	161.98-163.43	Shale
JH-15	126	163.43-164.31	Coal

Two hundred specimens were counted at generic level. Sample nos. JH-7, 11, 14 and 15 did not yield enough miospores and hence were left from the quantitative considerations. Several slides from each sample were also thoroughly scanned to record rare species. The analysis revealed the presence of 44 miospore genera. Their frequency has been given in Table 1 and a diagrammatic representation of the quantitatively important taxa is shown in Histogram 1.

GENERIC DEVIATION

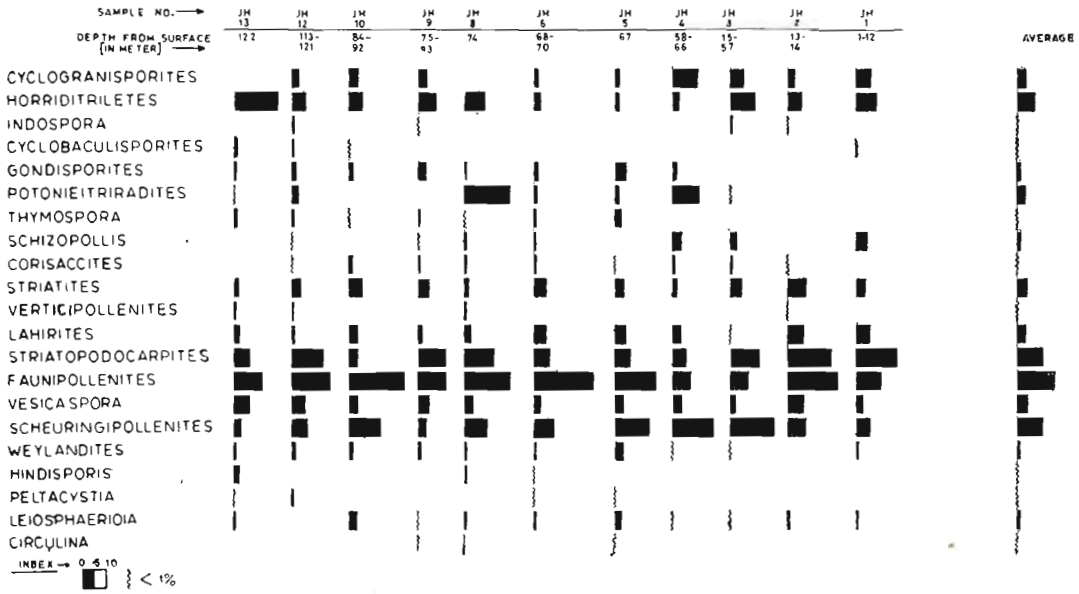
Qualitative — The following genera, found by us, were not recorded by Bharadwaj and Sinha (1969, 1969a) and Sinha (1969, 1972): *Guttulapollenites*, *Corisaccites*,, *Densoisporites*, *Kendosporites*, *Falcisporites*, *Lunatisporites* and *Hindipollenites*. This record of these genera is qualitatively important.

Quantitative — Histogram 2 given by Bharadwaj and Sinha (1969a) suggests that *Scheuringipollenites* records a general dominance in the lower-half of the coal seam, while *Faunipollenites* remains subdominant. In the upper-half of the coal seam a reverse trend was present; on an average, the nonstriate-disaccate genera (*Scheuringipollenites*, *Ibisporites*) and striate-disaccate genera (*Faunipollenites*, *Striatopodocarpites*) almost balance each other in frequency, although the former group has a little edge over the latter.

The present study shows (Histogram 1) that nonstriate-disaccate and striate-disaccate genera are represented in almost a ratio of 3:4. The striate-disaccate group of pollen, in general, dominates the spectrum from bottom up to the top of the coal seam, while nonstriate-disaccates remain subdominant. The zonate-cingulate miospores occur persistently almost in all the samples which were earlier recorded as rare. The dominance of striate-disaccates suggests a younger aspect than what has been suggested earlier for this coal seam. Also, the occurrence of cingulate-zonate triletes in significant percentages (*Potonieitriradites*— 20% in sample no. 8) has not been reported earlier from the Barakar Formation. The break-up of the dominant, sub-dominant, common and rare genera as found in the present

TABLE 1 — SHOWING PERCENTAGE DISTRIBUTION OF MIOSPORES IN BORE-HOLE NO. NCSJ-4, JHINGURDAH SEAM, MOHER BLOCK, SINGRAULI COALFIELD

Miospore genera / Sample nos. JH / Depth in meter	13 122	12 113-121	10 84-92	9 75-83	8 74	6 68-70	5 67	4 58-66	3 15-57	2 13-14	1 1-12	Average
Leiotriletes	1.0	2.0	0.5	2.0	1.0	0.5	2.0	1.0	2.0	—	—	1.1
Callumispora	1.0	—	—	—	—	—	—	—	—	—	—	0.1
Cyclogranisporites	—	3.0	4.0	4.0	—	2.0	2.0	11.0	6.0	3.0	6.5	3.7
Lophotriletes	1.0	—	1.5	0.5	1.0	0.5	0.5	2.0	1.0	—	2.0	0.9
Brevitriletes	1.5	4.0	1.5	1.0	0.5	2.0	0.5	0.5	0.5	1.0	2.0	1.4
Horriditriletes	19.0	6.0	6.0	8.0	9.0	3.0	2.0	3.0	11.0	6.0	9.0	7.4
Microbaculispora	3.0	3.0	—	—	—	—	—	0.5	—	—	—	0.6
Indospora	—	1.0	—	0.5	—	—	—	—	1.0	0.5	—	0.3
Cyclobaculisporites	1.5	1.0	0.5	—	—	—	—	—	—	—	0.5	0.3
Microfoveolatispora	2.5	1.0	—	5.0	1.0	1.0	2.0	3.0	2.0	—	0.5	1.6
Gondisporites	1.0	2.0	2.0	3.5	1.0	2.0	5.0	2.0	—	—	—	1.6
Potonieitriradites	0.5	3.0	—	—	20.0	1.5	2.0	12.0	0.5	—	—	3.6
Latosporites	10.5	5.0	1.0	8.0	1.0	3.0	4.0	3.0	2.0	1.5	4.0	4.0
Thymospora	1.5	1.0	0.5	1.0	0.5	1.0	3.0	—	—	—	—	0.7
Parasaccites	—	1.0	0.5	0.5	—	1.0	—	—	—	—	—	0.2
Tuberisaccites	1.0	—	—	—	—	—	—	—	—	—	—	0.09
Barakarites	1.0	—	—	—	—	—	1.0	0.5	0.5	—	—	0.1
Striomonosaccites	—	—	—	—	—	—	—	0.5	—	—	—	0.04
Cuneatisporites	1.5	0.5	—	1.0	1.0	—	—	0.5	2.0	0.5	1.0	0.7
Platysaccus	3.0	1.0	4.0	6.0	2.0	4.0	6.0	6.0	8.0	4.0	9.0	4.8
Schizopollis	—	0.5	—	0.5	1.0	1.0	—	4.0	3.0	—	5.0	1.4
Corisaccites	—	0.5	1.5	1.0	1.0	1.0	0.5	1.0	1.0	0.5	—	0.8
Striatites	2.0	4.0	6.0	5.0	2.0	5.5	4.0	2.0	5.0	8.0	4.0	4.3
Primuspollenites	1.5	4.0	4.0	4.0	2.0	2.0	1.5	2.0	4.0	2.0	3.0	2.7
Rhizonaspora	—	1.0	2.0	—	—	—	—	—	—	—	—	0.3
Verticipollenites	1.0	1.0	—	—	1.0	—	—	—	—	0.5	—	0.3
Lahirites	2.5	1.5	4.0	2.0	3.0	5.5	5.0	4.0	0.5	7.0	6.0	3.7
Hindipollenites	0.5	1.0	—	0.5	1.0	—	—	—	—	1.0	—	0.4
Striatopodocarpites	7.0	14.0	4.0	12.0	13.0	7.0	7.0	6.0	13.0	19.0	18.0	11.0
Faunipollenites	12.5	17.0	24.0	13.0	20.0	26.0	18.0	8.0	8.0	22.0	11.0	16.2
Crescentipollenites	1.0	—	—	—	—	—	—	—	0.5	1.0	1.0	0.3
Illinites	0.5	—	1.0	0.5	0.5	—	—	—	0.5	—	—	0.3
Vesicaspora	7.0	6.0	4.0	5.0	4.0	3.0	4.0	4.0	2.5	7.0	3.0	4.5
Scheuringipollenites	3.5	7.0	14.0	3.5	10.0	19.0	15.0	18.0	19.0	8.0	6.0	11.1
Ibisporites	2.5	4.0	4.0	7.0	—	5.0	6.0	4.0	4.5	6.0	4.0	4.2
Weylandites	1.0	2.0	2.0	1.5	1.0	1.0	4.0	0.5	0.5	—	1.0	1.2
Pilasporites	2.5	1.0	3.0	1.5	1.0	1.0	1.0	0.5	—	—	2.0	1.2
Hindisporis	2.5	—	—	—	1.0	0.5	—	—	—	—	—	0.4
Balmeella	1.0	—	1.0	—	—	—	—	—	—	—	—	0.2
Peltacystia	0.5	1.0	—	—	—	0.5	0.5	—	—	—	—	0.2
Leiosphaeridia	1.0	—	3.5	0.5	1.0	1.0	3.0	0.5	0.5	1.0	1.0	1.2
Spongocystia	0.5	—	—	1.0	—	0.5	—	—	—	—	—	0.2
Circulina	—	—	—	0.5	0.5	—	0.5	—	—	—	—	0.1
Striasulcites	—	—	—	—	—	—	—	—	—	0.5	0.5	0.1



Histogram 1 — Percentage frequency of important miospore genera through various levels in the Jhingurdah Seam.

analysis is given below (mean of the percentage is given in parenthesis):

1. Dominant:
   Faunipollenites 8-26% (16.2%)
2. Subdominant:
   Striatopodocarpites 4-19% (11%)
   Scheuringipollenites 3.5-19% (11.1%)
   Horriditriletes 2-19% (7.4%)
3. Common:
   Platysaccus 1-9— (4.8%)
   Vesicaspora 2.5-7% (4.5%)
   Striatites 2-8% (4.3%)
   Ibisporites 2.5-7% (4.2%)
   Latosporites 1-10.5% (4.0%)
   Lahirites 0.5-7% (3.7%)
   Potonieitriradites 0-20% (3.6%)
   Primuspollenites 1.5-4% (2.7%)
4. Rare:
   a. Between 1 and 2 per cent
      Leiotriletes, *Brevitriletes*, *Microfoveolatispora*, *Verrucosisporites*, *Gondisporites*, *Corisaccites*, *Falcisporites*, *Guttulapollenites*, *Schizopollis*, *Weylandites*, *Pilasporites*, *Leiosphaeridia*.
   b. Less than 1 per cent:
      Callumispora, *Lophotriletes*, *Microbaculispora*, *Indospora*, *Kendosporites*, *Cyclobaculisporites*, *Thymospora*, *Parasaccites*, *Cuneatisporites*, *Rhizomaspora*, *Verticipollenites*, *Crescentipollenites*, *Lunatisporites*, *Hindipollenites*, *Illinites*, *Hindisporis*, *Balmeela*, *Peltacystia*, *Spongocystia*, *Circulina* and *Striasulcites*.

The above listed miospores can be segregated into 10 groups. The mean percentage frequencies of these groups are as follows:

Miospore groups	Mean percentages
Apiculates triletes	15.0
Varitriletes	2.5
Zonate cingulates	5.2
Monoletes	3.7
Monosaccates (girdling type)	0.5
Striate-disaccates	38.5
Reticuloid striate-disaccates	2.9
Nonstriate-disaccates	27.0
Monocolpates	1.3
Alete and others	3.4

MIOFLORAL COMPARISONS

Succession in Singrauli Coalfield — As it has been stated earlier, the Jhingurdah seam, the youngest seam of the Coalfield, overlies the Barren Measures which in its turn overlie the Barakar containing Panipahari, Khadia,

TABLE 2 — SHOWING PERCENTAGE OF VARIOUS MIOSPORE GROUPS IN JHINGURDAH SEAM, SINGRAULI COALFIELD, INDIA

Miospore groups — Sample nos. JH/ Depth in meter	13 122	12 113-121	10 84-92	9 75-83	8 74	6 68-70	5 67	4 58-66	3 15-57	2 13-14	1 1-12	Average
Apiculate triletes	25.0	16.0	14.0	15.5	11.5	8.0	7.0	17.5	20.5	10.0	20.0	15.0
Varitriletes	5.5	5.0	—	5.5	1.0	1.0	2.0	3.5	3.0	0.5	0.5	2.5
Zonate triletes	1.5	5.0	2.0	3.5	21.0	3.0	7.0	14.5	0.5	—	—	5.2
Monoletes	12.0	6.0	1.5	9.0	1.5	4.0	7.0	3.0	2.0	1.5	4.0	3.7
Monosaccates	1.0	1.0	0.5	0.5	—	1.0	1.0	0.5	0.5	—	—	0.5
Nonstriate-disaccates	18.0	18.5	27.0	23.0	17.5	31.0	31.0	32.5	36.5	25.5	23.0	27.0
Striate-disaccates	26.5	39.5	39.5	34.0	42.0	46.0	35.0	25.0	32.0	59.0	45.0	38.5
Reticuloid disaccates	1.5	5.0	6.0	4.0	2.0	2.0	1.0	2.0	4.0	2.0	3.0	2.9
Colpates	1.0	2.0	2.0	1.5	1.0	1.0	4.0	0.5	0.5	—	1.0	1.3
Aletes	8.0	2.0	7.5	3.5	2.5	3.0	5.0	1.0	0.5	1.5	3.5	3.4

Purewa, Turra and Kota coal seams in descending order. The palynoflora of the Barren Measures of this area as well as Panipahari and Khadia seams is not known. There is, therefore, a gap in palynological information between the Purewa seam and Jhingurdah seam.

The mioflora of Purewa seam is typical of the Middle Barakar in having *Scheuringipollenites* as the dominant genus. The striate-disaccates are not prominent while the apiculate triletes are significant in this seam (Tiwari, 1969). The Jhingurdah seam, on the other hand, contains striate-disaccate as dominant group. *Scheuringipollenites* declines to more than half of its representation as compared to its position in Purewa seam. Khadia and Panipahari seams, successively overlying the Purewa seam, belong to the Upper Barakar Formation (also Basu, 1965) as they are conformably overlain by the Barren Measure Formation.

Miofloristic transgressions — It is now well established that the nonstriate-disaccate genera (e.g. *Scheuringipollenites*, *Ibisporites*, etc.) are dominant in the Middle Barakar mioflora. They decline in the Upper Barakar where the striate-disaccate genera rise to become almost the dominant elements (Tiwari, 1974). The Upper Barakar mioflora, therefore, is the beginning of "striate-disaccate phase" which continues through Barren Measures to the Raniganj mioflora. Broadly speaking, the striate-disaccate dominant phase transgresses the lithostratigraphic horizons and cuts across three formations, i.e. Upper Barakar, Barren Measures and Raniganj.

Obviously, the palynological differentiation of these stages poses certain problems. In such a discrimination, particularly of isolated cases, the older or the younger affinity of the spore-pollen assemblage has to be carefully determined and the general evolutionary level of mioflora in question has to be ascertained. Normally, the quantitative incidences decide the relative position of any mioflora but in the case where such differentiations are difficult, certain subtle qualitative indicators are very useful.

In case of Jhingurdah seam, the genera *Faunipollenites*, *Striatopodocarpites*, *Scheuringipollenites* and *Horriditriletes* contribute about 45 per cent of the mioflora. As such, there is an apparent resemblance of

this mioflora with that of the Upper Barakar mioflora but the presence of *Indospora*, *Gondisporites*, *Thymospora*, *Kendosporites*, *Guttulapollenites*, *Corisaccites*, *Falcisporites*, *Lunatisporites* and *Verticipollenites* rules out its being equivalent to the Barren Measures mioflora. Although in all other Raniganj miofloras the striate-disaccate dominance is much more pronounced than what we find in the Jhingurdah seam, yet the general resemblance between the two is quite convincing. It could, however, be possible that in the Singrauli Coalfield the process of vertical variation was relatively slow. In other words, a partial transgression of palynozone seems to have taken place. Nevertheless, in the tendency of qualitative and quantitative behaviour, the Jhingurdah mioflora corresponds more closely with those miofloras which are known from the Raniganj Formation and this result also corroborates the lithological observations.

CONCLUSION

The foregoing account indicates that the resemblance of the mioflora in Jhingurdah coal seam with that of the Barakar mioflora is apparent rather than real and shows a tendency of the influence of older biozone into the younger lithostratigraphic zone with a somewhat less-than-expected change. The Raniganj-affiliation of the Jhingurdah seam is, however, supported by qualitatively important miospore genera in its assemblage. The indications of an older age are absent. Thus, the palynological study supports the stratigraphical position of the Jhingurdah seam to be homotaxial with the Raniganj Formation.

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EXPLANATION OF PLATE

(All magnifications. × 500)

1. *Lunatisporites* (Lesch.) Bharad., 1974; slide no. 6660.
2. *Lueckisporites* Pot. & Kl., 1954; slide no. 6660.
3. *Vitreisporites* (Lesch.) Janson., 1962; slide no. 6657.
4. *Corisaccites* Venkat. & Kar, 1966; slide no. 6657.
5. *Guttulapollenites* (Goubin) Venkat. & Kar, 1967; slide no. 6656.
6. *Lueckisporites* Pot. & Kl., 1954; slide no. 6655.
7. *Kendosporites* (Sal.) Surange & Chandra, 1975; slide no. 6660.
8. *Indospora* Bharad., 1962; slide no. 6660.
9. *Microbaculispora* Bharad., 1962; slide no. 6652.
10. *Gondisporites* Bharad., 1962; slide no. 6660.
11. *Weylandites* Bharad. & Sriv., 1969; slide no. 6658.
12. *Verrucosisporites* (Ibr.) Smith *et al.*, 1964; slide no. 6660.
13. *Falcisporites* (Lesch.) Kl., 1963; slide no. 6659.
14. *Distriatites* Bharad., 1962; slide no. 6654.
15. *Hindipollenites* Bharad., 1962; slide no. 6653.

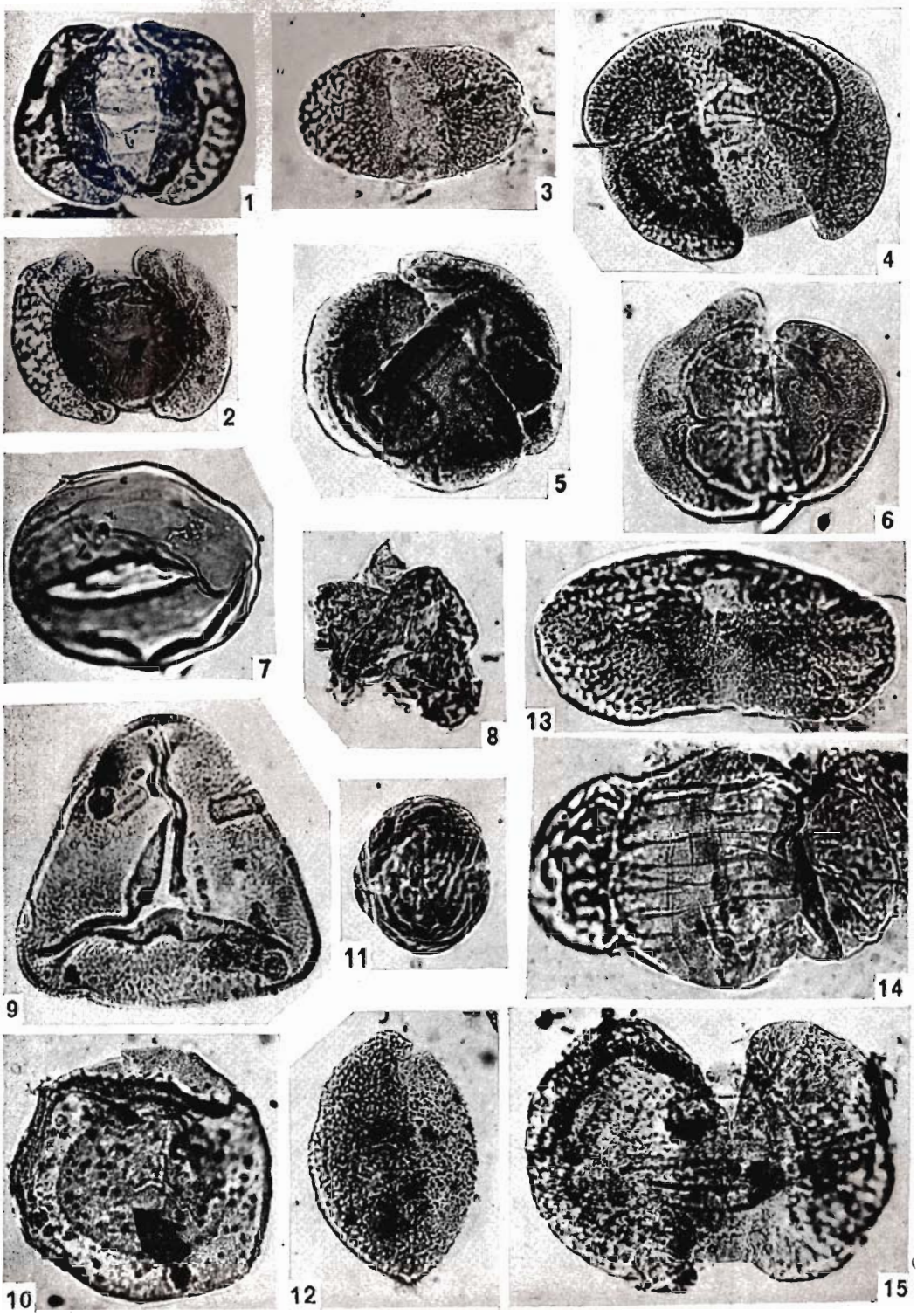

PLATE 1