

Palynosequence in subsurface Permian sediments in Talcher Coalfield, Orissa, India*

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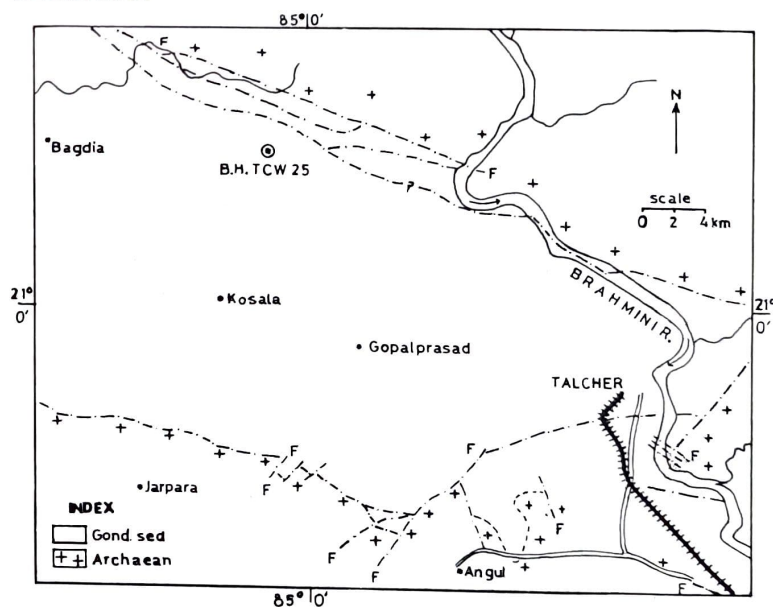
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The association and distribution pattern of spore and pollen species through the complete run of Bore-hole TCW-25 (450.00m deep) in the north-western part of Talcher Coalfield, Orissa demarcates three distinct palynozones 'namely' *Parasaccites korbaensis* Assemblage-Zone (Upper Talchir), *Scheuringipollenites barakarensis* Assemblage- Zone (Lower Barakar) and *Faunipollenites varius* Assemblage-Zone (Upper Barakar). The palaeoclimate during Lower Permian in this area has been discussed.

INTRODUCTION

THE palynological studies of Lower Permian coals of Talcher Coalfield, Orissa have been carried out in the south-eastern and western part of the coalfield (Das, 1958; Navale, 1966; Navale & Tiwari, 1966; Bharadwaj & Srivastava, 1969a, 1969b; Srivastava, 1970, 1984; Navale & Srivastava, 1971). Only recently, the occurrence of Upper Permian coal has been documented, on palynological evidence, from the surface sediments at Patrapara Village, north-western part of the coalfield (Tiwari, *et al.* 1991). An extensive drilling for exploration of coal by Geological Survey of India in the central and northern part of the basin has proved thick coal seams. The Bore-hole TCW-25, located in the north-western part $21^{\circ} 5' 37''$; $84^{\circ} 57' 12''$ of the basin (Map 1), has been taken up for the present palynological studies. This bore-hole is 450 m deep and the lithological composition includes coal, shale and sandstone (Table 1). In all 45 samples have been analysed for palynological analysis and are proved to be rich in organic matter-spore, pollen and woody material. In most of the samples the woody material is represented only by dark coloured blackish brown splintery pieces and in some samples well

preserved golden brown trachieds are present. In the present communication the spore-pollen species based on palynozonation model for Palaeozoic and Mesozoic sequence in India proposed by Tiwari and Tripathi (1992) is followed.



Map 1. Showing the location of bore hole TCW-25 in Talcher Coalfield, Orissa.

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Table 1. List of samples from Bore-hole TCW-25, Talcher Coalfield, Orissa

Sl.No.	Depth in m	Lithology	Remarks
1.	17.50	coal	spore pollen rich, bad preservation
2.	18.50	coal	spore pollen rich, badly preserved, woody material rich
3.	19.00	coal	spore pollen rare, full of woody material
4.	21.60	coal	spore pollen rare, full of woody material
5.	25.00	coal	spore pollen rare, bad preservation, full of woody material
6.	34.65	grey shale	spore pollen common, bad preservation
7.	40.65	coal	spore pollen absent, full of woody material
8.	43.90	coal	spore pollen common, bad preservation, full of woody material
9.	62.75	grey silty shale	spore pollen rich, bad preservation
10.	67.50	coal	spore pollen rich, bad preservation, woody material less
11.	71.35	shale	spore pollen rare, full of woody material
12.	81.00	shale	spore pollen rich, preservation not good, very few wood pieces
13.	96.25	shale	spore pollen rich, woody material less
14.	114.15	grey shale in sandstone	spore pollen common, bad preservation
15.	120.25	coaly shale	spore pollen common, badly preserved, full of woody material
16.	126.50	shale	spore pollen rare, full of woody material
17.	136.00	shale	spore pollen rich, woody material also present
18.	148.70	coal	spore pollen rare, broken, full of woody material
19.	151.20	coaly shale	spore pollen rich, bad preservation, few wood pieces
20.	156.00	coal	spore pollen common, full of woody material
21.	171.50	coal	spore pollen rare, broken, bad preservation full of woody material
22.	177.00	coaly shale	spore pollen rare, full of woody material
23.	181.85	grey shale + interbedded coal	spore pollen rare, full of woody material
24.	188.10	shale	spore pollen rare, broken, full of woody material
25.	196.50	shale with coal specks	spore pollen common, broken, full of woody material
26.	209.50	shale	spore pollen rich, detritus attached
27.	211.15	coal	spore pollen common, woody material rich
28.	234.50	shale and coal	rich in spore pollen and woody material
29.	256.95	coal	spore pollen rich, broken, woody material rich
30.	264.50	coal	spore pollen rare, broken, full of woody material
31.	265.75	shale	spore pollen very rare, full of woody material
32.	294.00	coal	spore pollen rare, full of woody material
33.	300.75	grey shale	spore pollen rare, full of woody material
34.	318.30	coal	spore pollen rare, full of woody material
35.	323.20	coaly shale	spore pollen rich, preservation not good, woody material less
36.	328.00	coal	spore pollen rare, full of woody material
37.	338.40	grey shale and coal	spore pollen rich, bad preservation, woody material rich
38.	341.20	grey shale	spore pollen rare, full of woody material
39.	350.65	grey shale	spore pollen rich, detritus attached
40.	351.65	coaly shale	spore pollen rich
41.	356.75	carbonaceous shale	spore pollen rare, full of woody material
42.	358.75	carbonaceous shale	spore pollen rare, full of woody material
43.	361.15	carbonaceous shale	spore pollen rare, full of woody material
44.	369.75	coal	spore pollen rare, full of woody material
45.	405.40	shale in khaki sandstone	spore pollen rich, woody material very less

OBSERVATIONS

The results of quantitative analysis and qualitative distribution of palynotaxa (Histogram 1, Table 2) reveal the presence of three distinct palynozones, viz., *Parasaccites korbaensis* Assemblage-Zone, *Scheuringipollenites barakarensis* Assemblage-Zone and *Faunipollenites varius* Assemblage-Zone.

1. Parasaccites korbaensis Assemblage-Zone—

This assemblage is recorded from the lowermost sample (405.00 m depth) in the studied sequence. It has the dominance of *Parasaccites* along with other radial monosaccates, viz., *Plicatipollenites*, *Potonieisporites* and *Caheniasaccites*. The nonstriate disaccates, e.g., *Paravesicaspora*, *Sahnites*, *Vestigisporites*, *Platysaccus*, *Scheuringipollenites* and *Primuspollenites* are subdominant. The striate disaccate pollen, viz., *Faunipollenites*, *Striatopodocarpites* and *Crescentipollenites* are fairly represented. The trilete spores are poor.

The quantitative analysis of palynotaxa in this assemblage is correlatable with the *Parasaccites-Plicatipollenites* Assemblage-Zone (B) of Tiwari and Tripathi (1988), representing the Upper Talchir.

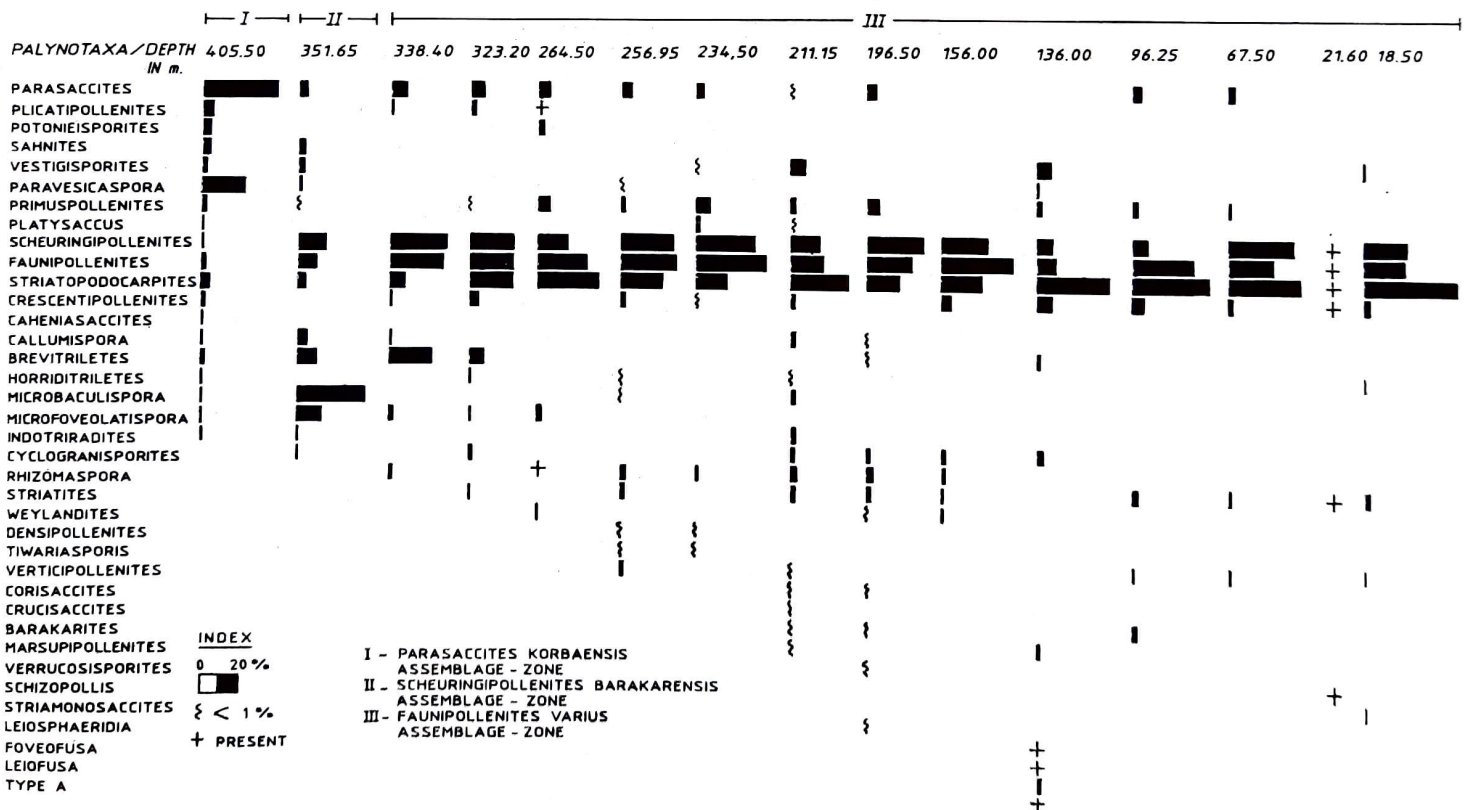
At the specific level this assemblage has many species

of radial monosaccate pollen, viz., *Plicatipollenites gondwanensis*, *P. indicus*, *Parasaccites korbaensis*, *P. bilateralis*, *P. obscurus*, *Caheniasaccites elongatus*, *C. indicus* and *Diuarisaccus lelei* and striate disaccate species *Striatopodocarpites asulcus*, *S. tiwarii*, *Crescentipollenites fuscus* and significant species of trilete and zonate spores, e.g., *Microbaculispora tentula*, *M. barakarensis*, *M. indica* and *Indotriradites sparsus*. Absence of species of *Jayantisporites*, *Crucisaccites* and *Circumstriatites* is noteworthy. This species composition corroborates with the *Parasaccites korbaensis* Assemblage-Zone defined by Tiwari and Tripathi (1992).

2. Scheuringipollenites barakarensis Assemblage-Zone—

The solitary sample (351.65 m depth) possess the dominance of trilete spores, e.g., *Microbaculispora*, *Microfoveolatispora* and *Brevitriletes*, followed by non-striate disaccate group, viz., *Scheuringipollenites*, *Sahnites*, *Vestigisporites*, *Paraveiscaspora* and striate disaccate taxa, viz., *Faunipollenites* and *Striatopodocarpites*. The radial monosaccates markedly decline.

This composition is very similar to the *Scheuringipollenites - Faunipollenites* Assemblage-Zone (A) of Tiwari and Tripathi (1988) defined from the Lower Barakar.



Histogram 1. Percentage frequency of palynotaxa recovered in the samples from B.H. TCW-25, Talcher Coalfield, Orissa.

Table 2. Distribution pattern of species through Borehole TCW-25, Talcher Coalfield, Orissa

Palynosppecies	Assemblage - Zone	<i>Parasaccites korbaisensis</i> Assemblage-Zone	<i>Scheuringipollenites barakarensis</i> Assemblage-Zone	<i>Faunipollenites varius</i> Assemblage-Zone
<i>Caheniasaccites elongatus</i>			
<i>Caheniasaccites indicus</i> (Pl. 1, Fig. 11)			
<i>Divarisaccus lelei</i>			
<i>Microfoveolatispora foveolata</i>			
<i>Plicatipollenites gondwanensis</i>			
<i>Primuspollenites dicavus</i>			
<i>Sahnites jayantiensis</i>			
<i>Scheuringipollenites maximus</i>			
<i>Indotriradites sparsus</i>			
<i>Microbaculispora barakarensis</i> (Pl. 1, fig. 1)			
<i>Microbaculispora indica</i>			
<i>Brevitriletes communis</i> (Pl. 1, fig. 8)			
<i>Callumispora gretensis</i> (Pl. 1, fig. 3)			
<i>Crescentipollenites fuscus</i> (Pl. 1, fig. 5)			
<i>Faunipollenites perexiguus</i>			
<i>Faunipollenites varius</i>			
<i>Microbaculispora tentula</i> (Pl. 1, fig. 7)			
<i>Parasaccites bilateralis</i>			
<i>Parasaccites korbaisensis</i>			
<i>Parasaccites obscurus</i> (Pl. 1, fig. 13)			
<i>Paravesicaspora indica</i>			
<i>Paravesicaspora obliqua</i>			
<i>Plicatipollenites indicus</i> (Pl. 1, fig. 17)			
<i>Sahnites barrelis</i> (Pl. 1, fig. 16)			
<i>Sahnites elongatus</i>			
<i>Scheuringipollenites maximus</i>			
<i>Vestigisporites novus</i>			
<i>Callumispora barakarensis</i>			
<i>Imparitriletes korbaisensis</i>			
<i>Indotriradites korbaisensis</i> (Pl. 1, fig. 2)			
<i>Lacinitriletes badamensis</i>			
<i>Sahnites thomasi</i> (Pl. 1, fig. 10)			
<i>Brevitriletes unicus</i>			
<i>Faunipollenites congoensis</i>			
<i>Primuspollenites levis</i>			
<i>Primuspollenites obscurus</i>			
<i>Scheuringipollenites barakarensis</i>			
<i>Striatopodocarpites decorus</i>			
<i>Vestigisporites dissectus</i>			
<i>Barakarites implicatus</i>			
<i>Barakarites indicus</i> (Pl. 1, fig. 18)			
<i>Barakarites triquetrus</i>			
<i>Corisaccites alutas</i>			
<i>Crescentipollenites gondwanensis</i>			
<i>Cyclogranisporites gondwanensis</i>			
<i>Densipollenites indicus</i>			

Palynosppecies	Assemblage - Zone	<i>Parasaccites</i> <i>korbaensis</i> Assemblage-Zone	<i>Scheuringipollenites</i> <i>barakarensis</i> Assemblage-Zone	<i>Faunipollenites</i> <i>varius</i> Assemblage-Zone
<i>Densipollenites invisus</i>			
<i>Foveofusa</i> sp. (Pl. 1, fig. 15)			
<i>Gingkgocycadopites</i> sp.			
<i>Horriditriletes curvibaculosus</i> (Pl. 1, fig. 9)			
<i>Indotriradites surangei</i>			
<i>Lahirites parvus</i>			
<i>Lahirites rarus</i>			
<i>Leiosphaeridia indica</i> (Pl. 1, fig. 14)			
<i>Marsupipollenites triradiatus</i>			
<i>Marsupipollentes striatus</i> (Pl. 1, fig. 4)			
<i>Primuspollenites densus</i>			
<i>Rhizomaspora indica</i>			
<i>Rhizomaspora singula</i>			
<i>Schizopollis disaccoidus</i>			
<i>Striasulcites ovatus</i>			
<i>Striatites communis</i> (Pl. 1 fig. 12)			
<i>Striatites irregularis</i>			
<i>Striatites parvus</i>			
<i>Striatites solitus</i> (Pl. 1 fig. 6)			
<i>Striatopodocarpites asulcus</i>			
<i>Striatopodocarpites diffusus</i>			
<i>Striatopodocarpites gigas</i>			
<i>Striatopodocarpites magnificus</i>			
<i>Striatopodocarpites ovalis</i>			
<i>Striatopodocarpites rotundus</i>			
<i>Striatopodocarpites subcircularis</i>			
<i>Striatopodocarpites tiwarii</i>			
<i>Striomonosaccites ovatus</i>			
Type A (Pl. 1 fig. 19, 20)			
<i>Verticipollenites gibbosus</i>			
<i>Verticipollenites secretus</i>			
<i>Vestigisporites nigratus</i>			

At the specific level, first appearance of several trilete and striate disaccate taxa is recorded. At the same time many species representing *Plicatipollenites*, *Caheniasaccites* and *Sahnites* of *Parasaccites korbaensis* Assamblage-Zone are absent. As such the species composition of this assemblage qualifies the *Scheuringipollenites barakarensis* Assemblage-Zone defined by Tiwari and Tripathi (1992).

3. *Faunipollenites varius* Assemblage-Zone—This assemblage (338.40-17.50 m depth) shows the dominance of striate disaccate pollen, viz., *Faunipollenites*, *Striatopodocarpites* together with *Crescentipollenites*. The nonstriate disaccates occupy the second position. The monosaccate pollen *Parasac-*

cites is consistently present, though in low frequency. The trilete spores are well represented at 338.40 m and 323.20 m depths and in rest of the sequence they are inconsistent and rare. A group of several new elements appear in this assemblage represented by *Rhizomaspora*, *Striatites*, *Verticipollenites*, *Corisaccites*, *Schizopollis*, *Barakarites*, *Striomonosaccites*, *Marsupipollenites*, *Tiwariasporis*, *Weylandites*, *Densipollenites* and *Verrucosisporites*. These forms occur inconsistently in low frequency throughout.

The presence of acritarch taxa, viz., *Foveofusa*, *Leiosphaeridia*, cf. *Leiofusa*, and Type A at depth level 136.00 m is remarkable, that may suggest marine or brackish water environment (Venkatachala & Tiwari, 1988).

The frequency analysis of the palynotaxa in this assemblage reveals similarity with the *Faunipollenites - Scheuringipollenites* Assemblage-Zone (B) recognised by Tiwari and Tripathi (1988) representing the Upper Barakar.

At the specific level this assemblage shows a high diversification of species. The species of *Scheuringipollenites korbaensis* Assemblage-Zone continue here. A number of species mark their first appearance in this zone which are stratigraphically significant, e.g., *Striatopodocarpites diffusus*, *S. magnificus*, *Striatites solitus*, *S. communis*, *Barakarites indicus*, *Schizopollis disaccoides*, *Verticipollenites gibbosus*, *Striasulcites ovatus*, *Horriditriletes curvibaculosus* and *Corisaccites alutas*. The species composition of this assemblage correlates well with the *Faunipollenites varius* Assemblage-Zone recognised by Tiwari and Tripathi (1992).

So far described palynoassemblages from Talcher Coalfield do not permit a detailed comparison at specific level. However, on the basis of generic composition and their quantitative occurrence it could be summarised that *Scheuringipollenites barakarensis* Assemblage-Zone and *Faunipollenites varius* Assemblage-Zone recorded in B.H. TCW -25 are correlatable with the palynoflora of Seam-I and Seam-II of B.H. NCTB-288 respectively, described by Srivastava (1984).

A close look and detailed analysis of Histogram 1 shows the persistent occurrence of radial monosaccate pollen, *Parasaccites*, as well as haploxytonoid disaccate pollen in fair amounts, well within the Upper Barakar, is noteworthy. These morphographic characters have been considered to be associated with cooler climate (Tiwari & Tripathi, 1988). This reveals that relatively cooler climate continued during the Upper Barakar in Talcher Coalfield as compared to the Damodar Basin coalfields. Similar

observation has also been made by Tiwari and Ram-Awatar (1989) in Johilla Coalfield, Son Valley.

CONCLUSION

1. Three palynoassemblage zones representing Upper Talchir and Barakar are identified.
2. The distribution pattern and FAD of spore pollen species reveals presence of *Parasaccites korbaensis* Assemblage-Zone, *Scheuringipollenites barakarensis* Assemblage-Zone and *Faunipollenites varius* Assemblage-Zone.
3. The palaeoclimate during Upper Barakar experienced relatively cooler climate as compared to Domodar Basin.
4. The presence of acritarch forms, e.g., *Leiosphaeridia*, cf. *Leiofusa*, *Foveofusa* and Type A probably indicates a brackish water or marine environment.

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Plate 1

Spore pollen species in Lower Permian assemblages in Bore-hole TCW-25, Talcher Coalfield, Orissa
(All photomicrographs x 500)

1. *Microbaculispora barakarensis*, BSIP Slide no. 10746.
2. *Indotriradites korbaensis*, BSIP Slide no. 10749.
3. *Callumispora gretensis*, BSIP Slide no. 10745.
4. *Marsupipollenites striatus*, BSIP Slide no. 10739.
5. *Crescentipollenites fuscus*, BSIP Slide no. 10743.
6. *Striatites solitus*, BSIP Slide no. 10738.
7. *Microbaculispora tentula*, BSIP Slide no. 10746.
8. *Brevitriletes communis*, BSIP Slide no. 10746.
9. *Horriditriletes curvibaculosus*, BSIP. Slide no. 10744.
10. *Sahnites thomasi*, BSIP Slide no. 10748.
11. *Caheniasaccites indicus*, BSIP Slide no. 10750.
12. *Striatites communis*, BSIP Slide no. 10738.
13. *Parasaccites obscurus*, BSIP Slide no. 10737.
14. *Leiosphaeridia indica*, BSIP Slide no. 10747.
15. *Foveofusa* sp., BSIP Slide no. 10742.
16. *Sahnites barrelis*, BSIP Slide no. 10746.
17. *Plicatipollenites indicus*, BSIP Slide no. 10749.
18. *Barakarites indicus*, BSIP Slide no. 10738.
- 19,20. Alete Type A., BSIP Slide nos. 10741, 10740.

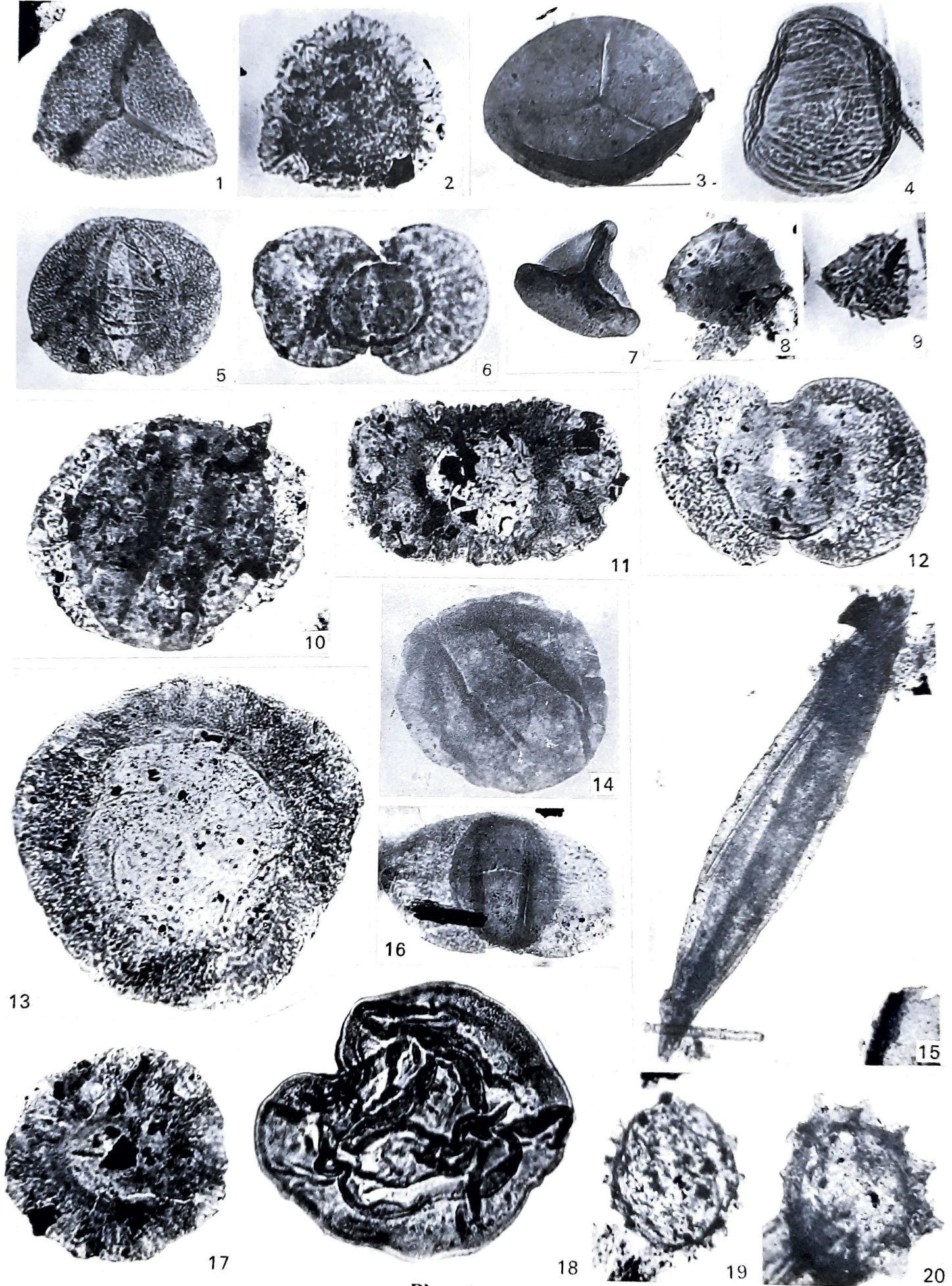


Plate 1

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