STUDIES IN THE TALCHIR FLORA OF INDIA-12. PALYNOLOGY OF THE TALCHIR FORMATION OF HUTAR COALFIELD, BIHAR

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ABSTRACT

Detailed systematic study of the Talchir mioflora has been done and 16 palynomorph genera have been recorded. Their distribution in various samples is given and comparison of this flora with those described from the Talchir Formation of other Lower Gondwana Basins has been done. The aspect of miospore preservation has also been dealt with.

INTRODUCTION

About a century ago, the Hutar Coalfield was first mapped geologically by BALL (1880). RIZVI (1972) remapped the area in further detail. Both the workers recognized the Talchir, Barakar and Mahadeva Groups. FEISTMANTEL (1886) reported *Gangamopteris cyclopteroides*, *Glossopteris* sp. and equisetalean stem from the Talchir Formation.

Detailed palaeobotanical and palynological studies in the Hutar Basin were taken up by us during the last 5 years and the area was geologically mapped by SHUKLA (in press). The present paper deals with the palynological fossils found in the Talchir Formation of the Hutar Coalfield.

GEOLOGY

The Talchir Formation forms a near continuous band around the Gondwana sediments of Hutar Coalfield. It rests non-conformably on the Archaeans. The Talchir Formation is well exposed in the sections of the Koel river, Deori Nala and Behra Nala. Stratigraphical sections were measured in these locations and a lithology was computed. The Formation has three members, viz. Sandstone Conglomerate Member (5 meters), Shale Member (13 meters) and Upper Sandstone Member (9 meters). The Talchir Formation (27 meters) is overlain by a conglomerate at the top marking the beginning of the Karharbari cycle of sedimentation.

MATERIAL AND METHOD

Material for this work was collected from various nala cuttings in the coalfield. Details of samples No., lithology and location is given on next page (Also vide map-1).

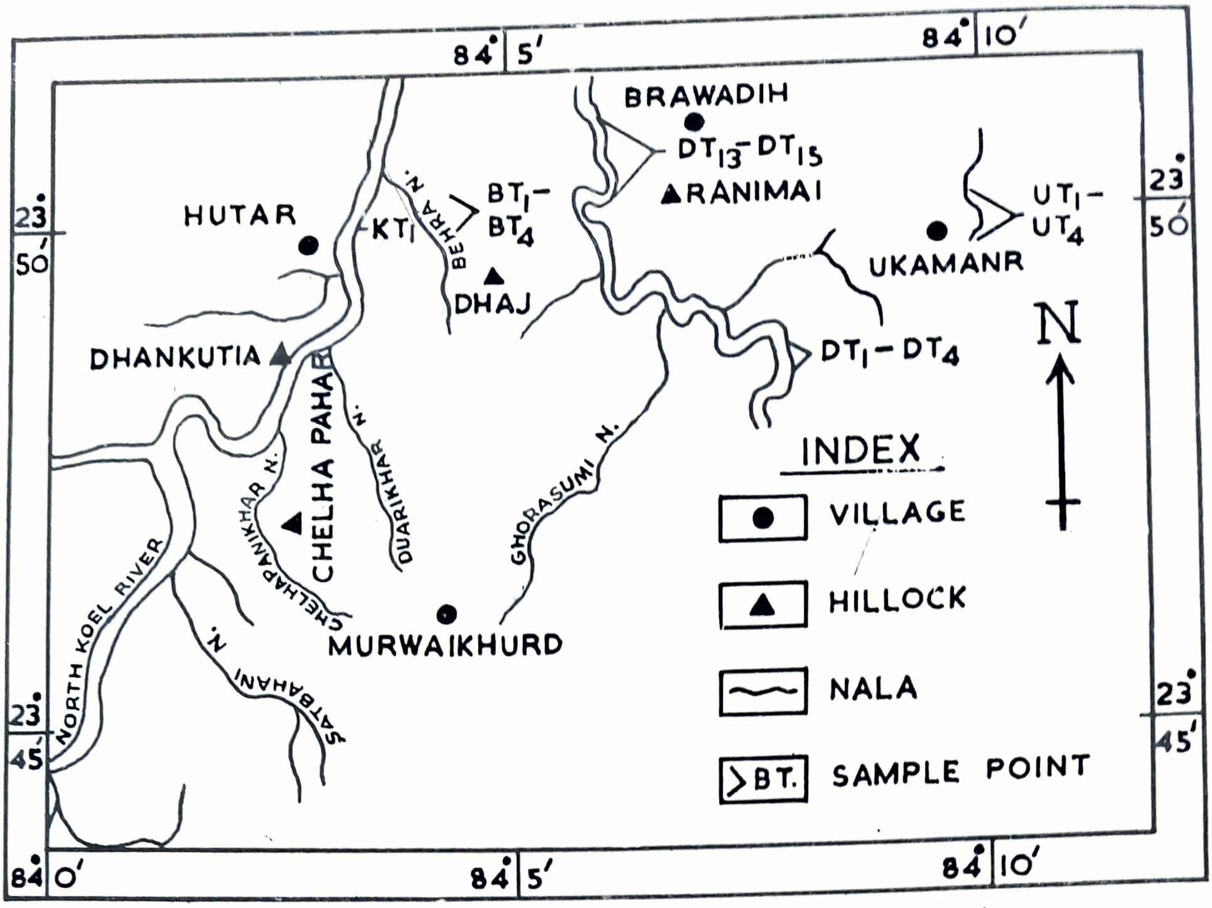
The sample were normally subjected to Hydrofluoric acid treatment for isolation of spores. Permanent slides were made in DPX mountant.

Complete list of palynofossils recovered from the Talchir Formation of Hutar Coalfield is as follows (Plate-1) :

Psilalacinites triangulus Kar, 1969.

Callumispora tenuis var. *minor* Bharadwaj & Srivastava, 1969.

Verrucosisporites sp.



Map 1—Showing location of various palynological samples.

Sl. No.	Sample No.	Lithology	Location
1.	DT_1	Sandstone Conglomerate	Deori Nala, southern contact with Archaeans
2.	DT_2-DT_4	Needle Shale with Siltstone	Immediately overlying the bed with sample no. DT_1
3.	DT_{13}, DT_{14}	Sandstone with conglomerate	Near Barwadih Village, Deoria Nala
4.	DT_{15}	Needle Shale with Siltstone	—do—
5.	DT_{16}	Sandstone	—do—
6.	KT_1	Shale	In Koel River, east of Hutar Village
7.	BT_1	Coarse green sandstone with lenses of conglomerate.	Behra Nala, N-W of Dhaj Pahar
8.	BT_2-BT_6	Needle Shale, Shale-Siltstone alternation, and Varves.	Behra Nala, N-W of Dhaj Pahar
9.	JhT_1	Needle Shale	Near confluence of Jhapidhora Nala and Deori Nala.
10.	JhT_2	Green Sandstone	Overlying the Needle Shale ($Jh\,T_1$) in Jhapidhora Nala
11.	UT_1	Shale with siltstone and varves	Ukamnar area in Saphi Nala
12.	UT_2	Sandstone	—do—
13.	MT_1	Needle Shale	Morrava Nala traverse from Deori Nala to Hutar Village

Horriditriletes curvibaculosus Bharadwaj & Salujha, 1964.
Jayantisporites pseudozonatus Lele & Makada, 1972.
J. conatus Lele & Makada, 1972.
Plicatipollenites indicus Lele, 1964.
P. gondwanensis (B. & H.) Lele, 1964.
P. trigonalis Lele, 1964.
P. diffusus Lele, 1964.
P. densus Srivastava, 1970.
Virkkipollenites obscurus Lele, 1964.
Potonieisporites neglectus Potonié & Lele, 1961.
P. jayantiensis Lele & Karim, 1971.
P. densus Maheshwari, 1967.
P. crassus Lele & Chandra, 1973.
Parasaccites distinctus Tiwari, 1965.
P. bilateralis Tiwari, 1965.
P. obscurus Tiwari, 1965.
P. diffusus Tiwari, 1965.
P. talchirensis Lele & Makada, 1972.
P. densicorpus Lele, 1975.
Tuberisaccites tuberculatus (Maheshwari) Lele & Makada, 1972.
Caheniasaccites distinctus Lele & Makada, 1972.
Vesicaspora sp.
Faunipollenites goraiensis (Potonié & Lele) Maithy, 1965.
Crescentipollenites amplus (B. & H.) comb. nov.
Botryococcus braunii Kutzing.
Foveofusa perforata Lele & Chandra, 1972.
F. obesa Lele & Chandra, 1972.
F. cylindrica Lele & Chandra, 1972.
F. mutabilis Lele & Chandra, 1972.
Organic plates.
Fungal filaments.

SYSTEMATICS

Subturma DISACCITES Cookson, 1947

Infraturma STRIATITI Pant, 1955

Genus—**Crescentipollenites** Bharadwaj, Tiwari & Kar, 1974

Crescentipollenites amplus (Balme & Hennelly) comb. nov.

Pl. 1, Fig. 18

Size rnge 64-100 $\times$ 45-55 μm, bisaccate, haploxylonoid ; body dense, oval, size 50-60 $\times$ 44-52 μm ; exine inframicroreticulate, horizontal striations 4-5, sometimes weakly developed ; saccus attachment with body marked by crescent shaped fold.

MIOFLORAL COMPOSITION AND COMPARISON

The Talchir mioflora in the Hutar Coalfield consists of 14 genera and 27 species, belonging to trilete, monosaccates and bisaccates. At group level the assemblage shows dominance of monosaccate spores (95.69%). Spore having amphilateral type of saccus attachment, belonging to infraturma Parasacciti and Caheniasacciti (60.17%) are more dominant than spores with subequatorial type of distal saccus attachment belonging to

Apertacorpiti and Vesiculomonoraditi (35.52%). Triletes (4.04%) and bisaccates (0.74%) form only small percentage of total flora. At generic level most dominant spore is *Parasaccites* (54.75%) followed by *Plicatipollenites* (23.7%), *Potonieisporites* (8.54%), *Caheniasaccites* (5.04%), *Virkkipollenites* (3.24%), and *Callumispora* (3.3%). Acritarch *Foveofusa* is also present in some of the samples and in the Koel river section it constitutes as much as 60% of total flora. Percentage counting has been done after excluding the acritarchs.

Among the important genera *Parasaccites* varies between 51.9% (Deori Nala) to 56% (Behra Nala), *Plicatipollenites* 19.5% (Koel River) to 31.7% (Deori Nala), *Potonieisporites* 5.7% (Deori Nala) to 12.5% (Koel River) and *Callumispora* 2% (Deori Nala and Behra Nala) to 6.5% (Deori Nala).

Histogram 1—Showing distribution of palynomorphs in the Talchir Formation of the Hutar Coalfield.

Thus the Talchir mioflora of Hutar Coalfield is dominated by radial monosaccates (*Parasaccites*, *Plicatipollenites* and *Potonieisporites*). *Caheniasaccites*, *Virkkipollenites* and *Callumispora* are present as subdominant forms (Tables 1 and 2). The various samples from the Deori Nala, Behra Nala and Koel River are by and large comparable in their miospore composition and may therefore, be assigned to a single broad zone, viz. *Parasaccites-Plicatipollenites* Assemblage Zone.

Considerable data has now accumulated on the composition and distribution of miofloras in the Talchir Formation. Chandra and Lele (1979) have recently published an exhaustive study of the Talchir miofloras from a number of areas in the South Rewa Gondwana Basin which has led them to envisage two miofloral zones in the Talchir Formation. The Lower Talchir miofloral zone is characterized by the prevalence of *Plicatipollenites* over *Parasaccites* whereas in the Upper Talchir mioflora *Parasaccites* dominates over *Plicatipollenites*. A similar contention is drawn by Bharadwaj *et al.* (1979) in their study of the Manendragarh Talchir mioflora.

The Talchir mioflora of the Hutar Coalfield shows a dominance of *Parasaccites* over *Plicatipollenites* and is, therefore, correlatable with the Upper Talchir miofloral zone (*Parasaccites-Plicatipollenites* Zone) of Chandra and Lele (1979). In the same way, the Hutar mioflora also compares with the following Talchir miofloral assemblages, viz. (1) Jayanti Coalfield (Middle and Upper set of Talchir mioflora, Lele & Makada, 1972);

Table-1—Distribution of palynomorphs in various sample of the Talchir Formation in the Hutar Coalfield.

	Talchir (General)	Deori Nala		Koel River	Behra Nala	
		DT_2+DT_3	DT_5	KT_1	BT_3	BT_4
1. *Psilalacinites*	+	+	—	—	—	—
2. *Callumispora*	3.3	2	6.5	3	4	2
3. *Verrucosisporites*	+	+	—	—	—	—
4. *Horriditriletes*	+	+	—	—	—	—
5. *Jayantisporitse*	0.74	0.7	2	—	+	1
6. *Parasaccites*	54.75	51.9	53	54	59	56
7. *Tuberisaccites*	0.04	0.2	—	—	—	—
8. *Caheniasaccites*	5.04	3.2	4.5	8.5	5	4
9. *Vesicaspora*	0.34	0.7	1	—	—	+
10. *Virkkipollenites*	3.24	3.2	2.5	5.5	2	3
11. *Plicatipollneites*	23.74	31.7	21.5	19.5	22	24
12. *Potonieisporites*	8.54	5.7	8.5	12.5	8	8
13. *Faunipollenites*	0.6	0.5	—	0.5	—	2
14. *Crescentipollenites*	0.14	0.2	0.5	—	—	—
15. *Foveofusa*	+	—	—	+	+	—
16. *Botryococcus*	+	—	—	+	—	—

Table-2—Distribution of major miospore groups in various samples of the Talchir Formation in the Hutar Coalfield.

Major Groups	Talchir (General)	Deori Nala		Koel River	Behra Nala	
		DT_2+DT_3	DT_{15}	KT_1	BT_3	BT_4
TRILETE						
Laevigati	3.3	2	6.5	3	4	2
Apiculati	+	+	—	—	—	—
Varitrileti	0.74	0.7	2	—	+	1
Murornati	—	—	—	—	—	—
MONOSACCATE						
Apertacorpiti + Vesiculomonoraditi	35.52	40.6	32.5	37.5	32	35
Parasacciti + Caheniasacciti	60.17	56.0	58.5	62.5	64	60
BISACCATE	0.74	0.7	0.5	0.5	—	2

(2) North Karanpura (Zone I, of KAR, 1973) ; (3) Korba Coalfield (Lower part of Zone I of SRIVASTAVA, 1973a) ; (4) Giridih (SRIVASTAVA, 1973b) ; (5) Mohpani (Zone I of BHARADWAJ & PRAKASH, 1972) ; (6) Pench-Kanhan Coalfield (Assemblage B of BHARADWAJ *et al.*, 1974) ; (7) West Bokaro Coalfield (Late Talchir mioflora of LELE, 1975) ; (8) Johilla Coalfield (Late Talchir mioflora of CHANDRA & LELE, 1979).

PRESERVATION OF MIOSPORE EXINES

The incidence of pseudostructures on the exine of spores and pollen is quite frequent (80%) in the Talchir Formation. Palynomorphs which are most susceptible to exine degradation belong to the genera *Plicatipollenites*, *Parasaccites* and *Callumispora*. In *Plicatipollenites*, many specimen develop puncta-like structures strongly recalling those of *Punctasaccites* (BOSE & KAR, 1966). However, the features in our specimens could be relegated to artifacts resulting from microbiological degradation of the exine. Miospores of *Parasaccites* show coccoid structures while those of *Callumispora* develop enlarged reticulations and pits. It seems very likely that the Talchir miospores were deposited in a shallow water basin which had enough oxygen to support microbial activity.

Degradation of spore exine may be due to many causes, viz. physical, chemical and biological, but it is difficult to differentiate one from the other (ELSIK, 1971). However, different types of corrosion are supposed to have been caused by one or more of these agencies. Some main types of corrosion present in the spores of the Hutar Coalfield were studied in the mioflora of the Talchir Formation.

State of preservation of spore exine in the Talchir Formation varies from sample to sample. Sometimes in same sample few grains are seen to be comparatively well preserved while others have degraded exine. Degradation of exine is mainly due to following causes :

BIOLOGICAL DEGRADATION OF EXINE

I. Direct microbial action : Following features are produced due to direct microbial action—

(i) Fine puncta like pits (Pl. 2, Fig. 42) with size 1/2-1 μm, and slightly bigger pits with size 1-3 μm (Pl. 2, Fig. 35). Similar pits have been described by ELSIK (1966, 68, 71) and HAVINGA (1967, 1971). They consider them to have formed due to microbial activity. Rhizoides of phycomycetes are supposed to puncture or digest the exine when they grow on these spores (GOLDSTEIN, 1960).

(ii) Bigger scars 4-14 μm size are seen in some spores (Pl. 2, Figs. 38, 39 and 41). Similar scars have been described by ELSIK (1971). He considers it the ultimate result of his rosette type of scar. Such affects are believed to be caused by the differential degradation of microspores exine by rhizoids of Actinomycetes and true fungi or by the direct growth of a bacterial or fungal colony.

(iii) Meandering groove 1/2-1 μm wide, are also seen on the body of some spores. Such features are more common on saccate spores (Pl. 2, Fig. 36). Similar grooves have been photographed by ELSIK (1971) and compared with simple branched Actinomycetes. They may also be formed by joining the closely placed puncta like pit.

II. Degradation due to precipitation of crystals—Some spore show hexagonal circular or triangular depressions in the exines with fold or ridge surrounding them (Pl. 2, Fig. 40). Similar features have earlier been described by LOVE (1962), NEVES AND SULLIVAN (1964) and MOORE (1963). They attribute them to the development of pyrite crystals on the exine. The precipitation of pyrite crystals is supposed to have been helped by the bacteria, which were already present on the exine of these spores.

Elsik (1971) attributes degradation similar to one shown in Plate 2, Figs. 38 and 39, as due to development of colonies of coccoid bacteria.

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EXPLANATION OF PLATES

(All slides (6375—6408) and photographs are deposited in the museum of Birbal Sahni Intsitute of Palaeobotany, Lucknow).

PLATE-1

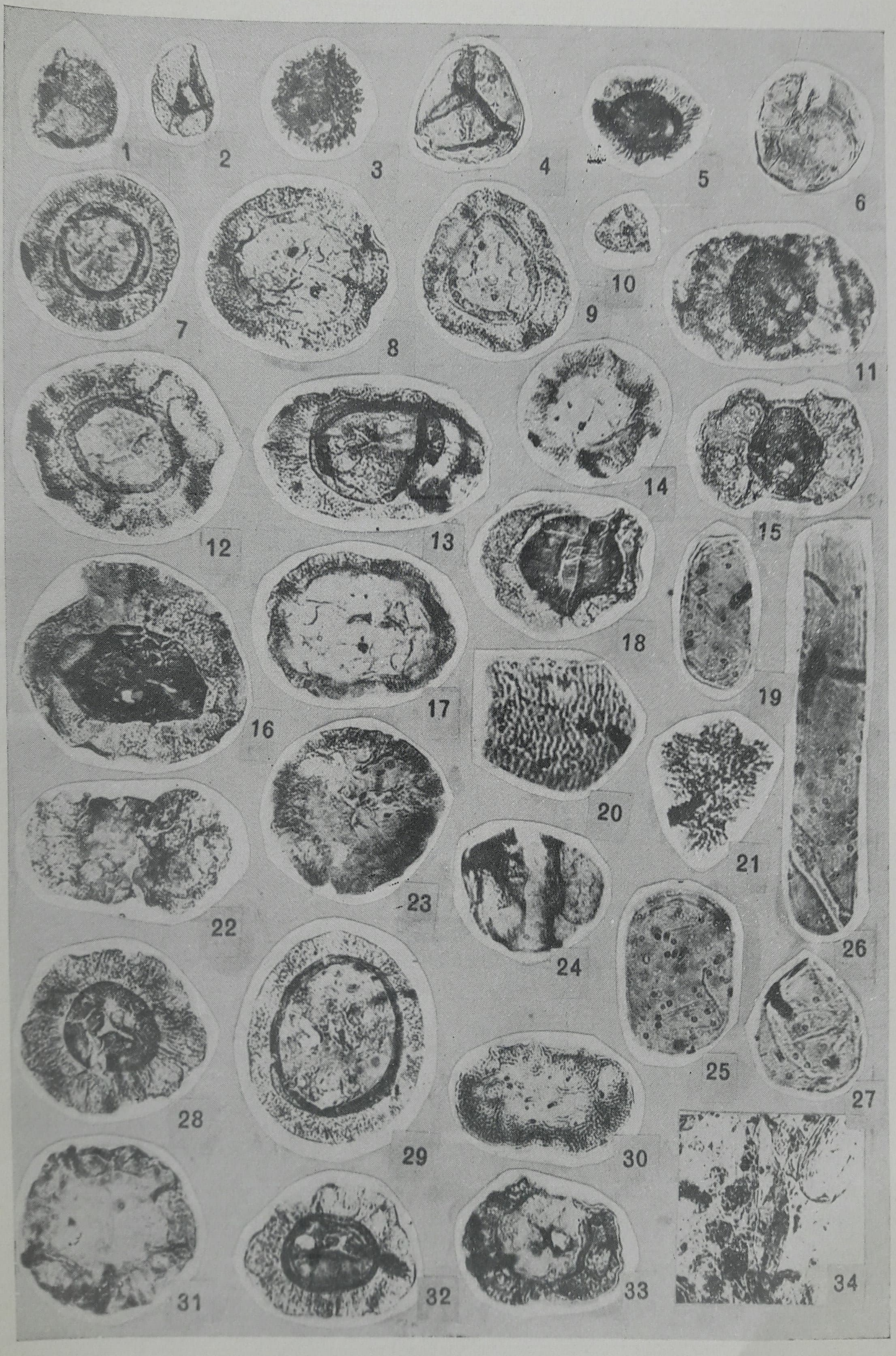
(All figures are 250 ×).

Fig. 1. *Jayantisporites pseudozonatus* Lele & Makada ; Slide No. 6393.
Fig. 2. *Verrucosisporites* sp. ; Slide No. 6390.
Fig. 3. *Jayantisporites conatus* Lele & Makada ; Slide No. 6388
Fig. 4. *Psilalacinites triangulus* Kar ; Slide No. 6388
Fig. 5. *Parasaccites densicorpus* Lele ; Slide No. 6396
Fig. 6. *Callumispora tenuis* var. *minor* Bharadwaj & Srivastava ; Slide No. 6398.
Fig. 7. *Plicatipollenites densus* Srivastava ; Slide No. 6377.
Fig. 8. *Plicatipollenites diffusus* Lele ; Slide No. 6383.
Fig. 9. *Plicatipollenites trigonalis* Lele ; Slide No. 6394.
Fig. 10. *Horriditriletes curvibaculosus* Bharadwaj & Salujha ; Slide No. 6393.
Fig. 11. *Potonieisporites crassus* Lele & Chandra ; Slide No. 6377.
Fig. 12. *Plicatipollenites gondwanensis* (Balme & Hennelly) Lele ; Slide No. 6377.
Fig. 13. *Potonieisporites neglectus* Potonié & Lele ; Slide No. 6394.
Fig. 14. *Virkkipollenites obscurus* Lele ; Slide No. 6393.
Fig. 15. *Potonieisporites jayantiensis* Lele & Karim ; Slide No. 6381.
Fig. 16. *Potonieisporites densus* Maheshwari ; Slide No. 6394.
Fig. 17. *Parasaccites distinctus* Tiwari ; Slide No. 6395.
Fig. 18. *Crescentipollenites amplus* (Balme & Hennelly) comb. nov. ; Slide No. 6376.
Fig. 19. *Foveofusa cylindrica* Lele & Chandra ; Slide No. 6396.
Fig. 20. Organic plate ; Slide No. 6396.
Fig. 21. *Botryococcus braunii*, Kutzing ; Slide No. 6395.
Fig. 22. *Vesicaspora* sp.; Slide No. 6381.
Fig. 23. *Parasaccites diffusus* Tiwari ; Slide No. 5377.
Fig. 24. *Faunipollenites goraiensis* (Potonié & Lele) Maithy ; Slide No. 6377.
Fig. 25. *Foveofusa obesa*, Lele & Chandra ; Slide No. 6396.
Fig. 26. *Foveofusa perforata* Lele & Chandra ; Slide No. 6395.
Fig. 27. *Foveofusa mutabilis* Lele & Chandra ; Slide No. 6397.
Fig. 28. *Parasaccites talchirensis* Lele & Makada ; Slide No. 6394.
Fig. 29. *Plicatipollenites indicus* Lele ; Silde No. 6394.
Fig. 30. *Parasaccites bilateralis* Tiwari ; Slide No. 6399.
Fig. 31. *Parasaccites obscurus* Tiwari ; Slide No. 6387.
Fig. 32. *Caheniasaccites distinctus* Lele & Makada ; Slide No. 6394.
Fig. 33. *Tuberisaccites tuberculatus* (Maheshwari) Lele & Makada ; Slide No. 6383.
Fig. 34. Fungal filaments ; Slide No. 6384.

PLATE-2

(All figures are 500 ×)

Fig. 35. *Potonieisporites*; effected by biological degradation; 1-3 μm large pits on body; Slide No. 6391.
Fig. 36. *Potonieisporites*; effected by biological degradation; 1/2-1 μm wide meandering grooves on the body ; Slide No. 6389.
Fig. 37. *Callumispora* ; exine showing enlarged reticulation ; Slide No. 6393.
Fig. 38. *Parasaccites* ; coccoid structures on the exine ; Slide No. 6381.
Fig. 39. *Parasaccites*; coccoid structure on the exine ; Slide No. 6381.
Fig. 40. *Plicatipollenites* ; triangular marking of the crystal of pyrite ; Slide No. 6393.
Fig. 41. *Plicatipollenites* ; coccoid structure on the body exine ; Slide No. 6391.
Fig. 42. *Potonieisporites* ; effected by biological degradation 1/2-1 μm large pits on the body ; Slide No. 6381.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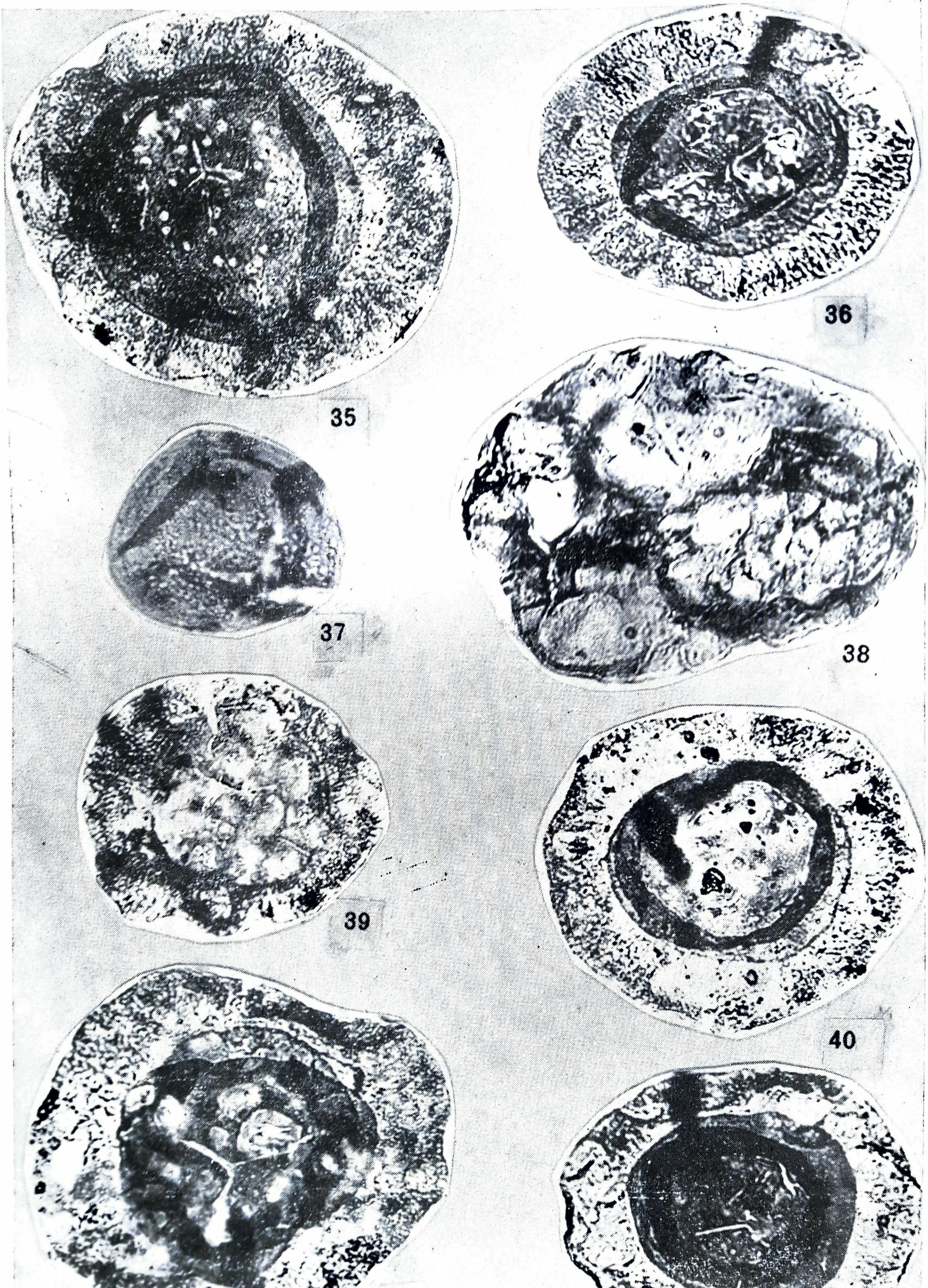
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