STUDIES IN THE TALCHIR FLORA OF INDIA. 8. MIOSPORES FROM THE TALCHIR BOULDER BED AND OVERLYING NEEDLE SHALES IN THE JOHILLA COALFIELD (M.P., INDIA)*

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ABSTRACT

Miospore assemblages are, for the first time, recorded from the Talchir Boulder Bed and overlying Needle Shales in the South Rewa Basin. The Boulder Bed assemblage contains 13 genera and 20 species, while the Needle shales have 17 genera and 24 species. Both assemblages, having several common taxa, are predominated by monosaccate pollen as is generally characteristic of other known Talchir miofloras. In the details of composition, however, the Boulder Bed assemblage of South Rewa appears to be distinct from that recorded from similar sediments of the Jayanti Coalfield. The present findings lend further support to the existence of the Glossopteris Flora during course of the Gondwana glaciation.

INTRODUCTION

MIOSPORES from the Talchir Boulder Bed became known only recently when Lele & Karim (1971) described well preserved miofloras from the two Talchir Boulder Bed intercalations of the Jayanti Coalfield. The present findings from Mangthar (Johilla Coalfield) furnish yet another example of a similar occurrence of mioflora in the Talchir Boulder Bed and the overlying Needle Shales.

Palynological work on the Lower Gondwanas of Johilla Coalfield was started long ago (Virkki 1946) and was subsequently followed by others. However, nothing was known about the miofloras of the Talchir Stage until Potonié & Lele (1961) described an assemblage from the beds near Goraia (Text-fig. 1), Birsinghpur Pali. Therefore, intensive palynological work on the Talchir strata was undertaken by us some years ago. The studies have resulted in the present findings from the Boulder Bed as well as of other micro-fossil assemblages from younger Talchir strata partly recorded earlier (Lele and Chandra 1967).

Geological background — The Talchir formation is well exposed along the Johilla river. The Archaean-Talchir boundary is seen south of Ponri (Text-fig. 1). Good sections are also seen here and there in small tributaries of the Johilla river as also near the present locality of Mangthar (81°7: 23°: 18′).

The section at Mangthar exposes the following sequence of the Talchir Stage which is overlain by younger strata. The location is about $\frac{3}{4}$ mile north west of Mangthar along a small water course. The beds dip gently (average 7°) towards north.

	Thickness ft.	Field No.
4. Greenish Needle shales (Rich in Miospores)	10	MA11-MA12
3. Boulder Bed (No Miospores)	7	MA12
2. Yellowish greenish sand stones (No Miospores)	10	MA11
1. Boulder Bed (Rich in Miospores)	10	MA10
Total Thickness	37	

In the above section, it may be noted that the Talchir formation is in fact recognizable into four distinct lithological units. The lower member is a Boulder Bed containing sub-rounded-rounded pebbles and boulders (2-3 feet in size) scattered in a greenish clayey to shaly matrix. Above this, is a zone of yellowish greenish sandstone which is free from boulders. This sandstone Unit is once more overlain by another Boulder Bed having similar characteristics as noted for the Basal Boulder Bed. The Boulder sequence is topped by a greenish Needle Shale member. These field observations lead to believe that the Boulder Bed in the Johilla Coalfield occurs in repetitions much in the same way as in the Jayanti Coalfield

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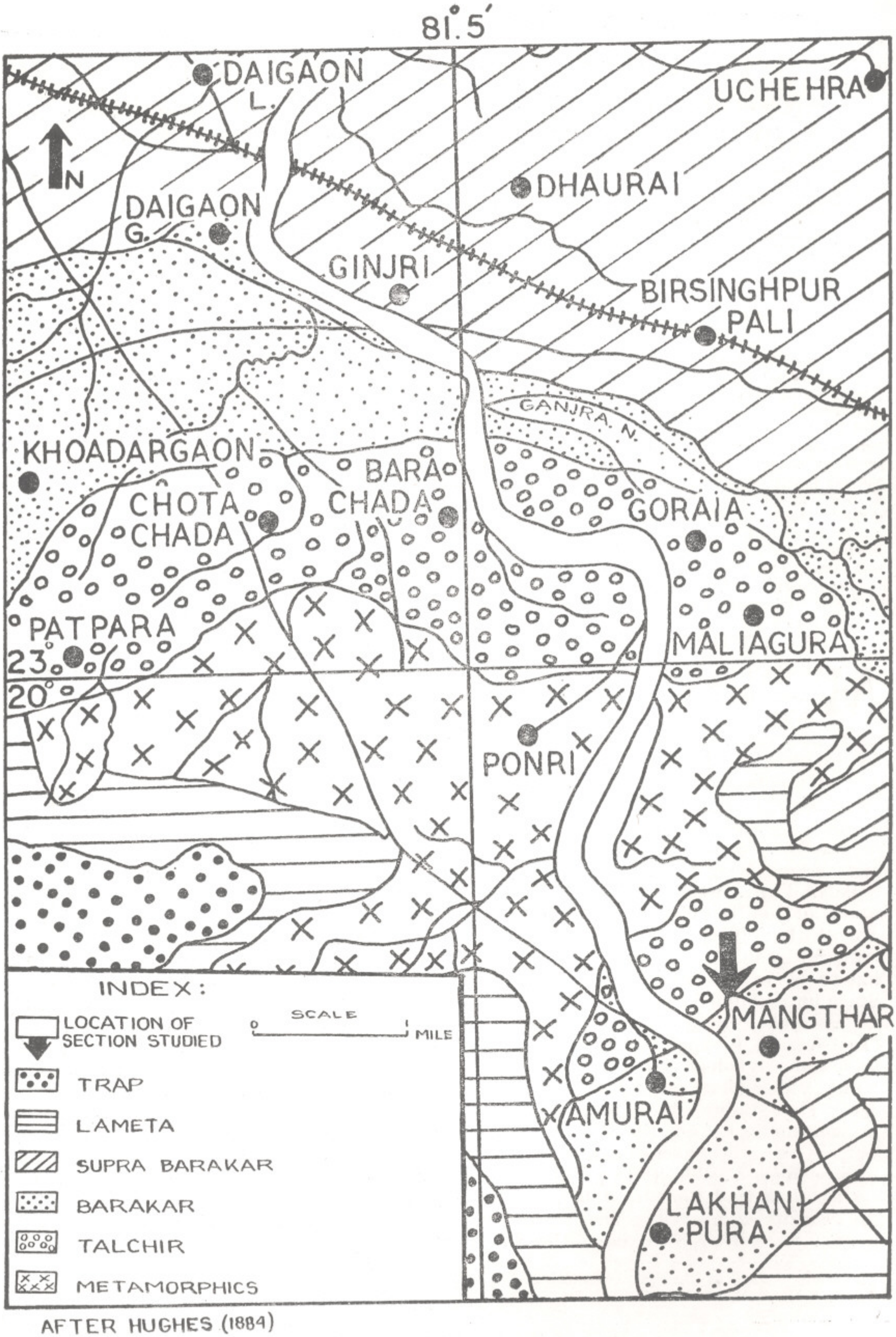


TEX-TFIG. 1.— Geological map of Birsinghpur Pali area, M.P.

(Lele and Karim, 1971) and several other basins (Lele, 1966).

Material and Methods — Samples from all the four beds from the above section were macerated in the usual manner using HF acid and mounted in polyvenyl alcohol followed by Canada Balsam. Spores and pollen were found only in the lower Boulder Bed (Bed No. 1) and in the Talchir Needle Shale (Bed No. 4). The intervening beds (No. 2 & No. 3) did not yield any miospores.

Percentage frequency counts are based on 200 spores per sample.

SYSTEMATIC DESCRIPTION

The miospore assemblages from the Boulder Bed and the overlying Needle Shale comprise a total of 31 species belonging to 19 genera (listed in Table 1). Taxa indicated by an asterisk in the Table are described below.

Anteturma — *Pollenites* Potonié, 1931
Turma — *Saccites* Erdtman, 1947
Subturma — *Monosaccites* (Chitaley) Potonié & Kremp, 1954
Infraturma — *Apertacorpiti* Lele, 1965

Genus — *Katangaites* Bose & Kar, 1967

Type species — *Katangaites densus* Bose & Kar, 1967.

Katangaites ovatus sp. nov.

Pl. 1, Figs. 1, 2

Diagnosis — Size range 88-126 $\mu \times$ 72-98 μ. Monosaccate, $\pm$ oval, central body distinct, dense, 42-58 μ, sub-circular to subtriangular. Body exine laevigate, haptotypic mark absent. Regular body infold system not seen, compression folds present, saccus laterally narrower, strongly built, frilled, muri radially arranged, distal overlap $\frac{1}{2}$-1/3 body radius.

Comparison — *K. densus* Bose & Kar (1967) is roundly triangular in shape and differs in size range.

Holotype — Pl. 1, Fig. 2.

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Needle Shales, Talchir Stage.

Genus — *Rugasaccites* Lele & Maithy, 1969

Type species — *Rugasaccites orbiculatus* Lele & Maithy, 1969.

Remarks on genus — See under Discussion: qualitative aspects.

Rugasaccites densus sp. nov.

Pl. 1, Figs. 3, 4

Diagnosis — Size range 100-140 $\mu \times$ 76-90 μ. Miospores oval, central body dense, 48-70 $\mu \times$ 38-68 μ, variable in shape. Body exine covered with small vermiculae, 0·5 to 1·5 μ wide and 2-6 μ long, anastomosed to form an imperfect reticuloid pattern. Monolete straight to bent, occasionally triletoid. Distal attachment typically associated with two vertical infolds or a $\pm$ polygonal infold system. Saccus usually oval, may be constricted laterally, muri radially arranged and associated with frills, intrareticulation medium.

Remarks — Central body may range in shape from sub-hexagonal, circular, subcircular to horizontally oval. The vermiculae are often better developed in the medium vertical region of the body. The dense nature of body exine may sometimes obliterate the elements. The body infold system has no consistent pattern.

Comparison — *R. densus* is distinguishable by its dense body from all the known species.

Holotype — Pl. 1, fig. 3.

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Boulder Bed, Talchir Stage.

Rugasaccites triangulatus sp. nov.

Pl. 1, Figs. 5, 6

Diagnosis — Size range 78-90 $\mu \times$ 110-120 μ. Miospores oval. Central body dense, roundly triangular, 55-65 μ. Exine covered with rugose to vermiculate elements, 1-2·5 μ thick, 1-10 μ long, branched and/or anastomosed. Trilete weak. Distal infold system roundly triangular, well apart from body margin. Saccus well developed, width variable on different sides of the body, intrareticulation medium, muri radially arranged and associated with frills.

Comparisons — The specimens are distinct from all the known species in having a dense, $\pm$ triangular central body, ill defined mark and a triangular infold system. The sculpture of the body is also coarser and convincingly distinct (Fig. 5).

Holotype — Pl. 1, Fig. 5.

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Needle Shales, Talchir Stage.

Rugasaccites orbiculatus Lele & Maithy, 1969

Pl. 1, Fig. 7

Holotype — Lele & Maithy, 1969; Pl. 2, Fig. 11.

Description — Size range 88-98 μ. Miospores ± circular. Central body distinct, 52-68 μ, circular, body exine ± smooth or finely structured. Both the surfaces with irregular vermiculate sculpture. Area enclosed by vermiculae 1-3 μ wide. Trilete mark distinct, rays asymmetrical, saccus narrow, 14-20 μ wide. Body infold ± circular in outline, close to body periphery, saccus radially frilled, intrareticulation medium.

Remarks — The present example shows the central body sculpture better than in the original illustrations of this species given by Lele & Maithy (1969).

Locality — Near Manghtar, Birsinghpur Pali, M.P.

Horizon — Talchir Needle Shale, Talchir Stage.

Infraturma — *Amphisacciti* Lele, 1965
Sub-infraturma — *Caheniasacciti* Bose & Kar, 1966

Genus — *Gondwanopollis* Lele & Maithy, 1969

Type species — *Gondwanopollis ganjrensis* Lele & Maithy, 1969.

Gondwanopollis densus sp. nov.

Pl. 1, Fig. 8, Pl. 2, Fig. 9

Diagnosis — Size range 104-164μ × 68-110μ. Miospores oval. Central body dense; 50-70μ, circular to horizontally oval, intramicroreticulate. Monolete mark usually distinct, straight, bent or triletoid. Saccus narrow or constricted laterally. Distal attachment usually associated with two semi-lunar folds or occasionally with a ± continuous fold-rim close to body periphery, intrareticulation medium to coarse.

Comparison — *G. densus* sp. nov. is distinct from *G. ganjrensis* Lele & Maithy (1969) in lacking a rhomboid body and a polygonal infold system. *G. concavus* Lele & Maithy (1969) has a thin body.

Holotype — Pl. 2, Fig. 9.

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Needle Shale, Talchir Stage.

Sub-Infraturma — *Divarisacciti* Venkatachala & Kar, 1966

Genus — *Divarisaccus* Venkatachala & Kar, 1966

Type species — *Divarisaccus lelei* Venkatachala & Kar, 1966.

Divarisaccus ovatus sp. nov.

Pl. 2, Fig. 10

Diagnosis — Size range 124-130μ × 76-100 μ. Miospore oval. Central body horizontally oval, 70-82 μ × 48-53 μ, exine intramicroreticulate, proximal attachment of saccus to central body sub-equatorial, distal attachment bilateral and parallel to the longer axis, distal channel wide. Saccus fairly wide, 17 μ broad, occasionally wider on the longer side of the spore.

Comparison — *D. lelei* Venkatachala & Kar (1966) has large body and a narrow saccus. Closer resemblance is found with *D. strengeri* Bose & Kar (1966) in general organization but that species is much larger.

Holotype — Pl. 2, Fig. 10.

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Needle Shales, Talchir Stage.

Infraturma — *Vesiculomonoraditi* (Pant), Bharadwaj, 1955

Genus — *Potoneisporites* Bharadwaj (1954), 1964

Type species — *Potoniéisporites novicus* Bharadwaj 1954

Potoniéisporites crassus sp. nov.

Pl. 2, Figs. 11, 12

Diagnosis — Size range 100-140 μ × 84-90 μ. Miospores oval, central body 58-66 μ × 58-64 μ, dense, circular, sub-circular or slightly horizontally oval, often showing ± 1·5 μ thick peripheral rim. Exine intramicroreticulate. Monolate straight or bent, occasionally triletoid. Distal body infold system prominent, usually circular. Saccus radially frilled, intrareticulation fine-medium, muri strong.

Comparison — *P. densus* Maheshwari (1967) and *P. congoensis* Bose & Maheshwari

(1968) differ in having a ± horizontally oval body and a tetragonal infold system. *P. lelei* Maheshwari, 1967, compares in the shape of the body infold but differs in its much larger size and absence of a dence body. *P. jayantiensis* Lele & Karim, (1971) has a dense body but its shape and the infold pattern is quite different.

Holotype — Pl. 2, Figs. 11

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Boulder Bed, Talchir Stage.

Potoniéisporites mutabilis sp. nov.
Pl. 2, Figs. 13, 14

Diagnosis — Size range 118-124 $\mu \times$74-82 μ. Miospores oval, central body distinct, 58-72 $\mu \times$46-60 μ, dense. Exine smooth, intramicroreticulate to microverrucose. Monolete distinct, straight to bent. Distal body infold irregular and variable in shape. Saccus narrower laterally, frilled, intrareticulation medium to coarse.

Remarks — The body has no consistent outline. Distal body infold system is also irregular in shape. Fold components may be disconnected or may join to form tetragonal, trapezoid or sub-triangular pattern.

Comparison — Comparable species with dense central body are *P. bilateralis* Singh (1964), *P. congoensis* Bose & Maheshwari (1968) and *P. jayantiensis* Lele & Karim (1971). All these species however differ in the consistent shape of the central body and infold system. *P. bilateralis* has an oval (or perhaps sub-triangular) body equator. *P. congoensis* has a horizontally oval body and a rectangular infold system. *P. jayantiensis* Lele & Karim (1971) has a sub-hexagonal body and generally two ± convex body infolds. In *P. mutabilis* sp. nov. the shape of the body as well as infold system is very variable.

Holotype — Pl. 2, Fig. 14.

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Boulder Bed, Talchir Stage.

Infraturma — *Monosaccireticuloidi* Tiwari, 1965

Genus — *Rimospora* Lele & Maithy, 1969

Type species — *Rimospora rimosa* Lele & Maithy, 1969.

Remarks on genus — See under Discussion: qualitative aspects.

Rimospora varia sp. nov.
Pl. 2, Figs. 15, 16

Diagnosis — Size range 104-130 $\mu \times$72-90 μ. Miospore oval, central body dense, 62-72 $\mu \times$58-68 μ, variable in shape but more generally circular — horizontally oval. Exine finely intramicroreticulate. Both surfaces possess subdued polygonal areas, 2-4 μ wide and up to 5 μ long bounded by narrow channels 1-2 μ wide. Mark bilete to trilete, distal attachment associated with a prominent infold system of variable shape. Saccus narrower laterally, muri strong, intrareticulation coarse.

Remarks — *Rimospora* is described by Lele and Maithy as a monosaccate pollen showing disaccoid tendency. Its assignment to *Disaccites* Cookson is, hence, erroneous. The forms in the present material grade from radial to bilateral and in the latter case the saccus may be laterally constricted to appear disaccoid.

Comparison — The present species differs from *R rimosa* Lele & Maithy (1969) chiefly in possessing dense central body with smaller polygonal areas. Besides, the shape of the body and infold system is also variable in *R. varia* sp. nov.

Holotype — Pl. 2, Fig. 15.

Type locality — Near Mangthar, Birsinghpur Pali, M.P.

Horizon — Talchir Needle Shale, Talchir Stage.

DISCUSSION

Qualitative Aspects — *Rugasaccites* and *Rimospora*, both abundantly represented in the Mangtnar mioflora have been examined for their details of body sculpture/structure as originally described by Lele & Maithy (1969) from the Ganjra Nala locality (Text-fig. 1). We have observed that the polygonal areas in *Rimospora* tend to become quite narrow and elongated and may derive an appearance of closely-spaced vermiculate rugae as in certain variants of *Rugasaccites*. Where the elements are finer, it may be difficult to distinguish between sculpture and structure. These points have been taken into consideration for recognizing *Rugasaccites* and *Rimospora* in the present studies. It is, however, felt that more

TABLE 1 — DISTRIBUTION OF MIOSPORE SPECIES IN THE TWO ASSEMBLAGES

	Talchir Boulder Bed	Talchir Needle Shale
1. *Punctatisporites ganjrensis* Lele & Maithy, 1969	+	+
2. *Plicatipollenites gondwanensis* Lele, 1964	+	+
3. *P. trigonalis* Lele, 1964	+	+
4. *P. densus* Srivastava, 1970	—	+
*5. *Katangaites ovatus* sp. nov.	+	—
*6. *Rugasaccites densus* sp. nov.	+	+
*7. *R. triangulatus* sp. nov.	+	+
8. *R. orbiculatus* Lele & Maithy, 1969	+	+
*9. *Rimospora varia* sp. nov.	+	+
10. *Parasaccites talchirensis* Lele & Makada, 1972	+	+
11. *P. obscurus* Tiwari, 1965	—	—
*12. *Gondwanopollis densus* sp. nov.	+	+
13. *Caheniasaccites densus* Lele & Karim, 1971	—	+
*14. *Divarisaccus ovatus* sp. nov.	+	+
15. *Stellapollenites talchirensis* Lele, 1965	—	+
*16. *Potoniéisporites crassus* sp. nov.	+	+
17. *P. neglectus* Potonie & Lele, 1961	+	+
*18. *P. mutabilis* sp. nov.	+	+
19. *P. lelei* Maheshwari, 1967	+	+
20. *P. magnus* Lele & Karim, 1971	+	+
21. *P. triangulatus* Tiwari, 1965	—	+
22. *Vestigisporites rudis* Balme & Henn., 1955	—	+
23. *Limitisporites hexagonalis* Bose & Maheshwari, 1968	+	+
24. *L. congoensis* Bose & Maheshwari, 1968	+	—
25. *Sulcatisporites tentulus* Tiwari, 1968	+	—
26. *Lunatisporites amplus* Balme & Hennelly, 1955	+	+
27. *Faunipollenites varius* Bharadwaj, 1962	—	+
28. *Stratites rhombicus* Bharadwaj & Salujha, 1964	—	+
29. *Striatites* sp.	+	+
30. *Strotersporites* sp.	—	+
31. *Verticipollenites* sp.	—	+

TABLE 2 — PERCENTAGE FREQUENCY OF GENERA IN THE TWO MIOSPORE ASSEMBLAGES

	Talchir Boulder Bed		Talchir Needle Shale	
1. *Punctatisporites*	3	Triletes 3	3	Triletes 3
2. *Plicatipollenites*	9	Mono-saccates 87·5	13·5	Mono-saccates 86
3. *Katangaites*	3		—	
4. *Rugasaccites*	40		42·5	
5. *Rimospora*	7·5		5	
6. *Parasaccites*	5		6·5	
7. *Gondwanopollis*	2·5		0·5	
8. *Caheniasaccites*	—		1	
9. *Divarisaccus*	1·5		1·5	
10. *Stellapollenites*	—		3	
11. *Potonieisporites*	19		11·5	
12. *Vestigisporites*	—		1	
13. *Limitisporites*	4	Disaccates 9·5	0·5	Disaccates 11
14. *Sulcatisporites*	1·5		—	
15. *Lunatisporites*	3·5		3·5	
16. *Faunipollenites*	—		2·5	
17. *Striatites*	0·5		3	
18. *Strotersporites*	—		0·5	
19. *Verticipollenites*	—		—	

critical investigation is warranted to determine the trends of sculpture/structure within these genera which are otherwise allied to *Plicatipollenites* and *Potonieisporites*.

Some well preserved examples of *Stellapollenites* in the material confirm the amphilateral mode of saccus attachment as diagnosed by Lele (1965). The amendation of *Stellapollenites* by Kar (1969) is, therefore, found untenable.

Quantitative Aspects — In the total population of 19 genera and 32 species from the Mangthar section, the Talchir Boulder Bed shares 13 genera and 20 species while the overlying Needle Shale includes 17 genera and 24 species (Table 1). Eleven genera are common to the assemblages (Table 2). Taxa restricted to the Talchir Boulder Bed are *Katangaites* and *Sulcatisporites*, whereas those restricted to the Needle Shale are *Caheniasaccites*, *Stellapollenites*, *Vestigisporites* and *Faunipollenites*.

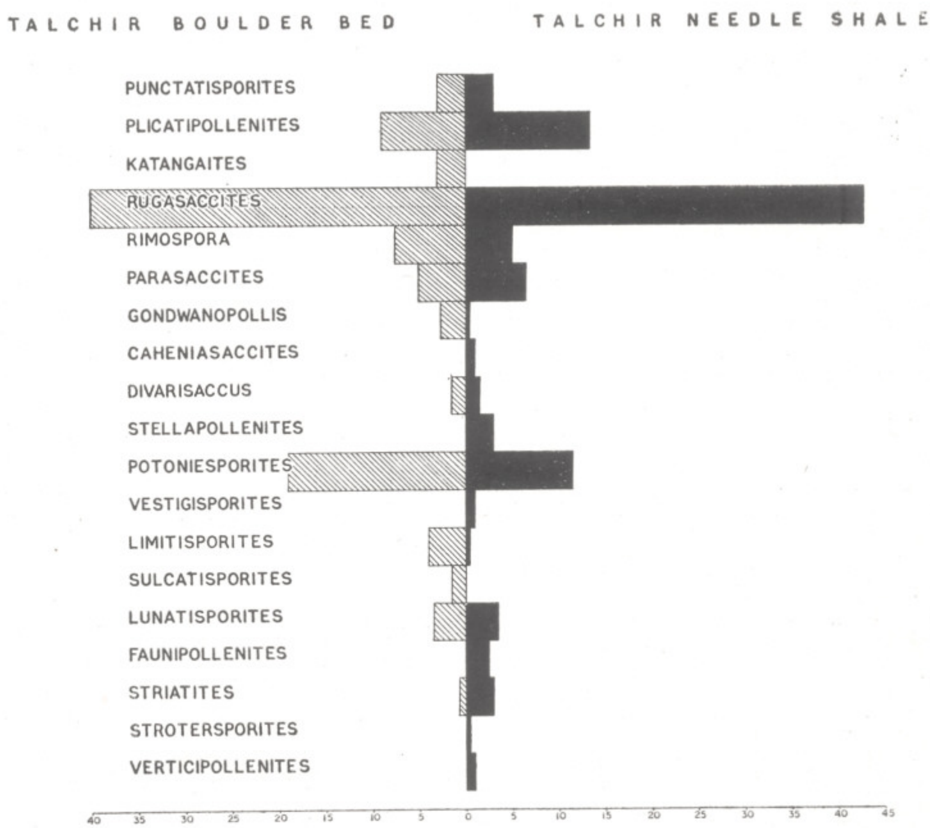
Quantitative assessment of genera (based on 200 counts; See Histogram 1) indicates that both assemblages are characterized by:

(a) the Dominance of *Rugasaccites*, *Potonieisporites*, *Plicatipollenites* and *Rimospora*.

(b) the Subdominance of *Parasaccites* and *Lunatisporites*

(c) Rare presence of *Punctatisporites* (or *Callumispora*) *Gondwanopollis* and *Striatites*.

In general both assemblages show overwhelming abundance of radial to bilateral monosaccate pollen making up to 86% of the total population (Histogram 2) Disaccates are subordinately represented (9·5-11%) and triletes are scanty (3%). Aletes, Monocolpates and Acritarchs have not been observed.



PERCENTAGE FREQUENCY OF GENERA IN THE TWO MIOSPORE ASSEMBLAGES

Erratum :

Read, POTONIEISPORITES for POTONIESPORITES

It is evident that the Talchir Boulder Bed and the overlying Needle Shale show close miofloristic relationship, especially in the common presence of all dominant and subdominant taxa (Tables 1 & 2). At the same time it may be noted that the number of genera slightly increases in the Talchir Needle Shale. Besides, *Limitisporites* appears to lend some peculiarity to the Boulder Bed mioflora as do *Vestigisporites* and *Stellapollenites* in the case of the Needle Shale. At any rate, it may be safely concluded that the Talchir Boulder Bed mioflora is continued up into the Needle Shale with only slight diversification.

Comparison — The only example of the Talchir Boulder Bed mioflora from the Jayanti Coalfield (Lele and Karim, 1971) may be compared with the Mangthar miospore assemblage in a very general way. Both miofloras show a similar preponderance of monosaccates, a subordinate representation of disaccates and the paucity of triletes. However, in the details of compositon the two miofloras are distinctly different.

The Jayanti mioflora is far more diversified (40 genera and 59 species) and shows a characteristic predominance of *Virkkipollenites*, *Plicatipollenites*, *Parasaccites*, *Vestigisporites* and *Potonieisporites*, along with the subdominant taxa *Caheniasaccites*, *Limitisporites* and *Vesicaspora*. About 22 taxa of the Jayanti assemblage were hitherto unknown in the Talchir miofloras elsewhere. On the contrary, the Mangthar mioflora shows a lower diversification and is characterized by the dominance of *Rugasaccites*, *Potonieisporites*, *Plicatipollenites* and *Rimospora*. Of these, *Rugasaccites* and *Rimospora* are very insignificant in the Jayanti mioflora. Conversely all the subdominant genera, except *Limitisporites*, in the Jayanti mioflora are missing from the Mangthar Boulder Bed. Similarly, monocolpates, aletes or leiospbaeres of the Jayanti assemblage are not found in the Mangthar mioflora.

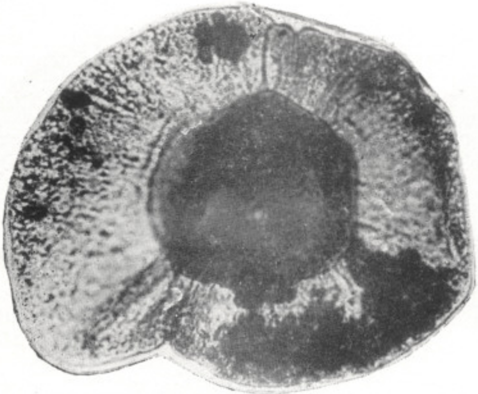
It is probable that the distinctive character of the Jayanti Boulder Bed mioflora may, among other factors, be due to its younger age as surmised by Lele & Karim (1971) on the basis of field and palynological evidences.

Other miofloras known from Giridih Coalfield, West Bokaro Coalfield (Lele, 1966) and from near Manendragarh (Lele & Chandra 1972) occur in the basal part of the Talchir formation in close stratigraphic proximity of the Talchir Boulder Bed as is also the case of the Talchir Needle Shale in the Mangthar section. These miofloras are rather poorly known and appear to contain more of the cosmopolitan genera like *Plicatipollenites*, *Virkkipolenites*, *Parasaccites* or *Potonieisporites*. None of them are so far known to show a dominance of *Rugasaccites* or *Rimospora* as in the case of the Mangthar mioflora. More critical re-examination of the basal Talchir miofloras of other regions is, therefore, very desirable.

A fairly rich miospore assemblage was described by Potonie and Lele (1961) from the siltstone and shale beds in the Upper part of the Talchir Stage near Goraia which lies few miles north of Mangthar (Text-fig. 1). Of the nearly 23 genera from the Goraia beds (Lele, 1966, Table 3) 8 genera are present in the Needle Shale at Mangthar. The Goraia mioflora is however, distinguishable by the prevalence of *Plicatipollenites*, *Virkkipollenites* (or *Parasaccites sensu* Bharadwaj, 1966 — Table 1) and *Faunipollenites* together with the significant presence of *Quadrisporites* and *Ginkgocycadophytus*. It is clear that the Mangthar Needle Shale mioflora is distinct in its dominant pollen association containing *Rugasaccites* and *Rimospora*. *Quadrisporites* and *Ginkgocycadophytus* are not known in the Mangthar Needle Shale and the triletes are much poorer in diversity and quantity as compared to those in the Goraia beds.

As regards other comparable assemblages from Gondwanaland countries, reference may be made to the Baccus Marsh Tillite assemblage of Australia (Virkki, 1946; Pant and Mehra, 1963) as well as to the mioflora from the Assise glaciares et periglaciares at Fundi Sadi, Congo (Bose and Maheshwari, 1966). Most of these assemblages, like the Mangthar mioflora show preponderance of monosaccates over other miospore groups.

In conclusion, it may be remarked that the findings of miofloras from the Talchir Boulder Beds in the Jayanti Coalfield and now in the Johilla Coalfield provide a substantial basis in favour of the view that the Glossopteris flora overlapped with the Gondwana glaciation during the Talchir Stage.



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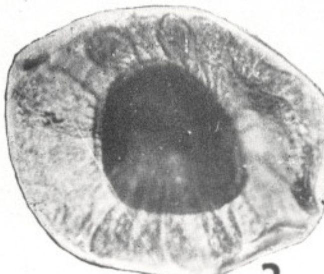

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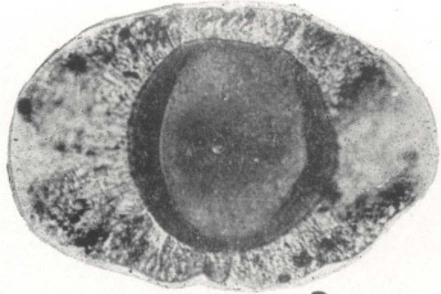

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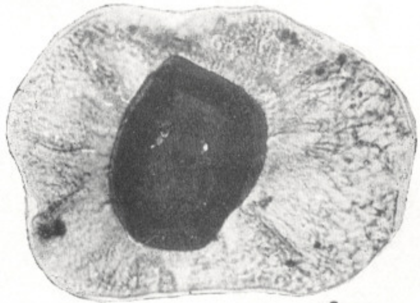

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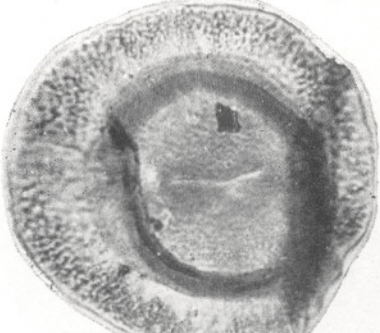

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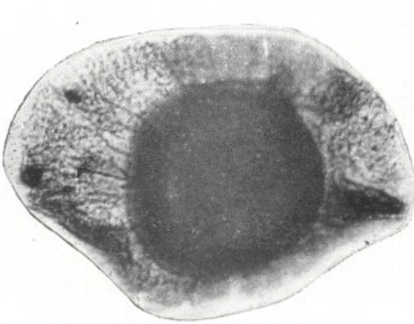

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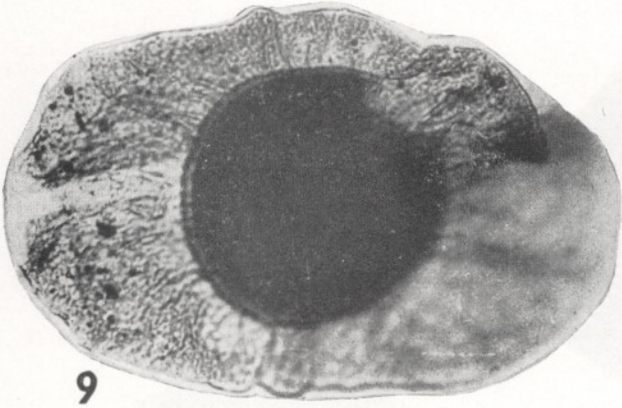
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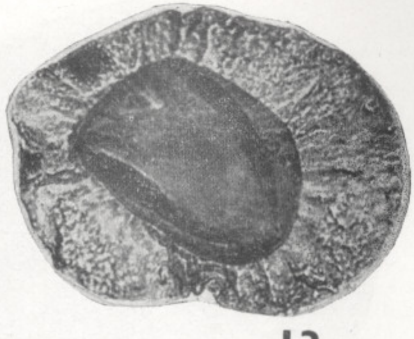
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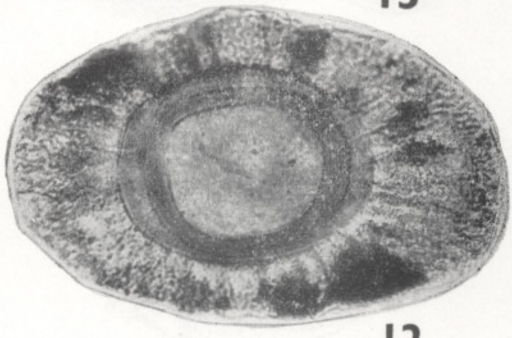
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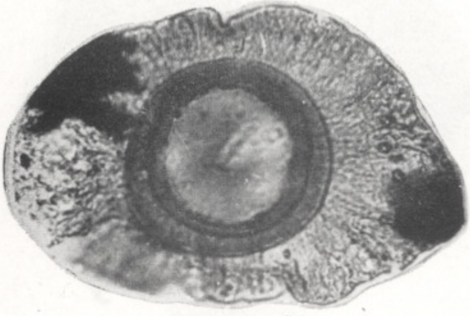
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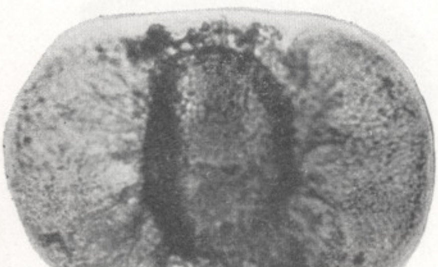
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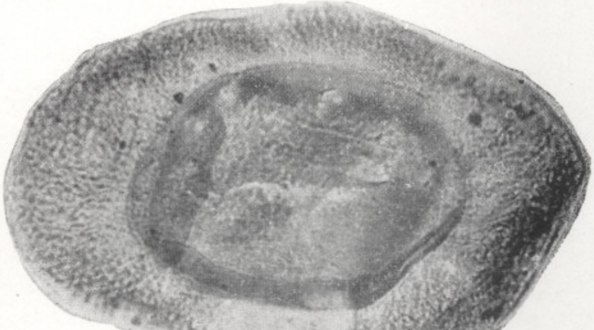
15

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EXPLANATION OF PLATES

(All photomicrographs are magnified 500 times)

PLATE 1

1, 2. *Katangaites ovatus* sp. nov. Slide Nos. 4310, 4312 (Holotype).

3, 4. *Rugasaccites densus* sp. nov. Slide Nos. 4310 (Holotype), 4312.

5, 6. *Rugasaccites triangulatus* sp. nov. Slide Nos. 4312 (Holotype), 4310.

7. *Rugasaccites orbiculatus* Lele & Maithy. Slide No. 4314.

8. *Gondwanopollis densus* sp. nov. Slide No. 4314.

PLATE 2

9. *Gondwanopollis densus* sp. nov. Slide No. 4312 (Holotype).

10. *Divarisaccus ovatus* sp. nov. Slide No. 4314 (Holotype).

11, 12. *Potoniéisporites crassus* sp. nov. Slide Nos. 4310 (Holotype), 4313.

13, 14. *Potoniéisporites mutabilis* sp. nov. Slide Nos. 4314, 4310 (Holotype).

15, 16. *Rimospora varia* sp. nov. Slide Nos. 4314 (Holotype), 4314.