MIOFLORAL TRANSITION AT RANIGANJ—PANCHET BOUNDARY IN EAST RANIGANJ COALFIELD AND ITS IMPLICATION ON PERMO-TARISSIC TIME BOUNDARY

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ABSTRACT

On the basis of palynostratigraphy of bore-cores from eatern-most part of the East Raniganj Coalfield the Raniganj/Panchet boundary has been narrowed down to a thickness of two meters. The striate-disaccate and *Densipollenites*-rich assemblage of the Raniganj Formation changes at the boundary level to a cavate-cingulate-taeniate-rich assemblage of the Panchet Formation. The change in the miofloral assemblages at this level is distinct and definite. The change in lithofacies also corroborates with the changes in the miofloral pattern, therefore the Permo-Triassic time boundary is indicated at the level of this alterations in palynological assemblage.

INTRODUCTION

The palynological investigation of two bore-cores, RAD-4 and RAD-5, is a part of our studies which are being continued in the eastern-most part of East Raniganj Coalfield, W. Bengal. The present communication adds significantly to the previously described miofloral successions (TIWARI, 1979; TIWARI & RANA, 1980; RANA & TIWARI, 1980; SINGH & TIWARI, 1981) in this area. It is more so because it reveals the Raniganj/Panchet transition as manifested in miofloral variation between the gap of two meter thickness of strata represented in the bore core RAD-5. Lithologically, the strata representing Raniganj Formation is 185 m and that of Panchet is 140.50 m thick in B. H. RAD-5; similarly in B. H. No. RAD-4, the Raniganj Formation is represented by 121.30 m thick sediments while the Panchet is 92.70 m.

The material was sent to us by the Coal Division II of GSI, Calcutta. The bore hole RAD-4 and RAD-5 are located off the G. T. Road, on northern side, nearly about 30 km west of Durgapur, West Bengal. They are separated from each other by a distance of 4 km. The samples analysed from these two bore holes are listed in table 1, where the yielding samples have been marked with an asterisk. Out of 110 samples, 43 yielded the miospores, but only 32 were found to be countable.

OBSERVATION

Bore-hole No. RAD-5

The samples in Bore-hole No. RAD-5 yielded better than those in Bore-hole No. RAD-4; therefore, the former makes the basis of present observation, although the general pattern of distribution is similar in both the bore-cores.

Histogram I depicts the litholog, the position of yielding samples as well as their miofloral contents. A perusal of this histogram clearly reveals that the samples can be grouped into two categories on the basis of the behaviour of the percentage frequency of different miospore genera.

Table 1—List of drill core samples (with depth in meters from surface) analysed during the present study. Yielding samples have been marked with asterisk. The detailed lithology is drawn in Text-fig. 1 for each level. The Lab. sample nos. are designated here as serial numbers.

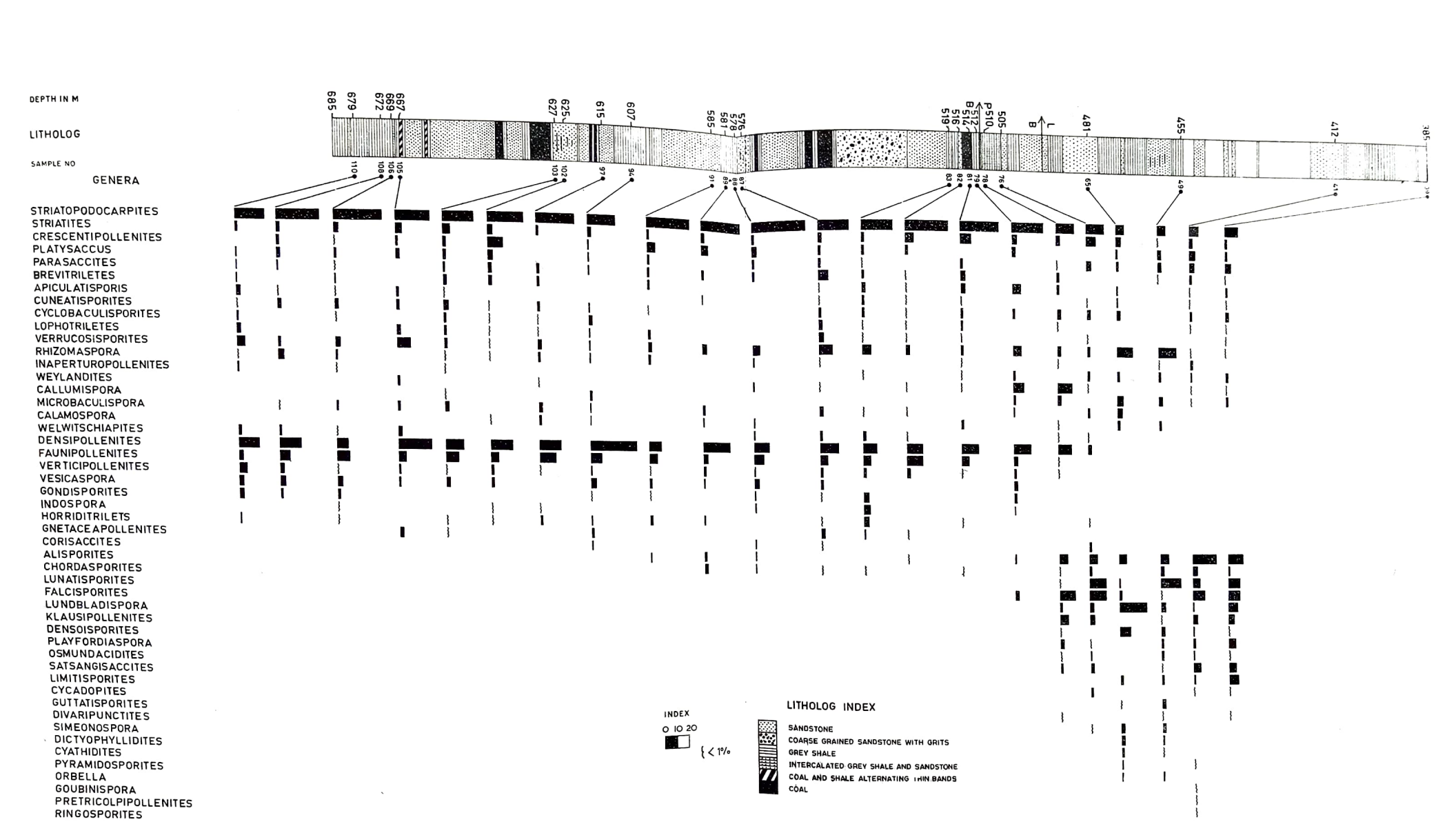
Borehole No. RAD-4.

1. RAD4-/324 m
2. ,, /326 m
3. ,, /328 m
4. ,, /330 m
5. ,, /332 m
6. ,, /364 m
7. ,, /366 m
8. ,, /368 m
9. ,, /370 m
10. ,, /372 m
11. ,, /373 m
12. ,, /375 m
*13. ,, /377 m
14. ,, /386 m
15. ,, /387 m
*16. ,, /388 m
*17. ,, /397 m
18. ,, /399 m
19. ,, /413 m
19a. ,, /416 m
— — —L. B.— — —
— — —P. B.— — —
*20. ,, /440 m
*21. ,, /443 m
*22. ,, /453 m
23. ,, /456 m
*24. ,, /458 m
25. ,, /472 m
26. ,, /474 m
27. ,, /476 m
28. ,, /518 m
29. ,, /520 m
30. ,, /522 m
31. ,, /524 m
32. ,, /528 m
*33. ,, /530 m
*34. ,, /532 m
35. ,, /536 m
*36. ,, /538 m

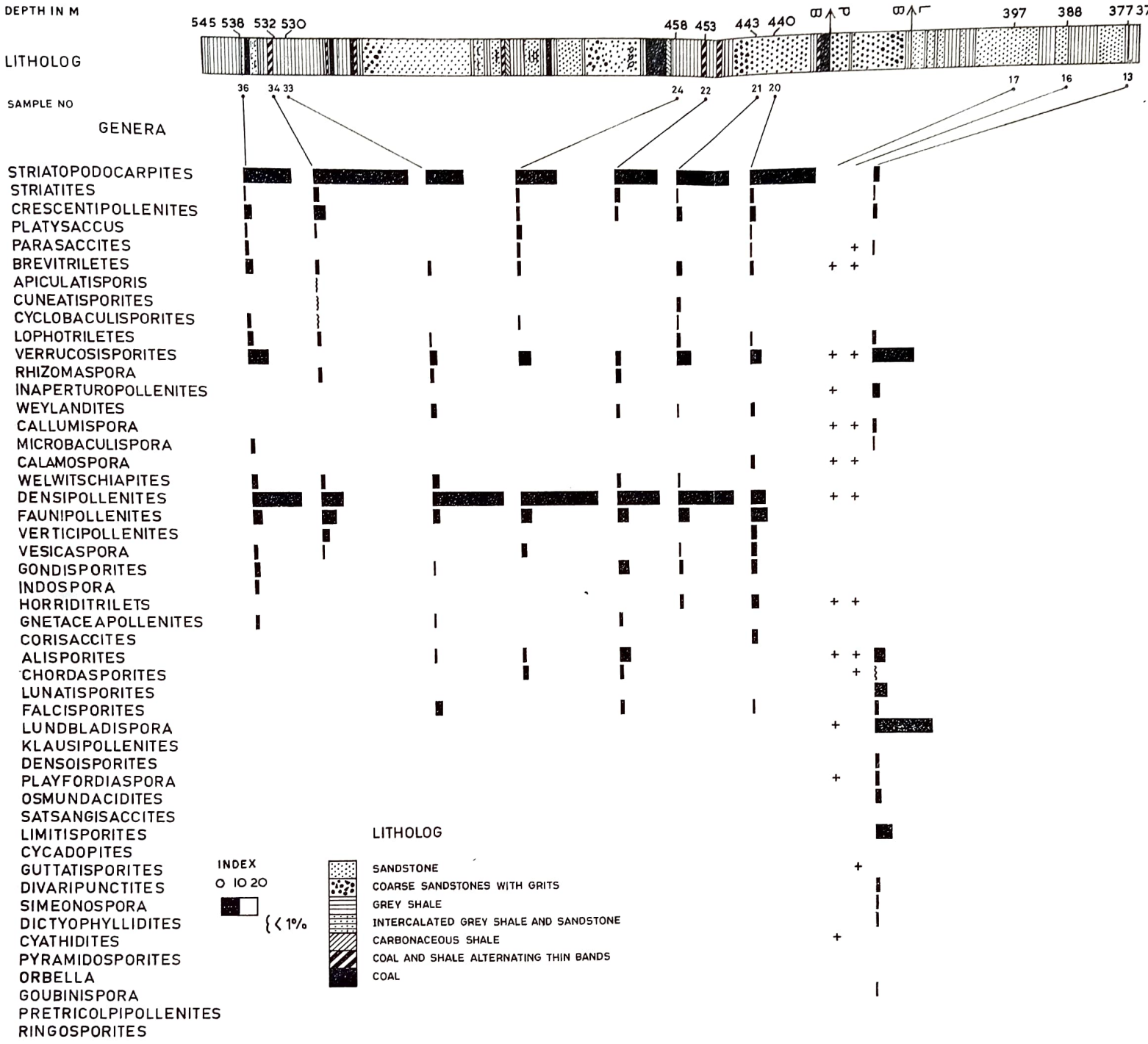
Borehole- No. RAD5.

37. RAD5 /353 m
38. ,, /366 m
*39. ,, /385 m
40. ,, /410 m
*41. ,, /412 m
42. ,, /428 m
43. ,, /430 m
44. ,, /434 m
45. ,, /443 m
46. ,, /446 m
47. ,, /447 m
*48. ,, /449 m
*49. , /455 m
50. ,, /456 m
*51. ,, /461 m
52. ,, /463 m
53. ,, /464 m
*54. ,, /465 m
55. ,, /467 m
56. ,, /469 m
57. ,, /470 m
58. ,, /471 m
59. ,, /472 m
60. ,, /473 m
61. ,, /474 m
62. ,, /475 m
63. ,, /477 m
64. ,, /480 m
*65. ,, /491 m
66. ,, /484 m
67. ,, /489 m
68. ,, /490 m
69. ,, /492 m
70. ,, /493 m
— — — L. B — — —
71. ,, /494 m
72. ,, /496 m
73. ,, /500 m
74. ,, /502 m
75. ,, /503 m
*76. ,, /505 m
77. ,, /508 m
*78. ,, /510 m
— — — P. B — — —
*79. ,, /512 m
*80. ,, /513 m
*81. ,, /514 m
*82. ,, /516 m
*83. ,, /519 m
84. ,, /521 m
85. ,, /531 m
86. ,, /574 m
*87. ,, /576 m
*88. ,, /578 m
*89. ,, /581 m
90. ,, /583 m
*91. ,, /585 m
*92. ,, /603 m
*93. ,, /605 m
*94. ,, /607 m
*95. ,, /612 m
*96. ,, /613 m
*97. ,, /615 m
98. ,, /617 m
*100. ,, /618 m
*101. ,, /623 m
*102. ,, /625 m
*103. ,, /627 m
*104. ,, /660 m
*105. ,, /667 m
*106. ,, /669 m
107. ,, /670 m
*108. ,, /672 m
109. ,, /675 m
*110. ,, /679 m

L. B.—Lithological boundary
P. B.—Palynological boundary


DEPTH IN M
LITHOLOG
SAMPLE NO
GENERA
STRIATOPODOCARPITES
STRIATITES
CRESCENTIPOLLENITES
PLATYSACCUS
PARASACCITES
BREVITRILETES
APICULATISPORIS
CUNEATISPORITES
CYCLOBACULISPORITES
LOPHOTRILETES
VERRUCOSISPORITES
RHIZOMASPORA
INAPERTUROPOLLENITES
WEYLANDITES
CALLUMISPORA
MICROBACULISPORA
CALAMOSPORA
WELWITSCHIAPITES
DENSIPOLLENITES
FAUNIPOLLENITES
VERTICIPOLLENITES
VESICASPORA
GONDISPORITES
INDOSPORA
HORRIDITRILETS
GNETACEAPOLLENITES
CORISACCITES
ALISPORITES
CHORDASPORITES
LUNATISPORITES
FALCISPORITES
LUNDBLADISPORA
KLAUSIPOLLENITES
DENSOISPORITES
PLAYFORDIASPORA
OSMUNDACIDITES
SATSANGISACCITES
LIMITISPORITES
CYCADOPITES
GUTTATISPORITES
DIVARIPUNCTITES
SIMEONOSPORA
DICTYOPHYLLIDITES
CYATHIDITES
PYRAMIDOSPORITES
ORBELLA
GOUBINISPORA
PRETRICOLPIPOLLENITES
RINGOSPORITES
685
679
669
672
667
627
625
615
607
585
581
576
519
516
512
B
P510
505
L
B
481
455
412
385
INDEX
0 10 20
< 1%
LITHOLOG INDEX
SANDSTONE
COARSE GRAINED SANDSTONE WITH GRITS
GREY SHALE
INTERCALATED GREY SHALE AND SANDSTONE
COAL AND SHALE ALTERNATING THIN BANDS
COAL

HIST. I


DEPTH IN M
545 538 532 530
458 453 443 440
397 388 377 375
LITHOLOG
SAMPLE NO
36 34 33 24 22 21 20 17 16 13
GENERA
STRIATOPODOCARPITES
STRIATITES
CRESCENTIPOLLENITES
PLATYSACCUS
PARASACCITES
BREVITRILETES
APICULATISPORIS
CUNEATISPORITES
CYCLOBACULISPORITES
LOPHOTRILETES
VERRUCOSISPORITES
RHIZOMASPORA
INAPERTUROPOLLENITES
WEYLANDITES
CALLUMISPORA
MICROBACULISPORA
CALAMOSPORA
WELWITSCHIAPITES
DENSIPOLLENITES
FAUNIPOLLENITES
VERTICIPOLLENITES
VESICASPORA
GONDISPORITES
INDOSPORA
HORRIDITRILETS
GNETACEAPOLLENITES
CORISACCITES
ALISPORITES
CHORDASPORITES
LUNATISPORITES
FALCISPORITES
LUNDBLADISPORA
KLAUSIPOLLENITES
DENSOISPORITES
PLAYFORDIASPORA
OSMUNDACIDITES
SATSANGISACCITES
LIMITISPORITES
CYCADOPITES
GUTTATISPORITES
DIVARIPUNCTITES
SIMEONOSPORA
DICTYOPHYLLIDITES
CYATHIDITES
PYRAMIDOSPORITES
ORBELLA
GOUBINISPORA
PRETRICOLPIPOLLENITES
RINGOSPORITES
INDEX
0 10 20
< 1%
LITHOLOG
SANDSTONE
COARSE SANDSTONES WITH GRITS
GREY SHALE
INTERCALATED GREY SHALE AND SANDSTONE
CARBONACEOUS SHALE
COAL AND SHALE ALTERNATING THIN BANDS
COAL

HIST. II

Group I—This group includes Sample Nos. 110, 108, 106, 105, 103, 102, 97, 94, 91, 89, 88, 87, 83, 82, 81, 79, ranging in depth from 679 to 512 meters.

Quantitatively important genera represented in this group of samples are:

Striatopodocarpites—dominant

Densipollenites—subdominant

Faunipollenites—subdominant

Other well-represented forms are :

Crescentipollenites, Verrucosisporites, Verticipollenites.

Beside the above forms, following genera which are established for characterising the Raniganj Formation are present in the Group I : *Brevitriletes, Apiculatisporis, Cyclobaculisporites, Vesicaspora, Gondisporites, Indospora.* The occurrence of these genera in their quantitative pattern determines that they are of Raniganj age (BHARADWAJ, 1962; BHARADWAJ & SALUJHA, 1965).

In this group of samples (i. e., in the Group I) the older samples are more or less uniform in their contents of the taxa, but the younger samples of the Group start showing the definite presence of certain genera, such as—*Inaperturopollenites, Weylandites, Alisporites, Chordasporites, Satsangisaccites,* which in the overlyirg group of samples (i. e. Group II) become more pronounced. This implies that a character of transition has set in the Sample No. 79—the top-most sample of Group I—which expresses its own character fully in the still younger horizon, which is overlying the Group I.

Group II

This group includes Sample Nos. 78, 76, 65, 51, 49, 48, 41, 39 ranging in depth from 510-385 meters. Quantitatively important genera represented in this group of samples are :

Falcisporites, Lundbladispora, Lunatisporites, Alisporites, Densoisporites, Weylandites, Verrucosisporites.

Individually these genera are not dominant in each sample but they record their prominence in one or the other sample, as shown in the Histogram I.

The additional genera qualifying this group of samples are :

Ringosporites, Goubinispora, Orbella, Pyramidosporites, Simeonospora, Guttatisporites, Playfordiaspora, Klausipollenites, etc.

The overall composition is definite indicative of Triassic age for this level of the strata in this bore core.

A closer comparison with the known Permo-Triassic palynological literature (MAHESHWARI & BANERJEE, 1975; TIWARI & RANA, 1980; RANA & TIWARI, 1980; SINGH & TIWARI, 1982 ; BHARADWAJ, TIWARI & ANAND-PRAKASH, 1979) has revealed that the level of samples in Group II being discussed here, belongs to the Lower Panchet Formation.

Histogram I—Percentage frequency of important miospore genera through the run of Bore-hole RAD-5

Histogram II—Percentage frequency of important miospore genera through the run of Bore-hole RAD-4.

A detailed analysis indicates that Group II can be further subdivided in to 5 sub-groups, from bottom to top, as follows (Histogram 1, Text-fig. 1) :

II-a : (Sample No. 78; Depth 510 m) characterised by—*Falcisporites, Densipollenites, Weylandites, Alisporites.*

II-b : (Sample No. 76; Depth 505 m) prominent genera are—*Falcisporties, Lunatisporites, Densipollenites, Alisporites.*

II-c : (Sample Nos. 65, 51; Depth 481 m, 461 m) prominent genera are *Lundbladispora, Verrucosisporites, Densoisporites.*

II-d : (Sample Nos. 49, 48; Depth 455 m, 449 m) important genera in this sub-group are—*Lunatisporites, Verrucosisporites, Alisporites.*

II-e : (Sample No. 41, 39; Depth 412 m, 385 m) prominent forms are—*Alisporites, Lunatisporites, Falcisporites, Lundbladispora.*

The above pattern shows a changing combination of prominent genera in the Triassic samples. This reflects quicker changes at this level of strata in this bore core.

Bore-hole No. RAD-4

The samples yielded from this bore-core represent a strata between 530 to 375 m. Out of 37 samples only 10 samples were found to be productive; hence, the representation is sparse. However, for general comparison, this data is also useful.

The palynological assemblages in this bore-core can be divided into two groups:

Group A

This group of samples includes Sample Nos. 36, 34, 33, 24, 22, 21, 20 ranging in depth from 538 to 440 meters (Histogram-II).

Quantitatively, the genera *Striatopodocarpites, Densipollenites, Faunipollenites, Crescentipollenities,* and *Verrucosisporites* are fairly well-represented genera. Qualitatively important miospore genera are—*Indospora, Gondisporites, Horriditriletes, Corisaccites.*

In some of the samples at the younger level of this group (e. g. Sample Nos. 22, 21, 20) few genera, which express their prominence in the Group B, start their appearance; such forms are—*Chordasporites, Lunatisporites, Falcisporites, Alisporites,* etc.

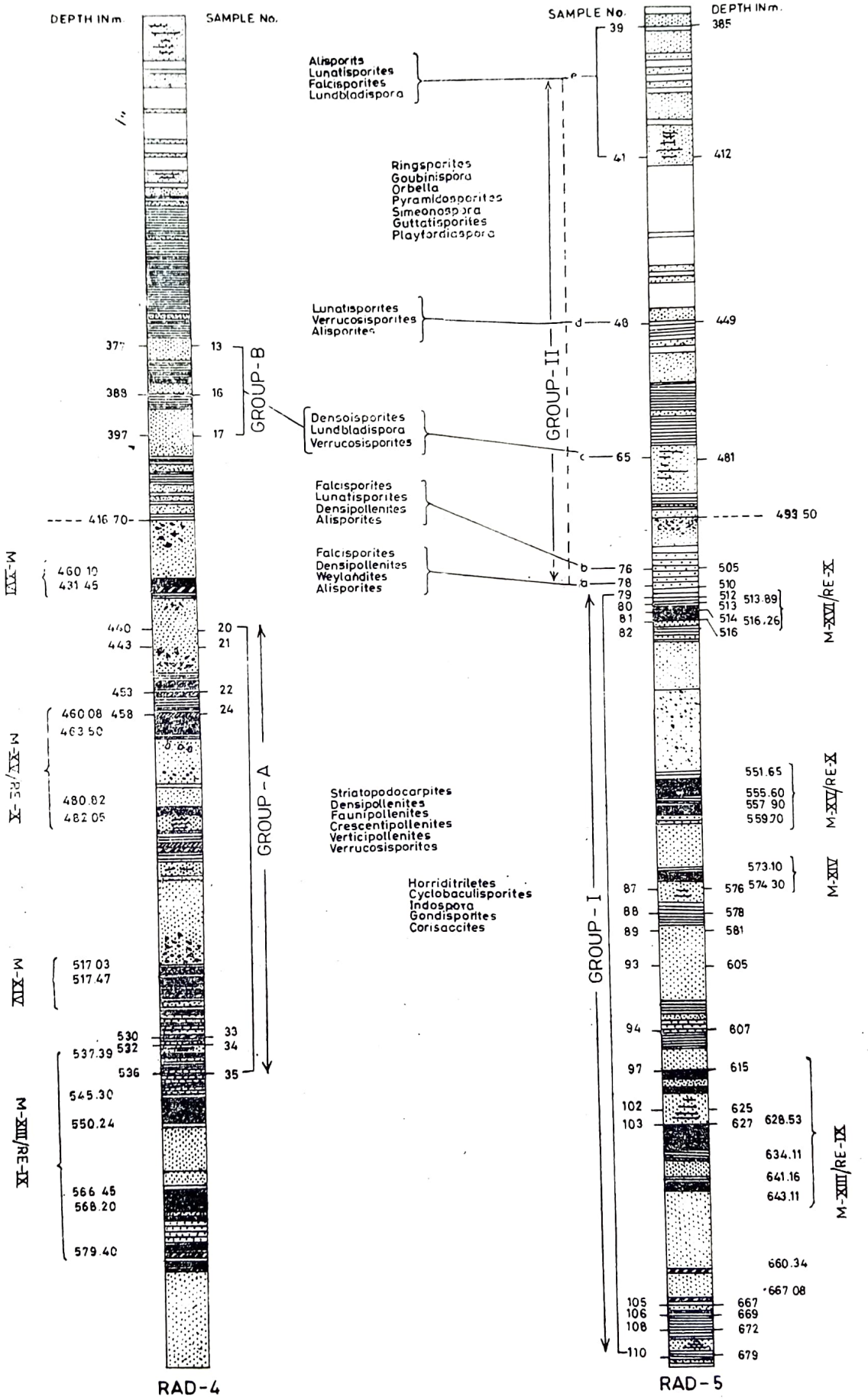
The total characteristic behaviour of the Group A of Bore-hole RAD-4 correlates with Group I of Bore-hole RAD-5.

Group B

The following samples have been put under this group: Sample Nos. 17, 16, 13 representing the strata between depth level 397-377 m. The numerically important genera are—*Verrucosisporites, Lundbladispora, Densoisporites, Limitisporites,* etc. (Histogram-II).

Other qualitatively significant forms are—*Goubinispora, Simeonospora, Playfordiaspora.*

In Sample Nos. 16 and 17, only presence of the miospore genera has been noted because the number of specimens is very small. Even then, they show a clear affinity



Text-fig 1. Comparative display of the lithological as well as palynological characteristics at the Raniganj/Panchet boundary in Bore Holes RAD-4 and RAD-5. Lithologs of two bore-cores have been reproduced after GSI. Index for lithology—as in Histogram I.

with Group B; these samples (i. e. 16 & 17) also contain *Densipollenites* which is absent from Sample No. 13, the youngest of the sequence.

Permo-Triassaic Boundary

The lithostratigraphic boundary between Raniganj and Panchet strata in Bore-hole RAD-5 is at the depth level 493.50 m (Text-fig.1) where the end of the coarse-grained sandstone above the seam XVI marks the demarcation. However, palynologically there is a shift in the boundary; the floral change is between 510 and 512 m depth level (Histogram-1). That means, there is a shift of about 17 meter downwards. The flora changes almost immediately above the seam XVI in this core.

In Bore-hole RDA-4, the lithological boundary drawn is at the depth level 416.17 (Text-fig. 1). The precise palynological level cannot be marked here because of the non-yielding nature of samples between 440 and 397 m depth-level (Histogram-II). Even then, the trends are similar to those in the bore hole RAD-5, and the palynological boundary could presumably be at 426 m level, i. e. slightly above the seam no XVI. This observation corroborates with that in the bore hole RAD-5.

Correlation

Between bore-cores RAD-4 and RAD-5 distinct palynological correlation has been established as depicted in Text-fig. 1. There is a relationship between Group I and Group A as well as between Group II and Group B of the bore cores RAD-5 and RAD-4, respectively.

CONCLUSION

The most important outcome of this study is that the Raniganj-Panchet boundary is narrowed down to a 2-meter-thick strata. Palynologically, the change is clear cut but not drastic. It is gradual, definite and distinct. The older taxa linger on into the Triassic sediments but the new genera appear and slowly gain prominence. There seems to be no gap or a hiatus in sedimentation at the Permo-Triassic boundary level as is evident from the pollen-spore spectrum as well as lithology in Bore hole RAD-5. The slight discrepancy in the palynological *vis-a-vis* lithological changes is interesting to note. It implies that with the change in climatic condition the flora has altered but the area of provenance or the geological set up of the basin changed a little later. This broader coincidence of the lithological boundary and the biostratigraphic (i. e. palynological) boundary suggests that this level of Raniganj/Panchet boundary represents a time boundary, i. e. the Permo-Triassic boundary. This contention is further supported by a clearcut qualitative change in the pollen-spore flora, an evidence of alteration in the totality of palaeoclimatological as well as floral evolutionary aspect of the set up.

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Table 2—Relative occurrence of some important miospore genera in B. H. RAD-5 & RAD-4, in the Raniganj and Panchet formations.

LOWER PANCHET

Prominent genera

Falcisporites Lesch. emend. Klaus, 1963

Lundbladispora Balme emend. Playf., 1965

Lunatisporites Lesch. emend. Bharad., 1974

Alisporites Janson., 1971

Densoisporites Wey. & Krieg. emend., Dettm., 1963

Weylandites Bharad. & Sriv., 1969

Verrucosisporites Ibr. emend. Smith *et al.*, 1967

Densipollenites Bharad., 1962

Satsangisacites Bharad. & Sriv., 1969

Other genera

Ringosporites Tiw. & Rana, 1980

Goubinispora Tiw. & Rana, 1980

Orbella Maljavkina, 1949

Pyramidosporites Segrove, 1967

Simeonospora Balme, 1970

Guttatisporites Visscher, 1966

Playfordiaspora Maheshw. & Baner., 1975

Klausipollenites Janson., 1962

BOUNDARY

RANIGANJ

Prominent genera

Striatopodocarpites Sedova, 1956

Densipollenites Bharad., 1962

Faunipollenites Bharad., 1962

Crescentipollenites Bharad., Tiw. & Kar, 1974

Verrucosisporites Ibr. emend. Smith *et al.*, 1967

Verticipollenites Bharad., 1962

Other genera

Brevitriletes Bharad. & Sriv. emend. Tiw. & Rana, 1981

Apiculatisporis Pot. & Kr., 1954

Cyclobaculisporites Bharad., 1962

Vesicaspora Schemel emend. Wils. & Venkatach., 1963

Gondisporites Bharad., 1962

Indospora Bharad., 1962

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EXPLANATION OF PLATES

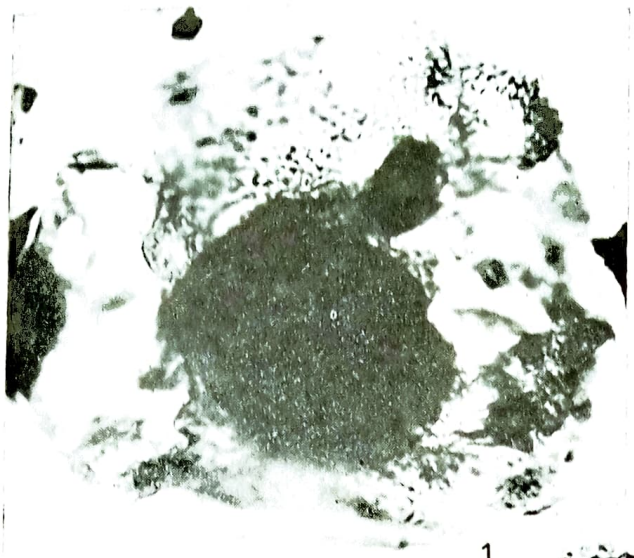
(All figures ca ×750).

Plate 1

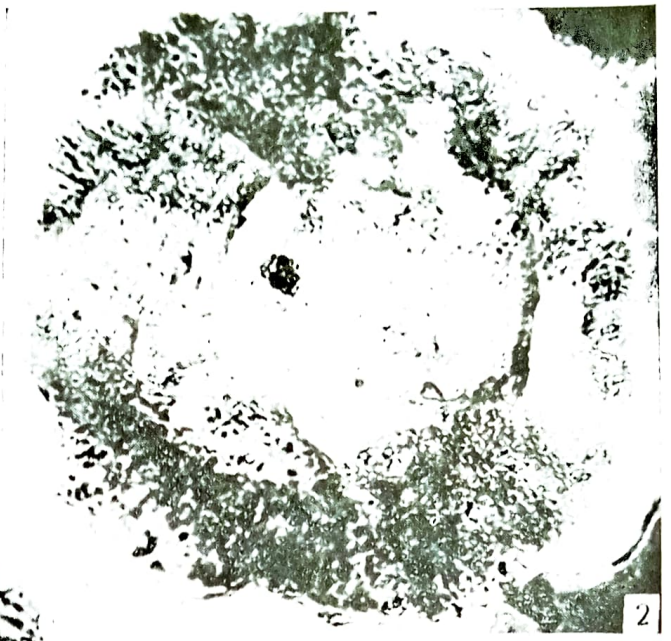
1. *Densipollenites* Film No. 124/2, Lab sample No. 102; B. H. RAD-5/625m; Sl.1, BSIP No. 8074
2. *Striamonosaccites* Film No. 122/13, Lab sample No. 39; B. H. RAD-5/385 m; Sl. 1, BSIP No. 8076.
3. *Brevitriletes* Film No. 123/31, Lab sample No. 93; B. H. RAD-5 605 m; Sl. 1, BSIP No. 8077.
4. *Guttulapollenites* Film No. 123/21, Lab sample No. 87; B.H. RAD-5/576 m; Sl.2, BSIP No. 8078
5. *Tiwariasporis* Film No. 123/24, Lab sample No. 87; B. H. RAD-5/576 m; Sl.3, BSIP No. 8079
6. *Cyclogranisporites* Film No. 123/16, Lab sample No. 87; B. H. RAD-5/576 m; Sl.1, BSIP No. 8080.
7. *Indospara* Film No. 124/31, Lab sample No. 100; B. H. RAD-5/618 m; Sl.2, BSIP No. 8081.
8. *Gondisporites* Film No. 123/12, Lab sample No. 83; B. H. RAD85/519 m; Sl.1, BSIP No. 8082
9. *Indotriradites* Film No. 122/19, Lab sample No. 41; B. H. RAD-5/412 m; Sl.1, BSIP No. 8083

Plate 2

10. *Distriomonocolpites* Film No. 123/17, Lab sample No. 87; B. H. RAD-5/576 m; Sl. 1, BSIP No. 8080.
11. *Goubinispora* Film No. 122/18, Lab sample No. 41; B. H. RAD-5/412 m; Sl. 1, BSIP No. 8083.
12. *Playfordiaspora* Film No. 124/14, Lab sample No. 39; B. H. RAD-5/385m; Sl 2, BSIP No. 8076.
13. *Lundbladispora* Film No. 122/6, Lab sample No. 39; B. H. RAD-5/385 m; Sl. 1, BSIP No. 8075.
14. *Concavisporites* Film No. 122/11, Lab sample No. 39; B. H. RAD-5/385 m; Sl. 1, B. SIP No. 8075.
15. *Falcisporites* Film No. 122/14, Lab sample No. 41; B. H. RAD-5/412 m; Sl. 1, BSIP No. 8083
16. *Cyathidites* Film No. 122/27, Lab Sample No. 49; B. H. RAD-5/455 m; Sl. 1, BSIP No. 8085.
17. *Lycopodiumsporites* Film No. 124/17, Lab sample No. 39; B. H. RAD-5/385 m; Sl. 2, BSIP No. 8076.
18. *Dictyophyllidites* Film No. 123/5, Lab sample No. 65; B. H. RAD-5/481 m; Sl. 1, BSIP No. 8086.
19. *Densoisporites* Film No. 121/25, Lab sample No. 39; B. H. RAD-5/385 m; Sl. 1, BSIP No. 8075.
20. *Ringosporites* Film No. 122/20, Lab sample No. 41; B. H. RAD-5/412 m: Sl. 2, BSIP No. 8084.



1



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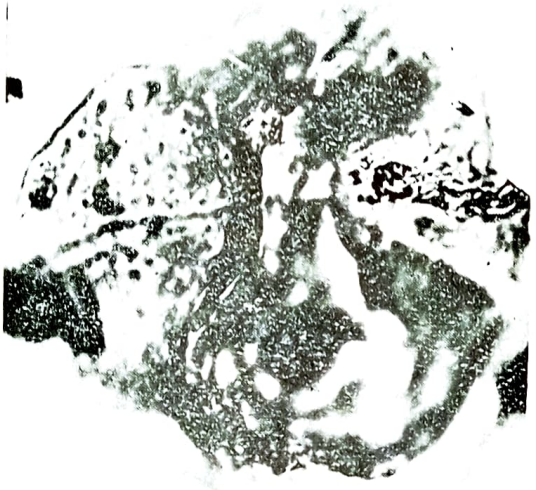

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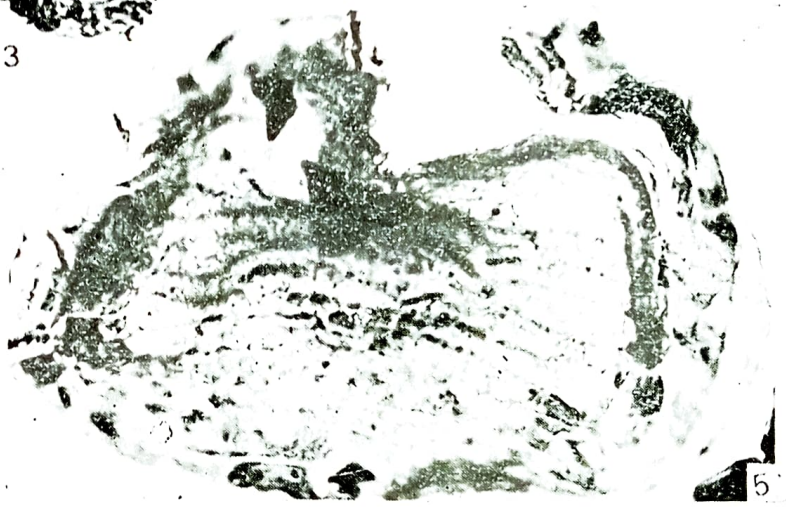

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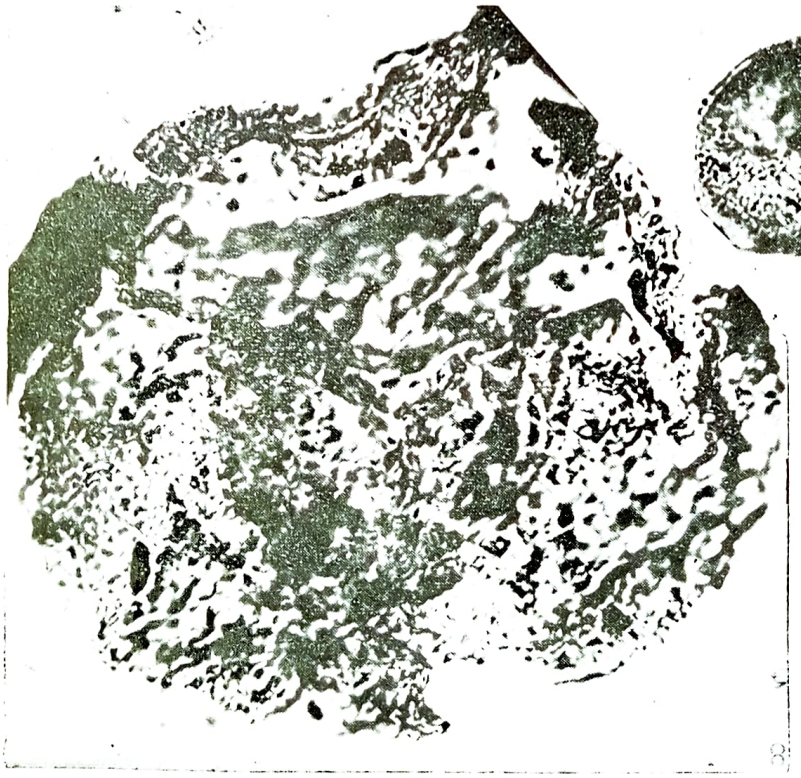

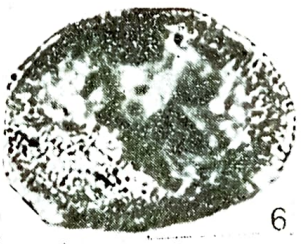

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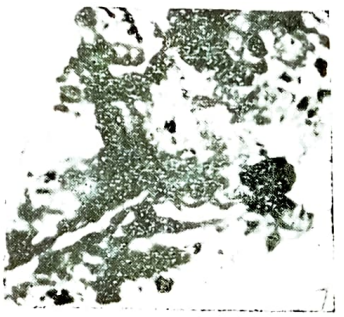

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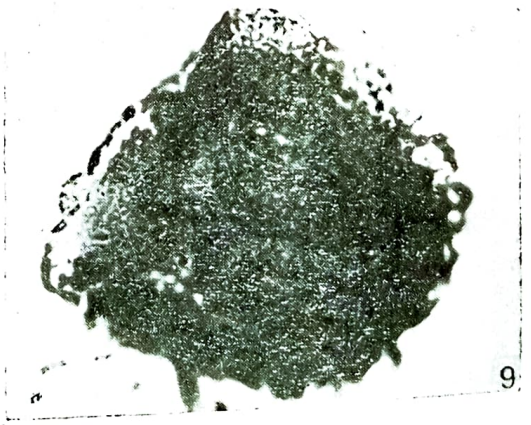

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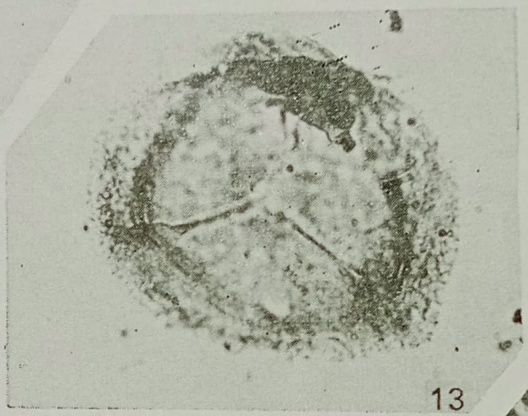
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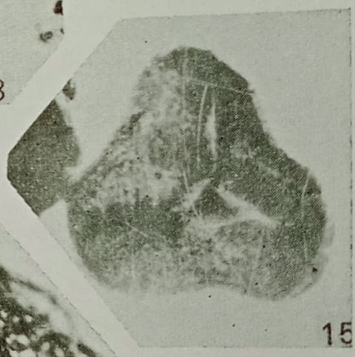
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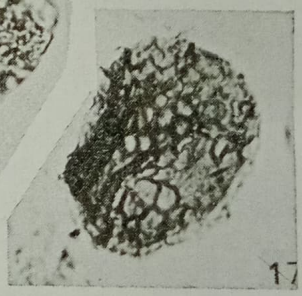
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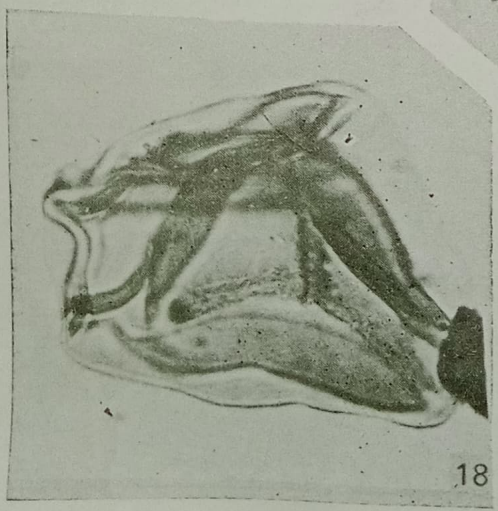
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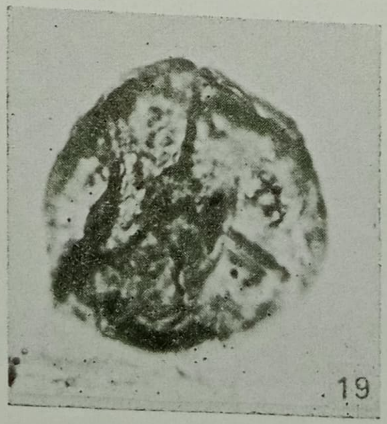
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Tiwari & Singh—Plate 2