

# PALYNOLOGY OF THE NORTH KARANPURA BASIN, BIHAR, INDIA. 4. SUBSURFACE PALYNOLOGY OF THE BORE-HOLE NO. K.5

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## ABSTRACT

The present paper deals with subsurface Palynology of Barakar Stage and Barren Measures present in the bore-hole no. K.5, located in the Baral-Raniganj-Kevendai area, North Karanpura basin (Sheet no. 73E/1), Bihar, India. 34 dispersed spore-pollen genera and 39 species have been recovered from Barakar Stage while Barren Measures have yielded 51 genera and 67 species. The palynological assemblage of both Stages comprises trilete, monolete, monosaccate, bisaccate, polysaccate, poly-plicate and colpate spores-pollen. The palynological assemblage of Barren Measures have been subdivided into three palynological zones on the basis of percentage of spores-pollen in the material.

## INTRODUCTION

**P**ALYNOLOGICAL assemblage of the Karanpura basin has been investigated by Bhattacharya, Raychowdhury and Datta (1957), Banerjee (1958), Bhara-dwaj and Tiwari (1966) and Venkatachala and Kar (1964, 1965, 1966, 1968a-b). The present paper deals with the subsurface palynology of the bore-hole No. K.5 located in the Baral-Raniganj-Kevendai area, North Karanpura basin (Sheet No. 73E/1). The

core was kindly supplied by the Geological Survey of India comprising Barakar, Barren Measures and Raniganj Stages. The Barakar Stage is represented by the sample Nos. BM. 196-BM. 214, Barren Measures by sample Nos. BM. 13-BM. 195 and Raniganj Stage by the sample Nos. BM. 1-BM. 12.

15-25 grams of material from each sample was macerated; but only sample No. BM. 202 yielded a respectable amount of spores and pollen grains of Barakar Stage. In the samples from BM. 209-211 they are very scanty while the rest of the samples turned to be barren. The maceration was done in commercial Nitric acid (40%) by standing the material from 3-7 days followed by a treatment with Potassium hydroxide solution (4%) for 3 minutes after washing the digested material several times in water. Siliceous elements in the macerates were dissolved with Hydrofluoric acid (40%) by keeping the material for 3-5 days. The slides were prepared with Polyvinyl alcohol and mounted in Canada balsam. The unused material and the slides have been deposited at the repository of the Birbal Sahni Institute of Palaeobotany, Lucknow.

The lithology of Barakar Stage supplied by the Geological Survey of India is as follows:

<i>Sample No.</i>	<i>From</i>	<i>To</i>	<i>Description</i>
BM. 196	326-70	326-80 metres	Medium-grained sandstone with shale bands.
BM. 197	327-40	327-50 "	Medium-grained sandstone with shale bands.
BM. 198	328-10	328-20 "	Medium-grained sandstone with shale bands.
BM. 199	328-80	328-90 "	Medium-grained sandstone with shale bands.
BM. 200	329-50	329-60 "	Alternate shale and sandstone bands.
BM. 201	330-00	330-10 "	Fine-grained sandstone with shale bands.
BM. 202	330-50	330-60 "	Grey sandy shale.

Sample No.	From	To	Description
BM. 203	331.00	331.10 metres	Alternate bands of shale and sandstone.
BM. 204	331.50	331.60 "	Medium-grained sandstone with shale bands.
BM. 205	332.00	332.10 "	Medium-grained sandstone with shale bands.
BM. 206	332.50	332.60 "	Alternate bands of shale and sandstone.
BM. 207	333.00	333.10 "	Medium-grained sandstone.
BM. 208	333.50	333.60 "	Coarse-grained gritty sandstone.
BM. 209	334.10	334.20 "	Grey sandy shale.
BM. 210	334.60	334.70 "	Grey sandy shale.
BM. 211	335.10	335.20 "	Grey sandy shale.
BM. 212	335.60	335.70 "	Fine-grained sandstone with shale bands.
BM. 213	336.10	336.20 "	Medium-grained sandstone with shale bands.
BM. 214	337.20	337.30 "	Medium-grained sandstone with shale bands.

#### SYSTEMATIC PALYNOLOGY

The dispersed spore-pollen genera and the species recovered from Barakar Stage have been arranged systematically as follows:

1. *Punctatisporites gretensis* Balme & Hennel., 1956.

2. *Apiculatisporis levis* Balme & Hennel., 1956.

3. *Cyclogranisporites gondwanensis* Bharad. & Sal., 1964.

4. *Lophotriletes rectus* Bharad. & Sal., 1964.

5. *Laevigatosporites colliensis* (Balme & Hennel.) Venkat. & Kar., 1968a.

6. *Punctatosporites dulcis* Venkat. & Kar., 1968a.

7. *Virkkipollenites obscurus* Lele, 1964.

8. *Venkatachalaites baralensis* Kar, 1968.

9. *Barakarites dubius* Venkat. & Kar., 1968b.

10. *Parasaccites bilateralis* Tiw. 1965.

11. *Densipollenites indicus* Bharad. 1962.

12. *Divarisaccus lelei* Venkat. & Kar., 1966a.

13. *Striomonosaccites ovatus* Bharad., 1962.

14. *Cuneatisporites* sp. Venkat. & Kar., 1968a.

15. *Striatites alius* Venkat. & Kar., 1968a.

16. *S. tectus* Venkat. & Kar., 1968a.

17. *Verticipollenites secretus* Bharad., 1962.

18. *Lahirites navicula* Venkat. & Kar., 1968b.

19. *Hindipollenites formosus* Venkat. & Kar., 1968a.

20. *Strotersporites decorus* (Bharad. & Sal.) Venkat. & Kar., 1964a.

21. *S. diffusus* (Bharad. & Sal.) Venkat. & Kar., 1964a.

22. *S. lentisaccatus* Kar, 1968.

23. *Strotersporites* sp. Venkat. & Kar., 1968a.

24. *Striatopiceites minutus* Venkat. & Kar., 1968a.

25. *S. digredius* Kar, 1968.

26. *S. rimosus* Venkat. & Kar., 1968b.

27. *Chatterjeeapollis minutosaccus* Kar (in press).

28. *Schizopollis disaccoidis* Venkat. & Kar., 1964b.

29. *Corisaccites alutas* Venkat. & Kar., 1966b.

30. *Rhizomaspora costa* Venkat. & Kar., 1968b.

31. *Hamiapollenites incestus* Venkat. & Kar., 1968a.

32. *Sulcatisporites ovatus* Bharad., 1962.

33. *Labiisporites nectus* Venkat. & Kar., 1968b.

34. cf. *Crustaesporites* sp.

35. *Guttulapollenites hannonicus* (Goub.) Venkat., Goub. & Kar., 1967.

36. *Striasulcites tectus* Venkat. & Kar., 1968b.

37. *Gnetaceapollenites punctatus* Venkat. & Kar., 1968a.

38. *Welwitschiapites tenuis* Bharad. & Sal., 1964.

39. *Ephedripites dentatus* Kar, 1968.

40. *Boutakoffites quibus* Bose & Kar, 1966.

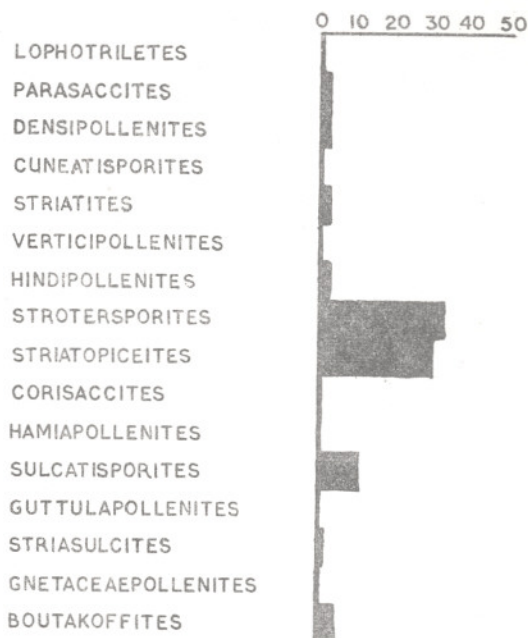
PALYNOLOGICAL ASSEMBLAGE

Only the sample No. BM. 202 was counted (upto 200) in Barakar and the various genera found in the counting are given below with their respective percentage (see TEXT-FIGS. 1 & 2).

<i>Lophotriletes</i>	... 1%
<i>Parasaccites</i>	... 3%
<i>Densipollenites</i>	... 3%
<i>Cuneatisporites</i>	... 1%
<i>Striatites</i>	... 3%
<i>Verticipollenites</i>	... 1%
<i>Hindipollenites</i>	... 3%
<i>Strotersporites</i>	... 33%
<i>Striatopiceites</i>	... 30%
<i>Corisaccites</i>	... 1%
<i>Hamiapollenites</i>	... 1%
<i>Sulcatisporites</i>	... 11%
<i>Guttulapollenites</i>	... 1%
<i>Striasulcites</i>	... 2%
<i>Gnetaceaepollenites</i>	... 1%
<i>Boutakoffites</i>	... 5%

The other genera mentioned before though present in the assemblage are not met within the counted specimens. The present palynological assemblage is closely comparable to the 'Zone C' of the Barakar assemblage described by Venkatachala and Kar (1968a) from the exposures near Badam, North Karanpura basin as well as that of Lungatoo of the same basin described by Venkatachala and Kar (1968b). The three assemblages referred here are all very rich in striate bisaccate pollen mostly represented by *Strotersporites* and *Striatopiceites*.

In total 23 samples consisting of Barren Measures were macerated and out of these 21 samples yielded a very good amount of spores and pollen grains (TEXT-FIG. 3). The samples were taken from bottom to top

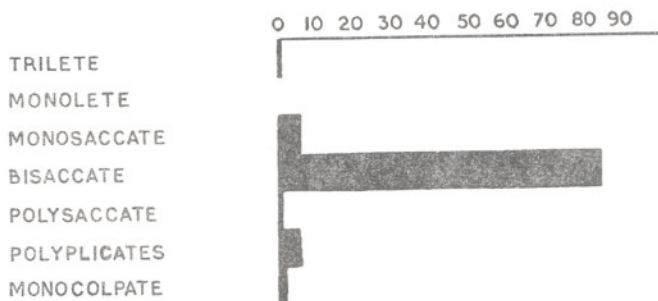


TEXT-FIG. 1 — Showing the distribution of various genera in Barakar Stage in the bore-hole no. K.5.

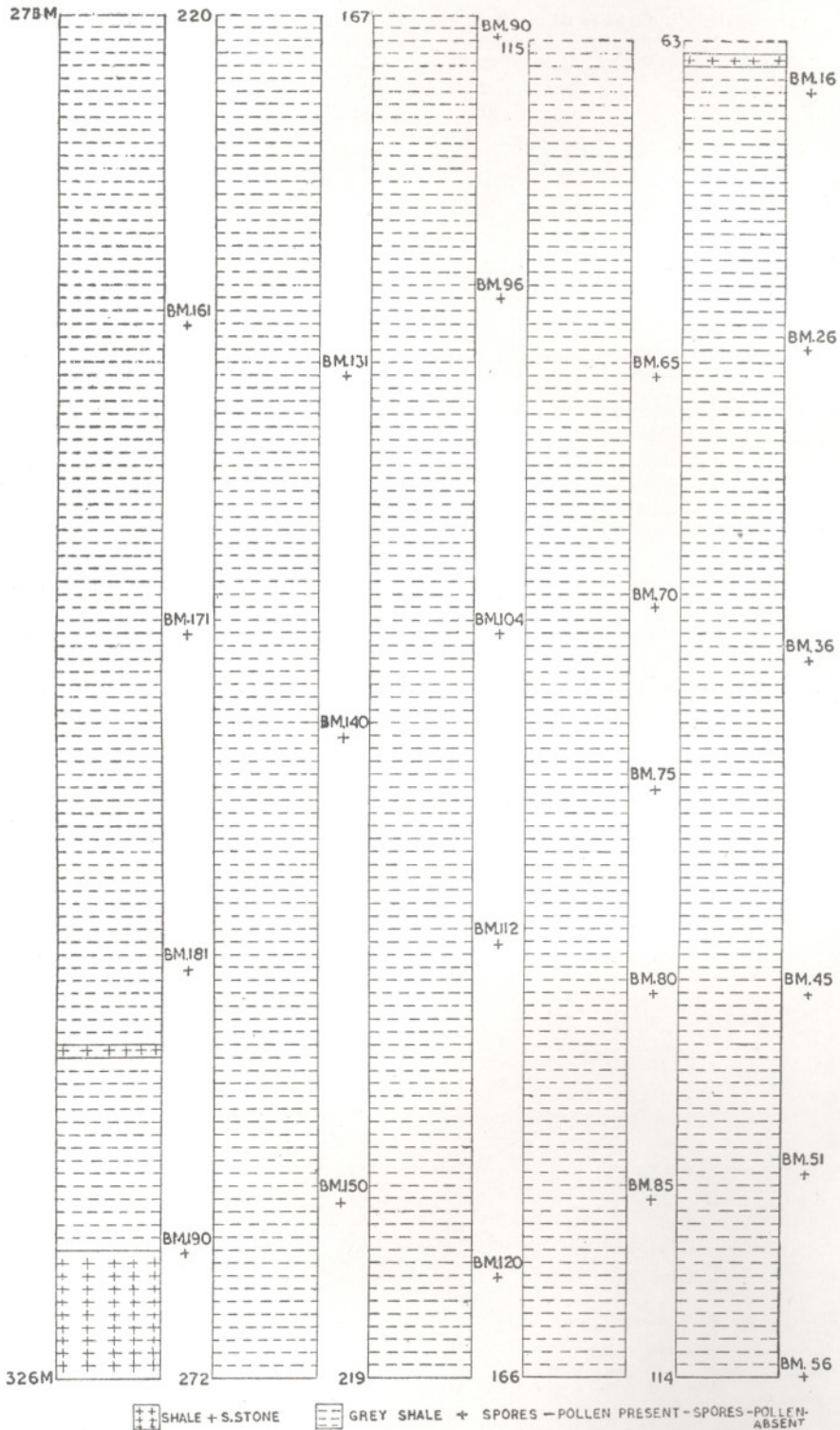
at an interval of 5-10 metres and they are mostly grey shale.

The dispersed spores — pollen genera and the species recovered from Barren Measures have been arranged systematically as follows:

1. *Punctatisporites gretensis* Balme & Hennel., 1956.
2. *Aulisporites rarus* Kar, 1968.
3. *Apiculatisporis levis* Balme & Hennel., 1956.
4. *Cyclogranisporites gondwanensis* Bharad. & Sal., 1964.
5. *Lophotriletes novus* Kar, 1968.



TEXT-FIG. 2 — Showing the distribution of major groups in Barakar Stage in the bore-hole no. K.5.



TEXT-FIG. 3 — Showing the lithology of Barren Measures in the bore-hole no. K.5.

6. *Cyclobaculisporites minimus* Kar, 1968.
7. *Laciniotriletes badamensis* Venkat. & Kar, 1965.
8. *Dentatispora crassa* Tiw., 1965.
9. *Laevigatosporites colliensis* (Balme & Hennel.) Venkat. & Kar, 1968a.
10. *Punctatosporites dulcis* Venkat. & Kar, 1968a.
11. *Thymospora* sp. Venkat. & Kar, 1968a.

**Turma** — *Aletes* Ibr., 1933  
**Subturma** — *Zonaletes* (Luber) Pot., 1958.  
**Infraturma** — *Zonareticulati* infraturma nov.

*Diagnosis* — Alete, zonate, rugose-reticulate, circular-subcircular spores.

**Genus *Zonareticulatisporis* gen. nov.**

*Type Species* — *Zonareticulatisporis goubinii* sp. nov.

*Diagnosis* — Alete, zonate, subcircular-circular spores; mostly reticulate, sometimes rugose; generally confined to one surface. Muri ± high, forming rectangular-square meshes. Exine ± laevigate-microverrucose.

*Description* — Spores mostly subcircular, sometimes circular; inner body generally confronting with the overall shape, distinct or indistinct; sometimes ill-developed. Size range 40-90 × 45-100 μ. Haptotypic mark not observed; in some specimens slightly raised muri apparently look like the same. Raised muri forming reticulate sculptures are observed in most specimens; in some cases, however, muri are ill-developed and appears to be rugose. Reticulation is mostly confined on one surface; but sometimes slightly raised and ill-developed muri are also seen on other side. Muri generally form rectangular-square meshes. Zona mostly well developed, sometimes ill-developed; ± uniformly broad, muri are comparatively rare in zona.

*Comparison* — *Reticulatisporites* (Ibr.) Pot. and Kr. (1955) resembles the present genus in the presence of cingulum (vide NEVES, 1964) and reticulate sculpture; the former can, however, be distinguished by its distinct trilete mark. *Maculatasporites* Tiw. (1964) is comparable to the present genus in the absence of haptotypic mark but it is azonate. *Greinervillites* Bose and Kar (1967) is also azonate and possessing flappy muri to form reticulate pattern. *Dictyotriletes* Pot. and Kr. (1954) is having distinct trilete mark and

is not zonate. *Valemisporites* Bharad. and Venkat. (1962) is also distinguished by its prominent trilete mark.

*Derivation of Name* — After N. Goubin, Institut Français du Pétrole, France.

12. *Zonareticulatisporis goubinii* sp. nov.

Pl. 1, Figs. 11-13

*Synonym:*

1964. *Forme* 981. Jekhowsky and Goubin (1964, pl. 5)

1965. *Incertae sedis* B. Goubin (1965, pl. 8, fig. 16, p. 1438)

*Holotype* — Pl. 1, Figs. 11-12, Size 59 × 54 μ. Slide No. 3336.

*Type Locality* — Bore-hole No. K. 5, depth 234.57-234.67M., Barren Measures Succession (Permian), North Karnapura basin, Bihar, India.

*Diagnosis* — Alete, zonate, subcircular-circular spores, mostly reticulate, occasionally rugose; sculptural elements mostly confined to one surface. Zona mostly distinct.

*Description* — Spores mostly subcircular, inner body ± subcircular, distinct or indistinct. Muri ± raised forming rectangular-square meshes; in some specimens muri are ill-developed and seems to be rugose. Muri mostly confined to one surface but sometimes it may be slightly rugose on the other side also. Exine up to 2.5 μ thick, ± laevigate-microverrucose. Zona well recognizable in most of the specimens, sometimes ill-developed and indistinct.

13. *Plicatipollenites indicus* Lele, 1964.

14. *Virkkipollenites obscurus* Lele, 1964.

15. *Venkatachalaites baralensis* Kar, (in press).

16. *Barakarites dubius* Venkat. & Kar, 1968b.

17. *Vesicaspora* sp.

18. *Parasaccites diffusus* Tiw., 1965.

19. *Densipollenites indicus* Bharad., 1962.

20. *D. invisus* Bharad. & Sal., 1964.

21. *Potonieisporites* sp. Venkat. & Kar, 1968b.

22. *Striomonosaccites circularis* Bharad. & Sal., 1964.

**Infraturma** — *Striasacciti* Bharad. 1962

**Genus *Bharadwajipollis* gen. nov.**

*Type Species* — *Bharadwajipollis striatus* sp. nov.

*Diagnosis* — Monosaccate pollen grains, central body distinct to indistinct, circular-

horizontally oval, intramicroreticulate, mostly horizontally striated, some vertical striations may also be present. Proximal attachment of saccus to central body equatorial, distally saccus completely covers central body. Saccus intrareticulate.

*Description* — Pollen grains monosaccate, circular, subcircular or oval in overall shape. Size range  $80-150 \times 50-130 \mu$ . Central body mostly distinct, sometimes indistinct, circular-horizontally oval, may or may not confront with overall shape; central body horizontally striated on proximal side, striations 5-20 in number, mostly well developed, sometimes indistinct; generally  $\pm$  parallel, extending from one end to other. In some specimens striations fall short at each end of central body. Vertical striations are also generally found, in most cases, however, they are not so well developed. Exine up to  $3 \mu$  thick, intramicroreticulate. Proximal attachment of saccus to central body equatorial, attachment zone mostly well defined. Saccus is not apparently attached to central body on distal side but covers it completely, central body in some specimens found not exactly in middle region and may be irregularly folded. Saccus is well developed, strongly built, mostly coarsely intrareticulate, sometimes seems to be leathery.

*Comparison* — *Striomonosaccites* Bharad. (1962) closely resembles the present genus in shape, size, striate and intramicroreticulate central body, the former is, however, distinguished by its distinct sub-equatorial distal attachment of saccus to central body. *Distriomonosaccites* Bharad. (1962) has striate, intramicroreticulate central body which is attached to saccus equatorially on proximal and sub-equatorially on distal side. Moreover, striations are known to occur on both the sides of central body. *Mabuitasaccites* Bose & Kar (1966) possesses indistinct central body with a distinct inner body and is horizontally striated on one side but vertically on the other. *Parastriapollenites* Mahesh. (1967) is distinguished by its amphilateral attachment which is  $\pm$  overlapping each other on both the sides of central body and the irregular striations forming pseudoreticuloid grooves on the central body. *Venkatachalaites* Kar (in press) approximates *Bharadwajipollis* in possessing equatorial proximal attachment of saccus to central body and distally almost covering the central body except for a small area. *Venkatachalaites* can, however, be

distinguished by its presence of warts on the proximal side of the central body. *Bharadwajipollis* instituted here is differentiated from all the known monosaccate genera by its circular-horizontally oval, intramicroreticulate and striate central body which is proximally attached to the saccus equatorially but distally it is completely covered by the saccus.

*Derivation of Name* — After Dr. D. C. Bharadwaj, Birbal Sahni Institute of Palaeobotany, Lucknow.

### 23. *Bharadwajipollis striatus* sp. nov.

Pl. 1, Figs. 1-10

*Holotype* — Pl. 1, Fig. 1. Size  $100 \times 90 \mu$ . Slide no. 3341.

*Type Locality* — Bore-core No. K.5, depth 240.59-240.69 M., Barren Measures Succession (Permian), North Karanpura basin, Bihar, India.

*Diagnosis* — Monosaccate pollen grains, circular-oval in shape. Central body distinct-indistinct, circular-oval, intramicroreticulate, mostly horizontally striated, some vertical striations may also be present. Proximal attachment of saccus to central body equatorial, distally saccus covers central body completely on distal side. Saccus intrareticulate.

*Description* — Pollen grains mostly sub-circular-oval in shape, size range  $80-125 \times 60 \times 100 \mu$ . Central body circular-oval, generally confronting with general shape of pollen, mostly distinct, rarely indistinct, size range  $60-110 \times 50-105 \mu$ . Horizontal striations generally well developed, 5-20 in number, a few vertical striations may also be present. Striations are found on proximal side, they are  $\pm$  parallel to each other, mostly extending from one end of central body to other, in some specimens, however, they may fall short. Exine of central body upto  $3 \mu$  thick, intramicroreticulate structure well developed, a few irregular fold may be present in some specimens on central body. Central body may not be situated just in middle region of pollen. Proximal attachment of saccus to central body is equatorial, attachment zone mostly distinct, sometimes indistinct. Saccus completely covers central body on distal side. Saccus well developed, mostly without any constrictions or undulations. In some specimens, however, a small constriction is noticed. Saccus coarsely intrareticulate,

mesh-size upto 3  $\mu$ , lumina shallow, in rare cases saccus seems to be leathery and intrareticulate structure is not clearly visible.

24. *Divarisaccus lelei* Venkat. & Kar, 1966a.

25. *Platysaccus* sp.

26. *Cuneatisporites rarus* Kar, 1968.

27. *Striatites alius* Venkat. & Kar, 1968a.

28. *S. varius* Kar, 1968.

29. *Verticypollenites secretus* Bharad., 1962.

30. *V. mineosus* Kar, 1968.

31. *Lahirites navicula* Venkat. & Kar, 1968b.

32. *Lahirites* sp. A. Kar, 1968.

33. *Hindipollenites formosus* Venkat. & Kar, 1968a.

34. *H. globosus* Kar, 1968.

35. *Lunatisporites amplus* Kar, 1968.

36. *Strotersporites decorus* (Bharad. & Sal.) Venkat. & Kar, 1964a.

37. *S. diffusus* (Bharad. & Sal.) Venkat. & Kar, 1964a.

38. *S. lentisaccatus* Kar, 1968.

39. *Striatopiceites minutus* Venkat. & Kar, 1968a.

40. *S. digredius* Kar, 1968.

41. *S. granulatus* Kar, 1968.

42. *Schizopollis wodehousei* Venkat. & Kar, 1964b.

43. *S. disaccoidis* Venkat. & Kar, 1964b.

44. *S. extremus* Venkat. & Kar, 1964b.

45. *Chatterjeeapollis minutosaccus* Kar (in press).

46. *Corisaccites alutas* Venkat. & Kar, 1966b.

47. *Rhizomaspora costa* Venkat. & Kar, 1968b.

48. *Hamiapollenites incestus* Venkat. & Kar, 1968b.

49. *Vittatina lata* Wils., 1962.

50. *Sulcatisporites ovatus* Bharad., 1962.

51. *Labiisporites nectus* Venkat. & Kar, 1968b.

52. *Trochosporites tripus* Venkat. & Kar, 1968b.

53. *Crustaesporites* sp.

54. *Guttulapollenites hannonicus* (Goub.) Venkat., Goub. & Kar, 1967.

55. *Gnetaceaepollenites biplicatus* Kar, 1968

56. *G. acutus* Kar, 1968.

57. *Welwitschiapites tenuis* Bharad. & Sal., 1964.

58. *Ephedripites dentatus* Kar, 1968.

59. *E. ellipticus* Kar, 1968.

60. *Boutakoffites quibus* Bose & Kar, 1966.

61. *B. cf. quibus* Bose & Kar, 1966.

#### Infraturma — *Apiculoplicates* infraturma nov.

*Diagnosis* — Polyplicate pollen grains with pilate-baculate, verrucose-spinose sculptural elements.

62. *Apiculoplicates pilatus* Kar (in press)

63. *Ginkgocycadophytus cymbatus* (Balme & Hennel.) Pot. & Lele, 1961.

64. *Striasulcites tectus* Venkat. & Kar, 1968b.

65. *S. ovatus* Venkat. & Kar, 1968b.

66. *Decussatisporites ovatus* Kar, 1968.

67. *D. cf. kinduensis* Bose & Kar, 1966.

#### PALYNOLOGICAL ASSEMBLAGE

To find out the palynological assemblage four slides (size of the cover glass 22×50 mm.) were studied from each sample and for percentage 200 spores-pollen were counted.

*Sample no. BM. 190* — This sample represents all the major groups of spores-pollen. The bisaccate contributes 65 per cent, polyplicates 15 per cent, monocolpate 12 per cent, trilete 3 per cent, monosaccate and polysaccate 2 per cent each and monolete 1 per cent.

*Sample no. BM. 181* — In this sample bisaccate represents 80 percent, monocolpate 9 per cent, polyplicates 7 per cent, monosaccate 3 percent and polysaccate 1 per cent.

*Sample no. BM. 171* — The assemblage consists only of bisaccate (85%), monosaccate (14%) and trilete (1%).

*Sample no. BM. 161* — The bisaccate contributes 75 per cent and monosaccate 25 per cent in the assemblage.

*Sample no. BM. 150* — This sample comprises mostly bisaccate (81%), monosaccate (18%) and polysaccate (1%).

*Sample no. BM. 131* — The assemblage mostly consists of bisaccate (74%), monosaccate (24%), trilete (1%) and polyplicates (1%).

*Sample no. BM. 120* — The assemblage is dominated by bisaccate (84%), monosaccate contributes 13 per cent while monolete, polysaccate and monocolpate represent 1 per cent each.

*Sample no. BM. 112* — The bisaccate (64%) and the monosaccate (34%) overwhelm in this assemblage.

*Sample no. BM. 104* — The present assemblage consists mostly of bisaccate (80%) and monosaccate (20%).

*Sample no. BM. 96* — The present assemblage consists mostly of bisaccate (77%), monosaccate (22%) and polyplicates (1%).

*Sample no. BM. 90* — Bisaccate contributes 68 per cent and monosaccate 32 per cent in this assemblage.

*Sample no. BM. 85* — The assemblage consists mostly of bisaccate (59%), monosaccate (40%) and polyplicates (1%).

*Sample no. BM. 75* — The bisaccate is very dominant (97%) while the monosaccate and the monocolpate contribute 2 per cent and 1 per cent respectively in the assemblage.

*Sample no. BM. 70* — The assemblage consists mostly of bisaccate (95%) and monosaccate (5%).

*Sample no. BM. 56* — The bisaccate is very dominant (95%) while monosaccate and polyplicates contribute 4 per cent and 1 per cent respectively in the assemblage.

*Sample no. BM. 51* — The assemblage is represented mostly by the bisaccate (95%) and the monosaccate (5%).

*Sample no. BM. 45* — The bisaccate contributes 95 per cent while monosaccate represents 5 per cent of the total assemblage.

*Sample no. BM. 36* — The bisaccate comprises 96 per cent while monosaccate and polyplicates contribute 2 per cent each to the assemblage.

*Sample no. BM. 26* — The assemblage comprises bisaccate 70 per cent, trilete 16 per cent and polyplicates 14 per cent.

*Sample no. BM. 16* — The assemblage comprises bisaccate 68 per cent, trilete 21 per cent, polyplicates 7 per cent, monoete 3 per cent and monosaccate 1 per cent.

The genera present in the above mentioned samples are tabulated as shown in Table 1.

## DISCUSSION

The present palynological assemblage is populated by 51 genera and 67 species. It may, however, be mentioned here that only 35 genera are found within the counted specimens in some samples or others. The samples from the bottom (i.e. sample nos. BM. 190 and BM. 181) are populated by most of the major groups of spores-pollen (See TEXT-FIGS. 4 & 5) and are more or less similar to the Barakar assemblage described here.

The palynological assemblage of the samples from BM. 171-BM. 36 is more or less homogenous and is dominated by bisaccate and monosaccate. In most of these samples trilete, monoete, polysaccate, polyplicates and monocolpate groups are rarely found within the counted specimens. Among the monosaccate *Densipollenites* is dominant, while *Strotersporites* and *Striatopiceites* are abundant among the bisaccate. *Densipollenites* is meagrely represented at the bottom samples but gradually it becomes prominent and contributes upto 40 per cent (sample no. BM. 85) of the total assemblage; its percentage, however, decreases at the upper samples of the bore-core. Bisaccate is very dominant in all these samples and represents 97 per cent (sample no. BM. 75) and 95 per cent (sample nos. BM. 70, BM. 56 & BM. 51) of the total assemblage.

In the uppermost samples of the bore-core (sample nos. BM. 26 & BM. 16) bisaccate is also dominant but its percentage never goes above 70. Trilete is next in abundance followed by polyplicates and monoete.

The palynological constituent present in this bore-core thus can be divided into three zones as follows:

Zone A (sample nos. BM. 190-BM. 181)	{	Trilete	rare
		Monoete	rare
		Monosaccate	negligible
		Bisaccate	dominant
		Polysaccate	negligible
		Polyplicates	abundant
Zone B (sample nos. BM. 171-BM. 36)	{	Monoete	rare
		Monosaccate	abundant
		Bisaccate	dominant
		Polysaccate	rare
		Polyplicates	rare
		Monocolpate	rare
Zone C (sample nos. BM. 26-BM. 16)	{	Trilete	abundant
		Monoete	negligible
		Monosaccate	rare
		Bisaccate	dominant
		Polysaccate	rare
		Polyplicates	abundant
		Monocolpate	rare

The present palynological assemblage of the Barren Measures Succession is more diversified than those of Bharadwaj, Sah



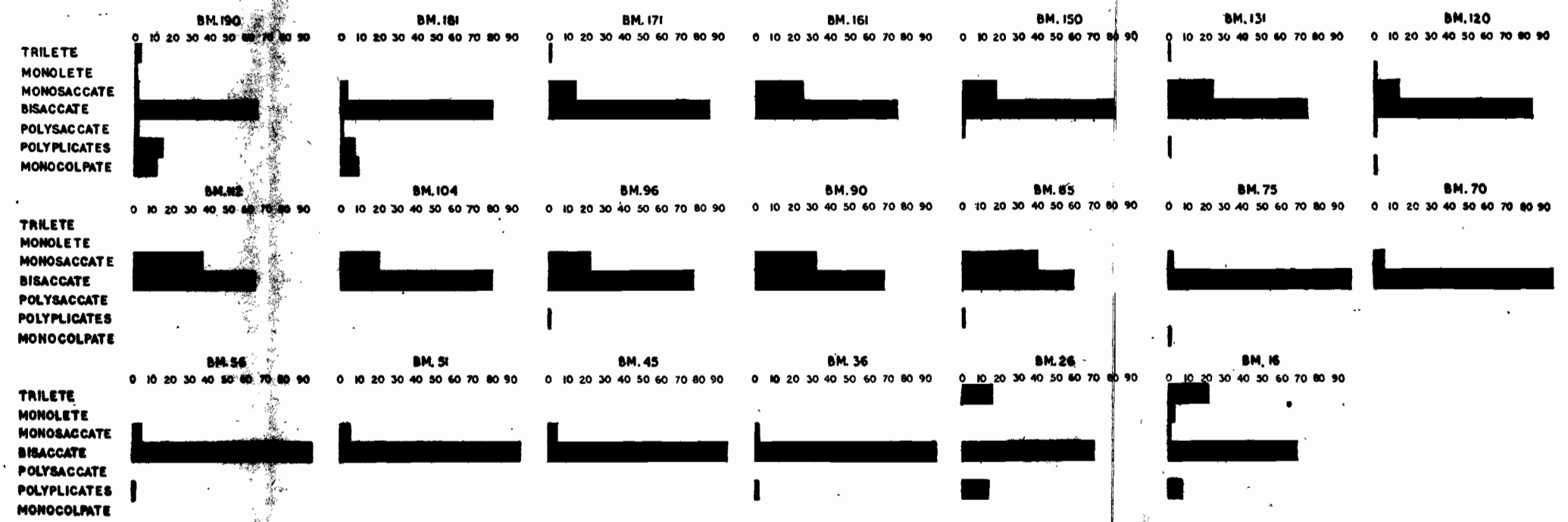
TABLE I—SHOWING THE PERCENTAGE OF DIFFERENT GENERA IN BARREN MEASURES IN THE BORE-HOLE NO. K.5

(+ Sign indicates that the genus is present in the sample but absent within the counted specimens)

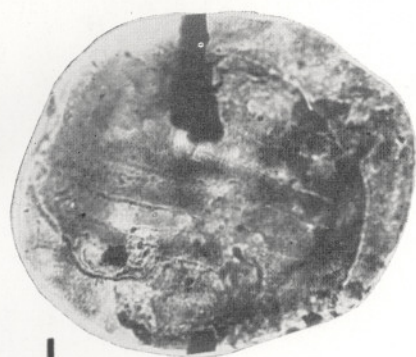
GENERA	SAMP. No. BM190 %	SAMP. No. BM181 %	SAMP. No. BM171 %	SAMP. No. BM161 %	SAMP. No. BM150 %	SAMP. No. BM131 %	SAMP. No. BM120 %	SAMP. No. BM112 %	SAMP. No. BM104 %	SAMP. No. BM96 %	SAMP. No. BM 90 %	SAMP. No. BM 85 %	SAMP. No. BM 75 %	SAMP. No. BM70 %	SAMP. No. BM56 %	SAMP. No. BM51 %	SAMP. No. BM45 %	SAMP. No. BM36 %	SAMP. No. BM26 %	SAMP. No. BM16 %
<i>Punctatisporites</i>		+					+				+					+	+	+	1	+
<i>Aulisporites</i>	+															+	+			
<i>Apiculatisporis</i>	2		1	+	+	1	+	+	+	+	+	+	+			+	+	6	8	
<i>Cyclogranisporites</i>						+	+	+							+	+	+	6	6	
<i>Lophotriletes</i>	1	+			+		+									+		3	6	
<i>Cyclobaculisporites</i>						+				+	+		+	+				+	1	
<i>Lacinitriletes</i>	+																			
<i>Dentatispora</i>											+	+								
<i>Laevigatosporites</i>	+		+	+		+	+	+			+		+		+	+		+	+	2
<i>Punctatosporites</i>	1				+	+	1	+					+			+	+	+	+	
<i>Thymospora</i>	+													+			+	+	+	
<i>Zonareticulatisporis</i>	+	+						+				+				+				
<i>Plicatipollenites</i>											+									
<i>Virkipollenites</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			+	+
<i>Venkatachalaites</i>	+	2	+	+	+	+	+	+									+	+		
<i>Barakarites</i>	+	+		+	+	+	+			+		+					1			
<i>Vesicaspora</i>			+																	
<i>Parasaccites</i>		+	+	+	+	+	+	+			+					+	4	2	+	
<i>Densipollenites</i>	2	+	14	25	18	24	12	36	20	22	32	40	2	5	4	5	4	2	+	1
<i>Potonieisporites</i>																				
<i>Striomonosaccites</i>	+	+	+													+				
<i>Bharadwajipollis</i>	+	+	+	+										+						
<i>Divarisaccus</i>	+	+		+	+	+	1		+											
<i>Platysaccus</i>	+												+							
<i>Cuneatisporites</i>	1	2	0	+	+	+	1		1	+	+	+	+	+	+		+	+	+	2
<i>Striatites</i>	3	1	2	2	2		3	1	3	4	1	4	4	4	8	6	10	8	4	8
<i>Verkipollenites</i>	1	1	+	1	2		+	+	1	1	+	+	3	2	2	2	4	4	4	2
<i>Lahirites</i>	2	1	+	+	2		2	1	3	2	2	2	4	3	6	6	6	6	3	4
<i>Hindipollenites</i>	+	+	+	+	+		+	+	2	1	1	+	3	2	2	3	3	3	3	1
<i>Lunatisporites</i>							+	+	+	+	+	2	+	+	+	1	3	+	3	2
<i>Strotersporites</i>	14	28	28	25	30	24	25	16	20	26	19	16	28	28	33	30	28	25	20	18
<i>Striato piceites</i>	23	32	49	40	39	44	46	44	42	37	40	31	47	52	40	41	40	40	25	26
<i>Schizopollis</i>	8	9	+																	
<i>Chatterjeeapollis</i>	1	+					+													
<i>Corisaccites</i>	+	+	+	+	+	+	+	+		1			+	+			+			
<i>Rhizomaspora</i>	+	+	+	+	+	+	+	+		+			+	+		+				
<i>Hamiapollenites</i>	4	+	1	+	1	+	1	+			+		+	+						
<i>Vittatina</i>	+	+											+	+						
<i>Sulcatisporites</i>	8	16	4	7	5	6	6	2	8	5	5	4	7	4	4	6	4	10	10	6
<i>Labiisporites</i>	+	+	+	+		+		+			+		1	+	+		+	+		
<i>Trochosporites</i>				+														10		
<i>Crustasporites</i>					+	+		+	+			+		+						
<i>Guttulapollenites</i>	2	+	+	+	1	+	1	+		+	+		+	+	+	+	+	+	+	+
<i>Gnetaceapollenites</i>	1		+	+		1	+	+		+	+		+	+	1	+	+	+	3	2
<i>Welwitschiapites</i>	1	1		+		+	+	+		+	+		+	+	+	+	+	1	1	1
<i>Ephedripites</i>	5	2	+		+	+	+	+	+	1	+		+	+	+	+	+	1		4
<i>Boulakoffites</i>	7	4	+																10	
<i>Apiculoplicates</i>	1																			
<i>Ginkgocycadophytus</i>	1	+		+	+	+	1	+		+			1	+		+	+	+	+	+
<i>Striasulcites</i>	10		+																	
<i>Decussatisporites</i>	1	+	+										+					+		



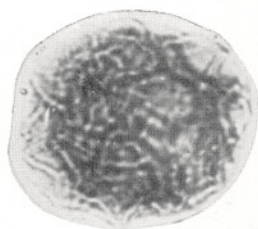
TEXT-FIG. 4.—Showing the distribution of the various genera in Barren Measures in the bore-hole no. K.5.



TEXT-FIG. 5 — Showing the distribution of major groups in Barren Measures in the bore-hole no. K.5.



1



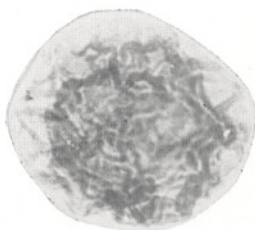
11



10



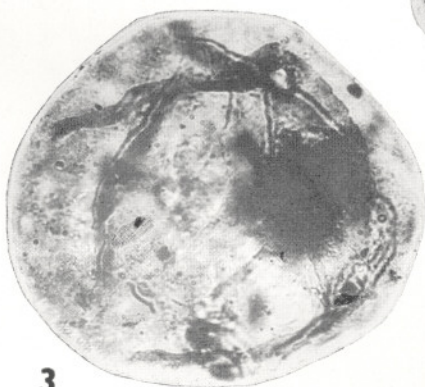
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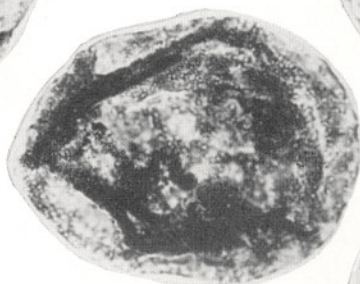
12



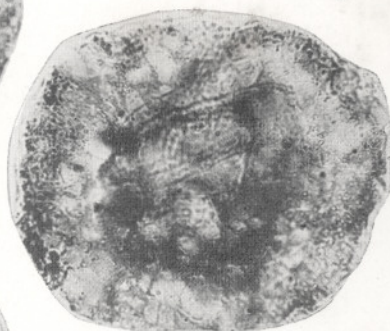
9



3



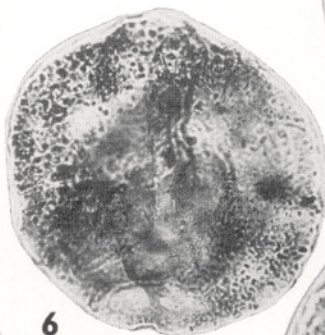
8



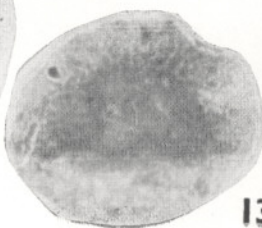
7



4



6



13



5

and Tiwari (1965) and Kar (1968) described from the Jharia coalfield of the same Succession. Some of the trilete genera described by them (e.g. *Leiotriletes*, *Verrucosisporites*, *Acanthotriletes*, *Neovastriackia*, *Microfoveolatispora*, *Microbaculispora*, *Indospora* and *Gondisporites*) are, however, not found in the present material.

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## EXPLANATION OF PLATE

(All photomicrographs are enlarged ca. × 500)

## PLATE 1

1-10. *Bharadwajipollis striatus* gen. et sp. nov.  
Slide Nos. 3338-3345.

11-13. *Zonarticulatisporis goubinii* gen. et sp. nov.  
Slide Nos. 3336, 3337.