

INSIGNISPORITES GEN. NOV., A NEW CAVATE MIOSPORE GENUS FROM BARAKAR STAGE (LR. GONDWANA) OF INDIA

D. C. BHARADWAJ AND ARCHANA DWIVEDI (MISS)

Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

Insignisporites gen. nov. has been described from Barakar Stage (Permian) of Indian Lower Gondwana. It is a trilete bearing cavate genus with unstructured exine, sculptured with grana and pila on both the faces.

INTRODUCTION

The present paper describes a cavate spore genus from Barakar Stage, which shows such organization and its associated structures as is not described so far. Barakar coals are rich in these forms providing an opportunity for their detailed study. However, their quantitative distribution through Lower Gondwana sequence has not been known so far. Miospores of comparable cavate organizations have been reported from northern hemisphere, e.g. *Grandispora* Hoffm., Stap. & Mall. (1955), *Auroraspora* Hoffm., Stap. & Mall. (1955), *Fragilipollenites* Konyali (1965), *Aulicosporites* Allen (1965), *Calyptosporites* Richardson (1962), *Rhabdosporites* Richardson (1960), *Pseudowilsonia* Taugourdeau-Lantz (1960), *Wilsonites* Kos. (1959), *Endosporites* Wils. & Coe emend. Bharad. (1965), *Spaeleotriletes* Neves & Owens (1966) and *Rugospora* Neves & Owens (1966).

The material for the present study is from South Karanpura Coalfield (85°7': 85°28' E, 23°38': 23°43' N), situated in Hazaribagh district of Bihar, India. Twenty six samples from the working faces of fourteen coal seams of this coalfield have been studied for their palynofloras. During this investigation the genus described here has been found in three coal seams. The coal samples were macerated by treatment with nitric acid and potassium hydroxide. The shale samples were firstly treated with hydrochloric acid and then hydrofluoric acid and thereafter with nitric acid; rest of the process is similar to that of maceration of coal.

DESCRIPTION

Anteturma ..	..	..	SPORITES Bharad., 1974
Subanteturma ..	..	..	ATENUITATI Bharad., 1974
Turma ..	..	..	NONCURVATURATI Bharad., 1974
Subturma ..	..	..	NONTRIQUETRI Bharad., 1974
Infrasubturma ..	..	..	NONSTRUCTURATI Bharad., 1974
Infraturma ..	..	..	NONPHAERA Bharad., 1974
Subinfraturma ..	..	..	CIRCULI Bharad., 1974
Infrasubinfraturma ..	..	..	LETI Bharad., 1974

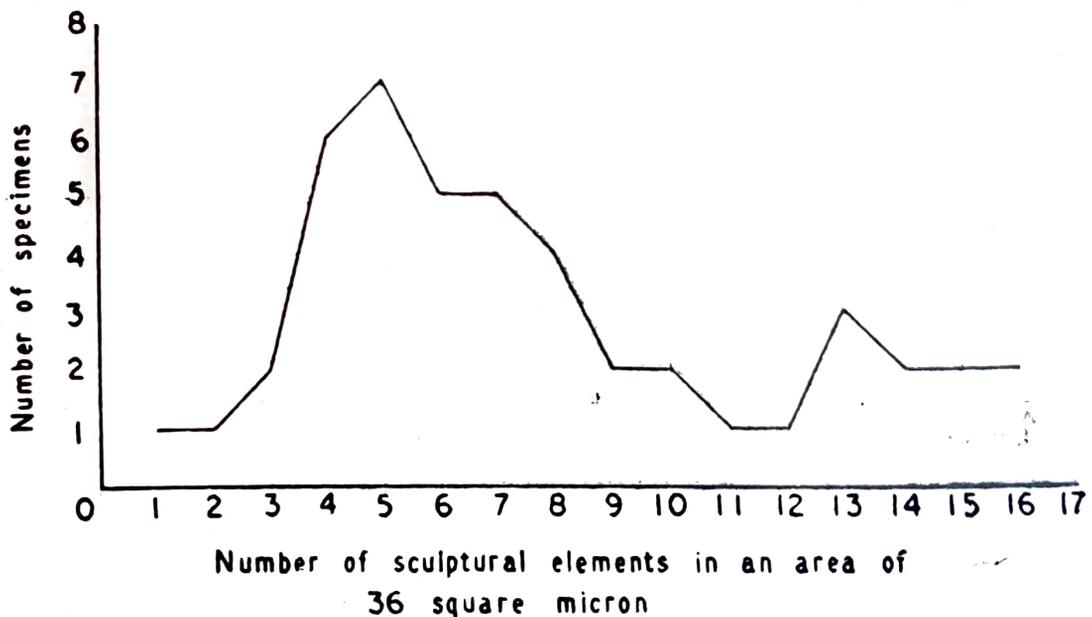
Genus—*Insignisporites* gen. nov.

Type species—*Insignisporites barakarensis* sp. nov.

Generic diagnosis—Trilete miospores circular, subcircular or subtriangular. Inner body distinct or indistinguishable. Trilete mark distinct, rays accompanied with folds. Exoexine unstructured but sculptured with grana and pila.

Generic description—Miospore amb circular (Pl. 1, Figs. 6, 10; Pl. 2, Fig. 12) to subcircular (Pl. 1, Figs. 1, 7; Pl. 2, Figs. 14, 17) and subtriangular (Pl. 1, Figs. 4, 5; Pl. 2, Fig. 15) in polar view with a thin or markedly thick exine. Spores enclosing a distinct inner body (Pl. 1, Figs. 2, 4; Pl. 2, Figs. 13, 19) sometimes distorted (Pl. 1, Fig. 10; Pl. 2, Fig. 14) or even indistinguishable (Pl. 1, Figs. 5, 7, 9; Pl. 2, Figs. 15, 17). Trilete mark always distinct, rays having folds (Pl. 1, Fig. 1; Pl. 2, Fig. 15), sinuous (Pl. 1, Figs. 1, 6; Pl. 2, Fig. 14), closed (Pl. 1, Figs. 1, 7; Pl. 2, Figs. 14, 15) or open leaving a triangular rent (Pl. 1, Figs. 5, 6, 10; Pl. 2, Figs. 12, 18, 22) reaching $1/2$ to $3/4$ body radius, labra thick (Pl. 1, Figs. 1, 7; Pl. 2, Fig. 15) to thin (Pl. 1, Figs. 5, 10; Pl. 2, Figs. 12, 22), vertex low (Pl. 1, Fig. 9); sometimes a triangular opening also present in the inner body within the triangular rent of the Y-mark (Pl. 2, Fig. 18). Exoexine structureless but sculptured by grana (Pl. 1, Figs. 4, 5, 7; Pl. 2, Figs. 14, 16) and pila (Pl. 1, Fig. 4), pila more distinct in laterally flattened specimen on the margin (Pl. 1, Figs. 3, 11). Sculptural elements sparsely (Pl. 1, Fig. 5; Pl. 2, Figs. 16, 20) to densely (Pl. 1, Figs. 2, 4, 8, 10) distributed on the distal face but proximally always sparsely distributed or sometimes even very few to none; sculptural processes sometimes show coalescing tendency in surface view (Pl. 1, Figs. 4, 8; Pl. 2, Fig. 16).

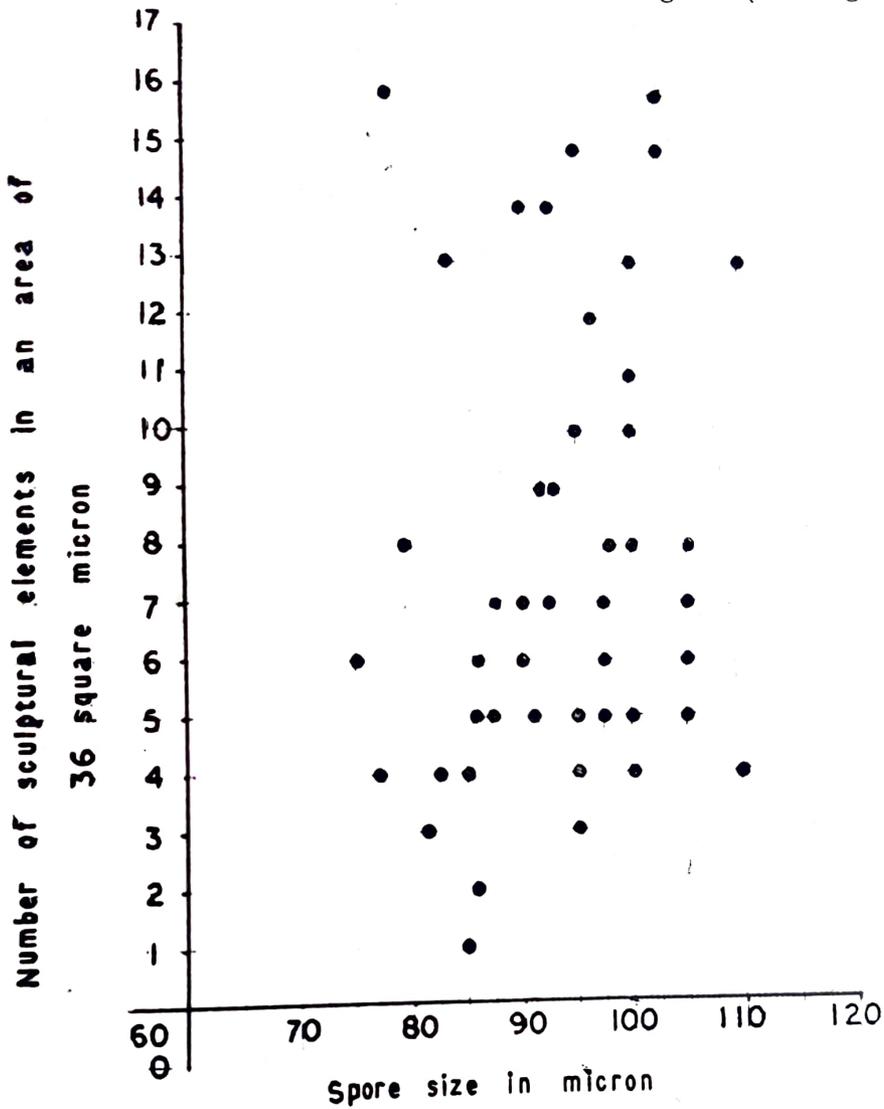
Biometrical analysis—The presently studied specimens show a large variation in the distribution of the sculptural elements on the distal face. In order to understand the mode of variation, a frequency polygon (Text-fig. 1) has been plotted considering the number



Text-fig. 1. Frequency polygon for the margin distribution of number of sculptural elements per 36 square microns on the distal face in the genus *Insignisporites* gen. nov.

of sculptural elements within 36 square microns on the distal face. It has been found that the number of these elements ranges from 1-16. In this curve, one maximum is obtained at 5 from where it starts descending, but once again it increases giving a peak at 13. The second peak, however, is not that prominent as to be considered a second maximum.

The latter condition, obviously is a variation of the former and therefore, the miospores studied here belong to only one taxon. Besides, a scatter diagram (Text-fig. 2) has been



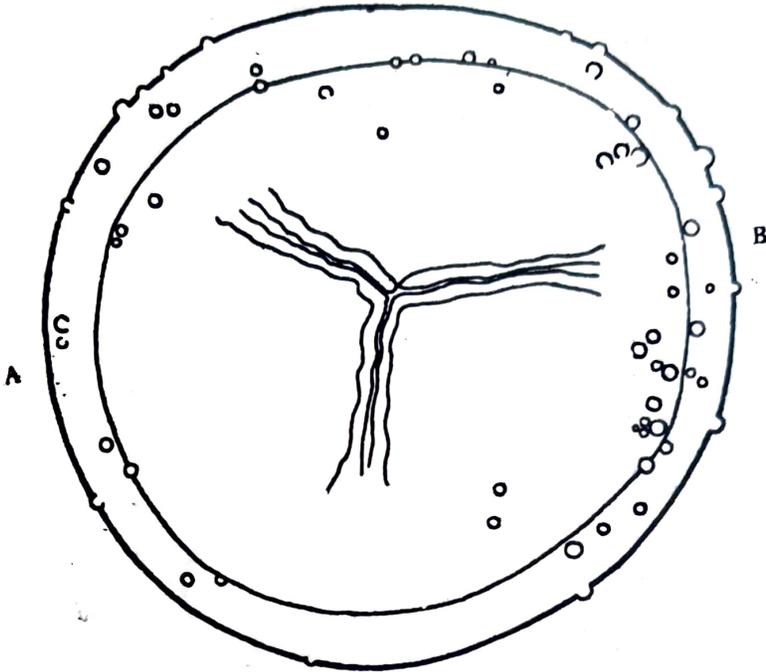
Text-fig. 2. Scatter diagram showing the relationship of the size of the spore and the number of sculptural elements per 36 square microns on the distal face in the genus *Insignisporites* gen. nov.

plotted to mark the relationship of the miospore size and the density of the sculptural elements on the distal face. This diagram reveals that the number of sculptural elements increases from 1-16 whereas the size of the miospores varies from 75-110 μ . Within this size range, the number of sculptural elements increases gradually from "sparse"—"dense"—"very dense". Obviously, both the characters do not show any relationship with each other. Most of the specimens having "sparse" and "dense" ornamentation have segregated themselves from the miospores with "very dense" ornamentation and appear to be one taxon. On closer examination it is revealed that the forms with "very dense" ornament do not separate out from the "sparse" and "dense" types because of a gradual variation from one condition to the other and mixed stratigraphical distribution. Hence, all the types encountered in the population have been grouped into one species.

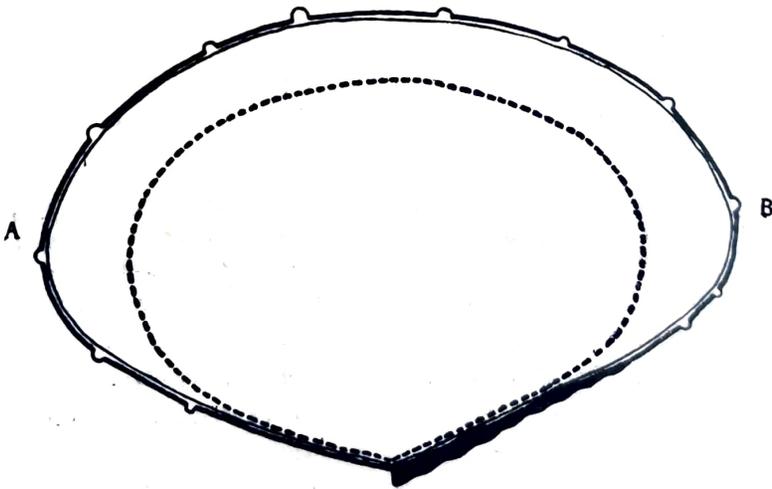
Number of specimens studied—Seventy.

Organization—The inconsistent position of the trilete mark in the flattened specimens (Pl. 1, Figs. 6, 10; Pl. 2, Figs. 17, 18, 20) and the association of circular to roundly triangular

shape of the miospore suggest subspherical nature of the spore in original condition. The slightly eccentric position of inner body in the spore (Pl. 1, Fig. 2; Pl. 2, Fig. 13) suggests that the inner body is attached to the exoexine with its proximal face to a small area and the distal face is free from the exoexine. Considering the above facts and construction of the laterally flattened specimens (Pl. 1, Fig. 9; Pl. 2, Fig. 19) observed in the present study the organization as represented in Text-figs. 3 and 4 is suggested for this genus.



Text-fig. 3. Organization of *Insignisporites* gen. nov.—polar view.



Text-fig. 4. Meridional section along A B in Text-fig. 3.

Affinity—The filicinean grains are always acavate with different types of ornamental patterns. In the lycopsids the miospores are cavate together with a cingulum or zona. The sphenopsid grains are organizationally similar to pro-gymnospermous grains in their cavate nature. The former, however, are different in being perfectly spherical or even bilateral at high level of evolution and in having only reticulate ornamentation in various forms. The genus *Insignisporites* is, no doubt, a cavate form but is neither perfectly spherical nor possesses reticulate sculpture. Hence, it cannot be a lycopsid,

sphenopsid or filicinean grain. Further, the presence of tigillate exoexine, the character non-gymnospermous grain, is also lacking in the present genus which suggests it to be a affinity.

Comparison—*Insignisporites* is organizationally similar to a number of pro-monosaccate (pro-gymnospermous) genera in its cavate nature with a proximal trilete mark. The present genus, however, is typical in its characteristic exoexine ornamentation which is structurally laevigate but sculptured with grana and pila. *Grandispora* has spinose exoexine. *Auroraspora* bears a thick-walled inner body and non-reticulate thin exoexine. In *Fragilipollenites* the exoexine is smooth with fine meridional folds whereas in *Aulicosporites* the exoexine is distally sculptured by cristo-reticulate ornament with cones or occasional spines. In *Calyptosporites* the pointed cones or spines of exoexine are bifurcated at the tip. In *Rhabdosporites* the exoexine is microbaculose. *Pseudowilsonia* and *Wilsonites* have reticulate exoexine; moreover, in the latter genus the body is laevigate to granulose. In *Endosporites* the exoexine is finely granulose. *Spaeleotriletes* has laevigate to structurally infrapunctate exoexine bearing mixed sculptural elements, e.g. small cones, grana, or verrucae forming short irregular ridges as a result of their fusion. In *Rugospora* the exoexine is microverrucose and bears persistent series of folds which give the spore an irregular and corrugated appearance.

Derivation of name—*Insignio* (L.)=to make known.

Distribution—Lower Sirka, Hathidari, and Upper Nakari seams.

***Insignisporites barakarensis* sp. nov.**

Pl. 1, Figs. 1-11; Pl. 2, Figs. 12-22.

Holotype—Pl. 1, Figs. 1, 2; Reg. Sl. No. BSIP 5269; Size 100.0 μ .

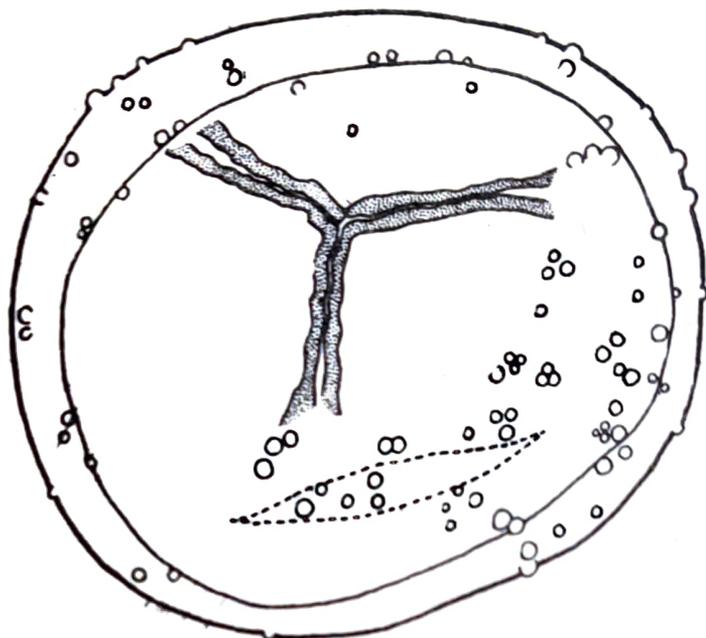
Isotype—Pl. 1, Fig. 4; Reg. Sl. No. BSIP 5280; Size 86.0 μ .

Locus typicus—Hathidari seam, South Karanpura Coalfield, Bihar.

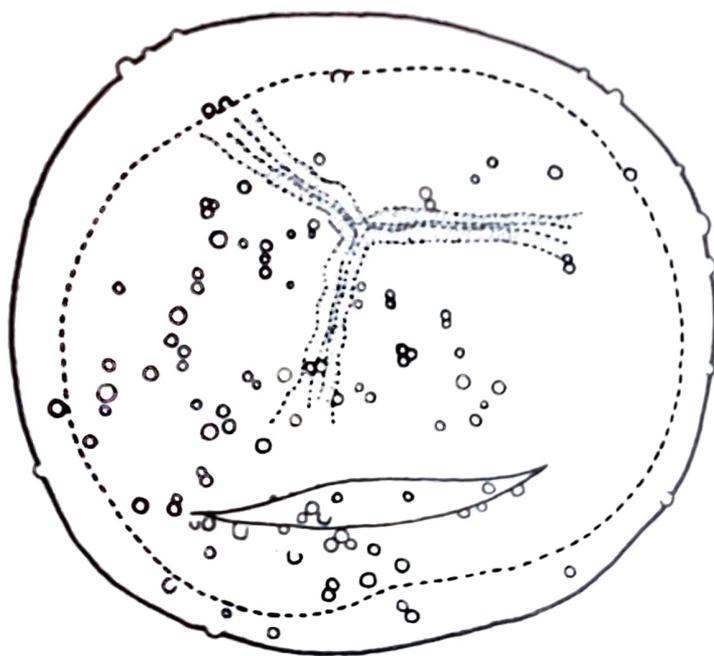
Age and Horizon—Barakar Formation, Lower Gondwana.

Diagnosis—Miospores circular to subcircular and subtriangular. Inner body distinct or indistinguishable. Y-mark distinct. Exine thin or thick, exoexine unstructured but sculptured with grana and pila on both the faces; sculptural elements sparsely to densely distributed on the distal face.

Description—Miospores 75-110 μ . Equatorially flattened miospores, circular to subcircular and subtriangular with a distinct (Text-fig. 5; Pl. 1, Fig. 2) or indistinguishable (Pl. 1, Figs. 5, 6) inner body. Exine thickness varying from 0.5—4.0 μ , membranous (Pl. 2, Figs. 12, 16, 19, 22) to dense (Pl. 2, Figs. 17, 18). Y-mark present on the proximal face, may be open leaving a triangular rent (Pl. 1, Figs. 5, 6, 10), rays sometimes folded (Pl. 1, Fig. 1), thick and elevated (Text-fig. 5; Pl. 1, Figs. 1, 6), sinuous (Pl. 1, Figs. 1, 6) reaching 1/2 to 3/4 spore radius, 20.0—45.0 μ long; sometimes within the triangular rent of Y-mark a triangular rupture in the inner body also present (Pl. 2, Figs. 17, 18). Exoexine granulose and pilate (Pl. 1, Figs. 2, 3, 11) on the margin (Pl. 1, Figs. 3, 11), distribution of sculptural elements denser on the distal face (Text-fig. 6; Pl. 1, Fig. 2; Pl. 2, Figs. 13, 16, 21: their number being 1-16 per 36 square microns) than on the proximal face (Text-fig. 5; Pl. 1, Fig. 1, Pl. 2, Fig. 15). Sculptures sparsely distributed and lesser on



Text-fig. 5. *Insignisporites barakarensis* gen. et sp. nov.-proximal face showing the trilete mark, and nature and distribution of sculptures.



Text-fig. 6. *Insignisporites barakarensis* gen. et sp. nov.-distal face showing distinct inner body, nature and distribution of grana and pila on the surface and margin, fusion of the sculptures on surface.

contact area (Text-fig. 5; Pl. 1, Figs. 1, 9, 11; Pl. 2, Figs. 14, 18) or sometimes present only nearer the equatorial region (Pl. 1, Fig. 6) on the proximal face. Processes 1-4 μ across and 2-5 μ high sometimes coalescing with each other (Pl. 1, Figs. 4, 8). Number of sculptural elements on periphery 0-42.

REFERENCES

- AGRALI, B., AKYOL, E., KONYALI, Y., CORSIN, P. M. & LAVEINE, J. P. (1965). Nouvelles formes de spores et pollen provenant de charbons primaires et tertiaire de divers gisements turcs. *Soc. Geol. Nord. Ann.* **85**: 169-182.
- ALLEN, K. C. (1965). Lower and Middle Devonian spore of North and Central Vestspitsbergen. *Palaeontology*. **8**: 287-748.
- BHARADWAJ, D. C. (1965). On the organization of *Spencerisporites* Chaloner and *Endosporites* Wilson & Coe with remarks on their systematic position. *Palaeobotanist*. **13**: 85-88.
- BHARADWAJ, D. C. (1974). On the classification of gymnospermous *sporae dispersae*. *Symp. Struct. Nomencl. Classif. pollen spores, Sahni Inst. Palaeobot.* **4**: 7-52.
- HOFFMEISTER, W. S., STAPLIN, F. S. & MALLOY, R. E. (1955). Mississippian plant spores from the Hardinsburg formation of Illinois and Kentucky. *J. Palaeont.* **29**: 372-399.
- KOSANKE, R. M. (1959). *Wilsonites*, new name for *Wilsonia* Kosanke, 1950. *J. Palaeont.* **33**: 700.
- NEVES, R. & OWENS, B. (1966). Namurian camerate miospores from the English Pennines. *Pollen Spores*. **8**: 337-360.
- RICHARDSON, J. B. (1960). Spores from the Middle Old Red Sandstone of Cromarty, Scotland. *Palaeontology*. **3**: 45-63.
- RICHARDSON, J. B. (1962). Spores with bifurcate processes from the Middle Old Red Sandstone of Scotland. *Palaeontology*. **5**: 171-194.
- TAUGOURDEAU-LANTZ, J. (1960). Sur la microflore du Frasnien inferieur de Beaulieu (Boulonnais). *Rev. Microplaeont.* **3**: 114-154.
- WILSON, L. R. & COE, E. A. (1940). Descriptions of some unassigned plant microfossils from the Des Moines Series of Iowa. *Ann. Midl. Nat.* **23**: 182-186.

EXPLANATION OF PLATES

(All photomicrographs are $\times 500$)

PLATE 1

1-11. *Insignisporites barakarensis* gen. et sp. nov.

1. Holotype-proximal face showing the nature of trilete mark and distribution of sculptures, Reg. Sl. No. B.S.I.P. 5269.
2. Holotype-distal face showing the inner body, dense distribution of sculptures, Reg. Sl. No. B.S.I.P. 5269.
3. Laterally flattened specimen; pila on the margin in focus, Reg. Sl. No. B.S.I.P. 5279.
4. Spore showing the inner body, dense distribution of sculptures on the distal face, fusion of sculptures on surface; pila on the margin, Reg. Sl. No. B.S.I.P. 5272.
- 5, 7, 8. Regd. Sl. Nos. B.S.I.P. 5270, 5268, 5272.
- 6, 10. Laterally flattened specimens showing the shape of the spore and the distribution of sculptures on proximal and distal faces, Reg. Sl. Nos. B.S.I.P. 5277, 5268.
9. Laterally flattened specimen showing the organization, Reg. Sl. No. B.S.I.P. 5281.
11. Laterally flattened specimen showing the sculptures; pila on the margin distinct, Reg. Sl. No. B.S.I.P. 5276.

PLATE 2

12-22. *Insignisporites barakarensis* gen. et sp. nov. (contd.)

12. Proximal face, open trilete mark in focus with a single grana on the surface, Reg. Sl. No. B.S.I.P. 5271.
13. Distal face of the same specimen, inner body and sparsely distributed sculptures in focus, Reg. Sl. No. B.S.I.P. 5271.
14. Isotype-trilete mark and sculptures on proximal face in focus, sculpture on distal face out of focus, Reg. Sl. No. B.S.I.P. 5280.
15. Specimen showing thick, folded and slightly sinuous trilete mark in focus with distal ornamentation out of focus, Reg. Sl. No. B.S.I.P. 5275.

16. Distal face of the same specimen showing ornamentation, coalescing tendency of sculptures, Reg. Sl. No. B.S.I.P. 5275.
- 17, 18. Laterally flattened specimens suggesting the shape of the spore in original condition, Reg. Sl. Nos. B.S.I.P. 5278, 5277.
20. Laterally flattened specimen suggesting the shape of the spore, showing nature of distribution of sculptures from proximal to distal face, Reg. Sl. No. B.S.I.P. 5271.
19. Laterally flattened specimen showing the organization of the spore, Reg. Sl. No. B.S.I.P. 5277.
- 21, 22. Reg. Sl. Nos. B.S.I.P. 5274, 5273.

