

STUDIES IN THE TALCHIR FLORA OF INDIA — 1. *SPORAE DISPERSAE* FROM THE TALCHIR BEDS OF SOUTH REWA GONDWANA BASIN

R. POTONIÉ* & K. M. LELE

Geologisches Landesamt, Krefeld & Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

Sporae dispersae from the Talchir shales at Goraia in the South Rewa Gondwana basin have been described. The spores are assigned to 13 genera. Two species, viz. *Potonieisporites neglectus* and *Lunatisporites goraiensis*, are new. The genus *Quadriflorites* of Hennelly (1958) is emended.

The spores are placed in organ and form genera and species according to the International Code of Palaeobotanical Nomenclature. The organ and form genera are then placed in a morphographic system because most of them cannot still be assigned to the morphological system of plant families.

INTRODUCTION

FOSSIL impressions from the locality of Goraia ($23^{\circ}20'50''$: $81^{\circ}2'43''$, Topo sheet No. 64 E/3, Survey of India) have already been described in an earlier paper by Surange and Lele (1956). The section exposed on the north bank of Johilla river, NW. of Goraia, reveals the following beds in ascending order:

7. Greenish yellow, micaceous sandstone
6. Upper grey shale (*with fragmentary impressions and microflora*)
5. Earthy yellow to khaki-coloured, muddy, micaceous silt (*unstratified and with badly preserved stem impressions*)
4. Greenish grey shale (*with fossil impressions described in the earlier paper, Surange and Lele, 1956*)
3. Micaceous sandstone
2. Lower grey shale (*with microflora*)
1. Calcareous sandstone

The total thickness of the section is about 20 ft. The strata show a gentle dip towards north-east.

The material which is described below has come from bed 2 (lower grey shale) and bed 6 (upper grey shale) of the above section. Of these two beds, the upper grey shale bed

(No. 6) contained a few very fragmentary fossil impressions which are unidentifiable. The shales of both the beds are fairly compact and rather siliceous. Consequently, hydrofluoric acid was preferred to Schulze's solution for their maceration. The material, after treatment with HF, was washed free of the acid and the finer residue was directly mounted in Canada balsam or glycerine jelly.

For the description of the *Sporae dispersae* the following method is adopted. For every more or less well-preserved specimen of the preparations an individual description (or analysis) is made containing all necessary data (only those analyses are retained in the paper which are of morphographical interest). Having done so, all the descriptions are compared with one another and with the species hitherto described, trying in this way to find the range of the species. Here often we have the best indications if we are able to compare our material with the hitherto described materials of other strata more or less older or younger, the stratigraphical point of view being very useful in finding out the limits of the species.

We are obliged to assign some of our specimens to the species of the European Carboniferous. Fortunately, however, these species are not stratigraphically important.

We must designate the spore contents of our shales as 'Thanatocoenoses'. A thanatocoenose is a complex of different fossils including species which did not live in the places where they were embedded. It represents an admixture of species coming from perhaps different ecological conditions. They have been put together by physical agencies, in our case by wind and water. Most of our spores must be allochthonous.

The spore content of a coal, on the other hand, will not contain so much allochthonous

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elements. There will be chiefly such spores produced from plants growing on the place of sedimentation. They could be called autochthonous or to be more exact hypautochthonous, a small transportation having occurred. Thus, those plant elements are called hypautochthonous which have been deposited without leaving the dwelling place of their mother plants. Such fossils speak of the ecological conditions of the site of deposition.

DESCRIPTION

Anteturma	<i>Sporites</i> H. Potonié 1893
Turma	<i>Triletes</i> (Reinsch 1881) Pot. & Kr. 1954
Subturma	<i>Azonotriletes</i> Lubert 1935
Infraturma	<i>Laevigati</i> (Benn & Kidst. 1886) R. Pot. 1956

LEIOTRILETES (NAUMOVA 1937) POT. & KR.
1954

Generic Diagnosis — See also Pot. & Kr. 1955, p. 36.

It is said in this diagnosis that in *Leiotriletes* are placed triangular and subtriangular forms with smooth exine even if the equator approaches very much a circle. This means there are \pm rounded subtriangular forms and only those which are very circular are to be placed in *Punctatisporites*. In *Leiotriletes* the rays of the trilete mark are mostly longer than half of the radius.

While in *Leiotriletes* the sides of the equatorial triangle are often not absolutely straight, it is so in the Cretaceous genus *Deltoidospora* (MINER, 1935) R. Pot. 1956, p. 13.

1. *Leiotriletes adnatoides* Pot. & Kr. 1955, p. 38 (diagnosis)

Pl. 1, Figs. 1-3

Hitherto known size range 30-40 μ ; we have 28-48 μ ; equator triangular to very triangular, the trilete rays in our forms attaining the equator; in the former diagnosis it is said that the trilete rays almost attain the equator.

2. *Leiotriletes* spp.

Pl. 1, Figs. 4-6

Form 1. Only two specimens, measuring greatest diameter 56 μ (Pl. 1, FIG. 4) and 66 μ ; equator triangular; exine smooth.

Form 2. *Analyses* —

(i) PL. 1, FIG. 5 — Size 44 \times 40 μ ; equator subtriangular with convex sides, rays of trilete mark nearly attaining equator, a little sinuous; exine with faint infrareticulation.

(ii) PL. 1, FIG. 6 — Size 52 μ ; rays straight, nearly attaining equator; exine infrareticulate; equator rounded subtriangular; agrees \pm with the spore in Pl. 1, Fig. 5.

PUNCTATISPORITES (IBR. 1933) POT. & KR.
1954, 1955 (DIAGNOSIS, p. 41)

3. *Punctatisporites punctatus* Ibrahim 1932

Pl. 1, Figs. 7, 8

Diagnosis — See also Pot. & Kr. 1955, p. 44.

Our specimens range from 40 to 68 μ in size. Formerly the known size range was 50-80 μ . The rays were so far known to almost attain the equator. In one of our forms the trilete rays appear to attain the equator; equator circular.

4. *Punctatisporites minutus* Kosanke 1950

Pl. 1, Figs. 9, 10

Diagnosis — See also Pot. & Kr. 1955, p. 43.

Formerly known size range 25-35 μ ; our specimens range from 32 to 34 μ ; trilete rays going near to the equator; previously it was mentioned that the rays are longer than half of the radius.

Analyses —

(i) PL. 1, FIG. 9 — Size 28 \times 32 μ ; equator \pm circular; tecta of trilete rays sharp, going near the equator and not visibly tapering; infrapunctation or infragranulation very fine.

(ii) PL. 1, FIG. 10 — Size 34 \times 28 μ ; trilete rays attaining nearly the equator; exine with some secondary folds; infrapunctation or infragranulation very fine.

5. *Sporae Laevigatae Incertae*

Pl. 1, Fig. 11

There are some laevigate miospores which have \pm a circular equator and where the trilete mark is not surely seen. They have often narrow secondary folds in spite of the fact that the exine is \pm thick.

**Infraturma *Apiculati* (Bennie & Kidston)
R. Pot. 1956**

GRANULATISPORITES (Ibr. 1933) Pot. & Kr.
1954

**6. *Granulatisporites parvus* Pot. & Kr. 1955,
p. 59**

Pl. 1, Fig. 12

Our specimens show, as in *parvus*, very faint grana which on the outline of the exine are often only partly seen. Our forms are sometimes more subtriangular to circular (see remarks under *Lophotriletes*). While previous authors mention that the trilete rays only almost attain the equator, in our specimens the equator is reached. We do not regard this difference as sufficient to make a new species.

Analysis —

(i) PL. 1, FIG. 12 — Size $40 \times 36 \mu$; trilete rays attain the equator, one of them little open near the apex; granulation to be seen in the extrema lineamenta; grana small and sparse.

**7. *Granulatisporites* (al. *Cyclogranisporites*)
orbiculus (Pot. & Kr. 1955) nov. comb.**

Pl. 1, Fig. 13

We have put the species in the genus *Granulatisporites* because there also occur more or less subtriangular forms. We have now the opinion that it would be better to place in *Cyclogranisporites* only those species which have an equator as good as absolutely circular.

Analysis —

(i) PL. 1, FIG. 13 — Size 32μ ; subtriangular; trilete mark extending up to the equator, rays of uniform breadth; on equator more than 12 grana between two rays.

CYCLOGRANISPORITES Pot. & Kr. 1954

Diagnosis — See also Pot. & Kr. 1955,
p. 60.

**8. *Cyclogranisporites leopoldi* (Kr.) Pot. & Kr.
1955**

Holotype — Pot. & Kr. 1955, p. 62; Pl. 30,
Fig. 174; 33μ ; West Germany, Ruhr basin;
Westfal B.

(A) *Cyclogranisporites leopoldi leopoldi*
Pl. 1, Fig. 14

Specimens with shorter trilete rays than in *C. leopoldi rewahensis* (see below).

Analysis —

(i) PL. 1, FIG. 14 — Size 44μ ; trilete rays more than half of the radius; between two rays perhaps 20 grana.

(B) *Cyclogranisporites leopoldi rewahensis*
nov. sub-sp.

Pl. 1, Figs. 15-17

Holotype — Pl. 1, Fig. 15; 40μ .

Locus Typicus — India, South Rewa Gondwana basin; Talchir Stage; Goraia, Bed 6.

Forms agree with *leopoldi*, but have trilete rays attaining the equator.

Analyses —

(i) PL. 1, FIG. 15 (Holotype) — Size 40μ ; trilete rays attaining equator; granulation not well preserved, some grana seen on the equator.

(ii) PL. 1, FIG. 16 — Size 32μ ; trilete rays perhaps approaching the equator; grana very brilliant.

(iii) PL. 1, FIG. 17 — Size 28μ ; trilete rays attaining equator; 18 grana from ray to ray, i.e. about 54 on the equator (in holotype of *leopoldi leopoldi* 65 grana).

LOPHOTRILETES (NAUMOVA 1937) Pot. & Kr.
1954

Diagnosis — See also Pot. & Kr. 1955,
p. 72.

It would be good to put in the genus *Lophotriletes* all forms with more or less triangular equator and in the genus *Apiculatisporis* only those forms which are as good as absolutely circular. The same holds good between the genera *Leiotriletes* and *Punctatisporites* and between *Granulatisporites* and *Cyclogranisporites*.

**9. *Lophotriletes cf. microsetosus* (Loose)
Pot. & Kr. 1955**

Pl. 1, Figs. 18, 19

While in *microsetosus* the equator is triangular with sometimes concave sides, our forms show \pm convex sides.

Analyses —

(i) PL. 1, FIG. 18 — Size 36μ ; trilete rays attaining equator; exine with little conii, 9 conii from ray to ray on the equator (holotype of *microsetosus* 39μ ; the species is known to have ± 35 conii on the equator).

(ii) PL. 1, FIG. 19 — Size 31μ (average); trilete mark not well seen; form subtriangular.

10. *Lophotriletes* sp.

Pl. 1, Figs. 20, 21

Analyses —

(i) PL. 1, FIG. 20 — Size 30μ ; subtriangular, edges rounded; trilete rays attaining equator; very fine coni, often not much greater than the grana; about 60 coni around the equator, points of the coni not always better seen. *Lophotriletes commisuralis* (Kosanke) has ± 45 coni around the equator.

(ii) PL. 1, FIG. 21 — Size 28μ ; flattened in the meridional line; trilete mark showing only two rays clearer.

APICULATISPORIS Pot. & Kr. 1956, p. 94

(Non-*Apiculatisporites* Ibr. 1933)

Generotype — *Apiculatisporis aculeatus* (IBRAHIM, 1933) R. Pot. 1956, p. 30.

Locus Typicus — W. Germany, Ruhr basin, junction of Westphal B and C.

Remarks Concerning Name of Genus — The name *Apiculatisporites* can no more be applied because it has disappeared with its generotype in the genus *Tuberculatisporites*. So it was necessary to introduce another name, *Apiculatisporis* (see R. Pot. 1956, p. 30), for the miospores not belonging to the megaspore genus *Tuberculatisporites*.

11. *Apiculatisporis* sp.

Pl. 1, Figs. 22-25

Our forms do not absolutely agree in size with those of Kosanke (1950), Potonié and Kremp (1955) and Knox (1950). The Russian literature, etc., was not accessible. Therefore, we describe these forms only as *Apiculatisporis* sp. They are not always absolutely rounded, sometimes a little more subtriangular. That means the two genera *Apiculatisporis* and *Lophotriletes* are not always easy to use.

Analyses —

(i) PL. 1, FIG. 22 — Size 36μ (with ornamentation); equator rounded polygonal; rays perhaps to be seen, narrow, approaching not completely the equator; ± 18 coni seen upon the whole equator, clear conical shape, pointed, covering the whole exine, not all of absolutely the same dimension.

(ii) PL. 1, FIG. 23 — Size 38μ (with ornamentation); equator rounded subtriangular; trilete mark clear, rays attaining equator; perhaps 18 coni on the whole equator.

(iii) PL. 1, FIG. 24 — Size about 40μ (with ornamentation); similar trilete mark visible.

(iv) PL. 1, FIG. 25 — Size 44μ (with ornamentation); equator irregular circular; trilete mark seems to be very faint and with short rays; exine covered with coni, only 22 to be seen on the whole equator, having broad bases; they seem to be sparse because the bases are broad, often they are well pointed.

Infraturma Murornati Pot. & Kr. 1954

12. *Sporae Murornatae incertae*

Analysis — Size 32μ ; rounded subtriangular, trilete rays attaining equator, coarse irregular reticulum; it is an infrareticulum because on one side of the extrema lineamenta the muri of the reticulum are seen covered by an exolamella. Single grain, therefore not determined.

Turma Aletes Ibrahim 1934

QUADRISPORITES (HENNELLY 1958) EMEND.

Generotype — *Quadrissporites horridus* (HENN. 1958), Pl. 5, Fig. 7 (chosen hereafter); Australia; N.S.W.; Appin Bore No. 4 at 1697 ft. 2 in.; Permian-Triassic Transition.

Emended Generic Diagnosis — Four bodies together in rhomboidal or square position; flattened in the bedding plane and perhaps originally more or less globular; bodies not bean-shaped, germinal aperture not seen; ornamentation shows grana, pilae or bacula.

Remarks — Hennelly's diagnosis is very inadequate and he has not given a differential generic diagnosis. Further, his description shows contradictions. For instance, on p. 364 he says: "The morphology of the tetrad suggests the monoete condition." If it is so, the tetrad should be in a rhomboidal position. But on p. 365 Hennelly speaks of "Tetragonal tetrads". He says this in spite of the fact that his photographs on Pl. 5, Figs. 6, 7, show clearly that all the four individuals of the tetrad are in the same bedding plane, exactly as in our case.

Differential Generic Diagnosis — Cookson (1947, p. 133) has proposed a unit *Droseridites*. If we consider it a form genus, the generotype would be the Tertiary form *Droseridites spinosa* (loc. cit., Pl. 16, Figs. 70, 71).

A generic diagnosis does not so far exist and hence the diagnosis of the latter form must represent it. Then a 'genus' *Droseridites* would differ from *Quadrisporites* in the presence of longer and sparse spinae on the exine of the grains.

13. *Quadrisporites horridus* (Henn.) emend.

PL. 1, Figs. 26-36

1946 Virkki; PL. 6, Fig. 71; Text-fig. 39

Emended Specific Diagnosis — Size range $32-80 \times 28-64 \mu$; four bodies lying near together in bedding plane, mostly not overlapping one another and forming together a rounded square or a rounded rhombus. It was not possible to find any germinal aperture, either monolete or other marks. The body of all the specimens is covered with an ornamentation ranging from fine and dense bacula to pilae which may sometimes be reduced by maceration or preservation so as to resemble grana.

Remarks — The forms of *Q. horridus* in our material are much better preserved than those of Hennelly's. It was, hence, possible to observe a number of details which are wanting in Hennelly's description.

There is a slight difference in the size range of our forms and those of Hennelly. However, the difference is not enough to warrant another species. The ornamentation elements are also better seen in our specimens. We believe that the 'interrupted microreticulum' observed by Hennelly (p. 365) is merely the picture of another focus position.

Analyses —

(i) PL. 1, FIG. 26 — Size $60 \times 52 \mu$; a tetrad of spores in \pm rhomboidal position; exine covered \pm regularly with little 'grana' to bacula which have between them spaces \pm as great as the diameter of the bacula; on the extrema lineamenta some of the bacula measure more than 2 times their diameter, perhaps these bacula have at their ends a little globular thickening, not all ornamentation elements are such long bacula or pilae, some of them being apparently shorter bacula or even grana; these variations of ornamentation may be produced by secondary effects.

(ii) PL. 1, FIG. 27 — Size $60 \times 56 \mu$; all ornamentation elements are little bacula; so in

the first case also they may have been bacula and not grana; globular thickenings at the ends of pilae not seen, outgrowths seem to be tapering so that they have more the shape of spinae or short hairs; in the centre of tetrad is seen a little hole so that each spore is only in lateral contact with two others.

(iii) Not figured — Size $80 \times 60 \mu$; four bodies form a rhomboidal tetrad, placed in such a way that two of them lie nearer together with a greater contact than the rest two; overall outline forms a rhombus and not a square.

(iv) PL. 1, FIG. 28 — Size $40 \times 36 \mu$; ornamentation lost by overmaceration; two spores approaching closer than the rest two; in spite of overmaceration the 4 bodies are together.

(v) PL. 1, FIG. 29 — Size $32 \times 28 \mu$; spores in square position; overmaceration has only left the bases of the ornamentation elements so as to appear granulate.

(vi) PL. 1, FIG. 30 — Size 60μ ; square arrangement; extrema lineamenta not composed of so many layers as the contact zones; in most cases ornamentation elements are little spinae, only sometimes with globular ends.

(vii) PL. 1, FIG. 31 — Size 64μ ; ends of the little spinae, bacula or pilae seem slightly globular.

(viii) PL. 1, FIG. 32 — Size $64 \times 60 \mu$; four bodies in square position, two of them approaching in the centre to one another more than the rest two.

(ix) PL. 1, FIG. 33 — Size 48μ ; four bodies seem flattened very much in bedding plane; before flattening they were perhaps globular or lens-shaped; grains overlap each other a little; ornamentation also visible in contact regions.

(x) PL. 1, FIG. 34 — Size 40μ ; extrema lineamenta of one of the bodies shows clear, little spinae.

(xi) PL. 1, FIG. 35 — Size 64μ ; only three bodies; ornamentation same; bacula sometimes long; in one of the bodies a part of the upper exine has disappeared so that the exine with ornamentation of the other side is exposed.

(xii) PL. 1, FIG. 36 — Size 24μ ; a single grain, perhaps of the species having \pm the same size as one of the tetrad; monolete mark or similar structure not seen; ornamentation finer than in other cases and all around the body.

Anteturma	<i>Pollenites</i> R. Pot. 1931
Turma	<i>Saccites</i> Erdtman 1947
Subturma	<i>Monosaccites</i> (Chitaley 1951) Pot. & Kr. 1954

NUSKOISPORITES POT. & KLAUS 1954
(DIAGNOSIS, P. 528)

Our forms of *Nuskoisporites* vary considerably. If we would make it as some other authors have done, we could create a quantity of new species, but it must be considered that the somewhat different specimens are in the same preparation. Therefore, it is neither of botanical nor stratigraphical value to create here many species. This is chiefly so because all the forms are in connection with one another by transitions. We may say once more that it is another thing if we find resembling forms in different strata, and in one of these strata, besides all these transitions mentioned before, we have some extreme or new forms which are not found in the other strata; that means we must define the limits of form- and organ-species by observing the stratigraphical point of view. In fact, this viewpoint is the most useful to see the limits between our species.

One of the points which led to the creation of the genus *Nuskoisporites* was that the rays of the trilete mark were mostly as broad at the apex as at the ends and there suddenly cut off bluntly. Because some of our spores show similar features, we place them in *Nuskoisporites* together with those which slowly deviate from the normal. It is no more good to say that a limbus is an absolutely necessary feature of the genus *Nuskoisporites*.

14. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis* (Mehta 1944) n. comb. & emend.

Pl. 1, Figs. 37, 38; Pl. 2, Figs. 39-50

Holotype — Mehta 1944, p. 129; Pl. 1, Fig. 1; ca. 75.4 μ .

Locus Typicus — India, South Rewa Gondwana basin, Pali beds; Permian.

1946, Virkki (Mrs. C. Jacob), Pl. 2, Figs. 13, 14 (Kathwai, Salt Range, 1½ ft. above Talchir boulder bed); Pl. 4, Figs. 45-48; Pl. 5, Fig. 52 (Kathwai, Salt Range, 20-25 ft. above); Pl. 8, Fig. 116 (Daltonganj Coalfield, Lower Barakar); Pl. 11, Figs. 142-146; Pl. 12, Fig. 147 (Pali beds, Rewa; this is the *locus typicus* of *N. triangularis*); Pl. 14, Fig. 184 (Australia, Victoria, Bacchus Marsh Tillite).

1951-52, Goswami, *Hymenozonotriletes triangularis* Mehta, Pl. 13, Fig. 10 (Burhar, Dhanpur, first seam in Mine 2).

1953, Sen, p. 135, Fig. 1 (Karharbari Coalfield).

1955, Surange & Lele, Pl. 2, Figs. 13, 14 (Giridih Coalfield, Talchir Needle shales).

1956a, *Nuskoisporites gondwanensis*, Balme and Hennely, Pl. 6, Figs. 62-65; Pl. 7, Fig. 66 (Lectoholotype \pm 160 μ), 67 (Australia, New South Wales, Big Ben Seam, Bloomfield Colliery, Tomago stage).

Specific Diagnosis — Size range 100-150 \times 96-140 μ ; equator mostly circular to oval or subtriangular, the equator line more or less undulated; central body mostly circular, outline clear, sometimes the central body seems to be lost and then the trilete mark is not visible; ends of trilete mark not attaining equator of the central body; length of the trilete radii \pm two-thirds of the radius of central body; breadth of the trilete rays uniform from the apex to their ends; breadth of the saccus usually more than half of the radius of central body; an infold of the saccus is seen surrounding the central body and producing a darker 'rim'; this occurs because the saccus in being flattened makes near the equator of the central body a circular fold system so that here we may see one over the other more layers of the exoexine forming the saccus.

Remarks — *N. gondwanensis* Balme & Hennely 1956a is identical with *N. triangularis* Mehta 1944. The holotype of *triangularis* is a little triangular but rounded triangular. Subsequently Goswami (1951-52, Pl. 13, FIG. 10) has published another specimen from the South Rewa Gondwana basin (from the first seam in Mine 2, Dhanpur, Burhar) which agrees very well with *triangularis*, but is irregularly rounded and not at all triangular. Also in our specimens and in the specimens of other authors there are both rounded and rounded triangular forms.

Differential Diagnosis — This form differs from *N. dulhuntyi* in the presence of longer trilete rays and by the fact that a limbus is not seen. The trilete mark has the length of *N. klausii* Grebe 1957. It compares with *N. klausii* in having sometimes a fold-rim surrounding the central body, but differs in not having a limbus. Further, sometimes it has subtriangular to oval shape and a more undulated equatorial margin. The undulations of the extreme equator are only obscurely seen in *N. klausii*. Compare also differential diagnosis given under *N. rotatus*.

Analyses —

(i) PL. 1, FIG. 37 — Size $148 \times 140 \mu$; equator undulated; equator of the saccus without limbus; reticulation of the saccus endosporoid; infrareticulation of saccus not so clear as in central body.

(ii) PL. 1, FIG. 38 — Size $116 \times 108 \mu$; fold-rim clear; trilete rays \pm two-thirds of radius of central body.

(iii) PL. 2, FIG. 39 — Size $96 \times 100 \mu$; more or less circular, central body well seen; on the distal side of central body the saccus is attached a little subequatorially; fold-rim very clear.

(iv) PL. 2, FIG. 40 — Size $120 \times 112 \mu$; trilete rays \pm half of the radius of central body; fold-rim well seen, having nearly one-third of breadth of saccus; equator undulated.

(v) PL. 2, FIG. 41 — Size 136μ ; in this case the trilete rays are as short as in *N. dulhuntyi*, but limbus absent

(vi) PL. 2, FIG. 42 — Size $108 \times 104 \mu$; breadth of trilete rays uniform from apex to ends; two of the rays smaller, measuring half of third ray; two deeper notches in the extrema lineamenta; fold-rim seen; infrareticulation of central body very delicate, breadth of saccus a little more than half of the radius of central body; shows transition to *rotatus*.

(vii) PL. 2, FIG. 43 — Size 100μ ; central body not well seen; equator circular but clearly undulated.

(viii) PL. 2, FIG. 44 — Size $132 \times 128 \mu$; central body not seen, probably lost.

(ix) PL. 2, FIG. 45 — Size $114 \times 108 \mu$; body dark brown; breadth of the saccus greater than half of the radius of central body; fold-rim broader than in other specimens; apex eccentric and, therefore, two of the rays much more longer than the other; equator very undulated.

(x) PL. 2, FIG. 46 — Size $120 \times 104 \mu$; this specimen resembles *N. triangularis*, but has only a monoete mark being very well placed across the centre of the body.

(xi) PL. 2, FIG. 47 — Size $124 \times 100 \mu$; shrunken specimen; fold-rim broad and clear; trilete rays attaining \pm the inner margin of the fold-rim; saccus frilled; equator of the saccus very undulated.

(xii) PL. 2, FIG. 48 — Size $128 \times 102 \mu$; this specimen has opened by a hole which appears like an inscribed triangle in the circle of the central body.

(xiii) PL. 2, FIG. 49 — Size $132 \times 104 \mu$; trilete mark clear, not attaining equator of

central body; rays of uniform breadth from apex to their ends; form more subtriangular; equator of saccus \pm undulated; limbus not seen; central body with delicate infragranulation.

(xiv) PL. 2, FIG. 50 — Size $104 \times 92 \mu$; form roundly triangular.

Stratigraphical Remarks — The species *triangularis* has so far been recorded from various horizons in India and Australia. From India it is known from $1\frac{1}{2}$ ft. and 20-25 ft. above the Talchir boulder beds at Kathwai, Salt Range, Pakistan (VIRKKI, 1946), from the Talchir needle shale (Stage) of the Giridih Coalfield (SURANGE & LELE, 1955), from the Karharbari stage of the Giridih Coalfield (SEN, 1953), from the Lower Barakars of Daltonganj Coalfield (VIRKKI, 1946) from the Pali beds (Lower Gondwana) of the South Rewa Gondwana basin (VIRKKI, 1946; MEHTA, 1944) and from the coals from Burhar in the South Rewa basin (GOSWAMI, 1951-52). In Australia it is known from the Bacchus Marsh Tillite (VIRKKI, 1946) and from the Tomago stage (Big Ben Seam, Bloomfield Colliery) of New South Wales (BALME & HENNELLY, 1956a).

Some specimens figured by Datta (1957; e.g. FIG. 34) from the Barakars of South Jhagrakhand (Madhya Pradesh) seem to be referable to *triangularis*.

Another specimen described by Goswami (1951-52, p. 193; PL. 12, FIG. 2) as *Endosporites burharensense* may perhaps also be included under *triangularis*, although the photograph is not sufficiently good to bring out the details.

The specimen figured by Surange and Lele (1955, PL. 2, FIG. 18) is not well preserved, but may belong to this species. More difficult is the determination of the specimen reproduced by the above authors on PL. 1, FIG. 9, which shows a monosaccus more narrow on two sides of the central body. This specimen being the only one in the preparation with others should be at present considered as perhaps an aberrant form.

15. *Nuskoisporites rotatus* Balme & Hennelly 1956

PL. 2, Figs. 51-56

Lectoholotype — Balme & Hennelly 1956a, PL. 8, FIG. 69 \pm 120μ (we consider this photo as the holotype hereafter).

Locus Typicus — Australia, N.S.W., Main Greta Seam, Hebburn No. 2 Colliery, Greta Coal Measures.

1946, Virkki (Mrs. C. JACOB); Pl. 2, Fig. 12 (Kathwai, Salt Range; $1\frac{1}{2}$ ft. above Talchir boulder bed); Pl. 3, Fig. 27 (Kathwai, Salt Range, $4\frac{1}{2}$ ft. above Talchir boulder bed); Pl. 6, Fig. 81 (Warcha, Salt Range; just below middle productus limestone); Pl. 8, Fig. 114 (Lower Barakar, Daltonganj Coalfield). 1951-52, Goswami; *Florinites* sp.; Pl. 12, Fig. 4.

Specific Diagnosis — Size range 92-124 × 88-108 μ ; equator circular to oval or sometimes subtriangular; breadth of the surrounding saccus usually less than a half of the radius of central body; equator line of saccus undulated, sometimes a little lobed; breadth of saccus not everywhere uniform; limb not seen in our specimens (Balme and Hennelly mention it for some specimens only); infrareticulation of saccus showing lumina with \pm the same diameter as the breadth of muri. Well-preserved specimens show around the equator of central body a fold-rim formed by the saccus-exoexine which appears darker because several layers of it are pressed one over the other. Sometimes the central body is more or less decayed. If it is not so, we may see very clearly the trilete mark. The apex of the trilete mark is placed \pm eccentrically so as to approach \pm the equator or the centre of the central body. The more it approaches the equator, the two branches of the trilete mark become shorter on that side, but they never attain the equator of the central body. So we have often one long and two short branches on the trilete mark. Occasionally, there is only a monolete mark. Such differences do not permit specific separation because they are present in the same sediment. If the apex approaches the centre of the central body, the rays of the trilete mark are \pm two-thirds of the radius of the central body. The tecta are of equal breadth from apex to their ends and there cut bluntly. These two features are almost seen in the genus *Nuskoisporites*. Infraornamentation of the central body very fine.

Differential Specific Diagnosis — *N. rotatus* differs from *N. triangularis* in having a narrower saccus. In *rotatus* the breadth of the saccus is half or generally less than half of the radius of the central body, while in *triangularis* it is usually more than half. It may be that the lumina of the saccus reticulum become relatively greater if the saccus is more blown out. The fold-rim between the saccus and the central body is better seen in *triangularis* than in *rotatus*.

It is difficult to separate the two species because there exist transitions from one to the other. However, since both species have been created by other authors and there has not been till now the opportunity to study the stratigraphical difference which perhaps may exist, we retain the two species.

Analyses —

(i) PL. 2, FIG. 51 — Size 108 μ ; trilete rays of equal length, having half of radius of central body; fold-rim not well seen; breadth of saccus less than half of the radius of central body; apex only a little eccentric; breadth of the saccus not uniform everywhere; trilete rays of equal breadth from apex to their ends; equator of saccus approaches subtriangular form; lumina of the infrareticulum of saccus not broader than muri separating them.

(ii) PL. 2, FIG. 52 — Size 112 × 104 μ ; trilete mark faintly seen; equator more subtriangular; breadth of saccus about half of the radius of central body, not uniformly broad everywhere; infrareticulation of saccus as in last specimen; extreme equator undulated.

(iii) PL. 2, FIG. 53 — Size 118 × 102 μ ; equator circular to roundly oval; breadth of the surrounding monosaccus \pm half of the radius of central body; fold-rim round the central body well seen, trilete mark with one longer and two shorter rays, the longer ray being \pm half of the radius of central body; ornamentation of central body not distinct; extreme equator undulated; apex \pm eccentric; trilete rays of equal breadth from apex to ends.

(iv) PL. 2, FIG. 54 — Size 116 × 108 μ ; as above but fold-rim not to be seen; trilete mark with two rays of equal length which measure nearly half of the longer ray; apex more eccentric than the above; shows transition to *triangularis*.

(v) PL. 2, FIG. 55 — Size 124 × 104 μ ; trilete mark with more equal rays, but apex a little eccentric; equator a little more oval; fold-rim not seen; transition to *triangularis*.

(vi) PL. 2, FIG. 56 — Size 112 × 104 μ ; resembles *N. rotatus*, but with a monolete mark in the centre; mark somewhat bent at one end.

16. *Nuskoisporites* spp.

(Extreme variations of the genus)

(i) PL. 2, FIG. 57 — Size 124 × 80 μ ; extrema lineamenta oval, undulated; breadth of saccus even in the narrower parts greater

than the radius of central body, in other parts two or three times the radius of central body.

Such a broad monosaccus has not been observed in other specimens. For the present we put the specimen aside without better definition because it is a solitary specimen. Mehta (1943, p. 173, PL. 22, FIG. 17) has also shown a specimen with very broad saccus, but it is not possible to say whether it agrees absolutely with ours. It has a well-developed darker rim between the saccus and the central body.

(ii) PL. 2, FIG. 58 — Size 48 μ ; equator subtriangular, notched; breadth of monosaccus \pm half of the radius of central body; tetrad mark not visible; exine of central body partly lost.

(iii) PL. 2, FIG. 59 — Size 66 μ ; equator subtriangular; breadth of saccus less than half of the radius of central body; outline of central body well seen; trilete mark \pm one-third of the radius of central body.

The spores represented in Pl. 2, Figs. 58, 59, are rather smaller in size than the present species of *Nuskoisporites*. They may be compared with certain small spores described by Virkki (1946; cf. PL. 5, FIGS. 50, 51; PL. 11, FIGS. 140, 141).

POTONIEISPORITES BHARDWAJ 1954

Generotype — *Potonieisporites novicus* Bhardwaj 1954, p. 521, Text-fig. 10 (drawing); 1955, Pl. 2, Fig. 13 (Photo of the same specimen); 140 μ ; Pfalz, Labachgrube bei Breitenbach, Grenzkohlen-Floez, Breitenbacher Schichten, Karbon, Stephan C.

Bhardwaj (1954, p. 519) calls the genotype *P. novicus*, but the same author (1955) calls it *novicus*, only in the explanation of the plates while in the text (p. 133) he erroneously writes *P. saarensis*, which name is invalid.

Potonieisporites has a monolete mark which sometimes is a little open by a fissure. This opinion is based on a new examination of the preparations of Bhardwaj and our present preparations. Formerly the mark was sometimes considered to be a fold or tenuitas. Germinal folds are broader and never so sharp as the tecta of monolete marks. We believe that the whole area surrounded by the folds which accompany the equator of the central body lies on the distal side and may be the germinal area; this is perhaps suggested by the two clearer folds which often occur (as in the bisaccate spores), facing one another and \pm at right angles to the longer axis of the grain.

The genus *Vestigisporites* differs from *Potonieisporites*. The authors (BALME & HENNELLY, 1955) have proposed the former genus for bisaccate spores where only sometimes the two sacci are joined to form a single air-sac. In *Potonieisporites* there is always only one saccus.

It was perhaps not good that in the Synopsis, Pt. II, of R. Potonié (1958, p. 46) *Vestigisporites* was placed under the *Monosaccati*. But such morphographical separations are often difficult, although in spite of this decisions must be made.

If we study preparations of *sporaes dispersae*, we may find at the first view 'thanatocoenoses' (see p. 22) with very different spores. But in studying such samples longer we sometimes see that there are transitions between the forms at first seeming so different. So it becomes difficult to put a systematical order in the matter. Such a case is exemplified by our samples. There are forms which we have called *P. neglectus*. We have to separate them from *P. novicus* found by Bhardwaj in the Saar Coals. Unfortunately, we now find transitions from the Gondwana form (*P. neglectus*) to the European form of the Saar Carboniferous (*P. novicus*).

In spite of this it is not good to put them together because till now transitions from *novicus* to *neglectus* have not been found in the Saar Carboniferous. It is disappointing yet significant that there are even transitions from *P. novicus* Bhardwaj to *Nuskoisporites*, chiefly to those forms which have been found in Australia as *N. triangularis* (al. *gondwanensis*) and *N. rotatus*. Because these forms have good relations with the European *N. dulhuntyi* (genotype), we must put them in the genus *Nuskoisporites*. On the other hand, the range of the transitions in our specimens is not the same as in Europe. This has perhaps stratigraphical value. Had we put from the beginning all forms together which show transitions between one another, we would not have made progress either from palaeobotanical point of view or from stratigraphical.

17. *Potonieisporites neglectus* n.sp.

Pl. 2, Figs. 60-63; Pl. 3, Figs. 64, 65

Holotype — Pl. 3, Fig. 64; 176 \times 120 μ .

Locus Typicus — India, South Rewa Gondwana basin; Talchir Stage; Goraia, Bed 6.

Specific Diagnosis — Size range 104-176 × 88-132 μ ; central body often more oval to trapezoid (in *P. novicus* more circular); monolete mark sometimes replaced by a very asymmetrical trilete mark (not so in *P. novicus*), but there are still many cases with a monolete mark; if the tetrad mark tends to be a trilete mark, it is always an asymmetric one where all the three rays are \pm of different length. The saccus surrounding the central body is relatively narrower on the longer sides of the extreme equator than in *P. novicus*. The fold-rim surrounding the central body is often well seen. The two transverse folds are not, as a rule, placed away from the equator of the central body.

Differential Specific Diagnosis — In *P. neglectus* the central body is \pm polygonal and even sometimes trapezoid while in *P. novicus* it is more circular (elliptical or ovoid, according to the diagnosis of Bhardwaj, 1954, p. 520). Unlike *novicus*, the breadth of the surrounding saccus is relatively smaller on the longer sides of the entire spore than on the small side.

Analyses —

(i) PL. 2, FIG. 60 — Size 148 × 100 μ ; equator oval; central body monolete, \pm trapezoid, parallel sides of the trapezium being parallel to longer axis of saccus; infrareticulation of saccus shows on the longitudinal periphery lumina which are a little greater than the breadth of the muri, sometimes double of the muri; equator of saccus shows most undulations in the middle of the longer sides.

(ii) PL. 2, FIG. 61 — Size 116 × 132 μ ; more regularly oval, central body more round, the folds surrounding the central body not so well developed, central body monolete; monolete mark measuring \pm one-third of the greatest equator of the central body (as in the first case) and also placed not exactly in the centre of the central body.

(iii) PL. 2, FIG. 62 — Size 104 × 88 μ ; central body trapezoid; tectum not well seen; infrareticulation of the saccus with lumina which have breadth often greater than that of muri; folds on both sides of the mark well seen, other folds comparatively smaller.

(iv) PL. 2, FIG. 63 — Size 120 × 88 μ ; mark seems more like a trilete mark with two shorter rays and one longer ray, the latter being placed along the longer axis of the grain; the two transverse folds are well marked; breadth of the surrounding saccus fairly reduced on the broader side of the outer equator.

(v) PL. 3, FIG. 64 (Holotype) — Size 176 × 120 μ ; extrema lineamenta oval; greatest breadth of monosaccus \pm as radius of central body, smallest breadth \pm one-fifth of radius of central body; folds chiefly seen on both sides of monolete mark, but not very broad; the two transverse folds not necessarily situated a little more away from equator as Bhardwaj emphasizes for *novicus*, they may also be \pm upon the equator of central body; monolete mark very central, \pm as long as radius of central body; infrareticulation of central body fine, lumina partly smaller than breadth of muri; lumina of saccus greater, sometimes two or three times the diameter of muri.

(vi) PL. 3, FIG. 65 — Size 136 × 120 μ ; equator \pm circular; resembles *novicus* in having a monosaccus which is \pm as wide on the longer side of the extreme equator as on the broader side of it.

Subturma *Dissacti* Cookson 1947
Infraturma *Striatiti* Pant 1954

LUNATISPORITES LESCHIK 1955

Generotype — *Lunatisporites acutus* Leschik 1955, p. 58, Pl. 7, Fig. 24.

Locus Typicus — Neuwelt near Basel; Schilfsandstein, Keuper.

Diagnosis — See also R. Pot., 1958, p. 52.

18. *Lunatisporites* (al. *Lueckisporites*) *amplus* (Balme & Hennelly 1955) R. Pot., 1958

Pl. 3, Figs. 66-69

Lectoholotype — Balme & Hennelly, 1955, Pl. 3, Fig. 24, \pm 106 μ ; (chosen from hereafter).

Locus Typicus — Australia, N.S.W., South Wallarah, New Castle Stage, Permian.

Some of our specimens agree very well with *Lunatisporites amplus* (BALME & HENNELLY, 1955). They have, as the authors say (l.c., p. 93), "only faintly discernible striae on the proximal face". Also the proportion of the size of sacci with the central body is the same. The forms have \pm oval equator, i.e. they are haploxyloide. Besides, we have forms which are absolutely oval and where the part of the sacci outside the central body is not so great as in the photos of Balme and Hennelly. In spite of this we believe it necessary to put together all these specimens with the clear *amplus* forms, they all being in the same preparation. The authors mention the size as 84-131 μ ; we have size variations from 80 to 140 μ .

19. *Lunatisporites goraiensis* n. sp.

Pl. 3, Figs. 70-72

Holotype — Pl. 3, Fig. 70; 126 μ .*Locus Typicus* — India; South Rewa Gondwana basin; Talchir Stage; Goraia, Bed 6.*Specific Diagnosis* — Size range 100-126 μ ; equator broadly oval to \pm circular; germinal area of the distal side between the saccus-lines \pm narrow; sacci \pm continuous on the longer side of the extrema lineamenta of the grain equator; 7 or more striations in most examples well seen; outline of the central body often not clear.*Differential Specific Diagnosis* — In the lectoholotype of *amplus* the width of the germinal area is \pm one-fourth of the greater diameter of the central body; in the holotype of *goraiensis* it is \pm one-tenth and, therefore, as narrow as in *Alisporites*. In equatorial section the sacci do not go out as much outside the central body as in *L. amplus*; infrareticulation of the sacci as in *amplus*, but in the more shrunken specimens the lumina are comparatively smaller than in those specimens which are more flattened.*Analyses* —(i) PL. 3, FIG. 70 (Holotype) — Size 126 μ ; equator broadly oval; germinal area between the sacci on distal side small as in *Alisporites*; striae well seen, 7 or more; lateral merging of sacci on the equator only little seen; infrareticulation of the sacci as in *amplus*, i.e. lumina \pm three times as broad as the muri.(ii) PL. 3, FIG. 71 — Size 108 μ ; the part of the saccus covering the central body greater than the part outside; equator broadly oval; sacci equatorially going together; infrareticulation with smaller lumina than in *amplus*.(iii) PL. 3, FIG. 72 — Size 122 μ ; equator haploxyloloid; germinal area narrow; about 7 striae seen; outline of central body not distinct.(iv) Size 84 μ ; equator approaching a circle; distal germinal area small; infrareticulation of sacci with greater lumina.(v) Size 112 μ ; equator haploxyloloid, more clearly so than in *amplus*; not so great a part of sacci outside central body as in *amplus*.**20. *Sporae Striatitae Incertae***

Pl. 3, Fig. 73

Analysis —(i) PL. 3, FIG. 73 — Size of the body 28 μ ; polygonal; striae about 14; sacci lost. Anundetermined form, not referable to a genus like *Welwitschiapites* Bolch. 1953.**Infraturma *Disaccitrileti* Leschik 1955
(Forms with clear or reduced Y-mark)****21. *Sporae Disaccitriletae Incertae***

Pl. 3, Fig. 74

Analysis —(i) PL. 3, FIG. 74 — Size 48 \times 40 μ ; equator of the central body rounded polygonal; outline finely notched; trilete mark with rays perhaps half of radius of central body; lumina of infrareticulation in body broader than muri between, e.g. 4 : 1; sacci seem placed more distally; in equatorial section of the grain the sacci outside the central body with a little less than half of their plane; plane of each saccus less than one-third of plane of central body; distal attachment lines of sacci far from one another so that the germinal area is broad, breadth perhaps half of the diameter of central body; infrareticulation in sacci finer than in central body; sometimes lumina in sacci not very much broader than muri between them.**Infraturma *Disaccitrileti* (Leschik 1955)**PITYOSPORITES (SEWARD 1914) R. POT. 1958,
P. 56 (DIAGNOSIS)We have between the Disaccites some examples where the distal area between the sacci is as small as in *Alisporites* and the outline of the equator is similarly haploxyloloid. But the forms are much smaller than *Alisporites* and the infrareticulation of the sacci finer, as fine as in some recent Podocarpaceae. Besides, we have transitions from these forms to others where the distal germinal area is broader, e.g. *Vitreisporites*. But *Vitreisporites* is much smaller and sometimes has a faint trilete mark. In one or two cases we also find the sacci very much turned about the distal side as in some of the smaller recent Podocarpaceae. But this may be a state of preservation. So it becomes difficult to place our bisaccate forms in one of the till-now-better-known fossil form genera of bisaccate spores. The task becomes more difficult because in the Russian literature there have been described several form genera which till now have not been studied well in other parts of the world. So, we believe, it will be the best in such cases to put the forms in the genus *Pityosporites* Seward 1914 as has been

done by many authors till now. It is said that in the genus *Pityosporites* such forms are placed whose accommodation with other genera is not quite possible (see R. POTONIÉ, Synopsis II, 1958, p. 57).

22. *Pityosporites* spp.

Pl. 3, Figs. 75-83

Analyses —

(i) PL. 3, FIG. 75 — Size 50 μ ; sacci smaller than half of the central body, approach one another on distal side; distally so much upturned that outlines of sacci lie \pm inside outline of central body.

(ii) PL. 3, FIG. 76 — Size 52 μ ; this form shows only some features of *Alisporites*, but no definite characters are present.

(iii) PL. 3, FIG. 77 — Size 50 μ ; sacci folded a little like those of *Cedrus*.

(iv) PL. 3, FIG. 78 — Size 58 μ ; the reticulum of sacci has very fine lumina as in *Podocarpidites* Cookson.

(v) PL. 3, FIG. 79 — Size 44 μ ; the form recalls *Indusiisporites* Leschik, but definite characters absent.

(vi) PL. 3, FIG. 80 — Size 52 μ ; approaching *Alisporites*; distal germinal area narrow; more than half of sacci outside outline of central body; infrareticulation of sacci fine; attachment haploxylo-noid.

(vii) Size 40 μ ; sacci upturned so much as in certain Podocarpaceae, but in the same preparation other forms show the sacci turned outside.

(viii) PL. 3, FIG. 81 — Size 48 μ ; germinal area broader than in *Alisporites*.

(ix) PL. 3, FIG. 82 — Size 128 μ ; lumina of sacci have sometimes diameter four or five times that of muri; infrareticulation abietinoid.

(x) PL. 3, FIG. 83 — Size 106 \times 84 μ ; form haploxylo-noid; germinal area broad, on each side a fold of the saccus present; outer line of fold seems to be the distal line of attachment of saccus; inner line representing only axis of fold.

SUCCINCTISPORITES LESCHIK 1955

Diagnosis — See also R. Pot., 1958, p. 59.

23. *Succinctisporites* sp.

Pl. 3, Fig. 84

Only a few specimens which do not allow specific determination.

Turma	<i>Monocolpates</i> Iverson & Troels-Smith 1950
Subturma	<i>Intortes</i> (Naumova 1937) emend. R. Pot. 1958

Colpus attaining the extrema lineamenta, opening mostly with a funnel-like widening at the ends.

GINKGOCYCADOPHYTUS SAMOILOWITZ 1953
Syn. *Entylissa* (Naumova 1937) ex Pot. & Kremp 1954

With the Russian literature available till now it seems that the name *Entylissa* must be replaced by *Ginkgocycadophytus*.

Generotype — *Ginkgocycadophytus caperatus* (LUBER, 1938, PL. 1, FIG. 11; more than 50 μ) Samoilowitz 1953, p. 30.

Locus Typicus — U.S.S.R., Siberia, Kuznetzk basin; about Lower Permian.

Shape \pm spindle-like; the longer axis shows a colpus which, if opened, is \pm funnel-shaped on both ends. The colpus or the opening reaches the extrema lineamenta of the exine.

Because in our material there are transitions between forms which are spindle-like and others which are broader and have a fold on either side of the colpus when opened, we have put all these in the same genus. Most of our forms agree best with the genus *Ginkgocycadophytus* which perhaps has unfortunately no more the name *Entylissa*. Since broader forms agree better with *Gynkgaletes*, we believe it will become more and more difficult, with increasing material, to separate from one another the genera *Ginkgocycadophytus* (al. *Entylissa*) and *Gynkgaletes* Luber, both having generotypes from the Lower Permian of Siberia, in the Kuznetzk basin.

We do not put our forms in *Cycadopites* (Wodehouse) ex Wilson & Webster 1946 because in the generotype of this taxon infragranulation is not mentioned and the size of the grain is smaller (39 μ).

24. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus* (Balme & Hennelly 1956, p. 63) n. comb.

Pl. 3, Figs. 85-95

Lectoholotype — Balme & Hennelly 1956, Pl. 3, Fig. 55; 54 μ chosen from hereafter.

Locus Typicus — Australia, N.S.W., Homeville Seam, Lower Split, Hebburn No. 1 Colliery; Permian.

Size range 52-68 μ ; outline boat-shaped to spindle-shaped, ends tapering to a point or \pm rounded; exine infragranulate; colpus following the longer axis of the exine and

expanded at the extremities. If the exine opens, this begins at the ends with a funnel-like shape. Also if the colpus is opened in the whole length, the opening is often larger at the ends. But there may be exceptions which cannot be placed in other species because they are all transitions in the same preparations. Sometimes the margin of the opening shows that the exine has folded itself more or less inside the grain so that the opening is accompanied by two folds. This fact also does not allow to make another species because all transitions are seen.

It would be possible to place some of our specimens in the species *vetus* Balme & Hennelly (1956, p. 63), but also between *vetus* and *cymbatus* are all transitions which are often found in the same preparation. Therefore, it is not suitable to distinguish the two species in our case.

Analyses —

(i) PL. 3, FIG. 85 — Size 64 μ ; colpus closed from one pole to the other; pole region tapering to a point.

(ii) PL. 3, FIG. 86 — Size 60 μ ; colpus attaining both poles, closed, appearing as a long, narrow, dark groove, on both sides accompanied by small clearer stripes; infra-ornamentation seen.

(iii) PL. 3, FIG. 87 — Size 68 μ ; form tapering a little to the poles; colpus only a little opened on poles; infragranulation to infra-reticulation well seen.

(iv) PL. 3, FIG. 88 — Size 64 μ ; colpus extending to poles, open only on one end; polar axis three times the equatorial axis; exine shows very fine infragranulation; grain resembles generotype of *Ginkgocycadophytus* (al. *Entylissa*).

(v) PL. 3, FIG. 89 — Size 62 μ ; colpus open, both sides of it overlapping one another, one of the poles still open; infraornamentation fine.

(vi) PL. 3, FIG. 90 — Size 64 μ ; colpus attaining poles, open along whole length but more on one of the ends; exine finely infragranulate.

(vii) PL. 3, FIG. 91 — Size 60 μ ; form somewhat tapering towards the poles; colpus attaining poles, open throughout but narrower in the middle.

(viii) PL. 3, FIG. 92 — Size 68 μ ; colpus funnel-like opened on both poles; exine finely infragranulate.

(ix) PL. 3, FIG. 93 — Size 66 μ ; colpus funnel-shaped on one side clearly.

(x) PL. 3, FIG. 94 — Size 60 μ ; form \pm rounded near the poles; colpus somewhat widely opened from one pole to the other, on both sides accompanied by clear folds.

(xi) PL. 3, FIGS. 95, 96 — Size 57 μ ; colpus broadly opened from one pole to the other but more on one of them; exine infragranulate.

25. *Sporae Monocolpatae Incertae*

Pl. 3, Figs. 96, 97

Analyses —

(i) PL. 3, FIG. 96 — Size 58 μ ; poles well rounded; colpus not going to poles, open most in the middle and tapering to ends, more approaching one of the poles; no folds on sides of colpus; structure of exine not available.

(ii) PL. 3, FIG. 97 — Size 44 μ ; poles rounded; exine everywhere closed; two broader folds tapering to ends and approaching one another; exine finely infragranulate.

COMPARISON AND DISCUSSION

Our present knowledge of the spore assemblages of the Indian Gondwana strata is not yet perfect. As regards the Lower Gondwanas, spores are known from a few feet above the Talchir boulder bed in the Salt Range (VIRKKI, 1946), from the Talchir shales (SURANGE & LELE, 1955; DATTA, 1957), from the Karharbari stage (SEN, 1953), from the Barakar stage (VIRKKI, 1946; SURANGE, SRIVASTAVA & SINGH, 1953; MEHTA, 1944; GOSWAMI, 1950-51, 1951-52; DATTA, 1957) and from the Raniganj stage (GHOSH & SEN, 1948).

It is difficult to compare the spore content of our samples with that of the earlier workers mentioned above because so far a detailed palaeobotanical investigation has mostly not been done. Especially our knowledge of the Talchir *Sporae dispersae* is far from complete. Virkki (1946) has described a large number of spores from horizons a few feet above the Talchir boulder bed (Salt Range, Pakistan), but the work was done at a time when a suitable morphographic system had not developed. However, the photographs of Virkki suggest that the overall spore complex of the strata is more or less the same as ours. There are certain different forms in which cases we do not know the stratigraphical importance. The occurrence of *Nuskoisporites* is strikingly common to both assemblages.

A clear difference is seen between our spore content and that of the Australian Permian sediments studied by Balme and Hennelly (1955, 1956, 1956a). Forms like *Acanthotriletes villosus* (1956a, PL. 3, FIGS. 37, 38), *Camptotriletes biornatus* (PL. 5, FIG. 55) and *Dulhuntyispora* (al. *Tholosporites egregius* (PL. 9)) are absent from our Talchir beds.

There is no palaeobotanical difference in the two beds of the section at Goraia. The spore assemblage is predominantly constituted of monosaccate spores, amongst which *Nuskoisporites* and *Potoniopsisporites* are most abundantly represented. The former genus seems also common in the horizons of Virkki.

The genus *Nuskoisporites* is known from Europe and Australia and the species mostly belong to the Permian and perhaps younger horizons. It is not so far recorded from European strata below Permian. In India, although the genus is present in the Permian

strata, it is also well represented in the Talchir beds of India and the Bacchus Marsh Tillite of Australia (VIRKKI, 1946) which are hitherto regarded as Upper Carboniferous. The other genus *Potoniopsisporites* is a Carboniferous genus of the Saar basin (W. Germany). The Talchir beds at Goraia and perhaps the Bacchus Marsh Tillite of Australia (VIRKKI, 1946, PL. 5, FIG. 49; TEXT-FIG. 30; PL. 10, FIGS. 135, 136; PL. 14, FIG. 187; see also BHARDWAJ, 1955, p. 134) also contain it.

In our samples the bisaccate spores are proportionately very few. Amongst these the genera *Pityosporites* and *Lunatisporites* are represented by some examples. In strata younger than the Talchirs, the bisaccate miospores become increasingly abundant — a fact which may be of some stratigraphical value. The monocolpate pollen grains of *Ginkgocycadophytus* (al. *Entylissa*) are fairly common in the present assemblage while the azonate trilete spores are rather rare.

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EXPLANATION OF PLATES

(The slides are preserved at the museum of the Birbal Sahni Institute of Palaeobotany)

PLATE 1

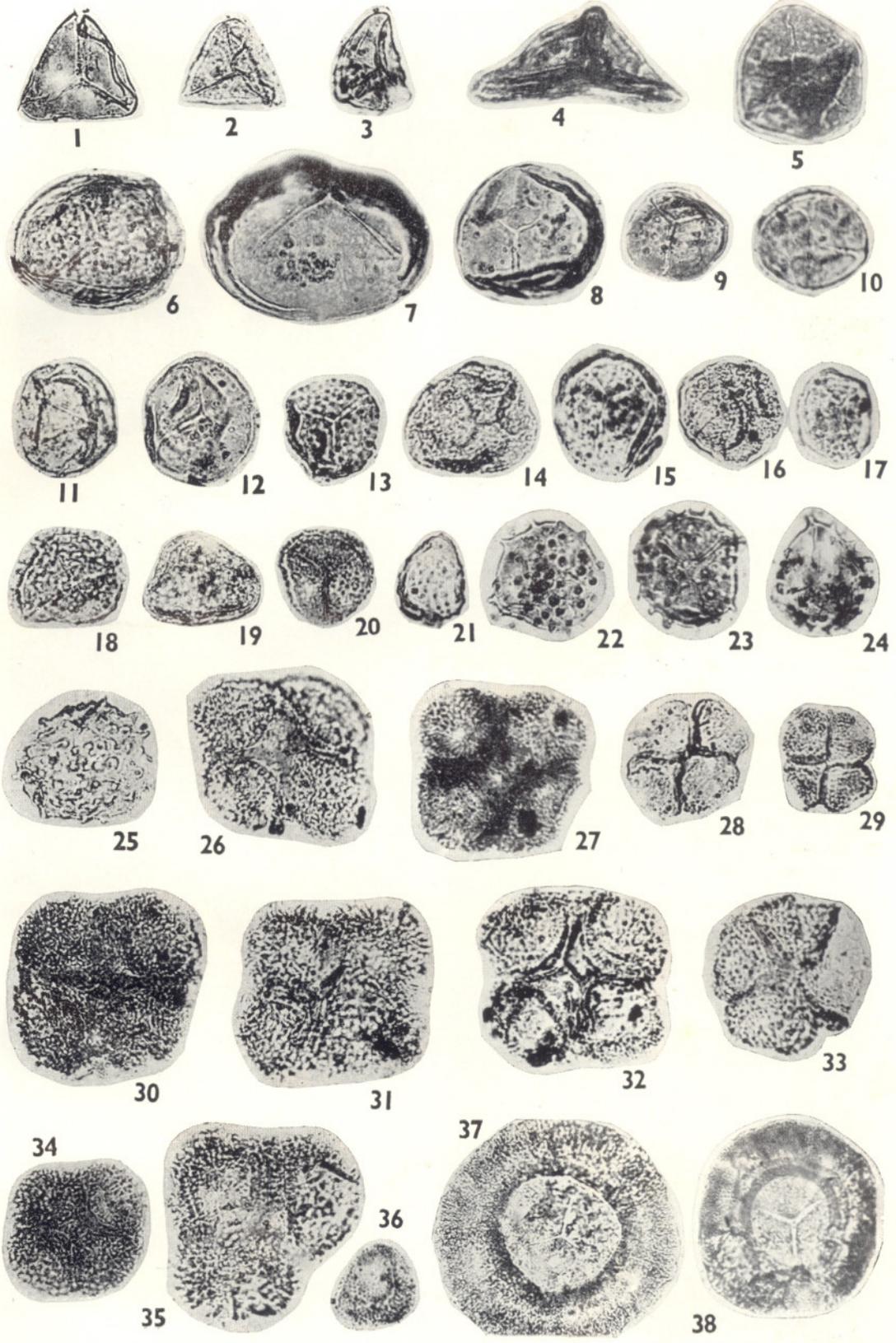
1. *Leiotriletes adnatoides*, Photo No. 105/17. × 500.
2. *Leiotriletes adnatoides*, Photo No. 92/24. × 500.
3. *Leiotriletes adnatoides*, Photo No. 95/18. × 500.
4. *Leiotriletes* sp. Form 1, Photo No. 94/21. × 500.
5. *Leiotriletes* sp. Form 2, Photo No. 93/6. × 500.
6. *Leiotriletes* sp. Form 2, Photo No. 94/22. × 500.
7. *Punctatisporites punctatus*, Photo No. 102/4. × 500.
8. *Punctatisporites punctatus*, Photo No. 94/30. × 500.
9. *Punctatisporites minutes*, Photo No. 102/9. × 500.
10. *Punctatisporites minutes*, Photo No. 102/12. × 500.
11. *Sporae Lavigatae Incertae*, Photo No. 101/3. × 500.
12. *Granulatisporites parvus*, Photo No. 102/15. × 500.
13. *Granulatisporites* (al. *Cyclogranisporites*) *orbiculus*, Photo No. 102/5. × 500.
14. *Cyclogranisporites leopoldi leopoldi*, Photo No. 94/14. × 500.
15. *Cyclogranisporites leopoldi rewahensis*, Holotype, Photo No. 99/27. × 500.
16. *Cyclogranisporites leopoldi rewahensis*, Photo No. 95/15. × 500.
17. *Cyclogranisporites leopoldi rewahensis*, Photo No. 93/3. × 500.
18. *Lophotriletes* cf. *microsetosus*, Photo No. 93/23. × 500.
18. *Lophotriletes* cf. *microsetosus*, Photo No. 101/5. × 500.
20. *Lophotriletes* sp., Photo No. 99/24. × 500.
21. *Lophotriletes* sp., Photo No. 102/23. × 500.
22. *Apiculatisporis* sp., Photo No. 99/14. × 500.
23. *Apiculatisporis* sp., Photo No. 99/20. × 500.
24. *Apiculatisporis* sp., Photo No. 100/9. × 500.
25. *Apiculatisporis* sp., Photo No. 100/8. × 500.
26. *Quadrisporites horridus*, Photo No. 95/19. × 500.
27. *Quadrisporites horridus*, Photo No. 96/6. × 500.
28. *Quadrisporites horridus*, Photo No. 102/16. × 500.
29. *Quadrisporites horridus*, Photo No. 98/12. × 500.
30. *Quadrisporites horridus*, Photo No. 99/3. × 500.
31. *Quadrisporites horridus*, Photo No. 99/4. × 500.

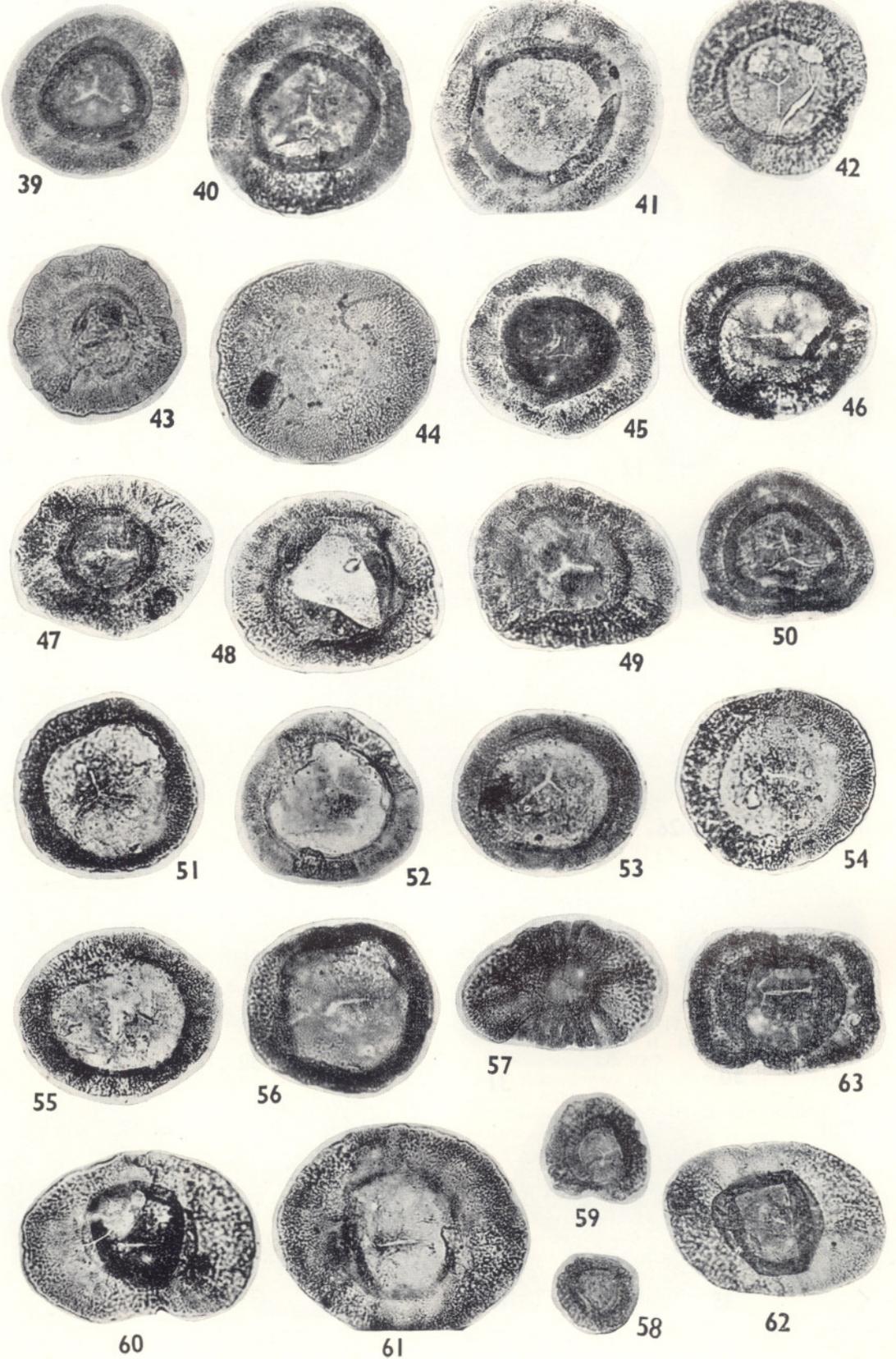
32. *Quadrisporites horridus*, Photo No. 99/29. × 500.
33. *Quadrisporites horridus*, Photo No. 99/19. × 500.
34. *Quadrisporites horridus*, Photo No. 103/33. × 500.
35. *Quadrisporites horridus*, Photo No. 99/26. × 500.
36. *Quadrisporites horridus*, Photo No. 95/25. × 500.
37. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 95/14. × ca. 250.
38. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 93/23. × ca. 250.

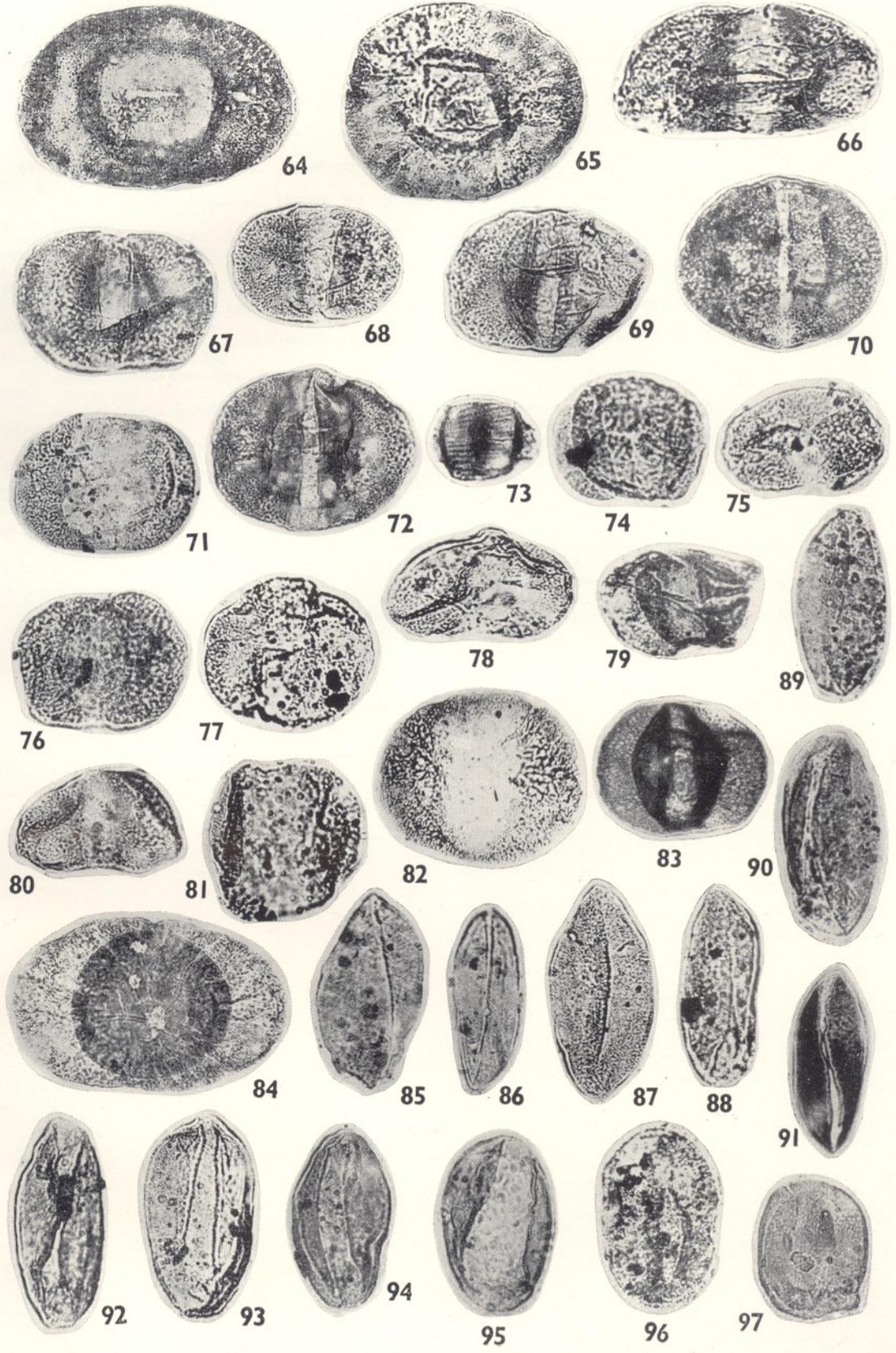
PLATE 2

(All photomicrographs, × ca. 250)

39. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 102/35.
40. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 88/6.
41. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 88/1.
42. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 93/19.
43. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 95/11.
44. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 89/15.
45. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 94/9.
46. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 102/19.
47. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 101/17.
48. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 92/7.
49. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 94/27.
50. *Nuskoisporites* (al. *Hymenozonotriletes*) *triangularis*, Photo No. 97/9.
51. *Nuskoisporites rotatus*, Photo No. 88/8.
52. *Nuskoisporites rotatus*, Photo No. 102/10.
53. *Nuskoisporites rotatus*, Photo No. 102/13.
54. *Nuskoisporites rotatus*, Photo No. 94/26.
55. *Nuskoisporites rotatus*, Photo No. 102/26.
56. *Nuskoisporites rotatus*, Photo No. 103/30.
57. *Nuskoisporites* sp., Photo No. 103/9.
58. *Nuskoisporites* sp., Photo No. 103/17.
59. *Nuskoisporites* sp., Photo No. 103/10.







60. *Potonieisporites neglectus*, Photo No. 102/27.
 61. *Potonieisporites neglectus*, Photo No. 102/11.
 62. *Potonieisporites neglectus*, Photo No. 88/15.
 63. *Potonieisporites neglectus*, Photo No. 102/8.

PLATE 3

64. *Potonieisporites neglectus*, Holotype, Photo No. 105/14. × ca. 250.
 65. *Potonieisporites neglectus*, Photo No. 93/4. × ca. 250.
 66. *Lunatisporites* (al. *Lueckisporites*) *amplus*, Photo No. 88/7. × ca. 250.
 67. *Lunatisporites* (al. *Lueckisporites*) *amplus*, Photo No. 90/9. × ca. 250.
 68. *Lunatisporites* (al. *Lueckisporites*) *amplus*, Photo No. 91/8. × ca. 250.
 69. *Lunatisporites* (al. *Lueckisporites*) *amplus*, Photo No. 93/26. × ca. 250.
 70. *Lunatisporites goraiensis*, Holotype, Photo No. 100/7. × ca. 250.
 71. *Lunatisporites goraiensis*, Photo No. 93/32. × ca. 250.
 72. *Lunatisporites goraiensis*, Photo No. 104/20. × ca. 250.
 73. *Sporae Striatitae Incertae*, Photo No. 100/6. × 500.
 74. *Sporae Disaccitrietae Incertae*, Photo No. 91/17. × 500.
 75. *Pityosporites* sp., Photo No. 91/13. × 500.
 76. *Pityosporites* sp., Photo No. 94/11. × 500.
 77. *Pityosporites* sp., Photo No. 94/16. × 500.
 78. *Pityosporites* sp., Photo No. 98/13. × 500.
 79. *Pityosporites* sp., Photo No. 99/7. × 500.
 80. *Pityosporites* sp., Photo No. 99/13. × 500.

81. *Pityosporites* sp., Photo No. 102/20. × 500.
 82. *Pityosporites* sp., Photo No. 102/24. × ca. 250.
 83. *Pityosporites* sp., Photo No. 103/36. × ca. 250.
 84. *Succinctisporites* sp., Photo No. 102/30. × ca. 250.
 85. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 102/28. × 500.
 86. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 94/32. × 500.
 87. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 102/7. × 500.
 88. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 89/9. × 500.
 89. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 91/6. × 500.
 90. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 102/14. × 500.
 91. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 105/13. × 500.
 92. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 91/30. × 500.
 93. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 102/29. × 500.
 94. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 102/21. × 500.
 95. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 93/18. × 500.
 96. *Ginkgocycadophytus* (al. *Entylissa*) *cymbatus*, Photo No. 103/3. × 500.
 97. *Sporae Monocolpatae Incertae*, Photo No. 98/10. × 500.
 98. *Sporae Monocolpatae Incertae*, Photo No. 102/25. × 500.