SPOROLOGICAL STUDY OF THE COALS FROM FALKENBERG (FAULQUEMONT) COLLIERY, LOTHRINGEN (LORRAIN), FRANCE*

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ABSTRACT

Fossil spores and pollen grains from the coals of Falkenberg colliery have been studied in detail. This study has been utilised to corroborate the correlation of the coal seams in the two sections of the colliery which lies in the Lothringen area of Lothringen-Saar-Pfalz basin. The spores recovered from these coals have been assigned here to 52 spore genera and 157 spore species out of which, 49 species, which have been newly proposed, are described in detail. In addition to this, 1 genus and 3 species have been emended and the emended diagnoses given.

The distribution of the dispersed spores in the different seams has been given and it has been concluded that miofloristically coal seams 1-4 of Southfield agree with coal seams 1-4 of Northfield, thus substantiating the correlation in vogue miofloristically. The spore assemblage of the succession but for coal seam 1, corresponds to division II of Bhardwaj 1955, correlated as Westphalian D in age. Seam 1 probably represents the initiation of Stephanian. The absence of *Lycospora* in this seam along with certain components is fairly suggestive.

In the final part of the discussion the flora of the Falkenberg coals has been compared with the spore flora of the Saar basin.

INTRODUCTION

IN recent years biopetrological studies relating to spores and pollen grains have assumed greater and greater importance due to their application in coal and oil stratigraphy. Investigations in this line have enabled, to a considerable extent, the dating of seemingly unfossiliferous rocks, correlation of coal seams in much faulted or otherwise disturbed coal fields and in oil prospecting.

Coal, which is nothing else but fossilized plant matter yields a rich assemblage of microfossils, i.e., spores, pollen grains, cuticles, seeds, wood fragments and other unrecognisable plant material, and among these the first two are of great importance in coal sporology.

Spores and pollen grains are reproductive units of plants produced and shed in large numbers. These are dispersed by various agencies and they carry forward the lifecycle of the plants they represent. In sedimentary strata a rich assemblage of spores and pollen grains, representing their parent plants, is frequently found. So that by a thorough study of the spores and pollen grains recovered from any strata an approximate assessment of the parent vegetation and its distribution can be made out.

Studies on the present day vegetation shows that each plant association is characterised by certain members which come to flourish and evolve there as a result of complex biotic influences. In the past also, as is presumable, the same principle affected each association. Since each coal bed represents the fossilized remains of such a plant association, it is reasonable to expect in the spore flora of each coal bed certain individualistic spores or pollengrains representing the most characteristic plant species, as we know that each plant has a typical morphographical type of spore or pollen grain. Thus a comparative study of the Sporae dispersae, representing various plant associations, helps to solve many problems concerning correlation, stratigraphy and age of the coal beds.

The success of sporological investigations has largely been due to the ease with which a large number of spores and pollen grains can be studied out of a small quantity of coal. Megafossils in the shales associated with coal beds, sometimes are not found in abundance or are fragmentary and mostly represent only a small part of the surrounding vegetation, whereas Sporae dispersae in coal, represent ± their total production and thus large numbers, which can even allow for a statistical study of the parent plant association.

Lothringen-Saar-Pfalz basin forms a part of a large sinking zone which extends S.W. to

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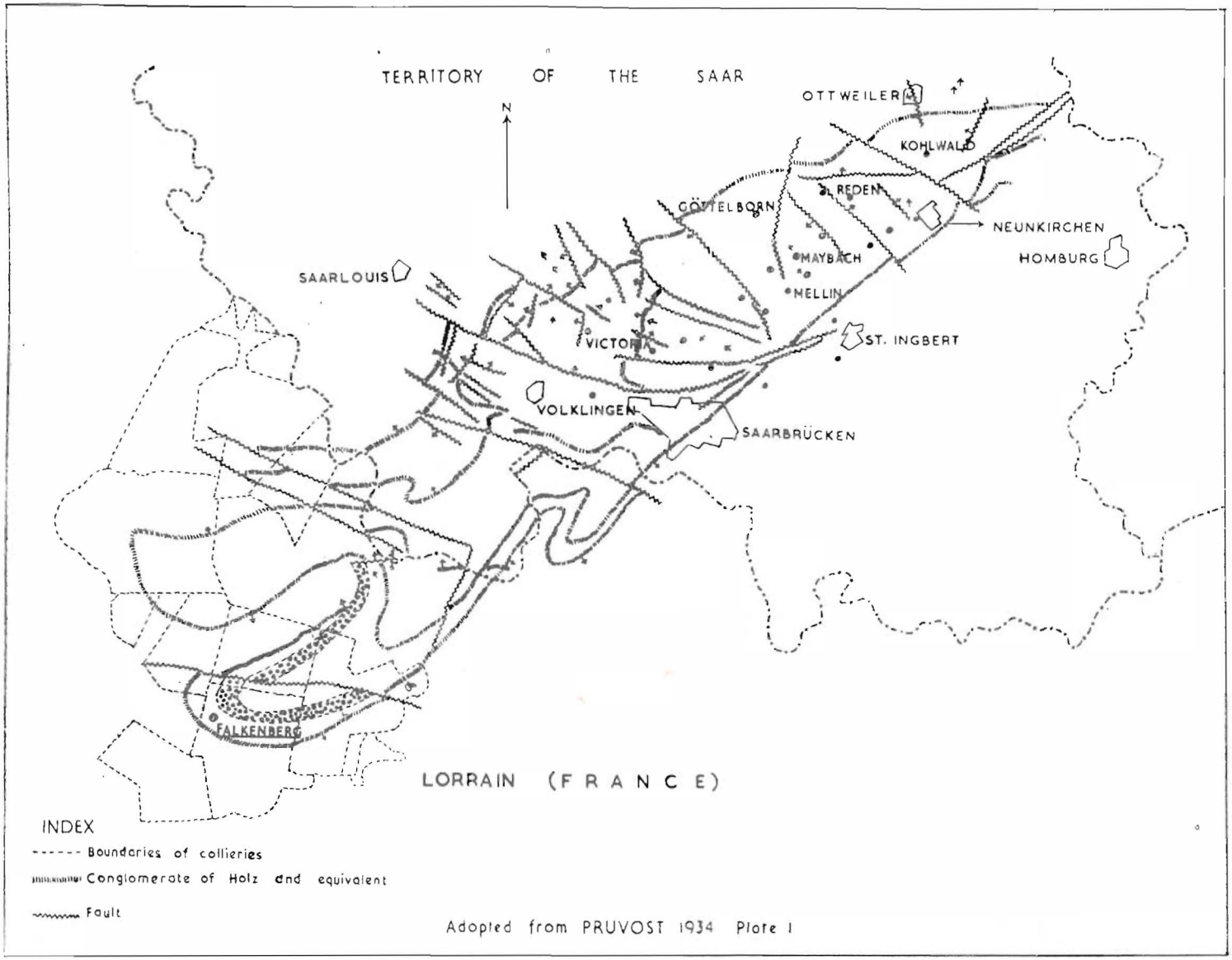


TEXT-FIG. 1 — A map of Lothringen-Saar-Pfalz coal basin.

N.E. from Lorrain in Central Eastern France to Pfalz in West Germany (TEXT-FIG. 1). In this basin a detailed study of the microflora was initiated by Bhardwaj in the year 1954 on the coals of the Saar. In his two papers (1955, 1957a) the studies on the Sporae dispersae of the Saar basin have been given.

The Sporae dispersae from the coals of Pfalz were studied by us (BHARDWAJ & VENKATACHALA, 1957), enabling us to suggest the probable boundary between the Carboniferous and the Permian systems in that region.

The present investigation deals with the sporological studies in the coals from Falkenberg colliery which lies in the South-Western part of Lothringen-Saar-Pfalz coal basin.

The Upper Carboniferous sediments containing the coal seams of Falkenberg colliery lie sharply dipping from N.E. to S.W. (TEXT-FIG. 2). These strata are overlain by Upper Rotliegend, Middle and Upper Buntsandstein, and Muschelkalk sediments, the last being at the top. The overburden is nearly 400-450 meters thick. The coal bearing sediments are traversed by a fault in the S.W. region of the colliery dividing the strata into a northern (Nordfeld) and a southern (Südfeld) field. A large number of coal seams occur in Falkenberg colliery which hitherto had not been investigated for their mioflora. As a result of the present investigations an attempt to correlate the seams in the two sectors of the coalfield, and to place them in the sporological stratigraphical scale has been made.

MATERIAL AND METHODS

The material for the present investigation was collected and sent to one of us (BHARADWAJ) by Dr. h. c. P. Guthörl, Bergschule, Saarbrücken. The samples were packed in dust proof paper bags and were neatly labelled to avoid chances of contamination or mixing up of samples. From each seam only 3 samples were taken, one each from roof, middle and floor parts of the seam, excepting in seam 1 Northfield and seam 1 Southfield where only two samples each were collected.

Location of samples — In the section of the coalfield, illustrated in Text-fig. 2, the locations of seams and other stratigraphical data have been given. The other details and maceration numbers of each sample have been presented in Table 1.

Maceration — The procedure of maceration followed by us is as follows:

Usually about 20 grams of coal was taken and broken into small pieces of 2-5 mm. size. The coal pieces were covered by commercial nitric acid and kept for a number of days till the oxidation was complete. Usually these coals needed 6-25 days for complete oxidation. Samples 213-218 took nearly 25 days and samples 219-224 and 207-212 about 14 days and the rest of the samples required the acid treatment for only 6 days. Later the macerate was thoroughly washed with water on a müllergauze sieve (0·06). Subsequently a major part of the residue left over on the sieve was treated with 10 per cent KOH for about 10-20 minutes, for megaspores, cuticles and other big pieces of organic remains. The minor part of the macerate was brought to boiling with 10 per cent KOH on a water bath for miospores. Both the macerates after this final treatment were thoroughly washed, the former was allowed to dry in a warm chamber and the latter stored in well corked specimen tubes for microscopical observations.

Observation of Macerates — The material for megaspores and cuticles was spread over a glass and was observed under a low power binocular microscope. The megaspores and cuticles were picked out and were stored in cavity slides; certain megaspores were also mounted in glycerine jelly.

The finer macerate containing numerous microspores and other smaller organic fragments, was concentrated in watch glasses to remove shreds of woods and other heavier organic pieces and also to separate the spore containing material from heavier mineral matter, resin and other such residue. The concentrated sporiferous material was centrifuged to remove water and then transferred to a vial with glycerine jelly (prepared according to Erdtman's 1947 formula). The slides were prepared by the customary method. Before sealing with gold size the edges of the coverslips were touched with formaldehyde to harden the jelly. Some preparations were also made, using Canada balsam as the mounting medium according to the method described by Bhardwaj (1957a). The glycerine jelly mounts were preferred to those of Canada balsam because of a much uniform spreading obtained in the former.

Taxonomic study of the spores was done in the manner described by Bhardwaj (1957a). About 16 slides were studied for

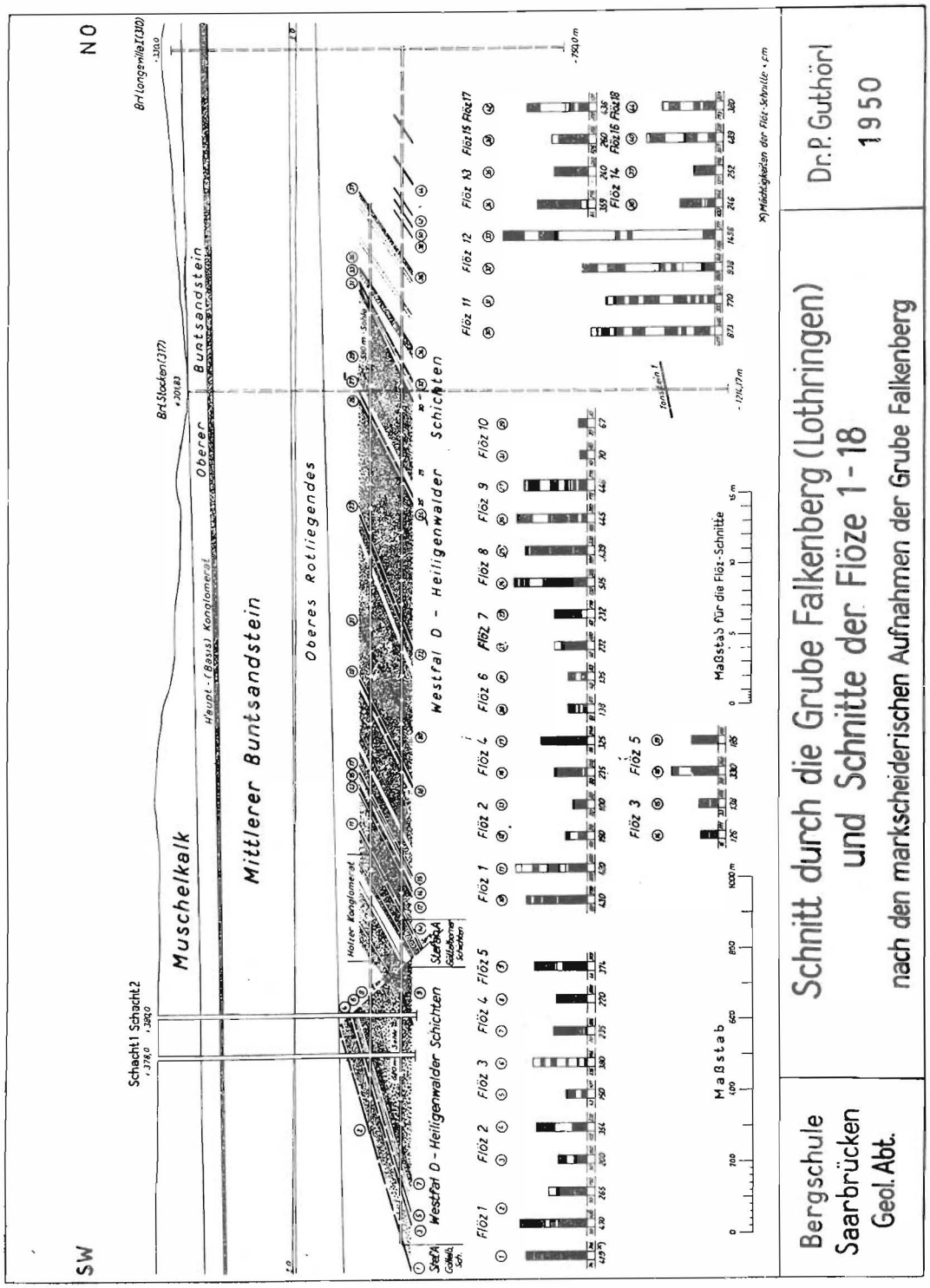


Fig. 2 — A section of Falkenberg colliery.

TABLE 1

Sample No. At B.S.I.P. Museum	Sample No. Guthörl	Seam	Coalfield sector	Location	Maceration Nos. (coal) at B.S.I.P. Lucknow (India)
21562	201	1	North	Roof part	24, 24a
21563	202	1	,,	Floor part	25
21564	203	1	South	Floor part	26, 26a, 26b*
21565	204	1	,,	Roof part	27, 27a*
21566	205	2	,,	Roof part	28, 28a*
21567	206	2	,,	Middle part	29, 29a*
21568	207	2	,,	Floor part	30
21569	208	2	North	Roof part	31
21570	209	2	,,	Middle part	32
21571	210	2	,,	Floor part	33
21572	211	3	,,	Roof part	34
21573	212	3	,,	Middle part	35
21574	213	3	,,	Floor part	36
21575	214	3	South	Roof part	37, 37a, 37b
21576	215	3	,,	Floor part	38, 38a, 38b
21577	216	3	,,	Middle part	39, 39a
21578	217	4	North	Roof part	40, 40a
21579	218	4	,,	Middle part	41
21580	219	4	,,	Floor part	42, 42a, 42b
21581	220	4	South	Roof part	43
21582	221	4	,,	Middle part	44
21583	222	4	,,	Floor part	45, 45a*
21584	223	5	North	Roof part	46, 46a
21585	224	5	,,	Middle part	47
21586	225	5	,,	Floor part	48, 48a, 48b
21587	226	6	,,	Roof part	49, 49a, 49b
21588	227	6	,,	Middle part	50, 50a
21589	228	6	,,	Floor part	51
21590	229	7	,,	Roof part	52, 52a*
21591	230	7	,,	Middle part	53, 53a
21592	231	7	,,	Floor part	61
21593	232	8	,,	Roof part	62
21594	233	8	,,	Middle part	63, 63a
21595	234	8	,,	Floor part	64
21596	235	9	,,	Roof part	65
21597	237	9	,,	Floor part	66

*Maceration for megaspores only.
The rest of the macerations both for Miospores as well as Megaspores.

each sample, however in special cases as many as 35-40 slides were scanned.

To study in detail the structure and nature of the inner bodies of the megaspores, selected and identified specimens were treated with nitric acid to which a small piece of potassium chlorate was added for about 2 to 5 days, which softened the outer exine partly exposing the inner body. These overmacerated spores were further floated in a dilute solution of ammonia (2·5 per cent) for about 72 hours, which dissolved the remaining exine and brought out the inner bodies. In cases where the inner bodies did not separate out even after this treatment, the same were taken out by careful dissection under a low power binocular microscope with microneedles.

To ascertain the frequency of spores in the population, 200 spores were counted for each sample, the slides being picked up at random. Thus for each seam mostly about 600 spores were counted and the spore percentages obtained.

SYSTEMATIC DESCRIPTION

The sporotaxa described in this paper are based on morphographical study. The descriptive terminology is that used by Potonié

& Kremp (1955, p. 9) and the suprageneric arrangement followed here is after Potonié (1956, 1958).

In all, a total of 52 genera and 157 species have been referred to in this work. Out of these, 49 species are new. The genus *Cadiospora* and three spore species have been emended.

Anteturma — *Sporites* H. Pot. 1893
Turma — *Triletes* (Reinsch) Pot. & Kr. 1954
Subturma — *Azonotriletes* Luber 1935
Infraturma — *Laevigati* (B. & K.) Pot. & Kr. 1954

***Leiotriletes* (Naum.) Pot. & Kr. 1954**

Leiotriletes grandis (Kos.) Bhard. 1957a

Pl. 1, Fig. 1

Remarks — The spore illustrated here appears to be an overmacerated specimen. The size range of this species according to Kosanke (1950) is 60-80 μ but the specimen illustrated here is over 90 μ.

Leiotriletes adnatoides Pot. & Kr. 1955

Pl. 1, Fig. 4

Leiotriletes subadnatoides Bhard. 1957a

Pl. 1, Fig. 5

Remarks — The inter-ray area appears to be as dark as in *Leiotriletes adnatoides* and in all the figures illustrated by Bhardwaj (1957a) as well as in the spore figured by us in Pl. 1, Fig. 5.

Leiotriletes sphaerotriangulus (Loose) Pot. & Kr. 1955

Pl. 1, Fig. 3

Remarks — *L. adnatoides* is smaller in size.

Leiotriletes convexus (Kos.) Pot. & Kr. 1955

Pl. 1, Fig. 2

***Punctatisporites* (Ibr.) Pot. & Kr. 1955**

Punctatisporites obesus (Loose) Pot. & Kr. 1955

Pl. 1, Figs. 10-13

Remarks — In Pl. 1, Fig. 10 a juvenile spore is illustrated. In Pl. 1, Fig. 12 a spore which possesses well marked irregular bands on the spore exine is illustrated. At first the spores of the latter kind were mistaken for *Knoxisporites*, but later, on further observation, it was found that they possess just the tetragonal compression marks, the like of which have been found in spores of *Corynepteris silesiaca* by R. & W. Remy (1955) and by Bhardwaj and Singh (1956) in *Asterotheca mariani* and thus, are not such bands as are seen in *Knoxisporites*.

Punctatisporites potoniei sp. nov.

Pl. 1, Fig. 6

Holotype — Pl. 1, Fig. 6.

Diagnosis — Circular, 70-80 μ. Y-rays 2/3 radius. Exine with fine punctations, upto 2 μ thick.

Description — Circular, holotype 80 μ. Y-rays 2/3 radius, two of the arms are bent in this spore, apparently due to eccentric flattening. Extrema lineamenta smooth with fine punctations, exine ± 2 μ thick in optical section.

Comparison — *P. obesus* is generally bigger than 80 μ. The other species listed by Potonié & Kremp (1955) do not compare.

Punctatisporites gravus sp. nov.

Pl. 1, Figs. 7, 8

Holotype — Pl. 1, Fig. 7.

Diagnosis — Circular, 100-110 μ. Y-arms equal, 30 μ in length. Extrema lineamenta smooth, exine with broad punctations almost giving a pseudoreticulate appearence, upto 2 μ thick in optical section.

Description — Dark brown miospores, holotype 110 μ. Y-rays straight, labra thin and low. Exine with broad punctations almost appearing like a pseudoreticulum, extrema lineamenta smooth, spore wall ± 2 μ thick in optical section.

Comparison — The spore does not compare with the other species of *Punctatisporites* and distinguishes itself by its broad punctations.

Punctatisporites laevigatus (Ibr.) comb. nov.

Pl. 1, Fig. 9

Syn. — *Laevigatisporites laevigatus* Ibrahim 1933.

Calamospora laevigata (Ibr.) S.W. & B. 1944.

Holotype — Ibrahim 1933, Pl. 6, Fig. 46.

Diagnosis (emended) — Circular, 150-200 μ, in size, Y-rays 1/3 radius, no contact area seen. Exine laevigate, 4-7 μ thick in optical section.

Description — Dark yellowish brown, circular miospores with a very small Y-mark which is prominent and up to 1/3 radius long or sometimes less. Exine and extrema lineamenta laevigate, contact area not differentiated. Exine very thick, rarely folded sometimes one or two prominent folds are present.

Comparison — This is by far the largest species of *Punctatisporites* recorded.

Remarks — *Calamospora* differentiates from *Punctatisporites* only in possessing a thinner sporecoat. This species was first described as *Laevigatisporites laevigatus* by Ibrahim (*loc. cit.*) and later transferred to *Calamospora* by Schopf, Wilson & Bentall (*loc. cit.*). In view of its characteristic thick nature of the spore coat, it is better to refer such spores to *Punctatisporites* than to *Calamospora*.

Calamospora S.W. & B. 1944

Calamospora falkenbergensis sp. nov.

Pl. 2, Fig. 14

Holotype — Pl. 2, Fig. 14.

Diagnosis — Circular, 120-130 μ. Y-rays 40 μ, 2/3 radius long, straight. Extrema lineamenta and exine smooth, uniformly 1·5-2 μ thick in optical section.

Description — Holotype 120 μ. Yellowish brown miospores, originally round, but acquiring many derived shapes. Y-rays about 40 μ, reaching up to 2/3 radius of the spores, straight, ends not tapering. Extrema lineamenta and exine laevigate, exine uniformly thick, without any differential thickening in the contact area.

Comparison — *C. perrugosa* has thinner exine and shorter rays only reaching up to 1/3 radius and the other species described by Potonié & Kremp (1955) and other authors are distinctly smaller in size.

Calamospora pallida (Loose) S.W. & B. 1944

Pl. 2, Fig. 18

Calamospora straminea Wills. & Kos. 1944

Pl. 2, Fig. 17

Calamospora densa sp. nov.

Pl. 2, Figs. 19, 20

Holotype — Pl. 2, Fig. 19.

Diagnosis — Circular, 90-110 μ. Y-rays up to 1/2 radius, labra thick, tecta ends blunt. Exine laevigate, inter-ray area very dark.

Description — Holotype 100 μ. Circular, dark amber coloured spores with many concentric folds, 90-110 μ. Y-arms 1/2 radius, up to 25 μ long, labra 4-6 μ thick, tecta do not taper, arm ends blunt. Extrema lineamenta and exine laevigate, thick, dark area in and around the *area contagionis* present. Dark area fairly wide, up to 50 μ, covering the Y-mark and mostly rendering it inconspicuous. Dark area sometimes appears to have shifted to a side of the spore, thus allowing for a presumption that it may be a globular inner body.

Comparison — *C. microrugosa* has shorter Y-rays and does not possess such a prominent dark inter-ray area, *C. mutabilis* has thicker spore coat and has a contact area differentiated by a thin line. The other species do not compare. The presence of a dark, thick area around the Y-mark distinguishes this spore from the other species.

Remarks — There appears to be an inner body which causes the darkness in the inter-ray area and around the trilete mark. *In situ* spores recovered from *Huttonia spicata* Wiss., by Hartung (1933, Pl. 9, Figs. 9-12) illustrate a similar dark, thick, globular body, almost covering the area of the trilete mark and making it obscure. Hartung also has recovered the inner bodies of these spores separately (*loc. cit.* Pl. 9, Figs. 15, 16 and 17).

Calamospora sp. A.

Pl. 2, Fig. 21

Description — Size 100 μ, light yellow spores, originally circular, but oval due to secondary folds. Y-mark clearly visible though very faint with tapering and finely drawn out ends. Extrema lineamenta and exine laevigate, contact area is not demarcated.

Comparison — *C. mutabilis* has longer rays, the ends of which are connected by thin low ridges enclosing a subspherical area around the Y-mark but in *C.* sp. A., no such ridge is visible. *C. pallida* and *C. pedata* are smaller in size and have more prominent Y-rays. *C. microrugosa* is bigger in size and possesses shorter Y-rays and darkened inter-ray area.

Calamospora sp. B.

Pl. 2, Fig. 22

Description — Spore circular, dark brown, 100 μ, eccentrically flattened. Y-rays 22 μ long, less than 1/2 the radius. Extrema lineamenta and exine uniformly laevigate.

Calamospora sp. C.

Pl. 2, Fig. 23

Description — Size 80-100 μ, circular to oval, light yellow spores, exine thin easily folded, the spore assuming various shapes. Y-mark conspicuous, arms equal, up to 3/4 radius, sometimes more, apex low, labra well developed. Extrema lineamenta and exine laevigate.

Comparison — *C. pallida* and *C. straminea* which compare well in other features are smaller in size. *C. pedata* Kos., is smaller in size and has thinner Y-arms. The other species either are bigger in size or possess a well differentiated *area contagionis*.

Calamospora perrugosa (Loose) S.W. & B. 1944

Pl. 2, Figs. 15, 16

Description of our specimens — Circular, 120-130 μ, with many folds. Y-rays ±20 μ, 1/3 radius, or sometimes less, ray ends do not taper. Extrema lineamenta and exine laevigate, the *area contagionis* darker than the rest of the exine. Spore wall relatively thin for the size of the spore.

Remarks — These spores are bigger than *C. microrugosa*.

Calamospora breviradiata Kos. 1950

Pl. 2, Fig. 24; Pl. 3, Fig. 25

Remarks — The specimens observed by us are up to 100 μ in size, whereas the holotype is only 65 μ and the size range is 52-71 μ according to Kosanke. However in view of the similarity in the nature of the rays, the specimens illustrated here have been included in this species.

Calamospora cf. *breviradiata* Kos. 1950

Pl. 3, Fig. 26

Description — Circular, dark yellowish brown miospores, 70-90 μ. Y-rays 1/2 radius, labra thick and raised, apex and vertex high. Exine laevigate.

Comparison — *C. breviradiata* does not possess such thick labra.

Calamospora microrugosa (Ibr.) S.W. & B. 1944

Pl. 3, Fig. 30

Calamospora hartungiana Schopf in S.W. & B. 1944

Pl. 3, Fig. 29

Calamospora mutabilis (Loose) S.W. & B. 1944

Pl. 3, Fig. 27

Calamospora cf. *mutabilis* (Loose) S.W. & B. 1944

Pl. 3, Fig. 28

Description — Circular, 90 μ, with concentric folds. Y-rays reaching up to 1/2 radius, ray-ends connected by a thin line to enclose a spherical area around the tetrad mark. This area is slightly darkened. Extrema lineamenta laevigate, exine infragranulose.

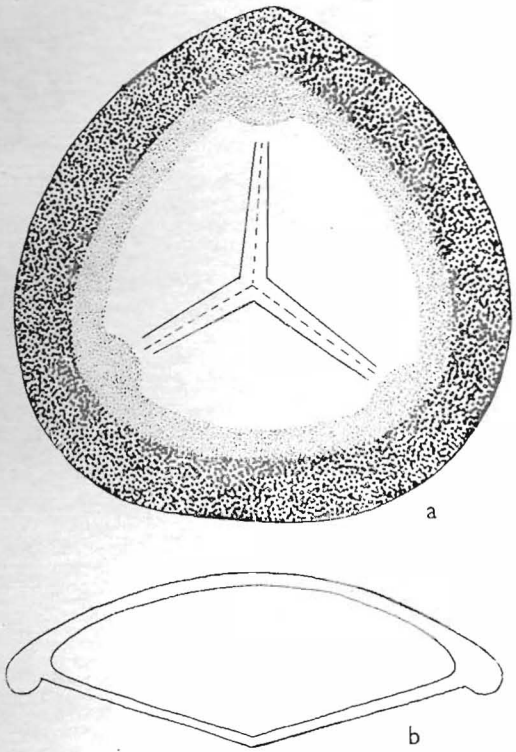
Comparison — *C. microrugosa* has a thickened, dark *area contagionis*, *C. perrugosa* and *C. hartungiana* are distinctly bigger in size. The other species described by Potonié & Kremp (1955) and other authors are distinctly different. The prominent infragranulose nature of the exine distinguishes this spore from *C. mutabilis*, though in both of them the line like ridge connecting the ray-ends and enclosing a sub-spherical area around the Y-mark is present.

Cadiospora (Kos. 1950) emend.

Genotype — *Cadiospora magna* Kos. 1950.

Diagnosis (emended) — Radial, sub-spherical to roundly triangular miospores. Trilete-rays distinct, up to 3/4 radius in length, ray-ends apparently bifurcating, *area contagionis* differentiated by its thinner exine, labra well developed. Exine surface laevigate, punctate to infrapunctate, exine normally 5-10 μ thick, usually thicker beyond the ray-ends and developing one or more, large mounds (TEXT-FIG. 3a and 3b).

Description — Sub-spherical to roundly triangular dark brown miospores with a thick



TEXT-FIG. 3 — *Cadiospora* — a. Polar view. b. Vertical section through the poles.

spore coat. Trilete mark very prominent, rays going up to 3/4 radius, apex and vertex low, labra fairly thick and prominent, beyond the ray-ends the exine is thickened into a mound due to which the ray-ends appear as if bifurcating. In one species a number of mounds are grouped in the angular region and in still another, the mounds extend all over the distal face, Exine up to 10 μ thick in optical section, infrapunctate. Generally *area contagionis* is well differentiated as its exine is thinner.

Remarks — The genus *Cadiospora* has been placed by Potonié & Kremp (1954) under *Zonotriletes*, infraturma *Cingulati*, interpreting the spores as having a cingulum. In view of the fact that the spores referable to *Cadiospora* lack a *cingulum* and only have a thick spore coat which appears like a cingulum in an optical section, this genus has now been placed under *Azonotriletes*, infraturma — *Laevigati* (observations confirmed by Prof. DR. R. POTONIÉ). Beyond the termination of the rays the exine is thick as a low mound and gives the impression as if the ray-ends are bifurcated. In the genero-holotype as apparent in the figure (KOS. 1950, PL. 16, FIG. 1) the spore is slightly obliquely flattened and thus due to the stress on one side, one of the rays appears to reach almost the inner margin of the thick spore coat, and due to the presence of a mound it appears to bifurcate and connect the inner marginal outline of the spore exine which has been interpreted as an arcuate ridge by Kosanke (1950); however in the other two rays of the Y-mark it can be well seen that the arms reach only 3/4 radius, and do not form any such structure. In all the undoubted specimens of *Cadiospora* observed by us as well as in the Genero-holotype, it appears that no arcuate ridges are present.

Cadiospora aggera sp. nov.

Pl. 3, Fig. 35; Pl. 4, Figs. 36, 37

Holotype — Pl. 3, Fig. 35.

Diagnosis — Circular to roundly triangular spores, 90-120 μ. Y-rays equal, 2/3 radius, labra thick and low, exine infrapunctate and covered with irregularly shaped and distributed, blunt mounds, on lateral and distal faces, exine up to 10 μ thick, exine thinner in the *area contagionis*.

Description — Holotype 110 μ, dark brown, circular to roundly triangular spores, generally they are very dark and in many cases details are not clearly seen, 90-120 μ. Y-rays equal, 2/3 radius long, ±30 μ, apex and vertex low, labra thick, about 4 μ on either side of the suture, tecta-ends tapering. Extrema lineamenta uneven, wavy, due to the presence of broad but low, rounded mounds, irregularly distributed over the distal surface. The size of mounds not uniform as also the extent of their development (PL. 4, FIG. 36 depicts a spore in meridional plane showing the irregular mounds on the distal face). Exine finely infrapunctate. Laterally as well as distally the spore wall up to 10 μ thick but in the *area contagionis* appearing thinner. No arcuate ridges discernible.

Remarks — The spore wall appears to be constituted by bacula as observed in many of the over-macerated spores and for that reason the exine appears infrapunctate.

Comparison — *C. magna* Kos., lacks the ornamentation, and is from the Mcleansboro horizon (Stephanian) of U.S.A.

Cadiospora absoluta sp. nov.

Pl. 4, Figs. 38-40

Holotype — Pl. 4, Fig. 38.

Diagnosis — Roundly triangular — circular spores, 110-130 μ. Y-mark 2/3 radius, labra thick, apex low. Exine up to 10 μ thick, infrapunctate and covered with blunt mounds, which are more crowded in the angular regions.

Description — Dense yellowish brown miospores. Holotype 115 μ. The arms of the trilete are equal, ±40 μ long, apex and vertex low, labra thick, ray-ends tapering. The three ray-ends are covered over by a group of unevenly developed mounds, which are more developed in one of the angles than at the other two. The *area contagionis* is infrapunctate without mounds and is thinner than the rest of the spore exine. Exine is 8-10 μ thick in optical section.

Comparison — *Cadiospora magna* lacks ornamentation. *C. aggera* differs from *C. absoluta* in possessing uniformly distributed mounds.

Remarks — In Pl. 4, Fig. 40, an overmacerated specimen is illustrated.

Cadiospora laminata sp. nov.

Pl. 3, Figs. 31, 32

Holotype — Pl. 3, Fig. 31.

Diagnosis — Circular to roundly triangular, 90-110 μ. Y-rays 1/2-2/3 radius long, labra thin and low. Exine 8-10 μ thick, dark, infrapunctate, sometimes appears laminated.

Description — Holotype 110 μ, circular to roundly triangular, brownish black spores. Y-rays up to 30 μ long, apex and vertex low. Three mounds, one each beyond a ray-end, give the appearance as if the rays are bifurcating. Exine 8-10 μ thick in equatorial optical section but only 4 μ thick near the vertex, dark, sometimes shows lamination (as in Pl. 3, Fig. 31), infrapunctate. The contact area is not as dark as the rest of the spore coat.

Comparison *C. aggera* has dark irregular mounds and *C. magna* is distinctly bigger.

Cadiospora tumula sp. nov.

Pl. 3, Figs. 33,34

Holotype — Pl. 3, Fig. 33.

Diagnosis — Spores roundly triangular, dark and very thick, 110-130 μ. Y-mark prominent, rays ±1/2 radius long, apex low, labra thickened. Three mounds present beyond the ray-ends, *area contagionis* well demarcated. Exine up to 10 μ thick, punctate.

Description — Holotype 110 μ, spores roundly triangular, sometimes subtriangular or oval, very dense and dark. Y-mark distinct, rays 28-32 μ long nearly equal in length in each specimen, apex and vertex low, labra thick, up to 6 μ on either side of the suture. The rays end at mound like thickenings of the exine, significantly inwards of the equator. The *area contagionis* is differentiated by its thinner exine as compared to the exine laterally as well as distally. Exine thick, up to 10 μ, punctate, puncta irregularly distributed.

Comparison — *C. aggera* has large mounds on the exine, *C. absoluta* has a number of mounds only in the angular regions and *C. laminata* is smaller, has thinner exine and lacks the well delimited *area contagionis*.

Cf. *Cadiospora*

Cf. *Cadiospora* sp.

Pl. 4, Fig. 41

Description — Roundly triangular dark brown miospores, ±85 μ. Y-rays 30 μ long, equal, apex and vertex raised, the ray-ends swollen into a globular head. Exine thick, infrapunctate.

Comparison — The three globular ray-ends apparently correspond with the mounds met with in *C. aggera*, *C. tumula* and *C. laminata*. The thick spore coat and the presence of globular ray-ends allows this to be placed near *Cadiospora*. Spores illustrated by Vimal (1952) as *Triletes* sporomorph 5 (Pl. 7, Figs. 7, 8) and sporomorph 7 (Pl. 7, Figs. 9-11) from the Tertiary Lignites of Pakistan appear to show some resemblance.

***Granulatisporites* (Ibr.) Pot. & Kr. 1955**

Granulatisporites parvus (Ibr.) Pot. & Kr. 1955

Pl. 4, Fig. 42

Granulatisporites minutus Pot. & Kr. 1955

Pl. 4, Fig. 43

***Cyclogranisporites* Pot. & Kr. 1954**

Cyclogranisporites grandiculus sp. nov.

Pl. 4, Figs. 44-46; Pl. 5, Fig. 47

Holotype — Pl. 4, Fig. 44.

Diagnosis — Circular, 90-110 μ. Y-rays unequal, longest arm ±50 μ and shorter ones ± 40 μ, labra thin, ray-ends tapering. Extrema lineamenta and surface covered with grana, grana 1 μ, confluence of the grana present.

Description — Holotype 110 μ, spore circular, generally with peripheral folds. Y-mark distinct, reaching 2/3 radius, two of the arms equally short, and one long, apex and vertex low, labra thin, ray-ends thinning out. Extrema lineamenta and the surface coarsely covered with wide grana. Confluence of the grana simulating a broken reticulum. In Pl. 5, Fig. 47 is illustrated a specimen bearing a prominent dark inner body.

Comparison — *C. aureus* is smaller in size, and so are the other species described by Potonié & Kremp (1955) and Bhardwaj (1957a).

Remarks — Among the species of *Cyclogranisporites* the size of *C. grandiculus* is the biggest. The spore figured as *Calamospora hartungiana* by Alpern 1958a possibly belongs to *Cyclogranisporites grandiculus*.

Cyclogranisporites aureus (Loose) Pot. & Kr. 1955

Pl. 5, Fig. 53

Cyclogranisporites fuscus sp. nov.

Pl. 5, Figs. 50-52

Alpern 1959, Pl. 2, Fig. 46.

Holotype — Pl. 5, Fig. 50.

Diagnosis — Circular, 80-110 μ. Y-rays 2/3 radius long, labra thick and granulose, arms ending bluntly. Extrema lineamenta coarse, exine uniformly beset with grana.

Description — Circular, yellowish brown miospores with few folds. Y-rays straight, darkish, appearing as if apex and vertex elevated, labra thick and granulose, ray-ends low and do not taper but are blunt. Extrema lineamenta coarse, exine beset with uniform grana.

Comparison — *C. aureus* has similar grana but lacks well developed thick labra. *C. microgranus* is smaller in size and distinguishes in possessing denser grana and thinner lips. The other species described by Bhardwaj (1957a) do not compare.

Cyclogranisporites parvigranus sp. nov.

Pl. 5, Figs. 54, 55

Holotype — Pl. 5, Fig. 54.

Diagnosis — Circular, 106-120 μ. Y-rays unequal, ±1/2-2/3 radius long. Extrema lineamenta and exine beset with fine, closely set and very low grana.

Description —Circular, due to folds appearing as oval, holotype 120 μ. Y-rays unequal, two shorter than the third, two of the arms bent in the holotype due to the eccentric flattening of the spore. Extrema lineamenta beset with fine grana seen clearly only with oil immersion lens. In lower magnifications the grana look like puncta.

Comparison — Such low set fine grana are not met with in the earlier described species of *Cyclogranisporites*, hence the other species described by Potonié & Kremp (*loc. cit.*), Bhardwaj (*loc. cit.*) and others are not comparable.

Cyclogranisporites formosus sp. nov.

Pl. 5, Figs. 48, 49

Holotype — Pl. 5, Fig. 48.

Diagnosis — Circular, 52-60 μ in size. Y-rays 1/2 radius. Exine and extrema lineamenta covered by closely set ±1 μ broad grana.

Description — Yellowish brown miospores, rarely with folds, holotype 54 μ (across). Y-rays ±18 μ long, labra low, thin, ray-ends do not taper. Exine with closely set, ±1 μ wide grana, which are uniform in size and equally spaced, extrema lineamenta rough due to grana, about 90 grana are present along the equator.

Comparison — Among the other species of *Cyclogranisporites*, *C.* cf. *micaceus* (BHARD. 1957a) distinguishes itself by possessing a weakly developed trilete mark and minutely reticuloid granulose surface. *C. aureus* is much bigger in size and has more closely set grana. *C. minutus* Bhard., though possessing similar grana, is much smaller and has more widely placed grana. *C. microgranus* Bhard., comes in the same size range, but has longer Y-rays, thicker exine and more densely placed, finer sculptural elements.

Infraturma — *Apiculati* (B. & K.) Pot. & Kr. 1955

***Converrucosisporites* Pot. & Kr. 1954**

Converrucosisporites sp.

Pl. 6, Fig. 63

Description — Roundly triangular, dark brown miospores with rounded angles. Y-mark prominent, rays ±2/3 radius. Spore coat thick, covered with dense verrucae. Extrema lineamenta uneven due to verrucae whose size and number cannot be ascertained due to the dense nature of the spore.

Comparison — Among the forms described by Potonié & Kremp (*loc. cit.*) *C. mosaicoides* is much smaller in size and has sparser verrucae and *C. triquetrus* is more triangular with pointed angles, has broader and less numerous verrucae and is also more rounded. The spore illustrated here approaches more the spore figured by Bhardwaj (1957b, Pl. 23, Fig. 32) as *C.* cf. *triquetrus* except that the spore illustrated here is bigger. Among the others, *C. densus* Bhardwaj (1957b) is smaller in size. *C. subverrucosus* (Bhardwaj, 1957a) also is smaller and has thickly set and low verrucae. *C. baccatus* (Imgr.) Pot. & Kr., and *C. varietus* (Imgr.) Pot. & Kr., are distinctly smaller in size and also possess smaller, not so thickly set verrucae and hence are not comparable.

Remarks — Since only 4 specimens have been studied they have not been put under a new species but have been retained just as a species of *Converrucosisporites*.

***Verrucosisporites* (Ibr.) Pot. & Kr. 1954**

Verrucosisporites guthörlii sp. nov.

Pl. 5, Figs. 56, 57

Holotype — Pl. 5, Fig. 56.

Diagnosis — Circular, 90-120 μ. Y-rays 38 μ long in the holotype, up to 3/4 radius long. Exine covered over by verrucae which are irregular in size, ±50 verrucae along the equator.

Description — Circular, yellowish brown spores, sometimes folded to spindle-oval shape, holotype 110 μ. Y-arms 3/4 radius long. Extrema lineamenta with ±50 verrucae. Verrucae of various sizes and shapes, not perfectly circular, irregular, 2·5-5 μ broad and 1·5-3 μ high. Exine fairly thick, up to 3-4 μ in optical section.

Comparison — *V. donarii* is smaller in size and has smaller verrucae which are almost uniform. *V. verrucosus* too is smaller in size with more uniform and closely set verrucae. The other species are all smaller in size and do not compare.

Verrucosisporites magnus sp. nov.

Pl. 5, Fig. 58

Holotype — Pl. 5, Fig. 58.

Diagnosis — Circular, 120 μ. Y-rays 1/2 radius. Exine with small confluent verrucae of uniform size, about 70 along the equator.

Description — Circular, frequently appearing ovalish, holotype 120 μ. Y-rays about 30 μ long. Exine thin, with about 2 μ broad verrucae uniformly spread over and usually confluent with the adjacent ones.

Comparison — *V. guthörlii* has separate, coarser, and irregular verrucae where as in *V. magnus* the verrucae are finer, more regularly distributed confluent and are uniform in size. The Y-rays are shorter in *V. magnus* as compared to *V. guthörlii*.

Verrucosisporites pertenuis sp. nov.

Pl. 6, Fig. 61

Holotype — Pl. 6, Fig. 61.

Diagnosis — Circular, 74-80 μ. Y-rays, equal, less than 1/2 radius. Exine covered with verrucae of irregular sizes, about 60 along the equator.

Description — Yellowish brown miospores, circular, generally with one or two prominent folds, thus assuming an oval shape, holotype 76 μ. Y-rays going up to 1/2 to less than 1/2 radius, ±12·5 μ long. Exine covered by small ± up to 2 μ broad verrucae, not regular in their size, evenly distributed. Extrema lineamenta rough due to the presence of closely packed verrucae. In a lower magnification the closely set verrucae appear like a reticulum due to confluence of elements. The exine is fairly thick.

Comparison — *Verrucosisporites donarii* is bigger in size and possesses broader and uniform verrucae. The other species of *Verrucosisporites* listed by Potonié & Kremp (*loc. cit.*) possess still bigger and more prominent verrucae and hence are not comparable.

Verrucosisporites donarii
Pot. & Kr. 1955

Pl. 6, Fig. 59

Remarks — The holotype illustrated by Potonié & Kremp (1955) measures only 71 μ,

whereas the specimen figured here is 82 μ. In view of the similarity in the ornamentation as well as the nature of the Y-mark, it has been referred to *V. donarii*.

Verrucosisporites pergranulus (Alpern 1959) comb. nov.

Syn.— Cyclogranisporites pergranulus Alpern, Pl. 6, Fig. 60

Holotype — Alpern 1959, Pl. 2, Fig. 55.

Diagnosis (emend) — Circular, 100-110 μ. Y-mark distinct, often displaced to one side, rays about 32 μ long. Exine covered with about 3 μ broad, low verrucae.

Description — Circular, yellowish miospores. Holotype 105 μ. Y-mark usually visible sometimes obscured, ray ± 32 μ long. Exine covered with verrucae, uniform in size, but very low, about 3 μ thick. Exine 3-4 μ thick, generally cracked from the equator inwards on flattening. Exine thickness characteristically seen along the margin in flattened spore.

Comparison — V. verrucosus Ibr., though agreeing in size with *V. pergranulus* distinguishes itself by its thinner exine and possessing distinct, prominent verrucae which are bigger in size. The other species listed by Potonié & Kremp (*loc. cit.*) are all smaller in size. *V. magnus* and *V. guthörlii* also distinguish by possessing prominent verrucae.

Remarks — Such low set verrucae have never been described among *Verrucosisporites*. *Planisporites* has finer and longer than broad coni.

Verrucosisporites sp.

Pl. 6, Fig. 62

Description — Spores circular to roundly triangular, 50-60 μ. Y-mark prominent, arms going up to 3/4 radius of the spore, exine covered with blunt to sharp tipped verrucae, about 35-40 along the extrema lineamenta, but around the trilete mark the verrucae are much crowded. The closely packed verrucae simulate a pseudoreticulum. In Pl. 6, Fig. 62., some ± equatorial folds in the exine apparently give an idea of a cingulum.

Comparison — V. donarii Pot. & Kr., is bigger in size and also distinguishes by possessing smaller verrucae. *V. verrucosus* Ibr., is bigger in size. *V. firmus* Loose, though approaching the size of *V.* sp., possesses more blunt and less crowded verrucae. Among the other species of *Verrucosisporites* described here all the species are bigger in size and hence do not compare.

***Planisporites* (Knox) Pot. & Kr. 1954**

Planisporites rarus sp. nov.

Pl. 6, Fig. 66

Holotype — Bhardwaj 1957a, Pl. 23, Fig. 13.

Diagnosis and Description — See Bhardwaj 1957a, p. 87 for *P. microtuberosus*.

Remarks — Bhardwaj 1957a, p. 87 described similar spores as *P. microtuberosus* (Loose) Knox. Since *P. microtuberosus* has already been transferred to *Microreticulatisporites microtuberosus* by Potonié & Kremp 1955, we have referred our specimens as well as those of Bhardwaj (*loc. cit.*) to a new species.

Planisporites circularis sp. nov.

Pl. 6, Figs. 64, 65

Holotype — Pl. 6, Fig. 64.

Diagnosis — Circular, 80-100 μ. Y-rays 1/2 radius. Exine beset with low, fine, sparse and irregularly distributed coni.

Description — Circular, holotype 100 μ. Y-rays 20-30 μ long, apex and vertex low, labra thin, ray-ends not tapering. Exine covered with fine, low-set minute coni, sparse and irregularly distributed. Coni are more crowded near the Y-mark. Exine thick due to which no major folds evident, faint differentiation of the contact area from the rest of the exine apparent.

Comparison — P. granifer is distinctly triangular in shape and *P. spinulistratus* possesses distinct, sparsely placed coni. *P. magnus* is bigger in size and has small very sparsely distributed coni, and *P. rarus* has prominent conspicuous coni.

Planisporites magnus Bhard. 1957a

Pl. 6, Fig. 68

Remarks — The size of *P. magnus* given by Bhardwaj (*loc. cit.*) is 120-150 μ but our specimens here extend the range to 175 μ.

Lophotriletes (Naum.) Pot. & Kr. 1955

Lophotriletes commissuralis (Kos.) Pot. & Kr. 1955

Lophotriletes pseudaculeatus
Pot. & Kr. 1955

Pl. 6, Fig. 72

Apiculatisporis Pot. & Kr. 1956

Apiculatisporis iucundus sp. nov.

Pl. 6, Fig. 67

Holotype — Pl. 6, Fig. 67.

Diagnosis — Circular, 120-130 μ. Y-rays up to 40 μ long. Extrema lineamenta and exine covered over by irregular coni with blunt and smooth points.

Description — Circular, brownish yellow spores, holotype 125 μ. Y-mark present, apex and vertex low, labra thin, rays distinct, one of them longer than the other two, rays in holotype up to 40 μ long. Extrema lineamenta and exine covered with coni of various sizes from fine round grana-like to thick irregular verrucae, and spaced 3-6 μ apart, about 40 coni along the equator.

Comparison — *A. latigranifer* is smaller in size and has uniform, sparsely placed coni. *A. singularis* and *A. maculosus* too are smaller in size and have bigger, more pronounced coni. The other species do not compare.

Apiculatisporis singularis sp. nov.

Pl. 6, Figs. 69-70

Holotype — Pl. 7, Fig. 70.

Diagnosis — Circular, 90-120 μ. Y-rays 2/3 radius, apex and vertex low, labra thin. Extrema lineamenta and exine beyond the inter-ray area sparsely covered by round coni with smooth, blunt points, some are 2-3 μ high about 30-35 along the margin, exine around the trilete mark has sparsely placed coni and is infrapunctate, almost suggesting an *area contagionis*.

Description — Circular, yellowish brown miospores often with folds making the spores more oval, holotype 114 μ. Y-rays up to 40 μ long, apex and vertex low, labra thin. Extrema lineamenta and exine ornamented with widely spaced coni having rounded apices. There can be found a transition from fine grana-like emergences to rounded coni as big as 5 μ. About 30-35 coni present along the equator. Exine around the trilete mark has much sparser distributed coni and is finely infrapunctate.

Comparison — *A. latigranifer* is smaller in size, distinguishes itself by shorter Y-mark, going only up to 1/2 radius length and low set uniform coni which are smaller in size and the exine lacking the infrapunctate nature. *A. iucundus* is bigger in size and has smaller coni. *A. maculosus* has smaller, more closely packed coni and the remaining species do not compare.

Remarks — *A. maculosus* described originally by Knox (*loc. cit.*) is comparable to our specimens. The only photographed record of *A. maculosus* is that figured by Butterworth & Williams (1958). Our specimens of *A. singularis* are of the same size, but *A. maculosus* has smaller more closely packed coni, hence our spores have been described as a new species. *A. maculosus* described by Knox (*loc. cit.*) is from the Lower Carboniferous Limestone group of Scotland and that described by Butterworth & Williams (*loc. cit.*) too is from the same horizon from Scotland, whereas *A. singularis* described here is from Westphalian D.

Apiculatisporis aculeatus Ibr. 1933

Pl. 7, Fig. 73

Remarks — Our specimens are slightly smaller in size, i.e., 45-48 μ only, whereas the range of *A. aculeatus* is from 50 to 60 μ, according to Potonié & Kremp (*loc. cit.*). However, in view of the similar ornamentation these specimens have been referred to this species.

Apiculatisporites cf. *setulosus*
(Kos.) Pot. & Kr. 1955

Pl. 6, Fig. 71

Pustulatisporites Pot. & Kr. 1954

Pustulatisporites pustulatus
Pot. & Kr. 1954

Pl. 7, Fig. 83

Remarks — The specimen described by Alpern (1958b) as *Triquitrites verrucosus* may belong to *Pustulatisporites*.

Raistrickia (S.W. & B.) Pot. & Kr. 1954

Raistrickia irregularis Kos. 1950

Pl. 7, Fig. 80

Raistrickia saetosa (Loose) S.W. & B. 1944

Pl. 7, Fig. 76

Remarks — The range given by Potonié & Kremp is inclusive of the bacula. Excluding the bacula, the size of the spore body in the illustrations of *R. saetosa* by Potonié & Kremp is 58-70 μ.

Raistrickia crocea Kos. 1950

Pl. 7, Fig. 75

Raistrickia grandibacculata sp. nov.

Pl. 7, Figs. 77-78

Holotype — Pl. 7, Fig. 77.

Diagnosis — Circular, 80-100 μ (excluding bacula). Y-rays 21 μ, 1/2 radius, apex and vertex low, labra thin, extrema lineamenta and exine covered with large cylindrical bacula up to 15 μ long, truncate but lacerated at the tips.

Description — Circular sometimes assuming an oval shape due to folds, holotype 86 μ. Y-mark clearly seen, 21 μ long, 1/2 radius, apex and vertex low, rays thin. Extrema lineamenta and exine uniformly covered by large bacula which are ±15 μ long and 4-5 μ broad. The bacula are much broadened and are lacerated at their tips. The bacula nearer the margin are more lacerate than the bacula near the tetrad mark which are also smaller and sparser. Spore exine thick, rarely folded.

Comparison — *R. saetosa* is smaller in size (excl. bacula) and has thinner bacula. *R. protensa* and *R. crocea* are smaller in size and have fewer bacula. R. *major* Bhardwaj, is bigger in size. The other species of *Raistrickia* distinguish in possessing non-lacerated bacula.

Remarks — The spore referred to *R. saetosa* by Bhardwaj (1957a) belongs to this species.

Raistrickia cf. *aculeata* Kos. 1950

Pl. 7, Fig. 79

Description — Circular, yellowish brown miospores, 100 μ (excluding spines). Spore coat ruptured along the trilete mark, hence it is difficult to determine the exact length of the rays, they appear to be 3/4 radius long. Spore coat not thick, covered with long bacula which are 4-11 μ long and only 2-4 μ broad; the tips are truncate and segmented, some having blunt rounded tips. The spines near the Y-mark are shorter than the ones near the margin.

Comparison — This spore is bigger than R. *aculeata* and also has less crowded bacula, hence it has been referred to as *R.* cf. *aculeata.*

Raistrickia angusta sp. nov.

Pl. 7, Fig. 82

Holotype — Pl. 7, Fig. 82.

Diagnosis — Circular, 70-85 μ. Y-mark very faint, arms 17 μ long, less than 1/2 radius, exine sparsely covered with bacula, 9 μ long and 1·5-3 μ broad. The bacula are uniform, thin, long, slender and have uniform tips, blunt or pointed sometimes rounded like a knob.

Description — Circular, holotype 80 μ. Y-rays less than 1/2 radius, apex and vertex low, labra thin. Extrema lineamenta and exine covered with bacula 1·5-3 μ broad and up to 9 μ long, tips truncate, blunt or drawn out into conical points, sometimes rounded into a knob. All bacula are almost uniform in size and very sparsely distributed, exine in between the bacula laevigate.

Comparison — *R. crinata* Kos., has a thicker spore coat, is smaller in size, and distinguishes by more crowded bacula and a prominent Y-mark, going right up to the margins. *R. aculeata* Kos., too has a thick set of bacula. *R. aculealata* Wils. & Hoffm., is smaller in size.

Raistrickia bulbosa sp. nov.

Pl. 7, Fig. 81

Holotype — Pl. 7, Fig. 81.

Diagnosis — Roundly triangular, 70-90 μ. Y-rays 2/3 radius. Exine thick, covered with broad-based bacula, conical or pointed at the tip.

Description — Roundly triangular, dark yellow miospores with rounded angles and straight sides. Holotype 82 × 90 μ, Y-mark prominent, 2/3 radius. Exine and extrema lineamenta covered densely with bacula 5-6 μ long and 2-3 μ broad, broader or sometimes bulbous at the base, some are very small almost like coni.

Comparison — *Apiculatisporis* have finer coni and are generally circular in shape. *Lophotriletes* are characterized by their triangular shape, smaller size and finer coni.

Among species of *Raistrickia*, *R. crinita* (KOSANKE, 1950) can be compared, but it differs in having longer and more uniform spines.

Raistrickia sp.

Pl. 7, Fig. 74

Description — Dark, yellowish brown, roundly oval miospores, 64-76 (excl. bacula). Y-rays going up to 2/3 radius length, labra low. Exine beset with up to 8 μ long, slender bacula narrower based appearing club shaped, bacula heads not lacerated.

Comparison — *R. superba* (Ibr.) S.W. & B., and *R. fibrata* (Loose) S.W. & B. which are apparently synonymous, are smaller in size of the body, have broader based heavier as well as fewer bacula as compared to *R.* sp. illustrated here.

Cyclobaculisporites Bhard. 1955

Cf. *Cyclobaculisporites* sp.

Pl. 7, Fig. 84

Description — Roundly triangular, yellowish brown miospores, 100 μ. Y-rays not distinctly seen due to the exine ornamentation, rays very small, on the surface being not more than 5 μ in length, however, in deeper focus two of the rays appear ± 1/2 radius in length and one 2/3 long. Extrema lineamenta and exine beset with fine, small bacula with flattened tips, unequal in size but equally spaced giving a fine pseudoreticulate appearance. Ornamentation similar on the proximal as well as on the distal sides, spore wall ± 2 μ thick.

Remarks — *Cyclobaculisporites* is always circular or subcircular and usually has more prominent bacula.

Tuberculatisporites (Ibr.) Pot. & Kr. 1954

Tuberculatisporites subfuscus (Wicher) Pot. & Kr. 1955

Pl. 7, Fig. 85 & Pl. 8, Fig. 86

Infraturma — _Murornati_ Pot. & Kr. 1954

Microreticulatisporites (Knox) Bhard. 1955

Microreticulatisporites novicus Bhard. 1957a

Pl. 8, Fig. 87

Microreticulatisporites aequabilis sp. nov.

Pl. 8, Figs. 92, 93

Holotype — Pl. 8, Fig. 92.

Diagnosis — Roundly triangular, 60-70 μ. Y-rays 26-28 μ, 3/4 radius. Exine having positive reticulum due to low muri, the meshes represented by nearly circular, distinct foveolae.

Description — Yellowish brown miospores, holotype 70 × 52 μ. Exine covered with low, uniform muri which enclose up to 1 μ wide lumina, distance between lumina 3·3-5 μ. Muri low, extrema lineamenta uneven due to muri.

Comparison — The other species of *Microreticulatisporites* do not possess such low set and regular muri.

Microreticulatisporites fistulosus (Ibr.) Knox 1950

Pl. 8, Fig. 89

Microreticulatisporites nobilis (Wicher) Knox 1950

Pl. 8, Fig. 88

Microreticulatisporites gravimuricatus sp. nov.

Pl. 8, Fig. 91

Holotype — Pl. 8, Fig. 91.

Diagnosis — Roundly triangular, size 56-81 μ (longest axis). Y-rays 1/2 radius, 25-40 muri along the extrema lineamenta, muri 6-8 μ broad and up to 5 μ high.

Description — Dark brown in colour, holotype 80 μ. Y-rays prominent, 1/2 radius almost subdued due to the presence of raised muri. Extrema lineamenta and exine covered with peaked muri 6-8 μ broad and about 5 μ high, in between the muri lumina are seen as irregular vermiculate areas. Spore coat thick, folds absent.

Comparison — *M. microtuberosus* has finer muri and possesses longer Y-rays, reaching the equator. *M. sifati* as well as *M. versus* are bigger in size, possessing longer Y-rays and finer meshes. *M. acquabilis* does not possess raised muri and is smaller and hence is not comparable.

Foveolatisporites Bhard. 1955

Genotype — *Foveolatisporites fenestratus* (Kos. & BROKAW) Bhard. 1955.

Remarks — As apparent from the illustration of *Foveolatisporites* given here and those of Alpern (1959, PL. 5, FIG. 107, 108) the spore has a lid by the separation of which the inner body bearing the trilete mark is exposed. The trilete mark as well as the inner body which is much folded and generally shifted to one side has been observed only in overmacerated specimens. In most of the specimens studied, the rays of trilete mark do not extend beyond the area of the lid above. The separated discs examined do not show any Y-mark, which substantiates the contention that the Y-mark is borne on the inner body and not on the outer spore exine.

Foveolatisporites fenestratus
(Kos. & Brokaw) Bhard. 1955

Pl. 8, Figs. 97-99

Description of our specimens — Circular, dark brown miospores, 68-130 μ, margin undulated due to the presence of muri. Muri are ± 1·5 μ high with rounded apices and appear in surface view forming a net work with each mesh enclosing a foveola. Y-mark is present, borne on the inner body.

The Y-mark is visible in the middle focus within the separating circular lid. Figure 97 shows such a condition. In Fig. 98 the spore has been photographed in top focus revealing the outline of the separating disc. The central body is thin-walled and much irregularly folded, as seen here. In Fig. 99, the separating lid is smaller than those of the other figures and the central body, as apparent from the darkening beyond the lid outline is bigger than it. In this specimen the foveola are also smaller than those of Figs. 97 and 98. The inclusion of this specimen here is to be considered provisional.

Foveolatisporites clarus sp. nov.

Pl. 8, Figs. 94-96

Holotype — Pl. 8, Fig. 94.

Diagnosis — Circular, 80-100 μ. Exine covered by thin muri enclosing foveolae, muri 1·5-2 μ high with rounded apex, foveolae in the meshes 2-6 μ in diameter, circular, oval to polygonal. Many a time there is a lid present, about 40 μ wide and circular, which separates to leave a circular hole exposing the inner body bearing the Y-mark. Y-rays less than 1/2 radius, only occasionally seen.

Description — Circular, holotype 90 μ. Margin uneven due to muri and generally thickened due to overcrowding of the muri which are 1·5-2 μ high, broad at the base and with rounded apices. In surface view the muri build up a net work enclosing circular, oval or polygonal foveolae, which are generally 2-6 μ broad and the muri between the foveolae about 3 μ wide. The spores open through a circular lid exposing the inner body which is laevigate and bears the trilete mark. The Y-mark seen only in some cases.

Pl. 8, Fig. 94, shows a spore with the delimitation of a lid, and Pl. 8, Fig. 95 shows the circular lid which has not yet been completely separated. In Pl. 8, Fig. 96 the lid is separated exposing the inner body.

Comparison — *F. fenestratus* distinguishes itself by having smaller and more uniformly sized meshes.

Foveolatisporites insignis sp. nov.

Pl. 8, Figs. 100-101

Holotype — Pl. 8, Fig. 101.

Diagnosis — ± circular, 60-80 μ. Extrema lineamenta undulating due to low muri, surface uniformly covered with muri, enclosing 1·5-2 μ broad, oval to circular foveolae.

Description — Circular, dark brown, holotype 80 μ. Exine ornamented with broad muri enclosing very small foveolae. Circular lid present (PL. 8, FIG. 101) which separates to expose the inner body. Y-mark so far not observed but it is presumed to be present on the inner body as in the earlier described spores.

Comparison — *F. fenestratus* has equally broad meshes but the muri are not so wide as in *F. insignis*. *F. clarus* has broader foveolae which are closely spaced. *F. valensis* has still smaller, more closely spaced foveolae.

***Vestispora* (Wils. & Hoffm.) Bhard. 1957b**

Remarks — In comparing *Foveolatisporites* with *Vestispora* there appears to be much in common between these two genera. The extra ornamentation in both, though not similar, is possessed of muri which are closely arranged to enclose a foveola in the former or loosely and irregularly arranged muri with wider meshes in the latter. In both the genera, there is the presence of the inner body which bears the trilete mark. In both

cases the trilete mark is small and limits itself to an area above which there is a ring like delimitation on the outer exine, to separate and expose the inner body and the Y-mark. It is more probable as suggested by Bhardwaj (*loc. cit.*) that we seek relationships of these two genera among the *Sphenopsida* than anywhere else. *In situ* spores, separated and described by Remy (1955) from cones of *Koinostachys* (*Sphenophyllum*) *Verticillata* Schlotheim show similar foveolate nature as in Foveolatisporites as well as show the inner bodies (REMY *loc. cit.* PL. 11, FIGS. 6-8). In spores of *Sphenophyllum hauchecornei* E. Weiss (*loc. cit.* PL. 12, FIG. 2) and *Anastachys caudata* (E. WEISS) Remy (*loc. cit.* PL. 12, FIG. 4) and *Koinostachys* sp. (REMY *loc. cit.* PL. 13, FIG. 8) there appears to be the disc like demarcation on the exine, as well as a clear trilete mark.

Glomospora, a genus recently described by Butterworth & Williams (1958) is based on an overmacerated specimen of *Vestispora*. In their photographs of *Glomospora* (B. & W. PL. 4, FIG. 5) there is a definite indication of the presence of a circular disc, as explained by Bhardwaj (*loc. cit.*). The exine ornamentation too in *Glomospora* and *Vestispora* are similar. Generally when the spores of *Vestispora* are overmacerated, the external structures are lost to give an effect similar to that seen in photographs of *Glomospora* by Butterworth and Williams. Even in the spore figured by them in Pl. 4, Fig. 6 the disc is faintly visible and the external ornamentation seems to have been reduced during the maceration treatment. In some of the overmacerated specimens of *Foveolatisporites* studied by us, such a reduction in ornamentation was also generally noticed. In view of this, *Glomospora* does not appear to be different from *Vestispora*.

Endosporites costata (BALME, 1951) which has been referred to *Glomospora* by these authors, has already been transferred to *Vestispora* by Bhardwaj (*loc. cit.*).

The spore figured by Alpern (1958a, FIG. 9, Spore 50) as *Calamospora* ? belongs to *Vestispora*. In the photograph, the circular lid and the trilete mark can be clearly seen.

Vestispora cf. *vinculata* (Ibr.) Bhard. 1957b

Pl. 9, Fig. 102

Description — Yellowish dark brown, circular to oval miospores. Trilete mark faintly discernible, but rays not exceeding 1/3 radius of the spore in length. Exine and extrema lineamenta uneven due to 2-3 μ broad and ± 2 μ high muri running irregularly on the surface building a coarse network of polygonal, irregular meshes. Rest of the exine apparently laevigate. There is present a circular disc shaped area which is well demarcated, possibly by the separation of which the inner body bearing the Y-mark is exposed.

Comparison — *V. costata* (BALME) Bhard. 1957 is circular and smaller in size and possesses broader meshes. *V. brevis* Bhard. (*loc. cit.*) is also much smaller in size. *V. vinculata* too is smaller in size and circular in its shape, with broader meshes.

Camptotriletes Naum. 1937

Camptotriletes falkenbergensis sp. nov.

Pl. 9, Figs. 103-105

Holotype — Pl. 9, Fig. 105.

Diagnosis — Spores roundly triangular, 90-120 μ. Y-rays up to 3/4 radius, apex and vertex raised, labra thick. Extrema lineamenta with 30-35 μ muri, raised and conical in shape, forming close, irregular, incomplete meshes.

Description — Dark yellowish spores, holotype 96 × 86 μ. Y-mark appears raised. Extrema lineamenta coarse due to muri, which are 4 μ high and have triangular, conical, sharp tips with swollen bases, extra reticulum irregular, imperfect and closely spaced.

Comparison — As compared to *C. falkenbergensis* the genotype as well as *C. bucculentus* (Loose) Pot. & Kr., are much smaller and possess broader and fewer muri.

Camptotriletes certus sp. nov.

Pl. 9, Figs. 106-108

Holotype — Pl. 9, Fig. 108.

Diagnosis — Subtriangular, with rounded angles, 60-80 μ, Y-mark distinct, going up to the inner margin of a narrow cingulum. Distal side ornamented with muri forming broken meshes while the proximal side is unornamented.

Description — Subtriangular, yellowish miospores, holotype 60 × 76 μ, with rounded angles, and straight to concave sides. Y-rays prominent, 2/3 radius. Extrema lineamenta undulated, exine covered with 6-8 μ broad meshes, muri flat.

The spore illustrated in Pl. 9, Fig. 106 is in polar view showing the broad meshes but in another photograph, illustrated in Pl. 9, Fig. 107, the spore has been flattened in meridional plane showing a part of the trilete mark and the meshes on the distal side which are irregular in size. From this spore it is evident that the muri near and around the equator are straight, whereas those on the distal pole form ± regular compact meshes.

Comparison — The distal mesh work in *C. certus* is comparatively much more regular than in any of the other species of the genus. It differs in the size also from *C. falkenbergensis* which is distinctly larger.

Reticulatisporites (Ibr.) Pot. & Kr. 1954

Reticulatisporites maximus Bharad. & Venk. 1961

Pl. 9, Fig. 109

Reticulatisporites ornatus Ibr. 1932

Pl. 9, Fig. 110

Remarks — The holotype illustrated by Potonié & Kremp (1956, Pl. 16, Fig. 309) is rather poor in appearance. Our specimens afford a better appreciation of the description of the species.

Turma — *Zonales* (B. & K.) Pot. & Kr. 1954
Subturma — *Auritotriletes* Pot. & Kr. 1954
Infraturma — *Auriculati* (Schopf) Pot. & Kr. 1954

Triquitrites (Wils. & Coe) Pot. & Kr. 1954

Triquitrites arculatus Wils. & Coe 1940

Pl. 9, Fig. 111

Description — In the specimens observed by us the spores are yellowish in colour, triangular with rounded angles and slightly concave sides. Y-rays 2/3 radius, tecta thin, uniform. The three angles at the tips of the rays are slightly thickened and not pronounced, subtended by flanges which are thinly connected along the sides. Exine is thin, laevigate, ± infrapunctate.

Triquitrites inusitatus Kos. 1950

Pl. 9, Figs. 112, 113

Remarks — The size range given by Kosanke (*loc. cit.*) is only 60-75 μ whereas the spores studied by us are up to 84 μ so the size range should be from 65 to 85 μ.

The spore referred to *T. inusitatus* by Wilson & Hoffmeister (1956, Pl. 3, Fig. 21) may not belong here in view of its smaller size which is only about 43 μ and the irregular mamillate warts projecting out of the spore margin.

Triquitrites gracilis sp. nov.

Pl. 9, Fig. 114

Holotype — Pl. 9, Fig. 114.

Diagnosis — Triangular, 64 × 72 μ. Y-rays 1/2 radius long, the three corners are rounded and have scanty thickening.

Description — Triangular, yellowish in colour, angles rounded. Y-rays 1/2 radius, tecta thin and uniform, exine beyond the rays thickened at the three rounded angles, no processes along the angular margins. Exine thin, laevigate.

Comparison — This species is not comparable to the known ones, because of its very simple organization. *T. exceptus* agrees in the overall size and appearance, but distinguishes itself by ornamented exine and short Y-rays. *T. simplex* and *T. leiolitus* are distinctly smaller in size and possess slight inter-ray thickenings.

Triquitrites fibraauris sp. nov.

Pl. 9, Figs. 115-116

Alpern 1959, Pl. 6, Fig. 142.

Holotype — Pl. 9, Fig. 115.

Diagnosis — Broadly triangular, 30-44 μ. Y-rays extending up to the valvate to auriculate angles. Exine thick and with a few tubercles sparsely distributed but concentrated at the angles.

Description — Dark brown, holotype 40 μ. Valvae thick with irregular finger-like and club shaped projections coming out of the three angles. Specimens also showing globular tubercles, distributed irregularly on the body but bigger and more at the angles. Exine thick.

Comparison — Comparable to *T. praetextus* Wils. & Hoffm., but the specimens figured by them have a very thick wall as well as more prominent valvae which do not possess finger-like processes met with in *T. fibraauris*. *T. crassus* Kos., though compares well, is bigger in size and has thicker exine. The spores referred to as *T. crassus*

by Wilson & Hoffmeister (1956) compare more with our specimens than with the holotype of *T. crassus*.

Triquitrites bransonii Wils. & Hoffm. 1956

Pl. 9, Fig. 118

Triquitrites exiguus Wils. & Kos. 1944

Pl. 9, Figs. 117 and 120; Pl. 10, Fig. 121

Triquitrites cuspidatus Bhard. 1957a

Pl. 10, Fig. 122

Triquitrites brevipulvinatus Bhard. 1957b

Pl. 10, Fig. 125

Triquitrites priscus Kos. 1950

Pl. 9, Fig. 119

Remarks — The size range as given by Kosanke (*loc. cit.*) is 36-45 μ, and the holotype is 40·5 μ whereas the specimen illustrated here is only ± 32 μ, hence the size range should be 32-45 μ.

Triquitrites leiolitus Bhard. 1957a

Pl. 10, Fig. 123

Triquitrites sp.

Pl. 10, Fig. 124

Description — Dark brown miospore, triangular; angles variously shaped, rounded or truncate to pointed; sides concave 50 μ. Y-mark prominent, rays up to 2/3 radius of the spore. Ends of the suture not straight but slightly wavy. Ray apex and vertex raised, labra 4·4-5 μ thick on either side of the commissure. Angles slightly thickened. Exine thick and laevigate.

Comparison — The spore compares with the specimens figured and described as *Triquitrites* sp. by Wilson & Hoffmeister, 1956 (PL. 3, FIG. 23, p. 26). The specimen described by them is a little smaller in size and has well developed finger-like unequal processes coming out of one of the valvae whereas in our specimen the spore has only slightly thickened valvae. However, both the spores distinguish themselves by possessing broad labra, the like of which has hitherto not been met with among *Triquitrites*. Wilson & Hoffmeister (*loc. cit.*) have found only one specimen and indicate that it may be an anomalous individual. In the material observed by us too, only one specimen has been recovered hence for the present we defer putting them together under a new genus.

***Ahrensisporites* Pot. & Kr. 1954**

Ahrensisporites angulatus (Kos.) Pot. & Kr. 1955

Pl. 10, Fig. 127

Remarks — This species was originally described as *Triquitrites angulatus* by Kosanke (*loc. cit.*) and now has been transferred to *Ahrensisporites* by Potonié & Kremp (*loc. cit.*).

Ahrensisporites symetricus Alpern 1959

Pl. 10, Fig. 128

Ahrensisporites mamillaris sp. nov.

Pl. 10, Figs. 129-130

Holotype — Pl. 10, Fig. 129.

Diagnosis — Triangular with concave sides, and broadly rounded angles, 80 μ. Y-rays ending just before the margin. Kyrtome boardering the Y-mark and covering the angular apices; exine ± 4 μ thick in optical section, beset with short coni bearing muri.

Description — Dark brown, exine covered with muri bearing sharply pointed or sometimes blunt coni. Y-rays almost reaching the equator, labra thin, apex and vertex low. Rays bordered by the kyrtome, which also is spinose. Exine ± 4 μ thick and with punctations in between the muri.

Comparison — The other species of *Ahrensisporites* do not easily compare with this species, but for the presence of a kyrtome. The ornamentation with its coni bearing muri seems to be an exceptional feature in this species of *Ahrensisporites*. In its ornamentation it compares with *Triquitrites mamosus* Bhardwaj (*loc. cit.*). It resembles the spores described by Radforth & McGregor (1954, pp. 604-5; PL. 1, FIG. 6), but the specimen described by them lacks the kyrtome.

***Savitrisporites* Bhard. 1955**

Savitrisporites cingulatus (Alpern 1958b) comb. nov.

Pl. 10, Figs. 131-132

Syn. — *Dictyotriletes cingulatus* Alpern 1958b.

Holotype — Alpern 1958b, Pl. 1, Fig. 5.

Diagnosis (emended) — Triangular with rounded angles, 38-50 μ, holotype ± 40 μ. Y-rays going up to the inner margin of a continuous, 3-4 μ broad cingulum with angular hyaline areas. Distal side strongly sculptured bearing coni united into ridges.

Description — Yellowish brown miospores, triangular, with straight sides and broadly rounded angles. Y-mark prominent, rays reaching the inner margin of the cingulum which is thick and continuous. The angles of the spore are broadened and are hyaline. The distal side is strongly sculptured with coni united together into muri.

Comparison — This species has been described by Alpern (*loc. cit.*) as *Dictyotriletes cingulatus;* in view of the presence of an unmistakable cingulum, these spores have now been assigned to *Savitrisporites* Bhard. (1955). *Savitrisporites triangulus* is bigger in size and distinguishes by a broader cingulum which is toothed along the sides. *S. majus* has more blunt coni and lacks angular thickenings. The three valvae are comparable to *Triquitrites.*

Callisporites a recent genus described by Butterworth & Williams (1958) is described to possess ornamentation both on proximal as well as the distal sides and is thus, said to differ from *Savitrisporites.*

Savitrisporites obliquus sp. nov.

Pl. 10, Figs. 133-134

Holotype — Pl. 10, Fig. 133.

Diagnosis — Roundly triangular, with strongly rounded angles, size 40-50 μ. Y-mark present but not clearly seen due to the usual oblique flattening of the spores. Proximal side with smooth, infraganulose exine whereas distal and the lateral sides possessing toothed ridges with 2-4 μ high blunt coni.

Description — Most of the specimens observed are obliquely flattened. There is also present a cingulum in the form of a subequatorial band, which is not broad.

Comparison — *S. cingulatus* and *S. triangulus* differ in possessing a prominent cingulum and valvate thickenings at the three angles. *S. obliquus* agrees with *S. majus,* in its organization, but is much smaller in size.

Savitrisporites camptotus (Alpern 1958b) nov. comb.

Pl. 10, Figs. 135-137

Syn. — *Dictyotriletes camptotus* Alpern 1958b.

Holotype — Alpern 1958b, Pl. 1, Fig. 3.

Diagnosis (emended) — Roundly triangular with rounded angles, 60-100 μ, holotype 90 μ. Y-rays reaching up to the inner margin of the cingulum, spore body with an equatorial, 8-10 μ thick, continuous cingulum. Proximal side smooth, distal side with blunt coni, united into muri.

Description — Yellowish brown miospores with a thick 8-10 μ wide cingulum. Proximal side laevigate, whereas the distal side ornamented with peaked ridges. The cingulum is laevigate to infrapunctate.

Comparison — *S. triangulus* differs in having a toothed cingulum and prominent angular thickenings comparable to *Triquitrites. S. majus* differs in having a denser sculpture. *S. cingulatus* is much smaller in size.

Subturma — *Zonotriletes* Waltz 1935
Infraturma — *Cingulati* Pot. & Kl. 1954

***Gravisporites* Bhard. 1954**

Gravisporites sp.

Pl. 10, Fig. 138

Also Alpern 1959, Pl. 7, Fig. 183 as *Cadiospora sphaera.*

Description — Dark yellowish miospores, roundly triangular in shape. ± 38 × 44 μ, Y-mark prominent, not extending up to the equator, but ending at the thick, crassitudinous rim, apex and vertex raised, labra thick. Crassitudo 5-8 μ thick. The exine appears to be thick.

Comparison — *G. sphaerus* is denser than the present species and is ornamented with closely set grana with irregularly placed verrucae and has been described from the Stephanian of the Saar by Bhardwaj 1955.

***Lycospora* (S.W. & B.) Pot. & Kr. 1954**

Lycospora rotunda Bhard. 1957a

Pl. 10, Figs. 139-140

Lycospora parva Kos. 1950

Pl. 10, Figs. 141-142

Lycospora triangulata Bhard. 1957a

Pl. 10, Figs. 143-144

Lycospora pseudoannulata Kos. 1950

Pl. 10, Fig. 145

Murospora Somers 1952

Murospora sp.

Pl. 10, Fig. 126

Description — Roundly triangular, trilete miospore, about 40 μ, possessing broad, unequally thickened, irregularly edged equatorial extension.

Cristatisporites Pot. & Kr. 1954

Cristatisporites elegans Bhard. 1957a

Pl. 10, Fig. 146

Crassispora Bhard. 1957b

Remarks — *Crassispora* was separated from *Planisporites* by Bhardwaj (*loc. cit.*) to include spores with the same ornamentation as that in *Planisporites* but with a dense equatorial crassitudo and a faint trilete mark, prominent mostly when open. Inspite of the very obvious morphology of the genus Alpern (1959) has preferred to retain *C. kosankei* (Pot. & Kr.) Bhard., in *Planisporites*.

Crassispora ovalis Bhard.

Pl. 10, Fig. 149

Crassispora pseudolaevigata sp. nov.

Pl. 11, Fig. 150

Holotype — Pl. 11, Fig. 150.

Diagnosis — Oval to roundly triangular, 140 × 110 μ. Trilete mark appearing as a triangular gap when open. The spore exine in the inter ray area rolled up. Crassitudinous rim present around the equator. Exine matt.

Description — Dark brown spores. Y-mark apparent, rays possibly 2/3 radius long. The crassitudinous rim is fairly thick and is more dense than elsewhere, exine matt. smooth, imperceptibly unevenly thick, giving a mottled appearance, no folds present.

Comparison — *C. pseudolaevigata* distinguishes in possessing smooth apparently unornamented exine. *C. pfalzensis* possesses minute coni and is smaller in size. The other species too possess ornamentation and hence are not comparable.

Crassispora pfalzensis Bhard. & Venk. 1957

Pl. 11, Fig. 151

Remarks — The spore figured by Alpern (1958a, in FIG. 9, spore 46) as indeterminé, probably belongs to this species.

Bullaspora Venk. 1961

Bullaspora implicata Venk. 1961

Pl. 11, Fig. 152

Bullaspora pulcherrima sp. nov.

Pl. 11, Fig. 154

Holotype — Pl. 11, Fig. 154.

Diagnosis — Oval 86-100 μ. Y-mark faint, going up to the inner margin of the crassitudo. Exine sparsely covered with up to 2 μ broad bacula, exine in between the coni finely punctate. Crassitudo ± 5-10 μ broad.

Description — Broadly oval, dark yellowish brown miospores, size 86-100 μ, holotype ± 90 μ, Y-mark present but hardly perceptible. Exine sparsely covered over with up to 2 μ broad coni or bacula, exine in between the coni finely punctate. Crassitudo ± 6-10 μ broad, thick and prominent. The coni and puncta in the crassitudinous region are more crowded than in the area of the spore body.

Comparison — *Bullaspora pulcherrima* differs from *B. implicata* in possessing finer sculptural elements and more prominent crassitudinous rim.

Bullaspora globosa sp. nov.

Pl. 11, Fig. 155

Holotype — Pl. 11, Fig. 155.

Diagnosis — Circular to oval, known size range 65-80 μ, holotype 74 μ. Y-mark present but hardly parceptible, exine and extrema lineamenta covered with 1-3 μ broad bacula, crassitudo thick and prominent.

Description — Bacula more thickly packed in the crassitudinous region than in the centre. Exine thin in the body region with occasional folds, causing the spore to look more oval than circular. About 60-65

bacula along the extrema lineamenta. At places there are also fine punctations in between the grana.

Comparison — *B. implicata* and *B. pulcherrima* are bigger in size and possess broader bacula.

Bullaspora fluctuara sp. nov.

Pl. 11, Fig. 153

Holotype - Pl. 11, Fig. 153.

Diagnosis — Oval, 60-70 μ, holotype 66 μ (across) Y-mark prominent, rays with apex and vertex raised, labra thick, tecta wavy, reaching up to the inner margins of the crassitudo. Exine and extrema lineamenta covered with closely packed bacula. Prominent crassitudo present.

Description — Yellowish brown miospores, with 4-8 μ wide prominent crassitudo. Y-mark prominent, tecta flexuous, apex much raised.

Comparison — Though the wavy tetrad mark allows *C. fluctuara* to be compared with *Anguisporites* Pot. & Kl., it lacks a prominent thick cingulum, and possesses instead of it a crassitudo. *B. implicata*, *B. pulcherrima* and *B. globosa* are bigger in size and possess broader bacula and thicker crassitudinous rim. *B. fluctuara* distinguishes from the other species of *Bullaspora* by its characteristic flexuous, trilete mark.

Aggerispora Venk. 1961

Aggerispora campta Venk. 1961

Pl. 11, Figs. 156-157

Galeatisporites Pot. & Kr.

Galeatisporites falkenbergensis sp. nov.

Pl. 10, Figs. 147-148

Holotype — Pl. 10, Fig. 147.

Diagnosis — Oval to roundly triangular, 50-80 μ, holotype 70 × 56 μ. Y-rays going up to the cingulum, labra thin. Exine covered with fine puncta and 2-3 μ broad verrucae, along the margin of the cingulum sharp, broad based coni present.

Description — Yellowish brown miospores, oval, certain spores tend more to be roundly triangular with broadly rounded angles and convex sides. Y-mark prominent, rays going up to the inner margin of the cingulum. Cingulum conspicuous, and uniformly 6-12 μ wide, finely punctate with prominent, broad based blunt coni, sometimes the coni being not very distinctly seen. Spore exine not very thick but uniformly covered with fine, about 2-3 μ broad verrucae. In between the verrucae, exine finely punctate. Rarely contact areas darkened (*see* Pl. 10, Fig. 147).

Comparison — *G. galeatus* Imgrund appears to be similar in organization but for the apparently dentate margin. Besides this there is also the geographical and stratigraphical difference, *G. galeatus* being a species from Stephanian of Kaiping Basin, China.

Remarks — These spores combine a number of sculptural elements such as puncta, coni and verrucae. The coni along the cingulum vary in number as well as size.

Cirratriradites Wils. & Coe 1940

Cirratriradites annulatus
Kos. & Brok. in Kosanke 1950

Pl. 11, Figs. 158-160

Description of our specimens — The spores observed by us are roundly triangular with convex sides with the zona following the contour of the spore body. Folding of the body or the zona is rare. Y-mark is prominent, tecta up to 8 μ high (Pl. 11, Fig. 160) which sometimes due to lateral compression get pressed on one side or become wavy due to vertical compression. The spore coat is coarsely punctate almost approaching a microfoveolate condition. The punctations are up to 1·5 μ wide. In certain cases as in Pl.11, Fig. 158, puncta on the proximal side are oval, irregularly longish and bigger, whereas on the distal side they are smaller, more rounded and sparsely, irregularly, distributed. The spore coat is thick. On the distal side, opposite the Y-mark, there are a series of thick ridges enclosing large, circular depressions. The number of these depressions vary from one to three. Sometimes they may be even four, or they may be totally absent. The exine is fairly thick around and between these areas. The equatorial zona is uniformly thin, papery and radially striated. The margin of the spore body is usually darker, probably due to folding.

Remarks — The number of circular areas surrounded by ridges vary from one to four in the specimens observed by us, sometimes

their absence also has been noted. This evidently is not an important character on which determination of the species can be based.

C. annulatus differs from *C. saturnii* in possessing coarser punctations, which are irregular in their distribution and size, more or less approaching a foveolate nature. The zona in *C. annulatus* lacks differential density unlike *C. saturnii*.

Cirratriradites saturnii (Ibr.) S.W. & B. 1944

Pl. 11, Figs. 161-162

Description of our specimens — Spores are roundly triangular with broad, pointed angles, 70-100 μ. Y-mark prominent, tecta extending into the zona up to the equator, elevated in the body region and decreasing from the apex towards the spore equator. Spore body roundly triangular, finely punctate, in some cases puncta so fine that they can hardly be seen in lower magnifications. There appears to be normally only one circular depression on the distal side of the spore in most cases. The zona is very thin and papery with dentate or finely dissected ends and is about 16-20 μ wide at the angles. Within the zona, three zones can be distinguished viz., an innermost narrow darkest zone next to the spore body, a middle lighter zone and an outer darkish expanse. The middle zone has irregular outline.

Remarks — The fine punctations and the three, dark light and mediumly dark zones respectively in the zona distinguish this species from *C. annulatus*. The other species are distinctly different.

Cirratriradites altitectus sp. nov.

Pl. 12, Figs. 164-165

Holotype — Pl. 12, Fig. 164.

Diagnosis — Roundly triangular with pointed angles, size 50-65 μ, body dense, finely punctate, Y-rays thick and elevated, zona with two zones only.

Description — Spores dark brown, roundly triangular with pointed angles. Y-mark well developed, tecta broad, raised, continuing up to the three angles of the spore but the trilete suture limits itself to the body of the spore. The body is finely punctate. The zona is 12-16 μ wide at the angles and has only two zones.

Comparison — The size is much smaller than *C. saturnii*, though there is close similarity in ornamentation. These spores also lack the lighter wavy band in the zona which is an important characteristic feature in *C. saturnii*. As compared to other known species also these specimens differ in spore size, height of tecta and ornamentation of the body hence they have been referred to as a new species.

Cirratriradites dilaterus sp. nov.

Pl. 12, Figs. 163, 166, 167

Holotype — Pl. 12, Fig. 163.

Diagnosis — Triangular, size 90-130 μ body dense, finely punctate, Y-rays thin but elevated, zona with two zones only.

Description — Spores roundly triangular, sometimes tending towards being more circular in shape, zona in the angles being rounded, but more often angular; 90-130 μ. Sides deeply convex. Y-mark prominent, tecta broad, connecting the three angles but due to vertical compression appearing wavy. Commissure small, only reaching up to 2/3 the radius. Spore body about 70 μ. Exine of the body finely punctate, in certain cases puncta hardly visible. On the distal side usually one ring like depression present. Zona 20-26 μ broad with dentate margin. There is a thick, darkened area in the zona adjacent to the spore body and rest of the area lighter in colour. The wavy zigzag bands of dark and light areas present but not very prominent. There appears to be an inner body which is intact in some cases (PL. 12, FIGS. 166) and in others, it gets shrunk and is present in a shrivelled state.

Comparison — These spores though almost agreeing in size with *C. annulatus* differ in having finer punctations on the body, whereas *C. annulatus* possesses coarse punctations which tend to become foveolae. *C. altitectus* is considerably smaller in size and has comparatively thicker tecta. *C. saturnii* is usually smaller in size (69-100 μ) the holotype being only 69 × 64 μ, and has punctations, which though not coarse are not very fine, as well as it distinguishes itself by prominent zigzag wavy bands of lighter and darker zones in the zona. *C. solaris* Hacq. & Barss, has smaller body and its zona has characteristic bifurcating, tenon-like veins.

***Bentzisporites* Pot. & Kr. 1954**

Bentzisporites tricollinus (Zerndt) Pot. & Kr. 1956

Pl. 12, Figs. 171-173

Remarks — When overmacerated, the spore exine completely dissolves to expose the inner body (Pl. 12, Fig. 173). The inner body is roundly triangular in shape with a prominent triradiate scar and three conspicuous, circular cushions, one each in the three inter-ray areas.

***Triangulatisporites* Pot. & Kr. 1954**

Triangulatisporites tertius Pot. & Kr. 156

Pl. 12, Figs. 168-170

Remarks — When slightly overmacerated the zona and the distal ornamentation dissolve, giving the spore a laevigate appearence; such spores were first mistaken for a different type. On further treatment the exine completely dissolves to expose the inner body, which is roundly triangular in shape and has a prominent triradiate scar without any inter-radial cushions as seen in *Bentzisporites*.

Turma — *Monoletes* Ibr. 1933
Subturma — *Azonomonoletes* Luber 1935

***Laevigatosporites* Ibr. 1933**

Laevigatosporites major sp. nov.

Pl. 12, Figs. 174-175

Holotype — Pl. 12, Fig. 174.

Diagnosis — Oval, size 130-150 μ, holotype 140 μ, monolete mark almost reaching the margins or sometimes slightly less. Exine thin and translucent, laevigate.

Description — Light yellowish miospores, oval in polar view. Monolete mark consists of a long slit, tecta low, labra thin, ends of the monolete mark not bifurcated. Exine laevigate. Polar axis only up to ± 100 μ.

Comparison — The biggest of the known species, *L. maximus* is smaller in size. The polar axis in the present species is longer than that of *L. maximus*.

Laevigatosporites maximus (Loose) Pot. & Kr. 1956

Pl. 12, Fig. 176; Pl. 13, Fig. 177

Laevigatosporites vulgaris Ibr.

Pl. 13, Fig. 178

Laevigatosporites desmoinensis (Wils. & Coe) S.W. & B. 1944

Pl. 13, Figs. 179-181

***Latosporites* Pot. & Kr. 1954**

Latosporites robustus (Kos.) Pot & Kr. 1954

Pl. 13, Figs. 185-186

Latosporites singularis sp. nov.

Pl. 13, Figs. 182-184

Holotype — Pl. 13, Fig. 182.

Diagnosis — Circular, size 80-90 μ, holotype 84 μ. Monolete mark 1/2 the length of the spore, sometimes little more. Exine laevigate, infrapunctate, thin.

Description — Spore usually flattened in equatorial plane and circular. The exine is thin with the result that the spores are generally much folded, laevigate, infrapunctate.

Comparison — *L. robustus* and *L. latus* do not possess such nearly circular shape, the other species of *Latosporites* do not compare.

Latosporites saarensis Bhard. 1957a

Pl. 13, Fig. 187

Latosporites falkenbergensis sp. nov.

Pl. 13, Fig. 189

Holotype — Pl. 13, Fig. 189.

Diagnosis — Spore 48-58 μ, holotype 58 μ. Monolete mark more than 1/2 the length of the spore. Exine laevigate, infrapunctate and thick.

Comparison — *L. saarensis* and *L. globosus* Schemel (1951), are both smaller in size.

Latosporites minutus Bhard. 1957

Pl. 13, Fig. 190

***Cymbospora* Venk. 1961**

Cymbospora magna Venk. 1961

Pl. 13, Fig. 191

***Punctatosporites* Ibr. 1933**

Puctatosporites minutus Ibr. 1933

Pl. 14, Fig. 195

Punctatosporites obliquus (Kos. 1950) comb. nov.

Pl. 14, Fig. 194

Holotype — Kosanke Pl. 2, Fig. 5.

Diagnosis (emended) — Circular, 30-40 μ. Monolete mark straight, more than 1/2 the length of the spore. Exine and extrema lineamenta coarse due to fine grana.

Description — Spores rarely with folds, monolete mark straight, sometimes with a third arm. Grana less than 1 μ thick and closely packed.

Remarks — In the photograph given by Kosanke (*loc. cit.*) there appears to be a trilete mark, in which two of the rays form a wide obtuse angle and the third ray is almost perpendicular to the other two. A very similar condition has been noted in some of our specimens. We consider that in such cases a crack has arisen in the middle of the monolete mark, while flattening, with the result that it appears like a trilete mark. The wide angles of two of the rays and the third being perpendicular substantiates this view. Such feature also has been noticed in the spores of *Asterotheca meriani* by Bhardwaj & Singh (1956) where fundamentally the spores are monolete with a bent monolete mark and occassionally a crack in the exine has been observed by them arising perpendicular to the slit giving a false impression of trilete mark. *Speciososporites minor* Alpern (1958b, Pl. 2, Fig. 46) should also be assigned here.

Punctatosporites sp.

Pl. 14, Fig. 196

Description — Spores bean-shaped, 22 μ. Monolete mark 3/4 the length of the spore. Exine covered with 1 μ wide grana, extrema lineamenta coarse.

***Verrucososporites* (Knox) Pot. & Kr. 1954**

Verrucososporites obscurus (Kos.) Pot. & Kr. 1956

Pl. 14, Figs. 197-198

***Torispora* Balme 1952**

Torispora securis Balme 1952

Pl. 14, Figs. 192-193

Subturma — *Zonomonoletes* Luber 1935

***Speciososporites* Pot. & Kr. 1954**

Cf. *Speciososporites* sp.

Pl. 13, Fig. 188

Description — Spore dark brown, 86 × 60 μ, oval. Monolete mark more than 1/2 the length of the spore, slightly bent in the centre. The labra are thickened, each about 7·5 μ wide and dense. There is also present a thick equatorial rim or cingulum around the spore which is about 10 μ wide. Spore exine distally as well as laterally beset with spines of irregular thickness, blunt, conical and with a broad base. They are densely packed on the exine the bases join up together to form a broken, incomplete reticulum as seen in *Camptotriletes*. On the proximal surface, the exine in between the cingulum and the labra is laevigate. Fine punctations are also met with interspersed among the coni.

Comparison — Among the Zonomonoletes, *Speciososporites* has a cingulum but it distinguishes by its ornamentation consisting of fine grana only. *Pericutosporites* has a much thicker cingulum and *Pectosporites* differs in its organization. The spore described here shows an organization which has not been reported so far. So far only one specimen has been found.

Anteturma — *Pollenites* R. Pot. 1931
Turma — *Saccites* Erdtman 1947
Subturma — *Polysaccites* Cookson 1947

***Alatisporites* Ibr. 1933**

Alatisporites potoniei sp. nov.

Pl. 14, Fig. 199

Holotype — Pl. 14, Fig. 199.

Diagnosis — Size 90-100 μ, holotype 110 × 80 μ. Y-mark prominent, rays going up to the margins. Body in all the three inter-radial areas covered with sacci. Body and bladders beset with up to 3 μ wide verrucae, sparse but uniform in shape and with fine grana interspersed between the verrucae. Body wall thick.

Description — Yellowish brown miospores, overall shape of the spore oval. Body of the spore triangular with rounded angles. Spore in perfectly flattened conditions rarely met with, in most cases the sacci overlapping

the body and making it obscure, in certain others sacci flattened in a particular way and the ornamentation being uniform the spores appearing like a tetrad. Saccus present on all the three sides of the spore body leaving only a small gap uncovered at the three angles and along the Y-mark. Rays traversing the entire length of the spore body. Body, and the bladders uniformly covered with coni which are up to 3 μ in thickness, fine grana interspersed with the verrucae. Body exine up to 4 μ thick.

Comparison — These spores compare with *A. inflatus* Kos., in the nature of the sacci, but the ornamentation is different in this case and does not afford any comparison, with the earlier described species.

Remarks — The ornamentation, by possessing grana and verrucae, departs from the usual ones met with in *Alatisporites*, though practically all sorts of sculptural elements are met with in this genus. The presence of verrucae adds to this range of variation.

Alatisporites rugosus sp. nov.

Pl. 14, Figs. 207-208

Holotype — Pl. 14, Fig. 207.

Diagnosis — Size 60-80 μ, holotype 70 μ. Y-mark prominent, rays ending at the equator, spore exine verrucose covered densely with verrucae. Sides bearing 2 sacci each borne nearer the angle. Exine of sacci infragranulose.

Description — Overall shape of the spore roundly triangular, body with convex sides and rounded angles, 66 × 56 μ, Y-mark prominent. Ornamentation of the spore body verrucose, verrucae closely spaced and of unequal sizes, extrema lineamenta of the spore body beset with low dentate projections. Bladders six in number, each about 32 μ long, two at each angle, one each at the end of a side, leaving small gap at the angles but wider space between those of the same side. Bladder exine finely infragranulose. Distal side of the spore body having certain dark, thickened, globular areas.

Comparison — The hitherto described species of *Alatisporites* do not compare with *A. rugosus*, the main difference being in the bladders so that the two bladders of the same side are located nearer the angles. Certain rounded dark areas, spread over on the distal side of the spore do not appear to be due to extraneous matter attached to the body exine. These bodies seem to be common in this species, met with in all the specimens observed. Such a feature has also been observed in the otherwise laevigate *A. inflatus* by Kosanke (1950).

Alatisporites cf. *exceptus* Alpern 1958b

Pl. 14, Fig. 200

Description — Triangular, 90-100 μ, Y-rays reaching the equator, labra not well developed, faint but prominent, exine verrucose, verrucae low and irregular. Bladders usually located, one each, round the three angles, infragranulose. Sometimes one or more of the bladders may show a notch or division opposite the ray-end.

Alatisporites falkenbergensis sp. nov.

Pl. 14, Figs. 204-206

Holotype — Pl. 14, Fig. 204.

Diagnosis — Triangular, 68-88 μ, holotype body 68 × 64 × 60 μ, overall size about 88 μ (across), including the bladders. Y-mark prominent, rays going up to the equator. Single bladder attached to the three sides of the spore leaving the three angles free. Exine laevigate, bladders infragranulose.

Description — The bladders cover the sides of the spore body wholly except for the three angles. Sometimes bladders get folded or even obliterated in the middle to give the impression of more than one bladder on each side. Sometimes bladders are wider than the length of the spore-side bearing it.

Comparison — *A. inflatus* and *A. verrucosus* have crassitudinous body equator, *A. exceptus* and *A.* cf. *exceptus* have angular bladders and *A. pustulatus* and *A. rugosus* have verrucose exine of the body. *A. potoniei* has verrucose sculpture on the bladders and body.

Alatisporites inflatus Kos. 1950

Pl. 14, Figs. 209, 210

Remarks — There seems to be very little difference between *A. varius* and *A. inflatus*. The difference between these species seems to be only in the nature of a fold in the bladder. It has been noticed that folds in the bladder may create such diverse feature

so as to appear having many small bladders or two or three bladders. In view of this it is advisable that these species may be placed together in a single species. An important feature of *A. inflatus* not remarked by Kosanke (1950) is the crassitudinous equator of the spore body clearly seen in the holotype as well as the specimens illustrated here.

Alatisporites pustulatus Ibr. 1933

Pl. 14, Figs. 202, 203

Remarks — The multibladdered appearance in these specimens is only due to the folding of the sacci and not actually due to the presence of many bladders. *A. pustulatus* hardly differs from *A. punctatus* Kos.

Subturma — *Monosaccites* (Chitaley 1951) Pot. & Kr. 1954
Infraturma — *Saccizonati* Bhard. 1957a

***Endosporites* Wils. & Coe 1940**

Remarks — *Endosporites* was created by Wilson and Coe (1940) to include bladdered miospores with a prominent central body and a trilete mark as is the case in the genotype *E. ornatus*. Similar spores had been earlier described by Ibrahim (1933 — *Zonale-sporites globiformis, Z. rotundus*) Loose (1934 — *Z. zonalis*) and Raistrick (C_1, C_4). Besides *E. ornatus*, Wilson and Coe (1940) as well as Kosanke (1950) added a number of other species to *Endosporites*. Chaloner (1953) described microspores of a lycopsid cone identifying them with *Endosporites*. From this study he also concluded that *E. globiformis, E. zonalis, E. ornatus, E. formosus* Kos., and *E. vesicatus* Kos. were one and the same species. In the opinion of Potonié and Kremp (1956) the species of *Endosporites* can be distinguished from each other mainly by the differences in the size ratio between the body and the bladder of the species. However, Chaloner (1950) has found that the body-bladder-size ratio varies so widely within a single cone of *Polysporia mirabilis* Newb., as to cover *E. globiformis, E. ornatus* and *E. zonalis*. Thus it is apparent that the body-bladder-size ratio is not enough for the separation of most of the species in the genus. In our opinion effort should be made to discover the tangibility of some other criteria for specific delimitation. Meanwhile specimens should be referred to one or the other existing species depending upon their closeness to the holotypes.

Endosporites ornatus Wils. & Coe 1940

Pl. 15, Fig. 211

Endosporites globiformis (Ibr.) S.W. & B. 1944

Pl. 15, Fig. 212

Endosporites zonalis (Loose) Knox 1950

Pl. 15, Figs. 213, 214

Cf. *Endosporites* sp.

Pl. 15, Fig. 215

Description — Yellowish brown miospores, with mostly oval to roundly triangular shape. The size is ± 160 μ. The spore body is roundly triangular ±80 μ, and the bladder is ± 56 μ wide and almost uniform around the spore body. Y-rays distinct, almost going up to the margins. In the spore illustrated here the spore body has slightly got shifted with the result that the prominent Y-mark is limited to the contour of the body, whereas there is another mark going up to the margin. The spore body is ± laevigate, there are three knob like dark cushions present in the three inter ray areas. The bladder is structured. There is present a darkened ridge-like limbus with fine sculpture of the nature of small coni.

Comparison — Cf. *Endosporites* sp. differs from *Endosporites* in possessing fine coni along the extrema lineamenta along with the infragranulations on the bladder.

Remarks — Since only one specimen has been studied so far, it has been referred to as Cf. *Endosporites* for the present, due to its overall resemblance to *Endosporites*.

Infraturma — *Triradites* (Pant) Bhard. 1955

***Wilsonia* Kos. 1950**

Wilsonia delicata Kos. 1950

Pl. 15, Fig. 216

Wilsonia kosankei Bhard. 1957a

Pl. 15, Figs. 217-218

***Candidispora* Venk. 1961**

Candidispora candida Venk.

Pl. 15, Fig. 219

Candidispora aequabilis sp. nov.

Pl. 15, Fig. 220; Pl. 16, Figs. 221-223

Holotype — Pl. 15, Fig. 220.

Diagnosis — Oval to circular, rarely roundly triangular, 120-150 μ. Two of the rays in Y-mark long, reaching the equator of the body, forming an obtuse angle and the third ending up before the inner margin of the rim or smaller; body exine finely verrucose. Equatorial area of the body not dark, instead, has the same density as the other portions of the body. Bladder infrareticulate.

Description — The shape of the body in most of the cases observed is circular to subcircular and the roundly triangular shape is very rarely met with. The equator of the spore body is not darkened, but clearly distinguishable and well marked, with a few arcuate or circular folds. Two of the rays meet virtually in a straight line with a slight notch and extend up to the equator of the body and the third ray is generally very small or even indistinguishable with the result that it appears almost as if the body has a monolete mark, but under higher magnifications and when open is clearly seen and the trilete nature is established. In certain cases the third arm is seen to reach the inner margin of the rim, but such instances are rare. Bladder infrareticulate.

Comparison — Though organizationally there is a great deal of similarity between *C. candida* and *C. aequabilis* the later distinguishes by mostly a circular to subcircular body with an unthickened equatorial region of body wall.

Candidispora falkenbergensis sp. nov.

Pl. 16, Figs. 224-225

Holotype — Pl. 16, Fig. 224.

Diagnosis — Oval, 110-140 μ, holotype 125 μ (along the longest diameter), central body 55-70 μ, in the holotype 55 μ, triangular with marginal folds. Y-mark prominent, rays almost reaching the margin of the body.

Description — Oval to elliptical, brownish yellow miospores, the central body is triangular with few marginal folds which are not regular. The exine of the spore body appears to be laevigate and the bladder infrareticulate.

Comparison — *C. candida* differs in possessing a thick rim around the spore body and *C. aequabilis* differs in the circuloid shape of body, both the characters being absent in *C. falkenbergensis*.

Latensina Luber 1955

Latensina trileta Alpern

Syn. — *Latensina triletus* Alpern 1958b, Pl. 16, Figs. 226-227.

Description of our specimens — Light yellowish brown miospores, circular, broadly elliptical to oval, 60-80 μ, body subcircular, closely following the contour of the spore, no folds present, 40-50 μ. The saccus is narrow ±8-10 μ and uniform around the body and thick as in the case of a limbus. Y-mark very faint, arms up to 8 μ, when open a window like gap apparent. In most of the cases the Y-mark is hardly perceptible. Thick nature of the bladder indicates that they are stuck together and not blown out.

Remarks — The specimen described by Schemel (1951) from the Mississipian of the Duggett county, Uttah, U.S.A., as *Endosporites pallidus* probably is a spore assignable here.

Guthörlisporites Bhard. 1954

Guthörlisporites magnificus Bhard. 1954, 1955

Pl. 16, Fig. 228

Guthörlisporites densus sp. nov.

Pl. 16, Figs. 229-230; Pl. 17, Fig. 231

Holotype — Pl. 16, Fig. 229.

Diagnosis — Oval — subcircular, size 90-130 μ, holotype 100 μ; prominent circular dark central body, ± 40-44 μ without any fold. Y-mark prominent, arms going up to the equator of the body.

Description — Generally oval, but occasionally circular, body light to dark brown and the bladder golden yellow in colour, body wall without any folds. Bladder infrareticulate.

Comparison — In contrast to *G. magnificus* the body lacks folds and is comparatively thicker and darker in colour. The spore figured by Cross & Schemel (1951, FIG. 2B), under *Endosporites* probably belongs to this species of *Guthörlisporites*.

Infraturma — _Aradiatii_ Bhard. 1955

Florinites S.W. & B. 1944

Florinites visendus (Ibr.) S.W. & B. 1944

Pl. 17, Fig. 232

Florinites similis Kos. 1950

Pl. 17, Figs. 233-234

Remarks — *F. visendus* approaches in size but differs in not possessing a well defined body. *F. volans* also has a similar size range but has a prominent trilete mark. *F. elegens* is much bigger in size.

Florinites junior Pot. & Kr. 1956

Pl. 17, Fig. 235

Florinites cf. *pumicosus* (Ibr.) S.W. & B. 1944

Pl. 17, Fig. 239

Description — The specimens observed by us are 70-84 μ in largest diameter, broadly elliptical to oval. The region of the central body is thin and shows no indication of a mark. The bladder is infrareticulate.

Remarks — As the holotype of this species has a prominent central body, the spores described here due to lack of a central body are referred here as a *F.* cf. *pumicosus*.

Florinites circularis Bhard. 1957a

Pl. 17, Fig. 238

Florinites mediapudens (Loose) Pot. & Kr. 1956

Pl. 17, Fig. 237

Florinites ovalis Bhard. 1957a

Pl. 17, Fig. 236

Infraturma — *Vesiculomonosaccites* (Pant) Bhard. 1955

***Potonieisporites* Bhard. 1955**

Potonieisporites sp.

Pl. 17, Fig. 242

Description — Yellowish brown miospores; size 120 × 90 μ, central body rounded, ± elliptical than oval. Due to flattening, central body folded secondarily into two series of folds, the first series of folds running along the margins of the central body and the second series running in the central portion, perpendicular to the monolete mark and biconvex in outline. Folds prominent and regular. Monolete mark prominent, and extending through the whole length of the central body. Bladder infrareticulate. Extrema lineamenta and exine laevigate.

Comparison — *P. novicus* Bhardwaj has a smaller monolete mark only extending up to 1/3 length of the spore and has been described from Britenbacher Schichten (Stephanian C) of Saar-Pfalz whereas our specimen is from an older horizon.

Subturma — *Disaccites* Cookson 1947

***Vesicaspora* Schemel 1951**

Vesicaspora incomposita sp. nov.

Pl. 17, Figs. 240-241

Holotype — Pl. 17, Fig. 240.

Diagnosis — Oval, 80-90 μ, holotype 94 μ, body elliptical, more like a spindle with long vertical-equatorial axis and a short horizontal-equatorial axis. The two bladders on the lateral sides of the body joined laterally. No germinal aperture on the spore body. Central body laevigate and bladder infrareticulate with fine meshes.

Description — On the body, fine striations are present which run parallel along the length of the body, these appear more like folds. The body occupies the whole width of the spore.

Comparison — *V. wilsonii* Schemel (1951) has a smaller, more oval body and is smaller in size.

Infraturma — *Striatiti* Pant

***Kosankeisporites* Bhard. 1955**

Kosankeisporites sp.

Pl. 17, Fig. 243

Description — Yellowish spores with two large bladders on either side of the spore body, generally flattened in an equatorial plane. Central body darker in colour, laevigate, ellipsoidal with a longer vertical equatorial axis bearing a well demarcated sulcus on the distal side, sulcus lies on the vertical-equatorial axis, sulcus as long as the central body and about 4·8 μ broad. On the proximal side of the central body there are thin striations running perpendicular to the sulcus. These are very faint and can be seen only under oil. Bladder infrareticulate with fine meshes.

Comparison — *K. elegans* (Kos.) Bhardwaj is bigger and has a more prominent uniform

sulcus and has striations running in a zigzag pattern on the proximal side of the spore.

Remarks — The spore figured by Cross & Schemel (1950, FIG. 2B), probably belongs to *Kosankeisporites*.

Turma — *Praecolpates* Pot. & Kr. 1954

***Schopfipollenites* Pot. & Kr. 1954**

Schopfipollenites ellipsoides (Ibr.) Pot. & Kr. 1954

Pl. 17, Figs. 244-245

MIOFLORAL COMPOSITION OF FALKENBERG COALS

In dealing with the miofloral composition of the Falkenberg coals the spore assemblage has been divided into dominant, subdominant, accessory, rare and very rare groups. The most prominent genera with the maximum percentage have been considered as dominant types. The subdominant and the accessory being relatively secondary and tertiary in importance. The rare types are generally represented by 2 per cent of the composite flora or less, while the very rare types are those which have not figured in the counting, but are present in the seam and represented by one or two specimens each. Their list has been provided here, to complete the picture of the flora in each seam, but, for the stratigraphical considerations they have been taken as absent.

SOUTH FIELD

Seam 4 (Samples 220, 221 and 222)

The miofloral of this seam is composed of 24 genera and 50 species of spores. *Apiculatisporis*, *Florinites* and *Torispora* form the major bulk of the spore assemblage. *Apiculatisporis* with a single species *A. iucundus* is the dominant spore genus with 27 per cent of the total assemblage. *Torispora* and *Florinites* form the subdominant genera.

Torispora is represented by *T. securis* and averages 14 per cent.

Florinites is represented by the following 5 species totaling 12 per cent of the assemblage.

F. visendus
F. similis
F. junior
F. circularis
F. mediapudens

Among the other notable genera which constitute accessory genera are, *Cyclogranisporites* with its two species *C. aureus* and *C. grandiculus;* and *Cadiospora* with all its four species, viz., *C. aggera, C. absoluta* and *C. tumula*. *Punctatosporites* with *P. minutus, P. obliquus* and *P.* sp. and *Candidispora* with all the three of its species *C. candida, C. falkenbergensis* and *C. aequabilis* comprise about 6 per cent each of the total assemblage.

Lycospora represented by *L. triangulata* and *L. parva* and *Verrucososporites* represented by *V. obscurus* are represented by 3 per cent each.

The following list comprises of only rare spores that have been recorded in the first 200 spores studied for each sample (each representing up to 2 per cent of the total assemblage).

Leiotriletes adnatoides
Punctatisporites laevigatus
Punctatisporites obesus
Calamospora straminia
Calamospora sp. C
Calamospora pallida
Raistrickia saetosa
Raistrickia bulbosa
Microreticulatisporites fistulosus
Foveolatisporites fenestratus
Foveolatisporites clarus
Camptotriletes falkenbergensis
Reticulatisporites ornatus
Triquitrites fibraauris
Triquitrites bransonii
Cirratriradites saturnii
Laevigatosporites major
Laevigatosporites desmoinensis
Cymbospora magna
Guthörlisporites magnificus

The spore species listed below are very rare ones, being represented by only 1 or 2 spores in the whole spore assemblage.

Leiotriletes grandis
Leiotriletes sphaerotriangulus
Calamospora hartungiana
Planisporites magnus
Raistrickia crocea
Microreticulatisporites nobilis
Triquitrites gracilis
Ahrensisporites mamillaris
Wilsonia delicata

Among the megaspore genera, *Tuberculatisporites* and *Schopfipollenites* are present in good number; and *Triangulatisporites* and *Bentzisporites* are absent.

Seam 3 (Samples 214, 215 and 216)

33 genera and 71 species are represented in this seam.

Florinites, Punctatosporites, Triquitrites and *Calamospora* form the major bulk of the spore population. *Florinites* forms about 30 per cent of the assemblage and is represented by the following 6 species:

F. visendus
F. junior
F. similis
F. circularis
F. ovalis
F. mediapudens

F. mediapudens and *F. circularis* constitute the main bulk, the rest of the species being represented by only a very negligible percentage.

Punctatosporites is represented by *P. obliquus* and *P. minutes* and averages about 12 per cent.

Triquitrites is represented by the following species:

T. inusitatus
T. bransonii
T. fibraauris
T. exiguus
T. leiolitus

Among the species of *Triquitrites* listed above only *T. bransonii* represents about 10 per cent and the rest comprise only about 3 per cent of the total assemblage.

Calamospora constitutes about 15 per cent of the assemblage and is represented by the following species:

C. falkenbergensis
C. perrugosa
C. microrugosa
C. pallida
C. straminea

The other important genera, that are well represented, are:

Cadiospora, with all the four species *C. aggera, C. laminata, C. tumula* and *C. absoluta* 6 per cent; *Foveolatisporites* with *F. clarus* and *F. fenestratus* averaging 5 per cent and *Torispora securis* averaging 6 per cent.

The following species listed here are represented only by a very meagre percentage (1-2 per cent or less than 1 per cent) among the first 200 spores observed in each sample:

Leiotriletes grandis
Leiotriletes adnatoides
Leiotriletes subadnatoides
Punctatisporites obesus
Granulatisporites minutus
Cyclogranisporites grandiculus
Lophotriletes commissuralis
Cyclogranisporites aureus
Planisporites magnus
Apiculatisporis iucundus
Apiculatisporis aculeatus
Pustulatisporites pustulatus
Microreticulatisporites novicus
Microreticulatisporites fistulosus
Reticulatisporites maximus
Savitrisporites cingulatus
Cirratriradites saturnii
Laevigatosporites desmoinensis
Cymbospora magna
Candidispora candida
Candidispora aequabilis
Candidispora falkenbergensis
Guthörlisporites densus
Lycospora triangulata
Lycospora parva
Lycospora rotunda

The following spore species though present in the slides studied, have not been met with among the first 200 spores counted for each sample and thus are very rare in this seam:

Punctatisporites gravus
Calamospora microrugosa
Raistrickia irregularis
Raistrickia sp.
Raistrickia crocea
Raistrickia saetosa
Microreticulatisporites nobilis
Camptotriletes falkenbergensis
Murospora sp.
Aggerispora campta
Laevigatosporites desmoinensis
Alatisporites potoniei
Alatisporites falkenbergensis
Alatisporites inflatus
Endosporites globiformis
Latensina trileta

Among the megaspore genera, *Bentzisporites* and *Schopfipollenites* are represented by a large number of spores; *Triangulatisporites* and *Tuberculatisporites* are totally absent.

Seam 2 (Samples 205, 206 and 207)

Seam 2 is by far the richest in its spore contents within the whole sequence studied, and 35 spores genera and about 91 species are represented. *Cirratriradites, Punctatosporites, Cyclogranisporites, Triquitrites, Lycospora* and *Florinites* are the dominant and the subdominant spore genera.

Punctatosporites is represented by two species viz., *P. obliquus* and *P. minutus* and averages 16 per cent.

Cirratriradites consists of two species *C. saturnii* and *C. altitectus* and is 13 per cent.

Cyclogranisporites is represented by 3 species viz.,

C. grandiculus
C. aureus
C. formosus

The first species is represented by 10 per cent and the other species constitute only about 0·5 per cent of the assemblage.

Triquitrites is represented by the following 5 species viz.,

T. fibraauris
T. bransonii
T. leiolitus
T. inusitatus
T. priscus

Only *T. bransonii* shows a good representation of about 11 per cent, the rest being represented by only one or two specimens among the whole series of slides observed.

Lycospora comes into prominence in this seam and forms 11·5 per cent and is represented by two species, *L. triangulata* and *L. parva*.

Florinites is represented in this seam by 6 species and forms only 9 per cent of the total assemblage. The species represented here are:

F. visendus
F. similis
F. junior
F. circularis
F. mediapudens

Among the accessory spores constituting about 2-3 per cent each are:

Leiotriletes adnatoides
Camptotriletes falkenbergensis
Cymbospora magna
Torispora securis

The spore species listed below form a very minor percentage of the whole flora. These are met with among the first 200 spores observed in each sample and are only represented by a very low percentage, 1 per cent or less than 1 per cent.

Punctatisporites obesus
Calamospora sp. C
Calamospora pallida
Calamospora straminea
Calamospora perrugosa
Granulatisporites minutus
Cadiospora absoluta
Cadiospora aggera
Apiculatisporis iucundus
Planisporites magnus
Lophotriletes pseudaculeatus
Raistrickia sp.
Raistrickia grandibacculata
Raistrickia saetosa
Raistrickia angusta
Foveolatisporites fenestratus
Microreticulatisporites fistulosus
Camptotriletes falkenbergensis
Savitrisporites cingulatus
Savitrisporites camptotus
Savitrisporites obliquus
Aggerispora campta
Galaeatisporites falkenbergensis
Laevigatosporites desmionensis
Alatisporites potoniei
Alatisporites rugosus
Alatisporites falkenbergensis
Alatisporites pustulatus
Candidispora candida
Candidispora aequabilis
Guthörlisporites densus

The following are very rare species which though present in this seam do not figure in counting and are represented by only one or two specimens. These are:

Calamospora falkenbergensis
Calamospora perrugosa
Lophotriletes commissuralis
Cadiospora laminata
Planisporites circularis
Raistrickia crocea
Raistrickia bulbosa
Microreticulatisporites novicus
Reticulatisporites maximus
Reticulatisporites ornatus
Ahrensisporites symetricus
Ahrensisporites angulatus
Ahrensisporites mamillaris
Camptotriletes certus
Crassispora pseudolaevigata
Crassispora pfalzensis
Bullaspora fluctuara
Bullaspora globosa
Bullaspora implicata
Bullaspora pulcherrima
Cf. *Speciososporites* sp.
Latosporites saarensis
Alatisporites cf. *exceptus*
Alatisporites pustulatus
Guthörlisporites densus
Latensina trileta

Calamospora, Raistrickia, Ahrensisporites, Bullaspora and *Alatisporites* though represented by a large number of species each (7, 6, 4, 4 and 5 respectively) form only a

very minor percentage of the population, each of the species being represented only by a few specimens.

The following species are also confined to this seam only:

Converrucosisporites sp.
Verrucosisporites sp.
Apiculatisporis aculeatus
Camptotriletes certus
Triquitrites leiolitus
Triquitrites priscus
Ahrensisporites symetricus
Ahrensisporites angulatus
Savitrisporites cingulatus
Crassispora pseudolaevigata
Crassispora pfalzensis
Cf. *Speciososporites* sp.

Bentzisporites, *Triangulatisporites* and *Schopfipollenites* are present and *Tuberculatisporites* is absent among the megaspore genera.

Seam 1 (Samples 203 and 204)

Seam 1 is the topmost in South field and is populated by 27 genera and about 44 species of spores.

Florinites, *Apiculatisporis*, *Punctatisporites* and *Punctatosporites* are spore genera forming the major bulk of the spore assemblage.

Florinites which is a dominant spore genus averaging 27 per cent, is represented here by 5 species viz.,

F. visendus
F. junior
F. circularis
F. ovalis
F. mediapudens

The last of the above listed species has the maximum representation of about 22 per cent and the rest forming only about 5 per cent, of the total assemblage.

Apiculatisporis averages about 20·75 per cent being represented by two species *A. iucundus* and *A. singularis*.

Punctatosporites the monolete spore genus, is represented by *P. minutus* and *P. obliquus* and averages about 14 per cent of the total assemblage.

Punctatisporites is represented by *P. obesus*, and *P. gravus* but *P. obesus* alone accounts for about 8 per cent and the other two though present are rare.

Torispora though well represented averages only 6 per cent of the population.

Verrucosisporites represented by *Verrucosisporites donarii*, *Verrucosisporites guthörlii* and *Verrucosisporites pergranulus* total about 6 per cent of the whole assemblage.

Triquitrites is represented by three species *T. bransonii*, *T. fibraauris* and *T. cuspidatus*, only the first having a sizable representation of 4 per cent and the other two being represented by less than 1 per cent each.

The following species are accessory spore types and form only a minor percentage of the spore population, represented by only 2-3·5 per cent each.

Cyclogranisporites grandiculus
Planisporites magnus

The spore species listed below though represented in the first 200 spores studied in each sample are rare and less than 1 per cent each of the total assemblage.

Leiotriletes adnatoides
Punctatisporites obesus
Calamospora microrugosa
Granulatisporites minutus
Verrucosisporites donarii
Verrucosisporites magnus
Cadiospora aggera
Cadiospora absoluta
Microreticulatisporites fistulosus
Camptotriletes falkenbergensis
Cirratriradites saturnii
Cirratriradites altitectus
Cymbospora magna
Verrucososporites obscurus
Laevigatosporites desmoinensis
Laevigatosporites maximus
Latosporites falkenbergensis

The species listed below are very rare and though present in the whole spore complex, have not been met with among the first 200 spores counted for each sample.

Punctatisporites gravus
Foveolatisporites clarus
Murospora sp.
Savitrisporites obliquus
Bullaspora fluctuara
Wilsonia delicata
Candidispora candida

Verrucososporites and *Cirratriradites* are represented here by a very minor percentage of less than 1 per cent each.

Among the megaspore genera *Tuberculatisporites*, *Bentzisporites*, and *Triangulatisporites* are represented here.

NORTH FIELD

Seam 9 (Samples 235 and 237)

27 genera and 51 species of spores are recorded from this seam.

Lycospora and *Foveolatisporites* comprise of 47 per cent and 16 per cent respectively of the total assemblage.

Foveolatisporites is represented by all the three species *F. fenestratus*, *F. clarus* and *F. insignis*.

Lycospora is represented by only one species *L. pseudoannulata*.

Among the subdominant spore genera are *Punctatosporites* and *Cirratriradites*, each forming 6 per cent of the total assemblage, the former represented by *P. minutus* and *P. obliquus* and the latter by 3 species *C. saturnii*, *C. altitectus* and *C. dilaterus*.

Torispora, *Leiotriletes* and *Camptotriletes* are the accessory genera.

Leiotriletes with 3 species, *L. grandis*, *L. sphaerotriangulus* and *L. adnatoides* is represented by 5 per cent of the total assemblage.

Camptotriletes and *Torispora* are represented each by 4·5 per cent, the former with one species *C. falkenbergensis* and the latter with its single species *T. securis*.

The following are the rare spore types, each represented by a very small percentage (less than 1 per cent).

Calamospora microrugosa
Calamospora pallida
Granulatisporites minutus
Cyclogranisporites grandiculus
Cyclogranisporites formosus
Triquitrites exiguus
Triquitrites fibraauris
Triquitrites bransonii
Triquitrites brevipulvinatus
Triquitrites arculatus
Candidispora candida
Florinites junior
Florinites circularis

The rest of the spores listed below are very rare types, represented by only one or two specimens in the whole assemblage and have not been met within the first 200 spores counted for each sample.

Punctatisporites laevigatus
Calamospora hartungiana
Cyclogranisporites aureus
Verrucosisporites donarii
Cadiospora laminata
Raistrickia crocea
Raistrickia bulbosa
Microreticulatisporites fistulosus
Microreticulatisporites nobilis
Aggerispora campta
Murospora sp.
Cymbospora magna
Laevigatosporites maximus
Laevigatosporites desmoinensis
Latosporites robustus
Verrucososporites obscurus
Alatisporites pustulatus
Alatisporites inflatus
Endosporites zonalis
Florinites visendus
Florinites cf. *pumicosus*

Among the megaspore genera *Bentzisporites* and *Schopfipollenites* are well represented and *Tuberculatisporites* and *Triangulatisporites* are absent.

Seam 8 (Samples 232, 233 and 234)

The spore flora of this seam comprises of 29 genera and 56 species.

Lycospora and *Torispora* are the dominant genera forming 43 per cent and 21 per cent respectively. *Torispora* is represented by *T. securis* and *Lycospora* by *L. triangulata* and *L. pseudoannulata*.

Punctatosporites is the subdominant genus represented by *P. minutus* and *P. obliquus* averaging 11 per cent.

Among the accessory spore genera are *Foveolatisporites* with 2 species *F. fenestratus* and *F. clarus* and *Verrucososporites* with a single species *V. obscurus* represented by 7·5 per cent and 6 per cent respectively.

It is of interest to note that among 56 species represented in this seam, only about 5 species constitute the major bulk.

Among the rare spore species the following are 1 per cent or less in total assemblage.

Leiotriletes sphaerotriangulus
Leiotriletes adnatoides
Punctatisporites obesus
Punctatisporites gravus
Calamospora perrugosa
Calamospora hartungiana
Cyclogranisporites aureus
Planisporites magnus
Apiculatisporis iucundus
Camptotriletes falkenbergensis
Reticulatisporites ornatus
Triquitrites bransonii
Triquitrites exiguus
Triquitrites brevipulvinatus
Cirratriradites saturnii
Laevigatosporites desmoinensis
Alatisporites falkenbergensis
Guthörlisporites densus
Guthörlisporites magnificus
Florinites junior
Florinites mediapudens

The following list of spore species are very rare types represented by only one or two specimens and have not been recorded in the first 200 spores counted for each sample.

Leiotriletes grandis
Leiotriletes convexus
Calamospora pallida
Calamospora microrugosa
Calamospora breviradiata
Lophotriletes commissuralis
Cyclogranisporites grandiculus
Cyclogranisporites fuscus
Cyclogranisporites formosus
Cadiospora laminata
Planisporites circularis
Raistrickia grandibacculata
Raistrickia crocea
Cf. *Cyclobaculisporites* sp.
Microreticulatisporites novicus
Microreticulatisporites fistulosus
Microreticulatisporites gravimuricatus
Camptotriletes falkenbergensis
Aggerispora campta
Cirratriradites altitectus
Ahrensisporites mamillaris
Cymbospora magna
Punctatosporites obliquus
Candidispora candida
Florinites cf. *pumicosus*
Florinites similis

Tuberculatisporites, *Bentzisporites* and *Schopfipollenites* are the megaspore genera that are well represented and *Triangulatisporites* is absent.

Seam 7 (Samples 229, 230 and 231)

The mioflora of this seam comprises of 29 spore genera and 47 species.

Torispora and *Verrucososporites* constitute the dominant spore genera, each represented by 37 and 27 per cent respectively. These genera are represented by their only species.

Laevigatosporites is the subdominant spore genus constituting 18 per cent of the total assemblage in this seam and represented by the following species.

L. maximus
L. vulgaris
L. major
L. desmoinensis

Apiculatisporis with one species, *A. iucundus* forms 4·5 per cent, *Cirratriradites* with two species *C. annulatus* and *C. dilaterus* forms 4·5 per cent, *Latosporites* represented by a single species *L. singularis* forms 3·5 per cent of the total assemblage.

Punctatosporites represented by two species *P. minutus* and *P.* sp. forms 4 per cent and *Lycospora* is 3·5 per cent of the total assemblage represented by *L. parva* and *L. triangulata*.

The following spore species listed here are the rare species represented by 1 per cent or less than 1 per cent.

Leiotriletes adnatoides
Punctatisporites obesus
Punctatisporites laevigatus
Cyclogranisporites formosus
Verrucosisporites donarii
Planisporites magnus
Raistrickia aculeolata
Microreticulatisporites aequabilis
Microreticulatisporites gravimuricatus
Foveolatisporites fenestratus
Foveolatisporites insignis
Triquitrites bransonii
Triquitrites inusitatus
Gravisporites sp.
Florinites cf. *pumicosus*
Florinites circularis

The other spore species in this assemblage which are very rare, being represented only by one or two specimens and not met with among the first 200 spores counted in each sample are:

Leiotriletes convexus
Cadiospora laminata
Planisporites circularis
Raistrickia grandibacculata
Microreticulatisporites novicus
Foveolatisporites clarus
Camptotriletes falkenbergensis
Triquitrites fibraauris
Triquitrites brevipulvinatus
Bullaspora globosa
Bullaspora implicata
Florinites visendus
Florinites junior
Candidispora candida

Among the megaspore genera, *Tuberculatisporites*, *Bentzisporites* and *Triangulatisporites* are present and *Schopfipollenites* which is throughout recorded is notably absent in this seam.

Seam 6 (Samples 226, 227 and 228)

The two top samples of this seam are highly coalified and hence do not yield well to maceration. Though a good number of spores could be secured, they are badly preserved.

In all about 27 genera and 59 species are represented in this seam.

Florinites is the dominant genus with 35 per cent representation.

Florinites is represented by 4 species:

F. junior
F. similis
F. pumicosus
F. circularis

F. junior and *F. circularis* are the most well represented species.

Lycospora is the subdominant genus with 21 per cent representation, and is represented by *L. triangulata*, *L. rotunda* and *L. parva*.

Vestispora with its only species *V.* cf. *vinculata* forms 8 per cent. *Apiculatisporis* is represented by *A. iucundus* comprises 5 per cent.

Calamospora is represented by the following species and forms 6·5 per cent of the total assemblage:

C. falkenbergensis
C. perrugosa
C. microrugosa
C. breviradiata
C. cf. *breviradiata*

Planisporites represented by *P. rarus* and *P. magnus* comprises 3·6 per cent.

Punctatosporites with only one species *P. minutus* forms 4·5 per cent of the total assemblage. The genera listed above represent the accessory groups.

Among the other spore species represented in this seam the following species form the rare types (represented by 1 per cent or less than 1 per cent).

Leiotriletes adnatoides
Leiotriletes subadnatoides
Punctatisporites obesus
Granulatisporites parvus
Lophotriletes commissuralis
Granulatisporites minutus
Cyclogranisporites grandiculus
Cyclogranisporites aureus
Cyclogranisporites formosus
Verrucosisporites donarii
Cf. *Cadiospora* sp.
Raistrickia grandibacculata
Microreticulatisporites nobilis
Foveolatisporites clarus
Triquitrites fibraauris
Triquitrites exiguus
Triquitrites bransonii
Triquitrites brevipulvinatus
Cirratriradites saturnii
Cristatisporites elegans
Laevigatosporites major
Laevigatosporites desmoinensis
Latosporites minutus
Torispora securis
Candidispora falkenbergensis
Guthörlisporites magnificus
Guthörlisporites densus

The following list comprises of very rare spore species which are only represented by one or two spores in the whole assemblage and not represented among the first 200 spores counted in each sample.

Punctatisporites potoniei
Raistrickia saetosa
Microreticulatisporites novicus
Microreticulatisporites gravimuricatus
Camptotriletes falkenbergensis
Aggerispora campta
Candidispora candida

Among the megaspore genera, *Bentzisporites* and *Schopfipollenites* are present and *Tuberculatisporites* and *Triangulatisporites* are absent in this seam.

Seam 5 (Samples 223, 224 and 225)

This seam has a very poor representation and is populated by only 15 genera and 26 species of spores. The spores in this seam are also not well preserved generally being much mutilated.

Foveolatisporites with two species *F. fenestratus* and *F. clarus; Punctatosporites* with two species *P. obliquus* and *P. minutus* are the dominant spore genera and represent 25 per cent and 13 per cent each of the spore population.

Apiculatisporis represented by *A. iucundus*. *Cirratriradites* represented by 2 species *C. saturnii* and *C.* cf. *saturnii*; *Lycospora* represented by *L. parva* and *Torispora* form 10 per cent each of the total assemblage.

Triquitrites, *Florinites* and *Cyclogranisporites* form 3-5 per cent each.

Triquitrites is represented by *T. bransonii*, *T. fibraauris* and *T. cuspidatus; Cyclogranisporites* is represented by *C. grandiculus* and *Florinites* is represented by the following 5 species, the last having the largest percentage.

F. visendus
F. cf. *pumicosus*
F. junior
F. circularis
F. mediapudens

The following are the rare spores represented by 1 per cent or less than 1 per cent of the total assemblage.

Leiotriletes adnatoides
Calamospora perrugosa

Camptotriletes falkenbergensis
Cymbospora magna

The following 2 spore species form the very rare types, not met with in the first 200 spores counted for each sample.

Granulatisporites minutus
Latensina trileta

Among the megaspore genera, *Triangulatisporites* and *Schopfipollenites* are present in a very small number and *Bentzisporites* and *Tuberculatisporites* are absent.

Seam 4 (Samples 217, 218 and 219)

Florinites with 5 species forms the dominant spore genus, being represented by 46 per cent of the total assemblage.

Florinites is represented by:

F. visendus
F. junior
F. cf. *pumicosus*
F. mediapudens
F. circularis

Florinites mediapudens is the most common spore species and constitutes 31 per cent of the total assemblage and the other four species constitute about 15 per cent.

Apiculatisporis with its common species *A. iucundus* and *Torispora* with its single species *T. securis* are the subdominant genera with 12 per cent and 14 per cent representation respectively.

Cadiospora and *Laevigatosporites*, the former with four species *C. aggera, C. laminata, C. absoluta* and *C. tumula* and the latter with three species, *L. major, L. desmoinensis* and *L. maximus*, are prominent among the accessory genera and are represented by 7 per cent each. *Laevigatosporites major* and *L. maximus* are the most common species among the species of *Laevigatosporites*. *Cyclogranisporites grandiculus, Punctatosporites minutus, Verrucososporites obscurus* and *Cymbospora magna* are represented each by 2-3 per cent of the total population.

The following are the rare spore types with a representation of 1 per cent or less than 1 per cent among the first 200 spores recorded.

Punctatisporites obesus
Calamospora mutabilis
Cirratriradites saturnii
Latosporites robustus
Latosporites singularis
Lycospora triangulata
Lycospora parva
Alatisporites falkenbergensis
Candidispora candida
Candidispora aequabilis

The spore species listed below are very rare types being represented only by one or two specimens in the whole assemblage but not represented in the first 200 spores counted for each sample.

Leiotriletes adnatoides
Planisporites circularis
Raistrickia cf. *aculeata*
Microreticulatisporites novicus
Camptotriletes falkenbergensis
Reticulatisporites maximus
Reticulatisporites ornatus
Alatisporites inflatus
Vesicaspora incomposita

Among the megaspore genera *Tuberculatisporites, Triangulatisporites, Bentzisporites* and *Schopfipollenites* are all well represented.

Seam 3 (Samples 211, 212 and 213)

29 genera and 61 species of spores are recorded in this seam.

Calamospora is the dominant spore genus.

Calamospora is represented here by the following species and forms 18 per cent of the total assemblage. The species present are *C. densa* and *C. pallida*.

C. densa is the more represented species having a representation of over 11 per cent.

The subdominant genera are *Punctatosporites, Triquitrites* and *Lycospora*.

Punctatosporites with its two species *P. obliquus* and *P. minutus* forms 12·5 per cent.

Triquitrites with the following 5 species constitutes about 11 per cent of which the most common species is *T. bransonii* represented by 10 per cent and the rest forming about 1 per cent of the total assemblage. The species represented here are:

T. inusitatus
T. fibraauris
T. bransonii
T. exiguus
T. brevipulvinatus

Lycospora forms 9 per cent and is represented by *L. triangulata, L. parva* and *L. rotunda*.

Florinites constitutes 8 per cent and is represented by *F. mediapudens, F. visendus, F. similis, F. circularis*.

Cyclogranisporites, Foveolatisporites, Torispora and *Camptotriletes* are well represented with percentages varying between 3-6 per cent.

Cyclogranisporites is represented by 2 species *C. grandiculus* and *C. aureus*; *Foveo-*

latisporites is represented by *F. clarus* and *F. fenestratus; Cirratriradites* is represented by *C. saturnii* and *C. ditaterus; Torispora* by *T. securis* and *Camptotriletes* by *C. falkenbergensis.*

Among the rare spore species listed here only few exceed 1 per cent and the rest are only represented by a very small percentage.

Leiotriletes adnatoides
Leiotriletes grandis
Punctatisporites obesus
Cadiospora aggera
Planisporites magnus
Apiculatisporis iucundus
Raistrickia grandibacuulata
Raistrickia irregularis
Microreticulatisporites fistulosus
Microreticulatisporites nobilis
Reticulatisporites ornatus
Laevigatosporites desmoinensis
Laevigatosporites vulgaris
Laevigatosporites desmoinensis
Latosporites singularis
Latosporites falkenbergensis
Alatisporites potoniei
Endosporites zonalis
Guthörlisporites densus
Florinites similis
Florinites circularis
Florinites mediapudens
Florinites visendus

The following spore species form the very rare types which are only represented by one or two specimens and have not been recorded among the first 200 spores counted for each sample.

Leiotriletes adnatoides
Punctatisporites gravus
Verrucosisporites donarii
Verrucosisporites guthörli
Apiculatisporis singularis
Apiculatisporis cf. *setulosus*
Pustulatisporites pustulatus
Savitrisporites obliquus
Bullaspora globosa
Verrucososporites obscurus
Candidispora candida

Among the megaspore genera *Bentzisporites* and *Schopfipollenites* are represented by a large number of specimens and *Triangulatisporites* and *Tuberculatisporites* are absent.

Seam 2 (Samples 208, 209 and 210)

This seam is populated by 28 genera and 53 species of spores; *Punctatisporites, Torispora, Planisporites, Verrucososporites* and *Florinites* form the dominant and subdominant spore genera.

Punctatosporites with its two species, *P. minutus* and *P. obliquus* amounts to 22·5 per cent of the total assemblage and is the most frequently metwith genus.

Torispora occupies the second place and comprises of 19 per cent of the assemblage.

Florinites with its large number of species comprises of 15 per cent, *F. mediapudens* being the most common.

Florinites is represented by the following 5 species:

F. visendus
F. junior
F. cf. *pumicosus*
F. mediapudens
F. similis

Verrucososporites and *Apiculatisporis*, the latter with its important species *A. iucundus*, each constitute 8 per cent of the total assemblage.

Triquitrites represented by the following 5 species, *Lycospora triangulata* and *Lycospora parva* with 3·5 per cent and *Foveolatisporites* with a single species *F. fenestratus* being 4 per cent are accessory spore genera.

T. fibraauris
T. bransonii
T. sp.

The following spores listed here are rare types, represented by a very meagre percentage (1 per cent or less than 1 per cent) of the spore population.

Leiotriletes adnatoides
Punctatisporites obesus
Calamospora pallida
Granulatisporites minutus
Cyclogranisporites grandiculus
Cyclogranisporites aureus
Cadiospora aggera
Cadiospora absoluta
Planisporites magnus
Raistrickia grandibacculata
Raistrickia bulbosa
Raistrickia angusta
Camptotriletes falkenbergensis
Savitrisporites camptotus
Cirratriradites saturnii
Endosporites zonalis
Latensina trileta

Among the other spores, the following very rare types are not encountered during counting of the first 200 spores for each sample.

Leiotriletes grandis
Calamospora perrugosa

Planisporites circularis
Lophotriletes pseudaculeatus
Raistrickia saetosa
Microreticulatisporites lacunosus
Alatisporites rugosus
Endosporites globiformis
Candidispora candida
Candidispora aequabilis
Potonieisporites sp.

Among the megaspore genera *Tuberculatisporites, Triangulatisporites* and *Schopfipollenites* are present and *Bentzisporites* is absent.

Seam 1 (Samples 201 and 202)

The spore flora of this seam comprises of 24 genera and 58 species. *Punctatisporites, Punctatosporites, Torispora, Florinites* and *Triquitrites* are the dominant and subdominant spore genera, which form the bulk of the spore population constituting about 57 per cent of the total assemblage.

Florinites is represented by the following 5 species and constitutes about 15 per cent of the composition.

F. visendus
F. similis
F. junior
F. mediapudens
F. circularis

Torispora with its single species *T. securis* forms about 15 per cent.

Punctatisporites is represented by only one species *P. obesus* and forms 9 per cent.

Triquitrites and *Punctatosporites* are represented by 9 per cent each, the former having as many as 4 species among which only *T. bransonii* forming 8·5 per cent and the rest of the species being represented by a very small percentage. *Punctatosporites* is represented by only one species, *P. minutus*. *Triquitrites* is represented by the following 4 species:

T. bransonii
T. cuspidatus
T. exiguus
T. fibraauris

Apiculatisporis with three species *A. iucundus, A. singularis* and *A. aculeatus* forms 5·25 per cent, among which *A. iucundus* is the most represented.

Among the accessory genera, *Cirratriradites* with only one species *C. saturnii* constitutes 6 per cent.

Leiotriletes adnatoides, Cyclogranisporites grandiculus and *Microreticulatisporites fistulosus* are also represented by a sizable percentage (2-5 per cent).

The following list comprises of rare spore species which are represented by a small percentage (1 per cent or less than 1 per cent).

Leiotriletes grandis
Leiotriletes convexus
Callamospora pallida
Calamospora microrugosa
Calamospora sp. A
Calamospora sp. B
Granulatisporites minutus
Lophotriletes commissuralis
Cyclogranisporites aureus
Cadiospora aggera
Cadiospora absoluta
Planisporites circularis
Apiculatisporis singularis
Apiculatisporis aculeatus
Raistrickia irregularis
Raistrickia grandibacculata
Microreticulatisporites nobilis
Foveolatisporites fenestratus
Foveolatisporites clarus
Camptotriletes falkenbergensis
Laevigatisporites desmoinensis
Cymbospora magna
Wilsonia delicata

The five species listed below are very rare types though represented in the whole assemblage but have not been recorded in the first 200 spores counted in each sample and are represented by only one or two spores each, in the whole assemblage.

Leiotriletes subadnatoides
Microreticulatisporites novicus
Ahrensisporites mamillaris
Lycospora parva

Among the megaspore genera *Tuberculatisporites, Bentzisporites, Triangulatisporites* and *Schopfipollenites* are all represented in this seam.

DISTRIBUTION OF THE SPORAE DISPERSAE

Leiotriletes is uniformly present throughout the Falkenberg colliery. It is an accessory type in seam 9 of Northfield, which is the lower most seam of the succession studied, and it is present as a rare type in all the other seams of the Northfield, except for seam 4 where it is a very rare type. In the Southfield it is present as a rare type throughout except for seam 2 where it gains prominence to become an accessory type.

Punctatisporites is present in all the seams studied both in Northfield as well as in Southfield. It starts in seam 9 of Northfield as a very rare type, represented by only few specimens and gains in seam 8 to become a rare type and continues in seams 7 and 6 but is absent in seam 5. It reappears in seams 4 and remains a rare type in seams 4, 3 and 2 and becomes a subdominant genus in seam 1. In Southfield it is present as a rare type in seams 4, 3 and 2 and finally becomes a subdominant genus in seam 1.

Calamospora is well represented in both the sectors, except for seams 4 and 7 in Northfield. It is a rare type in seams 9 and 8 and is totally absent in seam 7 and reappears as an accessory type in seam 6, to lose again and become a rare type in seams 5 and 4; it continues to be a rare type in the rest of the seams, except for the seam 3 where it is a dominant type. In the Southfield too it is throughout represented as a rare type, except for seam 3 where it is a subdominant type.

Granulatisporites has a discontinuous distribution and is present only in seams 9, 6, 5, 2 and 1 of Northfield and seams 3 and 1 of Southfield and is either a rare or very rare genus in these seams.

Cyclogranisporites is throughout present and forms an important spore genus in the Falkenberg colliery. It is present as a rare type in seams 9, 8, 7 and 6 of Northfield and gains prominence to become an accessory type in seams 5, 4 and 3. In seams 2 and 1 its percentage declines and it becomes a rare type. In Southfield, in seam 4 it is an accessory type but records a fall to become a rare type in seam 3, to gain prominence and become an important subdominant type in seam 2, while again in seam 1 it is represented as an accessory type.

Verrucosisporites is present in seams 9, 7, 6, 3, 2 and 1 of Northfield and seams 2 and 1 of Southfield and only forms a rare to very rare type, except in seam 1 of Southfield where it forms an accessory type.

Converrucosisporites is only represented in seam 2 of Southfield and that too as a very rare type.

Cadiospora is a well represented genus and is present in all the seams but for seams 6 and 5 of Northfield; while Cf. *Cadiospora* is restricted to seam 6 of Northfield only. In seams 9, 8 and 7 of Northfield Cadiospora is scanty and forms a very rare type while it is absent in seams 6 and 5. In seam 6 it is substituted by Cf. *Cadiospora*, which is also present as a very rare type. In seam 4 Cadiospora gains prominence to become an accessory type and in the rest of the seams of Northfield it is represented as a rare type. In Southfield, in seams 4 and 3 it is represented as an accessory type and delines in its percentage to become a rare type in the younger seams.

Planisporites is throughout represented except in seam 9 of Northfield which is the oldest of the succession studied. It is a rare type in seams 8 and 7 and gains prominence to become an accessory type in seam 6. Further it is represented in the younger seams of Northfield either as a rare type or a very rare type. In Southfield it remains a rare type in seams 4, 3 and 2 only to gain prominence again as a accessory type in seam 1.

Lophotriletes is restricted to seam 2 of both North and Southfields, remaining a rare type in both.

Apiculatisporis is well represented throughout, except for seams 9 and 7 of Northfield. It appears in seam 8 of Northfield as a rare type and gains importance to become an accessory type in the next two seams (i.e., 7 and 6) and subdominant type in seams 5 and 4. In seam 3 it remains just a rare type, and becomes subdominant in seam 2 and accessory in seam 1. In Southfield it starts as the dominant type in seam 4 and it is represented only as a rare type in seams 3 and 2 but in seam 1 it again becomes the most dominant type.

Raistrickia and *Microreticulatisporites* are present throughout the coal field as rare or very rare types, except for seam 5 where they are absent. *Microreticulatisporites* is an accessory spore type in seam 1 of Northfield.

Cf. *Cyclobaculisporites* is restricted to seam 8 of Northfield only.

Foveolatisporites is throughout represented but for seam 4 of Northfield. It starts as a dominant type in seam 9 and loses its importance to become an accessory type in the overlying seam. It remains just a rare type in seams 7 and 6 to gain further dominance in seam 5 as a dominant type. In seams 3 and 2 it is an accessory type, finally becoming scanty in seam 1. In the Southfield it is present as a rare type in seams 4 and 2 and as a very rare type in seam 1 and as an accessory type in seam 3.

Vestispora is confined to seam 6 of Northfield only and is an accessory type in that seam.

Camptotriletes is throughout represented. It starts as an accessory type in seam 9 of Northfield and declines to become a rare type in the rest of the seams, except for seam 3 where it is represented as an accessory type. In Southfield it is found as a rare type in all the four seams.

Reticulatisporites is restricted to seams 2 and 3 only in both the fields, either as a rare type or a very rare type. It is also represented by only one specimen in seam 8.

Triquitrites is throughout well represented, except for seam 4 of Northfield where it has not been recorded so far. From seam 9 up to seam 5 of Northfield it is throughout seen as a rare type and in seam 3 it is represented as a subdominant type. In seam 2 it looses its position to become an accessory type to gain prominence in seam 1 as a dominant type. In Southfield in seam 4 it starts as a rare type but becomes a subdominant type with a sizable percentage in seams 3 and 2 whereas it is present only as an accessory type in seam 1.

Ahrensisporites is only present as a very rare type in seams 8 and 1 of Northfield and seams 2 and 4 of Southfield.

Simozonotriletes is restricted as a very rare type in seams 3, 2 and 1 of Southfield and seam 9 of Northfield.

Savitrisporites is restricted to seams 3 and 2 of both North and South fields, but one or two doubtful specimens of *Savitrisporites* have also been observed in seam 1 of Southfield and seam 6 of Northfield.

Lycospora is throughout represented, except for seam 1 of both North and South fields. In Northfield it is a dominant type in seams 9 and 8 and becomes an accessory type in seam 7 to gain further prominence in the 2 overlying seams either as a dominant or as a subdominant genus. In seam 4 it is present as a rare type and becomes an accessory or subdominant type in seams 3 and 2 respectively finally absenting itself from seam 1. In Southfield *Lycospora* is accessory in seam 4, rare in seam 3 becoming subdoninant in seam 2 but is absent from seam 1.

Crassispora is restricted to seam 2 of Southfield only, while *Bullaspora* is confined to seams 1 and 2 of Southfield and 7 and 3 of Northfield. *Aggerispora* is also confined to seams 3 and 2 of Southfield and 8 and 6 of Northfield. All these genera are represented as rare to very rare types.

Cirratriradites is throughout represented in all the seams. It is an accessory type in seams 9 and 7, while in seams 8 and 6 it is represented as a rare type and it gains prominence as a subdominant type in seam 5. It is represented as a rare type in seams 4 and 2 and as an accessory type in seams 3 and 1 of Northfield. In Southfield it remains a rare type in seams 4 and 3, while in seam 2 it becomes a dominant type only to become again a rare type in seam 1.

Among the monolete genera *Laevigatosporites* is absent only in seams 8, 5 and 2 of Northfield and seam 1 of Southfield. In the remaining seams it is throughout present either as a rare or a very rare type, except in seam 4 of Northfield where it forms an accessory genus and in seam 7 where it is a subdominant genus.

Latosporites is not represented in seams 8, 5 and 1 of Northfield and seam 1 of Southfield. Except for seam 7 where it is an accessory type *Latosporites* is represented as a rare to very rare type.

Cymbospora is present in seams 9, 8, 5, 4 and 1 of Northfield and seams 4, 3 and 2 of Southfield. It is a rare type throughout except for seam 2 of Southfield where it is an accessory type.

Punctatosporites is distributed throughout. It starts in Northfield as a subdominant type in seams 9 and 8 and becomes an accessory type in seams 7 and 6, only to resume its subdominant position in seam 5. It is an accessory type in seam 4, while it is subdominant in seams 3 and 1, and dominant in seam 2. In the Southfield it is accessory in seam 4, while it is subdominant to dominant in the other seams.

Torispora starts as an accessory type in seam 9 of Northfield and becomes a subdominant type in seam 8, subsequently becoming the dominant type in seam 7. It records a fall and becomes a rare type in seam 3. In Southfield it is present as a subdominant type in seam 4, and as accessory in seams 3 and 2 gaining prominence as a subdominant type in seam 1.

Verrucososporites has a discontinuous distribution, not being present in seams 6 and 5 and 1 of Northfield and seams 3 and 2 of Southfield. It is present in seam 7 of Northfield as a dominant type, subdominant in seam 2, accessory in 8 and 4 and rare to very

rare in seams 9 and 3. In seams 4 and 1 of Southfield it is well represented as an accessory to rare type.

Cf. *Speciososporites* is confined to seam 2 of Southfield only.

Alatisporites has a discontinuous distribution and is absent in seams 7, 5 and 1 of Northfield and seams 1, 4 of Southfield. Wheresoever present it is found as a rare to very rare type.

Endosporites is present only in seams 9, 6, 3 and 2 of Northfield and seams 4 and 3 of Southfield and is a very rare type.

Wilsonia, a very rare type, is restricted to seams 9, 8, 2 and 1 of Northfield and seams 4, 2 and 1 of Southfield.

Candidispora is distributed in seams 8, 7, 6, 4, 3, 2 and 1 of Northfield and all the seams in Southfield; it is an accessory type in seam 4 of Southfield but in the other seams where present it is seen as a very rare to rare type.

Latensina is restricted to seams 5 and 2 of Northfield and 3 and 2 of Southfield; while *Guthörlisporites* is restricted to seams 8, 6, 3 and 2 of Northfield and seams 3, 2 and 1 of Southfield. Both the genera are present only as very rare genera.

Florinites is a very important genus in Falkenberg colliery and is represented in all the seams. It starts and remains a rare type in the older seams, i.e. 9 and 8 and 7 to emerge as a dominant type in seam 6. It loses importance to become an accessory type in seam 5 to regain its position either as a dominant or a subdominant type in the younger seams of Northfield. In Southfield it is either dominant or a subdominant type in all the seams.

Kosankeisporites, *Potonieisporites* and *Vesicaspora* are all restricted to particular seams. The first is present only in seam 3 of Southfield and seam 8 of Northfield, the second is restricted to seam 2 of Northfield and the third to seams 1 and 4 of Northfield.

Among the megaspore genera *Tuberculatisporites* is distributed in seams 1 and 4 of Southfield and 1, 2, 4, 7 and 8 of Northfield. *Triangulatisporites* is present in seams 1 and 2 of Southfield and seams 1, 2, 4 and 5 of Northfield. *Bentzisporites* is throughout present except for seam 4 of Southfield and seam 5 of Northfield. *Schopfipollenites* is nearly continuous in its distribution. In seam 7 of Northfield it has not been observed so far.

CORRELATION AND STRATIGRAPHY OF THE FALKENBERG COALS

Correlation:

The views prevailing on the correlation of Falkenberg coals are that seams 1-4 of Northfield correlate with seams 1-4 of Southfield.

Miofloristic studies in the coal seams of Southfield and Northfield indicate that there is great uniformity in the mioflora of these two parts. A detailed study reveals that seams 1-4 of Southfield agree most in their spore assemblage with seams 1-4 of Northfield rather than with any other seams in the sequence studied. It is of interest to note that the dominant and subdominant genera in both are almost the same though there are minor variations in the accessory and rare types. In the distribution of the spore species also there is great uniformity between the corresponding seams in the two sectors.

The correlation in vogue is further substantiated by the distribution of certain genera which show a discontinuous distribution or are restricted to certain seams only.

Seam 1 distinguishes in both the sectors by the absence of *Lycospora* along with *Alatisporites*. *Lycospora* which is a significant genus in seams 2-9 and 2-4 of the two fields, is absent from seam 1. The corresponding absence of this important genus is striking and adds to the evidence of the floristic uniformity of these, evidently two parts of one seam.

Pustulatisporites is confined to seam 3 only of both. *Reticulatisporites* and *Savitrisporites* also show a similar distribution, the former being restricted to seams 2, 3 and 4 and the latter to seams 2, and 3 only of both.

Even the following species are restricted to certain seams. *Lophotriletes pseudoculeatus* is restricted to seam 2 of both the sectors, *Raistrickia bulbosa* is only present in seam 2 while *Punctatisporites gravus* in seam 3, and *Triquitrites amplus* to seams 2 and 3 of both the sectors.

Thus it can be seen that seams 1-4 of Southfield have more common floristic similarities with seams 1-4 of Northfield than with any other seams.

Stratigraphy:

A careful study of the whole spore complex presented in the succession studied here,

shows a more or less uniform flora throughout, except for certain differences in seam 1 which is the youngest of the whole sequence.

The mioflora of the succession is characterised by the presence of genera like *Torispora, Lycospora, Triquitrites, Verrucosisporites* and *Punctatosporites*.

This assemblage is comparable to division II of Bhardwaj (1955 p. 2), where *Lycospora, Verrucososporites* and *Torispora* are said to be present and *Densosporites, Cristatisporites* and *Setosisporites* are normally absent, thus suggesting Westphalian D age for the assemblage.

The absence of the index association of spore genera characterising Westphalian C such as *Densosporites, Setosisporites* and *Radiatisporites* rules out the Westphalian C age and the presence of *Lycospora* and *Torispora* rules out the Stephanian A age for these seams (according to the table 2 of BHARDWAJ *loc. cit.*).

In seam 1, the absence of *Lycospora* which is prominent in the older seams, forbodes the change in the floral assemblage during the approaching Stephanian conditions.

The stratigraphical arrangement of Falkenberg coals may be tabulated in the following way:

TABLE 2

Stephanian A.	Not represented
Westphalian D.	Seams 1-9 (N); Seams 1-4 (S).
	Presence
	Lycospora
	Triquitrites
	Torispora
	Verrucososporites
	Punctatosporites
	Cirratriradites
	Alatisporites
	Absence
	Densosporites
	Radiatisporites
	Cristatisporites
	Setosisporites
	Zonalesporites
Westphalian C.	Not represented
	Presence
	Lycospora
	Densosporites
	Cristatisporites
	Triquitrites
	Radiatisporites
	Setosisporites

MIOFLORAL COMPARISON WITH THE WESTPHALIAN D OF THE SAAR COALFIELD

TABLE 3

	SAAR BHARADWAJ 1955	LOTHRINGEN
1. *Leiotriletes*	×	×
2. *Punctatisporites*	—	×
3. *Calamospora*	×	×
4. *Granulatisporites*	×	×
5. *Cyclogranisporites*	×	×
6. *Verrucosiporites*	—	×
7. *Converrucosisporites*	×	×
8. *Cadiospora*	—	×
9. *Planisporites*	×	×
10. *Lophotriletes*	×	×
11. *Apiculatisporis*	—	×
12. *Raistrickia*	×	×
13. *Pustulatisporites*	—	×
14. *Cyclobaculisporites*	×	×
15. *Tuberculatisporites*	×	×
16. *Microreticulatisporites*	×	×
17. *Foveolatisporites*	—	×
18. *Vestispora*	—	×
19. *Camptotriletes*	—	×
20. *Reticulatisporites*	—	×
21. *Lagenoisporites*	×	—
22. *Triquitrotes*	×	×
23. *Ahrensisporites*	—	×
24. *Savitrisporites*	—	×
25. *Valvisisporites*	×	—
26. *Gravisporites*	—	×
27. *Lycospora*	×	×
28. *Murospora*	—	×
29. *Cristatisporites*	×	×
30. *Cirratriradites*	×	×
31. *Bullaspora*	—	×
32. *Crassispora*	×	×
33. *Galeatisporites*	—	×
34. *Bentzisporites*	×	×
35. *Triangulatisporites*	×	×
36. *Zerndtisporites*	×	—
37. *Laevigatosporites*	×	×
38. *Latosporites*	—	×
39. *Cymbospora*	—	×
40. *Punctatosporites*	×	×
41. *Verrucososporites*	×	×
42. *Torispora*	×	×
43. Cf. *Speciososporites*	—	×
44. *Cystosporites*	×	—
45. *Alatisporites*	—	×
46. *Endosporites*	×	×
47. *Wilsonia*	—	×
48. *Florinites*	×	×
49. *Guthörlisporites*	—	×
50. *Candidispora*	—	×
51. *Latensina*	—	×
52. *Vesicaspora*	—	×
53. *Potonieisporites*	—	×
54. *Kosankeisporites*	—	×
55. *Schopfipollenites*	×	×

Out of the 55 genera listed here 25 genera are common to the Westphalian D of both Lothringen and the Saar basin. 4 genera are individualistic of the Saar basin and 26 of the Falkenberg coals. Among the latter some are already reported from other horizons in the Saar basin and some others may be found there upon more detailed work.

It is also interesting to note that among the index Westphalian D genera of the Saar listed by Bhardwaj (*loc. cit.*) all are represented in Falkenberg coals. Certain other genera like *Savitrisporites, Guthörlisporites* and *Wilsonia* which were so far considered to be confined to the Stephanian in the Saar (BHARDWAJ, *loc. cit.*) are present in Falkenberg coals. One to two specimens each of other Stephanian genera viz., *Kosankeisporites, Cyclobaculisporites, Gravisporites* and *Potonieisporites* have also been discovered in the Falkenberg coals. These appear to be exotic having flown in from some neighbouring area where they might have appeared earlier than in this basin. The megaspore genera, individualistic of the Saar basin are *Lagenoisporites, Valvisisporites, Cystosporites* and *Zerndtisporites*. These are absent from Falkenberg coals.

The occurrence of *Alatisporites, Punctatisporites, Vestispora, Converrucosisporites, Ahrensisporites* and *Reticulatisporites* in Lothringen constitute significant addition to the miofloral assemblage of the Saar — Lothringen coal basin. *Cristatisporites* has also been observed to occur rarely in a few seams of Falkenberg Colliery.

It is of interest to note that some of the genera from Falkenberg coals viz., *Vestispora, Apiculatisporis, Punctatisporites, Alatisporites, Ahrensisporites* and *Cadiospora*, though not reported from the Saar basin, are represented in contemporary horizons of the N.W. European paralic basin or the North American coal basins (POTONIÉ & KREMP 1954, 1955; BHARDWAJ 1954, 1955 & 1957; BUTTERWORTH & MILLOT 1954; KOSANKE 1950 and CROSS 1944 & 1946).

The present work and that on Pfalz (BHARDWAJ & VENKATACHALA 1957) together with those of Bhardwaj (1955, 1957 a) and Alpern (1958a, 1958b, 1959) have greatly enriched our knowledge of the sporae dispersae of the Lothringen-Saar-Pfalz basin. Though still not complete, the miofloral picture available, tends to maintain the sporological unity between Europe, Great Britain and North America during Westphalian.

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POST SCRIPT

Ever since this paper was written in 1959 a number of new publications have appeared and the holotypes of some spore species have been re-examined which necessitate the following changes —

The genus *Foveolatisporites* Bhard. 1955, has been suggested by Wilson & Venkatachala (1963b) to be a part of *Vestispora* (Wilson & Hoffmeister) as emended by them.

Cristatisporites Pot. & Kr. 1954, has been emended by Bharadwaj & Venkatachala (1961), and included in Infraturma-Crassiti.

A recent study of the holotype of *Galeatisporites galeatus* illustrated by Imgrund (1960) necessitates the transfer of *Galeatisporites falkenbergensis* sp. nov., described here, to *Bullaspora* Venk., as *B. falkenbergensis*.

Verrucososporites (Knox) Pot. & Kr. 1954, has been replaced by a new name *Thymospora* by Wilson & Venkatachala (1963a) on nomenclatoral grounds. The name *V. obscurus* will now read as *Thymospora obscura* (Kos.) Wils. & Venk.

A study of the holotype and other specimens of *Alatisporites hoffmeisterii* Morgan 1955, illustrated by its author reveals that *A. rugosus* sp. nov., described here, is synonymous with *A. hoffmeisterii*. Morgan (l.c.) records 7-11 bladders and observes that 8 bladders are common; however, in our

specimens only 6 bladders are normal while 7 to 8 bladders are exceptional.

Wilsonia has been subsequently changed to *Wilsonites* by Kosanke (1959) on nomenclatoral grounds. Hence *Wilsonia delicata* will read as *Wilsonites delicatus* and *W. kosankei* as *Wilsonites kosankei*.

In a recent study, *Vesicaspora* Schemel 1951, has been emended by Wilson and Venkatachala (1963c).

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EXPLANATION OF PLATES

(*All magnifications* × 500, *unless otherwise mentioned. In some cases the outline has been pencilled as per original condition.*)

Plate 1

1. *Leiotriletes grandis* (Kos.) Bhard. Photo 139/18.
2. *Leiotriletes convexus* (Kos.) Pot. & Kr.; photo 39/4.
3. *Leiotriletes sphaerotriangulus* (Loose) Pot. & Kr.; photo 49/21.
4. *Leiotriletes adnatoides* Pot. & Kr.; photo 42/24.
5. *Leiotriletes subadnatoides* Bhard.; photo 65/2.
6. *Punctatisporites potoniei* sp. nov.; photo 42/16; sl. 21565/16.
7, 8. *Punctatisporites gravus* sp. nov.; photos 123/2, 117/3; holotype sl. 21595/16.
9. *Punctatisporites laevigatus* (S.W. & B.) comb. nov.; photo 106.
10-13. *Punctatisporites obesus* (Loose) Pot. & Kr.; photos 65/17, 39/9, 46/10.

Plate 2

14. *Calamospora falkenbergensis* sp. nov.; photo 40/37; sl. 21564/2.
15, 16. *Calamospora perrugosa* (Loose) S.W. & B.; photos 50/16, 48/11.
17. *Calamospora straminea* Wils. & Kos.; photo 54/27b.
18. *Calamospora pallida* (Loose) S.W. & B.; photo 57/1.
19, 20. *Calamospora densa* sp. nov.; photos 154/3, 154/2; holotype sl. 21574/7.
21. *Calamospora* sp. A.; photo 39/11.
22. *Calamospora* sp. B.; photo 45/15.
23. *Calamospora* sp. C.; photo 44/10.
24. *Calamospora breviradiata* Kos.; photo 123/1.

Plate 3

25. *Calamospora breviradiata* Kos.; photo 60/30.
26. *Calamospora* cf. *breviradiata* Kos.; photo 137/2.
27. *Calamospora mutabilis* (Loose) S.W. & B.; photo 60/29.
28. *Calamospora* cf. *mutabilis* (Loose) S.W. & B.; photo 147/3.
29. *Calamospora hartungiana* Schopf in S.W. & B.; photo 50-21.
30. *Calamospora microrugosa* (Ibr.) S.W. & B.; photo 67/7.
31, 32. *Cadiospora laminata* sp. nov.; photos 67/23, 132/25; holotype sl. 21597/15.
33, 34. *Cadiospora tumula* sp. nov.; photos 137/16, 137/17; holotype sl. 21578/a.
35. *Cadiospora aggera* sp. nov.; photo 39/5; sl. 21562/27.

Plate 4

36, 37. *Cadiospora aggera* sp. nov.; photos 59/9, 59/8.
38, 39. *Cadiospora absoluta* sp. nov.; photos 47/31, 54/3; holotype sl. 21569/d.
40. Over macerated spore of *Cadiospora*; photo 138/20.
41. Cf. *Cadiospora* sp.; photo 132/27.
42. *Granulatisporites parvus* (Ibr.) Pot. & Kr.; photo 60/20.
43. *Granulatisporites minutus* Pot. & Kr.; photo 139/8.
44-46. *Cyclogranisporites grandiculus* sp. nov.; photos 46/32, 57/37, 66/11; holotype sl. 21568/23.

Plate 5

47. *Cyclogranisporites grandiculus* sp. nov.; photo 139/13.

48, 49. *Cyclogranisporites formosus* sp. nov.; photos 43/6, 45/6; holotype sl. 21566/4.
50-52. *Cyclogranisporites fuscus* sp. nov.; photos 54/18, 50/15, 66/4; holotype sl. 21577/v.
53. *Cyclogranisporites aureus* (Loose) Pot. & Kr.; photo 40/20.
54, 55. *Cyclogranisporites parvigranus* sp. nov.; photos 59/1, 40/25; holotype sl. 21582/2.
56, 57. *Verrucosisporites guthörlii* sp. nov.; photos 44/4, 41/6; holotype sl. 21566/7.
58. *Verrucosisporites magnus* sp. nov.; photo 45/2; sl. 21567/12.

Plate 6

59. *Verrucosisporites donarii* Pot. & Kr.; photo 59/13.
60. *Verrucosisporites pergranulus* (Alpern) comb. nov.; photo 48/24.
61. *Verrucosisporites pertenuis* sp. nov.; photo 41/17; sl. 21564/5.
62. *Verrucosisporites* sp.; photo 63/4.
63. *Converrucosisporites* sp.; photo 44/15.
64, 65. *Planisporites circularis* sp. nov.; photos 65/29, 45/15; holotype sl. 21595/9.
66. *Planisporites rarus* sp. nov.; photo 47/18; sl. 21568/31.
67. *Apiculatisporis iucundus* sp. nov.; photo 42/7; sl. 21565/13.
68. *Planisporites magnus* Bhard.; photo 147/3.
69, 70. *Apiculatisporis singularis* sp. nov.; photos 43/34a, 41/2; holotype sl. 21564/3.
71. *Apiculatisporis* cf. *setulosus* (Kos.) Pot. & Kr.; photo 69/9.
72. *Lophotriletes pseudaculeatus* Pot. & Kr.; photo 59/9.

Plate 7

73. *Apiculatisporis aculeatus* Ibr.; photo 55/4.
74. *Raistrickia* sp.; photo 47/19.
75. *Raistrickia crocea* Kos.; photo 46/24.
76. *Raistrickia saetosa* (Loose) S.W. & B.; photo 46/9.
77, 78. *Raistrickia grandibaculata* sp. nov.; photos 39/2, 161/3; holotype sl. 21562/25.
79. *Raistrickia* cf. *aculeata* Kos.; photo 57/31.
80. *Raistrickia irregularis* Kos.; photo 47/18.
81. *Raistrickia bulbosa* sp. nov.; photo 49/14; sl. 21571/8.
82. *Raistrickia angusta* sp. nov.; photo 46/25; sl. 21568/20.
83. *Pustulatisporites pustulatus* Pot. & Kr.; photo 58/21.
84. Cf. *Cyclobaculisporites* sp.; photo 65/6.
85. *Tuberculatisporites subfuscus* (Wicher) Pot. & Kr. × 50; photo 138/1.

Plate 8

86. *Tuberculatisporites subfuscus* (Wicher) Pot. & Kr. × 50; photo 138/2.
87. *Microreticulatisporites novicus* Bhard.; photo 67/8.
88. *Microreticulatisporites nobilis* (Wicher) Knox; photo 161/2.
89. *Microreticulatisporites fistulosus* (Ibr.) Pot. & Kr.; photo 38/9.
90. *Microreticulatisporites lacunosus* (Ibr.) Knox; photo 48/1.
91. *Microreticulatisporites gravimuricatus* sp. nov.; photo 63/4; holotype sl. 21589/5.
92, 93. *Microreticulatisporites aequabilis* sp. nov.; photos 117/2, 117/3; holotype sl.
94-96. *Foveolatisporites clarus* sp. nov.; photos 64/30, 64/28, 64/6.
97-99. *Foveolatisporites fenestratus* (Kos. & Brokaw) Bhard.; photos 60/2, 137/17, 60/7; holotype sl. 21587/1.
100, 101. *Foveolatisporites insignis* sp. nov.; photos 64/24, 54/11; holotype sl. 21577/s.

Plate 9

102. *Vestispora* cf. *vinculata* (Ibr.) Bhard.; photo 138/20.
103-105. *Camptotriletes falkenbergensis* sp. nov.; photos 45/12, 46/37, 54/34; holotype sl. 21577/4.
106-108. *Camptotriletes certus* sp. nov.; photos 46/5, 46/20, 46/23; holotype sl. 21568/20.
109. *Reticulatisporites maximus* Bh. & Venk.; photo 47/11.
110. *Reticulatisporites ornatus* Ibr.; photo 58/14.
111. *Triquitrites arculatus* Wils. & Coe; photo 139/9.
112, 113. *Triquitrites inusitatus* Kos.; photos 49/9, 49/13.
114. *Triquitrites gracilis* sp. nov.; photo 58/17; sl. 21581/3.
115-117. *Triquitrites fibraauris* sp. nov.; photos 49/27, 68/23, 41/21; holotype sl. 21571/11.
118. *Triquitrites bransonii* Wils. & Hoffm.; photo 46/7.
119. *Triquitrites priscus* Kos.; photo 45/35.
120. *Triquitrites exiguus* Wils & Kos.; photo 38/1.

Plate 10

121. *Triquitrites exiguus* Wils. & Kos.; photo 60/5.
122. *Triquitrites cuspidatus* Bhard.; photo 68/24.
123. *Triquitrites leiolitus* Bhard.; photo 115/4.
124. *Triquitrites* sp.; photo 49/a1.
125. *Triquitrites brevipulvinatus* Bhard.; photo 139/10.
126. *Murospora* sp.; photo 115/2.
127. *Ahrensisporites angulatus* (Kos.) Pot. & Kr.; photo 47/28.
128. *Ahrensisporites symetricus* Alpern 1959; photo 47/30.
129, 130. *Ahrensisporites mamillaris* sp. nov.; photos 65/15, 47/12; holotype sl. 21594/6.
131, 132. *Savitrisporites cingulatus* (Alpern) comb. nov.; photos 68/5, 47/14.
133, 134. *Savitrisporites obliquus* sp. nov.; photos 44/16, 42/14; holotype sl. 21566/14.
135-137. *Savitrisporites camptotus* (Alpern) Comb. nov.; photos 46/36, 117/2, 118/1.
138. *Gravisporites* sp.; photo 117/4.
139, 140. *Lycospora rotunda* Bhard.; photos 130/1, 131/4.
141, 142. *Lycospora parva* Kos.; photos 127/4, 130/2.
143, 144. *Lycospora triangulata* Bhard.; photos 137/18, 130/3.
145. *Lycospora pseudoannulata* Kos.; photo 137/20
146. *Cristatisporites elegans* Bhard.; photo 60/31.
147, 148. *Galeatisporites falkenbergensis* sp. nov.; photos 43/14, 46/35; holotype sl. 21566/6.
149. *Crassispora ovalis* Bhard.; photo 62/25.

PLATE 11

150. *Crassispora pseudolaevigata* sp. nov.; photo 43/18; sl. 21566/6.
151. *Crassispora pfalzensis* Bhard. & Venk.; photo 44/12.
152. *Bullaspora implicata* Venk.; photo 46/31.
153. *Bullaspora fluctuara* sp. nov.; photo 43/12; sl. 21566/5.
154. *Bullaspora pulcherrima* sp. nov.; photo 62/10; sl. 21590/8.
155. *Bullaspora globosa* sp. nov.; photo 62/9; sl. 21590/8.
156, 157. *Aggerispora campta* Venk.; photos 67/10, 48/30.
158-160. *Cirratriradites annulatus* Kos. & Brokaw; photos 62/18, 62/5, 61/25.
161. *Cirratriradites saturnii* (Ibr.) S.W. & B.; photo 46/30.
162. *Cirratriradites saturnii* (Ibr.) S.W. & B.; photo 42/27.

PLATE 12

163. *Cirratriradites dilaterus* sp. nov.; photo 62/15; sl. 21590/9.
164, 165. *Cirratriradites altitectus* sp. nov.; photos 102/1, 102/2.
166, 167. *Cirratriradites dilaterus* sp. nov.; photos 64/14, 153/35.
168. *Triangulatisporites tertius* Pot. & Kr. × 50; photo 138/11.
169. *Triangulatisporites tertius* Pot. & Kr. × 50; photo 138/12.
170. Inner body of *Triangulatisporites tertius* Pot. & Kr. × 50; photo 153/37.
171, 172. *Bentzisporites tricollinus* (Zerndt) Pot. & Kr. × 50; photos 155/4, 155/5.
173. Inner body of *Bentzisporites tricollinus* (Zerndt) Pot. & Kr. × 50; photo 153/36.
174, 175. *Laevigatosporites major* sp. nov.; photos 59/2, 63/20; holotype sl. 21582/2.
176. *Laevigatosporites maximus* (Loose) Pot. & Kr.; photo 63/11.

PLATE 13

177. *Laevigatosporites maximus* (Loose) Pot. & Kr.; photo 63/5.
178. *Laevigatosporites vulgaris* Ibr.; photo 61/12.
179-181. *Laevigatosporites desmonensis* (Wils. & Coe) S. W. & B.; photos 56/7, 59/38, 43/5.
182-184. *Latosporites singularis* sp. nov.; photos 61/14, 64/13, 64/16; holotype sl. 21590/1.
185, 186. *Latosporites robustus* (Kos.) Pot. & Kr.; photos 59/15, 66/8.
187. *Latosporites saarensis* Bhard.; photo 54/15.
188. Cf. *Speciososporites* sp.; photo 46/6.
189. *Latosporites falkenbergensis* sp. nov.; photo 43/21; sl. 21566/1.
190. *Latosporites minutus* Bhard.; photo 60/10.
191. *Cymbospora magna* Venk.; photo 107.

PLATE 14

192, 193. *Torispora securis* Balme.; photos 111/3, 38/18.
194. *Punctatosporites obliquus* (Kos.) comb. nov.; photo 44/26.
195. *Punctatosporites minutus* Ibr.; photo 43/21.
196. *Punctatosporites* sp.; photo 49/26.
197, 198. *Verrucososporites obscurus* (Kos.) Pot. & Kr.; photos 124/2, 40/31.
199. *Alatisporites potoniei* sp. nov.; photo 47/7; sl. 21568/7.
200. *Alatisporites* cf. *exceptus* Alpern; photo 112/1.
201-203. *Alatisporites pustulatus* Ibr.; photos 137/19, 66/15, 112/3.
204. *Alatisporites falkenbergensis* sp. nov.; photo 56/21; sl. 21579/1.
205, 206. *Alatisporites falkenbergensis* sp. nov.; photos 57/7, 112/2.
207, 208. *Alatisporites rugosus* sp. nov.; photos 45/32, 45/37; holotype sl. 21568/1.
209, 210. *Alatisporites inflatus* Kos.; photos 153/38, 153/39.

PLATE 15

211. *Endosporites ornatus* Wils. & Coe; photo 138/12.
212. *Endosporites globiformis* (Ibr.) S.W. & B.; photo 31/2.
213, 214. *Endosporites zonalis* (Loose) Knox; photos 118/2, 137/3.
215. Cf. *Endosporites* sp.; photo 109.
216. *Wilsonia delicata* Kos.; photo 40/9.
217, 218. *Wilsonia kosankei* Bhard.; photos 39/3, 38/7.
219. *Candidispora candida* Venk.; photo 49/16.
220. *Candidispora aequabilis* sp. nov.; photo 58/32; sl. 21581/8.

PLATE 16

221-223. *Candidispora aequabilis* sp. nov.; photos 43/3, 108, 57/33.
224, 225. *Candidispora falkenbergensis* sp. nov.; photos 58/10, 43/1; holotype sl. 21581/2.
226, 227. *Latensina trilete* Alpern; photos 45/22, 47/2.
228. *Guthörlisporites magnificus* Bhard.; photo 117/1.
229, 230. *Guthörlisporites densus* sp. nov.; photos 44/28, 51/14; holotype sl. 21567/8.

PLATE 17

231. *Guthörlisporites densus* sp. nov.; photo 48/6.
232. *Florinites visendus* (Ibr.) S.W. & B.; photo 45/13.
233, 234. *Florinites similis* Kos.; photos 50/38, 48/5.
235. *Florinites junior* Pot. & Kr.; photo 138/12.
236. *Florinites ovalis* Bhard.; photo 137/6.
237. *Florinites mediapudens* (Loose) Pot. & Kr.; photo 61/7.
238. *Florinites circularis* Bhard.; photo 49/4.
239. *Florinites* cf. *pumicosus* (Ibr.) S.W. & B.; photo 62/4.
240, 241. *Vesicaspora incomposita* sp. nov.; photos 39/10, 56/24; holotype sl. 21562/29.
242. *Potonieisporites* sp.; photo 155/a.
243. *Kosankeisporites* sp.; photo 39/8.
244, 245. *Schopfipollenites ellipsoides* (Ibr.) Pot. & Kr.; photos 138/19, 138/20.

REVIEW

AN INTRODUCTION TO A SCANDINAVIAN POLLEN FLORA. By G. Erdtman, B. Berglund, J. Praglowski. Pp. 1-92; Pl. 74, 585 photomicrographs (Stockholm: Almqvist & Wiksell, 1961). Price Rs. 38.00 (Approx.).

THE term 'Pollen Flora' is really a misnomer but recently it has come into use with the wide application of pollen and spores as indices for carrying out palaeo-ecological studies based on pollen-analysis. The senior author, Professor G. Erdtman, is a world renowned authority on pollen and spore morphology of living plants and already has three books and several scores of research papers to his credit. The present volume results from collaboration with his colleagues at the Palynological laboratory of the Swedish Natural Science Research council. Mrs. M. Wahlborg has made the slides and B. Berglund and J. Praglowski have contributed to the writing of pollen and spore descriptions. The two last named authors have also collaborated with K. E. Samuelsson and H. D. Goldmann in taking the photomicrographs. Professor Erdtman holds himself solely responsible for the direction of the work and the terminology used in the text.

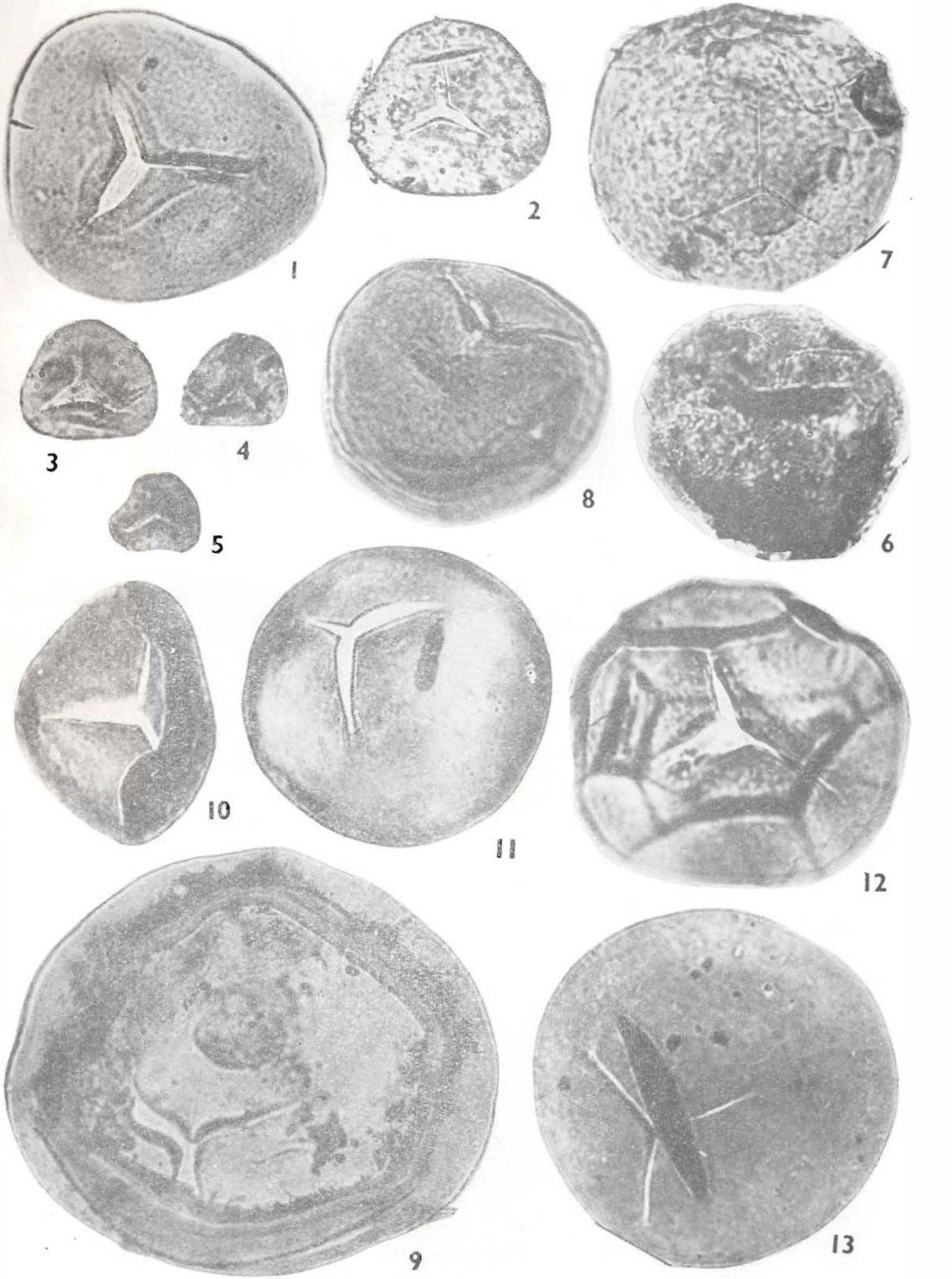
The plant groups dealt with are Angiospermae, Gymnospermae, Pteridophyta and Bryophyta. However, the number of species included in each case is by no means complete even for the Scandinavian region; nevertheless, the present volume paves the way towards the compilation of a comprehensive pollen flora for the entire region. The description of pollen and spores, according to the authors, is provisional and "the size figures may sometime be misleading". Caution should, therefore, be excercised in dealing with these two factors.

A useful purpose has been served by the inclusion of an appendix on synonyms which gives a list of the terms previously used by Erdtman and some of those in use by other schools for the same pollen and spore characters.

The book should not only be of interest to the Scandinavian palynologists but should be equally valued by others, in Europe and elsewhere. In particular, it should be especially welcome to the protagonists of photomicrography, who hold it to be a better means of illustrating pollen and spore structures than the customary hand-drawings or palynograms. The large number of photomicrographs, depicting selected pollen and spore types, in several foci in some cases, and covering nearly three quarters of the species, dealt with, are excellent. The addition of cross references, in the relevant cases, to the text-figures in Erdtman's earlier books on pollen and spore morphology (1952, 1958), should be found quite useful.

On the whole, the volume is an important contribution to current palynological literature.

GURDIP SINGH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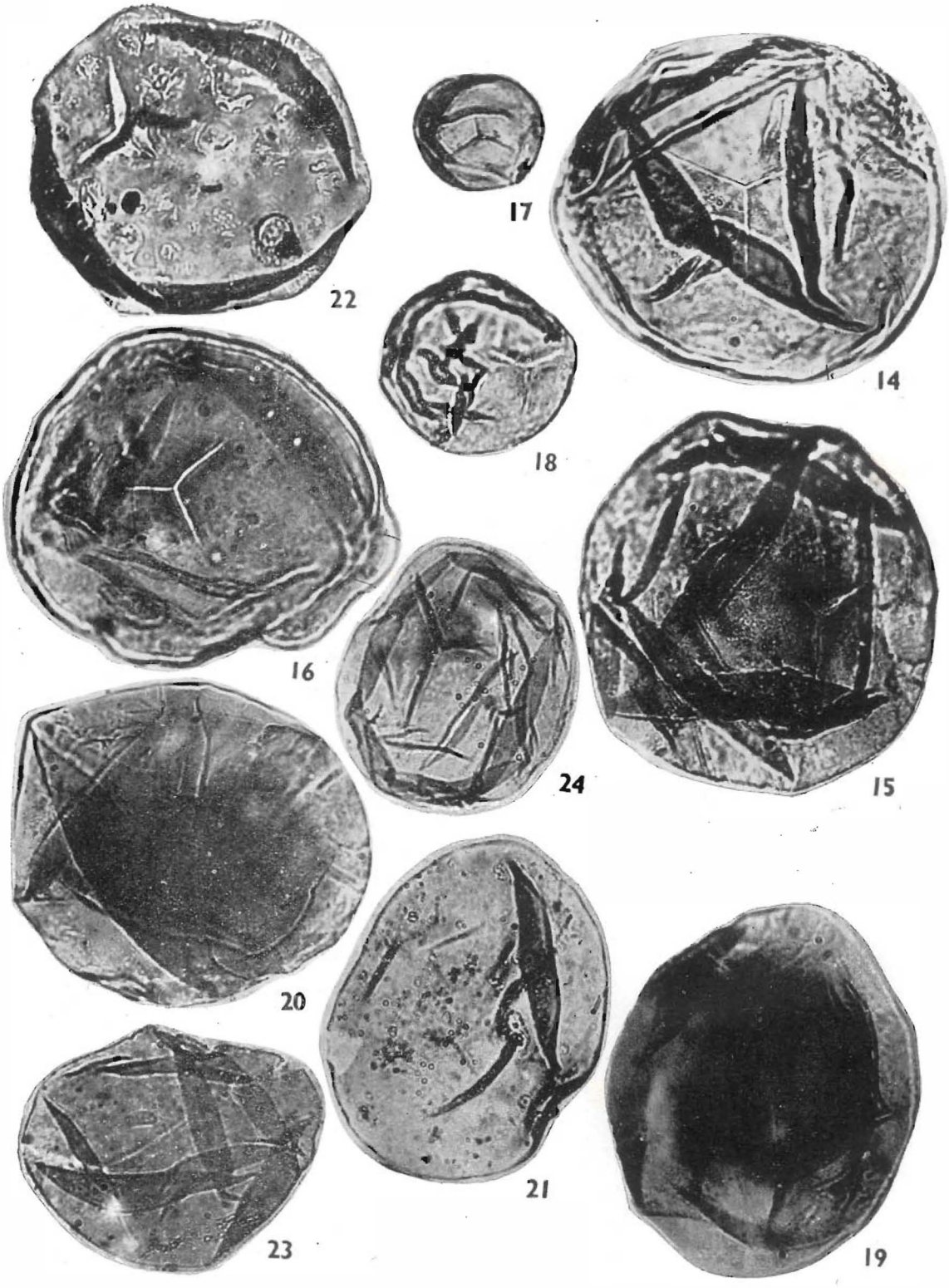
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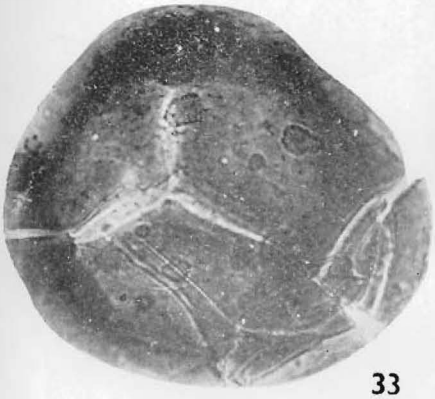
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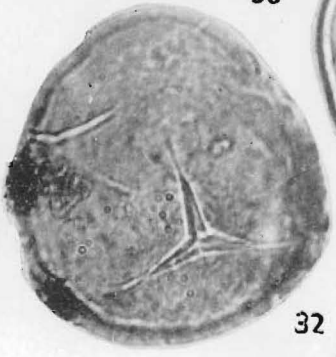
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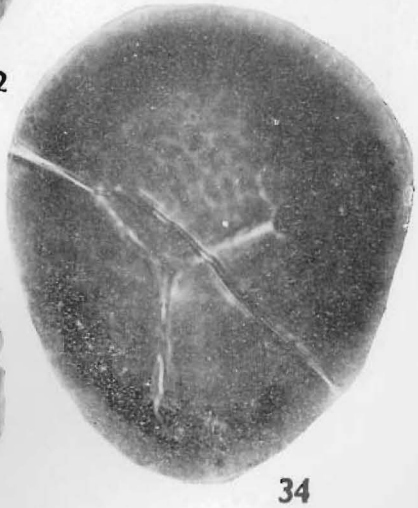
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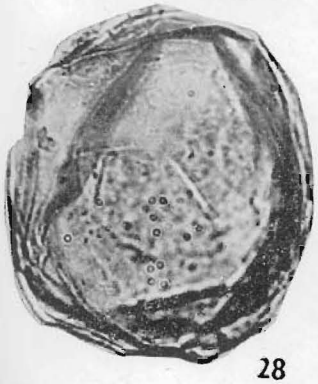
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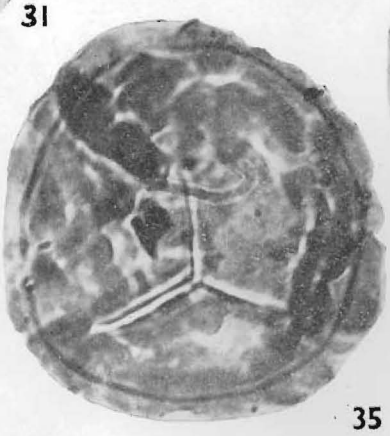
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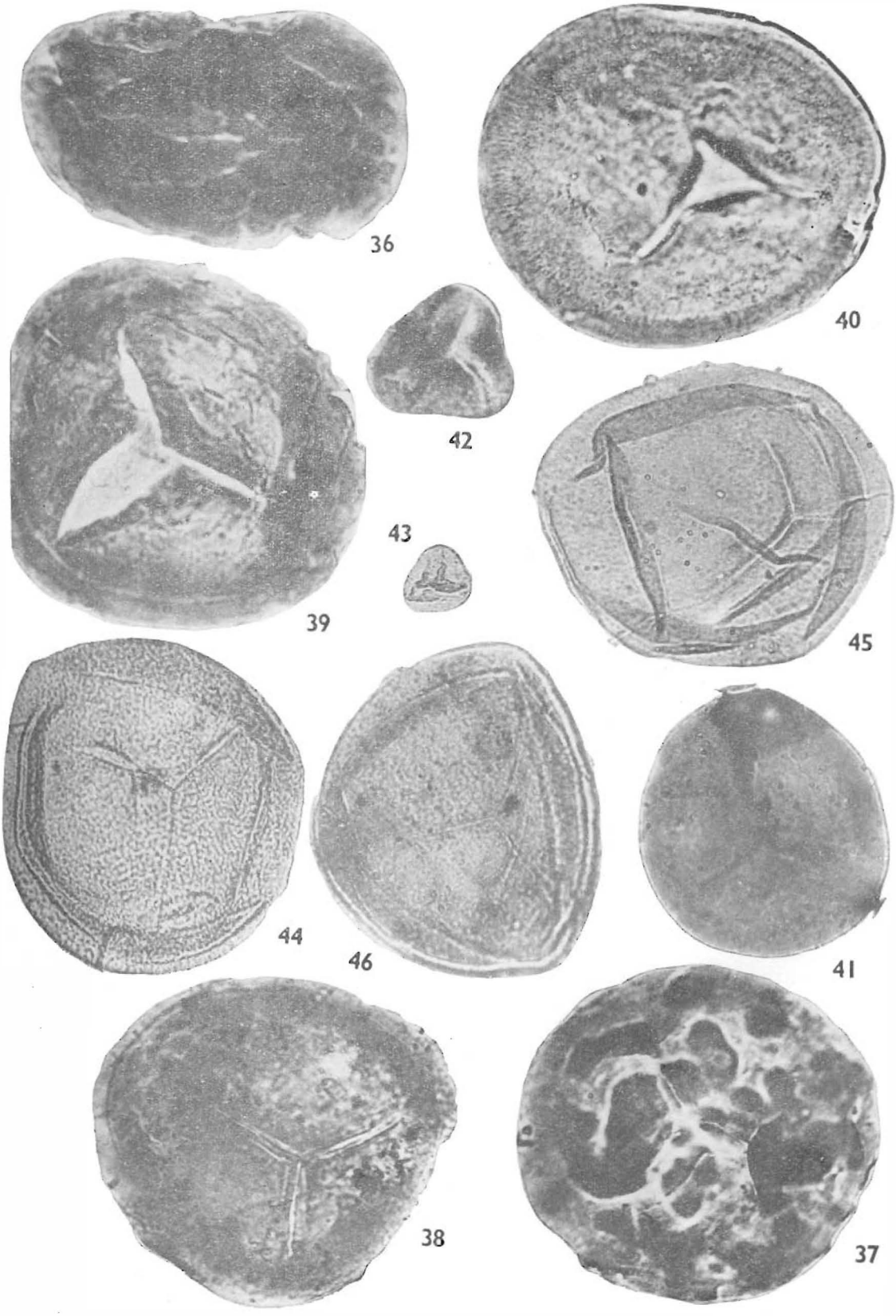
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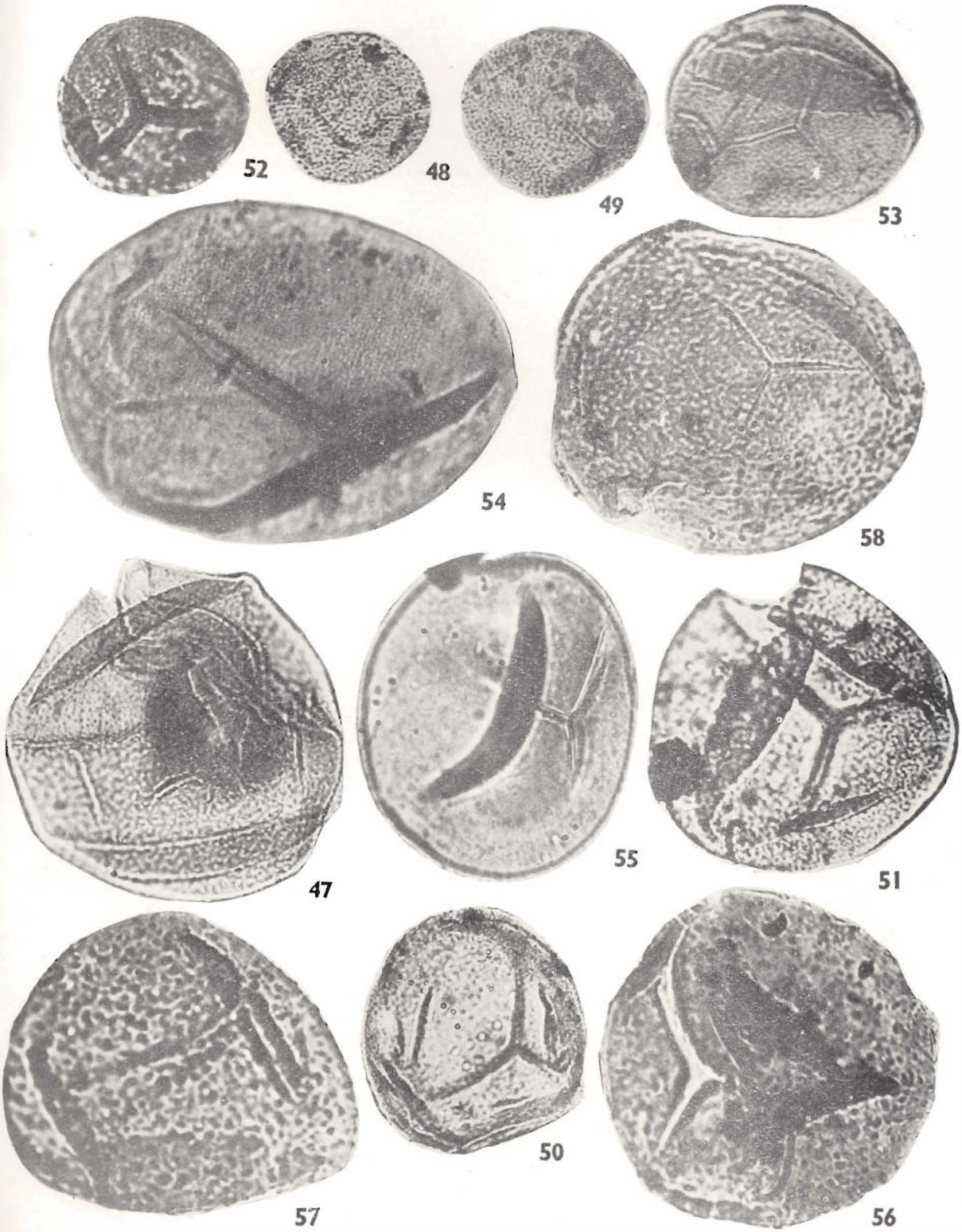
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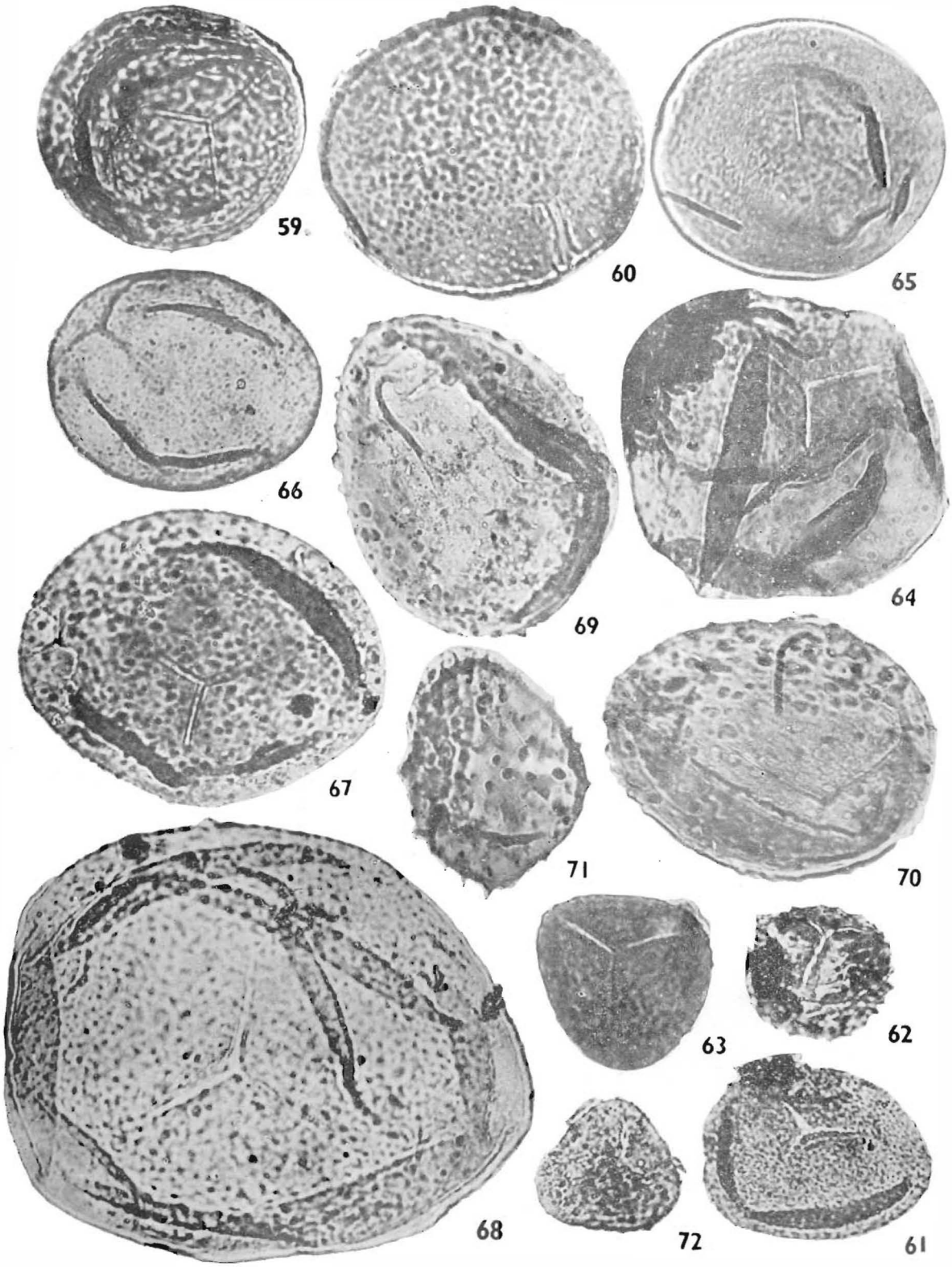
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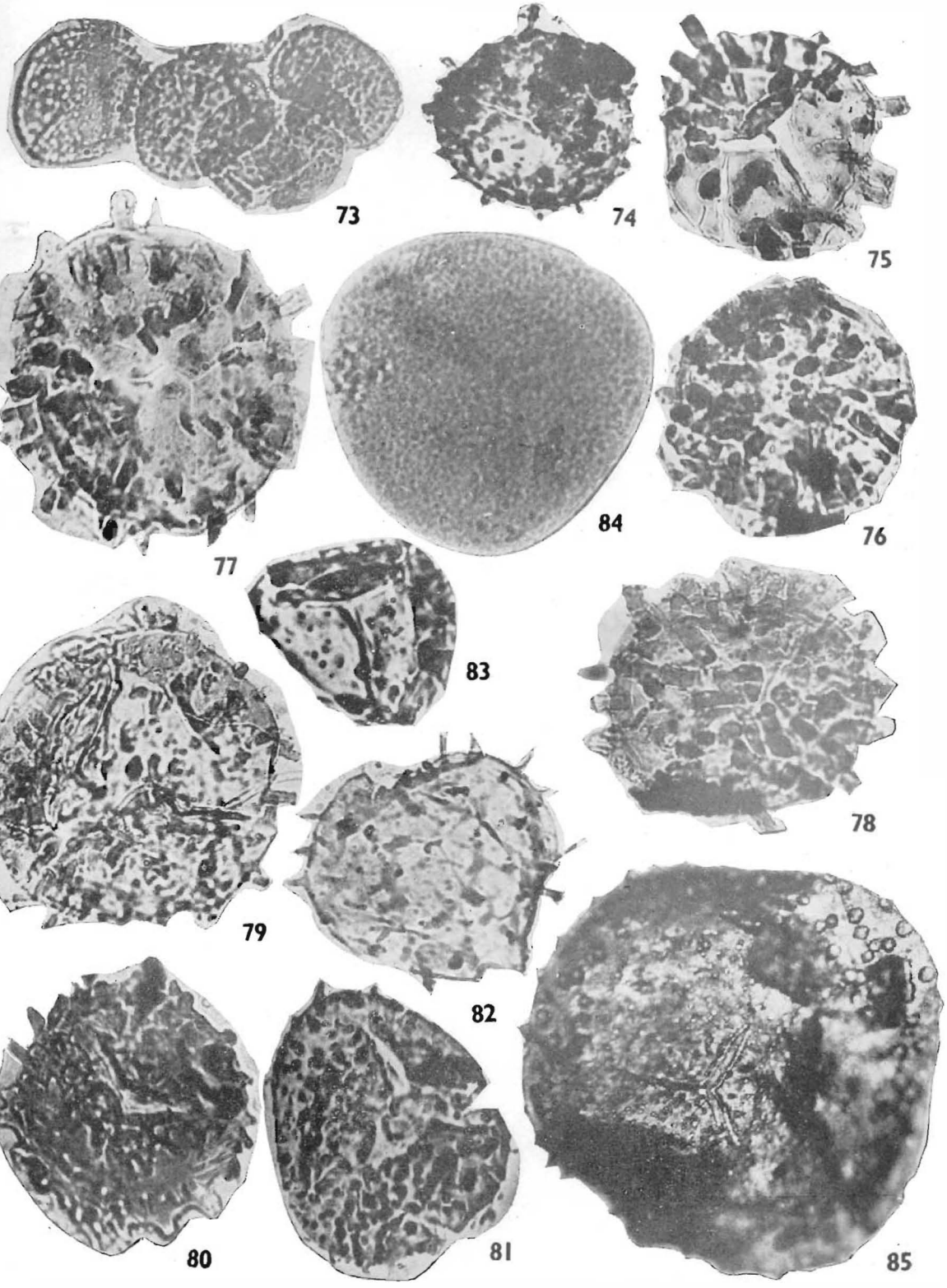
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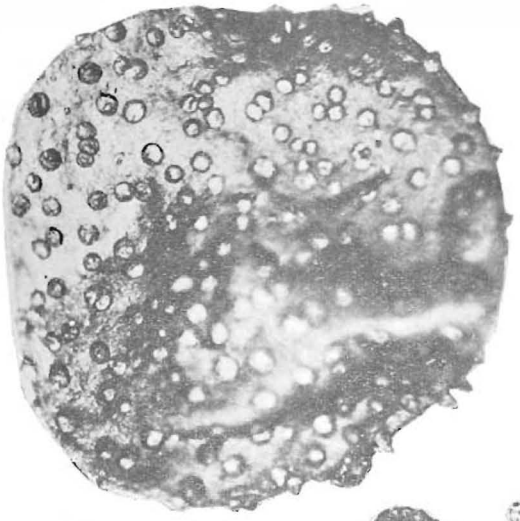
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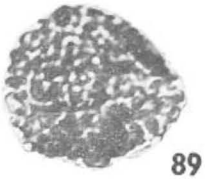
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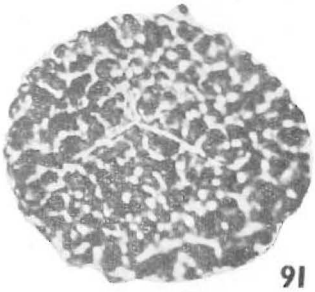
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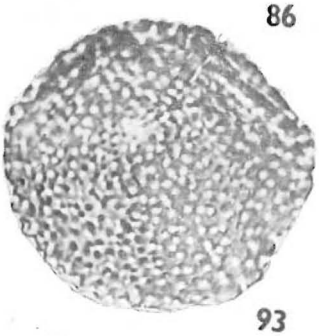
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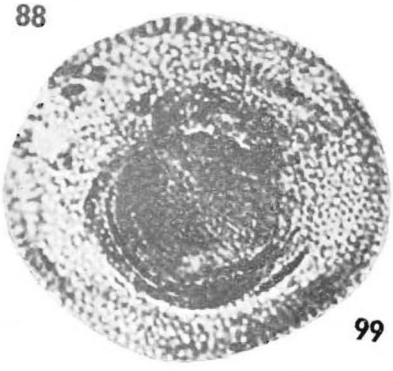
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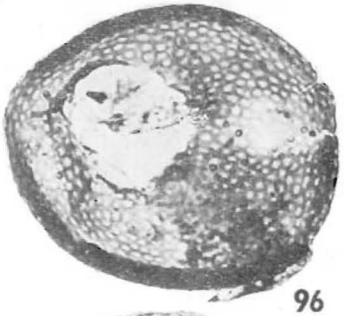
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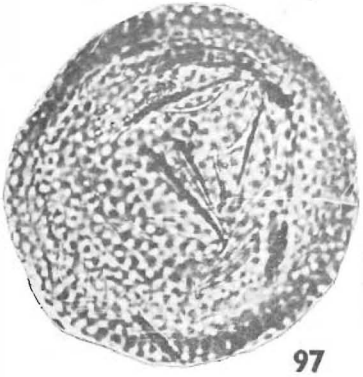
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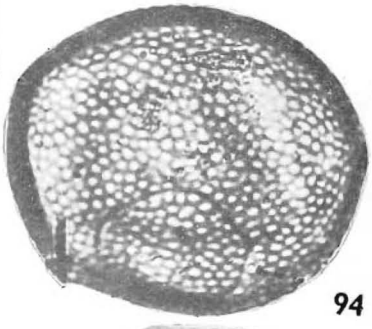
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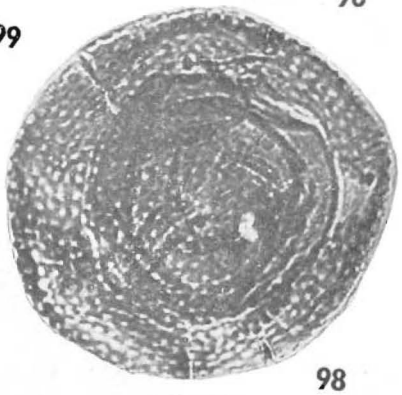
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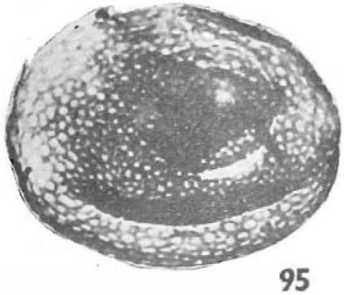
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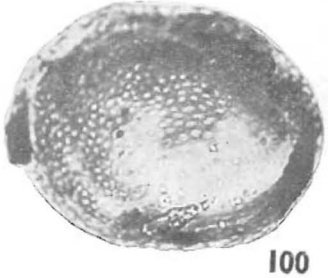
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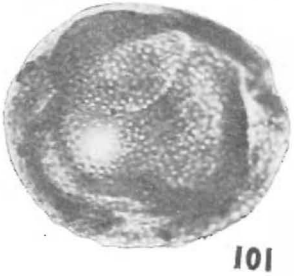
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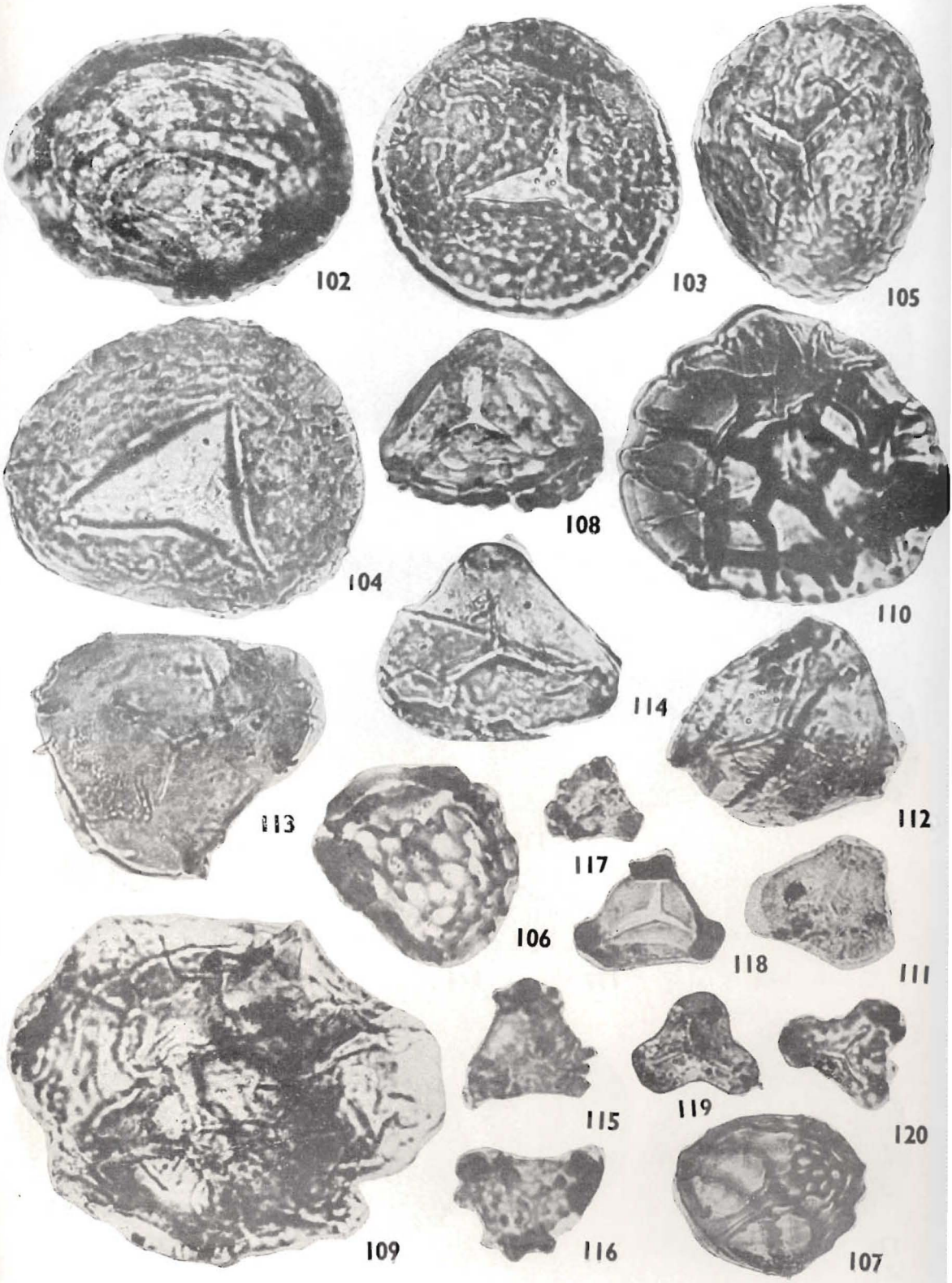
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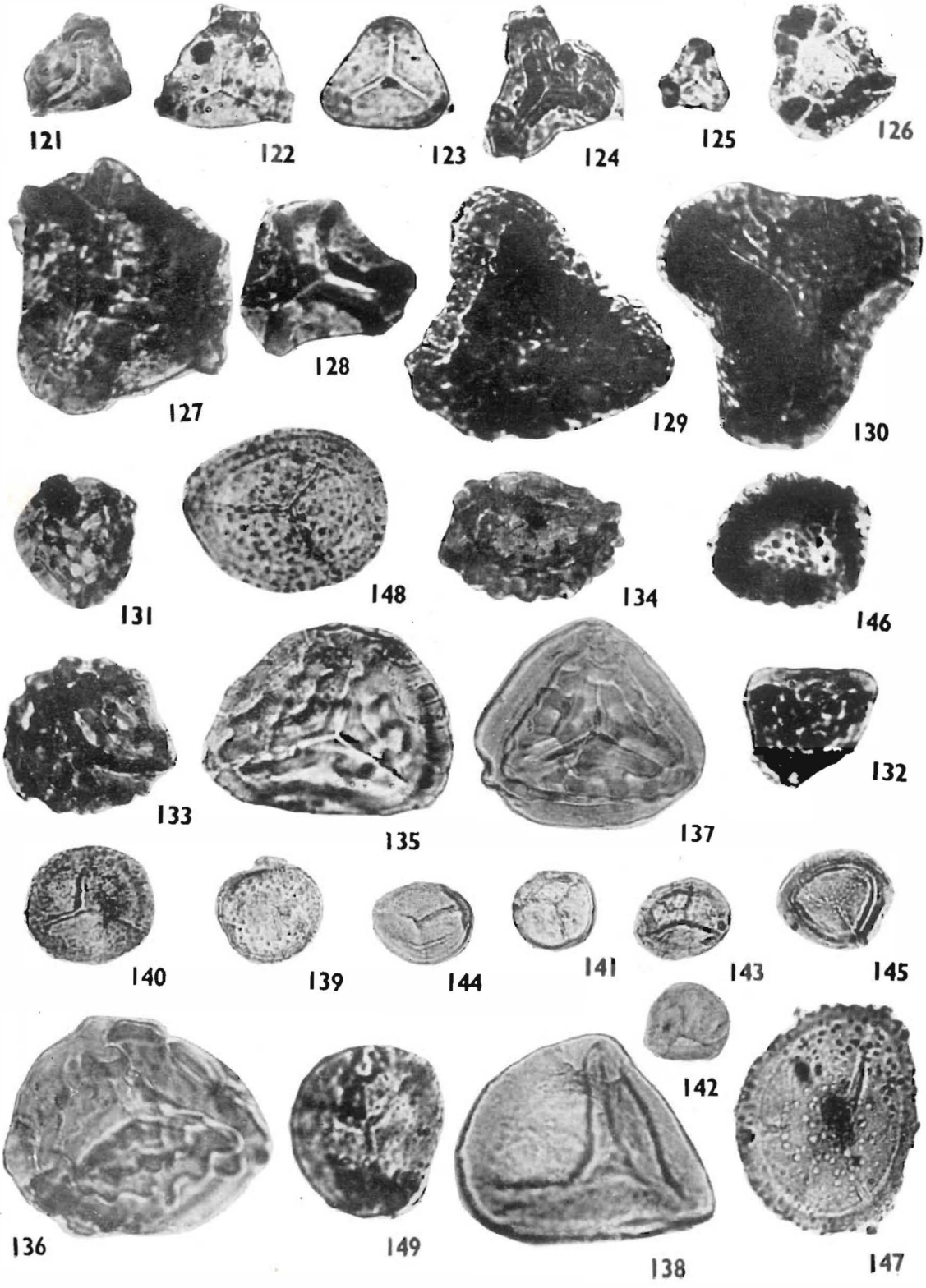
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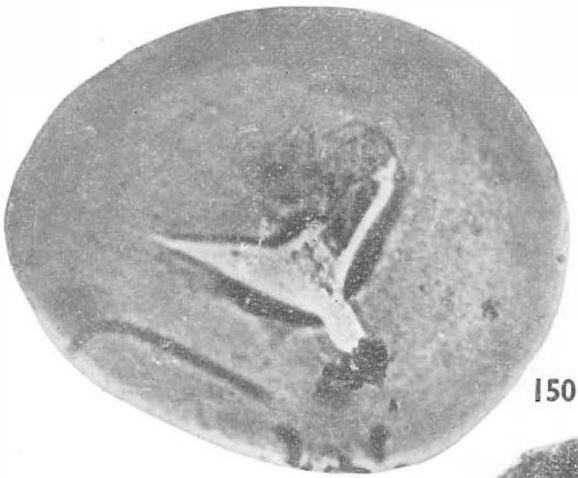
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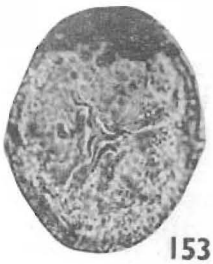
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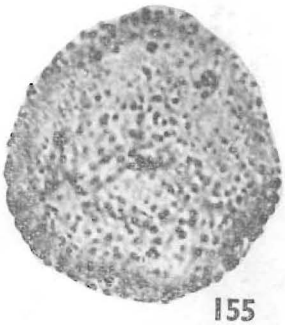
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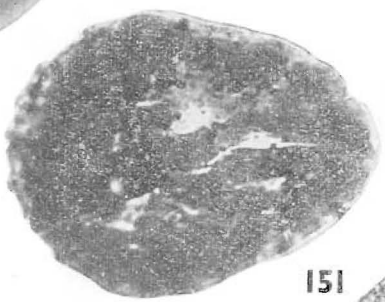
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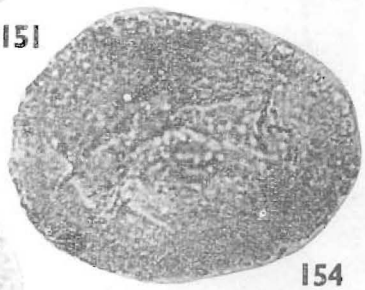
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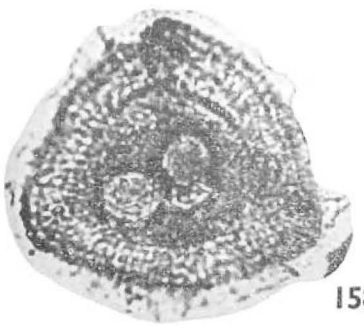
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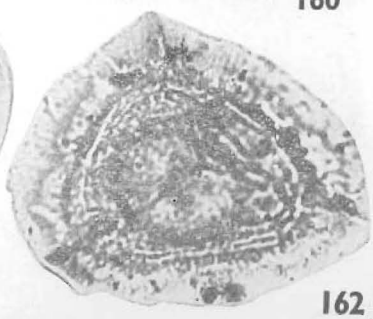
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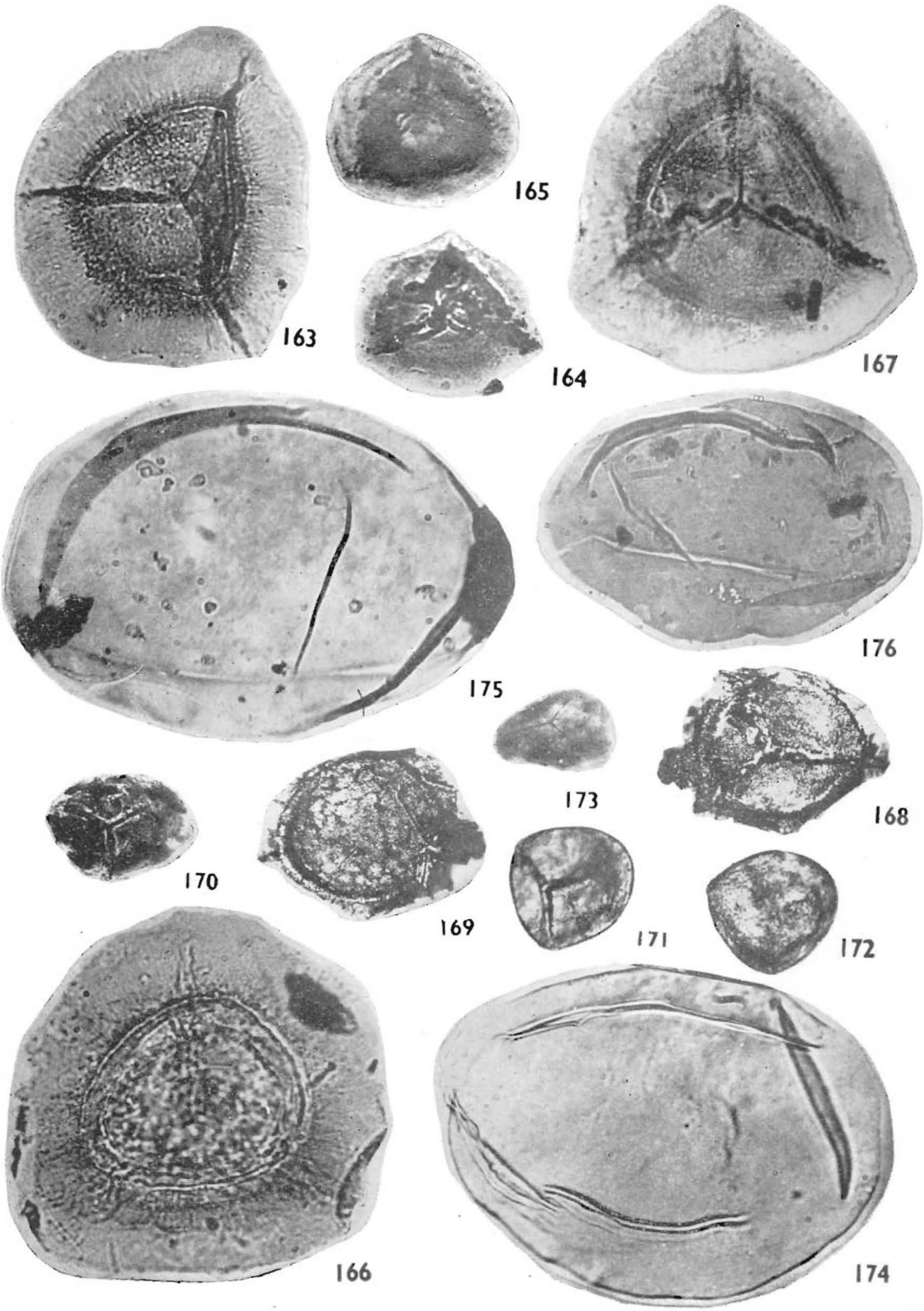
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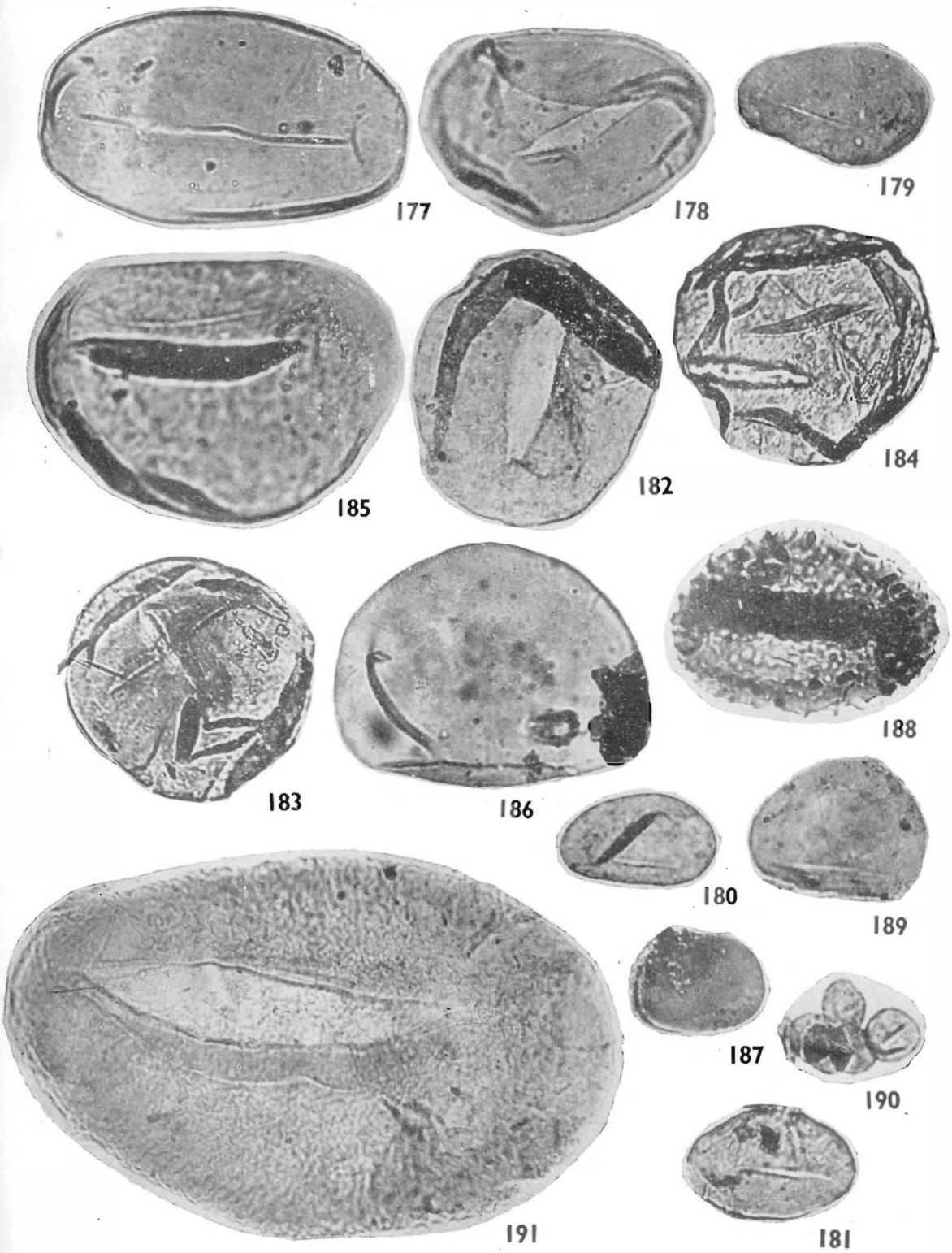
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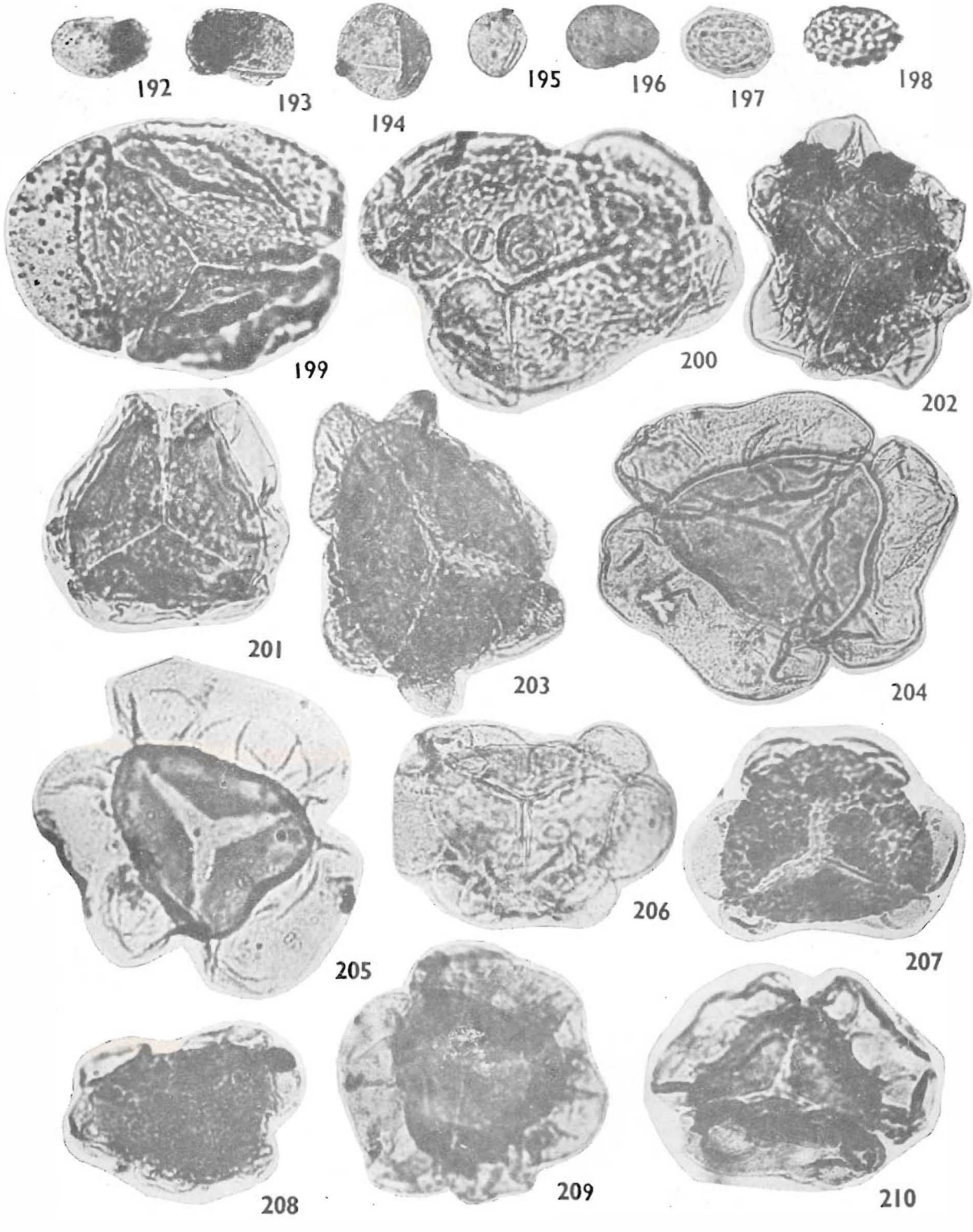
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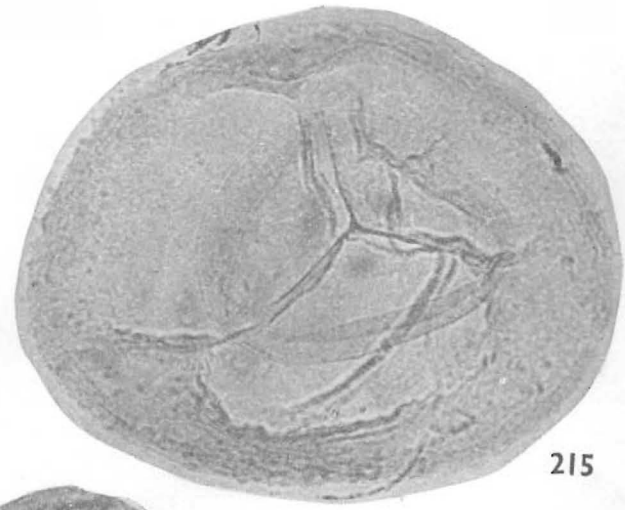

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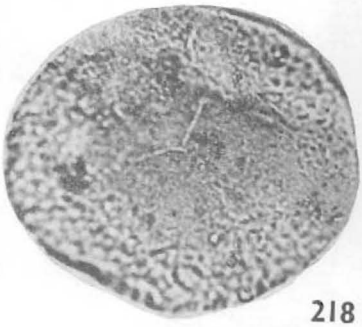

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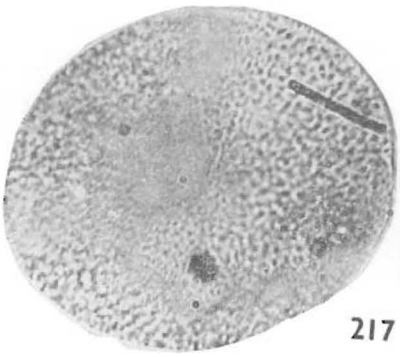

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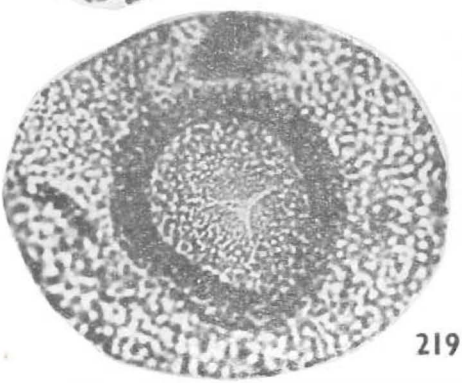

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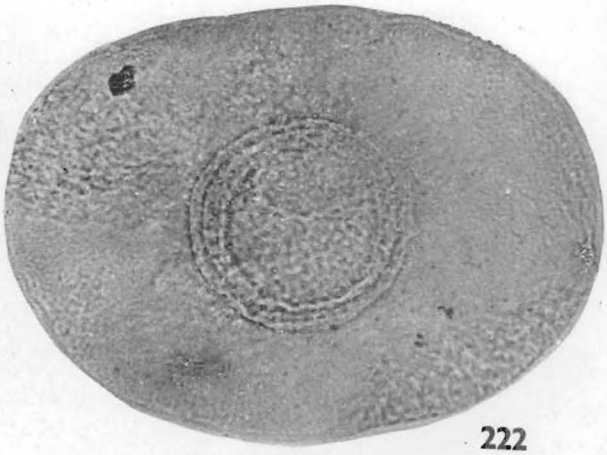

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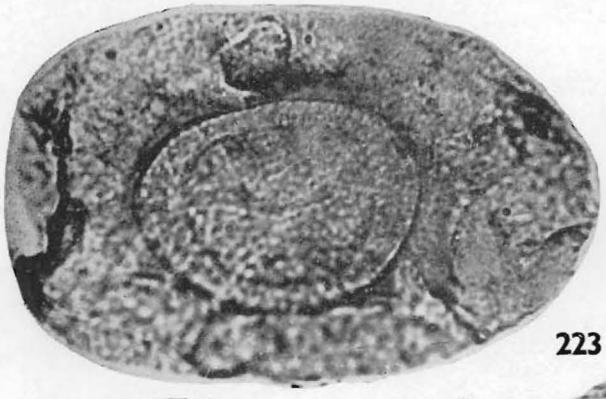

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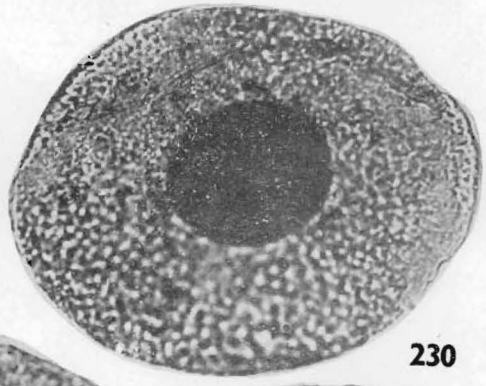

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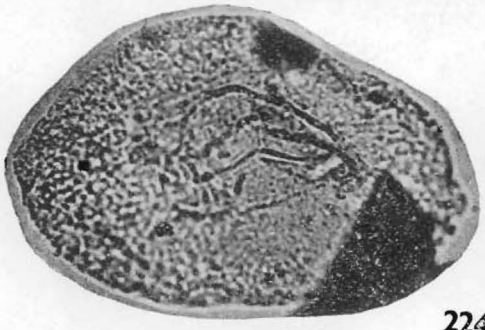

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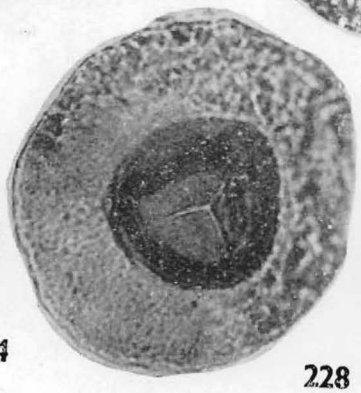

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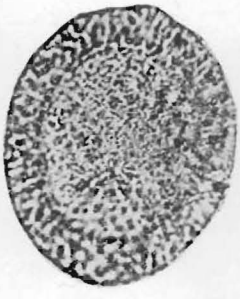

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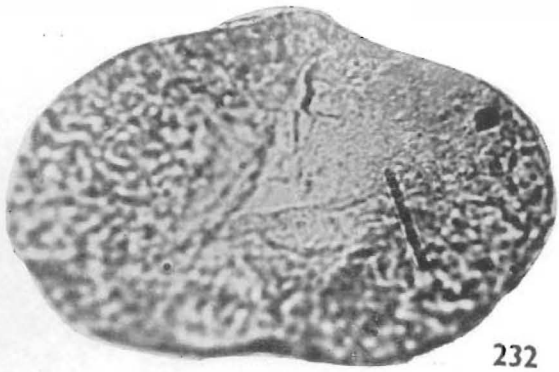

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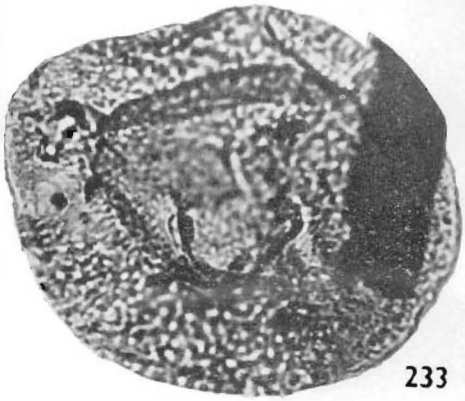

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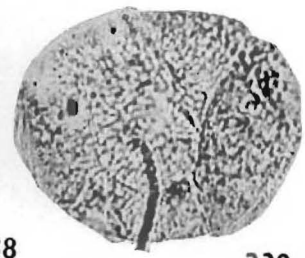

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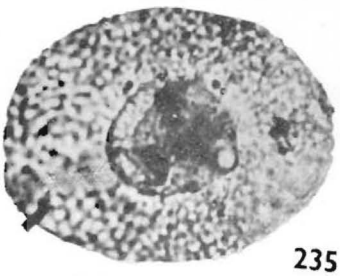

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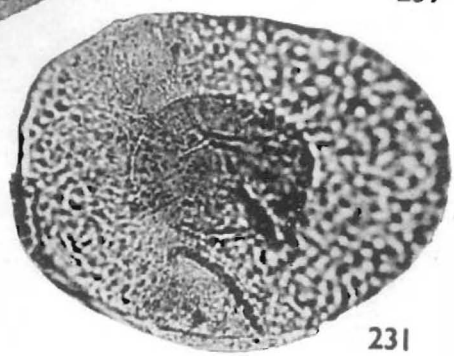

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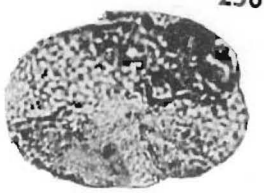

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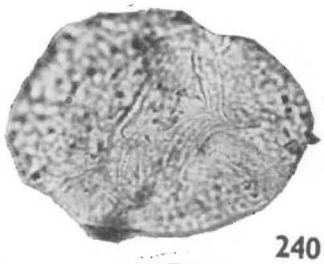

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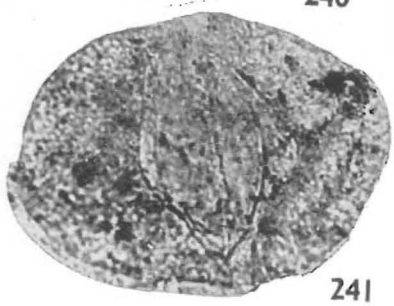

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