PALYNOLOGY OF THE MESOZOIC SEDIMENTS OF KUTCH — 4. SPORES AND POLLEN FROM THE BHUJ EXPOSURES NEAR BHUJ, GUJARAT DISTRICT

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ABSTRACT

The present paper deals with the palynology of Bhuj sediments exposed on the banks of Pur and Pat rivers near Bhuj, Kutch. 3 sections were measured and samples collected for systematic study.

The assemblage is dominated by *Impardecispora*, *Applanopsis* and *Araucariacites*; *Laricoidites* and *Schizosporis* are frequently found while *Concavissimisporites*, *Bhujiasporites*, *Matonisporites*, *Boseisporites* and *Alisporites* are rare.

INTRODUCTION

RAJNATH (1932) on the basis of structural evidences placed the upper division of the Umia series (Waagen) including the Zamia beds (Upper Jurassic of Wynne) over the Ukra beds and named them the Bhuj series. He also considered the Ukra beds as Aptian, thus indicating a post-Aptian age to the Bhuj series.

The problem of dating the plant bearing beds i.e., the Bhuj series which was considered equivalent to the upper Jurassic by Wynne (1869) is important as its marks the upper limit of the Gondwanas in India. Feistmantel (1876) considered the age of the Umia beds as Lower Oolitic (Bathonian) on the basis of plant megafossils. Spath (1924) and Rajnath (1924) from a study of faunal and floral evidences have opined that the Umia beds (= Bhuj series) are post-Aptian in age. This view of Rajnath (*l.c.*) was mainly based on the identification of *Palmoxylon mathuri* by Sahni (1932) from the plant beds of Kutch.

Rajnath (1952) divided the Bhuj series into *Zamia* beds at the bottom, *Ptilophyllum* beds in the middle and *Palmoxylon* beds at the top.

Blanford (1867) believed that the plant bearing beds are intercalated with the marine Jurassic rocks. Wynne (1869) on the basis of *Ptilophyllum* found common to Rajmahal and Kutch regarded the age of Plant bearing beds in Kutch as equivalent to Rajmahals. Feistmantel (1876), however, did not agree in identifying the horizon of Kutch with Rajmahals and assigned the Rajmahal deposits a Lower Jurassic age and the Kutch a Upper Jurassic age.

Waagen (1873) on the basis of ammonites contained in the ammonites beds referred them to post-Tithonian age. Spath (1933) indicated a Upper Tithonian age to the same. Cotter (1917) on the basis of Kitchin's (1903) study of *Trigonia* and the similarity of Umia beds with Uitenhage series of South Africa ascribed them a Lower Cretaceous age. Fox (1931 & 1940) accepted this view.

Stoliczka regarded the plant beds as occurring between the limits of two marine beds, one of Tithonian age and the other of Aptian age, and consequently referred them to Wealden. These beds were referred to as Wealden or Neocomian by Blanford (1878); doubtful Wealden by Oldham (1893) and as Barremian by Vredenburg (1910).

The ages ascribed to Katrol and Bhuj sediments by various authors are summarised in Table 1 of the subsequent paper dealing with the palynology of the Katrol sediments (VENKATACHALA, KAR & RAZA, 1969).

The present study is confined to 3 sections of Bhuj exposures exposed on the banks of the Pur and the Pat rivers (*see* TEXT-FIG. 1).

MATERIAL AND METHODS

Section near Trambau, B.S.I.P. No. J(743B)

This section is exposed on the northern bank of the Pur river. The exposure consists mostly of shales and sandstones (TEXT-FIG. 1). The thickness of rock units are given below:

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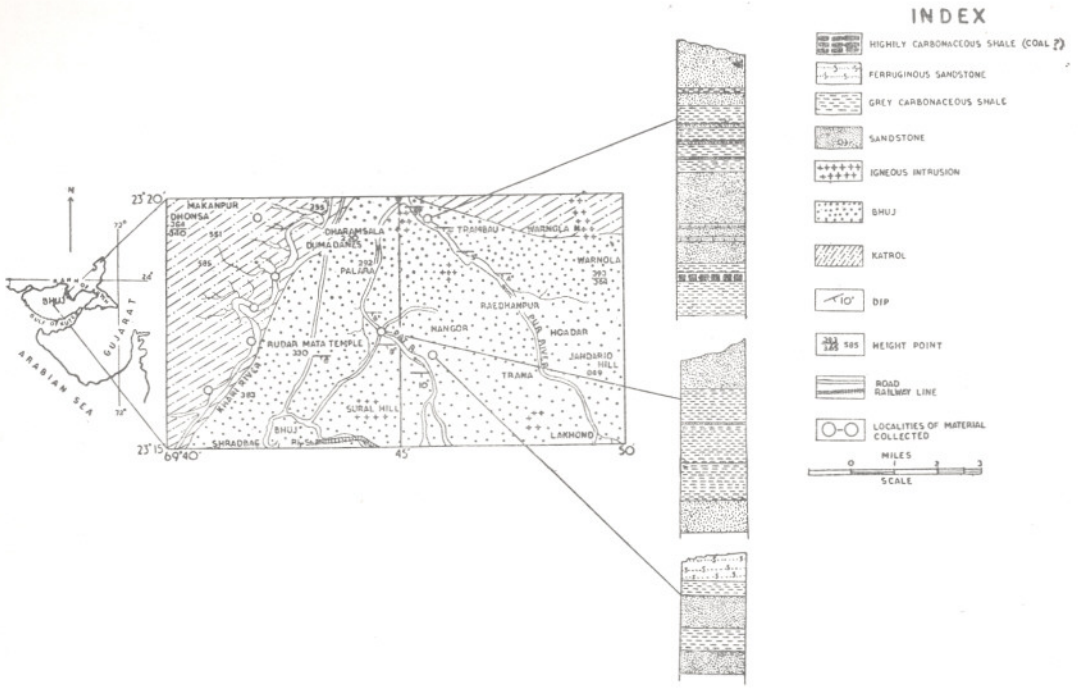

TEXT-FIG. 1 — Showing the locality of the three sections studied.

Lithology	*Thickness (in feet)*
Grey-Carbonaceous shale (base not seen)	9
Highly Carbonaceous shale	2
Light-dark grey shale	2
Fine grained sandstone	4
Grey shale	½
Coarse grained sandstone	2
Grey shale	½
Coarse grained sandstone	10
Sandy shale	2
Fine grained sandstone	½
Grey shale	2
Fine grained sandstone	½
Grey shale	2
Fine grained sandstone	1
Grey shale	4
Fine grained sandstone	2
Sandy shale	1
Coarse grained sandstone (upper part eroded)	10
Total thickness	55

The two other sections studied are situated on the bank of the Pat river (TEXT-FIG. 1). Their lithology is as follows:

Section near Pat river, B.S.I.P. No. K(906)

Lithology	*Thickness (in feet)*
Fine grained sandstone (base not known)	7
Grey-Carbonaceous shale with occasional thin bands of sandstone	17
Siltstone	½
Grey shale	6
Fine grained sandstone (upper part eroded)	9
Total thickness	39½

Section near Pat river, B.S.I.P. No. L(902)

Lithology	*Thickness (in feet)*
Coarse grained sand stone (base not known)	4
Grey shale	4
Fine grained sand stone	6
Grey-Carbonaceous shale	2
Ferruginous sand stone (upper part eroded)	6
Total thickness	22

Maceration — Ten-twelve grams of material were kept in Hydrofluoric acid (40%) for 2-4 days followed by Nitric acid (40%) for 2-3 days. Potassium hydroxide solution (3%) was used for 2-3 minutes. The slides were prepared with Polyvenyl alcohol and mounted in canada balsam. The slides and unused material are deposited at the repository of the Birbal Sahni Institute of Palaeobotany, Lucknow.

SYSTEMATIC PALYNOLOGY

Anteturma — *Sporites* H. Pot., 1893
Turma — *Triletes* (R.) Pot. & Kr., 1954
Subturma — *Azonotriletes* Lub., 1935
Infraturma — *Laevigati* (Ben. & Kid.) Pot. 1956

Cyathidites Coup., 1953

Type Species — *Cyathidites australis* Coup. 1953.

Cyathidites grandis Singh *et al.*, 1964

Pl. 1, fig. 11

Remarks — The specimens described under this heading differ from *C. australis* in possessing distinctly lobed angles and are bigger in size.

Dictyophyllidites (Coup.) Dettm. 1963

Type Species — *Dictyophyllidites harrisii* Coup. 1958.

Dictyophyllidites pectinataeformis (Bolkhov.) Dettm., 1963

Holotype — *Dictyophyllidites* (*Matonia*) *pectinataeformis* Bolkhov. pl. 1, fig. 12.

Remarks — The broad kyrtome-like thickenings boardering the elevated labra of the trilete mark allows the present placement.

Biretisporites (Delc. & Sprum.) Delc., Dettm. & Hug., 1963

Type Species — *Biretisporites potoniaei* Delc. & Sprum., 1955.

Biretisporites spectabilis Dettm. 1963

Pl. 1, Figs. 13-14

Remarks — Specimen illustrated in Pl. 1, Fig. 14 clearly shows the raised apex of the trilete mark.

Infraturma — *Apiculati* (Benn. & Kid.) Pot. 1956

Concavissimisporites (Delc. & Sprum.) Delc. Dettm. & Hug., 1963

Type Species — *Concavissimisporites verrucosus* Delc. & Sprum. 1955.

Remarks — *Concavissimisporites* is here restricted to spores with triangular – roundly triangular amb and uniformly verrucate sculpture.

Concavissimisporites kutchensis sp. nov.

Pl. 1, Figs. 18, 19

Holotype — Pl. 1, Fig. 19. Slide no. Bha 8/4.

Type Locality — Pur river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Microspores trilete, roundly triangular with slightly concave sides and rounded angles, 80-100 μ. Y-mark distinct, straight rays reaching upto 3/4 radius of the spore, raised, apex and vertex high. Exine upto 4 μ thick, verrucate, verrucae closely spaced 2-4 μ high and as broad with circular to polygonal bases.

Comparison — *C. verrucosus*, *C. crassatus* (Delc. & Sprum.) Delc. *et al.* has distinctly trilobed amb. *C. punctatus* and *C. parkinii* (Poc.) C. Singh are both granulose in ornamentation. *C. variverrucatus* (Coup.) C. Singh is smaller in size and also possesses smaller verrucae. *C. penolaensis* Dettm. has irregular verrucae for ornamentation.

Concavissimisporites crassatus Delc. et al., 1963

Pl. 2, Fig. 4

Remarks — The spores are characterized by distinctly lobed angles with concave sides and large dome shaped verrucae.

Concavissimisporites subverrucosus sp. nov.

Pl. 1, Fig. 17; Pl. 2, Figs. 1-3, 7

Holotype — Pl. 1, Fig. 17. Slide no. Bha 8/2.

Type Locality — Pur river section, near Bhuj, Bhuj Series (Cretaceous).

Description — Microspores trilete, amb roundly triangular with slightly concave — almost straight sides and rounded angles 80-100 μ. Y-mark distinct, rays upto 3/4 radius of the spore, apex and vertex raised, labra thick, exine 4-6 μ thick, ornamented with low set verrucae [sub-verrucae of C. Singh (l.c.)] which are evenly distributed.

Comparison — *C. punctatus* (Delc. & Sprum.) Poc., *C. parkinii* (Pocock) C. Singh and *C. potoniei* Poc. are subgranulose and subverrucose in ornamentation but differ from *C. subverrucosus* in smaller size. The specific differentiation in these species can be made only on the basis of the extent of development of the sculptural elements.

Concavissimisporites sp.

Pl. 2, Fig. 8

Description — Microspores triangular, amb distinctly trilobed with lobed angles and notched sides. 74 μ. Y-mark distinct, rays reaching upto 3/4 radius. Exine 2-4 μ thick, subgranulose in ornamentation.

Comparison — *C. verrucosus* (Delc. & Sprum.) Delc. *et al.* has the same ornamentation. *C.* sp. described here is distinguished by three distinct angular lobes.

Concavissimisporites potoniei Poc. 1964

Pl. 2, Fig. 5

Impardecispora Venk., Kar & Raza (1968)

Type Species — *Impardecispora apiverrucata* (Coup.) Venk., Kar & Raza., 1968

Impardecispora simplex sp. nov.

Pl. 3, Fig. 3

Holotype — Pl. 3, Fig. 3. Slide no. 9/743B.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Microspores trilete, roundly triangular, 98 μ. Y-mark distinct almost reaching equator, apex and vertex high, labra broad, open in one of the rays of the holotype. Exine 4-6 μ thick, thickened at the angles with faintly descernible verrucae, laevigate throughout the area except in the angular regions where it is also intrapunctate.

Impardecispora lobata sp. nov.

Pl. 4, Figs. 5-6

Holotype — Pl. 4, Fig. 5. Slide no. Bha 8/1.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Microspores trilete, variously lobed, (4 lobed ones illustrated here) ornamentation verrucose, verrucae set uniformly except at the lobes where it is crowded. The species comes closest to *I. apiverrucatus* in distribution of ornamentation and the nature of the mark etc. This species is here considered as a variation of the type exemplified in *T. apiverrucata*.

Impardecispora indica sp. nov.

Pl. 3, Fig. 10, 11 & 19

Holotype — Pl. 3, Fig. 11

Description — Microspores trilete, amb triangular with slightly concave inter apical margins, 65-80 μ Y-mark distinct upto 3/4 radius. Exine upto 4 μ thick, verrucose, verrucae concentrating at the angular apices, other area around the Y-mark ornamented with low set irregularly distributed verrucae.

Comparison — *I. apiverrucata* and *I. uralensis* are distinctly trilobed and have larger concentration of verrucae at angular apices. *I. verrucosus* is ornamented with broad verrucae throughout the spore area and a high concentration of them at the angular apices. *I. Simpex* is distinctly larger with faint ornamentation. *I. indica* is

distinguished by the thick spore exine and two types of verrucae distributed on the exine.

Impardecispora cf. *I. trioreticulosus* (Cook. & Dettm.) comb. nov.

Pl. 3, Fig. 16

Description — Microspores trilete, amb triangular with concave sides 70 μ. Y-mark present, rays reaching upto angular ornamented areas. Exine upto 3 μ thick, granulose, angular areas reticulate — foveolate with fine muri enclosing almost circular meshes.

Impardecispora sp.

Pl. 3, Fig. 15

Description — Microspores trilete, amb triangular with slightly concave sides, 60 μ. Y-mark distinct, rays upto 3/4 radius. Exine upto 3 μ thick, laevigate — infrapunctate, apical areas foveoreticulate with fine muri enclosing less than 2 μ wide foveola.

Comparison — *T. trioreticulosus* has wide meshes at angular apical areas. *T.* cf. *T. trioreticulosus* is granulose. The present species distinguishes in possessing fine foveolate ornamentation at the valvae.

Frangospora Venkat. & Kar, 1968

Type Species — *Frangospora fracta* Venkat. & Kar, 1968.

Frangospora fracta Venkat. & Kar, 1968

Pl. 4, Fig. 18

Infraturma — *Murornati* Pot. & Kr. 1954

***Foveotriletes* V. d. Ham. ex Pot., 1956**

Type Species — *Foveotriletes scroboculatus* (Ross) Pot. 1956.

Foveotriletes parviretus (Balme) Dettm. 1963

Pl. 2, Fig. 10

Remarks — The specimen illustrated here is smaller in size, i.e. only 40 μ, while the ones described by Balme (*l.c.*) and Dettm. (*l.c.*) are larger in size.

Foveotriletes kutchensis sp. nov.

Pl. 2, Figs. 9, 11-12, 15

Holotype — Pl. 2, Fig. 9. Slide no. 11.2.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Cretaceous).

Description — Microspores trilete, biconvex, triangular with slightly concave sides in equatorial view, 80-100 μ. Y-mark distinct, 3/4 radius, with elevated broad lips. Exine upto 4 μ thick, foveolate — foveoreticulate, foveolae irregular in shape and size sometimes anastomosing to form reticulate — canaliculate structures, mostly evenly distributed. Most of the specimens studied show a perisporal covering over the spores. Perispore thin, transluscent, and closely fitting thes pore.

Comparison — The present species is closely comparable to *F. parviretus* (Balme) Dettm. 1963, in the structure of the exine. *F. kutchensis* is only larger in size. The occurrence of the perine is not considered here as a specific character. This coat which is generally destroyed during preservation can, however, be preserved in some cases.

Klukisporites Coup., 1958

Type Species — *Klukisporites variegatus* Coup. 1958.

Klukisporites punctatus sp. nov.

Pl. 2, Figs. 18-21

Holotype — Pl. 2, Fig. 19. Slide no. 11.3.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Trilete miospores, roundly triangular in equatorial view, 45-60 μ. Y-mark present, rays almost extending upto the margins, labra thick, raised. Exine punctate on both the surfaces and distally covered with 4-5 μ high, muri forming 8-10 μ meshes.

Comparison — *K. scaberis* (Cook. & Dettm.) Dettm. is granulose.

Klukisporites sp.

Pl. 2, Fig. 17

Description — Trilete miospores, roundly triangular in equatorial view, 50 μ. Y-mark present, rays extending upto the margins,

labra thick, raised. Exine laevigate, distally covered with ±6 μ high muri anastomosing to form vermiculate — irregularly reticulate pattern.

Comparison — Differs from *K. punctatus* in posessing laevigate exine.

Subturma — *Zonotriletes* Waltz, 1935
Infraturma — *Auriculati* (Sch.) Pot. & Kr., 1954

***Matonisporites* (Coup.) Dettm., 1963**

Type Species — *Matonisporites phlebopteroides* Coup. 1958.

Matonisporites kutchensis sp. nov.

Pl. 3, Figs. 1-2

Holotype — Pl. 3, Fig. 1. Slide no. Bha 8/4.

Type Locality — Pur river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Microspores trilete, amb triangular with broad rounded angles and straight to convex sides 90-110 μ. Y-mark distinct, rays almost reaching the margin, raised, apex and vertex high, labra thick, exine upto 6 μ thick at the sides, valvate exine upto 10 μ thick, laevigate.

Comparison — *Matonisporites phlebopteroides* is comparable but differs in possessing better developed valvae. *M. crassiangulatus* (Balme) Dettm. has better developed valvae and is smaller in size. *M. cooksoni* Dettm. is smaller in size and has sinuous or pitted laesurate-margins.

***Ischyosporites* Balme, 1957**

Type Species — *Ischyosporites crateris* Balme, 1957.

Ischyosporites crateris Balme, 1957

Pl. 4, Fig. 4

Remarks — Spores triangular, 54 μ. Trilete, rays well developed extending upto three-fourths the radius. Exine upto 4 μ thick, pits not well pronounced.

***Concavisporites* Pflug in Thom. & Pf., 1963**

Type Species — *Concavisporites rugulatus* Pf. in Thom. & Pf. 1953.

Remarks — *Concavisporites* is here restricted to include triangular spores with thick laevigate exine, valvate thickenings and a prominent kyrtome bordering the trilete rays. The valvate thickenings in some specimens may not be well differentiated. *Matonisporites* and *Boseisporites* are both valvate spores but do not possess the arcuate kyrtomic thickenings bordering the trilete rays. *Concavissimisporites* are also sculptured, simple trilete, triangular spores and also lack the kyrtome. Many such species referred to *Concavissimisporites* by Pocock and others (*see* CHAITANYA SINGH, 1964) should be transferred from this genus.

Concavisporites indicus sp. nov.

Pl. 4, Figs. 9-12

Holotype — Pl. 4, Fig. 11. Slide no. Bha 8/2.

Type Locality — Pur river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Trilete microspores, amb triangular with straight to convex sides 40-50 μ. Y-mark distinct, rays upto the spore margin, simple, boardered by a 4-6 μ broad kyrtome. Exine laevigate, 4 μ thick, valvate, valvae upto 8 μ broad.

Remarks — The known species from the Tertiary of Europe described by Thomson and Pflug (*l.c.*) are not comparable.

Infraturma — *Cingulati* Pot. & Kl., 1954

***Murospora* Som. 1952**

Type Species — *Murospora kosankei* Som. 1952.

Murospora punctata sp. nov.

Pl. 4, Figs. 14, 24

Holotype — Pl. 4, Fig. 14. Slide no. 11.5.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Cingulate miospores, trilete, roundly triangular, 60-70 μ. Y-mark distinct, rays reach upto cingulum. Cingulum upto 8 μ broad, uniform. Exine of the central body punctate, puncta evenly distributed.

Comparison — *Murospora florida* (Balme) Poc., 1961 has a broad flange. *M. mesozoica* has a smooth central body. The specimens figured by Dettm. (*l.c.*) as *M. florida* (PL. XIV, FIGS. 11, 12) show distinct puncta as here described. Dettmann explains this structure as due to corrosion. The uniform size of the puncta and their even distribution

over the spore exine allows me to conclude that the exine is distinctly structured and not corroded. Corroded specimens observed by the author show uneven, mottled or rough surface.

Cingutriletes (Pier.) Dettm., 1963

Type Species — *Cingutriletes congruens* Pier. 1961

Cingutriletes sp.

Pl. 3, Fig. 9

Description — Trilete miospores, roundly triangular, cingulate. 30 μ. Y-mark distinct, rays extending upto the cingulum. Cingulum 2-3 μ wide. Exine proximally smooth, distally covered with warts; warts 2-4 μ broad irregularly distributed.

Comparison — Closely comparable to *C. clavus* (Balme) Dettm. The distal warts are more in number in the species described here.

Boseisporites (Dev.) Singh *et al.*, 1964

Type Species — *Boseisporites praeclarus* (Dev) Singh *et al.*, 1964.

Remarks — Dettmann (1963) includes *Boseisporites* under *Matonisporites* (Coup.) emended in her paper. She, however, includes only "smooth-walled, trilete microspores having exinal thickenings (valvae) in the three radial regions at the equator" under the genus *Matonisporites*. *Boseisporites* as emended by Singh *et al.* is here retained to include such other cingulate spores that do not come under the circumscription of *Matonisporites sensu* Dettmann (*l.c.*).

Boseisporites insignitus sp. nov.

Pl. 3, Figs. 5-6

Holotype — Pl. 3, Fig. 6. Slide no. 11.1.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Miospores trilete, triangular with rounded angles and straight to concave sides. 65-70 μ. Y-mark distinct, rays extending upto the equator, raised, lips broad. Exine punctate, puncta less than 1 μ, closely spaced and evenly distributed over the contact area. Equatorial cingulum unequal upto 6 μ broad at the sides and upto 10 μ broad at the angles, laevigate, differentially thickened indicating valvate development.

Remarks — Specimen illustrated in Pl. 3, Fig. 5 shows torn proximal exine and distinct puncta.

Comparison — *Boseisporites praeclarus* has infrapunctate proximal exine and is larger in size.

Boseisporites punctatus sp. nov.

Pl. 3, Fig. 7

Holotype — Pl. 3, Fig. 7. Slide no. 11.5.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Microspores trilete, triangular with rounded angles and distinct concave sides 54 μ. Y-mark distinct, rays extending upto inner margin of cingulum slightly raised. Exine punctate, puncta upto 1 μ, closely spaced and evenly distributed. Equatorial cingulum unevenly thickened and unequal 4 μ broad at the sides and 6 μ at the angles to form distinct valvae, puncta sometimes traverse through the cingulum in the form of vermiculate canals.

Comparison — *B. insignitus* is larger in size and has crowded puncta in the contact area. *B. praeclarus* is infra-punctate and is much larger in size.

Boseisporites lobatus sp. nov.

Pl. 3, Fig. 12

Holotype — Pl. 3, Fig. 12. Slide no. 11.2.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Microspores trilete, triangular with rounded angles and lobed amb. 85-100 μ. Y-mark distinct, rays extending upto the inner margin of the cingulum, raised, apex high, ±2 μ wide. Exine punctate, puncta circular to vermiculate. Cingulum, lobed intrapunctate.

Comparison — *B. punctatus* and *B. insignitus* lack the lobed intrapunctate cingulum. *B. lobatus* does not possess marked valvate thickenings.

Turma — _Hilates_ Dettm., 1963

Coptospora Dettm., 1963

Type Species — *Coptospora striata* Dettm., 1963.

Coptospora kutchensis sp. nov.

Pl. 4, Figs. 16, 17, 21-22

Holotype — Pl. 4, Fig. 17. Slide no. Bha 8/4.

Type Locality — Pur river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Circular spores, circular to subcircular. 80-100 μ. Exine infrapunctate, differentially thickened. Central part of the spore thinner, irregularly breaking up in the form of a large 40-50 μ wide opening.

Comparison — *Coptospora striata* the type species seems to have an almost laevigate exine and radially striated thickened area. *C. paradoxa* is smaller and has non-thickened exine. *C. reticulata* (Poc.) Dettm. also has a thickened exine and is reticulate.

Cooksonites (Poc.) Dettm., 1963

Type Species — *Cooksonites variabilis* Pocock, 1962.

Cooksonites minor sp. nov.

Pl. 4, Fig. 23

Holotype — Pl. 4, Fig. 23. Slide no. 11.5.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Spores inaperturate, cingulate, roundly triangular, spheroidal. 50-60 μ. Cingulum upto 12 μ wide, thick. Tetrad mark faint. Distally exine verrucate, verrucae irregularly distributed, distal pore like area present not well defined.

Comparison — *Cooksonites variabilis* is larger in size.

Aequitriradites (Delc. & Sprum.) Dettm., 1963

Type Species — *Aequitriradites dubius* Delc. & Sprum. 1963 emend. Delc., Dettm. & Hugh. 1963.

Remarks — *Aequitriradites* is placed under turma Hilates based on the presence of the characterestic distal pore, which character is important in taxonomic considerations.

Aequitriradites verrucosus (Cook. & Dettm.) Cook. & Dettm. 1961

Pl. 5, Figs. 1-3

A. tilchaensis (Cook. & Dettm.) Cook. & Dettm. 1961

Anteturma — _Pollenites_ Pot. 1931
Turma — _Saccites_ Erdt., 1947
Subturma — _Disaccites_ Cook., 1947

Platysaccus sp.

Pl. 5, Fig. 18

Description — Pollen grains bilateral, 50 × 100 μ. Central body elongated oval, 30 × 44 μ, exine granulose, bladders large than the body, more than hemispherical. Meshes closely set, distal sulcus narrow, extending throughout the length of the pollen body.

Comparison — *Platysaccus* sp. figured by Singh *et al.* is closely comparable but is bigger in size.

Platysaccus indicus sp. nov.

Pl. 6, Figs. 1-3

Holotype — Pl. 6, Fig. 1. Slide no. 11·5.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Pollen grains bilateral, 80-120 μ broad, central body spindle oval, 30-40 × 40-55 μ. Exine granulose, bladders larger than the body, hemispherical. Distal sulcus narrow, 4-8 μ broad.

Comparison — *Platysaccus* sp. figured by Singh *et al.* is larger in size.

Podocarpidites Cook. ex Coup. 1963

Type Species — *Podocarpidites ellipticus* Cook. 1947.

Podocarpidites densus sp. nov.

Pl. 5, Figs. 16-17, 21

Holotype — Pl. 5, Fig. 17. Slide no. 11.1.

Type Locality — Pat river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Broadly oval bilateral pollen, bisaccate, 95-110 μ. Central body 35 μ, circular, body exine thick, verrucose. Verrucae closely set, sacci hemispherical more than three times the size of the body.

Remarks — Large sacci and densely verrucate central body distinguish this species.

Turma — _Aletes_ Ibr., 1933
Subturma — _Azonaletes_ (Lub.) Pot. & Kr. 1954
Infraturma — _Psilonapiti_ Erdt., 1947

***Laricoidites* Pot., Thom. & Thierg. 1950**

Laricoidites indicus Singh *et al.* 1963

Pl. 6, Fig. 5

Laricoidites sp.

Pl. 6, Fig. 8

Description — Subcircular, 60 μ, irregularly folded, intrapunctate.

Comparison — The present species is distinguished from *Laricoidites indicus* by its smaller size.

Incertae Sedis

***Schizosporis* Cook. & Dettm. 1959**

Type Species — *Schizosporis reticulatus* Cooks. & Dettm. 1959.

Schizosporis reticulatus Cook. & Dettm.

Pl. 6, Figs. 9, 12

S. spriggi Cook. & Dettm. 1959

Pl. 6, Fig. 16

S. laevigatus sp. nov.

Pl. 6, Figs. 13-15

Holotype — Pl. 6, Fig. 13. Slide no. Bha 8/1.

Type Locality — Pur river section, near Bhuj, Bhuj Series (Lower Cretaceous).

Description — Elliptical, splitting equatorially into two halves. 100-150 μ. Exine upto 4 μ thick, laevigate.

Comparison — *Schizosporis rugulatus* is ornamented. *S. sprigii* Cook. & Dettm. is circular and *S. parvus* is smaller in size.

Remarks — Smooth-walled species are now included under a new genus *Psilospora* Venkat. & Kar (1968).

The following taxa are also present in the assemblage.

Cyathidites australis Coup.
C. cf. *C. australis* Coup.
C. minor Coup.
C. asper (Bolkhov.) Dettm.
C. cutchensis Singh *et al.*
C. pseudopunctatus Singh *et al.*
Todisporites major Coup.
Osmundacidites wellmanii Coup.
Lycopodiacidites asperatus Dettm.
Lycopodiumsporites facetus Dettm.
Cicatricosisporites australiensis (Cook.) Pot.
C. ludbrooki Dettm.
Bhujiasporites hirsutus Venkat. *et al.*
Impardecispora apiverrucata (Coup.) Venkat. *et al.*
I. uralensis (Bolkhov.) Venkat. *et al.*
I. verrucosus (Singh *et al.*) Venkat. *et al.*
I. purverulentus (Verbit.) Venkat. *et al.*
Gleicheniidites cercinidites (Cook.) Dettm.
Contignisporites glebulentus Dettm.
C. cooksonii Dettm.
C. sp.
Densoisporites velatus Weyl. & Kreig.
Leischikisporis indicus Bharad. & Singh.
Applanopsis dampieri (Balme) Doer.
A. trilobatus (Balme) Goubin *et al.*
A. monoalasporus (Dev) Venkat. & Kar.
A. segmentatus (Balme) Venkat. & Kar.
Alisporites grandis (Cook.) Dettm.
Microcachryidites antarcticus Cook.
Vitreisporites pallidus Reis.
Araucariacites australis Cook.
A. cooksonii Singh *et al.*
Classopollis classoides (Plf.) Poc. & Jans.

PALYNOLOGICAL COMPOSITION

The palynological assemblage of the three sections studied here is dominated mostly by three genera, viz. *Impardecispora, Applanopsis* and *Araucariacites. Cyathidites, Podocarpidites, Laricoidites* and *Schizosporis* are also frequently found within the counts of 200 specimens per sample. *Concavissimisporites, Bhujiasporites, Matonisporites, Boseisporites* and *Alisporites* are meagrely represented. Taxa that are encountered in the 200 counts are tabulated in Table 1.

Section J — The assemblage is dominated by *Applanopsis* and *Impardecispora. Schizosporis* is found in good abundance in the assemblage. *Cyathidites, Concavissimisporites, Bhujiasporites, Matonisporites, Boseisporites, Podocarpidites, Alisporites* and *Laricoidites* are meagrely represented.

Section K — The assemblage is dominated by *Araucariacites. Applanopsis* and *Laricoidites* are also abundant, while *Cyathidites, Impardecispora, Podocarpidites* and *Schizosporis* are rarely encountered.

Section L — This assemblage is also dominated by *Applanopsis* and *Impardecispora. Cyathidites, Bhujiasporites, Podocarpidites, Alisporites, Laricoidites* and *Schizosporis* are found within the counted specimens.

	SECTION. J (7438)	SECTION. K (906)	SECTION. L (902)
CYATHIDITES CUTCHENSIS			
CYATHIDITES PSEUODOPUNCTATUS			
CYATHIDITES GRANDIS			
MUROSPORA PUNCTATUS			
IMPARDECISPORA APIVERRUCATA			
BIRETISPORITES SPECTABILIS			
CONCAVISPORITES INDICUS			
OSMUNDACITES WELLMANII			
CONCAVISSIMISPORITES CRASSATUS			
CONCAVISSIMISPORITES KUTCHENSIS			
CONCAVISSIMISPORITES SUBVERRUCOSUS			
IMPARDECISPORA PURVERULENTUS			
LYCOPODIACIDITES ASPERATUS			
LYCOPODIUMSPORITES FACETUS			
FOVEOTRILETES PARVIRETUS			
CICATRICOSISPORITES LUDBROOKI			
MATONISPORITES KUTCHENSIS			
PODOCARPIDITES DENSUS			
PLATYSACCUS INDICUS			
SCHIZOSPORIS RETICULATUS			
SCHIZOSPORIS SPRIGII			
SCHIZOSPORIS LAEVIGATUS			
CYATHIDITES ASPER			
DICTYOPHYLLIDITES PECTINATAEFORMIS			
FOVEOTRILETES KUTCHENSIS			
KLUKISPORITES PUNCATUS			
CICATRICOSISPORITES AUSTRALIESIS			
BOSEISPORITES PRAECLARUS			
DENSOISPORITES VELATUS			
LAEVIGATOSPORITES SP.			
PLATYSACCUS SP.			
BOSEISPORITES INSIGNITUS			
BOSEISPORITES PUNCATUS			
BOSEISPORITES LOBATUS			
ISCHYOSPORITE CRATERIS			
COOKSONITES MINOR			
AEQUITRIRADITES VERRUCOSUS			

Errata:

Read, *Osmundacidites wellmanii* for *Osmundacites wellmanii*
Schizosporis spriggi for *S. sprigii*
Klukisporites punctatus for *K. puncatus*
Cicatricosisporites australiensis for *C. australiesis*
Boseisporites punctatus for *B. puncatus*
Ischyosporites crateris for *Ischyosporite crateris*

TABLE 1 — Showing the distribution of the various genera and species in the three sections

PALYNOLOGICAL COMPARISON

The present palynological assemblage closely resembles that of Trombau and Ghuneri described by Singh *et al.* (1964). The following genera are common to both:

Cyathidites, Gleicheniidites, Concavisporites, Osmundacidites, Matonisporites, Boseisporites, Lycopodiacidites, Lycopodiumsporites, Ischyosporites, Contignisporites, Trilobosporites, Densoisporites, Aequitriradites, Leschikisporis, Applanopsis, Platysaccus, Podocarpidites, Microcachryidites, Araucariacites, Laricoidites, Schizosporis, Classopollis.

The palynological assemblage described by Venkatachala (1968) from the Bhuj exposures near Walkamata is comparable to the present one in the dominance of *Applanopsis, Araucariacites* and *Alisporites.* The former assemblage can, however, be distinguished by the presence of *Aequitriradites, Contignisporites, Cicatricosisporites, Staplinisporites, Polycingulatisporites, Cornatispora.* and ? *Appendicisporites.*

The Bhuj exposures near Dayapar described by Venkatachala and Kar (in press) can also be differentiated by the presence of *Alsophilidites, Leptolepidites, Staplinisporites, Thymospora, Ephedripites* and *Cycadopites* in the assemblage.

The *Microcachiyrdites* Assemblage of Balme (1964) is closely comparable to the assemblage described here.

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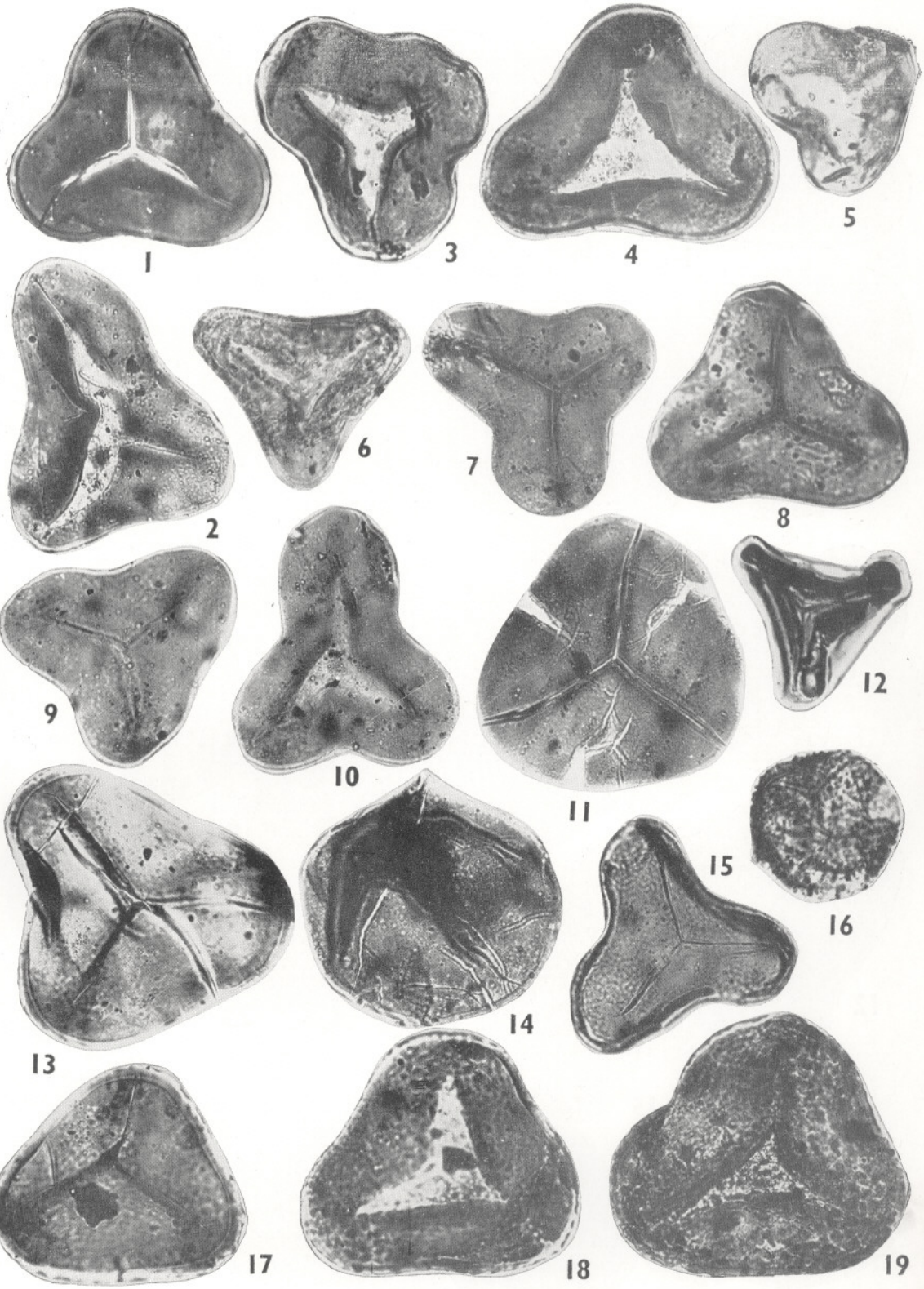
EXPLANATION OF PLATES

(All photomicrographs are enlarged *ca.* × 500)

PLATE 1

1. *Cyathidites australis* Film no. 109/20.
2. *Cyathidites* cf. *C. australis* Film no. 231/1.
3. *Cyathidites cutchensis* Film no. 229/7.
4. *Concavissimisporites pseudopunctatus* Film no. 232/10.
5. *Cyathidites minor* Film no. 224/19.
6. *Cyathidites asper* Film no. 230/36.
7. *Cyathidites* cf. *C. australis* Film no. 232/9.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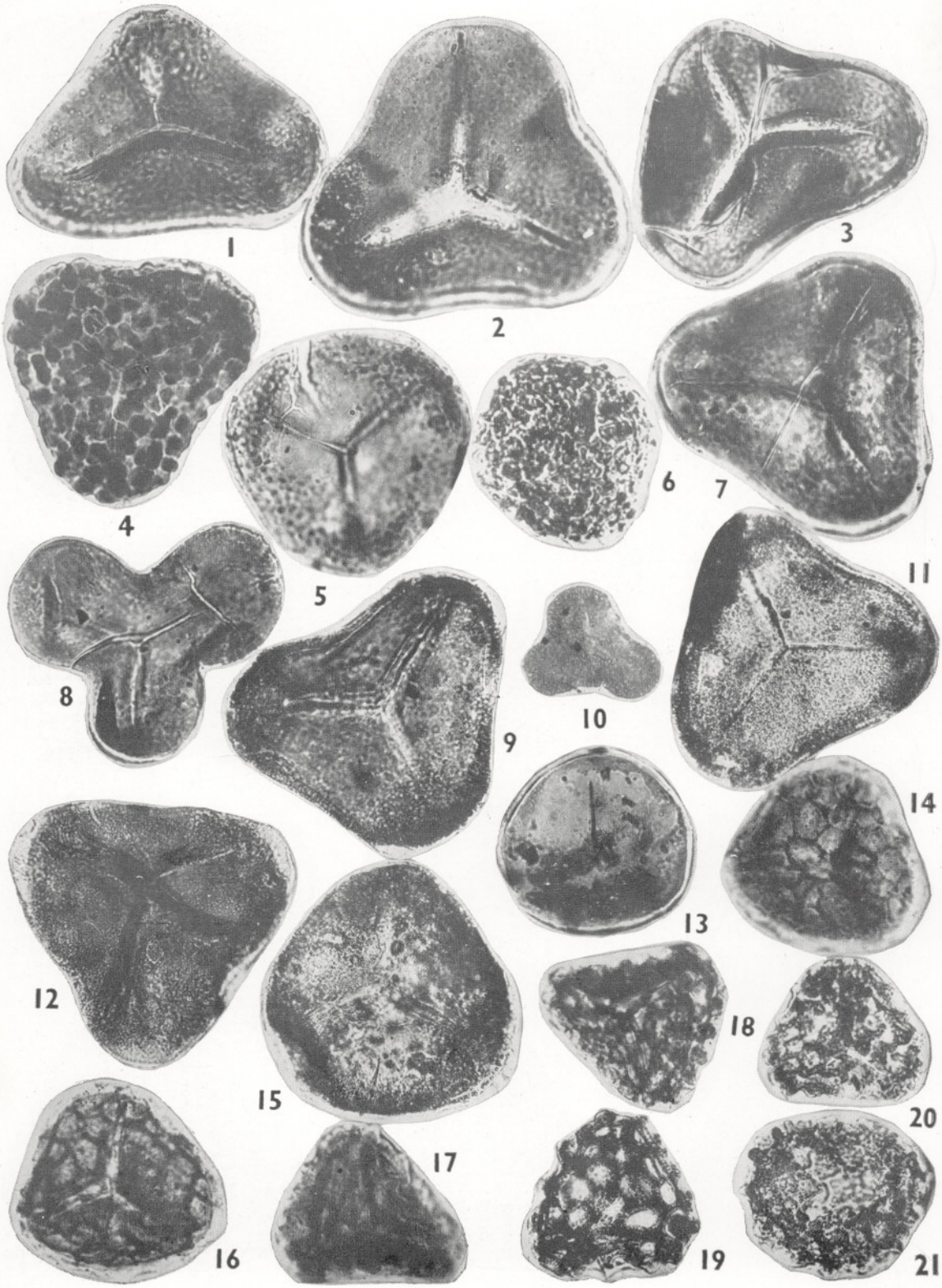
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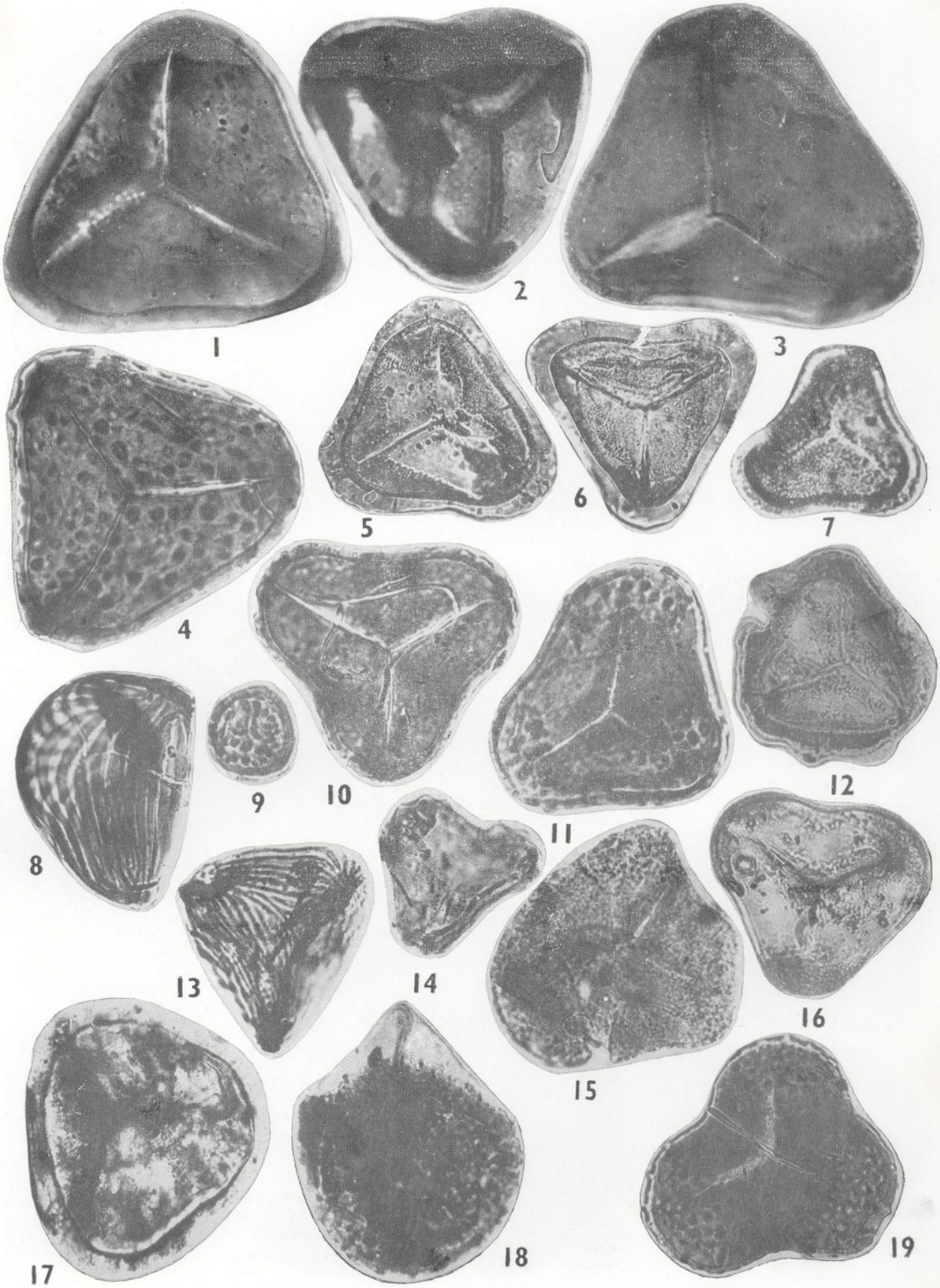
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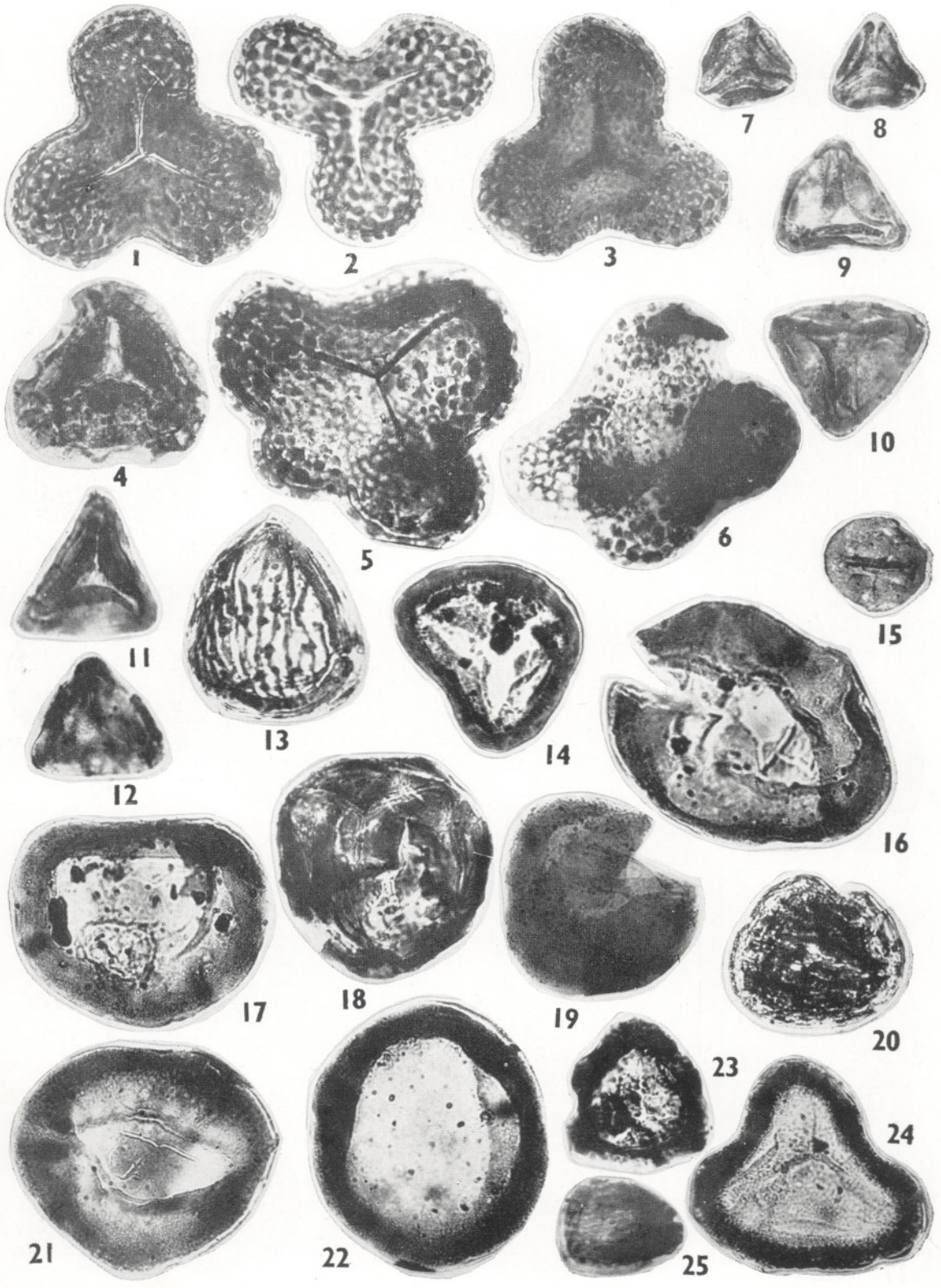
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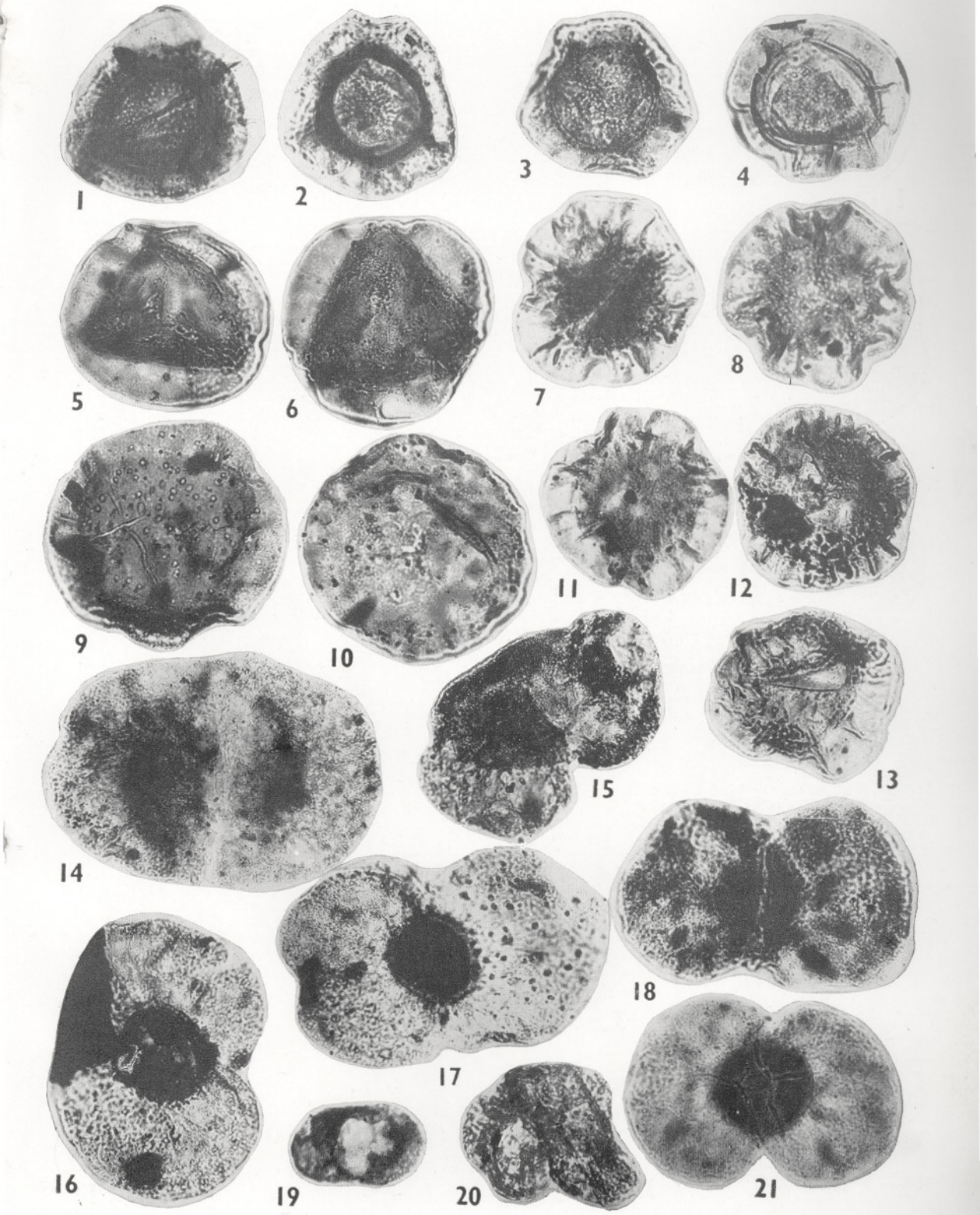
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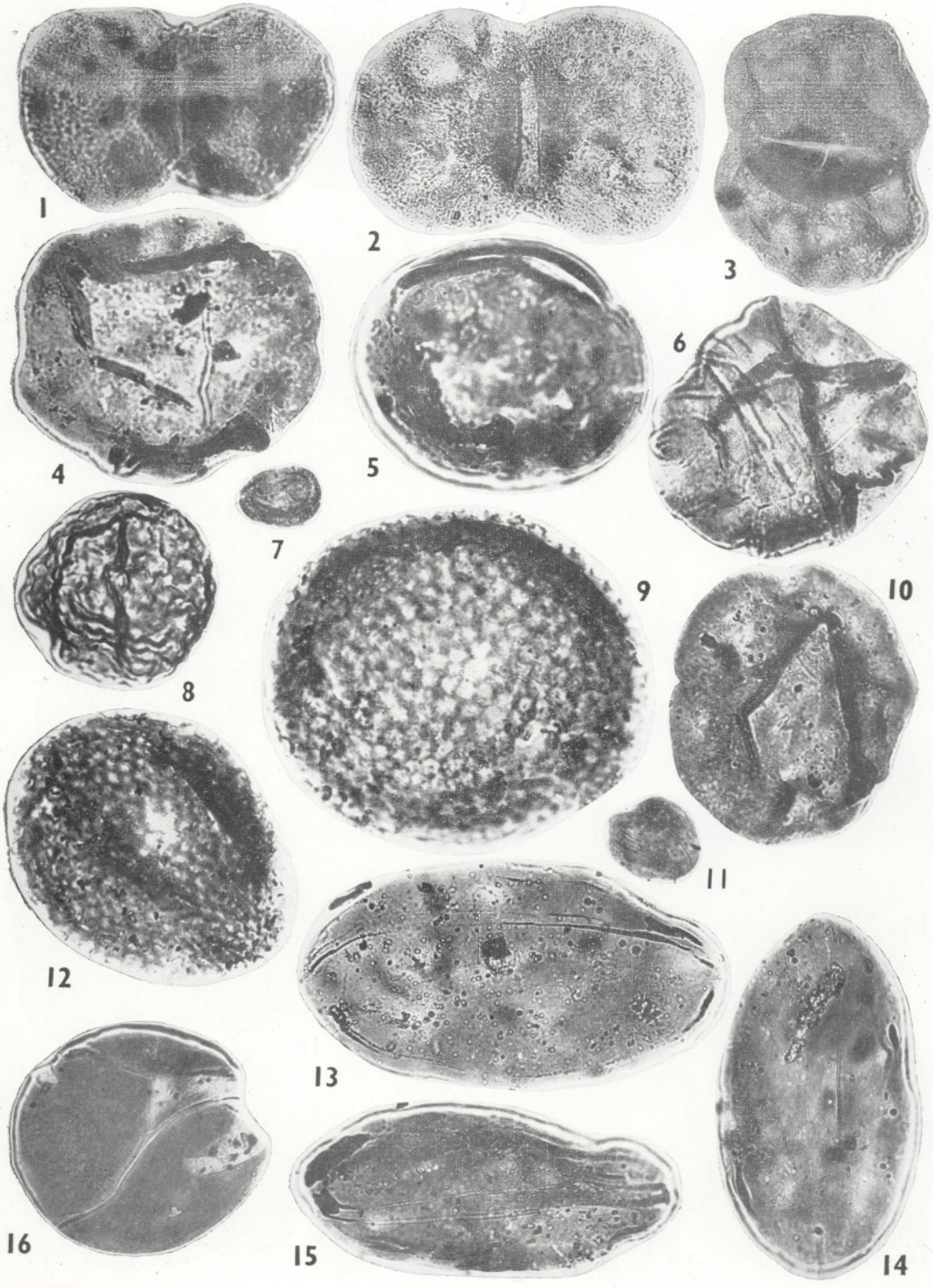
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8. *Cyathidites cutchensis* Film no. 233/34.
9. *Cyathidites* cf. *C. australis* Film no. 234/9.
10. *Cyathidites* cf. *C. australis* Film no. 234/19.
11. *Cyathidites grandis* Film no. 235/3.
12. *Dictyophyllidites pectinataeformis* Film no. 230/31.
13-14. *Biretisporites spectabilis* Film nos. 234/12, 233/16.
15. *Cyathidites asper* Film no. 230/1.
16. *Osmundacidites wellmanii* Film no. 115/36.
17. *Concavissimisporites subverrucosus* Film no. 234/21.
18-19. *Concavissimisporites kutchensis* Film nos. 232/5, 233/21.

PLATE 2

1-3. *Concavissimisporites subverrucosus* Film nos. 234/3, 234/29, 232/27.
4. *Concavissimisporites crassatus* Film no. 109/9.
5. *Concavissimisporites potoniei* Film no. 234/10.
6. *Lycopodiacidites asperatus* Film no. 229/1.
7. *Concavissimisporites subverrucosus* Film no. 232/5.
8. *Concavissimisporites* sp. Film no. 233/7.
9. *Foveotriletes kutchensis* Film no. 230/7.
10. *Foveotriletes parviretus* Film no. 110/24.
11-12. *Foveotriletes kutchensis* Film nos. 230/15, 230/9.
13. *Todisporites major* Film no. 231/24.
14. *Lycopodiumsporites facetus* (distal view) Film no. 235/5.
15. *Foveotriletes kutchensis* Film no. 230/24.
16. *Lycopodiumsporites facetus* (proximal view) Film no. 235/6.
17. *Klukisporites* sp. Film no. 230/34.
18-21. *Klukisporites punctatus* Film nos. 230/33, 230/30, 229/25, 230/28.

PLATE 3

1-2. *Matonisporites kutchensis* Film nos. 231/2, 235/27.
3. *Impardecispora simplex* Film no. 110/15.
4. *Impardecispora verrucosus* Film no. 234/29.
5-6. *Boseisporites insignitus* Film nos. 231/33, 231/31.
7. *Boseisporites punctatus* Film no. 229/3.
8. *Cicatricosisporites ludbrooki* Film no. 232/19.
9. *Cingutriletes* sp. Film no. 229/22.
10-11. *Impardecispora indica* Film nos. 233/1, 234/8.
12. *Boseisporites lobatus* Film no. 230/22.
13. *Cicatricosisporites australiensis* Film no. 231/12.
14. *Impardecispora purverulenta* Film no. 110/14.
15. *Impardecispora* sp. Film no. 231/21.
16. *Impardecispora* cf. *I. trioreticulosus* Film no. 229/9.
17-18. *Bhujiasporites kutchensis* Film nos. 235/29, 235/4.
19. *Impardecispora indica* Film no. 235/16.

PLATE 4

1. *Impardecispora uralensis* Film no. 233/9.
2. *Impardecispora apiverrucata* Film no. 234/7.
3. *Impardecispora uralensis* Film no. 109/26.
4. *Ischyosporites crateris* Film no. 229/24.
5-6. *Impardecispora lobata* Film nos. 109/17, 116/9.
7-8. *Gleicheniidites cercinidites* Film nos. 113/25, 113/28.
9-12. *Concavisporites indicus* Film nos. 113/27, 113/37, 114/29, 113/28.
13. *Contignisporites* sp. Film no. 230/35.
14. *Murospora punctata* Film no. 229/10.
15. *Leschikisporis indicus* Film no. 109/30.
16-17. *Coptospora kutchensis* Film nos. 232/32, 233/27.
18. *Frangospora fracta* Film no. 233/15.
19. *Densoisporites* sp. Film no. 231/16.
20. *Contignisporites glebulentus* Film no. 229/11.
21-22. *Coptospora kutchensis* Film nos. 229/17, 229/21.
23. *Cooksonites minor* Film no. 229/12.
24. *Murospora punctata* Film no. 231/35.
25. *Contignisporites cooksonii* Film no. 115/25.

PLATE 5

1-3. *Aequitriradites verrucosus* Film nos. 229/15, 229/11, 230/8.
4. *Applanopsis dampieri* Film no. 230/6.
5-6. *Applanopsis trilobatus* Film nos. 231/13, 233/8.
7-8. *Applanopsis segmentatus* Film nos. 229/4, 229/16.
9-10. *Applanopsis monoalasporus* Film nos. 233/3, 231/26.
11-13. *Applanopsis segmentatus* Film nos. 231/11, 231/19, 231/19.
14-15. *Alisporites grandis* Film nos. 235/24, 231/29.
16-17. *Podocarpidites densus* Film nos. 231/17, 231/11.
18. *Platysaccus* sp. Film no. 231/10.
19. *Vitreisporites pallidus* Film no. 114/3.
20. *Microcachryidites antarcticus* Film no. 229/27.
21. *Podocarpidites densus* Film no. 234/15.

PLATE 6

1-3. *Platysaccus indicus* Film nos. 231/10, 235/10, 234/22.
4. *Araucariacites australis* Film no. 233/10.
5. *Laricoidites indicus* Film no. 233/30.
6. *Araucariacites cooksonii* Film no. 233/24.
7. *Classopollis classoides* Film no. 109/29.
8. *Laricoidites* sp. Film no. 229/13.
9. *Schizosporis reticulatus* Film no. 109/24.
10. *Araucariacites australis* Film no. 233/31.
11. *Classopollis classoides* Film no. 114/23.
12. *Schizosporis reticulatus* Film no. 109/15.
13-15. *Schizosporis laevigatus* Film nos. 234/11, 234/20, 232/26.
16. *Schizosporis spriggi* Film no. 232/35.