PALYNOLOGY OF THE TERTIARY SEDIMENTS OF KUTCH — 1. SPORES AND POLLEN FROM BORE-HOLE NO. 14

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ABSTRACT

The present paper deals with the preliminary palynological investigation of the spore-pollen recovered from the bore-hole no. 14, drilled near Matanamadh, in the district of Kutch, Gujarat state, India. 32 spore-pollen genera and 45 species have been described; out of them 9 genera viz. *Rostriapollenites, Nymphaeoipollis, Cryptopolyporites, Umbelliferoipollenites, Polybrevicolporites, Sastriipollenites, Pseudonothofagidites, Sonneratioipollis* and *Lakipollis* are new. The assemblage is dominated by Angiosperms comprising monocolpate, dicolporate, tricolpate, tricolporate, polycolpate, polycolporate, monoporate, triporate and panporate pollen. Pteridophytic spores are meagrely represented.

INTRODUCTION

THE Laki Stage represents an important rock unit in Kutch, Gujarat state, India. It is equivalent to Eocene in age and is represented by sediments of considerable thickness (*ca.* 200 ft.).

The present project was undertaken to investigate the feasibility of zoning the Laki sediments by palynological fossils and correlating them with the other known Eocene rocks of Indo-Malayan region. The present paper deals with the Systematic Palynology of the spore-pollen found in the bore-hole No. 14, drilled near Matanamadh, by the Kutch Lignite Project, Directorate of Geology and Mining, Government of Gujarat, India. The material was kindly supplied by the above directorate to the authors for palynological investigation.

Fifteen to twenty grams of material were kept in commercial Nitric acid (40 %) for one day followed by a treatment of Potassium hydroxide solution (3 %) for three minutes. The material was washed several times and dried on the cover glass by Polyvenyl alcohol and finally mounted in canada balsam. The unused material and slides have been preserved at the repository of the Birbal Sahni Institute of Palaeobotany, Lucknow. The new taxa proposed in this paper are from bore hole No. 14 drilled near Matanamadh and from the Laki stage (Eocene) (information supplied by Gujarat Directorate of Geology and Mining).

SYSTEMATIC PALYNOLOGY

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

Genus — *Intrapunctisporites* Krutz. 1959

Type Species — *Intrapunctisporites intrapunctis* Krutz. 1959.

Intrapunctisporites apunctis Krutz. 1959

Pl. 1, Fig. 2

Remarks — The spores are comparable to the spores of *Lygodium.*

Genus—*Punctatisporites* (Ibr.) Pot. & Kr. 1954

Type Species — *Punctatisporites punctatus* Ibr. 1933.

? *Punctatisporites* sp.

Pl. 1, Fig. 1

Description — Spores triangular-subtriangular. Trilete distinct, rays well developed, slightly raised, uniformly broad. Commissure well defined. Exine 2-3 μ thick, proximally punctate, puncta well developed, mostly concentrated in contact area; exine on distal side laevigate.

Genus — *Sphagnumsporites* Raatz 1937

Type Species —*Sphagnumsporites stereoides* (Pot. & Ven.) Raatz, 1937.

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Cf. *Sphagnumsporites* sp.

Pl. 1, Fig. 6

Description — Spore subtriangular, 12 μ. Trilete not traceable but three folds are seen in the middle region. Exine 1·5 μ thick, psilate, radially folded along the margin, folds ± parallel to each other.

Remarks — The spore with its psilate exine and subtriangular shape resembles *Sphagnumsporites* Raatz (1937). *Sphagnumsporites* has been reported from many Tertiary formations (*see* WILSON & WEBSTER, 1946; COOKSON, 1947, 1953; POTONIÉ, THOMSON & THIERGART, 1950; POTONIÉ & VENITS, 1934; NEUY-STOLS, 1958; DOKTOROWICS-HREBNICKA, 1960, 1961; ROUSE, 1962 and MARTIN & ROUSE, 1965). Some of the specimens of *Sphagnumsporites stereoides* (Potonié & Venits) Raatz (1937; PL. 1, FIG. 4) illustrated by Raatz are comparable with the present species in the presence of radial folds along the margin. That species can, however, be readily distinguished by its large size (23 μ) and distinct trilete mark. The present specimen does not show definite trilete mark and is smaller in size in comparison to other species described by the above mentioned authors; hence the present specimen has only been compared with *Sphagnumsporites*.

Spore type–1

Pl. 1, Fig. 3

Description — Spore triangular, 21 μ. Apices broadly rounded, inter-apical margins slightly concave. Trilete, rays sinuous. Exine 3 μ thick, scabrate, intrapunctate.

Spore type–2

Pl. 1, Fig. 4

Description — Spore roundly triangular, 30 μ. Apices very broad, inter-apical margins convex. Trilete well developed, ± sinuous, extending almost upto margin. Exine 2 μ thick, laevigate and intrapunctate.

Spore type–3

Pl. 1, Fig. 5

Description — Spore triangular, 21 μ. Apices acutely rounded, inter-apical margins ± concave. Trilete, rays extending almost upto margin. Exine 2 μ thick, laevigate and intrapunctate.

Turma — *Monoletes* Ibr. 1933
Subturma — *Azonomonoletes* Lub. 1935
Infraturma — *Laevigatomonoleti* Dyb. & Jach. 1957

Genus — *Polypodiaceaesporites* Thierg. 1940

Type Species — Polypodiaceaesporites haardti (Pot. & Ven.) Thierg., 1940.

Polypodiaceaesporites sp.

Pl. 1, Fig. 8

Description — Spore ± oval with constriction at one of the lateral ends, parallel to longitudinal axis; 47×32 μ. Monolete mark present, not well developed, extending more than half of radius longitudinally. Exine 1·5 μ thick, scabrate.

Comparison — Polypodiaceaesporites haardti (Pot. & Ven.) Thierg. (1940) resembles the present species in size range and shape but is distinguished by its less scabrate exine. *P. levis* Sah (1967) has laevigate and infrastructured exine. *Polypodiaceaesporites* sp. described by Sah (1967) approximates the present species in size but is differentiated by its indistinct sculptural elements which seems to be subverrucose.

Genus — *Verrumonoletes* v. d. Ham. 1956

Type Species — Verrumonoletes usmensis V. d. Ham., 1954.

Verrumonoletes sp.

Pl. 1, Fig. 7

Description — Spore subcircular, 30×25 μ. Monolete well developed, lip slightly raised, extending ± three-fourth the longitudinal axis. Exine ±2 μ thick, verrucose, verrucae closely placed, ± uniformly distributed, forming pseudoreticulum in surface view.

Comparison —Verrumonoletes sp. described by Banerjee (1966, PL. 1, FIG. 1) from the Tertiary rocks of Andaman islands resembles the present species in sculptural elements but is distinguished by its larger size and ± elliptical shape.

Anteturma — *Pollenites* Pot. 1931
Turma — *Plicates* (Naum.) Pot. 1960
Subturma — *Monocolpates* Iv. & Tr. Sm. 1950

Genus — *Palmaepollenites* Pot. 1951

Type Species — *Palmaepollenites tranquillus* (Pot.) Pot., 1951.

Palmaepollenites kutchensis sp. nov.

Pl. 1, Figs. 9-10

Holotype — Pl. 1, Fig. 9. Size 29×23 μ. Slide No. 3317.

Diagnosis — Pollen grains oval with ± equally broad lateral ends, 25-30×10-15 μ. Monocolpate, colpus broad, boat shaped, not reaching up to margins. Exine ± laevigate.

Description — Pollen grains mostly oval with broadly rounded to pointed lateral ends. Colpus distinct, generally broader at middle region and tapering at ends, boat-shaped, never reaching margins. Exine upto 2 μ thick, laevigate or slightly granulose.

Comparison — *Palmaepollenites eocenicus* (Biswas) Sah & Dutta (1966) closely resembles the present species in shape and nature of the colpus but is distinguished by their larger size range. *P. communis* Sah & Dutta (1966) is also comparable to the present species in shape but is differentiated by its narrow, slightly raised colpus which mostly extends from one margin to the other. *P. neyvelii* Ramanuj. (1966) is larger in size and is characterized by crassimarginate colpus. *P. indicus* Ramanuj. (1966) is also larger in size than the present species, has a very narrow, raised sulcus. *Monosulcites* (*Palmidites*) *minima* described by Chitaley (1951, PL. 13, FIG. 9) is distinguished from the present species by its subcircular shape, smaller size and extension of the colpus from one margin to other. *Monosulcites* (*Palmidites*) *spinosa* Chit. (1951, PL. 13, FIG. 11) has spinose exine.

Remarks — Types E & F described by Sen (1948) from the Laitryngew coalfield seem to belong to the present species described here. The size range, shape, nature and extension of the colpus are almost same to that of the present species. The specimen referred to *Psilamonoletes* by Ghosh and Banerjee (1963, PL. 1, FIG. 1) is also comparable to the present species.

Palmaepollenites nadhamunii sp. nov.

Pl. 1, Figs. 11-12

Holotype — Pl. 1, Fig. 11. Size 29×17 μ. Slide No. 3313.

Diagnosis — Pollen grains elliptical-spindle in shape, 25-30×15-22 μ. Monocolpate, colpus narrow, extending from one margin to other. Exine laevigate.

Description — Pollen grains mostly elliptical in shape with pointed or blunt lateral ends. Colpus well developed, narrow, uniformly broad or somewhat broadened at one end. Exine up to 2·5 μ thick, laevigate, sometimes granulose.

Comparison — *Palmaepollenites kutchensis* resembles the present species in size and shape but is distinguished by its broad, boat-shaped sulcus not extending from one margin to other. *P. communis* Sah & Dutta (1966) approximates the present species in shape and the presence of a narrow sulcus but is differentiated by its larger size. *P. eocenicus* (Bis.) Sah & Dutta (1966) has larger size and broader sulcus. *P. neyvelli* Ramanuj. (1966) has narrow sulcus but is distinguished by its larger size and thicker exine. *P. indicus* Ramanuj. (1966) is characterized by narrow, raised sulcus and is separated by its larger size.

Derivation of name — Named after Mr. B. S. Nadhamuni, Officer-in-Charge, Kutch Lignite Project, Directorate of Geology & Mining, Govt. of Gujarat who helped in collecting the samples on which the study is based.

Genus — *Liliacidites* Coup. 1953

Type Species — *Liliacidites kaitangataensis* Coup, 1953.

Liliacidites ellipticus sp. nov.

Pl. 1, Fig. 13

Holotype — Pl. 1, Fig. 13. Size 38×28 μ. Slide No. 3319.

Diagnosis — Pollen grains oval-elliptical in shape, 30-42×25-28 μ. Sulcus broad, ± boat shaped. Exine finely intramicroreticulate.

Description — Pollen grains mostly oval in shape with ± equally broad lateral ends; some specimens are, however, elliptical. Sulcus wide, broader at middle and tapered at ends to provide a boat-shaped appearance. Exine upto 2·5 μ thick, finely intramicroreticulate, not well discernible in some specimens.

Comparison — *Liliacidites kaitangataensis* Coup. (1953) is comparable in shape but is

distinguished by its larger size and broader reticulum than the present species. *L. variegatus* Coup. (1953) is comparable to the present species in size and overall shape but is differentiated by its narrow sulcus which may even be trichotomosulcate in some specimens, sexine in *L. variegatus* is clavate-baculate while it is finely intramicroreticulate in the present species. *L. intermedius* Coup. (1953) approximates the present species in size but can readily be separated by its clavate-baculate sculptural elements.

Liliacidites baculatus sp. nov.

Pl. 1, Fig. 17

Holotype — Pl. 1, Fig. 17. Size 51×45 μ. Slide No. 3312.

Diagnosis — Pollen grains oval-elliptical in shape, 45-65×30-45 μ. Colpus well developed, funnel shaped. Exine intrabaculate forming negative reticulum in surface view.

Comparison — *Liliacidites ellipticus* resembles the present species in shape and size range but differs in possessing intramicroreticulate structure and broad sulcus. *L. kaitangataensis* Coup. (1953) approximates the present species in size range and clavate-baculate sculptural elements but is distinguished in its nature of reticulum which is about 5 μ at centre and 1 μ at ends. *L. variegatus* Coup. (1953) and *L. intermedius* Coup. (1953) are smaller in size. *L. sphericus* Coup. (1960) has clavate-baculate sculptural elements but is subcircular-circular in shape. *L. waitunaensis* Coup. (1960) is also clavate-baculate but is distinguished by its smaller size range.

Genus — *Couperipollis* gen. nov.

Type species —*Couperipollis* (*Monosulcites*) *perspinosus* (Coup.) comb. nov.

Diagnosis —Pollen grains subcircular, oval or elliptical in shape. Monosulcate, sulcus well developed, mostly extending from one margin to other. Exine ornamented with verrucae, bacula and spines.

Description — Pollen grains mostly oval-circular in outline, Monosulcate, sulcus well developed, generally uniformly broad, sometimes constricted in middle or unequally broad to form a funnel shaped structure. Sulcus sometimes obscured by sculptural elements. Exine ±2—3·5 μ thick, sculptural elements well developed in most of the cases, robustly built, may be upto 10 μ long, when closely placed and uniformly distributed exine appears pseudoreticulate in surface view. Spines vary in degree of development and distribution, interspersed with bacula or sometimes a few verrucae are also seen with them. Specimens possessing only bacula or verrucae are also found.

Comparison — *Arecipites* Wodeh. (1933) is comparable with the present genus in being monosulcate but can very well be differentiated by its psilate exine. *Palmaepollenites* Pot. (1951) is also monosulcate and oval-elliptical in shape. The exine in *Palmaepollenites* is however, laevigate and intragranulose with a distinct colpus not extending from one margin to the other. *Sabalpollenites* Thierg. (1938) is oval, monosulcate and possesses granulose exine. *Liliacidites* Coup. (1953) is monosulcate but has distinct reticulate exine. *Monosulcites* (*sensu* Cooks., 1947) is monosulcate and the exine is devoid of any marked sculptural elements.

Remarks — Cookson (1947) described two species of *Monosulcites* Erdtman (1947), *viz. Monosulcites minima* Cookson and *M. maxima* Cookson from the Tertiary rocks of Kerguelen archipelago. Couper (1953) retained *Monosulcites* and designated *Monosulcites minimus* Cookson (al. *M. minima*) as the type species of this genus. *M. minimus* is diagnosed as follows: oval, 29·6-34 μ long, 26·5-29 μ broad, with well-defined, longitudinal boat-shaped sulcus and laevigate exine. *M. maxima* Cookson is larger in size than *M. minimus* and the exine may in some cases be slightly granulose. Couper (1953) though designated a laevigate species, *viz. M. minimus* as the type species of *Monosulcites* also included ornate species (*M. palisadus* Couper and *M. perspinosus*) under this genus. *M. palisadus* is clavate-baculate to form pitted-reticulate ornamentational pattern in surface view, while *M. perspinosus* is distinctly spinose. Couper (1960) described *M. gemmalus* and *M. granulatus* which have gemmate projections and granulose exine respectively. Potonié (1958) also commented on these inclusions of Couper (*l.c.*) under *Monosulcites* and pointed out (*see* POTONIÉ, 1958; p. 95) that the type species, *e.g. M. minimus* has not any marked sculptural elements. Thus *Monosulcites* (*sensu* Couper *l.c.*) becomes a heterogeneous grouping containing both psilate as well as ornate forms. *Couperipollis* is here instituted to

accommodate those monosulcate pollen grains which are mostly oval with spinose sculptural elements while, *Monosulcites* (Erdtman) Cookson (1947) is retained to include psilate, monosulcate, oval-elliptical, pollen grains.

Derivation of Name — Named after Dr. R. Couper of the Shell Oil Company.

Couperipollis (Monosulcites) perspinosus (Coup.) comb. nov

Holotype — Coup. 1953, pl. 8, fig. 133.
Type Locality — Wanganuian (Pliocene), New Zealand.
Specific Diagnosis and *Description* — *See* Coup. 1953; p. 65.

The following species also belong to *Couperipollis*:

Couperipollis (*Monosulcites*) *gemmatus* (Coup.) comb. nov.

Holotype — Coup. 1960; pl. 12, fig. 20.
Type Locality —Pareora Series (Oligocene), New Zealand.

Couperipollis (*Monosulcites*) *granulatus* (Coup.), comb. nov.

Holotype — Coup. 1960; pl. 12, fig. 17.
Type Locality — Teurian (Danian), New Zealand.

Couperipollis (*Monosulcites*) *rarispinosus* (Sah & Dutta) comb. nov.

Syn. — *Monosulcites rarispinosus* Sah & Dutta, 1966.
Holotype — Sah & Dutta, 1966; pl. 1, fig. 28.
Type Locality — Laitryngew (Eocene), Assam, India.

Couperipollis (*Monosulcites*) *wodehousei* (Bis.) comb. nov.

Syn. —
(1) *Monosulcites wodehousei* Bis., 1962.
(2) *Monosulcites wodehousei* (Bis.) Sah & Dutta, 1966.
Holotype — Biswas, 1962; pl. 12, fig. 30.
Type Locality — Sylhet Limestone (Eocene), Assam, India.

Couperipollis (*Monosulcites*) *brevispinosus* (Bis. 1962) comb. nov.

Holotype — Baksi, 1962; pl. 2, fig. 22.
Type Locality — Tura Formation (Eocene), Assam, India.

Couperipollis (Monosulcites) sp. in Sah & Dutta, 1966

Description — See Sah & Dutta, 1966; p. 77.

Couperipollis kutchensis sp. nov.

Pl. 1, Figs. 15-16

Holotype — Pl. 1, Fig. 16. Size 50×48 μ. Slide No. 3314.
Diagnosis — Pollen grains ± subcircular in shape, 35-65×30-60 μ. Monosulcate, sulcus ill-developed, hardly discernible, extending from one end to other. Exine spinose, spines with bulbous base and pointed tip.
Description — Pollen grains mostly subcircular in shape but sometimes oval due to longitudinal foldings. Sulcus obscured by sculptural elements in most specimens; extending from one margin to other and ± uniformly broad. Exine upto 2·5 μ thick, spinose, spines upto 5 μ long, with bulbous base and sharply pointed tips, closely placed, evenly distributed to give pseudoreticulate appearance in surface view.
Comparison — *Couperipollis rarispinosus* (Sah & Dutta) resembles the present species in shape and size but is distinguished by sparse sculptural elements. *C. wodehousei* (Sah & Dutta) also approximates the present species in shape and size but is differentiated by its very strongly built, long spines (9-14 μ). *C. brevispinosus* is comparable to the present species in shape and inconspicuous sulcus but is readily separated by its larger size and longer spines which are not so densely placed as in the present species.

Genus —*Rostriapollenites* Venkat. & Kar 1969

Type Species — *Rostriapollenites kutchensis* Venkat. & Kar, 1969

Rostriapollenites kutchensis Venkat. & Kar, 1969

Pl. 1, Figs. 19-21a-c

Pollen type–4

Pl. 1, Fig. 14

Description — Pollen grains elliptical, 45 × 21 μ. Colpus well defined, broad, extending from one end to other. Exine about 1·5 μ thick, psilate and infrastructured.

Remarks — Only a single specimen has been recovered and so no detailed study is possible. It is, however, distinct from other monocolpate genera by its large size and very broad colpus extending from one margin to the other.

Infraturma —*Sphaerozonisulcates* infraturma nov.

Diagnosis — Pollen grains subcircular-circular, zoni sulcate, sulcus ± parallel to the equatorial margin.

Genus — *Nymphaeoipollis* gen. nov.

Type Species — *Nymphaeoipollis marginatus* sp. nov.

Diagnosis — Pollen grains subcircular-circular in shape, zonisulcate, sulcus ± parallel to margin, often breaking along equator into two ± equal halves. Size range 30-70 × 25-60 μ (in unfolded specimens). Exine tectate, scrobiculate, sometimes microreticulate.

Description — Pollen grains mostly subcircular, sometimes circular or ± oval forms also met with. Zonisulcate, weakened area parallel to the equatorial margin splitting the pollen into two ± equal halves; the moiety thus formed generally remain adpressed to each other or separated from one another. In some of the specimens studied breakage complete at some parts while in other it is intact to give a 'bivalved' appearance. Exine 2-3·5 μ thick, sometimes irregularly folded. Exine tectate, scrobiculate to microreticulate.

Comparison — *Schizosporis* Cooks. & Dettm. (1959) closely resembles the present genus in shape and its mode of splitting. However, *Schizosporis* is atectate and coarsely reticulate in the type species. *Inaperturopollenites* (Pf.) Thom. & Pf., 1953 (*sensu* MANUM, 1962) differs in not possessing any distinct sulcus. *Nymphaeacidites* Sah (1967) is subcircular-circular in shape but is monosulcate. *Nonaperturipites* Bis. (1962) is ornamented with tubercles, warts or is coarsely reticulate. *Araceaepites conditi* Bis. (1962. PL. 13, FIGS. 42-43) generally divides into two equal halves like the present genus but has laevigate exine. *Classoidites* van Amer. (1965) also resembles *Nymphaeoipollis* in appearance but the former is distally monoporate. Pollen types 2 & 3 described by Norem (1965, PL. 1, FIGS. 2-3) from the Eocene of Venezuela though comparable are circular, nonaperturate, laevigate without any pronounced infrastructure. Some of the species of *Disulcites* (Erdt.) ex Pot. (1960), a disulcate pollen [*e.g. D. kalewansis* Pot. (1960)] described from the Eocene coal of Kalewa, Burma resembles the present genus when split into two parts. *Proxapertites* v. d. Ham. (1956) is ± circular and apparently resembles the present genus but is distinguished by its 'dyad-like' nature. *Potamogetonaceaepites pramathi* Bis. (1962, PL. 13, FIG. 41) described from the Sylhet Limestone of Assam resembles the present genus in size and subcircular shape but is distinguished by its non-aperturate condition. *Retipilonapites* Ramanuj. (1966) is retipilate, non-aperturate and possesses a depression in the central region. *Smilacipites* Wodeh. (1933) and *Verruinaperturites* Pierce (1961) are also nonaperturate and possess various sculptural elements. *Nymphaeoipollis* instituted here is distinct from other known genera by its subcircular-circular shape, zoni-sulcate aperture, pollen splitting into two equal halves and tectate, scrobiculate exine.

Remarks — The dispersed spore genus *Nymphaeoipollis* closely resembles the pollen grains of some species of extant Nymphaeaceae. Zonisulcate pollen are found in some species of *Nymphaea* (two or three colpate pollen grains are also found in the genus). The pollen grains of *Nymphaea stellata*, *Nymphaea stellata* var. *parviflora* and *N. alba* approximate the present genus in zonisulcate condition but differs in possessing distinct sculptural elements. The pollen grains of *Nymphaea zanzibariensis* are also zonisulcate with obscure stratification of the exine (ERDTMAN, 1952). Pollen of *Victoria regia* is also zonisulcate and are united in tetrahedral tetrads (ERDTMAN, 1943).

Zonisulcate pollen also occur in *Lomandreae* of the family Liliaceae. *Acanthocarpus preissii* and *Chamaexeros serra* are originally two sulcate but they may appear to be zonisulcate. The various species of *Lomandra* are, however, either zonisulcate or spiraperturate with spines or spinules and

possess bacula as sculptural elements (ERDTMAN, 1952).

The pollen grains of *Afroraphidophora africana* of Araceae are mostly three colpate but apparently resemble the *Nymphaeoipollis* in their frequent equatorial breaking of the pollen grains into two equal halves. The pollen grains of *Heteropsis salicifolia*, a native plant of Brazil also of the family Araceae resemble *Nymphaeoipollis* in apparent zonisulcate condition. However, the pollen grains of *Heteropsis salicifolia* are subisopolar consisting of two halves with a thin-walled operculoid area intercalated in between the unequally thickened proximal and distal surfaces (ERDTMAN, 1952).

Nymphaeoipollis appears to be closely related to the species of *Nymphaea* rather than with any other genus. The zonisulcate condition is common in both. The sculptural elements seems to be different but as all the living species of *Nymphaea* have not been extensively studied a closer comparison is rendered difficult.

Nymphaeoipollis marginatus sp. nov.

Pl. 2, Figs. 24-25

Holotype — Pl. 2, Fig. 24. Size 40×36 μ.

Diagnosis — Pollen grains subcircular-circular, zonisulcate. Sulcus ± circular along the equatorial margin. 35-45×30-43 μ. Exine tectate, scrobiculate. Pollen grains in many specimens divide into two ± equal halves due to equatorial breaking.

Description — Pollen grains mostly subcircular-circular, distinctly zonisulcate. Sulcus ± uniformly broad (2-4 μ in closed pollen grains), appears as a groove along equator, sometimes may not be distinctly seen at some parts thus appearing to be discontinuous. Exine 2-3 μ thick, scrobiculate with distinct reticulate pattern which can be clearly estimated by LO analysis.

Nymphaeoipollis flavatus sp. nov.

Pl. 2, Fig. 27

Holotype — Pl. 2, Fig. 27. Size 65×48 μ. Slide No. 3318.

Diagnosis — Pollen grains subcircular, sometimes longitudinally folded to form oval shape, 45-70 × 35-60 μ. Zonisulcate, sulcus indistinct, placed near margin, ± parallel to each other. Exine upto 3·5 μ thick, intrapunctate.

Description — Pollen grains mostly oval in shape. Zonisulcate condition is hardly distinguishable in most of the specimens; however, there is a slight depression near the margin indicating a weak zone.

Comparison —*Nymphaeoipollis marginatus* resembles the present species in shape and in disposition of sulcus parallel to the equatorial margin. *N. marginatus* is, however, smaller in size-range and with pronounced zonisulcate condition, comparatively thinner exine, and distinct intrapunctate structure.

Nymphaeoipollis sp.

Pl. 2, Fig. 26

Description — Pollen grains subcircular, irregularly folded, 30×25 μ. Zonisulcate, sulcus parallel to equatorial margin but inconspicuous and hardly discernible. Exine 1·5 μ thick, tectate, scrobiculate.

Comparison —*Nymphaeoipollis marginatus* is comparable to the present species in overall shape but is distinguished by larger size range and well discernible zonisulcate condition.

Subturma — *Triptyches* (Naum.) Pot. 1960

Genus — *Tricolpites* (Erdt.) Coup. 1953

Type Species — *Tricolpites thomasii* Cook. & Pike, 1954.

Tricolpites sp. 1

Pl. 1, Fig. 18

Description — Pollen grain markedly three lobed. Colpi well developed, tapering at ends, upto 20 μ long. Mesocolpia ± equally broad but unequally long. Exine 1·5 μ thick, reticulate.

Remarks — Only a single specimen has been recovered.

Tricolpites sp. 2

Pl. 2, Fig. 50

Description —Pollen grain subcircular with three lobes, Tricolpate, colpi narrow, ± funnel shaped, upto 8 μ long. Exine 2 μ thick, sexine as thick as nexine, intrabaculate.

Subturma — *Dicolporites* (Erdtman) v. d. Ham., 1956
Infraturma — *Subprolati* infraturma nov.

Diagnosis — Pollen grains oval-spindle shaped, may be constricted at middle on both or only at one end parallel to the shorter axis of the pollen grains.

Genus— *Umbelliferoipollenites* gen. nov.

Type species — *Umbelliferoipollenites ovatus* sp. nov.

Diagnosis — Pollen grains spindle-oval in shape, generally constricted in middle. Dicolporate. Exine 2-3 μ thick, laevigate and finely intramicroreticulate.

Description — Pollen grains mostly oval in shape with equally broad lateral ends, 20-35 × 8-20 μ. Colpi two in number, well recognizable in most of the specimens, extending upto three-fourth the length of the longitudinal axis. Pores 2 in number distinct-indistinct, placed in the middle of the colpus, lolongate, sometimes rectangular, 3-6 × 2-3 μ in size. Exine 2-3 μ thick, sexine thicker than nexine; exine generally equally thickened, sometimes less thickened in middle and in some specimens it is unevenly thickened, to provide an unequally thickened constriction area in the middle part. Exine laevigate and finely intramicroreticulate.

Comparison — *Ailanthipites* Wodeh. (1933) is comparable to the present genus in overall shape, size range and finely intramicroreticulate structure of the exine but the former can easily be distinguished by its tricolporate condition. *Araliaceoipollenites* Pot. (1951) approximates the present genus somewhat in overall shape and size range but can be differentiated by its tricolporate condition. *Caprifoliipites* Wodeh. (1933) is also distinguished by its tricolporate condition. *Cupuliferoipollenites* Pot. (1951) closely resembles *Umbelliferoipollenites* in its spindle-oval shape, size range and ornamentational pattern of the exine but is distinguished by tricolporate condition, and lacks the constriction in the middle part of the pollen. *Castaneoidites* Pot. *et al.* (1950) also resembles the present genus in oval shape but is differentiated by lack of constriction in the middle of the pollen and tricolporate condition. *Cornaceoipollenites* Pot. (1950), *Platanoidites* Pot. *et al.* (1950), *Tricolpites* (Erdt.) Coup. (1953) are all distinguished from the present genus by their tricolpate condition.

Remarks —*Umbelliferoipollenites* instituted here shows close resemblance with the extant pollen grains of the family Umbelliferae. The pollen grains of Umbelliferae are mostly subprolate or perprolate. They have recently been studied by Cerceau-Larrival (1959, 1961, 1965); Ting (1961); Rossignol (1962); Maurizio and Louveaux (1964) and Joshi and Raghuvanshi (1965). Fossil pollen grains comparable to Umbelliferous pollen have been reported by Thiergart (1940); Nagy (1958); Krutzsch (1959); Beug, Dorn, Strunz, Thiergart, Franz and Windisch (1960); Graham-Heinsch (1960); Fuji (1960); Brelie (1961); Wolf (1961) and Timoshina (1964).

The general shape in most of the pollen grains in the family Umbelliferae are spindle-oval (*e.g. Podistera nevadensis*), elliptical (*e.g. Lomatium rigidium*), oblongly elliptical (*e.g. Eryngium articulatum*), rhomboidal (*e.g. Oenanthesarmentosa*) or constricted in the middle region (*e.g. Perideridia bolanderi, see* TING, 1961). They are two-four aperturate, colporate; colpi extending from one end to the other parallel to the longitudinal axis of the pollen grains or may be subterminal, short continuous (*e.g. Sanicula arctopoides*) or discontinuous (*e.g. Orogenia fusiformis*) over the ora. The ora also shows a great deal of variation. It is lalongate or lolongate, oval-rectangular or deeply lobed (*e.g. Daucus pusillus*), conspicuous or inconspicuous in its appearance.

The pollen grains placed under *Umbelliferoipollenites* closely resemble the extant pollen grains of the Umbelliferae. Two colporate pollen with a middle constriction are mostly found in *Echinophoreae* (*e.g. Anisosciadum isosciadium, Echinophora sibthorpiana* and *Pycnocycla tomentosa*) while in *Hydrocotyloideae* there is no constriction in the middle (*e.g. Hydrocotyle vulgaris, Trachymene caerula* and *Xanthosia ciliata, see* ERDTMAN, 1952). The genus newly proposed here shows a closer resemblance with *Echinophoreae* than *Hydrocotyloideae*.

Araliaceae, Calyceraceae, Cornaceae, Euphorbiaceae, Vitaceae and some genera of Compositae also have similar pollen. The pollen grains of *Anomopanax schlechteri* of Araliaceae is oval, 25 × 16 μ and tricolporate. This type can, however, be easily distinguished from the Umbelliferous type by its distinct incrassate nexine in equatorial region. Three colporate pollen grains found in the various species (*e.g. Nastanthus patagonicus*) of Calyceraceae are roundly oval

(25×21 μ) in shape and thus can easily be differentiated from Umbelliferae. Pollen grains of Cornaceae are also mostly tricolporate generally with subcircular shape. The pollen grains of *Mastixia clarkeana* is, however, subprolate (37×29 μ) but can readily be distinguished from *Umbelliferoipollenites* as the colpi are in association with incrassate sexinous brims which are connected laterally with the main part of mesocolpia by narrow, streak-like structure of the exine.

Punt (1962) has studied the pollen morphology of various species belonging to Euphorbiaceae and has established *Antidesma* subtype where the pollen grains are tricolporate, perprolate-prolate and the colpus mostly extending from one end to the other. The pollen grains of *Hyeronima latifolia* (PUNT, 1962; PL. 2, FIG. 1), *Antidesma bunius* (PUNT, 1962; PL. 2, FIG. 2) and *Phyllanthus niruri* (PUNT, 1962; PL. 2, FIG. 9) of this subtype particularly closely resemble *Umbelliferoipollenites* but differs in their tricolporate nature. Moreover, the ora in these pollen are very well developed and there is no constriction in equatorial region and thus can also be easily distinguished from the pollen grains of Umbelliferae.

Umbelliferoipollenites ovatus sp. nov.

Pl. 2, Figs. 29-32

Holotype — Pl. 2, Fig. 31. Size 29×12 μ. Slide No. 3312.

Diagnosis — Pollen grains, oval with equally broad lateral ends, 25-35×10-18 μ. Two colporate, colpi extending more than three fourth of pollen grains longitudinally. Pore distinct, lolongate. Exine 2-3 μ thick, laevigate and very finely intramicroreticulate.

Description — Pollen grains generally more than double the breadth in equatorial view. Overall shape without any marked constriction in middle. Colpi well recognisable, ± parallel to each other and extending three-fourths the length of the pollen grains. Pores distinct, seems to be sunken in the exine. Exine 2-3 μ thick, sexine thicker than nexine.

Remarks — Umbelliferous pollen grains described by Beug *et al.* (1960, PL. 2, FIG. 10) approximates the present species in size but can be distinguished by its tricolporate condition. Pollen grains of Umbelliferae reported by Graham and Heimsch (1960, PL. 5, FIGS. C-F) are larger in size than the present species. *Tricolporopollenites cingulum* (Pot.) Thom. & Pf. (1953) sub sp. *oviformis* described by Wolf (1961, PL. 6, FIG. 18) approximates *U. ovatus* in size range and shape but is distinguished by its tricolporate nature.

Umbelliferoipollenites constrictus sp. nov.

Pl. 2, Fig. 33

Holotype — Pl. 2, Fig. 33. Size 27×10 μ. Slide No. 3320.

Diagnosis — Pollen grains oval with equally rounded lateral ends and marked constriction in middle, 25-30×8-14 μ. Two colporate, colpi extending more than three-fourths the radius along longitudinal axis. Pores indistinct. Exine laevigate and intrastructured.

Description — Pollen grains mostly knuckle-bone shaped in appearance due to marked constriction at both ends in middle region. Colpi well developed, parallel to each other and extending three-fourths to almost up to the margins. Pores not distinct, seems to be lalongate. Exine 2-3 μ thick, generally unequally thickened, thinner in middle region and thus provide the constricted appearance. Sexine thicker than nexine, laevigate and intrabaculate.

Comparison — *Umbelliferoipollenites ovatus* closely resembles the present species in size and two colporate condition but the latter can, however, be distinguished by its marked constriction in the middle region at both ends.

Remarks — Some of the extant species of Umbelliferae produce constricted pollen similar to the type described here. The pollen grains of *Psammogeton crinitum* and *Daucus persicus* described by Cerceau-Larrival (1965, PL. 3, FIGS. 1-2, 17-18) are conspicuous by their markedly constricted appearance on both sides in the middle. The pollen grains of *Echinophora spinosa* (CERCEAU, 1959; PL. 1, FIG. 1) and *Pimpinella tragium* (CERCEAU, 1959; PL. 1, FIG. 13) also show minor constrictions in the middle region.

Subturma — *Ptychotriporites* (Naum.) Pot. 1960

Infraturma — *Prolati* Erdt. 1943

Genus — *Ailanthipites* Wodeh. 1933

Type Species —*Ailanthipites berryi* Wodeh., 1933.

Ailanthipites sp.

Pl. 2, Fig. 47

Description — Pollen grain, 32×28 μ. Tricolporate. Colpi long, ± uniformly broad, extending almost from one margin to other, ± parallel to each other. Pores well recognizable, lalongate. Exine upto 4 μ thick, laevigate or finely intrabaculate.

Comparison — *Ailanthipites berryi* Wodeh. (1933) approximates the present specimen in size, nature and extension of the apertures but the latter can be differentiated by its more ovoid shape and intrabaculate structure.

Genus — *Araliaceoipollenites* Pot. 1951

Type species — *Araliaceoipollenites euphorii* (Pot.) Pot., 1951.

Araliaceoipollenites matanamadhensis sp. nov.

Pl. 2, Fig. 46

Holotype — Pl. 2, Fig. 46. Size 21×20 μ. Slide No. 3323.

Diagnosis — Pollen grains subcircular, 20-28×18-26 μ. Tricolporate. Colpi long, narrow, sharply bending at equatorial region. Pores well developed. Exine laevigate and finely intramicroreticulate.

Description — Pollen grains mostly subcircular, sometimes oval in polar view. Colpi well developed, ± uniformly broad except at the region of pore; extending almost from one margin to other. Pores easily distinguishable, lalongate. Exine upto 2·5 μ thick, intramicroreticulate structure well developed, meshes thick, lumina narrow.

Comparison — *Araliaceoipollenites potoniei* Ramanuj. (1966) is comparable to the present species in size range and trizonicolporate condition but the latter can be distinguished by its subcircular shape and well developed intramicroreticulate structure. *A. euphorii* (Pot.) Pot. (1951) is characterized by its oval shape and unequal thickening of the exine in the margin.

Genus — *Cupuliferoipollenites* Pot. 1951

Type species — *Cupuliferoipollenites pusillus* (Pot.) Pot., 1951.

Cupuliferoipollenites ovatus sp. nov.

Pl. 2, Fig.s 44-45

Holotype — Pl. 2, Fig. 44. Size 26×19 μ. Slide No. 3323.

Diagnosis — Pollen grains oval in polar view, 18-28×10-24 μ. Tricolporate. Colpi, long, narrow, extending from one end to other. Pores well recognizable. Exine intrapunctate.

Description — Pollen grains mostly oval with equally rounded lateral ends. Colpi well pronounced, ± parallel to each other, tapering at ends. Pores lalongate, zoniporate. Exine 1-2 μ thick, intrapunctate, structure easily recognizable in most of the specimens.

Comparison — *Cupuliferoipollenites oratus* (Thierg. *et al.*) Ramanuj. (1966) closely resembles the present species in shape, size and nature of the apertures but the latter is easily distinguished by its well developed intrapunctate structure. *C. pusillus* (Pot.) Pot. (1951) approximates the present species in shape and presence of intrastructure but is readily separated by its smaller size.

Genus — *Rhoipites* Wodeh. 1933

Type Species — *Rhoipites bradleyi* Wodeh., 1933.

Rhoipites kutchensis sp. nov.

Pl. 2, Figs. 41-43

Holotype — Pl. 2, Fig. 42. Size 24×20 μ. Slide No. 3323.

Diagnosis — Pollen grains oval in polar view, 15-25×10-18 μ. Colpi narrow, long, extending almost from one end to other. Pores easily recognizable. Exine thin, finely intramicroreticulate.

Description — Pollen grains generally oval with equally rounded lateral ends. Colpi narrow, ± uniformly broad or slightly tapering at ends, parallel to each other. Pore well recognizable, lalongate. Exine 1-2 μ thick, finely intramicroreticulate.

Comparison — *Rhoipites bradleyi* Wodeh. (1933) is comparable to the present species in shape and nature of the apertures but the former is distinguished by its larger size. *R. pseudocingulum* (Pot.) Pot. (1960) is also differentiated by its larger size.

Genus — *Symplocoipollenites* Pot. 1957

Type Species — Symplocoipollenites vestibulum Pot., 1931.

Symplocoipollenites kutchensis sp. nov.

Pl. 2, Figs. 38-39

Holotype — Pl. 2, Fig. 38. Size 14×13 μ. Slide No. 3323.

Diagnosis — Pollen grains roundly triangular, 12-18×9-15 μ. Tricolporate. Colpi very small, pores well developed. Exine finely intramicroreticulate.

Description — Pollen grains mostly triangular, sometimes subtriangular. Colpi short not more than 6 μ long, occasionally slit-like and not easily perceptible. Pores comparatively well developed, outer margin of pores not thickened. Exine upto 2 μ thick, finely intramicroreticulate.

Comparison — Symplocoipollenites indicus Ramanuj. (1966) is comparable to the present species in shape, disposition of the apertures and ornamentational pattern but the latter can easily be differentiated by its smaller size. *S. vestibulum* Pot. (1951) is also distinguished by its bigger size and granulose rugose exine.

Symplocoipollenites minutus sp. nov.

Pl. 2, Figs. 34-37

Holotype — Pl. 2, Fig. 35. Size 9×8 μ. Slide No. 3323.

Diagnosis — Pollen grains small in size, mostly roundly triangular in overall shape. Colpi small not more than 3 μ, occasionally slit-like. Pores not always recognizable, outer margin of pores slightly thickened in some specimens. Exine upto 2 μ thick, finely intramicroreticulate.

Comparison — Symplocoipollenites kutchensis closely resembles the present species in shape, nature of the apertures and ornamentational pattern but is distinguished by its larger size. *S. indicus* Ramanuj. (1966) can also easily be differentiated by its larger size and triangular shape. *S. minutus* is distinguished from all of the known species of this genus by its roundly triangular-subcircular shape, smaller size and very fine intramicroreticulate exine.

Genus — *Nyssapollenites* Thierg. 1937

Type Species — Nyssapollenites pseudocruciatus (Pot.) Thierg., 1937.

Nyssapollenites kutchensis sp. nov.

Pl. 2, Figs. 48-49

Holotype — Pl. 2, Fig. 48. Size 27×25 μ. Slide No. 3317.

Diagnosis — Pollen grains roundly triangular, 20-35×18-32 μ. Tricolporate, colpi short, narrow, inconspicuous. Pores very well developed with rounded margin. Exine thick, laevigate and intragranulose.

Description — Pollen grains roundly triangular in polar view. Colpi short, not more than 7 μ, tapering at ends, hardly perceptible in most specimens. Pores well pronounced, broad with rounded margins. Exine 1·5-3 μ thick, psilate-intragranulose.

Comparison — Nyssapollenites coromandelinum Ramanuj. (1966) is comparable with the present species in shape and disposition of the colpi but the latter species can readily be distinguished by its very well developed pores. *N. pseudocruciatus* (Pot.) Thierg. (1937) is smaller in size and the pores are not so broad as in the present species.

Genus — *Palaeocoprosmadites* Ramanuj. 1966

Type Species — Palaeocoprosmadites arcotense Ramanuj. 1966.

Palaeocoprosmadites arcotense Ramanuj., 1966

Pl. 2, Figs. 40-40a

Genus — *Hippocrateaceaedites* Ramanuj. 1966

Type species — Hippocrateaceaedites van compoae Ramanuj., 1966.

Hippocrateaceaedites sp.

Pl. 2, Fig. 59

Description — Pollen grains subtriangular, 34 μ. Tricolporate, colpi long, easily distinguishable, tapered at ends. Exine intragranulose, pores not well pronounced, outer margin of pores not thickened. Exine ±2 μ thick, laevigate and finely intragranulose.

Comparison — Hippocrateaceaedites van compoae Ramanuj. (1966) is comparable with the present species in size, shape and tricolporate condition, the present species can, however, be distinguished by its intragranulose structure. Ramanujam (*l.c.*) compares his material with *Simerestis* of Hippocrateaceae.

Genus — *Margocolporites* Ramanuj. 1966

Type species — Margocolporites tsukadai Ramanuj., 1966.

Margocolporites tsukadai Ramanuj., 1966

Pl. 3, Figs. 60-62

Remarks — The specimens studied here are smaller in size than those originally described by Ramanujam (*l.c.*) from the Neyveli lignites.

Margocolporites sitholeyi Ramanuj., 1966

Pl. 3, Figs. 63-64

Remarks — The specimens referred here to *M. sitholeyi* Ramanuj. (1966) have more or less the same size, but in the specimens studied the bacular elements are less developed.

Margocolporites sahnii Ramanuj., 1966

Pl. 3, Figs. 65-67

Genus — *Lakiapollis* gen. nov.

Type species — Lakiapollis ovatus sp. nov.

Diagnosis — Pollen grains subcircular-circular in polar view. Tricolporate, brevicolpate, colpi narrow. Pores well developed, oval-elliptical in shape, broader than the colpus. Exine laevigate and infrastructured.

Description — Pollen grains mostly subcircular in polar view, 27-50×24-48 μ. Tricolporate, brevicolpate, colpi up to 8 μ long, masked by pores. Colpi mostly appear like a slit, elliptical or funnel shaped. Pores well developed, prominent, oval-elliptical in shape, outer margin of pores thickened considerably in most of the specimens studied here. Pores subequatorially situated, rarely seen at equatorial region. Exine 1·5-4 μ thick, regularly folded, psilate, sexine mostly thicker than nexine or as thick as nexine.

Comparison —Faguspollenites Raatz (1937) is closely comparable to the present genus in subcircular-circular shape, size and tricolporate condition but the pores in *Faguspollenites* are rounded without any marginal thickening and are equatorially placed with comparatively thinner intragranulose-intrabaculate exine. *Nyssapollenites* Thierg. (1937) resembles the present genus in tricolporate condition and intrapunctate structure but can easily be differentiated by its subtriangular shape. *Cyrillaceaepollenites* (Mürr. & Pf.) Pot. (1960) approximates the present genus in subcircular shape and laevigate exine but is differentiated by the longer colpi. *Vitipites* (Wodeh.) Pot. (1960) and *Rhamnacidites* (Chit.) Pot. (1960) are distinguished by their long, narrow colpi. *Trilatiporites* Ramanuj. (1966) is comparable to the present genus in the subequatorial position of the pores but is devoid of colpi. *Hippocrateaceaedites* Ramanuj. (1966) is trizonicolporate, subtriangular in shape and the sexine of each lobe is prolonged into knob like processes on both sides of the colpus. *Psilatricolporites* v. d. Ham. (1965) is also trizonicolporate but the colpi are very long and the exine is laevigate. *Lakiapollis* instituted here is characterized by subcircular-circular shape, tribrevicolporate aperture with thickening on the outer pore margin, psilate and occasionally well structured exine.

Derivation of Name — Named after the *stratum typicum* — Laki Stage in Kutch, W. India.

Lakiapollis ovatus sp. nov.

Pl. 3, Figs. 77-78

Holotype — Pl. 3, Fig. 77. Size 43×37 μ. Slide No. 3318.

Diagnosis — Pollen grains subcircular, 40-50×35-45 μ. Tribrevicolporate, Colpi inconspicuous, hardly discernible in most specimens. Pores well developed, oval-elliptical, outer margin thickened; pores mostly situated subequatorially. Exine upto 2·5 μ thick, generally psilate.

Description — Pollen grains mostly subequatorial in polar view. Colpi not more than 9 μ long, ± oval or funnel shaped; generally ill-developed and not traceable in most of the specimens. Pores well recognizable oval-elliptical in outline; outer margin of the pores appreciably thickened, sometimes more thickened at lateral ends of the pore. Exine 1·5-2·5 μ thick, generally irregularly folded, sexine thicker than nexine, psilate without any discernible intrastructure.

Lakiapollis matanamadhensis sp. nov.

Pl. 3, Figs. 79-80

Holotype — Pl. 3, Fig. 79. Size 37×35 μ. Slide No. 3318.

Diagnosis — Pollen grains circular, 28-40 × 25-38 μ. Tribrevicolporate; colpi short, inconspicuous. Pores well developed, ± oval-elliptical, surrounded with thickened rim, subequatorial in position. Exine 2·5-5 μ thick, scrobiculate.

Description — Pollen grains mostly subequatorial in polar view. Colpi very small, not more than 8 μ long; appears as slit, sometimes hardly discernible due to thickness of the exine. Pores well developed, situated subequatorially, outer margin ± uniformly thickened, sometimes more pronounced at both lateral ends along the longitudinal axis. Exine thick, sexine generally thicker than nexine or as thick. Exine scrobiculate, showing close-set foveolate pattern in surface view.

Comparison — *Lakiapollis ovatus closely* resembles the present species in shape and disposition of the apertures; the latter can, however, be distinguished by its smaller size, thicker scrobiculate exine.

Genus — *Sastriipollenites* gen. nov.

Type Species — *Sastriipollenites trilobatus* sp. nov.

Diagnosis — Pollen grains tricolporate, margocolpate, three lobed; colpi long, funnel shaped, ora distinct to indistinct. Exine granulose or intrabaculate.

Description — Pollen grains markedly three lobed due to well developed colpi, 25-60×20-55 μ. Colpi in most of the specimens very well developed; almost approaching syncolpate condition but for a small part in the middle region. Colpi gradually tapering inwards to form a funnel shaped aperture, interspaced between two colpi broad (margocolpate). Ora mostly distinct, lolongate. Exine 1·5-3 μ thick, intrabaculate, appearing finely reticulate in surface view.

Comparison —*Margocolporites* Ramanujam (1966) closely resembles the present genus in shape, size and margocolporate condition. *Margocolporites* is characterized by thick, reticulate or retipilate exine which in *Sastriipollenites* is intrabaculate-granulose.

Derivation of Name — Named after Dr. G. G. K. Sastri, Director, Directorate of Geology & Mining, Government of Gujarat, India, who made available core-samples for study.

Sastriipollenites trilobatus sp. nov.

Pl. 3, Figs. 68-69

Holotype — Pl. 3, Fig. 69. Size 40×36 μ. Slide No. 3321.

Diagnosis —Pollen grains isopolar, trilobed in equatorial view. Tricolporate, margocolpate. Colpi well developed, invaginated inwards. Ora distinct to indistinct. Exine upto 2 μ thick, intrabaculate.

Description — Pollen grains subcircular in outline, trilobed, 30-40×28-36 μ. Colpi well developed, broad on outer side but gradually narrowed inwards to give a funnel shaped appearance, usually long but in some specimens they are extraordinarily long, almost approaching a syncolpate condition. Ora distinct, sometimes inconspicuous, lolongate in equatorial view, forming a slight constriction at margins. Intercolpate area wide. Exine 1·5-2 μ thick, intrabaculate.

Subturma — *Plychopolyporines* (Naum.) Pot. 1960

Genus — *Stephanocolpites* (v. d. Ham.) Pot. 1960

Type Species — *Stephanocolpites costatus* v. d. Ham., 1954.

Stephanocolpites globatus sp. nov.

Pl. 2, Figs. 51-52

Holotype — Pl. 2, Fig. 52. Size 28×27 μ. Slide No. 3318.

Diagnosis — Pollen grains subcircular, 22-30×20-26 μ. Tetracolpate, brevicolpate. Exine 3-6 μ thick, finely intrabaculate.

Description — Pollen grains generally subcircular with four lobes at polar view. Colpi small, well developed, funnel shaped, extending inwards upto 8 μ. Mesocolpate region wide. Exine very thick, sexine thicker than nexine. Intrabaculate.

Comparison — *Stephanocolpites neyveliense* Ramanuj. (1966) closely compares with the present species in tetrabrevicolpate condition but can easily be distinguished by its comparatively thinner and coarsely granulose exine. *S. arcotense* Ramanuj. (1966) has very broad colpi and 1·3 μ thick exine.

Stephanocolpites granulatus sp. nov.

Pl. 2, Figs. 57-58

Holotype — Pl. 2, Fig. 58. Size 34×30 μ. Slide No. 3314.

Diagnosis — Pollen grains subcircular, tetracolpate, colpi short, narrow, slit like. Exine upto 2 μ thick, granulose.

Description — Pollen grains subcircular, sometimes circular in polar view, 24-30 ×22-25 μ. Colpi well developed, narrow, not more than 8 μ long. Mesocolpate region broad. Exine about 2 μ thick, intragranulose.

Comparison — *Stephanocolpites globatus* closely resembles the present species in sculptural elements and brevicolpate condition but is distinguished by its thicker exine and wide colpi. *S. neyveliense* Ramanuj. (1966) approximates the present species in granulose exine and size but can be distinguished by its shape and disposition of the colpi. *S. arcotense* Ramanuj. (1966) resembles the present species in the presence of broad colpi but can readily be differentiated by thinner and intramicroreticulate exine.

Stephanocolpites flavatus sp. nov.

Pl. 3, Fig. 76

Holotype — Pl. 3, Fig. 76. Size 25×24 μ. Slide No. 3317.

Diagnosis — Pollen grains subcircular. Tetracolpate, colpi short, narrow, slit-like. Exine upto 2 μ thick, granulose.

Description — Pollen grains subcircular, sometimes circular in polar view. Size range 24-30×22-25 μ. Colpi well defined, narrow, not more than 8 μ long. Mesocolpate region broad, rounded. Exine about 2 μ thick, intragranulose.

Comparison — *Stephanocolpites globatus* closely resembles the present species in sculptural elements and brevicolpate condition but is distinguished by its thicker exine and wide colpi. *S. neyveliense* Ramanuj. (1966) approximates the present species in granulose exine and size but can be distinguished by its shape and disposition of the colpi. *S. arcotense* Ramanuj. (1966) resembles the present species but can readily be differentiated by its broader colpi and intramicroreticulate exine.

Stephanocolpites cf. *S. arcotense* Ramanuj. 1966

Pl. 2, Fig. 54

Remarks — The specimens of pollen grains studied here are 23×21 μ, subcircular with four lobes. Tetracolpate. Colpi well pronounced, not more than 8 μ long, funnel shaped. Mesocolpate regions wide, rounded. Exine ± 2 μ thick, intrabaculate.

Stephanocolpites arcotense Ramanujam (1966) very colsely resembles the present specimen in the breadth of the colpi and intrabaculate structure but the latter has distinctly funnel shaped colpi while in the former the inner margins of the colpi are somewhat rounded; hence the present specimen has only been compared with *S. arcotense*.

Stephanocolpites nadhamunii sp. nov.

Pl. 2, Fig. 53

Holotype — Pl. 2, Fig. 53. Size 32×30 μ. Slide No. 3311.

Diagnosis — Pollen grains subcircular, 28-35×25-32 μ. Pentabrevicolpate, colpi narrow, upto 9 μ long. Exine 2-4 μ thick.

Description — Pollen grains generally subcircular, sometimes ± oval perhaps due to compression at the time of fossilization. Pollen found only at polar view. Colpi narrow, well defined, sometimes appear as only slit like structure in the closed aperturate ones. Exine ± 3 μ thick in most of the specimens, sexine thicker than nexine, sometimes finely intrabaculate.

Comparison — *Stephanocolpites globatus* and *S. flavatus* resemble the present species in size but the latter can easily be distinguished by its pentacolpate condition. *Pentacolpopites* sp. B. described by Biswas (1962, PL. 5, FIG. 6) from the Tura formation of Assam closely resembles the present species in size and brevicolpate condition but is distinguished by larger colpi area. *Pentacolpopites* sp. A. also described by Biswas (1962, PL. 5, FIG. 19) from the same formation approximates the present species in size and nature of the colpi but is differentiated by its thinner exine with well developed intramicroreticulate structure. *P. turaensis* Bis. (1962) is distinguished from the present species by its shorter colpi which appears as slit-like structure in most of the specimens.

Genus — *Polybrevicolporites* gen. nov.

Type Species — *Polybrevicolporites cephalus* sp. nov.

Diagnosis — Pollen grains subcircular-circular. Polycolporate, brevicolpate. Exine 3-8 μ thick, intrabaculate.

Description — Pollen grains subcircular with lobed margins; 20-40×15-38 μ. Apertures generally more than four, situated between lobes. Colporate, colpi short, extending over the outer limits of the pores in equatorial view; broad at outer margin and tapered at ends. Pores well developed semicircular in equatorial view, can easily be demarcated; margins of pores not thickened and mask the short, inconspicuous colpi. Exine thick, sexine thicker than nexine, very finely intrabaculate, bacula heads appear granulose in differential foci.

Comparison —*Stephanocolpites* (v. d. Ham.) Pot. (1960) resembles the present genus in shape and brevicolpate nature but the present genus can easily be differentiated by its colporate condition. *Polycolpites* Coup. (1953) also resembles the present genus in shape but is only brevicolpate. *Tetracolporites* Coup. (1953) is tetracolporate and the colpi are longer and easily distinguishable as compared to the colpi/pore in the present genus. *Stephanoporopollenites* Pf. (*in* THOM. & PF. 1952, 1953) resembles the present genus in size and shape but is only porate. *Juglanspollenites* Raatz (1937) has 6-10, irregularly arranged pores. *Palaeocoprosmadites* Ramanuj. (1966) is ± subtriangular shape in equatorial view and trizonicolporate. *Polybrevicolporites* instituted here, is distinguished from all the known fossil form genera by its subcircular shape in equatorial view, polybrevicolporate condition and lobed, intrabaculate exine.

Rao and Vimal (190; PL. 1, FIG. 1) referred some specimens as type 1 from the Palana lignite of Bikaner which is similar to the present genus. According to the authors the specimens are hexa-aperturate, with thick exine.

Pentacolpopites turaensis described by Biswas (1962, PL. 5, FIG. 8) from the Tura formation of Assam resembles the present genus in its subcircular shape, brevicolpate condition, thick exine and finely intramicroreticulate structure. According to Biswas (*l.c.*), however, the specimens are only colpate and not colporate.

Pentacolpites type A described by Ghosh *et al.* (1963, PL. 27, FIG. 4) is comparable to the present genus in shape, size, breviaperturate nature of the aperture and structure of the exine. These specimens need further examination.

Nothofagidites antiquum Ramanuj. (1966, PL. 6, FIGS. 112-113) compares with *Polybrevicolporites* in shape, size, breviaperturate nature and structure of the exine. The placement of the specimens by Ramanujam with *Nothofagidites* (Erdt.) Coup. (1953) is doubtful, perhaps it would be assignable here.

Polybrevicolporites cephalus sp. nov.

Pl. 2, Figs. 55-56

Holotype — Pl. 2, Fig. 55. Size 27×25 μ. Slide No. 3322.

Diagnosis — Pollen grains subcircular in equatorial view, 20-35×17-30 μ Polycolporate, usually pentacolporate, brevicolpate, pores well developed. Exine 3-6 μ thick, intrabaculate.

Description — Pollen grains mostly subcircular in equatorial view, distinctly 5 lobed. Colpi short, extends upto or little over the inner limit of the pores. Pores well developed, encroach inwards upto 5 μ in the equatorial view and thus may look like colpi. Pores generally mask the colpi and ± overlapping throughout in most of the cases. Sexine thicker than nexine. Exine very finely intrabaculate.

The following species belong to *Polybrevicolporites* gen. nov.

Polybrevicolporites (*Nothofagidites*) *antiquum* (Ramanuj.) comb. nov.

Holotype —Ramanuj., 1966, pl. 6,fig. 113.

Type Locality — South Arcot district, Madras, Miocene.

Emended Diagnosis — Pollen grains subcircular in equatorial view, 24-34 μ. Polybrevicolporate with six apertures. Exine thick, generally fine intramicroreticulate, sometimes seems to be granulose.

Turma — *Poroses* (Naum.) Pot. 1960
Subturma — *Monoporines* Naum. (1937) 1939

Genus — *Monoporopollenites* (Mey.) Pot. 1960

Type Species — *Monoporopollenites gramineoides* Mey., 1956.

Monoporopollenites sp.

Pl. 3, Fig. 75

Description — Pollen grain circular, 32 μ. Monoporate. Pore circular, diameter 6 μ. Exine 1·5 μ, exine as thick as nexine, psilate.

Comparison — *Monoporopollenites gramineoides* Mey. (1956) approximates the present species in shape and psilate exine but is distinguished by its smaller size. *Monoporopollenites* sp. described by Jones (1962; PL. 2, FIG. 12) from the Mid-way Walcox boundary in South-Central Arkansas is larger in size and the pore is outlined by thickened margin. *M. gramineoides* Meyer reported by Ramanuj. (1966; PL. 5, FIG. 87) from the South Arcot district, Madras is smaller in size (22-25 μ) with pore possessing thickened outer margin.

Genus — *Trilatiporites* Ramanuj. 1966

Type Species — *Trilatiporites erdtmani* Ramanuj., 1966.

Trilatiporites kutchensis sp. nov.

Pl. 3, Figs. 81-83

Holotype — Pl. 3, Fig. 81. Size 34×33 μ. Slide No. 3321.

Diagnosis — Pollen grains roundly triangular, 30-35×27-33 μ. Triporate, pores ± subequatorial in position, margin of pores not appreciably thickened. Exine thick, sexine thicker than nexine, finely microreticulate.

Description —Pollen grains mostly roundly triangular in polar view, sometimes subcircular forms are also met with. Pores well recognizable, rounded, outer margin of pores slightly thickened. Pores ± subequatorially placed. Exine 3-5 μ thick, sexine thicker than nexine, intramicroreticulate, mesh-structure almost uniform giving the appearance of foveola.

Comparison — *Trilatiporites erdtmani* Ramanuj. (1966) is comparable with the present species in shape, size and thickness of the exine but is distinguished by thickened outer margin of pores and granulose exine. *T. noremi* Ramanuj. (1966) is bigger in size and the exine is minutely reticulate at mesoporia but finely granular at apoporia. *T. sellingi* Ramanuj. (1966) and *T. cooksoni* Ramanuj. (1966) are distinguished by their larger size.

Subturma — *Triporines* (Naum.) Pot. 1960

Genus — *Sonneratioipollis* gen. nov.

Type Species — *Sonneratioipollis bellus* sp. nov.

Diagnosis — Pollen grains oval-spindle shape in equatorial view without any constriction in middle. Triporate, zoniporate, pores oval, lolongate. Exine psilate.

Description — Pollen grains always found in equatorial view, oval with equally rounded lateral ends, 18-30×20-15 μ. Middle region of pollen grains in equatorial view broadest. Pores distinct, situated in the same plane, 2-4×1-2 μ in size, oval or spindle-oval, elongated along longitudinal axis, borders slightly thickened, sometimes more pronounced at two lateral ends of pore parallel to longer axis. Exine upto 2·5 μ thick, sexine thicker than nexine, psilate.

Comparison — *Santalumidites* (Cooks. & Pike) Pot. (1960) closely resembles the present genus in shape and triporate condition. *Santalumidites* can, however, be distinguished by its larger size and well defined oroid zone in which the exine is thicker and coarsely sculptured than the rest part. Some of the pollen grains studied here show some slight thickening around the pores but never form a pronounced zone as always found in *Santalumidites*. *Casuarinidites* Cooks. & Pike (1954) approximates the present genus in triporate condition but can be differentiated by their strongly aspidate nature. *Betulaeceoipollenites* Pot. (1951) is comparable with the present genus in size range, triporate and lolongate condition but can easily be separated by its presence of distinct labrum and very thick exine. *Betulaeceoipollenites* Pot. (1943) has also distinct labrum and the exine is regularly folded to form arc-like structure in polar view. *Engelhardtioipollenites* Pot. (1951) is triporate but is differentiated by its rounded pore which is slightly aspidate. *Engelhardtioidites* Pot. *et al.* (1950) is of smaller size range and otherwise has ± same character as in *Engelhardtioipollenites* Pot. (1951). *Myriaceoipollenites* Pot. (1951) is triporate but possesses intramicroreticulate structure. *Myricipites* Wodeh. (1933) and *Triatripollenites* (Thom. & Pf.) (1953) are both aspidate pollen. *Sonneratioipollis* instituted here is distinct from all the known triporate genera by its small size, zoniporate condition and without any distinct thickened area around the pores.

Remarks — *Sonneratioipollis* shows close resemblance to the pollen grains belonging to the family Sonneratiaceae. The pollen grains in this family are mostly triaperturate and usually subprolate. They are mostly porate or colporate. The pollen grains of *Sonneratia caseolaris* are subprolate and colpoidorate whereas those of *S. griffithii* a species commonly found in Andaman islands are colporate and subprolate. The pollen grains of *Duabanga moluccana*, commonly found in Philippines, very closely resemble the fossil pollen described here in possessing triporate, subprolate (23×18·5 μ) and obscure stratification of the exine. But the pores found in the pollen grains of this species are surrounded by well developed thin collars. This character is not distinctly seen in the fossil pollen grains studied here but the indication of a slight thickening around the pores in some specimens may be taken as collars round the pores.

Pollen grains similar to Sonneratiaceae are also found in Balanophoraceae, Lythraceae, Myrtaceae and Santalaceae. The pollen grains of *Sarcophyte sanguinea* of Balanophoraceae are triporate, ± subprolate (20× 16·5 μ) but can easily be distinguished from *Sonneratioipollis* by their heteropolar ornamentational pattern. Triporate pollen grains found in *Diplusodon ovatus* a native plant of Brazil (ERDTMAN, 1952) are larger in size (76×63 μ) and the sexine is areoloidate. The pollen grains of *Lafoensis punicaefolia* (Lythraceae) figured by Van Campo (1965, PL. 3, FIG. 3) also apparently show some resemblance to *Sonneratioipollis* but can readily be distinguished by their size. The pollen grains of *Actinodium cunninghamii* of the family Myrtaceae is triporate and are of the same size as in *Sonneratioipollis*, but is distinguished by its different kinds of exine stratification. Several species of the family Santalaceae produce triporate pollen grains (*e.g. Fusanus acuminatus* and *Santalum handersonense*). Swamy (1949) also studied some species of Santalaceae producing triporate pollen grains. In his opinion the pollen grains in the genera *Santalum*, *Fusanus* and *Mida* are triporate with square to rectangular pores and internally heavily thickened borders.

Sonneratioipollis bellus sp. nov.

Pl. 3, Figs. 70-71

Holotype — Pl. 3, Fig. 71. Size 25×14 μ. Slide No. 3318.

Diagnosis — Pollen grains oval-spindle-oval, 18-30×10-15 μ. Triporate, zoniporate, pores margin do not show any marked thickening, lolongate. Exine ± tectate, smooth.

Description — Pollen grains oval without any constriction in middle with equally broad lateral ends. Middle region of the pollen grains broadest. Pores distinct, 2-4×1-2 μ, lolongate, zoniporate, pores in some specimens show slight thickening on margins particularly at lateral ends parallel to longitudinal axis. Exine psilate, upto 2·5 μ thick, sexine thicker than nexine.

Subturma — *Polyporines* (Naum.) Pot. 1960

Genus — *Pseudonothofagidites* gen. nov.

Type Species — *Pseudonothofagidites kutchensis* sp. nov.

Diagnosis — Pollen grains ± subcircular with regular lobed margins. Polyporate, pores rimmed, invaginated inwards. Exine upto 3 μ, finely granulose.

Description — Pollen grains, with regular lobed margins in polar view. Apertures situated at depressed parts, 20-40×17-35 μ; variable five to eight in number among the specimens studied here. Pores rimmed at margins with distinct arches. Exine microgranulose.

Comparison — *Nothofagidites* Erdtman ex Potonié (1960) closely resembles the present genus in the presence of rimmed outer pores but can easily be distinguished by the sunken pores being situated in the interangular area in contrast to *Nothofagidites* where it is situated at the angles. Pollen grains illustrated by Ramanujam (1966) as *Nothofagidites couperi* and *N. couperi* (?) (*l.c.*, PL. 6, FIGS. 108-110) perhaps belong to the present genus.

Pseudonothofagidites kutchensis sp. nov.

Pl. 3, Figs. 72-73

Holotype — Pl. 3, Fig. 73. Size 26×25 μ. Slide no. 3320.

Diagnosis — Pollen grains with lobed margins in polar view. Pores 5-6 in number, well developed, rimmed at the invagination of the lobes, exine granulose.

Pseudonothofagidites cerebrus sp. nov.

Pl. 3, Fig. 74

Holotype — Pl. 3, Fig. 74. Size 32×30 μ. Slide No. 3323.

Diagnosis — Pollen grains subcircular with broadly lobed margins. Pores 8 in number, situated at the inter-marginal area of the lobe, rimmed. Sexine roughly granulose.

Description — Pollen grains comparatively larger in size, 28-40×25-35 μ. Pores well developed, outer margin of pores ± uniformly thickened, pores encroaching inwards. Exine granulose.

Genus — *Cryptopolyporites* gen. nov.

Type Species — *Cryptopolyporites cryptus* sp. nov.

Diagnosis — Pollen grains circular in polar view. Panporate. Pores hidden, not easily recognisable, covered with baculate processes as in non-porate region.

Description — Pollen grains mostly circular, sexine and nexine ± equally thick or the latter may be slightly thicker than the former. Panporate, pores uniformly distributed, 3-6 μ in diameter, ± circular in shape, concealed by the baculate processes. Exine 2-3·5 μ thick.

Comparison — *Polyporina* (Naum.) Pot. (1960) is comparable with the present genus in its subcircular-circular shape and panporate condition; the latter can, however, be distinguished by its concealed pores and the ornamentational pattern of the exine. *Liquidambarpollenites* Raatz (1937) also approximates the present genus in its subcircular shape and rounded pores; the former can, however, be differentiated by its presence of 8-12 readily identifiable pores and laevigate to finely microreticulate exine. *Periporites* v. d. Ham. (1956) is characterised by pores with rounded ends and distinct opening. *Periporopollenites* Pf. (1952) and *Smilacipites* Wodeh. (1933) are considered by Pot. (1960) as synonyms of *Liquidambarpollenites*. *Juglanspollenites* Raatz (1937) is subcircular in shape, possessing 6-10 big, open pores, which are not concealed by the structural pattern of the exine. *Multiporopollenites* (Pf.) Pot. (1960) approximates *Cryptopolyporites* in size range, overall shape but is distinguished by its pores which are not hidden and thus readily identifiable. *Pentapollis* Pf. (1953) is triangular in shape and has only five pores as germinal apertures. *Cryptopolyporites* proposed here is distinguished by its circular shape, pan-porate nature, pores being concealed by the baculate ornamentation of the exine which is same as in the non-apertural region.

Remarks — Polyporate pollen grains are found in various Tertiary formations (*see* NAGY, 1958; MACRO, 1959, 1961; DOKTOROWICZ HREBNICKA, 1960; JONES, 1962; MARTIN & ROUSE, 1965; KUPRIANOVA, 1966; SAH, 1967 and others).

Several extant Angiosperm families (*e.g.* Amaranthaceae, Chenopodiaceae, Caryophyllaceae, Convolvulaceae, etc.) also produce polyporate pollen. The pollen grains of Amaranthaceae-Chenopodiaceae types are very difficult to distinguish from each other in the dispersed condition except the *Gomphrena* type where the pores may not be easily recognisable because they are situated in lumina or luminoid depressions (*see* ERDTMAN, 1952). Pollen grains of *Alternanthera gracilis* have twelve pores and in *Brayulinea densa* pore like structures may be up to sixteen. *Agrostemma githago* of the family Caryophyllaceae is also polyporate but is bigger in size (65 μ) and crassisexinous with punctitegillate and spinuliferous structures. *Thylacospermum rupifragum* of the same family is twelve porate but is also crassisexinous and the granulose aperture is membranous. Chanda (1962) studied some of the panporate pollen grains belonging to the family Caryophyllaceae where the pores are not concealed and easily distinguishable.

Cryptopolyporites has close resemblance to pollen of some of the Linaceae as panporate pollen grains are also found in some of the members of the genus *Linum*. The pollen grains of *Linum* have been extensively studied by Saad (1961). In his opinion the pollen grains found in *Linum heterosepalum, L. multicaule, L. olgae, L. rigidum* and *L. stelleroides* are polyporate. The pores, however, unlike other polyporate types are covered with the same ornamentational pattern as the non-porate regions. The pores in all these species can only be recognized by careful analysis of the exine pattern because the pores possess a thin nexine membrane in which some processes are rooted. The pores having such character of concealment have been termed 'Cryptopore' by Saad (1961).

The pores of *Cryptopolyporites* instituted here closely resemble the cryptopores found

in some of the species of *Linum*. Panporate pollen grains of *Linum* described by Saad (*l.c.*) are not less than 70 μ in size (e.g. *Linum heterosepalum*). Some species of *Linum* (*e.g. L. rigidum*) produce pollen upto 125 μ in size. while; the size range in *Cryptopolyporites* is only 30-50 μ.

Cryptopolyporites cryptus sp. nov.

Pl. 2, Fig. 28

Holotype — Pl. 2, Fig. 28. Size 36×34 μ. Slide No. 3324.

Diagnosis — Pollen grains circular in overall shape, 30-50 μ. Panporate, pores are concealed by the ornamentational pattern of the exine; aperturate as well as non-aperturate regions ornamented by closely set bacula.

Description — Pollen grains mostly circular in shape. Exine 2-3 μ thick; sexine and nexine distinguishable, nexine as thick as or slightly thicker than sexine. Pores are uniformly distributed, 15-25 in numbers, rounded, 3-6 μ in diameter; not easily distinguishable and concealed by the ornamentational pattern. Exine thick, bacula uniformly distributed.

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EXPLANATION OF PLATES

(All photomicrographs are enlarged *ca.* × 1000)

PLATE 1

1. ? *Punctatisporites* sp. Slide no. 3322.
2. *Intrapunctisporites apunctus* Krutzsch. Slide no. 3311.
3. *Spore type* — 1. Slide no. 3322.
4. *Spore type* — 2. Slide no. 3312.
5. *Spore type* — 3. Slide no. 3316.
6. *cf. Sphagnumsporites* sp. Slide no. 3311.
7. *Verrumonoletes* sp. Slide no. 3318.
8. *Polypodiaceaesporites* sp. Slide no. 3321.
9-10. *Palmaepollenites kutchensis* sp. nov. Slide nos. 3317, 3318.
11-12. *Palmaepollenites nadhamunii* sp. nov. Slide nos. 3313, 3314.
13. *Liliacidites ellipticus* sp. nov. Slide no. 3319.
14. *Pollen type* — 4. Slide no. 3314.
15-16. *Couperipollis kutchensis* sp. nov. Slide nos. 3314, 3315.
17. *Liliacidites baculatus* sp. nov. Slide no. 3312.
18. *Tricolpites* sp. 1. Slide no. 3317.
19-21a-c. *Rostriapollenites kutchensis* Slide nos. 3311, 3317, 3318.

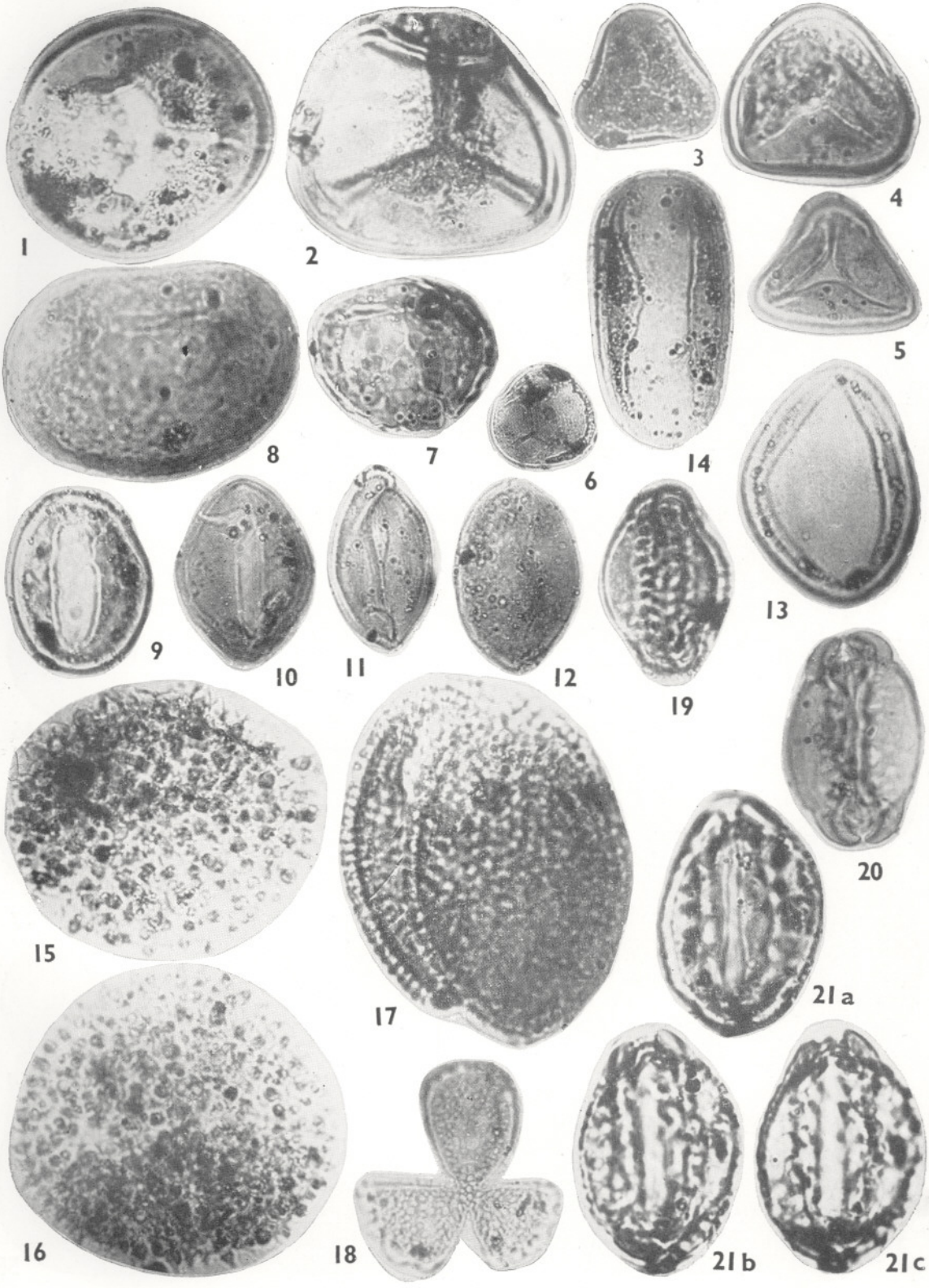
PLATE 2

24-25. *Nymphaeoipollis marginatus* gen. et sp. nov. Slide nos. 3318, 3317.
26. *Nymphaeoipollis* sp. Slide no. 3314.
27. *Nymphaeoipollis flavatus* sp. nov. Slide no. 3318.
28. *Cryptopolyporites cryptus* gen. et sp. nov. Slide no. 3324.
29-32. *Umbelliferoipollenites ovatus* gen. et sp. nov. Slide nos. 3320, 3318, 3312, 3322.
33. *Umbelliferoipollenites constrictus* sp. nov. Slide no. 3320.
34-37. *Symplocoipollenites minutus* sp. nov. Slide nos. 3323.
38-39. *Symplocoipollenites kutchensis* sp. nov. Slide no. 3323.
40-40a. *Palaeocoprosmadites arcotense* Ramanujam Slide no. 3323.
41-43. *Rhoipites kutchensis* sp. nov. Slide no. 3323.
44-45. *Cupuliferoipollenites ovatus* sp. nov. Slide no. 3323.
46. *Araliaceoipollenites matanamadhensis* sp. nov. Slide no. 3323.

47. *Ailanthipites* sp. Slide no. 3323.
48-49. *Nyssapollenites kutchensis* sp. nov. Slide nos. 3317, 3318.
50. *Tricolpites* sp. 2. Slide no. 3320.
51-52. *Stephanocolpites globatus* sp. nov. Slide nos. 3314, 3318.
53. *Stephanocolpites nadhamunii* sp. nov. Slide no. 3311.
54. *Stephanocolpites cf. S. arcotense* Ramanujam. Slide no. 3313.
55-56. *Polybrevicolporites cephalus* gen. et. sp. nov. Slide nos. 3322, 3311.
57-58. *Stephanocolpites granulatus* sp. nov. Slide nos. 3318, 3314.
59. *Hippocrateaceaedites* sp. Slide no. 3323.

PLATE 3

60-62. *Margocolporites tsukadai* Ramanujam Slide nos. 3322, 3323, 3311.
63-64. *Margocolporites sitholeyi* Ramanujam Slide no. 3323.
65-67. *Margocolporites sahnii* Ramanujam. Slide nos. 3323, 3318.
68-69. *Sastriipollenites trilobatus* gen. et sp. nov. Slide nos. 3320, 3321.
70-71. *Sonneratioipollis bellus* gen. et sp. nov. Slide no. 3318.
72-73. *Pseudonothofagidites kutchensis* gen. et sp. nov. Slide nos. 3323, 3320.
74. *Pseudonothofagidites cerebrus* sp. nov. Slide no. 3323.
75. *Monoporopollenites* sp. Slide no. 3323.
76. *Stephanocolpites flavatus* sp. nov. Slide no. 3317.
77-78. *Lakiapollis ovatus* gen. et sp. nov. Slide no. 3318.
79-80. *Lakiapollis matanamadhensis* sp. nov. Slide no. 3318.
81-83. *Trilatisporites kutchensis* sp. nov. Slide nos. 3321, 3318, 3319.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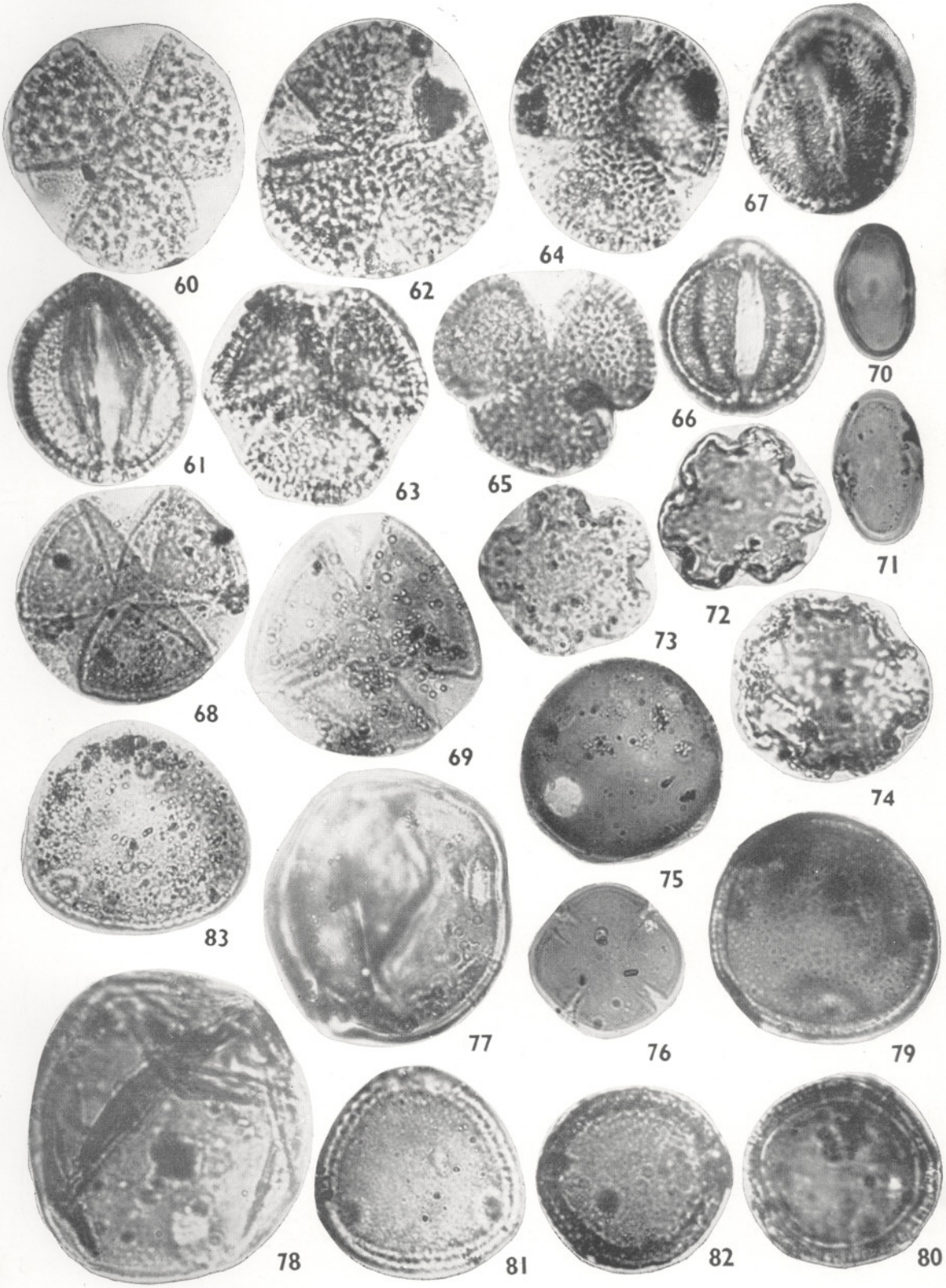
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