PALYNOLOGICAL INVESTIGATION OF THE GONDWANA OUTCROP FROM VEMAVARAM WITH REMARKS ON THE AGE OF THE BED

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ABSTRACT

The present paper deals with the dispersed spores-pollen recovered from Vemavaram shale (Jurassic) in the east coast Gondwanas, Andhra Pradesh, India. The palynological assemblage comprises 21 genera and 43 species, out of which two genera, viz. *Ramanujamiaspora* and *Singhiapollis* are new. The assemblage is dominated by gymnospermous pollen grains mostly represented by *Callialasporites*, *Singhiapollis*, *Podocarpidites*, *Laricoidites* and *Araucariacites*. The trilete spores are not common and mostly represented by *Cyathidites* and *Ramanujamiaspora*. The monolete and monocolpate pollen grains are rare. The trisaccate pollen grains are also meagrely represented by *Podosporites*. Operculate pollen grains are also rare and represented by *Classopollis* and *Granuloperculatipollis*. The present palynological assemblage has also been compared with the other known Jurassic assemblages of India. Palynological evidence indicates an Upper Jurassic age for the Vemavaram shales.

INTRODUCTION

PALYNOLOGICAL investigation of a greyish shale collected from near the village of Vemavaram was done by Ramanujam (1957). He recovered a good number of spores-pollen from this material comprising trilete, monolete, monosaccate, bisaccate, trisaccate and monocolpate pollen grains. He, however, described them mostly as "type 1" and "type 2" etc. without following the binomial nomenclature. The age of the Upper Gondwana outcrops of East Coast of India has till now remained a controversial problem. Reinvestigation of the Vemavaram shale was, therefore, undertaken to revise the sporological information with the object of indicating index fossil forms contained in it. A total of 43 species assignable to 21 genera have been classified. In the light of the present information the age of the Vemavaram bed has been discussed.

The maceration of the shale was done in 40% commercial nitric acid and washed in 3% potassium hydroxide solution. The macerates were dried on the cover glass by means of Polyvenyl alcohol and finally mounted in Canada balsam. The slides have been deposited in the repository of the Birbal Sahni Institute of Palaeobotany, Lucknow.

Only the hitherto unknown spores-pollen have been figured and described or those necessitating new combinations. The various spores-pollen genera and species obtained in the present material are systematically considered below:

SYSTEMATIC PALYNOLOGY

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

Genus — *Cyathidites* Coup., 1953

Type species — *Cyathidites australis* Coup., 1953

Species found:

1. *Cyathidites minor* Coup., 1953
2. *Cyathidites punctatus* (Delc. & Sprum.) Delc., Dettm. & Hugh., 1963

Remarks — Delcourt, Dettmann and Hughes (1963) merged *Concavisporites punctatus* Delc. & Sprum. (1955), *C. baldurensis* Delc. & Sprum. (1955), *Cingulatisporites cavus* Delc. & Sprum. (1955) and *Lygodium asper* Bolkh. (1963) into *Cyathidites punctatus*. *Concavisporites baldurensis* reillustrated by them (1963, PL. 42, FIGS. 1-2) seems to be quite distinct from the holotype of *Cyathidites punctatus* by their markedly concave interapical margin.

3. *Cyathidites pseudopunctatus* Singh, Sriv. & Roy, 1964
4. *Cyathidites cutchensis* Singh, Sriv. & Roy, 1964

Remarks — *Microreticulatisporites parvirites* Balme (1957) described from the Upper Mesozoic sediments of Western Australia closely resembles *Cyathidites cutchensis* Singh, Sriv. & Roy (1964) in shape, size and extension of the haptotypic mark. In the opinion of Balme (1957) the exine in this species is, however, microreticulate. A closely placed, well developed, intrapunctate exine may also look like intramicroreticulate structure.

5. *Cyathidites trilobatus* Sah & Jain, 1965

Remarks — Sah and Jain (1965) pointed out that diversified plant groups were responsible for producing this type of spores. The resemblance of the dispersed spores with *Coniopteris onychioides* Vas. & K.-M., *C. burjensis* (Zal.) Sew. and *C. hymenophylloides* (Brongn.) Sew. are, however, very striking (COUPER, 1953; VACHRAMEEV & DOLUDENKO, 1961 and DETTMANN, 1963).

In India, *Coniopteris* Brongn. is represented by *C. hymenophylloides* Brongn. (SAHNI & RAO, 1933; BOSE, 1960; SURANGE, 1966 and BOSE & SAH, 1968). This species is quite dominant in Rajmahal hills and is also found in other localities. But unfortunately, no spore has been found *in situ* in Indian specimens.

Cyathidites cf. C. asper Coup., 1953

Pl. 1, Fig. 4

Description — Spore triangular, 60 μ. Apices rounded, interapical margin concave. Trilete rays extending up to equator. Exine about 2 μ thick, folded along trilete rays; laevigate and intramicropunctate.

Remarks — The specimen closely resembles *Cyathidites asper* Coup. (1953) in shape and size but is distinguished by its presence of fold along the haptotypic mark.

Cyathidites cf. C. minor Coup. 1953

Pl. 1, Fig. 3

Description — Spore triangular, 62 μ. Apices rounded, interapical margin concave. Trilete, rays extending three-fourths radius. Exine 2 μ thick, laevigate and weakly intrastructured.

Remarks — The present specimen is somewhat bigger in size than *Cyathidites minor* Coup. (1953). Moreover, the exine is also more thick with weak intrastructure, hence it has only been compared with that species.

6. *Cyathidites jurassicus* sp. nov.

Pl. 1, Figs. 1-2

Holotype — Pl. 1, Fig. 1. Size 60 μ. Slide no. 3385.

No. of specimens studied — 15.

Diagnosis — Spores triangular, 50-65 μ. Apices rounded, interapical margin straight — slightly concave. Trilete, rays extending half-radius, mostly open. Exine 1-1·5 μ thick, laevigate.

Comparison — *Cyathidites minor* Coup. (1953) closely resembles the present species in shape but can be distinguished by its smaller size and extension of the trilete almost up to equator. *C. flavatus* Venkat., Kar & Raza (1969) approximates the present species in size but can be separated by its markedly convex interapical margin. *C. trilobatus* Sah & Jain (1965) is smaller in size (30-50 μ) and the haptotypic mark extends almost up to equator.

7. *Cyathidites* sp.

Pl. 1, Fig. 5

Description — Spore triangular, 44 μ. Apices rounded, interapical margin markedly concave. Trilete, rays narrow, extending almost up to equator. Exine 4·5 μ thick, laevigate.

Comparison — *Cyathidites concavus* (Bolkh.) Dettm. (1963) closely resembles the present species in size and markedly concave interapical margin but the latter can be distinguished by its very thick exine.

Infraturma — *Apiculati* (Benn. & Kids.) Pot., 1956

Genus — *Osmundacidites* Coup., 1953

Type Species — *Osmundacidites wellmanii* Coup., 1953

Osmundacidites cf. O. wellmanii Coup., 1953

Pl. 1, Fig. 7

Description — Spore subcircular, 50 μ. Trilete not traceable. Exine about 2 μ

thick, granulose, grana up to 2 μ in size, closely placed, uniformly distributed.

Remarks — The present specimen closely resembles *Osmundacidites wellmanii* Coup. (1953) in size, shape and ornamentation pattern but the latter can be differentiated by its well developed trilete rays extending up to three-fourths radius.

Genus — *Callispora* Dev, 1961

Type Species — *Callispora potoniei* Dev, 1961

cf. Callispora sp.

Pl. 1, Fig. 6

Description — Spore triangular, 70 μ. Apices rounded, interapical margin slightly concave. Trilete, rays extending up to equator. Exine about 4 μ thick, more thickened at interradial area; laevigate and intragranulose, grana closely placed, uniformly distributed.

Remarks — *Callispora* was instituted by Dev (1961) to accommodate triangular, trilete microspores with thick, granulose exine. The present specimen resembles very much *Callispora* in all aspects except the intragranulose structure. For this reason, it has only been compared with *Callispora*.

Infraturma — *Murornati* Pot. & Kr., 1954

Genus — *Lycopodiumsporites* Thierg. ex Delc. & Sprum., 1955

Type Species — *Lycopodiumsporites agathoecus* (Pot.) Thierg., 1938

Lycopodiumsporites sp.

Pl. 1, Fig. 15

Synonym

1953 *Dictyotriletes* Naum.: Sah, p. 5, pl. 1, fig. 17.
1954 *Reticulatisporites* Type 3 Vish.-Mitt., p. 120, pl. 1, figs. 19-20.
1957 *Reticulatisporites* Type 1 Raman., p. 355, pl. 10, figs. 16.

Description — Spore triangular, 54 μ. Apices rounded, interapical margin slightly convex. Trilete, rays narrow, extending up to equator. Exine 2 μ thick, proximally laevigate, distally reticulate, meshes ± uniform in size, 6-10 μ, ± polygonal; muri raised up to 3 μ forming uneven margin.

Comparison — *Lycopodiumsporites austraclavatidites* (Cooks.) Pot. (1956) can be distinguished from the present species in subcircular shape. *L. circolumenus* Cooks. & Dettm. is also subcircular and the meshes are more thick than the present specimen. *L. austraclavatidites forma tenuis* Balme (1957) approximates the present specimen in mesh structure but can be differentiated by its incipient cingulum and smaller size range.

Remarks — The spores described by Ramanujam (1957 as *Reticulatisporites* Types 2, 3, 4 & 5 should also be transferred to *Lycopodiumsporites*. *Reticulatisporites* (Ibr.) Neves (1964) is restricted to cingulate spores with two zones of thickening bearing a broad, reticulate mesh.

Genus — *Ischyosporites* Balme, 1957

Type Species — *Ischyosporites crateris* Balme, 1957.

Ischyosporites sp.

Pl. 1, Fig. 14

Description — Spore subtriangular, 70 μ. Apices broadly rounded, interapical margin convex. Trilete, rays extending up to three-fourths radius. Exine ± 3 μ thick, proximally laevigate, distally strongly reticulate, muri raised up to 8 μ, meshes ± uniform throughout.

Comparison — *Ischyosporites crateris* Balme (1957) resembles the present species in shape and general organization but can be distinguished by its thicker exine, prominent trilete rays and strongly arched distal side. *I. incompositus* Jain & Sah (1966) is 40-45 μ in size, trilete extending up to the equator and ornamented with thick, uneven ridges anastomosing to form an incomplete to complete reticulum on distal side.

Genus — *Ramanujamiaspora* gen. nov.

Type Species — *Ramanujamiaspora reticulata* sp. nov.

Generic Diagnosis — Spores triangular – subtriangular in polar view, ± cordate in meridional view. Trilete, rays well developed, lips surrounded by thickened, intrabaculate exine. Exine mostly proximally

laevigate, distally reticulate, sometimes a few meshes are also observed at ray ends on proximal side. Muri raised, thick, reticulation strongly built.

Description — Spores mostly triangular in polar view, sometimes subtriangular forms are also observed. Apices rounded, interapical margin straight – convex, margin undulated due to raised muri. Size range 35-70 × 40-60 μ. Trilete rays well developed, raised, extending two-thirds of radius to equator. Exine in association with rays thickened, intrabaculate, bacula closely placed, evenly distributed. Trilete rays are found mostly open probably due to intrabaculate exine in interradial areas. Due to raised trilete and thickened exine in association with it, spores generally folded along haptotypic mark. In some specimens this flattening also forms a sort of gulate structure. Commissure in intact specimens well recognizable. Exine up to 4 μ thick, generally proximally laevigate, in some cases a few meshes are also observed at ray ends. The meshes are mostly observed at one or two ray ends, but in some it is found in all the three. Sometimes, at one ray end it is more developed than others. In some specimens encroachment of a few muri at the interapical margin are also noticed. Reticulation on distal side very well developed, muri raised up to 6 μ, meshes square-rectangular, 6-10 × 4-8 μ, ± of same size throughout, lacunae shallow-deep.

Comparison — *Ischyosporites* Balme (1957) closely resembles the present genus in triangular-subtriangular shape, prominent trilete rays and presence of distal reticulation. *Ischyosporites* can, however, be distinguished by its strongly arched, thickened apices on distal side and absence of intrabaculate structure in haptotypic area. *Klukisporites* Coup. (1958) also approximates the present genus in shape and presence of foveo-reticulate sculpture on distal side, but can be differentiated by its non-intrabaculate exine in contact area. Moreover, in the opinion of Dettmann (1963) the proximal surface in *Klukisporites* is granulose-verrucose. *Lycopodiumsporites* Thierg. ex Delc. & Sprum. (1955) has laevigate exine on proximal side without any intrastructure and distally it is foveo-reticulate (Krutzsch, 1959; Manum, 1962; Dettmann, 1963 and Delcourt, Dettmann & Hughes, 1963). *Dictyosporites* Cooks. & Dettm. (1958) has reticulation on both surfaces with two or more superimposed reticula (Dettmann, 1963). *Dictyotriletes* (Naum.) Pot. & Kr. (1954) is mostly subtriangular with a raised, prominent trilete rays and reticulation only on distal surface (Neves, 1964; Venkatachala & Kar, 1968). *Ramanujamiaspora* instituted here is, however, distinguished by its characteristic intrabaculate structure along the lips of the trilete.

Derivation of name — Named after Dr. C. G. K. Ramanujam of the Osmania University, India, who first figured specimens assignable to the present genus.

Remarks — The spores with triangular – subtriangular shape, proximally laevigate or slightly ornamented and distally distinctly foveo-reticulate are thought to be closely similar to schizaeaceous spores. The extant spores of *Klukia exilis* Phill, *Stachypteris hallei* Thom. and *S. spicans* Pom. are comparable to the present genus. Some members of Dicksoniaceae also produce similar spores (Balme, 1957). The recent spores of *Lycopodium fastigiatum* R. Br., *L. scariosum* Fort., *L. cernuum* Linn. and *L. serpentinum* Kinze are distinguished from *Ramanujamiaspora* by their rugulate to lopho-reticulate pattern of ornamentation (Wilson, 1934; Knox, 1950 and Harris, 1955).

Ramanujamiaspora reticulata sp. nov.

Pl. 1, Figs. 8-13

Synonym

1957 *Striatatuberculatisporites* Type 1, Ramanujam, p. 356, pl. 10, figs. 24-25.

Holotype — Pl. 1, Fig. 8. Size 60 μ. Slide no. 3385.

No. of specimens studied — 37.

Diagnosis — Spores mostly traingular, ± cordate in meridional view; 38-62 μ. Trilete, rays well developed, surrounded by intrabaculate exine. Exine generally proximally laevigate, distally reticulate, muri raised, reticulation strongly built.

Description — Spores generally triangular with bluntly rounded apices, sometimes subtriangular; interapical margin straight-convex. Trilete rays raised, uniformly broad or tapering at ends, extending two-thirds of radius to almost up to equator; rays surrounded by thickened, intrabaculate exine, bacula closely placed, uniformly broad, evenly distributed. Spores generally folded along trilete rays to form ± cordate

shape with an occasional gulate structure. Exine proximally laevigate, sometimes a few meshes may also be found at ray ends. Meshes may present in all ray ends but mostly they are more developed at one or two ends. Exine up to 4 μ thick, distally strongly reticulate, muri raised up to 6 μ forming ± uniform squre-rectangular meshes.

Rmarks — The specimens described as *Striatatuberculatisporites* Type 1 by Ramanujam (1957) are folded along the meridional line showing the prominent trilete and strongly built reticulation on the distal surface. The margin of the spores are uneven due to raised muri which look like tuberculate processes.

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

Genus — *Leschikisporis* (Pot.) Bharad. & Singh, 1964

Type Species — *Leschikisporis aduncus* (Lesch.) Bharad. & Singh, 1964.

Leschikisporis rudis sp. nov.

Pl. 1, Fig. 18

Holotype — Pl. 1, Fig. 18. Size 40×25 μ. Slide no. 3386.

No. of specimens studied — 11.

Diagnosis — Spores oval, 30-50×18-30 μ. Monolete, lip ill-developed. Exine granulose.

Description — Spores mostly oval, sometimes subcircular. Monolete not raised, narrow, ± straight, mostly extending up to three-fourths along longitudinal axis. Exine 1-2 μ thick, grana about 1 μ in size, somewhat subgranulose, closely placed, evenly distributed.

Comparison — *Leschikisporis indicus* Singh, Sriv. & Roy (1964) closely resembles the present species in shape and ornamentational pattern but can be separated by its smaller size range. *L. aduncus* (Lesch.) Bharad. & Singh (1964) has a monolete mark with a median bend in the middle.

Anteturma — *Pollenites* Pot., 1934
Turma — *Saccites* Erdt, 1947
Subturma — *Monosacites* (Chit.) Pot. & Kr., 1954

Genus — *Callialasporites* Dev, 1951

Type Species — *Callialasporites trilobatus* (Balme) Dev, 1961.

Remarks — Goubin, Taugourdeau & Balme (1965) emended *Applanopsis* Döring (1961) and placed *Callialasporites* Dev (1961) and *Pflugipollenites* Pocock (1962) as junior synonyms of it. Pocock (1968), however, pointed out that *Applanopsis* Döring was actually published in February, 1962 and not in 1961 and hence the name lost priority to *Callialasporites* Dev. Venkatachala & Kar (1969) elaborated and modified the diagnosis of *Applanopsis* and placed hitherto known species of *Callialasporites* to *Applanopsis* following Goubin, Taugourdeau & Balme (1965). Since *Applanopsis* was actually published in 1962 according to Pocock (1968) so *Callialasporites* is considered here as valid genus. The species found in the present material are:

1. *Callialasporites trilobatus* (Balme) Dev, 1961.
2. *C. segmentatus* (Balme) Dev, 1961.
3. *C. dampieri* (Balme) Dev, 1961.
4. *C. monoalasporus* Dev, 1961.
5. *C. lucidus* (Poc.) comb. nov.

Genus — *Singhiapollis* gen. nov.

Type Species — *Singhiapollis* (*Callialasporites*) *triletus* (Singh, Sriv. & Roy) comb. nov.

Generic Diagnosis — Pollen grains monosaccate, central body distinct-indistinct, subcircular-subtriangular, granulose-microverrucose. Trilete, rays straight or sinuous, mostly associated with fold, extending two-thirds to equator. Saccus well deveoped-rudimentary, subsaccate, leathery, granulose-microverrucose, attached at equatorial region.

Description — Monosaccate, generally radially symmetrical, 60-90×55-85 μ. Central body mostly confronts with overall shape, 40-68×34-66 μ, may be denser than saccus, sometimes light and inconspicuous. Exine 2-3·5 μ thick, grana and microverrucae well developed, up to 1·5 μ in size, closely placed, evenly distributed. Trilete rays generally well defined, rays narrow, equal, uniformly broad or slightly tapering at ends, associated fold well developed, extending throughout the length, in some specimens folds may fall short. Commissure recognizable. Saccus fleshy, generally entire, sometimes trilobed, lobes may be incipient or well marked, may be radially folded. Saccus granulose–microverrucose, sculptural elements interspersed each other, generally closely placed,

sometimes saccus may be more or less laevigate. Attachment zone of saccus to central body distinct or indistinct, irregular folds may be present at the region.

Comparison — The present genus can be distinguished from *Zonalapollenites* Pflug (1953), *Cerebropollenites* Nils. (1958), and *Callialasporites* Dev (1961), by the presence of well developed trilete rays, granulose–verrucose central body and saccus.

Remarks — The pollen grains comparable to *Singhiapollis*, *Zonalapollenites*, *Cerebropollenites* and *Callialasporites* are well known in all the Mesozoic sediments of the world (Potonié & Venitz, 1934; Raatz, 1937; Balme, 1957; Dev, 1961; Pocock, 1962; Dettmann, 1963; Staplin, Pocock & Jansonius, 1967, Venkatachala & Kar, 1969 and others).

It may be mentioned here that Gamerro (1956a) described pollen grains comparable to *Zonalapollenites* and *Callialasporites*, from *Apterocladus lanceolatus* Archang. The present genus though closely resembles in general organization those pollen grains but can readily be separated by its prominent haptotypic mark and its associated fold system. Since this group of pollen is cosmopolitan in distribution in all the Mesozoic sediments it is quite likely that more than one generic group was responsible for producing such prolific number of pollen grains. The present genus with its well defined trilete mark perhaps strengthen this supposition.

Derivation of name — Named after Dr. H. P. Singh, Birbal Sahni Institute of Palaeobotany, Lucknow.

Singhiapollis (*Callialasporites*) *triletus* (Singh, Sriv. & Roy) comb. nov.

Pl. 1, Figs. 19-20

Synonym

1961 cf. *Callialasporites* sp. Dev, p. 49, pl. 4, figs. 30-31.
1964 *Callialasporites triletus* Singh, Sriv. & Roy, p. 297, pl. 7, figs. 95-96.
1969 *Applanopsis* (*Callialasporites*) *triletus* (Singh, Sriv. & Roy) Venkatachala & Kar, p. 37.

Holotype — Singh, Sriv. & Roy, 1964, Pl. 7, Fig. 96.

Diagnosis — See Singh, Sriv. & Roy, 1964, p. 297.

Singhiapollis rudis sp. nov.

Pl. 1, Figs. 16-17

Holotype — Pl. 1, Fig. 16. Size 70×68 μ. Slide no. 3386.

No. of specimens studied — 19.

Diagnosis — Pollen grains monosaccate, subcircular, central body indistinct, granulose-microverrucose. Trilete, rays associated with fold, extending upto three-fourths radius. Saccus entire or incipiently trilobed, granulose-microverrucose.

Description — Radially symmetrical pollen grains, 60-90×55-87 μ. Margin entire or undulated. Central body confronting with overall shape, ill-defined, exine 2-3 μ thick, grana and microverrucae interspersed each other, closely placed, uniformly distributed. Trilete rays well developed, straight or sinuous, associated fold well marked, extending throughout the length of rays. Commissure recognizable. Attachment zone of saccus to central body equatorial, saccus may be radially folded, other irregular folds are also occasionally observed, saccus granulose-microverrucose.

Comparison — *Singhiapollis triletus* (Singh, Sriv. & Roy) comb. nov. resembles the present species closely in general organization and sculptural elements but the latter can be differentiated by its inconspicuous central body and extension of the trilete rays only up to three-fourths radius.

Subturma — *Disaccites* Cooks., 1947
Infraturma — *Pinosacciti* (Erdt.,) Pot., 1958

Genus — *Alisporites* (Daugh.) Nils., 1958

Type Species — *Alisporites opii* Daugh., 1941.

Species found:
1. *Alisporites grandis* (Cooks.) Dettm., 1963.

***Genus — Podocarpidites* Cooks., 1947 ex Coup., 1953**

Type Species — *Podocarpidites ellipticus* Cooks., 1947.

Species found:
1. *Podocarpidites multesimus* (Bolkh.) Poc., 1962.
2. *P. rarus* Singh, Sriv. & Roy, 1964
3. *P. cristiexinus* Sah & Jain, 1965.
4. *P. grandis* Sah & Jain, 1965.
5. *P. typicus* Sah & Jain, 1965.

Podocarpidites sp. A

Pl. 2, Fig. 22

Description — Bisaccate, bilaterally symmetrical pollen grain, 86×56 μ. Central body distinct, subcircular, 56×52 μ, intramicroreticulate. Proximal attachment of sacci to central body equatorial, distal attachment straight, subequatorial. Sulcus wide, distinct. Sacci hemispherical, intrareticulate.

Comparison — The present species resembles closely *Podocarpidites rarus* Singh Sriv. & Roy (1964) in size range but the former can be distinguished by its wide sulcus. *P. grandis* Sah & Jain (1965) is larger in size range while *P. typicus* Sah & Jain (1965) has vertically oval central body, small sacci and they are closely placed distally.

Podocarpidites sp. B

Pl. 2, Fig. 23

Description — Pollen grain bisaccate, haploxylonoid, bilaterally symmetrical, 90×56 μ. Central body indistinct, subcircular, intramicroreticulate. Proximal attachment of sacci to central body equatorial, distal attachment subequatorial, straight. Sulcus distinct, uniformly broad. Sacci hemispherical intrareticulate, mesh size up to 2·5 μ, lumina shallow.

Comparison — *Podocarpidites* sp. A approximates the present species in size but can be distinguished by its distinct, subcircular central body and wide sulcus. *Podocarpidites* sp. described by Singh, Sriv. & Roy (1964) from the Lower Cretaceous of Kutch has granulose central body and usually of smaller size range.

Infraturma — *Podocarpoiditi* Pot., Thom. & Thierg., 1950

Genus — *Platysaccus* (Naum.) Pot. & Kl., 1954

Type Species — *Platysaccus papilionis* Pot. & Klaus 1957.

Platysaccus sp.

Pl. 2, Fig. 24

Description — Bisaccate, diploxylonoid, bilaterally symmetrical pollen grain, 100×40 μ. Central body light, subcircular, 40×36 μ, exine about 2 μ thick, laevigate. Proximal attachment of sacci to central body equatorial, distal attachment subequatorial. Sulcus distinct, biconvex. Sacci intrareticulate, irregularly folded, mesh-size up to 2·5 μ, lumina shallow.

Comparison — *Platysaccus indicus* Sah & Jain (1965) can be separated from the present species by its smaller size range, granulose central body and very closely placed distal attachment. *Platysaccus* sp. A described by Sah & Jain (1965) may also be distinguished by its vertically oval central body and juxtaposed distal attachment. *Platysaccus* sp. B also described by Sah & Jain (1965) approximates the present species in biconvex sulcus but can readily be differentiated by dense central body and smaller size. *Platysaccus* sp. described by Singh, Sriv. & Roy (1964) is very big in size (146×100 μ), has vertically oval central body and a narrow, slit-like sulcus.

Genus — *Abietineaepollenites* Pot., 1931

Type Species — *Abietineaepollenites microalatus* (Pot.) Pot., 1958.

Species found:

1. *Abietineaepollenites robustus* sp. nov.

Pl. 2, Figs. 25-26

Holotype — Pl. 2, Fig. 25. Size 72×52 μ. Slide no. 3382.

No. of specimens studied — 17.

Diagnosis — Pollen grains bisaccate, 65-90×40-60 μ. Central body with marginal ridge, vertically oval, intramicroreticulate. Sacci intrareticulate.

Description — Bilaterally symmetrical pollen grains. Central body dense, mostly vertically oval, sometimes subcircular. Exine up to 5 μ thick, marginal ridge well developed. Proximal attachment of sacci to central body equatorial, distally sacci covering most part of central body, attachment zone straight. Sulcus narrow. Sacci well developed, hemispherical, mesh size 2-3 μ, lumina shallow.

Comparison — *Abietineaepollenites minimus* Coup. (1958) resembles the present species in possessing vertically oval-subcircular central body but can be distinguished by its broad meshes which are 3-5 μ in size. *A. dunrobinensis* Coup. (1958) approximates the present species in marginal ridge but can be differentiated by their larger size range.

2. *Abietineaepollenites ellipticus* sp. nov.

Pl. 2, Fig. 27

Holotype — Pl. 2, Fig. 27. Size 90×60 μ. Slide no. 3383.

No. of specimens studied — 12.

Diagnosis — Pollen grains bisaccate, 80-102×45-70 μ. Central body distinct, horizontally oval, generally with marginal ridge. Distal attachment closely placed. Sacci intrareticulate.

Description — Bilaterally symmetrical pollen grains, mostly elliptical in overall shape. Central body dense, confronting with general shape, intramicroreticulate. Proximal attachment of sacci to central body equatorial, distal attachment straight, sulcus narrow, in some specimens appear as a longitudinal slit. Sacci intrareticulation 2-3 μ in size, uniform.

Comparison — *Abietineaepollenites robustus* closely resembles the present species in size range and general organization but the former can be distinguished by its vertically oval - subcircular central body. *A. minimus* Coup. (1958) and *A. dunrobinensis* Coup. (1958) have broad meshes and larger size respectively and thus can easily be separated from the present species.

Remarks — The pollen grains comparable to *Abietineaepollenites robustus* and *A. ellipticus* are found in extant *Pinus cembra* Linn. (Couper, 1958), *Pinus exeguus* (Bolkhovitina, 1959) and in some species of *Abies* and *Keteleeria* (Bolkhovitina, 1952; Van Campo, 1958; Srivastava, 1960). In the dispersed stage it is, however, difficult to recognize with certainty to which particular genus they belong. Morphologically, they look rather similar with a considerable variation in size range. Wodehouse (1935), Cain (1940) and Grayson (1954) emphasized on the size range to identify them in dispersed condition. The abnormality is also quite frequent making the identification more difficult (Van Campo, 1950; Lakhanpal & Nair, 1956; Vishnu-Mittre, 1957 and others).

Genus — *Cedripites* Wodehouse, 1933

Type Species — *Cerdipites cocenicus* Wodehouse, 1933.

Species found:

1. *Cedripites nudis* sp. nov.

Pl. 2, Figs. 28-29

Holotype — Pl. 2, Fig. 28. Size 80×40 μ. Slide no. 3381.

No. of specimens studied — 15.

Diagnosis — Pollen grains bisaccate, 65-92×35-60 μ. Central body horizontally oval, distinct, intramicroreticulate, curved. Sacci small, partially covering central body.

Description — Pollen grains haploxylonoid. Central body markedly horizontally oval, curved perhaps due to unequal thickening on dorsal and ventral sides. Sacci small, covers only a part of central body. Proximal attachment of sacci to central body equatorial, distal attachment subequatorial, sacci closely placed at constricted end of central body.

Comparison — *Cedripites cretaceus* Poc. (1962) can be distinguished from the present species by its subcircular-circular central body and larger size range. *C. canadensis* Poc. (1962) has also subcircular-circular central body with marked constriction at one end due to well developed proximal cap (Singh, 1964).

2. *Cedripites* sp. A

Pl. 2, Fig. 31

Description — Pollen grain bisaccate, 76×64 μ, strongly haploxylonoid. Central body subcircular, distinct, 64×60 μ, intramicroreticulate. Proximal attachment of sacci to central body equatorial, distal attachment subequatorial. Sacci small, ill-developed, intramicroreticulate.

Comparison — The present species can be distinguished from *Cedripites nudis* by its subcircular shape and minute sacci. *C. cretaceus* Poc. (1962) has subcircular-circular central body but may be separated from the present species by its curved central body. The central body in *C. canadensis* Poc. (1962) is also markedly curved with close association of sacci on that region.

3. *Cedripites* sp. B

Pl. 2, Fig. 30

Description — Pollen grain bisaccate, strongly haploxylonoid, 80×60 μ. Central body subcircular, 70×60 μ, curved at one lateral side perhaps due to unequal thickening on dorsal and ventral side of central body. Exine about 3 μ thick, intramicroreticulate. Proximal attachment of sacci

to central body equatorial, distal attachment subequatorial, sacci closely placed at constricted side, intrareticulate.

Comparison — *Cedripites nudis* approximates the present species in its small, closely placed sacci on the curved side but can readily be separated by its horizontally oval central body. *Cedripites* sp. A can also be distinguished by its nonconstricted central body. *C. cretaceus* (1962) and *C. canadensis* have granulose proximal cap on the central body (SINGH, 1964).

Genus — *Indusiisporites* Lesch., 1955

Type Species — *Indusiisporites velatus* Leschik, 1955.

Indusiisporites microsaccatus sp. nov.

Pl. 2, Fig. 37

Holotype — Pl. 2, Fig. 37. Size 69×60 μ. Slide no. 3384.

Diagnosis — Pollen grains bisaccate, central body vertically oval, distinct, intramicroreticulate. Sacci small, encroaching inwards, intrareticulate. Sulcus straight, narrow.

Description — Bilaterally symmetrical, haploxylonoid pollen grains, 50-60×45-58 μ. Central body vertically oval with uniformly broadly rounded lateral ends, 50-65 ×40-58 μ. Proximal attachment of sacci to central body equatorial, distal attachment straight, closely placed. Sacci ill-developed, less than hemisphere.

Comparison — *Indusiisporites velatus* Lesch. (1955) resembles the present species in general organization but can be differentiated by its smaller size range. *I. parvisaccatus* (de Jers.) de Jers. (1964) approximates the present species in closely placed sacci and vertically oval central body but may also be separated by its smaller size range.

Subturma — *Polysaccites* Cooks., 1947

Genus — *Podosportes* Rao, 1943

Type Species — *Podosporites tripakshi* Rao, 1943

Podosporites raoi sp. nov.

Pl. 2, Fig. 32

Holotype — Pl. 2, Fig. 32. Size 86×50 μ. Slide no. 3385.

No. of specimens studied — 13.

Diagnosis — Pollen grains trisaccate, 70-100×40-60 μ. Central body oval-subcircular, intramicroreticulate. Sacci intrareticulate.

Description — Pollen grains distinctly trisaccate. Central body distinct or indistinct, vertically or horizontally oval, sometimes subcircular. Exine up to 2 μ thick. Proximal attachment of sacci to central body equatorial, distal attachment subequatorial. Sacci equal or unequal in size, sometimes one saccus is smaller than the two.

Comparison — *Podosporites tripakshi* Rao (1943) resembles the present species in general organization but can be distinguished by its smaller size range. *Podosporites* sp. cf. *tripakshi* described by Sah & Jain (1965) is circular and the exine of central body is infragranulose. *P. microsaccatus* (Coup.) Dettm. (1963) can be differentiated by its small, ill-developed sacci.

Derivation of name — Named after Prof. A. R. Rao of Lucknow University.

Remarks — Trisaccate pollen grains comparable to *Podosporites* has been recovered from *Trisacocladus tigrensis* Archang. by Gamerro (1965b) from the Lower Cretaceous of Santa Cruz province.

Turma — *Monocolpates* Iver. & Tr.-Smith, 1950

Subturma — *Intortes* (Naum.) Pot., 1958

Genus — *Ginkgocycadophytus* Samoil., 1953

Type Species — *Ginkgocycadophytus caperatus* (Lub.) Samoil., 1953.

Species found:

1. *Ginkgocycadophytus deterius* var. *majus* Dev, 1961.

Pl. 2, Fig. 41

2. *Ginkgocycadophytus srivastavae* sp. nov.

Pl. 2, Fig. 40

Synonym

1963 *Ginkgocycadophytus cf. G. deterius* var. *major* Sukhdev: Srivastava, p. 1323, fig. 4.

Holotype — Pl. 2, Fig. 40. Size 88×44 μ. Slide no. 3386.

No. of specimen studied — 9.

Diagnosis — Pollen grains monocolpate, oval-spindle, 77-95 × 35-50 μ. Colpus end to end, open at one end. Exine laevigate and intrastructured.

Description — Pollen grains mostly oval with one lateral end more pointed than other. Colpus distinct. Exine up to 2·5 μ thick, intrastructure generally well developed in most specimens.

Comparison — *Ginkgocycadophytus deterius* var. *majus* Dev (1961) closely resembles the present species in size and somewhat in shape but can be distinguished by its presence of folds along the border of the colpus. *Cycadopites* sp. A and B described by Singh, Srivastava and Roy (1964) are much smaller in size. *Cycadopites sakrigaliensis* Sah & Jain (1965) is ornamented with coarse grana.

Derivation of name — The species is named after Dr. S. K. Srivastava who first figured a specimen assignable to the present species.

3. *Ginkgocycadophytus asymmetricus* sp. nov.

Pl. 2, Fig. 38

Holotype — Pl. 2, Fig. 38. Size 80 × 56 μ. Slide no. 3388.

No. of Specimens studied — 12.

Diagnosis — Pollen grains monocolpate, 70-90 × 35-60 μ, colpus funnel shaped, extending end to end. Exine microverrucose.

Description — Pollen grains oval-elliptical with uniformly or unequally broad lateral ends. Colpus distinct, wide at one end, some folds may be present at border. Exine up to 3 μ thick, microverrucae about 1 μ size, sometimes interspersed with grana, closely placed, evenly distributed.

Comparison — *Ginkgocycadophytus srivastavae* is laevigate and intrastructured. *G. deterius* var. *majus* Dev (1961) is much larger in size and the colpus is associated with fold at the border. *Cycadopites sakrigaliensis* Sah & Jain (1965) approximates the present species in size and shape but the latter is differentiated by its funnel-shaped colpus and microverrucose ornamentation. *Sporites navicula* Rao (1943) is elliptical and the furrow is uniformly broad. *Entylissa* type 1 and type 2 described by Vish.-Mitt. (1964) are smaller in size. *Entylissa* type 1 and type 2 figured by Raman. (1957) are mostly oval and have boat-shaped sulcus.

Remarks — Jansonius (1962) emended *Cycadopites* (Wodehouse) ex Wilson & Webster (1946) to accommodate ellipsoidal – oval pollen grains with a furrow extending from one end to other but usually closed in the middle by furrow edges overlapping in shrinkage. Jansonius (1962) included *Ginkgocycadophytus* Samoilovich (1953) along with a host of genera like *Ginkgoretectina* Malyavkina (1953), *Palmidites* (Chitaley) Couper (1953) and *Lagenella* Malyavkina ex Klaus (1960) as synonyms to it. The genus *Palmidites* originally described by Chitaley (1951) from the Mohgaon-Kalan beds of Madhya Pradesh, India, seems to be angiospermic. *Lagenella* in the opinion of Klaus (1960) is striated horizontally as well as vertically. It seems that by inclusion all these genera into *Cycadopites*, the genus becomes a heterogenous complex. So *Ginkgocycadophytus* Samoilovich (1953) has not been considered here as a synonym to *Cycadopites*.

Turma — *Aleles* Ibr., 1933
Subturma — *Azonaletes* (Lub.) Pot. & Kr., 1954
Infraturma — *Psilonapiti* Erdt., 1947

Genus — *Laricoidites* Pot., Thoms. & Thierg., 1950

Type Species — *Laricoidites magnus* Pot., 1934.

Species found:

1. *Laricoidites indicus* Singh, Sriv. & Roy, 1964

Infraturma — *Granulonapiti* Cooks., 1947

Genus — *Araucariacites* Cooks., 1947

Type Species — *Araucariacites australis* Cooks., 1947.

Species found:

1. *Araucariacites australis* Cooks., 1947

Turma — *Poroses* (Naum.) Pot., 1960
Subturma — *Monoporines* Naum., 1959
Infraturma — *Operculati* Venkat. & Góc., 1964

Genus — *Classopollis* (Pf.) Poc. & Jan., 1931

Type Species — *Classopollis classoides* (Pf.) Poc. & Jan., 1961.

Classopollis torosus (Reiss.) Coup., 1958

Pl. 2, Fig. 33

Remarks — *Classopollis torosus* or pollen grains closely comparable to it has already been reported from the Rajmahal hills by

Sah & Jain (1965) and from the Katrols by Venkatachala, Kar & Raza (1969). It may be mentioned here that *Classopollis* like pollen has been described from *Cheirolepidium musteri* Schenk. by Höerhammer (1933), *Brachyphyllum scotti* Kend. and *Pagiophyllum connivens* Kend. by Kendall in 1949 and 1952 respectively. Recently, Barnard (1968) described pollen grains similar to *Classopollis torosus* from *Masculostrobus rishra* Barnard from the Jurassic of Iran. In India, *Masculostrobus rajmahalensis* Rao (1943), *M. sahnii* Vishnu-Mittre (1956) and *M. podocarpiodes* Vishnu-Mittre (1959) are known from the Rajmahal hills, Bihar. None of these specimens, however, produce *Classopollis* like pollen on the contrary they produce bisaccate and trisaccate pollen grains.

Genus — *Granuloperculatipollis* Venkat. & Góc. 1964

Type Species — Granuloperculatipollis rudis Venkat. & Góc., 1964.

Species found:

1. *Granuloperculatipollis flavatus* Kar, 1970
Pl. 2, Fig. 34

2. *Granuloperculatipollis subcircularis* sp. nov.
Pl. 2, Fig. 36

Holotype — Pl. 2, Fig. 36. Size 70 μ. Slide no. 3381.

No. of specimens studied — 14.

Diagnosis — Pollen grains subcircular, 50-72 μ. Operculate, operculum well defined. Exine microverrucose.

Description — Operculum in most specimens subcircular, exine may be irregularly folded at margin or over operculum. Exine up to 2·5 μ thick, microverrucae well developed, sometimes interspersed with grana, very closely placed, up to 2 μ in size.

Comparison — Granuloperculatipollis problematicus Kar (1970) closely resembles the present species in shape and size range but can be distinguished by its conied-spinose ornamentation. *G. flavatus* Kar (1970) also approximates the present species in shape and size but can be differentiated by its granulose ornamentation.

3. *Granuloperculatipollis triletus* sp. nov.
Pl. 2, Fig. 35

Holotype —Pl. 2, Fig. 35. Size 60 μ. Slide no. 3383.

No. of specimens studied — 17.

Diagnosis — Pollen grains circular – subcircular, operculate. Trilete, exine granulose, grana bigger in size in operculate region.

Description — Pollen grains mostly circular, while folded they may be of various shapes, 55-65 μ. Trilete, rays extending up to two-thirds radius. Operculum distinct — indistinct. Exine up to 2·5 μ thick, granulose, grana outside operculum about 1 μ while on operculum they are about 2 μ in size, grana closely placed, evenly distributed.

Comparison — Granuloperculatipollis flavatus Kar (1970) resembles the present species in shape and size but the latter can be distinguished by its well developed trilete and bigger size of the grana in operculate region. *G. subcircularis* is microverrucose and the trilete rays are also not traceable. *G. rudis* Venkat. & Góc. (1964) is smaller in size than the present species and the grana are more or less of same size.

Remarks — Granuloperculatipollis triletus instituted here is conspicuous by the presence of well developed trilete rays and bigger grana in the middle region.

Incertae Sedis

Pollen Type — 1, Pl. 1, Fig. 21.

Description — Monosaccate, radially symmetrical pollen grain, 90×86 μ. Central body indistinct, ± laevigate and intrastructured, has a triangular inner body with three long, arm-like projections. Saccus leathery, intrastructured.

Plankton Type — 1, Pl. 2, Fig. 39.

Description — Specimen subcircular, 40×36 μ with a long, tail like flagellum. Body ± granulose, thin, irregularly folded. Flagellum thick, cylindrical, laevigate, tapering at end and attached in middle region of body.

Remarks — Only a single specimen has been recovered in the present material. In the preparation, however, there are detached and lacerated flagella indicating that there must have been more specimens. The flagellum is so long that it is rather difficult to get intact specimens after maceration.

It may be mentioned here that planktonic bodies with and without flagellum has also been recovered from the Lower Gondwanas

in the North Karanpura coalfield, Bihar, India, by the authors (unpublished data).

The present specimen is broadly comparable to *Pseudoceratium gochtii* Pocock (1962) in the presence of an apical horn which apparently looks like a tail (SINGH, 1964). The theca and the plates are, however, not distinguishable in the present specimen.

A supposedly fungal spore described and figured by Jen (1958) from the Lower Cretaceous beds of Wenmingsze, Southern Hunan, China approximates the present specimen in possessing a tail-like flagellum. However, the former can be distinguished by its elliptical body.

PALYNOLOGICAL AND STRATIGRAPHIC INTERPRETATION

The present palynological assemblage comprises 21 genera and 43 species. Of them, 6 genera of trilete and 1 of monolete belong to fern and fern allies and the rest to gymnosperms. The pteridophytic spores are meagrely represented in the assemblage. Among them *Cyathidites* and *Ramanujamiaspora* are somewhat common while *Osmundacidites, Callispora, Lycopodiumsporites, Ischyosporites* and *Leschikisporis* are hardly encountered in the present material.

The gymnospermous pollen grains are dominant in the assemblage both from the quantitative as well as qualitative point of view. They consist of 2 genera belonging to monosaccate, 6 to bisaccate, 1 to trisaccate, 1 to monocolpate, 2 to alete and 2 to operculate pollen grains. Among them, *Callialasporites, Singhiapollis, Podocarpidites, Laricoidites* and *Araucaricites* are fairly common while *Alisporites, Cedripites, Podosporites, Ginkgocycadophytus, Classopollis* and *Granulopreculatipollis* are meagrely represented.

A comparison of the present assemblage with that of Rajmahal hills described by Sah & Jain (1965) shows that the latter assemblage are more rich in pteridophytic spores represented by 22 genera. The genera like *Deltoidospora, Alsophilidites, Gleicheniidites, Divisisporites, Converrucosisporites, Concavissimisporites, Foraminisporis, Baculatisporites, Verrucosisporites, Acanthotriletes, Cicatricosisporites, Trilobosporites* and *Cingulatisporites* are not found in the present assemblage. Both the assemblages have, however, *Cyathidites, Callispora, Osmundacidites, Lycopodiumsporites* and *Ischyosporites* in common. The gymnospermous pollen genera like *Callialasporites, Podocarpidites, Laricoidites* and *Araucariacites* are also fairly common in Rajmahal assemblage.

The Jaisalmer (Rajasthan) palynological assemblage described by Srivastava (1963) closely resembles the present one in the presence of *Cyathidites, Osmundacidites, Ischyosporites, Callialasporites, Ginkgocycadophytus, Classopollis, Laricoidites* and *Araucariacites.*

The miospore assemblage described by Jain & Sah (1966) from Andigama (Ceylon) comprises 26 genera out of which 16 are pteridophytic. The trilete spores are quite common in the assemblage and they mostly belong to *Cyathidites, Deltoidospora, Gleicheniidites, Osmundacidites Baculatisporites, Stereisporites, Perotriletes, Foveosporites, Ischyosporites, Lycopodiumsporites, Concavissimisporites, Cicatricosisporites, Contignisporites, Ceratosporites, Acanthotriletes* and *Verrucosisporites.* Among the gymnosperms, *Callialasporites, Podocarpidites, Alisporites, Podosporites* and *Laricoidites* are common.

The palynological assemblage from the Katrol Series (Kutch) described by Venkatachala, Kar & Raza (1969) approximates the present one in the dominance of gymnospermous pollen grains and paucity of trilete spores. In both the assemblages *Callialasporites, Podocarpidites, Laricoidites* and *Araucaricites* are abundant. The pteridophytic spores like *Cyathidites, Lycopodiumsporites* and *Leschikisporis* are also common in both of them. But *Ramanujamiaspora,* a trilete spore with differential sculptural elements is not reported from the Katrol Series so far. The bisaccate pollen genera like *Cedripites, Abietineaepollenites, Indusiisporites* and operculate pollen like *Granuloperculatipollis* are also not known from the Katrol Series. The last named trilete and bisaccate genera seem to represent the local elements.

From the above comparisons it is evident that the Vemavaram palynological assemblage contains forms almost identical with those described from the Katrol Series of Western India (VENKATACHALA, KAR & RAZA, 1969).

The age of the Upper Gondwana sediments of the East Coast of India has long been a debatable problem. In 1933 Spath, on

the basis of cephalophod fauna, assigned a Neocomian age to all the Gondwana outcrops exposed near Budavada, Raghavapuram and Vemavaram. On the other hand the rich assemblage of Gondwana plants known from Vemavaram exhibits a typically Jurassic character. So far, the Vemavaram flora has not yielded any Lower Cretaceous form known from India or abroad. The plant megafossils from Vemavaram are closely related to those from Raghavapuram and, therefore, the two outcrops are considered to be synchronous.

Cotter (1917, p. 27) found marine fossils together with plant fossils from Raghavapuram. In his opinion the identification of the two forms, *Macrocephalites* and *Trigonia interloevigita*, pointed towards a Lower Oolitic age. However, Spath (1933, p. 827) considered all the Gondwana outcrops of the East Coast to be Neocomian. The above two palaeontological evidences thus show considerable difference of opinion. The reason for this inconsistency cannot be determined at present.

Considering the palaeobotanical evidence, both megafossils as well as microfossils are in agreement in ascribing an Upper Jurassic age to the Gondwana outcrop at Vemavaram. The plant megafossils from Vemavaram are older than those of Bhuj Series (Lower Cretaceous) of Western India and the Jabalpur Series of Central India as they do not contain the two significant Cretaceous forms, viz. *Onychiopsis* and *Weichselia*. Similarly the miospore genera like *Contignisporites*, *Bhujiasporites* and *Coptospora*, etc. which are typically Lower Cretaceous are present in Bhuj but absent in Vemavaram. The Bhuj Series in Western India is underlain by Katrols which are definitely Upper Jurassic in age. The palynological assemblage of the Katrol Series, as has been pointed out earlier, shows close identity with that of Vemavaram. Hence, we are inclined in favour of an Upper Jurassic age for the Vemavaram outcrop.

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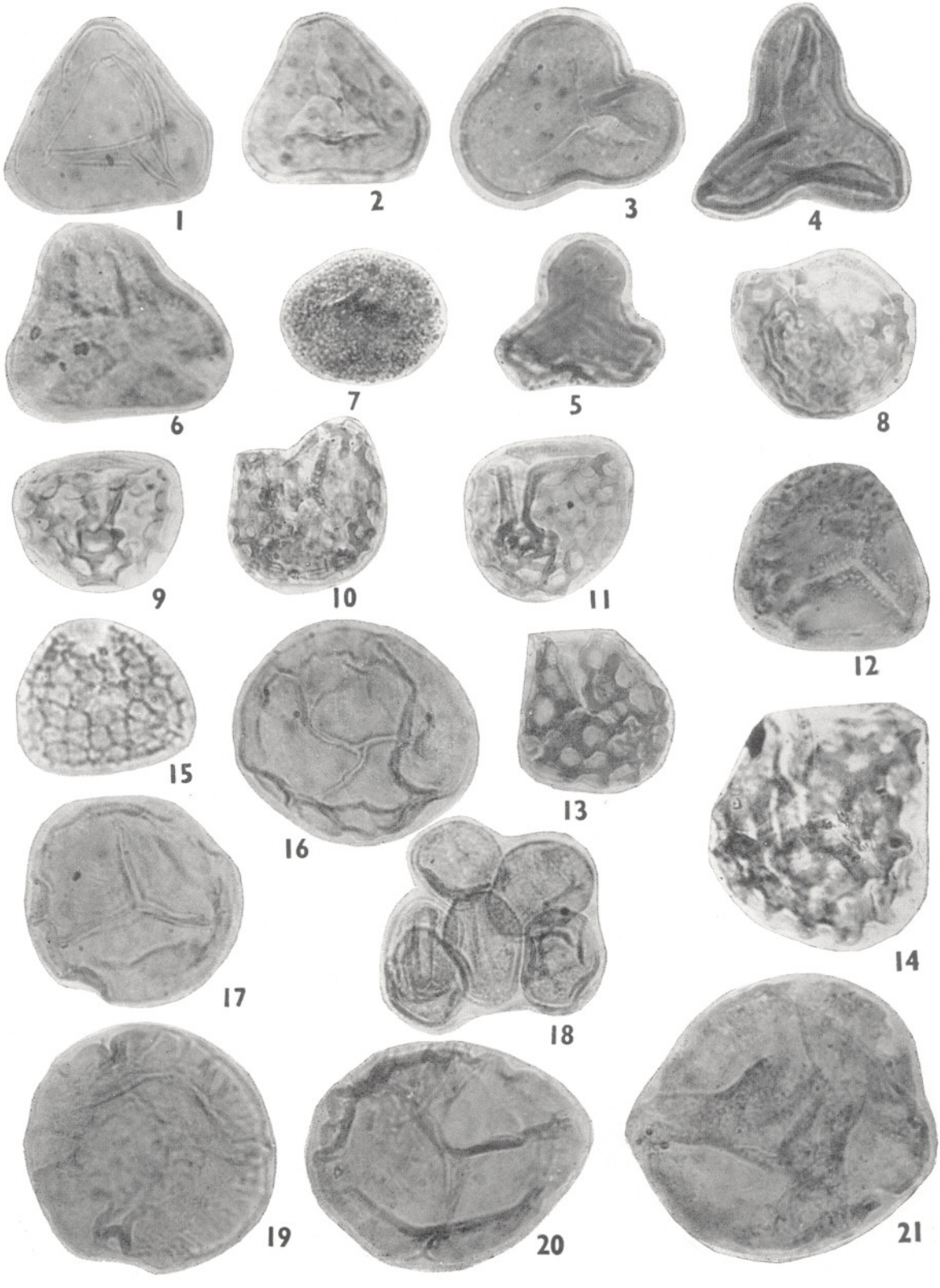
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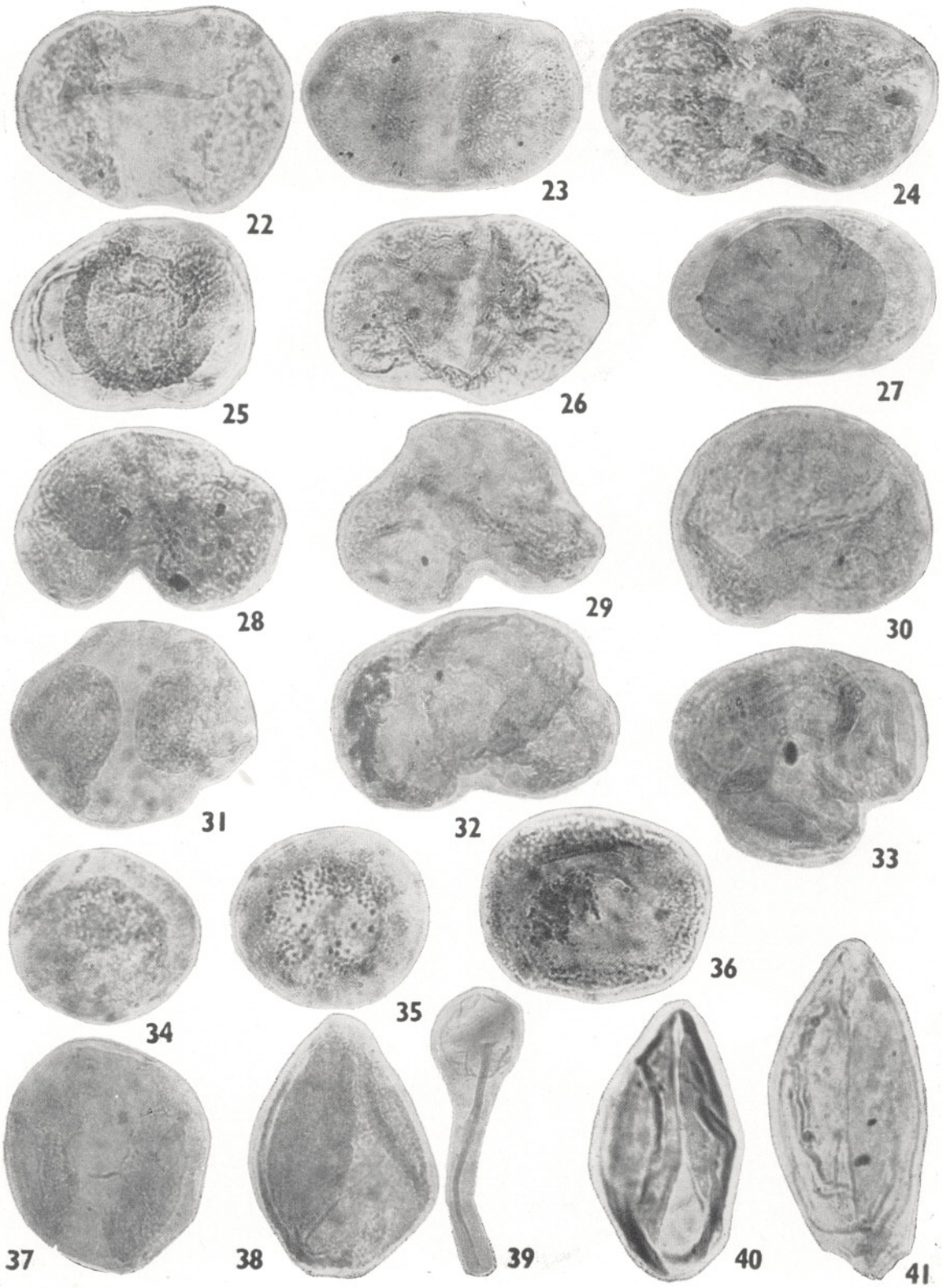
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EXPLANATION OF PLATES

(*All photomicrographs are enlarged ca.* × 500 *unless otherwise mentioned*)

PLATE 1

1-2. *Cyathidites jurassicus* sp. nov. Film nos. 249/20, 246/14.
3. *Cyathidites cf. C. minor* Couper. Film no. 248/27.
4. *Cyathidites cf. C. asper* Couper. Film no. 250/32.
5. *Cyathidites* sp. Film no. 248/9.
6. *cf. Callispora* sp. Film no. 249/16.
7. *Osmundacidites* cf. *O. wellmanii* Couper. Film no. 246/9.
8-13. *Ramanujamiaspora reticulata* gen. et sp. nov. Film nos. 249/18, 250/1, 206/1, 246/22, 249/35, 248/22.
14. *Ischyosporites* sp. Film no. 247/21.
15. *Lycopodiumsporites* sp. Film no. 246/21.
16-17. *Singhiapollis rudis* sp. nov. Film nos. 249/24, 249/29.
18. *Leschikisporis rudis* sp. nov. Film no. 250/5.
19-20. *Singhiapollis triletus* comb. nov. Film nos. 248/14, 248/24.
21. *Pollen type*-1. Film no. 248/3.

PLATE 2

22. *Podocarpidites* sp. A. Film no. 250/4.
23. *Podocarpidites* sp. B. Film no. 249/17.
24. *Platysaccus* sp. Film no. 247/15.
25-26. *Abietineaepollenites robustus* sp. nov. Film nos. 246/26, 249/14.
27. *Abietineaepollenites ellipticus* sp. nov. Film no. 247/30.
28-29. *Cedripites uudis* sp. nov. Film nos. 246/15, 249/10.
30. *Cedripites* sp. B. Film no. 249/5.
31. *Cedripites* sp. A. Film no. 250/12.
32. *Podosporites raoi* sp. nov. Film no. 249/1.
33. *Classopollis torosus* (Reiss.) Couper. Film no. 250/33.
34. *Granuloperculatipollis flavatus* Kar. Film no. 246/47.
35. *Granuloperculatipollis triletus* sp. nov. Film no. 247/19.
36. *Granuloperculatipollis subcircularis* sp. nov. Film no. 246/5.
37. *Indusiisporites microsaccatus* sp. *nov. Film* no. 248/25.
38. *Ginkgocycadophytus asymmetricus* sp. nov. Film no. 250/17.
39. *Plankton type*-1. *ca.* × 300. Film no. 250/31.
40. *Ginkgocycadophytus srivastavae* sp. nov. Film no. 250/2.
41. *Ginkgocycadophytus deterius* var. *majus* Dev Film no. 249/9.