Palynological investigation of the Jayamkondacholapuram Well–12, Tiruchirapalli district, Tamil Nadu, India

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A palynofloral assemblage, containing 57 genera and 104 species, is recorded from the Jayamkondacholapuram Well-12 in Tiruchirapalli District, Tamil Nadu. The assemblage includes 12 genera and 19 species of pteridophytic spores assignable to Cyatheaceae, Osmundaceae, Polypodiaceae, Gleicheniaceae and Schizaeaceae and 45 genera and 85 species of angiospermous pollen referable to Arecaceae, Potamogetonaceae, Liliaceae, Meliaceae, Brassicaceae, Gunneraceae, Araliaceae, Oleaceae, Rubiaceae, Caesalpiniaceae, Bombacaceae, Rhizophoraceae, Sapotaceae, Myricaceae, Alangiaceae, Ericaceae, Hippocrateaceae, Betulaceae, Ctenolophonaceae and Onagraceae. The present day distribution of these families indicates prevalence of a tropical climate with plenty of rainfall during the sedimentation of the studied stratigraphic sequence. Based on frequency analysis and vertical distribution of the palynofossils, three distinct biozones, viz., *Neocouperipollis* spp. Cenozone, *Triangulorites bellus* Cenozone and *Trilatiporites sellingii* Cenozone have been recognized. Each of these zones can be identified by its characteristic palynofossils. Comparison with known palynoassemblages indicates a Late Palaeocene-Middle Eocene age for the lignite and associated sediments of the Jayamkondacholapuram Well section.

Key-words - Palynology, Biostratigraphic zonation, Palaeocene-Eocene, Jayamkondacholapuram Well, Tiruchirapalli District, Tamil Nadu (India).

INTRODUCTION

PALYNOFLORAL investigation of the lignite and associated clays from Tamil Nadu (mostly Neyveli lignite mines) has been carried out by Navale (1962), Thiergart and Frantz (1963), Ramanujam (1966, 1967, 1982), Deb (1972), Deb *et al.* (1973), Venkatachala (1973), Navale and Misra (1979), Ambwani *et al.* (1981), Bande and Ambwani (1982), Reddy *et al.* (1984), Ramanujam and Reddy (1984), Sarma *et al.* (1984), Saxena (1984), Ramanujam *et al.* (1984, 1985, 1988), Siddhanta (1986), Sarma and Ramanujam (1988), Singh (1991), Singh and Misra (1991a, b, c), Singh *et al.* (1992).

The present study is based on the samples collected from Jayamkondacholapuram Well-12 (Lat. 11°11'27"N: Long. 79°24'02"E), located about 45 km south of Neyveli, in Tiruchirapalli district, Tamil Nadu (Map-1). The stratigraphic sequence encountered in Jayamkondacholapuram Well-12 consists of a variety of sandstones, shale and clays with lignite bed at the top (Text-figure 1). The details of the samples as to their stratigraphic position, lithology and palynological productivity are given in Table-1.

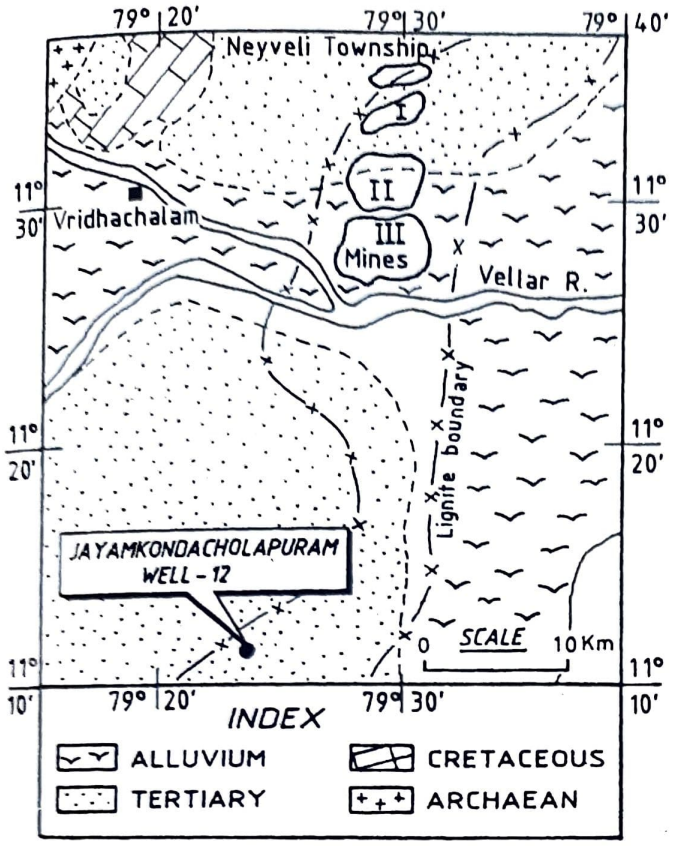
CHECK-LIST OF THE PALYNOTAXA

Pteridophytic spores – *Cyathidites australis* Couper 1953, *Garotriletes assamicus* Singh & Singh 1978, **Gleicheniidites concavus* sp. nov. (Pl. 1, figs 1-2), *Intrapunctisporis gigantica* Kar & Kumar 1986, *Laevigatosporites lakiensis* Sah & Kar 1969, **L. tertiarus* (Sah & Dutta 1968) comb. nov., **L. variabilis* sp. nov. (Pl. 1, fig. 7), *Lygodiumsporites eocenicus* Dutta & Sah 1970, *L. lakiensis* Sah & Kar 1969, *Neyvelisporites bolkhovitinae* (Ramanujam 1967) Ramanujam 1972, *Osmundacidites kutchensis* Sah & Kar 1969 (Pl. 1, fig. 3), *Polypodiisporonites mawkmaensis* (Dutta & Sah 1970) Mathur & Chopra 1982, **P. repandus* (Takahashi 1964) comb. nov., **Polypodiisporonites* sp. (Pl. 1, fig. 10), *Schizaeoisporites digitatoides* (Cookson 1957) Potonie 1960, *S. minimus* Ramanujam 1967, *S. sinuata* Ramanujam 1967, *Seniasporites verrucosus* Sah & Kar 1969, *Todisporites kutchensis* Sah & Kar 1969.

Table-1

Sample no.	Depth in m	Lithology	Productive/ unproductive
S-27	20.0	Mottled clay	Unproductive
S-28	35.0	Greyish-white clay	,,
S-29	36.0	Mottled clay	,,
S-30	48.0	Greyish-white clay	,,
S-31	106.5	,,	,,
S-32	113.5	White clay	,,
S-1	114.0	Lignite	Productive
S-2	115.0	,,	,,
S-3	116.0	,,	,,
S-4	117.0	,,	,,
S-5	118.0	,,	,,
S-6	119.0	,,	,,
S-7	120.0	,,	Unproductive
S-8	121.0	,,	,,
S-9	122.0	,,	Productive
S-10	123.0	,,	Unproductive
S-11	124.0	,,	Productive
S-12	125.9	,,	,,
S-13	127.0	,,	,,
S-14	127.5	Lignitic clay	,,
S-15	128.0	,,	,,
S-16	142.3	Carbonaceous sandstone	,,
S-17	144.0	Sandstone interbedded with carbonaceus lamina	,,
S-18	144.6	Carbonaceous sandy clay	Unproductive
S-19	156.0	Carbonaceous clay	Productive
S-20	159.3	,,	,,
S-21	168.0	Black clay	Unproductive
S-22	171.0	Carbonaceous clay	,,
S-23	175.2	,,	,,
S-24	206.0	Greyish-black shale	Productive
S-25	211.0	Greyish-black silty shale	Unproductive
S-26	226.5	Greyish-black shale	,,
S-33	512.0	Calcareous sandstone	,,

Angiospermous pollen – **Acanthotricolpites brevispinosus* sp. nov. (Pl. 2, fig. 12), **A. karii* sp. nov. (Pl. 2, figs 17-18), **A. microreticulatus* sp. nov. (Pl. 2, figs 10-11), **A. robustus* sp. nov. (Pl. 2, figs 8, 16), **A. tiruchirapalliensis* sp. nov. (Pl. 2, figs 2, 15), *cf. *Acanthotricolpites* sp. (Pl. 2, fig. 3), *Alangiopollis arcotense* Navale & Misra 1979 (Pl. 2, fig. 20), *Araliaceoipollenites matanomadhensis* Venkatachala & Kar 1969, *Arecipites bellus* Sah & Kar 1970, *A. punctatus* Wodehouse 1933, *Arengapollenites achinatus* Kar 1985, **Cryptopolyporites indicus* sp. nov. (Pl. 2, fig. 23), **Cryptopolyporites* sp. (Pl. 2, fig. 14), **Ctenolophonidites magnus* sp. nov. (Pl. 2, fig. 4), *Ctenolophonidites saadii* Ramanujam & Rao 1973, *Dracaenoipollis circularis* Sah & Kar 1970 (Pl. 1, fig. 13), *Echimonoporopollis grandiporus* Saxena *et al.* 1991, *E. neyveliensis* Saxena *et al.* 1991, **Echitricolporites* sp. (Pl. 1, fig. 19), *Ericipites sahnii* Ramanujam 1966, **Foveotrico-lpites tamilensis* sp. nov. (Pl. 1, fig. 17), **Gemmatriporopollis triangulus* gen. et sp. nov. (Pl. 2, figs 6-7), *Hippocrateaceaedites vancampoae* Ramanujam 1966, *Jacobipollenites magnificus* Ramanujam 1966, *Lakiapollis ovatus* Venkatachala & Kar 1969, **Margocolporites ghoshii* (Ramanujam 1966) comb. nov., **M. granimuratus* sp. nov. (Pl. 1, fig. 22), *M. oligobrochatus* Ramanujam 1966, *M. sitholeyi* Ramanujam 1966, *M. tsukadae* Ramanujam 1966, **Matanomadhiasulcites major* (Singh 1977) comb. nov., *Meliapollis iratus* (Sah & Kar 1974) Navale & Misra 1979, *M. navalei* Sah & Kar 1970, *M. quadrangularis* (Ramanujam 1966) Sah & Kar 1970, *M. ramanujamii* Sah & Kar 1970, *M. raoi* Sah & Kar 1970, **Meliapollis* sp. (Pl. 1, fig. 16), **Myricipites* sp. (Pl. 2, fig. 1), *Neocouperipollis achinatus* (Sah & Kar 1970) Kar & Kumar 1987, *N. brevispinosus* (Biswas 1962) Sarkar & Singh 1988, **N. cymbatus* (Venkatachala & Rawat 1972) comb. nov., **N. donaensis* (Rao *et al.* 1985) comb. nov., *N. kutchensis* (Venkatachala & Kar 1969) Kar & Kumar 1987, *N. rarispinosus* (Sah & Dutta 1966) Singh 1990, **N. robustus* (Saxena 1979) comb. nov. **N. wodehousei* (Biswas 1962) comb. nov., *Paleosantalaceaepites minutus* Sah & Kar 1970, *Palmaepollenites plicatus* Sah & Kar 1970, *Palmidites maximus* Couper 1953, *P. naviculus* Kar & Saxena 1981, *P. plicatus* Sah & Kar 1970, *Pellicieroipollis langenheimii* Sah & Kar 1970, **Periretitricolpites indicus* sp. nov. (Pl. 1, figs 24-25), *Polybrevicolporites cephalus* Venkatachala & Kar 1969 (Pl. 1, fig. 14), *Proxapertites assamicus* (Sah & Dutta 1966) Singh 1975 - Tetrad (Pl. 1, fig.



Map 1. Showing location of the Jayamkondacholapuram Well-12, Tiruchirapalli District, Tamil Nadu.

9), *P. microreticulatus* Jain *et al.* 1973, **Pseudonothofagidites septaporatus* sp. nov. (Pl. 2, figs 21-22), **Psilastephanocolpites quadrangularis* sp. nov. (Pl. 1, fig. 21), **Psilatricolporites sahii* sp. nov. (Pl. 2, fig. 5), *Retimonosulcites ovatus* (Sah & Kar 1970) Kar 1985, *Retipilonapites arcotense* Ramanujam 1966, **Retipollenites laevigatus* sp. nov. (Pl. 1, fig. 8), **R. ramanujamii* sp. nov. (Pl. 1, fig. 11), *Retitrescolpites decipiens* Sah 1967, **Retitricolpites ramanujamii* sp. nov. (Pl. 1, fig. 12), **Retitricolpites singhii* sp. nov. (Pl. 1, fig. 5), **Retitricolporites minor* sp. nov. (Pl. 1, fig. 6, pl. 2, fig. 13), **Retitricolporites* sp. (Pl. 1, fig. 15), *Spinainaperturites conatus* Venkatachala & Rawat 1972, *S. densispinus* Venkatachala & Rawat 1972, *S. horridus* Venkatachala & Rawat 1972 (Pl. 1, fig. 18), *Spinizonocolpites echinatus* Muller 1968, **S. venkatachalae* sp. nov. (Pl. 1, figs 4, 23, pl. 2, fig. 9), **Thomsonipollis psilatus* sp. nov. (Pl. 2, fig. 19), *Triangulorites bellus* (Sah & Kar 1970) Kar 1985, **Triangulorites* sp. (Pl. 1, fig. 20), *Tricolpites crassireticulatus* Dutta & Sah 1970, *T. matanomadhensis* Saxena 1979, *T. minutus* Sah & Kar 1970, *T. retibaculatus* Saxena 1979, *T. reticulatus* Cookson 1947, *Tricolporopollis matanomadhensis* (Venkatachala & Kar 1969) Tripathi & Singh 1985, *T. rubra* Dutta & Sah 1970, *Trilatiporites sellingii* Ramanujam 1966, *Triporopollenites parvus* Sah 1967.

Taxa marked with asterisk (*) are described or commented upon herein. Plate and figure numbers given in the above list in parentheses refer to the illustrations of the present paper. Holotypes are permanently stored at the repository of the Birbal Sahni Institute of Palaeobotany, Lucknow.

DESCRIPTION

Genus - ***Gleicheniidites*** Ross 1949 emend. Dettmann 1963

Gleicheniidites concavus sp. nov.

Pl. 1, Figs 1-2

Holotype - Pl. 1, figs 1-2, slide no. BSIP 10376, coordinates 38.2 x 96.1.

Type Locality - Jayamkondacholapuram Well-12 (depth 127.5 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

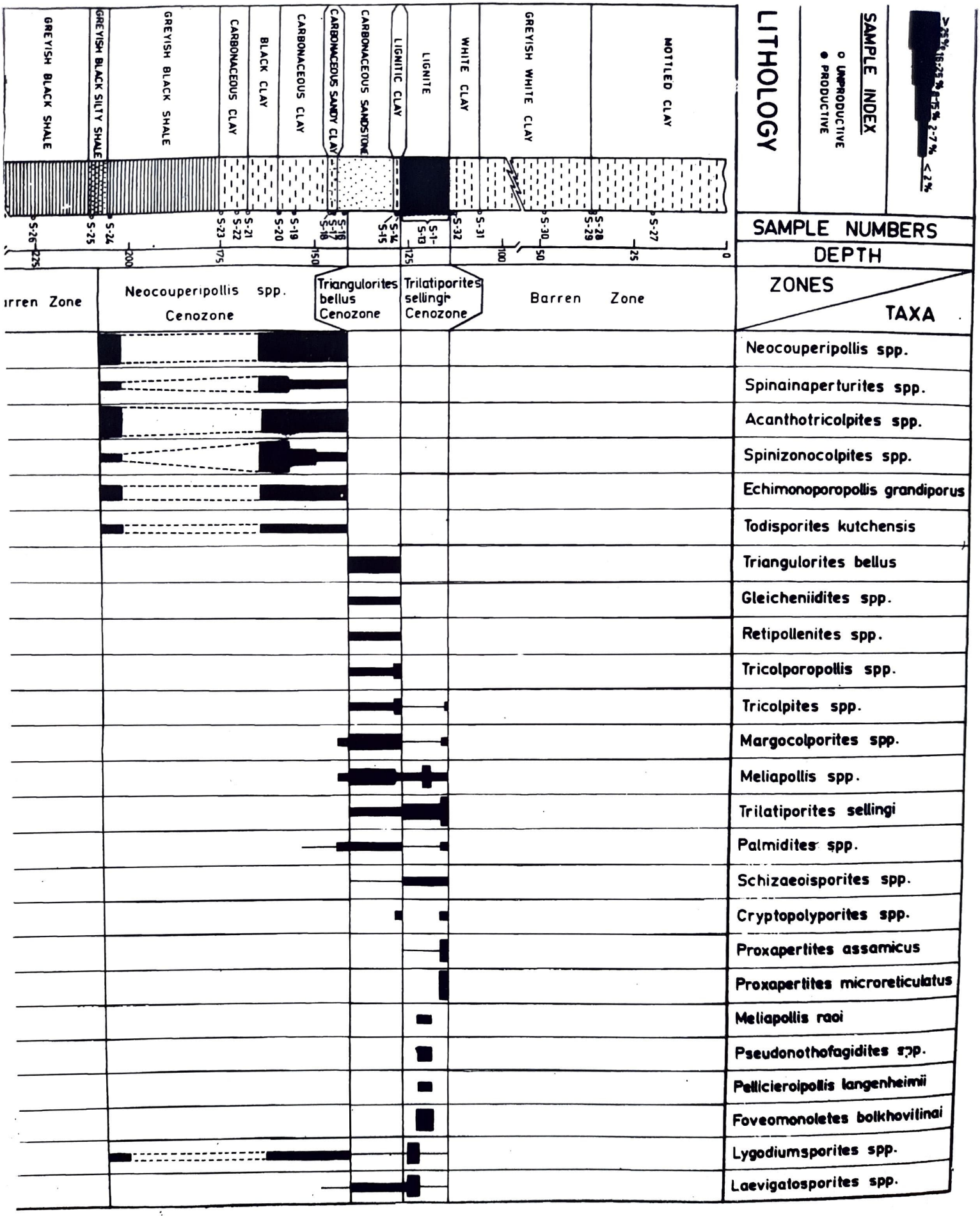
Diagnosis - Spores triangular with rounded apices and concave interapical sides. Size range 50-60 µm. Trilete, rays distinct, extending up to three-fourths radius, bordered by psilate folds. Exine 1.5-2 µm thick, psilate.

Comparison - The present species differs from *G. senonicus* Ross (1949, 24-34 x 13-19 µm) by its bigger size. *Gleicheniidites* sp. (Singh 1977, pl. 1, fig. 22) is distinguished by its intrapunctate inter-radial area. *Gleicheniidites indicus* Singh *et al.* (1964) is smaller in size (28-48 µm) and has angular apices.

Genus - ***Laevigatosporites*** Ibrahim 1933

Laevigatosporites tertiarus (Sah & Dutta 1968) comb. nov.

Basionym - *Polypodiaceaesporites tertiarus* Sah & Dutta 1968, *Palaeobotanist* **16** (2): 185-186, Pl. 1, Fig. 12.



Text-figure 1. Palynostratigraphic zonation of the Jayamkondacholapuram Well–12, Tiruchirapalli District, Tamil Nadu.

Remarks - Srivastava (1971) considered *Polypodiaceaesporites* Thiergart (1938) ex Potonie (1956) as an obligate junior synonym of *Laevigatosporites* Ibrahim (1933) and we agree with this treatment. *Polypodiaceaesporites tertiarus* Sah & Dutta (1968) is accordingly transferred to *Laevigatosporites* Ibrahim (1933).

Laevigatosporites variabilis sp. nov.

Pl. 1, Fig. 7

Holotype - Pl. 1, fig. 7, slide no. BSIP 10386, coordinates 83.9 x 101.1.

Type Locality - Jayamkondacholapuram Well-12 (depth 128.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Spores oval in shape. Size range 50-67 x 40-52 µm. Monolete, ray well developed, extending from one end to the other along the longer axis. Exine 1.5-3 µm thick, granulate to scabrate, folded.

Comparison - *Laevigatosporites ovatus* Wilson & Webster (1946), *L. arcotensis* Ramanujam (1967) and *L. lakiensis* Sah & Kar (1969) differ by their laevigate exine. *Laevigatosporites cognatus* Sah & Kar (1969) is distinguished by its subcircular shape and laevigate exine.

Genus - ***Polypodiisporonites*** Potonie 1931

Polypodiisporonites repandus (Takahashi 1964) comb. nov.

Basionym - *Polypodiisporites repandus* Takahashi 1964, *Mem. Faculty Sci., Kyushu Univ., Ser. D, Geol.* **14** (3): 217, pl. 30, figs 1-11, pl. 31, fig. 1, pl. 40, figs 22a, b; Holotype - Pl. 30, figs 5a, b.

Remarks - Since *Polypodiisporonites* Potonie (1931) is an obligate senior synonym of *Polypodiisporites* Potonie (1931) in Potonie & Gelletich (1933) ex Potonie (1956), *Polypodiisporites repandus* Takahashi (1964) is shifted to *Polypodiisporonites* Potonie (1931).

***Polypodiisporonites* sp.**

Pl. 1, Fig. 10

Description - Spores oval. Size 52-56 µm. Monolete, ray faintly discernible, extending up to 2/3 of the longer axis. Exine 2 µm thick, verrucate, verrucae rounded, 3-4 µm high.

Comparison - *Polypodiisporonites repandus* (Takahashi 1964) comb. nov. can be distinguished by its comparatively larger and flat-topped verrucae. *Polypodiisporites ornatus* Sah (1967) has conical verrucae and *Polypodiisporites minor* Sah (1967) is smaller (48-51 x 26-35 µm) and ellipsoidal in shape.

Genus - ***Retipollenites*** Gonzalez Guzman, 1967

Retipollenites laevigatus sp. nov.

Pl. 1, Fig. 8

Holotype - Pl. 1, fig. 8, slide no. BSIP 10378, coordinates 56.8 x 106.5.

Type Locality - Jayamkondacholapuram Well-12 (depth 128.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular to subcircular. Size range 55-61 x 50-56 µm. Inaperturate, enveloped by loose reticulum. Exine 1.5-2.5 µm thick (excluding reticulum), retipilate, reticulum coarse, muri 2.5-3.5 µm thick, lumina vary in shape from circular-oval to triangular, 6-11 µm in diameter, reticulum supported by sparsely placed pila, inner body laevigate.

Comparison - *Retipollenites confusus* Gonzalez Guzman (1967) differs in being smaller (48 µm) and having comparatively smaller (1.5 - 7 µm) lumina.

Retipollenites ramanujamii sp. nov.

Pl. 1, Fig. 11

Holotype - Pl. 1, fig. 11, slide no. BSIP 10375, coordinates 61.6 x 101.1.

Type Locality - Jayamkondacholapuram Well-12 (depth 127.5 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular-oval. Size range 50-59 x 40-55 µm. Inaperturate, covered by loose, coarse reticulum, reticulum supported by 5-6 µm high pila, muri 2.5-3.5 µm thick, lumina vary in shape, 4-12 µm in diameter. Exine 2-3.5 µm thick (excluding reticulum), ornamented with minute, delicate, hair-like bacula or spinules.

Comparison - The present species can be distinguished from *R. confusus* Gonzalez Guzman (1967) and *R. laevigatus* sp. nov. by its baculate/ spinulate sculpture of the inner body.

Genus - ***Matanomadhiasulcites*** Kar 1985

Matanomadhiasulcites major (Singh 1977) comb. nov.

Basionym - *Liliacidites major* Singh 1977, *Palaeobotanist* **23** (3): 196, pl. 3. figs 51-53; Holotype - Pl. 3, fig. 51.

Remarks - *Liliacidites major* described by Singh (1977, pl. 3, figs 51-53) conforms with the generic diagnosis of *Matanomadhiasulcites*, hence transferred to the latter as a new combination.

Genus - ***Neocouperipollis*** Kar & Kumar 1987

Neocouperipollis wodehousei (Biswas 1962) comb. nov.

Basionym - *Araceaepites wodehousei* Biswas 1962, *Bull. geol. Min. metall. Soc. India* **25**: 47, pl. 12, fig. 30.

Neocouperipollis cymbatus (Venkatachala & Rawat 1972) comb. nov.

Basionym - *Couperipollis cymbatus* Venkatachala & Rawat 1972, in Ghosh A.K. *et al.* (Eds.) - *Proc. Sem. Paleopalynol. Indian Stratigr., Calcutta, 1971*. Bot. Dept., Calcutta Univ.: 296, pl. 1, figs 11-12; Holotype - Pl. 1, fig. 11.

Neocouperipollis robustus (Saxena 1979) comb. nov.

Basionym - *Couperipollis robustus* Saxena 1979, *Palaeobotanist* **26** (2): 131-132, pl. 1, fig. 8.

Neocouperipollis donaensis (Rao *et al.* 1985) comb. nov.

Basionym- *Couperipollis donaensis* Rao *et al.* 1985, *Geophytology* **15** (1): 10, pl. 1, figs 11-13; Holotype - Pl. 1, fig. 12.

Genus - ***Spinizonocolpites*** Muller 1968

Spinizonocolpites venkatachalae sp. nov.

Pl. 1, Figs 4, 23, pl. 2, Fig. 9

Holotype - Pl. 1, fig. 4, slide no. BSIP 9945, coordinates 43.6 x 97.6.

Type Locality - Jayamkondacholapuram Well-12 (depth 142.3 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains subcircular to oval. Size range 43-50 x 32-45 µm. Zonisulcate. Exine 1-1.5 µm

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PLATE 1 →

1-2. *Gleicheniidites concavus* sp. nov.; slide no. BSIP 10376, coordinates 38.2 x 96.1.
3. *Osmundacidites kutchensis* Sah & Kar; slide no. BSIP 10377, coordinates 64.8 x 104.0.
4, 23. *Spinizonocolpites venkatachalae* sp. nov.; slide no. BSIP 9945, coordinates 43.6 x 97.6; slide no. BSIP 10389, coordinates 71.6 x 95.5.
5. *Retitricolpites singhii* sp. nov.; slide no. BSIP 9944, coordinates 49.9 x 110.8.
6. *Retitricolporites minor* sp. nov.; slide no. BSIP 9945, coordinates 37.7 x 95.6.
7. *Laevigatosporites variabilis* sp. nov.; slide no. BSIP 10386, coordinates 83.9 x 101.1.
8. *Retipollenites laevigatus* sp. nov.; slide no. BSIP 10378, coordinates 56.8 x 106.5.
9. *Proxapertites assamicus* (Sah & Dutta) Singh - Tetrad; slide no. BSIP 10377, coordinates 57.9 x 94.2.
10. *Polypodiisporonites* sp.; slide no. BSIP 10379, coordinates 34.0 x 95.7.
11. *Retipollenites ramanujamii* sp. nov.; slide no. BSIP 10375, coordinates 61.6 x 101.1.
12. *Retitricolpites ramanujamii* sp. nov.; slide no. BSIP 10375, coordinates 61.6 x 94.3.
13. *Dracaenoipollis circularis* Sah & Kar; slide no. BSIP 10386, coordinates 60.2 x 110.0.
14. *Polybrevicolporites cephalus* Venkatachala & Kar; slide no. BSIP 10383, coordinates 30.8 x 99.6.
15. *Retitricolporites* sp.; slide no. BSIP 10386, coordinates 63.6 x 100.3.
16. *Meliapollis* sp.; slide no. BSIP 10386, coordinates 61.5 x 105.5. x500.
17. *Foveotricolpites tamilensis* sp. nov.; slide no. BSIP 10386, coordinates 26.6 x 103.2.
18. *Spinainaperturites horridus* Venkatachala & Rawat; slide no. BSIP 10376, coordinates 55.1 x 99.1.
19. *Echitricolporites* sp.; slide no. BSIP 10375, coordinates 56.0 x 103.5.
20. *Triangulorites* sp.; slide no. BSIP 10378, coordinates 71.1 x 101.1.
21. *Psilastephanocolpites quadrangularis* sp. nov.; slide no. BSIP 10386, coordinates 63.5 x 100.8.
22. *Margocolporites granimuratus* sp. nov.; slide no. BSIP 10386, coordinates 38.3 x 109.9.
24-25. *Periretitricolpites indicus* sp. nov.; slide no. BSIP 10375, coordinates 40.6 x 95.8.

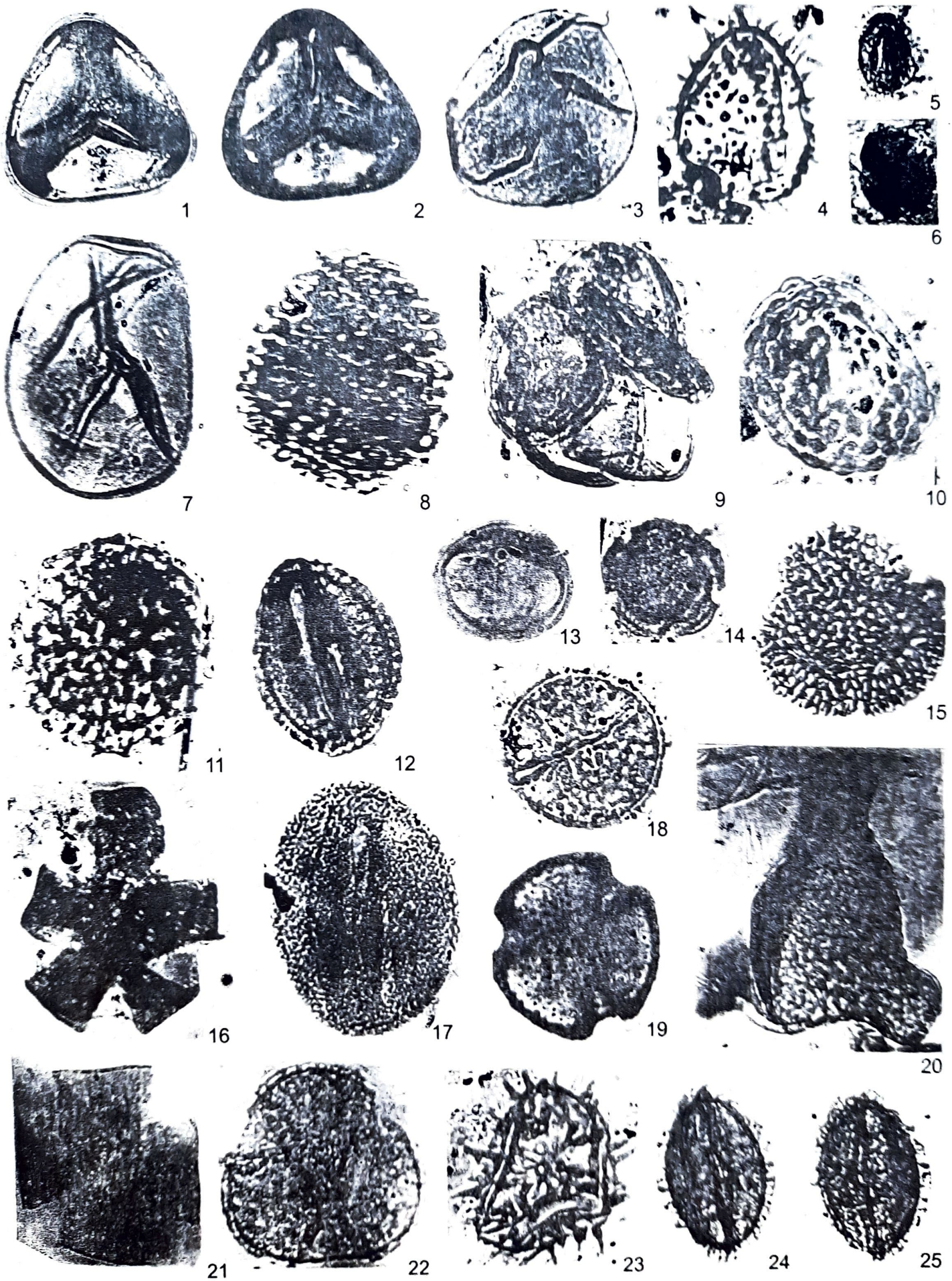

PLATE I

thick, spinose, spines 5-7.5 μm long with pointed tips, interspinal area laevigate.

Comparison - The present species can be distinguished from *S. echinatus* Muller (1968) by its laevigate interspinal area. *Spinizonocolpites quilonensis* Rao & Ramanujam (1978) differs from the present species by its smaller size (35-42 x 26-30 μm), thicker exine (3.5 μm) and shorter spines (up to 3 μm). *Spinizonocolpites spinulosus* Ramanujam (1987) is distinguished by its smaller size (23-28.5 x 14.5-18 μm) and microreticulate interspinal area. *Spinizonocolpites baculatus* Muller (1968) is baculate, hence not comparable with the present species.

Genus - ***Periretitricolpites*** Jan du Chene *et al.* 1978

Periretitricolpites indicus sp. nov.

Pl. 1, Figs 24, 25

Holotype - Pl. 1, figs 24-25, slide no. BSIP 10375, coordinates 40.6 x 95.8.

Type Locality - Jayamkondacholapuram Well-12 (depth 127.5 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains oval in equatorial view. Size range 45-47 x 30-36 μm. Tricolpate, colpi narrow, extending from one end to the other. Exine (including pila) 5 μm thick, retipilate, pila 4 μm long and form coarse loose reticulam, interpilar area scabrate.

Comparison - *Periretitricolpites anambraensis* Jan du Chene *et al.* (1978) differs by its bigger size (74 μm), wider lumina (11-18 μm) and psilate body.

Genus - ***Foveotricolpites*** Pierce 1961

Foveotricolpites tamilensis sp. nov.

Pl. 1, Fig. 17

Holotype - Pl. 1, fig. 17, slide no. BSIP 10386, coordinates 26.6 x 103.2.

Type Locality - Jayamkondacholapuram Well-12 (depth 128.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grain oval in equatorial view. Size 56-62 x 48-52.5 μm. Tricolpate, colpi narrow, about two-third of the polar axis in length. Exine 2-5 μm thick, tectate, columella distinct, sculpture foveoreticulate, foveolae small and densely placed.

Comparison - *Foveotricolpites prolatus* Rao & Ramanujam (1982) resembles the present species in having small and closely placed foveolae and long colpi but differs by its broader colpi, thinner exine (1.8 μm thick) and smaller (26-38 x 17.5-32 μm) size.

PLATE 2 →

1. *Myricipites* sp.; slide no. BSIP 10376, coordinates 46.8 x 94.9.
2,15. *Acanthotricolpites tiruchirapalliensis* sp. nov.; slide no. BSIP 10389, coordinates 48.1 x 98.2, slide no. BSIP 10387, coordinates 29.6x96.5.
3. cf. *Acanthotricolpites* sp.; slide no. BSIP 9944, coordinates 54.6x94.0.
4. *Ctenolophonidites magnus* sp. nov.; slide no. BSIP 10390, coordinates 33.8 x 100.5.
5. *Psilatricolporites sahii* sp. nov.; slide no. BSIP 10377, coordinates 69.4 x 95.8.
6-7. *Gemmatriporopollis triangulus* sp. nov.; slide no. BSIP 10385, coordinates 60.7 x 95.7, slide no. BSIP 10385, coordinates 69.0 x 96.2.
8,16. *Acanthotricolpites robustus* sp. nov.; slide no. BSIP 10383, coordinates 63.0 x 108.3, slide no. BSIP 10383, coordinates 31.3 x 109.5.
9. *Spinizonocolpites venkatachalae* sp. nov.; slide no. BSIP 10389, coordinates 53.4 x 102.6.
10-11. *Acanthotricolpites microreticulatus* sp. nov.; slide no. BSIP 10391, coordinates 47.9 x 100.3, slide no. BSIP 9944, coordinates 53.2 x 99.0.
12. *Acanthotricolpites brevispinosus* sp. nov.; slide no BSIP 10388; coordinates 28.8 x 98.5.
13. *Retitricolporites minor* sp. nov.; slide no. BSIP 9945, coordinates 37.7 x 95.6.
14. *Cryptopolyporites* sp.; slide no. BSIP 10392, coordinates 26.1x91.2.
17-18. *Acanthotricolpites karii* sp. nov.; slide no. BSIP 10384, coordinates 53.7 x 105.4.
19. *Thomsonipollis psilatus* sp. nov.; slide no. BSIP 10378, coordinates 52.8 x 99.6.
20. *Alangiopollis arcotense* Navale & Misra; slide no. BSIP 10378, coordinates 32.4 x 103.2.
21-22. *Pseudonothofagidites septaporatus* sp. nov.; slide no. BSIP 10385, coordinates 48.6x103.0.
23. *Cryptopolyporites indicus* sp. nov.; slide no. BSIP 10376, coordinates 34.7x71.3.

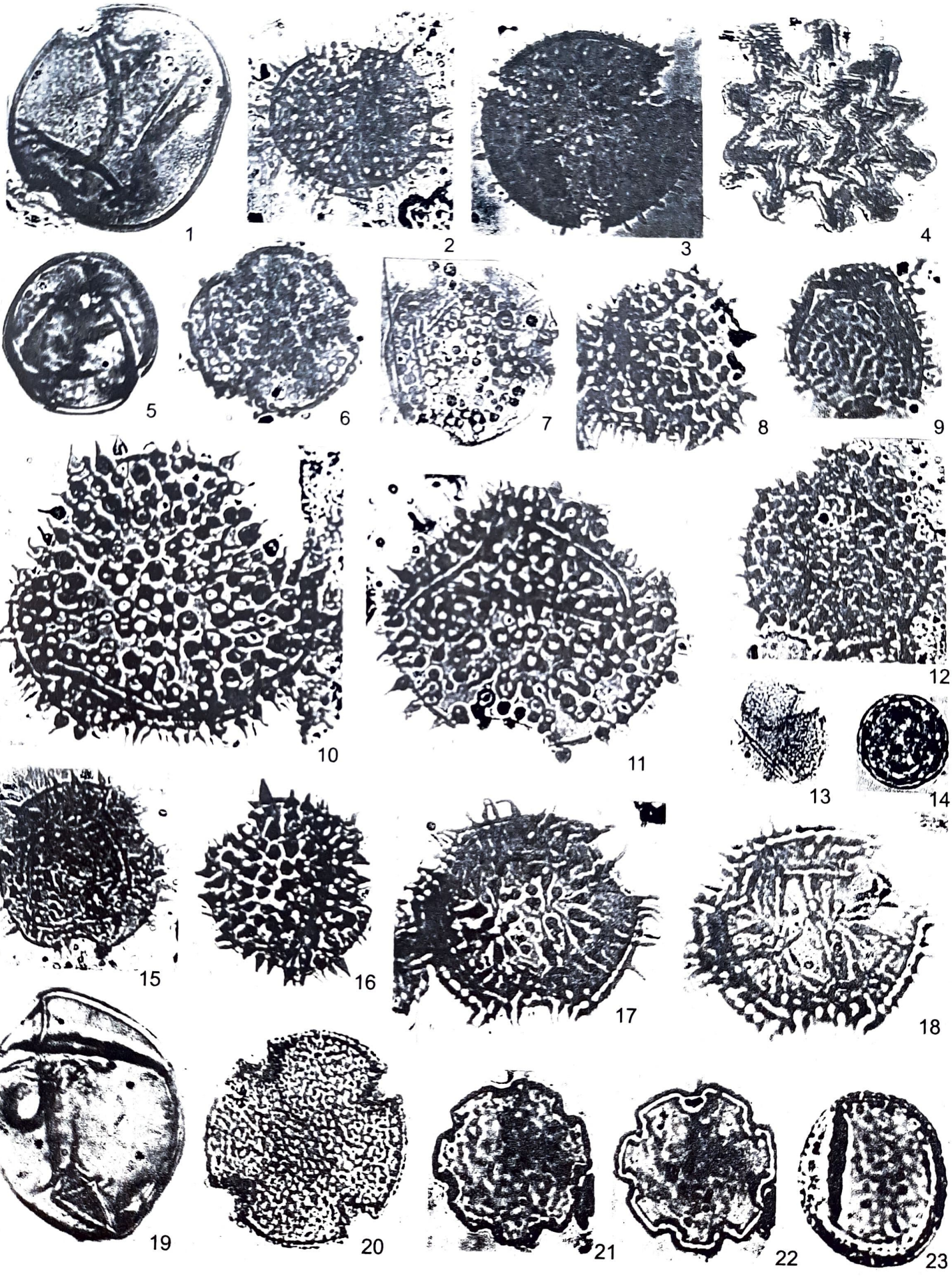

PLATE 2

Genus - ***Retitricolpites*** van der Hammen, 1956 ex Pierce 1961

Retitricolpites ramanujamii sp. nov.

Pl. 1, Fig. 12

Holotype - Pl. 1, fig. 12, slide no. BSIP 10375, coordinates 61.6 x 94.3.

Type Locality - Jayamkondacholapuram Well-12 (depth 127.5 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis – Pollen grains subcircular in equatorial view. Size 52-54 x 48-51 µm. Tricolpate, colpi narrow, long, colpi margin thickened. Exine 4µm thick, tectate, sexine thicker than nexine, retipilate, pila 3.5 µm high, muri thick, simplipilate, lumina polygonal in shape.

Comparison – Retitricolpites dipterocarpoides Rao & Ramanujam (1982) is distinguished from the present species by its thinner exine (1.5 µm thick). *R. marginatus* von Hoeken Klinkenberg (1966, 24-29 µm) and *R. sitholeyi* Ramanujam (1966, 26-30 µm) are smaller than the present species.

Retitricolpites singhii sp. nov.

Pl. 1, Fig. 5

Holotype - Pl. 1, fig. 5, slide no. BSIP 9944, coordinates 49.9 x 110.8.

Type Locality - Jayamkondacholapuram Well-12 (depth 144.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis – Pollen grains oval in equatorial view. Size 21-23 x 14-16 µm. Tricolpate, colpi long with thickened margin. Exine 1.5-2 µm thick, tectate, sexine as thick as nexine, retipilate, pila less than 1 µm high, reticulum very fine.

Comparison – Retitricolpites microreticulatus van der Hammen & Wymstra (1964) and *R. marginatus* von Hoeken Klinkenberg (1966) described by Rao & Ramanujam (1982) are distinguished from the present species by their larger size (21-25 µm and 24-29 µm respectively) and comparatively coarser reticulum. The present species also differs from *R. sitholeyi* Ramanujam (1966) and *R. dipterocarpoides* Rao & Ramanujam (1982) by its smaller size and finer reticulum.

Genus - ***Psilastephanocolpites*** Leidelmeyer 1966

Psilastephanocolpites quadrangularis sp. nov.

Pl. 1, Fig. 21

Holotype - Pl. 1, fig. 21, slide no. BSIP 10386, coordinates 63.5 x 100.8.

Type Locality - Jayamkondacholapuram Well-12 (depth 128.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis – Pollen grains quadrangular. Size range 52-74 µm. Tetra- pentacolpate, colpi broad and long, colpi margin not thickened. Exine 1-3 µm thick, psilate.

Comparison – Psilastephanocolpites arcotense Ramanujam (1966) and *P. raoi* (Ramanujam 1966) Saxena (1982) are smaller in size than the present species. *P. maia* Leidelmeyer (1966) is distinguished by its smaller size (25 µm).

Genus - ***Psilatricolporites*** van der Hammen 1954 ex Pierce 1961

Psilatricolporites sahii sp. nov.

Pl. 2, Fig. 5

Holotype - Pl. 2, fig. 5, slide no. BSIP 10377, coordinates 69.4 x 95.8.

Type Locality - Jayamkondacholapuram Well-12 (depth 156.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis – Pollen grains circular in shape. Size range 42-45 µm. Tricolporate, colpi long and narrow with pointed ends, pores distinct 0.5 µm in diameter, pore margin slightly thickened. Exine 1.5 µm thick, tectate, columella distinct, sexine as thick as nexine, ±psilate.

Comparison – Psilatricolporites ebenoides Rao & Ramanujam (1982) differs from the present species by its smaller size (22-29 x 11-16 µm) and triangular shape. *Psilatricolporites minor* Ramanujam (1966) differs by its smaller (21.3 x 18.2 µm) and thicker exine (2-3 µm).

Genus – ***Retitricolporites*** van der Hammen 1956 ex van der Hammen & Wymstra 1964

Retitricolporites minor sp. nov.

Pl. 1, Fig. 6, Pl. 2, Fig. 13

Holotype - Pl. 2, fig. 13, slide no. BSIP 9945, coordinates 37.7 x 95.6.

Type Locality - Jayamkondacholapuram Well-12 (depth 142.3 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis – Pollen grains circular in polar view and oval in equatorial view. Size range 22-25 µm. Tricolporate, colpi moderately long with pointed ends, pores 3.3-4 µm in diameter. Exine 1.5-2 µm thick, tectate, retipilate, pila 1 µm high, reticulum fine.

Comparison – Retitricolporites cuddalorense Ramanujam (1966) differs from the present species by its larger size range (30-35 x 38-42 µm), thicker exine and comparatively coarser reticulum. *Retitricolporites* sp. (Kar & Kumar 1986) is distinguished by its very large size (80-84 x 60-70 µm). *R. rhombicus* Ramanujam (1987) is similar to the present species in size but is distinguished by its longer colpi, thicker exine and coarser reticulum. *R. operculatus* and *R. variabilis*, both described by Ramanujam (1987), are distinguished by their larger size, triangular shape and coarser reticulum. The present species is distinguished from *R. crassioratus* Rao & Ramanujam (1982) by its retipilate exine.

***Retitricolporites* sp.**

Pl. 1, Fig. 15

Description - Pollen grain isopolar, subtriangular in polar view. Size 50 x 49 µm. Tricolporate, longicolpate, colpi broad with pointed ends, ora distinct. Exine 3.3 µm thick, tectate, sexine thicker than nexine, reticulate, reticulim coarse, muri simplibaculate, lumina polygonal to subcircular in shape.

Comparison – Retitricolporites crassioratus Rao & Ramanujam (1982) can be distinguished from the present species by its smaller size (25-35 µm) and thinner exine (1.8 µm). *R. annulatus* Salard-Cheboldaeff (1978) is distinguished by its smaller size (16-22 µm).

Genus - ***Margocolporites*** Ramanujam 1966

Margocolporites ghoshii (Ramanujam 1966) comb. nov.

Basionym - Retitricolporites ghoshii Ramanujam 1966, Pollen Spores 8(1): 173, pl. 3, fig. 63.

Remarks – The specimens described by Ramanujam (1966, p. 173, pl. 3, fig. 63) as *Retitricolporites ghoshii* show margo structure, hence transferred to *Margocolporites* as a new combination.

Margocolporites granimuratus sp. nov.

Pl. 1, Fig. 22

Holotype - Pl. 1, fig. 22, slide no. BSIP 10386, coordinates 38.3 x 109.9.

Type Locality - Jayamkondacholapuram Well-12 (depth 128.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis – Pollen grains isopolar, subtriangular in polar view. Size range 52-56 x 52-54 µm. Trimargocolporate, longicolpate, colpi 9-11 µm broad, mesocolpia wide. Exine 2 µm thick, sexine thicker than nexine, retipilate, pila sparsely placed, muri thinner than lumina, granulate, lumina circular to subcircular, 3-5 x 2-4 µm in size.

Comparison – The present species is distinguished from *M. tsukadae, M. sitholeyi, M. sahnii, M. dubius* and *M. oligobrochatus*, all described by Ramanujam (1966), by its granulate muri.

Genus - ***Echitricolporites*** van der Hammen, 1956 ex Germeraad *et al.* 1968

***Echitricolporites* sp.**

Pl. 1, Fig. 19

Description - Pollen grain subtriangular in polar view. Size 42 µm. Tricolporate, brevicolpate, ora distinct, 10 µm in diameter, pore margin thickened. Exine 2.5 µm thick, sexine thicker than nexine, spinose, interspinal area punctate to granulate.

Comparison - Echitricolporites spinosus (van der Hammen, 1956) Germeraad *et al.* (1968) differs in its smaller size (28 µm) and longer spines (3-6 µm) with bulbous base. *Echitricolporites mcneillyi* Germerrad *et al.* (1968) is also distinguished by its smaller size (23 µm). *Echitricolporites* sp. (Kar 1985) differs by its longer spines (6-10 µm) and indistinct pores.

Genus - ***Meliapollis*** Sah & Kar 1970 emend. Navale & Misra 1979

***Meliapollis* sp.**

Pl. 1, Fig. 16

Description - Pollen grain isopolar, subcircular in polar view. Size 72 µm. Pentacolporate, colpi long, ora faintly developed. Exine 2.5 µm thick, psilate.

Comparison - *Meliapollis navalei* Sah & Kar (1970) closely compares with the present species in being pentacolporate, but differs by its shorter colpi and ora surrounded by prominent exinal thickenings.

Genus - ***Ctenolophonidites*** von Hoeken-Klinkenburg, 1966

Ctenolophonidites magnus sp. nov.

Pl. 2, Fig. 4

Holotype - Pl. 2, fig. 4, slide no. BSIP 10390, coordinates 33.8 x 100.5.

Type Locality - Jayamkondacholapuram Well-12 (depth 128.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grain circular in polar view. Size 61 µm. Decacolpate, colpi distinct, 11 µm long, 5-6 µm broad. Exine 45 µm thick, granulate, irregular stripes of endexinous thickenings developed in apocolpial region.

Comparison - The present species is distinguished from *C. erdtmanii*, *C. keralensis* and *C. saadii*, all described by Ramanujam and Rao (1973), by its bigger size and decacolpate condition.

Genus - ***Myricipites*** Wodehouse 1933

***Myricipites* sp.**

Pl. 2, Fig. 1

Description - Pollen grain subcircular in shape. Size 61 x 56.5 µm. Triporate, pores distinct, circular, 9 µm in diameter, pore margin thickened. Exine 2 µm thick, tectate, sexine as thick as nexine, laevigate to granulate.

Comparison - The present species is distinguished from *Myricipites vulgaris* Dutta & Sah (1970) by its bigger size (31-36 µm) and circular shape. The present species is closely comparable to *Myricipites globatus* Kar & Saxena (1981) but the latter is tricolporate, hence Kar (1985) transferred it to *Dermatobrevicolporites*.

Genus - ***Thomsonipollis*** Krutzsch 1960 emend. Elsik 1968

Thomsonipollis psilatus sp. nov.

Pl. 2, Fig. 19

Holotype - Pl. 2, fig. 19, slide no. BSIP 10378, coordinates 52.8 x 99.6.

Type Locality - Jayamkondacholapuram Well-12 (depth 128.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular to subcircular. Size 64-66 x 53-56 µm. Triporate, pores subequatorial, circular to subcircular, 7-15 µm in diameter, surrounded by granulate exinal thickening. Exine 2-2.5 µm thick, tectate, sexine as thick as nexine, psilate.

Comparison - The present species is distinguished from *T. palaeocenicus* Elsik (1968) by its bigger size. *Thomsonipollis submarginatus* and *T. variornatus*, described by Venkatachala and Rawat (1973), differ by their smaller size and pilate/baculate and granulate exine respectively. *Thomsonipollis* sp. (Rao & Ramanujam 1982) differs by its smaller size (30-38 µm).

Genus - ***Triangulorites*** Kar 1985

***Triangulorites* sp.**

Pl. 1, Fig. 20

Description - Pollen grain triangular with protruded angles. Size 72 x 58 µm. Interapical margins slightly convex. Triangulaperturate, apertures circular in shape, 6 µm in diameter. Exine 2.5 µm thick, columella distinct, unditegillate due to variable size of columella, foveolate, lumina circular, small and closely placed.

Comparison - The present species is distinguished from other known species of *Triangulorites* by its unditegillate exine.

Genus - ***Gemmatriporopollis*** gen. nov.

Type species - *Gemmatriporopollis triangulus* gen. et sp. nov.

Diagnosis - Pollen grains isopolar, subtriangular to subcircular in shape. Triporate, pores subcircular. Exine gemmate, intergemmate area finely baculate/ conate to microreticulate.

Comparison - *Verrutriporites* Muller (1968) differs in having verrucate exine ornamentation. *Gemmastephanoporites* Gonzalez Guzman (1967) closely compares to the present genus in having gemmate ornamentation but differs by being stephanoporate. *Echitriporites* van der Hammen ex von Hoeken-Klinkenberg (1964) differs by its echinate exine. *Acanthotricolpites* Kar (1985) emend. Singh & Misra (1991c) resembles the present genus in being triporate but differs in having spinose ornamentation. *Trilatiporites* Ramanujam (1966) ex Potonie (1970) differs in being heteropolar and in having granulate to microreticulate ornamentation. *Thomsonipollis* Krutzsch (1960) emend. Elsik (1968) is distinguished by psilate to granulate ornamentation. *Verrutriporites* van der Hammen (1956) is illegitimate because holotype of its type species is a Recent pollen.

Gemmatriporopollis triangulus sp. nov.

Pl. 2, Figs 6-7

Holotype - Pl. 2, fig. 6, slide no. BSIP 10385, coordinates 60.7 x 95.7.

Type Locality - Jayamkondacholapuram Well-12, (depth 119.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains isopolar, subtriangular to subcircular. Size 44-49 x 42-48 µm. Triporate, pores distinct, subcircular in shape, 5.5-6 µm in diameter. Exine (excluding gemma) 2.5-3 µm thick, tectate, gemmate, gemmae large sized, 3.3-4.5 µm in height, uniformly distributed, intergemmate area finely baculate/conate, forming microreticulum.

Genus - ***Acanthotricolpites*** Kar 1985 emend. Singh & Misra 1991c

Remarks - Kar (1985) instituted *Acanthotricolpites* for echinate-tricolpate pollen. Singh & Misra (1991c) restudied the type species of this genus, viz. *A. bulbospinosus* Kar (1985) and found it to be triporate instead of tricolpate. They accordingly emended the generic diagnosis. In the present study also, echinate-triporate pollen have been placed under this genus.

Acanthotricolpites tiruchirapalliensis sp. nov.

Pl. 2, Figs 2, 15

Holotype - Pl. 2, fig. 15, slide no. BSIP 10387, coordinates 29.6 x 96.5.

Type Locality - Jayamkondacholapuram Well-12 (Depth 206.6 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular to subcircular. Size range 32-44 x 32-42 µm (excluding spines). Triporate, pores 6-11 µm in diameter, pore margin unthickened. Exine 1-1.5 µm thick, spinose, spines 4.5-6 µm long with pointed tips, uniformly distributed, interspinal area punctate to laevigate.

Comparison-Acanthotricolpites bulbospinosus Kar (1985) differs by its spines having bulbous bases.

Acanthotricolpites brevispinosus sp. nov.

Pl. 2, Fig. 12

Holotype - Pl. 2, fig. 12, slide no. BSIP 10388, coordinates 28.8 x 98.5.

Type Locality - Jayamkondacholapuram Well-12 (depth 142.3 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis-Pollen grains circular to subcircular. Size range 44-49 x 42-47 µm (excluding spines). Triporate, pores subequatorial, 15-17 µm in diameter, pore margin unthickened. Exine up to 1.5 µm thick, spinose, spines 3-4 µm long with pointed tips, uniformly distributed, interspinal area microreticulate.

Comparison - Acanthotricolpites tiruchirapalliensis sp. nov. differs by its smaller pore diameter (6-11 µm) and longer spines (4.5-6 µm long).

Acanthotricolpites microreticulatus sp. nov.

Pl. 2, Figs 10-11

Holotype - Pl. 2, fig. 10, slide no. BSIP 10391, coordinates 47.9 x 100.3.

Type Locality - Jayamkondacholapuram Well-12 (depth 206.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular-subcircular to subtriangular. Size range 60-69 x 55-67 μm (excluding spines). Triporate, pores distinct, 29-32 μm in diameter, pore margin unthickened. Exine 1.5-2 μm thick, tectate, spinose, spines with bulbous base and pointed tip, 6.5-9 μm long, uniformly placed, interspinal area microreticulate.

Comparison - The present species is distinguished from *A. tiruchirapalliensis* and *A. brevispinosus* by its bigger size, bulbous spine bases and much bigger pore diameter.

Acanthotricolpites robustus sp. nov.

Pl. 2, Figs 8, 16

Holotype - Pl. 2, fig. 16, slide no. BSIP 10383, coordinates 31.3 x 109.5.

Type Locality - Jayamkondacholapuram Well-12 (depth 156.0 m from ground level). Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular to subtriangular. Size range 38-42 x 36-39 μm (excluding spines). Triporate, pores distinct, 11-15 μm in diameter, pore margin unthickened. Exine up to 2 μm thick, spinose, spines robustly built with blunt tips, 4.5-5.5 μm long, densely placed, interspinal area faintly microreticulate.

Comparison -Acanthotricolpites tiruchirapalliensis sp. nov. resembles the present species in having same size range but latter species differs by its robustly built spines with blunt tips. *Acanthotricolpites brevispinosus* sp. nov. differs by its larger size and shorter spines (3-4 μm). *Acanthotricolpites microreticulatus* sp. nov. is distinguished by its bigger size range (60-69 x 55-67 μm) and bulbous spine bases.

Acanthotricolpites karii sp. nov.

Pl. 2, Figs 17-18

Holotype - Pl. 2, figs 17-18, slide no. BSIP 10384, coordinates 53.7 x 105.4.

Type Locality - Jayamkondacholapuram Well-12 (depth 144.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular to subtriangular. Size range 50-52 x 49-51 μm (excluding spines). Triporate, pores distinct, 14-18 μm in diameter, pore margin unthickened. Exine up to 2 μm thick, spinose, spines 7-10 μm long with thick bases and pointed tips, sparsely distributed, interspinal area punctate to scabrate.

Comparison - Acanthotricolpites tiruchirapalliensis sp. nov. and *A. brevispinosus* sp. nov. are distinguished by their comparatively smaller size range (32-44 x 32-42 and 44-49 x 42-47 μm respectively) and shorter spines (4.5-6 and 3-4 μm respectively). *Acanthotricolpites microreticulatus* sp. nov. is distinguished by its bigger size range (60-69 x 55-67 μm) and bulbous spine bases. *Acanthotricolpites robustus* sp. nov. differs by its robustly built spines with blunt tips.

cf. *Acanthotricolpites* sp.

Pl. 2, Fig. 3

Description - Pollen grain isopolar, circular in shape. Size 43 μm (excluding spines). Tricolpate, brevicolpate. Exine 2 μm thick, spinose, spines small and sparsely placed, 2.5-3 μm long with pointed tips, interspinal area microreticulate.

Comparison - Acanthotricolpites bulbospinosus Kar (1985) differs in having longer spines (5-8 mm long) with bulbous base. Since *Acanthotricolpites* is triporate, the present species is only compared with it.

Genus - ***Pseudonothofagidites*** Venkatachala & Kar 1969

Pseudonothofagidites septaporatus sp. nov.

Pl. 2, Figs 21-22

Holotype - Pl. 2, figs 21-22, slide no. BSIP 10385, coordinates 48.6 x 103.0.

Type Locality - Jayamkondacholapuram Well-12 (depth 119.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains circular to subcircular in polar view. Size 36-43 x 33-43 μm. Septaporate, pores distinct, circular, 5 to 7 μm in diameter, embedded, imparting a septalobate appearance, pore margin thickened. Exine 1.5 - 2.2 μm thick, granulate to punctate.

Comparison - *Pseudonothofagidites kutchensis* Venkatachala & Kar (1969) is distinguished by its penta- to hexaporate nature and smaller size (26 x 25 µm). *Pseudonothofagidites cerebrus* Venkatachala & Kar (1969) differs in being octaporate.

Genus - ***Cryptopolyporites*** Venkatachala & Kar 1969

Cryptopolyporites indicus sp. nov.

Pl. 2, Fig. 23

Holotype - Pl. 2, fig. 23, slide no. BSIP 10376, coordinates 34.7x71.3.

Type Locality - Jayamkondacholapuram Well-12 (depth 127.5.0 m from ground level), Tiruchirapalli District, Tamil Nadu, India.

Diagnosis - Pollen grains subcircular. Size 41-44 x 37-39 µm. Polyporate, periporate, pores circular, up to 2 µm in diameter, uniformly distributed all over the exine. Exine 2 µm thick, sexine as thick as nexine, punctate to granulate.

Comparison - The present species differs from *C. cryptus* Venkatachala & Kar (1969) by its smaller and closely placed pores and granulate sculpture.

***Cryptopolyporites* sp.**

Pl. 2, Fig. 14

Description - Pollen grain circular. Size 24 µm. Polyporate, periporate, pores circular, 3 µm in diameter uniformly distributed. Exine 1.5 µm thick, sexine as thick as nexine, granulate.

Comparison - *Cryptopolyporites cryptus* Venkatachala & Kar (1969) differs by its larger size (30-50 µm) and thicker (2-3 µm), baculate exine.

QUALITATIVE ANALYSIS

Division - Pteridophyta

The pteridophytic spores are richly represented in the present assemblage by the following five families :

Cyatheaceae - This family is poorly represented by *Cyathidites australis* and grows in tropical-subtropical climate.

Osmundaceae - This family is represented by *Osmundacidites kutchensis* and *Todisporites kutchensis*. Members of this family are cosmopolitan in distribution. The preferred habitat of the family is damp woods and thickets.

Polypodiaceae - *Polypodiisporonites repandus*, *P. mawkmaensis*, *Polypodiisporonites* sp., *Laevigatosporites lakiensis*, *L. tertiarus*, *L. variabilis* and *Seniasporites verrucosus* represent this family. The family is cosmopolitan in distribution but rarely occurs in dry region.

Gleicheniaceae - This family is poorly represented by *Gleicheniidites concavus* and chiefly grows in tropical region.

Schizaeaceae - *Schizaeoisporites digitatoides*, *S. minimus*, *S. sinuta*, *Lygodiumsporites lakiensis*, *L. eocenicus*, *Intrapunctisporis gigantica* and *Neyvelisporites bolkhovitinae* represent this family. The distribution of this family is restricted to tropical and subtropical regions.

Division - Spermatophyta

Subdivision - Angiospermae

Angiospermous pollen, being represented by 45 genera and 86 species, form the most dominant group in the present palynoflora.

Class - Monocotyledonae

This group is represented by the following four families:

Arecaceae - The rich representation of the various species of *Neocouperipollis*, viz. *N. wodehousei*, *N. brevispinosus*, *N. rarispinosus*, *N. achinatus*, *N. cymbatus*, *N. kutchensis*, *N. robustus*, *N. donaensis* and *Arecipites punctatus*, *A. bellus*, *Arengapollenites achinatus*, *Spinainaperturites conatus*, *S. densispinus*, *S. horridus*, *Proxapertites assamicus*, *P. microreticulatus*, *Trilatiporites sellingii*, *Spinizonocolpites echinatus*, *S. venkatachalae*, *Echimonoporopollis grandiporus*, *E. neyveliensis*, *Acanthotricolpites brevispinosus*, *A. microreticulatus*, *A. karii*, *A. tiruchirapalliensis*, *A. robustus* and cf. *Acanthotricolpites* sp. make this family an important element of the present palynoflora. The present day distribution of this family is restricted to tropical and subtropical regions.

Potamogetonaceae - This family is represented by *Retipilonapites arcotense*. The family characteristically grows in fresh water and is cosmopolitan in distribution.

Liliaceae - This family is poorly represented by *Matanomadhiasulcites major* and *Dracaenoipollis circularis* and has a cosmopolitan distribution.

Class - Dicotyledonae

Dicotyledonous pollen constitute an important group in the assemblage and are represented by the following families.

Meliaceae - *Meliapollis ramanujamii*, *M. navalei*, *M. iratus*, *M. raoi*, *M. quadrangularis* and *Meliapollis* sp. represent this family. The geological history of this family dates back to Palaeocene. The family has tropical to subtropical distribution.

Brassicaceae - This family is poorly represented by *Tricolpites minutus*. The family has cosmopolitan distribution and grows in diverse conditions.

Gunneraceae - The family is represented by *Tricolpites reticulatus* and is cosmopolitan in distribution.

Araliaceae - *Araliaceoipollenites matanomadhensis* shows affinity to this family. The family chiefly grows in tropical region.

Oleaceae - This family is represented by *Retitrescolpites decipiens*, *Tricolpites crassireticulatus* and *T. retibaculatus* and has tropical to temperate distribution. The geological history of Oleaceae dates back to Eocene.

Rubiaceae - This family is represented by *Retitricolporites minor* and *Retitricolporites* sp. and is found in tropical region.

Caesalpiniaceae - *Margocolporites tsukadae*, *M. oligobrochatus*, *M. sitholeyi*, *M. ghoshii* and *M. granimuratus* show affinity with this family. The family chiefly grows in tropical region and is a major indicator of mangrove condition.

Bombacaceae - This family is represented by *Lakiapollis ovatus Tricolporopollis rubra* and *T. matanomadhensis*. The geological history of Bombacaceae dates back to the Early Tertiary. The family grows in tropical-subtropical region.

Rhizophoraceae - This family is represented by *Paleosantalaceaepites minutus* and is restricted to tropical-subtropical region. The family is a major element of mangrove vegetation.

Sapotaceae - This family is poorly represented by *Thomsonipollis psilatus* and has tropical to subtropical distribution.

Myricaceae - *Myricipites* sp. represents this family. It has temperate to subtropical distribution.

Alangiaceae - This family is represented by *Pellicieroipollis langenheimii* and *Alangiopollis arcotense* and is cosmopolitan in distribution.

Ericaceae - *Ericipites sahnii* represents this family. The family grows in most part of the world except in deserts and hot-damp tropical regions.

Hippocrateaceae - This family is represented by *Hippocrateaceaedites vancampoae* and is tropical to subtropical in distribution.

Betulaceae - *Triporopollenites parvas* is doubtfully referred to this family (Sah 1967). The family was abundantly represented during the Eocene and Oligocene times and is now found in temperate region and tropical mountains.

Ctenolophonaceae - This family is represented by *Ctenolophonidites saadii* and *Ctenolophonidites magnus* and has tropical distribution.

Onagraceae - *Triangulorites bellus* richly represents this family. The famly has tropical to temperate distribution.

QUANTITATIVE ANALYSIS

Quantitative analysis of the assemblage is based on the frequency of a species in a count of 200 specimens per sample. The pteridophytic spores, represented by 12 genera and 19 species, constitute 14 per cent of the total assemblage. In the lower part of the sequence, i.e. *Neocouperipollis* spp. Cenozone, pteridophytic spores are meagrely represented, mainly by *Todisporites kutchensis* (4%). *Gleicheniidites concavus* is restricted in the middle part of the sequence, i.e. *Triangulorites bellus* Cenozone. The top zone (*Trilatiporites sellingii*

Cenozone) is rich in *Neyvelisporites bolkhovitinae* (18% in the middle part of the cenozone) and *Schizaeoisporites* spp. (3%). *Lygodiumsporites lakiensis* commonly occurs throughout the sequence. The angiospermous pollen are represented by 45 genera and 85 species. Of these, 11 genera and 29 species belong to the monocotyledons whereas 34 genera and 56 species belong to dicotyledons. Angiospermous pollen constitute 75 percent of the total assemblage. Quantitative analysis shows that monocotyledonous pollen constitute the most dominant group, being represented by 47% of the total assemblage. In *Neocouperipollis* spp. Cenozone, the major part of the monocotyledonous pollen is represented by a variety of spinose pollen, e.g. *Neocouperipollis* (30%), *Acanthotricolpites* (23%), *Spinizonocolpites* (14%), *Echimonoporopollis* (9%) and *Spinainaperturites* (8%). All spinose forms are restricted to *Neocouperipollis* spp. Cenozone. *Proxapertites assamicus* and *P. microreticulatus* are restricted to the upper-most part of the *Trilatiporites sellingii* Cenozone.

Dicotyledonous pollen constitute 28 per cent of the whole assemblage with *Triangulorites bellus*, *Margocolporites* spp. and *Retipollenites* spp. as significant taxa. *Trilatiporites sellingii* dominates (about 45 %) in the upper part of the *Trilatiporites sellingii* Cenozone. Dicotyledonous pollen are most dominant in *Triangulorites bsllus* Cenozone and *Trilatiporites sellingii* Cenozone whereas in the *Neoouperipollis* spp. Cenozone, these are marked by the overwhelming representation of spinose pollen grains.

The fungal remains are represented by 12 genera and 25 species (Saxena & Khare 1992). Of these, 5 genera and 11 species belong to epiphyllous microthyriaceous fungi. Fungal remains constitute 11 per cent of the total assemblage and commonly occur throughout the sequence.

BIOSTRATIGRAPHIC ZONATION AND AGE

The stratigraphic sequence of the Jayamkondacholapuram Well-12 has been divided into three biozones, viz. *Neocouperipollis* spp. Cenozone, *Triangulorites bellus* Cenozone and *Trilatiporites sellingii* Cenozone.

The *Neocouperipollis* spp. Cenozone is characterized by the overwhelming representation (85%) of a variety of spinose pollen, viz. *Neocouperipollis brevispinosus*, *N. cymbatus*, *N. donaensis*, *N. kutchensis*, *N. rarispinosus*, *N. robustus*, *N. wodehousei*, *Arengapollenites achinatus*, *Echimonoporopollis grandiporus*, *E. neyveliensis*, *Spinizonocolpites echinatus*, *S. venkatachalae*, *Acanthotricolpites tiruchirapalliensis*, *A. brevispinosus*, *A. microreticulatus*, *A. karii*, *A. robustus*, *Spinainaperturites conatus*, *S. horridus* and *S. densispinus*, common occurrence of *Lygodiumsporites eocenicus*, *Todisporites kutchensis*, *Meliapollis iratus*, *Triporopollenites parvus* etc. and restricted occurrence of *Neocouperipollis* spp., *Spinizonocolpites* spp., *Acanthotricolpites* spp., *Echimonoporopollis* spp. and *Spinainaperturites* spp.

The *Triangulorites bellus* Cenozone is characterized by the significant representation of *Triangulorites bellus*, *Tricolporopollis rubra*, *T. matanomadhensis*, *Margocolporites tsukadae*, *M. sitholeyi*, *M. oligobrochatus*, *M. ghoshii*, *Trilatiporites sellingii*, *Retipilonapites arcotense*, *Palmidites plicatus*, *P. maximus*, *Retipollenites ramanujamii*, *R. laevigatus*, *Cryptopolyporites* spp., *Tricolpites retibaculatus*, *T. matanomadhensis*, *Meliapollis ramanujamii*, *M. navalei*, *M. iratus*, *Lakiapollis ovatus*, *Ctenolophonidites* spp., *Psilastephanocolpites quadrangularis*, *Matanomadhiasulcites major*, *Schizaeoisporites digitatoides*, *S. sinuata*, *Seniasporites verrucosus*, *Gleicheniidites concavus*, *Polypodiisporonites mawkmaensis* and *P. repandus* and restricted occurrence of *Retipilonapites* spp., *Margocolporites oligobrochatus*, *Triangulorites bellus*, *Tricolporopollis matanomadhensis*, *Tricolpites retibaculatus* and *Psilastephanocolpites quadrangularis*.

The *Trilatiporites sellingii* Cenozone is characterized by the significant representation of

Trilatiporites sellingii, *Proxapertites microreticulatus*, *P. assamucus*, *Neyvelisporites bolkhovitinae*, *Meliapollis ramanujamii*, *M. iratus*, *M. navalei*, *M. raoi*, *Pseudonothofagidites septaporatus*, *Schizaeoisporites digitatoides*, *Tricolpites crassireticulatus*, *Margocolporites* spp., *Cryptopolyporites* spp., *Palmidites plicatus*, *P. maximus*, *Retitrescolpites decipiens*, *Pellicieroipollis langenheimii*, *Ctenolophonidites* spp., *Lygodiumsporites lakiensis*, *Laevigatosporites* sp. and restricted occurrence of *Proxapertites assamicus*, *P. microreticulatus*, *Meliapollis raoi*, *Pseudonothofagidites septaporatus* and *Pellicieroipollis langenheimii* (Text-fig. 1).

A broad perusal of the above cenozones indicates that the lower zone, viz. *Neocouperipollis* spp. Cenozone, is characterized by the overwhelming representation of a variety of spinose pollen; the middle zone, viz. *Triangulorites bellus* Cenozone, is characterized by the absence or negligible representation of spinose pollen and dominance of *Triangulorites bellus* and *Margocolporites* spp.; and the upper zone, viz. *Trilatiporites sellingii* Cenozone, is characterized by the absence of spinose pollen and *Triangulorites bellus* and dominance of *Trilatiporites sellingii* and *Proxapertites* spp.

A comparison of the above biozones with the contemporary biozones/assemblages from Kutch (Saxena 1981, Kar 1978, 1985), Rajasthan (Sah & Kar 1974, Singh & Dogra 1988), Bengal Basin (Baksi & Deb 1980), Garo (Sah & Singh 1974), Khasi (Baksi 1962, Kar & Kumar 1986) and Jaintia (Tripathi & Singh 1984) Hills and Cauvery Basin (Venkatachala & Rawat 1972) suggests an Upper Palaeocene to Middle Eocene age for the Jayamkondacholapuram Well profile.

CONCLUSIONS

From the foregoing discussion, the following conclusions have been derived.

(i) The palynoassemblage encountered in Jayamkondacholapuram Well-12, Tiruchirapalli District, Tamil Nadu consists of algal and fungal remains (not included in the present paper), pteridophytic spores and angiospermous pollen. The bryophytic and gymnospermous elements are, however, unrepresented.

(ii) The angiospermous pollen, being represented by 75 per cent, are the dominant constituent of the assemblage, whereas pteridophytic spores and fungal remains are subordinately represented. After ignoring the fungal remains, representation of angiospermous pollen comes to 84 per cent.

(iii) Qualitative analysis of the assemblage indicates that the pteridophytic spores are represented by Cyatheaceae, Osmundaceae, Polypodiaceae, Gleicheniaceae and Schizaeaceae whereas angiospermous pollen may be related to Arecaceae, Potamogetonaceae, Liliaceae, Meliaceae, Brassicaceae, Gunneraceae, Araliaceae, Oleaceae, Rubiaceae, Caesalpin-iaceae, Bombacaceae, Rhizophoraceae, Sapotaceae, Myricaceae, Alangiaceae, Ericaceae, Hippocrateaceae, Betulaceae, Ctenolophonaceae and Onagraceae.

(iv) The palynoflora suggests prevalence of a tropical climate with plenty of rainfall.

(v) Three distinct biozones, viz. *Neocouperipollis* spp. Cenozone, *Triangulorites bellus* Cenozone and *Trilatiporites sellingii* Cenozone have been recognized. These cenozones are identified by their characteristic and restricted palynofossils.

(vi) Based on comparison of the present assemblage with the known Tertiary palynoassemblages from Kutch (Gujarat), Rajasthan, Garo, Khasi and Jaintia Hills (Meghalaya), Bengal Basin and Cauvery Basin (Tamil Nadu), a Palaeocene to Middle Eocene age has been assigned to the Jayamkondacholapuram well sequence.

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