

ADDITIONS TO THE PLAYNOFLORA OF THE NEYVELI LIGNITE, TAMIL NADU

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ABSTRACT

The paper deals with the systematic study of some additional palynotaxa from the Neyveli lignite deposit of the South Arcot district, Tamil Nadu. These are *Retibrevitricolpites semilunaris* n. sp., *Baksipollis micaceous* (Ramanujam) comb. n., *Heterocolpites combretoides*, *Verrutricolporites rotundiporus*, *Pentalesporites neyvelense* Gen. et n. sp., and *Heteropollis dakshinense* Gen. et n. sp.

INTRODUCTION

During a detailed palynological investigation of the lignite and its underlying clay horizon of the first and second mine areas of the Neyveli lignite deposit (Miocene) in the South Arcot district, Tamil Nadu, the authors have encountered a number of well preserved and morphographically interesting angiosperm palynomorphs hitherto either unrecorded or inadequately studied (Thiergart and Frantz, 1962; Ramanujam, 1966; Deb, 1972; Navale and Misra, 1979; Ramanujam, Reddy and Sarma, 1980; Ambawani, Bande and Prakash, 1981; and Reddy, Srisailam and Ramanujam, 1983). This paper includes only the more characteristic and frequent of these pollen types. In a recent publication Ramanujam and Reddy (1984) discussed the overall palynoflora of the Neyveli lignite deposit and its bearing on the floristics and palaeoenvironmental considerations of the lignite field and its environs.

MATERIAL AND METHODS

The material consists of numerous lignite and clay samples from the B Block of the first mine area and Five Boreholes of the second mine area (For location Map see Ramanujam, 1982). Traditional techniques of maceration with minor modifications were employed for the recovery and concentration of the palynofossils. The holotypes and the unused samples are deposited at the Palaeobotany-Palynology laboratory of the Department of Botany, P. G. College of Science, Osmania University, Saifabad, Hyderabad.

The following is the inventory of the Five boreholes and the palynosamples of the second mine area.

Sr. No.	Borehole No.	Thickness of lignite seam	Number and nature of samples studied	Approximate interval between the samples
1.	E/V/7	13.45 Mts.	16 lignite & 1 clay	0.20 to 2.00 Mts.
2.	E/V/16	28 Mts.	14 lignite	0.75 to 3.35 Mts.
3.	E/V/20	About 16 Mts.	1 clay	From the bottom of lignite at 76.40 Mts. below ground level
4.	E/V/93	23.15 Mts.	3 lignite	From the Top, Middle and Bottom portions
5.	E/V/96	16 Mts.	1 lignite	From the Top of Lignite at 86.75 Mts. below ground level

DESCRIPTION OF PALYNOTAXA

Genus *Retibrevitricolpites* VAN HOEKEN KLINKENBERG 1966

Genotype *R. triangulatus* VAN HOEKEN KLINKENBERG 1966

Retibrevitricolpites semilunaris n. sp.

(Pl. I—1-4)

Holotype: Pl. I—1-4; Slide No. E/V/16-12(1), coordinates 34.0 × 101.5 (Amb 36 μm in diam.)

Number of specimens studied: 5

Diagnosis: Pollen grains isopolar, radially symmetrical, oblate, amb triangular, 36-55.50 μm in diam.,

apices \pm truncate. sides straight to slightly concave ; zonaperturate, angulaperturate, tricolpate, brevicolpate, colpi narrow slit-like with conspicuous costae (nexinous thickenings) surrounding them, costae upto $4.5 \mu\text{m}$ thick; exine upto $5 \mu\text{m}$ thick, subtectate, mesocolpia with prominent semilunar, cushion-like nexinous thickenings (upto $3.5 \mu\text{m}$) sweeping from aperture to aperture, surface finely reticulate, muri high, meshes polygonal, lumina smooth.

Comments : According to Germeraad, Hopping and Muller (1968), the holotype of *Retibrevitricolpites triangulatus* is a tricolporate pollen. The neyveli species, *R. semilunaris* n. sp. differs from all the other species of this genus in the possession of prominent semilunar - cushion-like nexine thickenings at the mesocolpia and the conspicuous costae bordering the short colpi. *Reti brevitricolpites* sp. from the Oligocene of Kutch (Kar-1979) has funnel shaped colpi as against the slit-like colpi of the Neyveli taxon.

Affinity : Mesocolpial nexinous thickenings are found in some members of Clusiaceae (Guttiferae). It has not been possible, however, to establish any close relationship of the fossil taxon with any modern member of Clusiaceae.

Locality : Neyveli lignite Second mine area, S. Arcot district, Tamil Nadu, India.

Geological Age : Miocene

Genus *Baksipollis* n. gen.

Genotype *B. miocenicus* (RAMANUJAM) n. comb.

Diagnosis : Pollen grains spheroidal, prolate to subprolate equatorially, 3-brevissimicolporate, zonorate, exine thicker at poles, sexine with conspicuous columellae, simple or forked, tectate, infrareticulate, surface smooth.

Comments : Ramanujam (1966) earlier included this pollen type under the genus *Palaeosantalaceae* Biswas (1962). As emended by Dutta and Sah (1970), however, the diagnosis of *Palaeosantalaceae* now includes pollen with brevi as well as longi colpi, grandiorate or zonorate with distinctly columellate or structureless sexine. Ramanujam's (1966) *P. miocenicus* is easily distinguishable from all other species of this genus in its brevissimicolporate, distinctly zonorate condition and prominent, simple or forked columellae in the sexine. It is therefore felt desirable to remove this species from *Palaeosantalaceae* and include it under the new genus *Baksipollis*.

The generic name is in honour of late Dr. S. K. Baksi of the Jadhavapur University, Calcutta.

Baksipollis miocenicus (RAMANUJAM) n. comb.

Syn. *Palaeosantalaceae* *miocenicus* RAMANUJAM 1966.

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Holotype : Pl. III, Fig. 52 in Ramanujam (1966)

Paratypes : Pl. I—5-10 of the present paper.

Elaborated Diagnosis : Pollen grains isopolar, radially symmetrical, amb spheroidal, prolate to subprolate equatorially, $30-38 \times 20-28 \mu\text{m}$, polar area smoothly arched, equatorial zone often bulging on either side, zonaperturate, 3-brevissimicolporate, colpi short (upto $3.5 \mu\text{m}$ long and $2.5 \mu\text{m}$ broad), tenuimarginate, ends blunt, ora conspicuous, broader and longer than colpi. extremely lalongate and fusing to form prominent zonorate band at the equatorial zone ; margin of oral band thickened, often uneven or dentate; exine $2-3.5 \mu\text{m}$ thick ; thinner at equatorial zone and thicker at polar areas, sexine thicker than nexine, tectate, prominently columellate, columellae simple or forked. infrareticulate, surface psilate.

Comments : The elaborated specific diagnosis is based upon a restudy of the holotype in addition to a number of paratypes.

Affinity : Ramanujam (1966) indicated the affinities of this pollen type with *Exocarpus* and *Omphacomeria* of Santalaceae. The pollen grains of these taxa are longicolpate with the exine indistinctly structured (Erdtman, 1952; Selling, 1947). The exact affinities of *Baksipollis miocenicus* are as yet unknown.

Locality : Neyveli, S. Arcot district, Tamil Nadu, India.

Geological Age : Miocene

Genus *Heterocolpites* (VAN DER HAMMEN) VAN DER HAMMEN & GARCIA DE MUTIS 1965

Genotype *H. palaeocenica* VAN DER HAMMEN & GARCIA DE MUTIS 1966

Heterocolpites combretoides RAO & RAMANUJAM 1982

(Pl. I—11-13)

Description : Pollen grains isopolar, radially symmetrical, amb rounded-hexalobed, $28-32 \mu\text{m}$ in diam., prolate to subprolate equatorially, zonaperturate, tricolporate, longicolpate, ora faint or distinct, rounded to slightly lalongate, three colpoid streaks (pseudocolpi) alternating with three oroid colpi ; pseudocolpal margins tend to fold inward ; exine upto $2 \mu\text{m}$ thick, sexine slightly thicker than nexine, columella rather indistinct to faint, surface psilate.

Comments : Pollen grains of this type were frequently encountered in the clay horizon underlying the lignite and the lower part of the lignite seam. The pseudocolpi represent the nonfunctional apertures. Remarkably similar pollen grains were earlier recorded from the Miocene of Marshall islands in the Pacific (Leopold Estella, 1969). *Heterocolpites palaeocenica* from the Palaeocene of Columbia and compared with the pollen of

Melastomaceae is subspheroidal with flattened poles (Hammen and Garcia, 1965). *H. laevigatus* from the Upper Eocene to Lower Miocene of Cameroun (Salard-Chebaldoeff, 1978) is smaller and infragranulate to scabrate. *H. pseudostratus* and *H. verrucatus* from the Oligocene to Lower Miocene of Cameroun (Salard-Chebaldoeff, 1978) possess different type of sculpture. *H. combretoides* was originally recorded from the Quilon Formation (Lower to Middle Miocene) of Kerala (Rao and Ramanujam, 1982).

Affinity : Heterocolpate pollen grains are encountered in Combretaceae, Lythraceae and Melastomaceae. *Heterocolpites combretoides* is referable to Combretaceae and shows close resemblances with the pollen of *Lumnitzera* (Leopold Estella, 1969 ; Blasco and Caratini, 1973). The species of *Lumnitzera* are either small trees or shrubs and are found in East Africa, Indo-Malayan region, and Pacific islands. They occur in saline swamps associated with *Bruguiera*, *Sonneratia* and *Rhizophora*. *Lumnitzera* (*L. littorea*) is a common element of the Indian mangroves.

Genus Verrutricolporites VAN DER HAMMEN & WYMSTRA 1964

Genotype V. rotundiporis VAN DER HAMMEN & WYMSTRA 1964

Verrutricolporites rotundiporis SYN DER HAMMEN & WYMSTRA 1964

(Pl. I—14-18)

Description : Pollen grains isopolar, radially symmetrical, amb rounded to rounded triangular, prolate to subprolate equatorially, $24-35 \times 18.5-26 \mu\text{m}$; zonaperturate, tricolporate, colpal margins thin, often faint, ora distinct, rounded to slightly lalongate, upto $3 \mu\text{m}$ in diam., distinctly rimmed, exine $1.6 \mu\text{m}$ thick, sexine thicker than nexine, surface uniformly with low verrucae upto $1.6 \mu\text{m}$ in diam.

Comments : *Verrutricolporites rotundiporis* is a frequent pollen type of the clay horizon underlying the lignite. The fossil grains show considerable variation in the degree of verrucation. This pollen type was earlier recorded from the Lower Miocene of Caribbean area, Nigeria (Germeraad, Hopping and Muller, 1968) and Cameroun (Salard-Chebaldoeff, 1976). *Verrutricolporites irregularis* from the Eocene of South-eastern Nigeria (Jan du Chene, Onyike and Sowunmi, 1978) is larger ($48 \times 34 \mu\text{m}$) with prominent colpi and large irregularly distributed verrucae.

Affinity : The fossil pollen shows remarkable resemblances with the pollen of *Crenea* of Lythraceae (Germeraad, Hopping and Muller, 1968). The *Crenea* pollen shows high variability in the degree of verrucation. The Neyveli specimens show resemblances particularly

with the clearly verrucate type of *Crenea* pollen. The present day *Crenea* inhabits swampy places along river courses and also the mangrove areas.

Genus *Pentadesmapites* n. gen.

Genotype *P. neyveliense* n. sp.

Diagnosis : Pollen grains oblate to suboblate spheroidal, amb squarish (tetragonal), zonaperturate, tetracolporate (rarely pentacolporate), colpi medium, margins distinct, ora conspicuous, lalongate, with conduplicate costae (nexinous thickenings) : exine prominently thickened, nexine 2 or 3 times thicker than sexine and with undulate inner surface, sexine structure indistinct, surface psilate.

Comments : The squarish amb, the tetracolporate (most commonly) nature, the exaggerated thickening of nexine (crassinexine) and the conspicuous ora with conduplicate costae are the characteristic features of this pollen type. A smaller percentage with similar apertural pattern and wall thickness but pentacolporate and pentagonal were also encountered in our preparations. These are considered to be of the nature of variation and probably constitute aberrant specimens.

In a recent palynological study of the Neyveli lignite Navale and Misra (1979) included somewhat similar grains under the genus *Meliapollis* by emending and elaborating the generic circumscription of this taxon. These authors have broadened the generic diagnosis of *Meliapollis* so much by including in it suboblate to subprolate grains with 3 to 5 colpi which may be brevi or longi colpi and thin or prominently thickened exine, that this genus has now become quite heterogeneous and unwieldy. We feel that the generic diagnosis of *Meliapollis* as originally provided by Sah and Kar (1970) should be retained without any alteration. The specimen illustrated in Plate 2, Fig. 66 of Sah and Kar (1970) is morphographically quite different from the rest of *Meliapollis* species described and figured by these authors and in view of its apparent similarities with *Pentadesmapites*, merits a restudy. *Meliapollis simplex* (Navale and Misra, 1979) but for its pentacolpate condition is similar to the above pollen specimen of Sah and Kar (1970). It should be mentioned here pertinently that in the pollen of Meliaceae, the nexine is considerably thickened at the apertures and not elsewhere.

Affinity : This characteristic pollen type shows remarkable resemblances with the pollen of *Pentadesma* of Clusiaceae (Guttiferae) now confined to tropical Africa (Seetharam, 1983). The pollen of *Platonia* and *Symphonia* two other members of Clusiaceae with exaggerated exinous thickening are easily distinguishable from the fossil pollen. The pollen of *Symphonia* is essentially tetraporate and that of *Platonia* though mostly tetracolporate, shows nexinous thickening confined only

to the mesocolpial region of the pollen wall and the colpi are surrounded by thin areas (Erdtman, 1952; Seetharam, 1983). The authors themselves have examined the pollen of *Pentadesma* (cf. *P. butyracea*) and are convinced of the affinities of the Neyveli fossil pollen with this Clusiaceae member.

Calophyllumpollenites, *Platoniapollenites*, *Keilmeyerapollenites* and *Platoniapollis* are other fossil pollen from India that have been affiliated with Clusiaceae. The former three taxa were described from the Eocene of Palana lignite in Rajasthan (Sah and Kar, 1974) and *Platoniapollis* was recorded from the Lower Eocene of Meghalaya (Tewari and Singh, 1984). All these are easily distinguishable from the Neyveli pollen. *Calophyllumpollenites* is tricolporate and laevigate to finely reticulate. *Platoniapollenites* is 3-4 colporate with the colpi bordered by relatively thin exine and the nexine thickened at the mesocolpial regions. The pollen of *Keilmeyerapollenites* is tricolporate, retipilate and in tetrahedral tetrads. *Platoniapollis* has much thickened exine at the mesocolpial and apocolpial regions and seem to be more frequently polycolpate (with more than four colpi).

Pentadesmapites neyveliense n. sp.
(Pl. I—19-22)

Holotype: Pl. I—19-21: Slide 2-1B, coordinates 34.1 x 102.1 (Amb 40 μ m in diam.)

Paratype: Pl. I—22.

Number of specimens studied: 25

Diagnosis: Pollen grains isopolar, radially symmetrical, oblate to suboblate spheroidal, amb squarish (tetragonal), to rarely pentagonal, 40-70 μ m in diam., zonaperturate, angulaperturate, predominantly tetracolporate (rarely pentacolporate), colpi medium, margins distinct, ends pointed, ora conspicuous, alongate with conduplicate costae (nexinous thickenings); exine 5-8 μ m thick, tectate, nexine upto 6 μ m, and 2 or 3 times thicker than sexine, with distinctly undulate inner surface, sexine structure indistinct, surface psilate.

Comments: The pollen grains of *Pentadesmapites neyveliense* were frequently encountered in the clay and lignite horizons. While the tetracolporate condition is the most predominant, we have also encountered some specimens which are pentacolporate. When pentacolporate the grains are pentagonal. The fossil grains are strikingly similar to the pollen of *Pentadesma* of Clusiaceae. The pollen grains described as *Psilastephanocolporites boureaui* from the Miocene of Cameroun (Salard-Cheboldaeff, 1975) are very different from the rest of the species of *Psilastephanocolporites* Leidelmeyer (1966), and on the other hand, agree closely with *Pentadesmapites* except in their scabrate surface. The illustrations of *Psilastephanocolporites boureaui* provided by Salard-Cheboldaeff (1975) do not clearly bring

out the nature of the oral costae. If on a restudy the ora of *Psilastephanocolporites boureaui* show the conduplicate costae, this pollen should then be transferred under *Pentadesmapites*. It is interesting to note that Salard-Cheboldaeff (1975) also indicated the affinities of the above Cameroun pollen with *Pentadesma*. *P. boureaui* has also been recorded from the Late Eocene-Oligocene of Nigeria (Jan du Chene, Onyike and Sowunmi, 1978).

Locality: Neyveli, S. Arcot district, Tamil Nadu, India.

Genus: *Hexagonopollis* n. gen.

Genotype: *Hexagonopollis dakshinense* n. sp.

Geological Age: Miocene

Diagnosis: Pollen grains oblate spheroidal, amb hexagonal, zonaperturate, hexaporate, surface retipilate, sculpture reduced to psilate condition at polar areas.

Comments: The hexagonal amb with a pore at each angle and the retipilate sculpture which gets reduced to psilate condition at the polar areas, are the characteristic features of this taxon.

The generic name is after the characteristic shape of the amb.

Hexagonopollis dakshinense n. sp.
(Pl. I—23-26)

Holotype: Pl. I—23, 24: slide 2-1B, coordinates 43.3 x 111.2 (Amb 25 μ m in diam.)

Paratype: Pl. I—25, 26.

Number of specimens studied: More than 25

Diagnosis: Pollen grains insopolar, radially symmetrical, oblate spheroidal, amb hexagonal, 25-25 μ m in diam., sides straight to slightly concave, zonaperturate, angulaperturate, hexaporate, pores upto 2 μ m in diam., distinctly rimmed, sometimes ovoid, exine upto 3 μ m thick, subtectate, sexine thicker than nexine, surface retipilate, pila fairly prominent upto 2.5 μ m high, heads 1.6 μ m in diam., heterobrochate, brochi larger relatively at mesopolar regions and becoming gradually smaller towards polar areas, sculpture reduced to psilate condition at polar areas, muri simplipilate, lumina smooth.

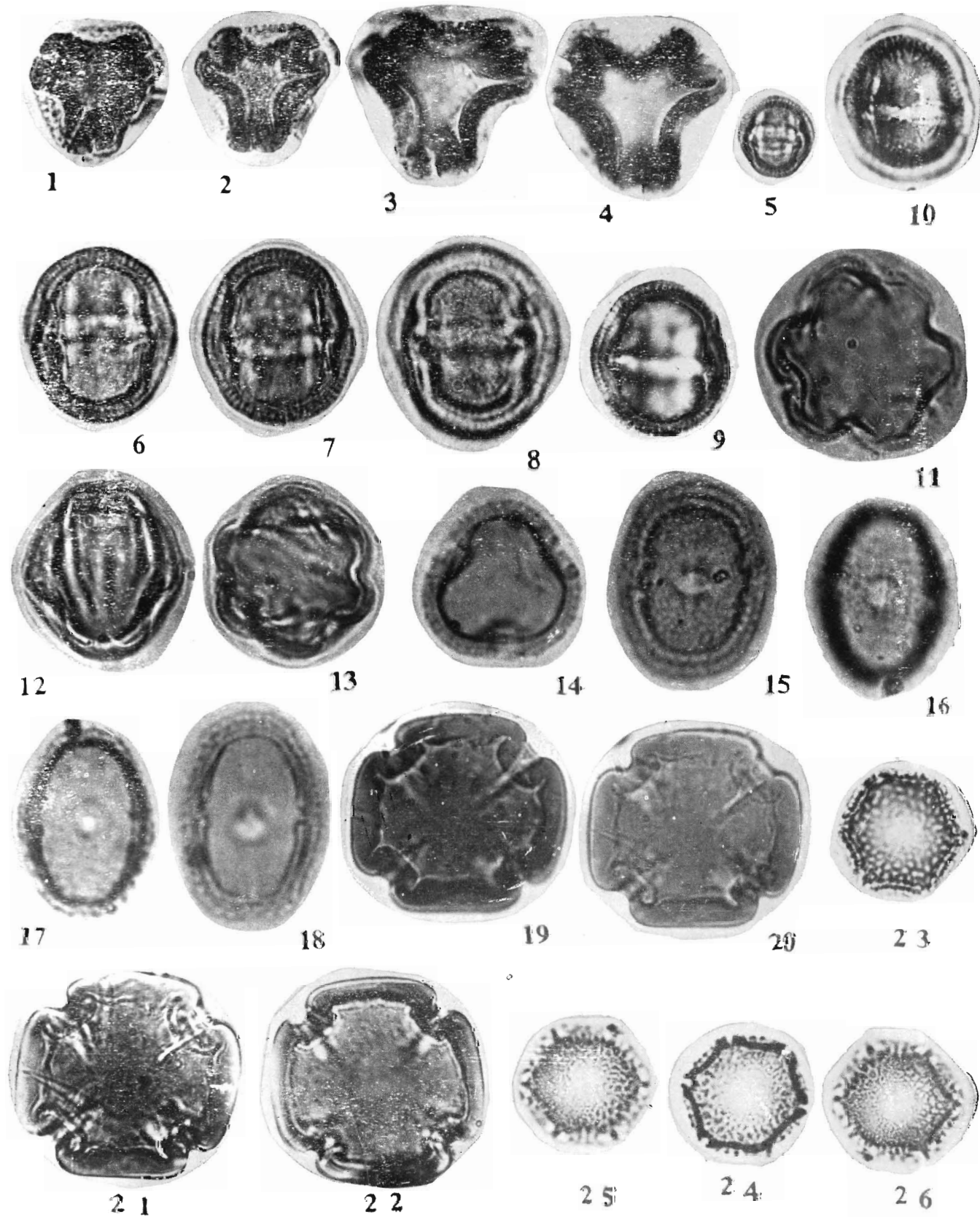
Comments: The pollen grains of *Hexagonopollis dakshinense* were frequently encountered in the clay as well as lignite samples. The authors are not aware of any published records of similar pollen type. There is variation in the size of the pila which makes the retipilate condition either coarse or fine.

The specific name indicates the occurrence of the genotype in South India.

Affinity: Unknown.

Locality: Neyveli, S. Arcot district, Tamil Nadu, India.

Geological Age: Miocene



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EXPLANATION OF PLATE

(Unless otherwise mentioned all figs are $\times 1000$)

PLATE I

- 1, 2. *Retibrevitricolpites similunaris* n. sp. (Holotype) $\times 550$.
- 3, 4. *R. similunaris* Optical sections of Holotype. $\times 750$.
- 5, 7. *Baksipollis miocenicus* (Paratype) Fig. 5 $\times 500$.
- 8, 10. *B. miocenicus* (Paratypes).
- 11, 13. *Heterocolpites combratooides*.
- 14-18. *Verrutricolporites rotundiporis*.
- 19-21. *Pentadesmapites neyveliense* Gen. et n. sp. (Holotype).
22. *P. neyveliense* (Paratype).
- 23, 24. *Hexagonopollis dakshinense* Gen. et n. sp. (Holotype).
- 25, 26. *H. dakshinense* (Paratype).