Palynological investigation of Palaeocene sediments from Thanjinath, Meghalaya

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Mandal, J. 1990. Palynological investigation of Palaeocene sediments from Thanjinath, Meghalaya. *Palaeobotanist* **37**(3) : 324-330.

Palynofloral investigation of the Palaeocene sediments exposed near the village Thanjinath, Meghalaya reveals that pteridophytic spores are dominant in the lower seam while angiospermous pollen increase gradually towards the upper seam. No cenozone has been recognised in the assemblage as the change of palynofloral constituents in different seams are gradual. The quantitative and qualitative analyses of the assemblage, depositional environment and regional correlation on the basis of palynofossils have also been discussed.

Key-words—Palynology, Palaeoenvironment, Palaeocene, Meghalaya (India).

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सारांश

मेघालय में थाँजीनाथ के पुरानूतन अवसादों का परागाणविक अन्वेषण

जगन्नाथ प्रसाद मंडल

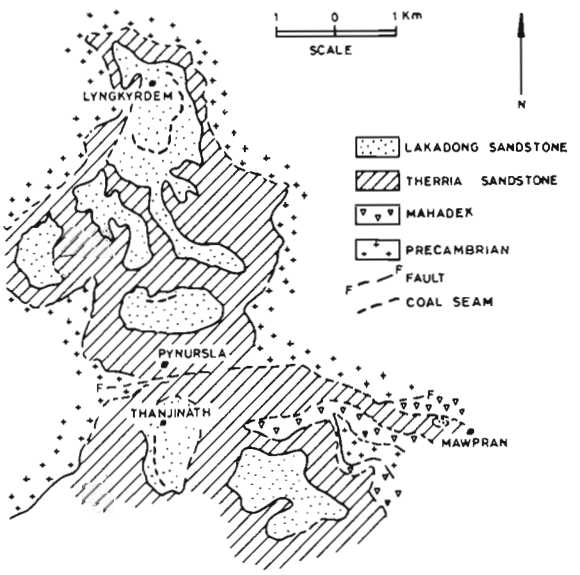
मेघालय में थाँजीनाथ गाँव के समीपस्थ विगोपित पुरानूतन कालीन अवसादों के परागाणविक अन्वेषण से व्यक्त होता है कि निचली सीम में टेरिडोफ़ाइटी बीजाणुओं की बाहुल्यता है जबकि अनावृतबीजी परागकणों की संख्या ऊपरी सीम की ओर शनैः शनैः बढ़ती जाती है। चूँकि विभिन्न सीमों में परागाणविक परिवर्तन मन्द-मन्द है अतः इस समुच्चय में कोई नवमंडल अभिनिर्धारित नहीं किया जा सका। इसके अतिरिक्त समुच्चय के परिमाणात्मक एवं गुणात्मक विश्लेषणों, निक्षेपणीय वातावरण तथा परागाणविकरूपकों के आधार पर क्षेत्रीय सहसम्बन्धों की विवेचना की गई है।

PALYNOLOGICAL investigations of the Lower Tertiary sequence of Khasi and Jaintia Hills, Meghalaya were carried out by Biswas (1962), Sah and Dutta (1968), Dutta and Sah (1970), Salujha *et al.* (1974), Tripathi and Singh (1984) and others. However, very little information is available from the southern margin of Shillong Plateau. Recently, Kar and Kumar (1986) published a spore-pollen assemblage from Laitryngew and Mawlong coalfields. The present work deals with the palynofloral investigation of the sediments from Thanjinath. The investigation was taken up to evaluate the palynofloral behaviour and to decipher the history of past vegetation in the depositional area.

BRIEF GEOLOGY OF THE AREA

Lower Tertiary sequence of rocks are well-exposed in the Khasi and Jaintia Hills. These sediments are laid down over Shillong Group of rocks and range from Upper Cretaceous to Upper Eocene in the shelf facies. The Lower Tertiary succession in Khasi Hills is divided into Langpar, Sylhet Limestone and Kopili formations in ascending order. Coal seams are developed in discontinuous patches within the Lakadong Sandstone throughout the Shillong Plateau. Stratigraphically, Sylhet Limestone Formation contains three limestone and three clastic interbands. They are Therria Sandstone, Lakadong Limestone, Lakadong Sandstone, Umlatdoh Limestone, Narpuh Sandstone and Prang Limestone in ascending order. Lakadong Sandstone is massive, light grey to greyish white and brown, hard consolidated, noncalcareous and medium to fine grained with intercalation of coal at places.

Important foraminifera like *Miscellanea miscella, Discocyclina* sp., *Assilina* sp., occur in abundance within Lakadong Limestone. Umlatdoh Limestone which overlies the Lakadong Sandstone is nummulitic in nature and has been dated as Lower Eocene in presence of *Nummulites* spp., *Discocyclina* sp., *Alveolina* sp., etc. (Nagappa, 1962;



Map 1—Geological map of Thanjinath area.

Biswas, 1962). Samanta and Roychoudhury (1983) have dated Lama Formation (this formation includes Therria Sandstone, Lakadong Limestone and Lakadong Sandstone) as Middle to Upper Palaeocene on larger foraminiferal evidences.

Lakadong Sandstone contains spore-pollen in good number which collectively indicate Palaeocene age (Biswas, 1962; Dutta & Sah, 1970; Singh, 1977; Kar and Kumar, 1986). Jain (1982) also proposed Palaeocene age of these sediments on the basis of dinoflagellate cysts.

MATERIAL

The present palynological study of the coal seams was undertaken around Thanjinath (25°18′ 00 : 91°53′ 30″). The locality is situated about 12 km south-east of Cherrapunji on Cherrapunji-Dauki Road (Map 1). Three ill-developed coal seams are present in this area, which are intercalated with shale, massive sandstone and carbonaceous shale. None of the seams is more than one meter thick. The lower, middle and upper seams are 0.5 m, 1.0 m and 0.6 m thick, respectively.

PALYNOLOGICAL ASSEMBLAGE

The following is the list of spore-pollen genera recovered from this area :

Lycopodiumsporites speciosus Dutta & Sah 1970
L. palaeocenicus Dutta & Sah 1970
L. parvireticulatus Sah & Dutta 1966
Dandotiaspora dilata Sah, Kar & Singh 1971
D. telonata Sah, Kar & Singh 1971
Foveosporites triangulus Dutta & Sah 1970
Todisporites major Couper 1958
Cyathidites australis Couper 1953
Foveotriletes pachyexinous Dutta & Sah 1970
Biretisporites bellus Sah & Kar 1969
Corrugatisporites formosus Dutta & Sah 1970
Osmundacidites sp.
Lygodiumsporites lakiensis Sah & Kar 1969
L. eocenicus Dutta & Sah 1970
Laevigatosporites lakiensis Sah & Kar 1969
Polypodiisporites repandus Takahashi 1964
Schizaeoisporites phaseolus Sah & Kar 1972
S. crassimurus Dutta & Sah 1970
Psiloschizosporis psilata Kar & Saxena 1981
P punctata Kar & Saxena 1981
Palmidites maximus Couper 1953
Palmaepollenites ovatus Sah & Kar 1970
P. nadhamunii Venkatachala & Kar 1969
P. communis Sah & Dutta 1966
Arecipites bellus Sah & Kar 1970
Spinizonocolpites echinatus Muller 1968
Matanomadhiasulcites maximus (Saxena) Kar 1985
M. kutchensis (Saxena) Kar 1985
Retimonosulcites ellipticus (Venkatachala & Kar) Kar 1985
Racemonocolpites thanjinathensis sp. nov.
R. trichotomosulcatus sp. nov.
Neocouperipollis kutchensis (Venkatachala & Kar) Kar & Kumar 1986
N. echinatus (Sah & Kar) Kar & Kumar 1986
N. wodehousei (Venkatachala & Kar) comb. nov.
Proxapertites emendatus (Sah & Dutta) Kar & Kumar 1986
P. operculatus van der Hammen 1953
P. microreticulatus Jain, Kar & Singh 1973
Tricolpites crassireticulatus Dutta & Sah 1970
Tricolpites reticulatus Cookson ex Couper emend. Potonié
T. globus Dutta & Sah 1970
T. levis Sah & Dutta 1966
Retitribrevicolporites rubra (Dutta & Sah) Kar & Kumar 1986
Myricipites harisii (Couper) Dutta & Sah 1970
Psilastephanocolporites psilatus Kar & Kumar 1986
Kielmeyerapollenites eocenicus Sah & Kar 1972
Retitrescolpites typicus Sah 1967
Retitrescolpites sp.
Rhoipites kutchensis Venkatachala & Kar 1969

Proteacidites excertus Dutta & Sah 1970
Podocarpidites khasiensis Dutta & Sah 1970

SYSTEMATIC DESCRIPTION

Genus—*Racemonocolpites* Guzmán 1967

Type species—*Racemonocolpites racematus* (van der Hammen) Guzmán 1967.

Racemonocolpites thanjinathensis sp. nov.
Pl. 1, figs 5-10

Holotype—Pl. 1, fig. 5; size 42.1 × 60.8 μm; Slide no. BSIP 9580.

Occurrence—Thanjinath (middle seam), Lakadong Sandstone Member, Sylhet Limestone Formation, Meghalaya.

Diagnosis—Pollen grains elliptical in polar view; monosulcate, sulcus distinct, extending up to margin. Exine sculptured with closely placed clava, bacula and gemmae, intersculptural exine granulose/microbaculose.

Description—Symmetry and form—elliptical, margin uneven due to projection of sculptural elements, 42-56 × 50-82 μm in size. Aperture monosulcate, sulcus distinct, extending up to margin in polar view. Exine intectate, 1.0-1.5 μm thick, layers not separable due to dense sculptural elements; sculptural elements clava, bacula and few gemmae; clava 3-5.5 μm long and 2.5-2 μm broad, bacula 2-4.4 μm long and 1-3.2 μm broad, gemmae 3-5.2 μm broad, inter-sculptural area microbaculose, sculptural elements densely distributed on both the surfaces even on aperture margin.

Remarks—Racemonocolpites racematus Guzmán 1967 closely resembles the present species. However, in *R. racematus* intersculptural exine is laevigate and sculptural elements dominantly gemmate. *Racemonocolpites facilis* Guzmán 1967 and *R. romanus* Guzmán 1967 possess grana between the sculptural elements as in the present species but differ having indistinct sculcus and exine mainly gemmate.

Racemonocolpites trichotomosulcatus sp. nov.
Pl. 1, figs 1-4

Holotype—Pl. 1, figs 1, 2; size 59.2 × 60.8 μm; Slide no. BSIP 9581.

Occurrence—Thanjinath (middle seam), Lakadong Sandstone Member, Sylhet Limestone Formation, Meghalaya.

Diagnosis—Pollen grains triangular to subcircular in polar view, trichotomosulcate; exine sculptured with clava, bacula and gemmae, intersculptural elements microbaculose/granulose.

Description—Symmetry and form—triangular to subcircular, margin uneven due to projection of sculptural elements, 50-59 × 56-62 μm in size. Aperture trichotomosulcate, sulcus narrow at equator and wide towards pole. Exine intectate, 1.0-1.5 μm thick, different layers not observed due to dense sculptural elements; sculptural elements: clava, bacula and few gemmae; clava 3-5.5 μm long and 2-5.2 μm broad, bacula 2-3.5 μm long and 1-3 μm wide, gemmae 3.0-6.2 μm; intersculptural area granulose/microbaculose.

Remarks—Trichotomocolpites van der Hammen 1956 and *Trichotomosulcites* Couper 1953 were instituted to accommodate trichotomosulcate aperturate pollen. However, van der Hammen (1956) designated a recent palm pollen *Pyrenoglyphis major* as the holotype for *Trichotomocolpites*. Jansonius and Hill (1976) considered this name as illegitimate. In 1960, Couper considered that the type species of *Trichotomosulcites* (*Trichotomosulcites subgranulatus*) is actually *Trisaccites microsaccatus* (Couper) Couper 1960 with very poorly developed saccus and thus this name also stands superfluous (Jansonius & Hill, 1976).

According to Muller (1979), *Racemonocolpites* is closely comparable to *Iriartia* pollen. *Iriartia* pollen though morphologically comparable with the present taxa is much smaller in size (26-40 μm). Sculptural elements of *Racemonocolpites thanjinathensis* and *R. trichotomosulcatus* resemble

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PLATE 1 →

1-4. *Racemonocolpites trichotomosulcatus*
1, 2. Showing grana on intersculptural areas, Slide no. BSIP 9581 (L54/3); fig. 1, × 1000 and fig. 2, × 500.
3, 4. Showing trichotomosulcate aperture, Slide no. BSIP 9579 (041/3); fig. 3, × 500 and fig. 4, × 1000.
5-10. *Racemonocolpites thanjinathensis*
5. Depicts the exomorphic features, Slide no. BSIP 9580 (T46/3), × 1000.
6. Shows monosulcate aperture and sculptural elements, Slide no. 9582 (T44/2), × 1000.
7. Illustrates intersculptural exinal ornamentation, Slide no. BSIP 10250 (V41), × 1000.
8-10. SEM photographs showing exinal features particularly ornamentation in intersculptural areas; fig. 8, × 1600; fig. 9, × ca. 3055; fig. 10, × ca. 4000.

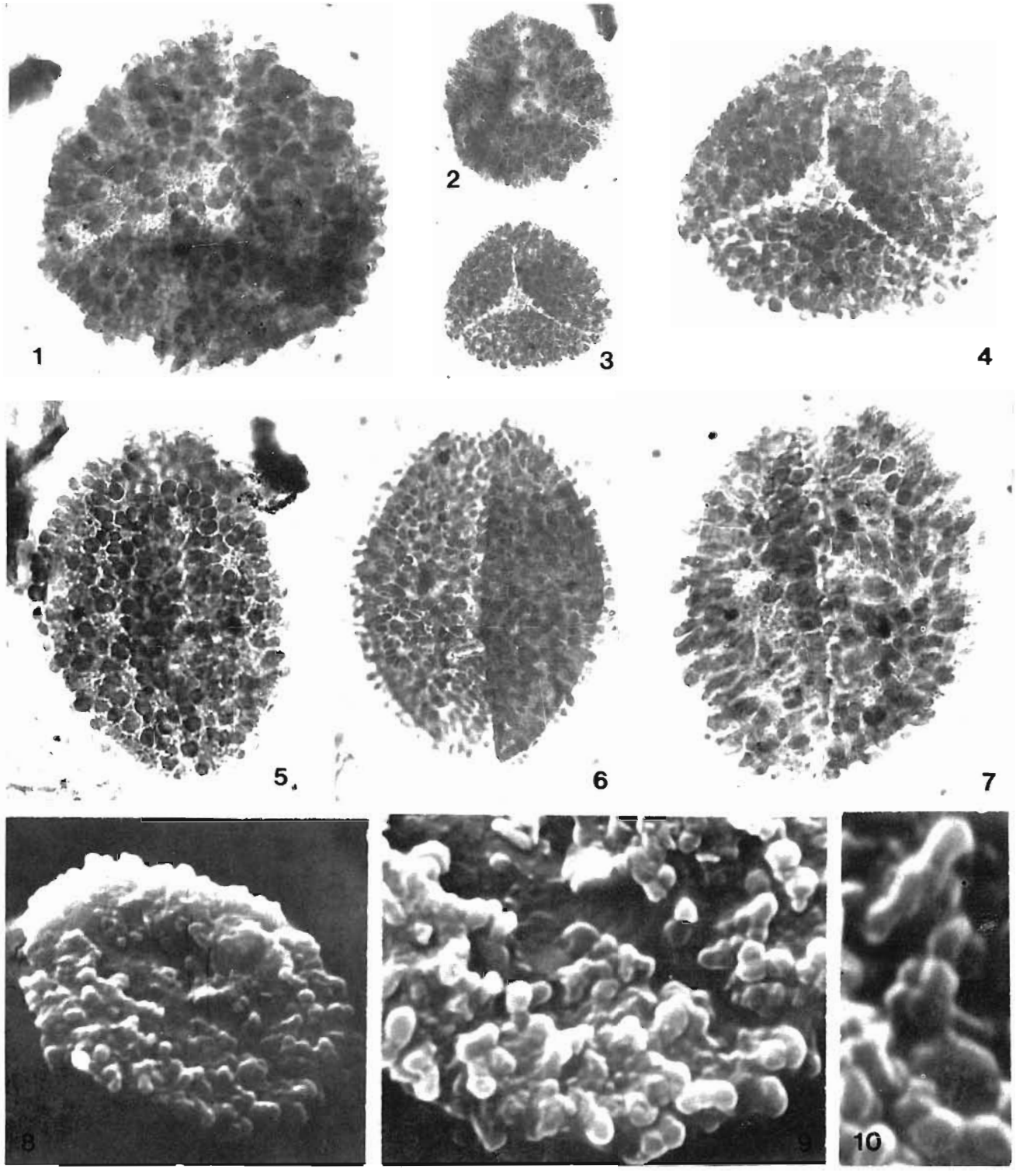
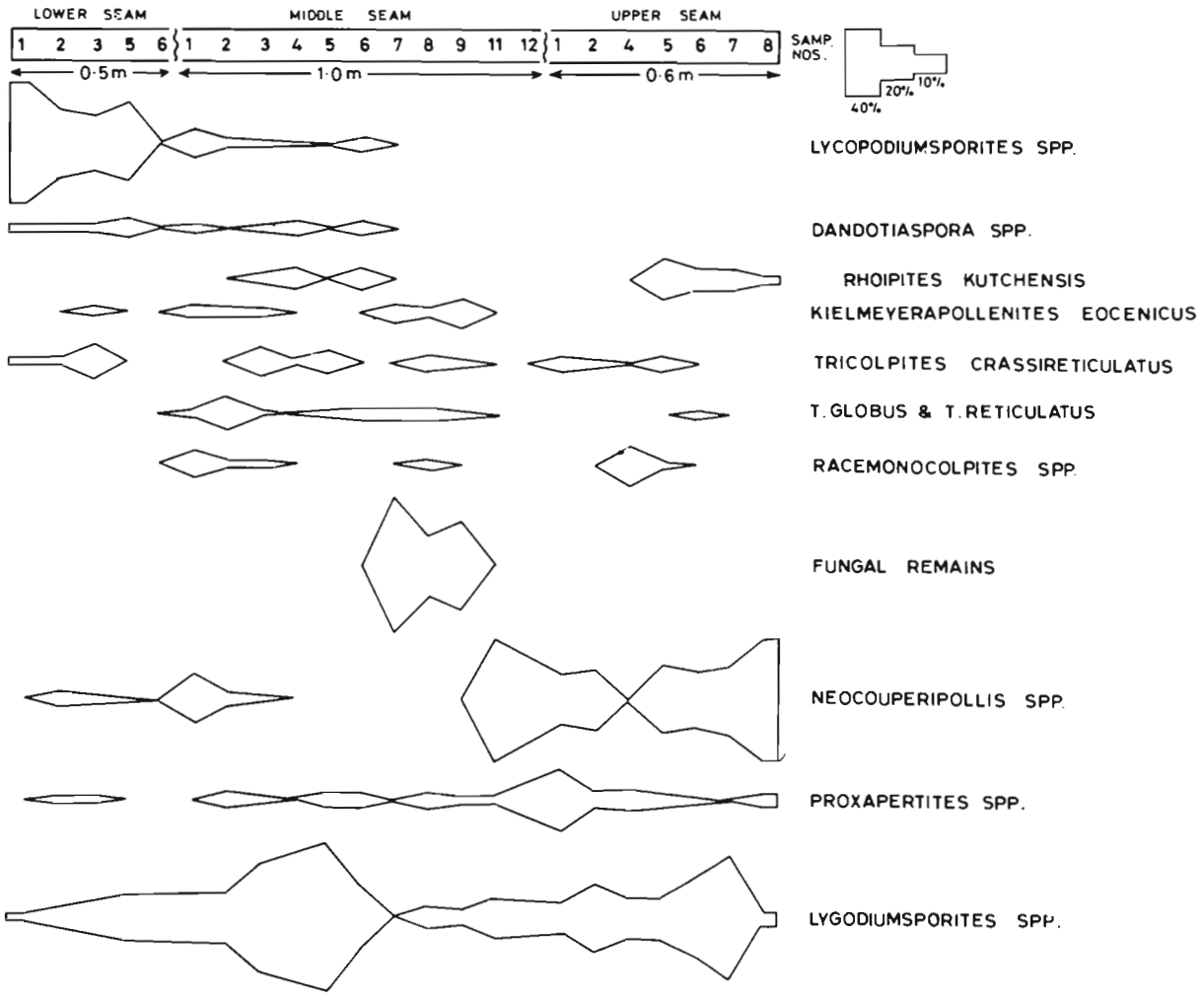


PLATE 1



Text-figure 1—Showing the frequency of important palynotaxa in different seams.

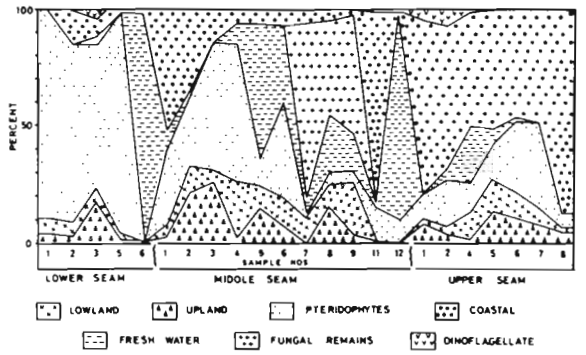
pollen of *Pinanga coronata* described by Thanikaimoni, 1970 (pl. 2, figs 18-24). *Pinanga coronata* also produces both mono- and trichotomosulcate aperturate pollen. *Pinanga* now (115 species) grows in India to southern China, and eastward to New Guinea as a forest undergrowth. *Pinanga coronata* now a days is restricted to Malaysia.

The present specimens have been described under *Racemonocolpites* because of their exomorphic features and in having both nono- and trichotomosulcate aperture.

DISCUSSION

The palynoflora recovered from Thanjinath area consists of 34 genera and 55 species. Pteridophytic spores (36%) in the assemblage are represented by 13 genera and 19 species, angiospermous pollen (57%) by 19 genera and 33 species and gymnospermous pollen poorly by single species. Algal remains comparable to *Tetraporina* and microthyriaceous fungi occur in good numbers. Phytoplanktons are also encountered but insignificantly. Lower seam consists of 25 species belonging to 21 genera. Pteridophytic spores with 49 per cent dominate over angiospermous pollen which occupy only 32 per cent. *Lycopodiumsporites* is the dominant genus and is recorded up to 65 per cent in some samples followed by *Dandotiaspora dilata* (10%). Monocot pollen, dominated by *Neocouperipollis* and *Proxapertites*, are represented by 20 per cent while dicotyledonous pollen are poorly represented.

The assemblage of middle seam is rich in variety and consists of 29 genera and 41 species. Angiosperm pollen contribute 55 per cent followed by spores (37%). *Lygodiumsporites* and *Cyathidites* are the dominant taxa and the remaining spore genera behave like the lower seam except



Text-figure 2—Showing the behaviour of spores, palm pollen and dicotyledonous pollen grains from Lower to Upper seams.

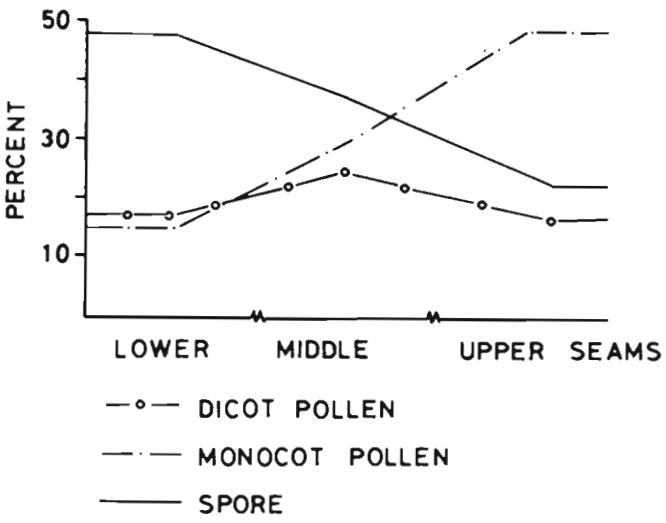
Lycopodiumsporites which declines significantly. Palm pollen exhibit their gradual abundance upward and are dominated by *Neocouperipollis*. *Kielmeyerapollenites* and *Tricolpites* are major elements among the dicot and the dicot pollen grains are far less than the palm pollen both quantitatively and qualitatively. A few genera appear in this seam and significant amongst them is trichotomosulcate palm pollen. These pollen have been designated as *Racemonocolpites trichotomosulcatus* and *R. thanjinathensis*. In the upper seam the assemblage consists of 22 genera and 29 species and spores. Monocot genera are less diversified but are rich (48%). Dicotyledonous pollen occur insignificantly, only *Rhoipites* contributes up to 12 per cent. *Podocarpidites*, the only gymnosperm member present poorly in this seam.

The above analysis shows that the pteridophytic spores are dominant in the lower seam and the angiosperms pollen in the upper seams (Text-fig. 2). *Lycopodiumsporites* overwhelmingly represents in the lower seam but absent in the upper seam. Likewise *Kielmeyerapollenites*, one of the dominant taxa of the middle seam, does not occur in other seams. Fungal remains confined to the middle seam while gymnospermous pollen have been recovered from upper seam only. The distribution of the major spore-pollen taxa is shown in Text-figure 1. It is also evident that the change of palynofloral succession in different seams is gradual and there is no break during deposition of sediments.

The present spore-pollen assemblage is closely comparable with the palynological association reported by Salujha *et al.* (1972), Singh (1977) from Tura Formation, Saxena (1980) and Kar (1985) from Matanomadh Formation and Kar and Kumar (1986) from Lakadong sandstone as the significant taxa are common in the assemblages. Some of the taxa recovered here could be tagged with the undermentioned families. Lycopodiaceae—*Lycopodiumsporites, Foveosporites*; Schizeaceae—*Schizaeoisporites, Lygodiumsporites*; Osmundaceae—*Osmundacidites*; Cyathiaceae—*Cyathidites*; Polypodiaceae—*Polypodiisporites* and *Laevigatosporites*; Podocarpaceae—*Podocarpidites*; Arecaceae—*Neocouperipollis, Proxapertites, Spinizonocolpites* and *Racemonocolpites*; Annonaceae—*Matanomadhiasulcites*; Fabaceae—*Tricolpites crassireticulatus*; Brassicaceae—*Tricolpites globus*; Polygonaceae—*Tricolpites levis*; Bombacaceae—*Lakiapollis*; Clusiaceae—*Kielmeyerapollenites*; Gunneriaceae—*Tricolpites reticulatus, Retistephanocolpites*; Polygalaceae—*Psilastephanocolporites*; Anacardiaceae—*Rhoipites*. These families are known to grow chiefly in tropical areas (Lakhanpal, 1970; Dutta & Sah, 1970; Saxena, 1980).

Thus it seems that Thanjinath enjoyed a tropical climate during the time of deposition. Presence of palm pollen in abundance, in particular, indicates near coastal environment. Rich pteridophytic flora suggests a swamp type of vegetation with high humidity. Low land elements and fresh water algae were carried from the surroundings of the depositional area. The coal seams were deposited near shore in shallow marine condition. The presence of dinoflagellates also corroborates this assumption.

The Thanjinath palynoflora has been classified under seven groups according to their habitat and the data plotted in the form of a diagram (Text-fig. 3). The diagram shows that there was not much of upland flora. Pteridophytes dominate in lower seam



Text-figure 3—Showing the distribution pattern of major palynofloral-ecological complexes.

and gradually decline upward, whereas the coastal elements invade upwards slowly.

ACKNOWLEDGEMENTS

Sincere appreciation is extended to Dr R. K. Kar for various comments. I would like to thank Dr K. Ambwani for the SEM photographs.

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