Light-Microscopy and SEM studies of *Striatriletes* and *Malayaeaspora* from India and Malaysia*

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Striatriletes van der Hammen emend. Kar (1979) and *Malayaeaspora* Trivedi *et al.* (1981), were investigated under light-microscope and SEM. It was observed under SEM that in *Striatriletes* costae are discontinuous and the individual verrucae could be recognized. They have some transverse ridges connecting the costae on either side. In *Malayaeaspora* verrucae are absent on the proximal side and distally they sometimes coalesce but never form the true costae. The spores of *Ceratopteris thalictroides* Brong. and *Mohria caffrorum* (L.) Desv. were also studied. It was observed that spores of *C. thalictroides* closely resemble *Striatriletes microverrucosus* Kar & Saxena (1981).

Key-words - Palynology, *Striatriletes*, *Malayaeaspora*, India, Malayasia.

INTRODUCTION

The dispersed fossil spores of *Ceratopteris* Brong. of the Parkeriaceae known as *Striatriletes* van der Hammen emend. Kar (1979) are pan-tropical in distribution (Germeraad *et al.*, 1968). The oldest record of *Striatriletes* is from the Middle Eocene of India, while in other regions it appears in Oligocene. It exhibits maximum development in Oligocene and Miocene. This led Kar (1984) to advocate that the fern *Ceratopteris* originated in India. The present day distribution of *Ceratopteris*, according to Hooker and Baker (1968), is throughout the tropics.

CERATOPTERIS AND RELATED FOSSIL GENERA

Spores of *Ceratopteris* are triangular to subtriangular in shape, the trilete rays are well developed and extend upto three-fourths of radius. Exine costate, costae arising from inter-radial areas or apices and extend on to the corresponding areas of distal sides forming three concentric rings. Sometimes, on the distal polar region the sets of costae are closely placed leaving a triangular area in between them. The spores, though easy to identify, have been described under various names by different authors. Baksi (1962) called them as *Schizaeaceaesporites* (Pl. 3, fig. 41) and *Parkeriaceaesporites* sp. (Pl. 5, fig. 54) while Biswas (1962, p. 35), Sah and Dutta (1968, p. 185), Salujha *et el.* (1972, p. 272), Nandi (1975, p. 415) described them under *Cicatricosisporites* Potonie and Gelletich (1934). Germeraad *et al.* (1968) proposed *Magnastriatites* to accommodate similar type of spores hitherto described as *Striatriletes*. Kar (1979) discussed the nomenclatural problem and treated *Schizaeaceaesporites*, *Parkeriaceaesporites* and *Magnastriatites* as synonyms of *Striatriletes*.

Cicatricosisporites was proposed by Potonie and Gelletich (1934) to include fossil schizaeaceous spores akin to *Anemia* and *Mohria*. The spores are triangular-subtriangular and costate but the costae on proximal side run parallel to that of the distal side and as observed in *Ceratopteris*, the costae do not traverse on the distal side to form concentric rings.

Morphology of Malayaeaspora - *Malayaeaspora* Trivedi *et al.* (1981) was first recorded from the Middle-Upper Eocene deposits of Malaysia and subsequently was recorded from the Oligocene sediments of India. This genus does not extend into Miocene and hence represents a marker fossil for the Middle-Upper Eocene and Oligocene of Malaysia and India. The spores are triangular-subtriangular in shape; the trilete mark is distinct and the exine is proximally laevigate but distally verrucose - costate, verrucae being closely placed, adhered together and aligned in rows to impart a costate look.

Striatriletes and Malayaeaspora - Morphological similarities between *Striatriletes* and *Malayaeaspora* and their comparable stratigraphic range prompted us to study these genera under SEM. The spores of extant *Ceratopteris*

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thalictroides Brong. and *Mohria caffrorum* (L.) Desv. were also investigated under SEM in this connection. For this study, the spores were mounted on a thin cover glass and were sputter-coated by gold-palladium alloy. The specimens were studied under SEM (Philips 505). The working voltage for the image analysis was 30 kv.

Fossil and extant spores of Ceratopteris - The spores of *Ceratopteris thalictroides* Brong. are larger than those of *Striatriletes;* but gross morphological characters are similar in both. Under SEM, the costae in *Ceratopteris thalictroides* Brong. appear as continuous, raised ridges without any appreciable break (Pl.1, figs 1-4). The costae as well as the inter-costal regions are granulose. *Striatriletes susannae* van der Hammen emend. Kar (1979), the type species of the genus, is devoid of grana but *Striatriletes microverrucosus* Kar & Saxena (1981) described from the Middle-Upper Eocene of Kutch, is microverrucose to granulose. The costae of *S. susannae, S. multicostatus* Kar & Saxena (1981) and *S.microverrucosus* look slightly discontinuous with undulation and individual verrucae could be recognized. Costae in *S.susannae* also exhibit some transverse ridges on either side connecting the adjacent costae (Pl. 1, figs 9-11).

Spores of Mohria, Striatriletes and Malayaeaspora - The spores of *Mohria caffrorum* (L.) Desv. under SEM show costae like *Ceratopteris*. The costae are raised, not joined and the inter-costal regions laevigate (Pl. 1, figs 5-6). *Malayaeaspora costata* Trivedi *et al.* (1981) in SEM does not show any sculpture on proximal side, distally the verrucae are prominent, sometimes fused to form incipient costae. The arrangement of verrucae in close linear fashion imparts a pseudocostate look (Pl. 1, figs 7-8). The costae in *M.costata* differ from *Striatriletes* as they are discontinuous and the individual entity of verrucae could be traced. Intercostal exine in *M.costata* is laevigate.

DISCUSSION

Striatriletes and *Malayaeaspora* both originated in Indo-Malayan region during Middle-Upper Eocene. *Striatriletes* soon became pan tropical and in Oligocene and Miocene, it was established as one of the dominant taxa. After Miocene it started dwindling, but still continued to occur in the flood plains of tropics. *Malayaeaspora,* on the other hand, has no living counterpart. It never became prominent and disappeared at the end of Oligocene. Perhaps, *Striatriletes* was more adaptable than *Malayaeaspora* and its highly developed costate spores were instrumental in effective dispersal and to withstand the unfavourable climatic condition. Emergence of flood plains and riverine deposits in Oligocene and Miocene in the pan tropical areas suited it most, resulting the acme development.

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PLATE 1

1. *Ceratopteris thalictroides* Brong. SEM photograph in proximal view showing the nature of trilete mark and the orientation of costae, *ca.* x 512.
2. Distal view of the same showing arrangement of costae and their branching, *ca.* x 512. 3. A part of the trilete mark magnified showing its granular nature, *ca.* x 1950.
4. Magnified costae showing grana on the costae and in intercostal area, *ca.* x 1950.
5. SEM photograph of *Mohria caffrorum* (L.) Desv. spore showing the nature of costae, *ca.* x 1000.
6. A magnified view of portion of the same to show smooth costae, *ca.* x 2000.
7. *Malayaeaspora costata* Trivedi *et al.* showing the verrucae, *ca.* x 1000.
8. A magnified portion of the same showing verrucae, *ca.* x 3000.
9. *Striatriletes susannae* van der Hammen emend. Kar showing proximal view, *ca.* x 1000.
10. Magnified view of costae near trilete mark, note the arrangement of costae, *ca.* x 2400.
11. Costae of the distal side showing transverse ridges, *ca.* x 1500.

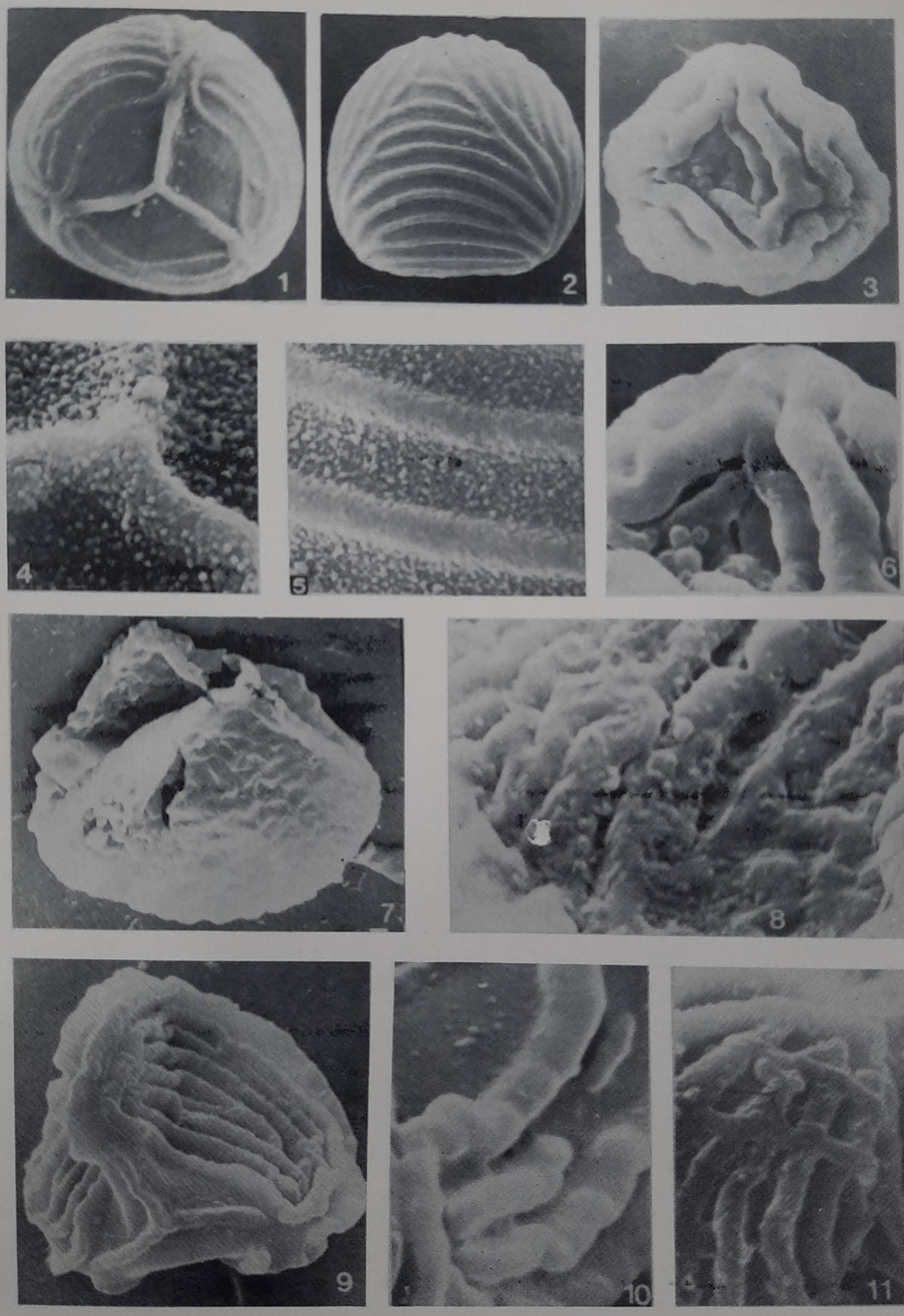

PLATE 1