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STUDIES IN INDIAN PTERIDOPHYTES—III
THE FAMILY MARATTIACEAE (*SENSU COPELAND*, 1947) IN INDIA

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ABSTRACT

The family is represented by 6-7 living genera and about 100-214 spp. in the world flora. With a view to bringing out an illustrated manual on the systematics of the family Marattiaceae in India, the three living genera *Angiopteris* 1 spp. (3 spp. according to *Nishida*, 1966), *Marattia* 1 sp., and *Christensenia* 1 sp. occurring in India have been dealt with. It shows that while *Angiopteris* is distributed throughout India, *Marattia* and *Christensenia* are restricted to the Southern and the Eastern India, respectively.

The family Marattiaceae (*sensu Copeland*, 1947) consists of 6-7 living genera in the world flora. Botanists, however, do not agree on the number of families to which they belong. Bower (1926) and Eames (1936) recognise only one family Marattiaceae with 7 living genera *viz.* *Angiopteris* 1 sp. or 111 spp., *Macroglossum* 1 sp., *Archangiopteris* 4 spp., *Marattia* 60 spp., *Protomarattia* 1 sp., *Danaea* 32 spp., *Christensenia* 1 or 5 spp. Christensen (1938) recognised two families and 6 genera *viz.* Angiopteridaceae to include *Angiopteris, Macroglossum, Archangiopteris* and Marattiaceae to include *Marattia, Christensenia* and *Danaea.* Campbell (1940, p. 333) while segregating *Christensenia* to a distinct family Kaulfussiaceae, suggested that the other 6 genera may be retained in the family Marattiaceae. Copeland (1947) treated the 6 genera in four groups in the family Marattiaceae of the natural order Marattiales but felt that the four-groups may perhaps be treated as distinct-families. But he did not do so himself as neither phylogeny nor convenience demanded it. Pichi-Sermolli (1959), however, agreed with Reimer in recognising 4 families and 7 genera *viz.* Angiopteridaceae: *Angiopteris, Macroglossum* and *Archangiopteris;* Marattiaceae: *Marattia, Protomarattia;* Danaeaceae: *Danaea;* Kaulfussiaceae: *Christensenia.* The three living Indian genera *viz.* *Angiopteris* 1 sp., *Marattia* 1 sp. and *Christensenia* 1 sp. belong then to three different families *viz.* Angiopteridaceae, Marattiaceae, Kaulfussiaceae.

Distribution: The family is well represented in tropical humid forests of both the hemispheres. Whereas *Marattia* is pantropic occurring also in South Africa and New Zealand, *Angiopteris* is common from Madagascar across Polynesia to Southern Japan and Northern Australia, and *Christensenia* (=*Kaulfussia*) is confined to Indo-Malyan region. *Archangiopteris* and *Protomarattia* are restricted to South-China, Tonking and Formosa; *Macroglossum* to Borneo and Sumatra and *Danaea* to tropical America (cf. *Campbell*, 1940; *Copeland*, 1947).

Fossil: The family is undoubtedly an ancient one. Fossils showing fertile fronds clearly related to living members, have been found in the Upper Paleozoic and early Mesozoic rocks from all continents, some from places far north of 30°N which is the present northern limit of the family (cf. *Holttum*, 1954, p. 43). Bower (1926, p. 123) considers that "Nothing in paleobotany is more striking than a detailed comparison of the Paleozoic sori of *Ptychocarpus* or of *Scolecopteris* with those of living *Christensenia* and *Marattia.* The living genera show many archaic features and have not much in common with other families of ferns".

Although Mamay (1950) has suggested the derivation of the Marattidae from the exannulate carboniferous genus Chorionopteris (Primofilicidae, Anachoropteridales) and has also produced phyletic diagram of the Marattidae, Pichi-Sermolli (1959) treats his arguments as not entirely convincing and maintains that much remains to be known concerning the origin and the evolution of the Marattidae.

SYSTEMATIC ACCOUNT

Marattiaceae Kaulfuss, Enum. 31.1824, as Ordo.

Danaeaceae Agardh, Aphor 177. 1822, as Ordo. This is the older ordinal name.

Angiopteridaceae C. Chr. in Verdoorn, Manual 527.1938.

Kaulfussieae Presl, Suppl. Tent. 17. 1845 (*Copeland*, 1947).

KEY TO THE INDIAN GENERA OF MARATTIACEAE

1. Sporangia in each group along the veins near margins of leaflets, veins free
   2. Sporangia in each group free ... *Angiopteris*
   2. Sporangia in each group united laterally into elongated synangia ... ... *Marattia*
1. Sporangia in each group united laterally to form a small circle, the circular groups scattered over the surface; veins anastomosing ... *Christensenia*

Angiopteris Hoffm., Comm. Soc. Reg. Sc. Gotting. 12 (Cl. Phys.): 29.1796. nom. cons., non Adanson 1763 (cf. Taxon 2: 12, 1953; 3: 155, 233, 1954). (Angio, open; pteris, fern=the open sporangia).

Clementia Cavanilles, Descr. Pl. 2: 553.1803.

Psilodochea Presl, Suppl. Tent. Pterid. 27.1845.

Type species: *Angiopteris evecta* (Forst.) Hoffm. Comm. Soc. Reg. Sc. Gotting 12: (Cl. Phys.): 29, t. 5. 1796.

Rhizome short, globose, radially symmetrical, massive fleshy stock; fronds bipinnate; stipe fleshy, green, swollen at the base; pinnae attached to the main rachis by swollen bases; veins free. Sori dorsal, near the margin, elongate along the veins, sporangia in two dorsal rows, about 20 in number, contiguous but not coherent. Sporangium provided with a group of dark cells at the top, simulating the "annulus" of the Filices, but not homologous to it. Recurrent 'false' veins run from the margin between the two veins.

The number of accepted species ranges from 1 (one) to about 100 or 111 (cf. *Holttum*, 1954; *Copeland*, 1947). Some authors prefer to regard all of them as one species.

Angiopteris evecta (Forst.) Hoffm., Comm. Soc. Reg. Gott. 12: 29. t. 5.1796; C. Chr. Index Fil. 56.1906; Bedd., Handb. Ferns Brit. India 460, t. 285.1883; Ferns South India 27, t. 78. 1863.

Basinym: *Polypodium evectum* Forst., Prodr. 81: 1786.

Synonyms: *Angiopteris crassipes* Wallich [Cat. log. 187. (1828)] ex Presl, Suppl. Tent. Pterid. 23: 1845; M. Nishida in Flora of Eastern Himalayas, Pteridophyta p. 454. 1966.

A. salicifolia (Presl) de Vries, Monogr. 34: 1853, M. Nishida *l.c.* p. 454. 1966.

Handsome huge ferns growing luxuriantly in swampy forest floor, in humid slopes near water fall, in evergreen forest along the road-side or among the bamboo groves, on rocky substratum and on sandy loam. It is associated with *Thelypteris, Cyathea* etc. Rhizome subglobose, fleshy *ca.* 60 cm thick, often becoming erect in age; stipes green with scattered whitish streaks and covered with small brown hairs when young, smooth and also becomes very notchy at age, *ca.* 2-3 m long. Fronds bipinnate (young sterile ones are often pinnate, Fig. 1), sometimes or exceptionally adult ones tripinnate (Fig. 2), *ca.* 6-18 m long and 1-3 m broad and spreading, with the lowest pinnae the largest; rachises green, hairy, like the stipes and swollen at the base; pinnae *ca.* 100 cm long with pinnules 2-3 cm apart, *ca.* 5-30 cm×2-4 cm, dark green, glabrous, shining, sessile or shortly stalked, base unequal, shape various *viz.* ovate, linear-oblong to ovate-oblong (Figs. 3-5) margin entire or serrulate, apex acuminate and strongly toothed, texture subcoriaceous; veins simple or forked raised on both the surfaces, translucent when living; recurrent 'false' veins slender, commonly indistinct beyond the sori, rarely traceable half-way to midrib.

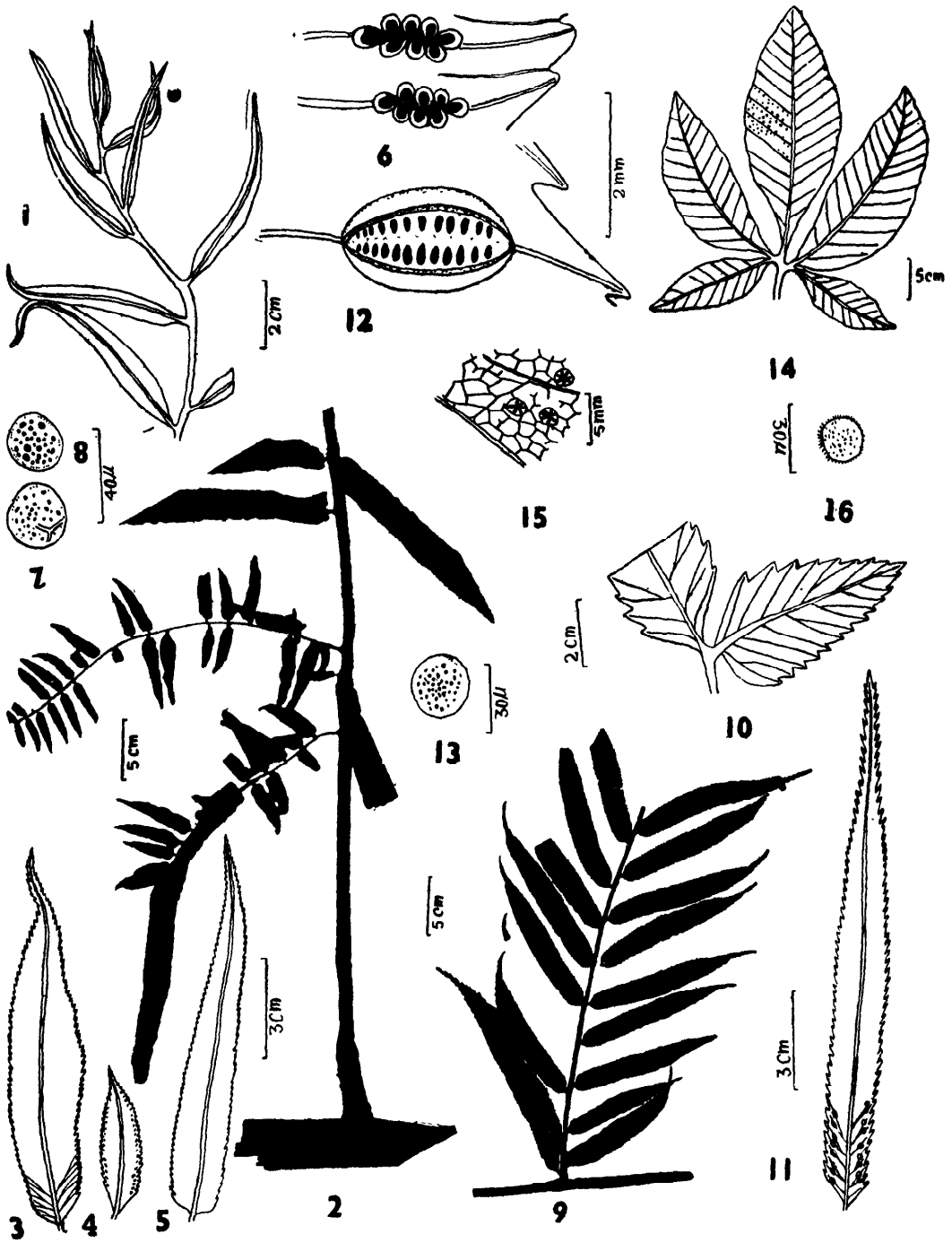
Fertile pinnules not contracted, sori *ca.* 1 mm away from the margin, consisting of usually *ca.* 7-12 sporangia in each group (Fig. 6); clouds of spores (Figs. 7-8) come out on shaking, *amb.* circular *ca.* 23-25 μ in diameter and with verrucoid protuberances on the exine. Abundant.

Fertile: Throughout the year.

Distribution in India: The following record of distribution is based on our own study of herbarium sheets. NEFA. Subansiri Frontier District: Kimin foot hills; Tirap F.D.: Lusa to Bimalapur and Laju hills; Siang F.D.: Eyo to Tumbing (500-700 m). ASSAM: Mikir hills; Foot hills; Lushai hills; Naga hills; Garo hills; Khasi and Jaintia hills; Nongstoin; Shella; Haflong; Jowai; Lakhimpur: Kokai Reserve forest; Sibsagar: Digboi; Manipur: Sikkim. WEST BENGAL: Darjeeling; Himalayas. MADHYA PRADESH: Pachmarhi; Bailadila. ORISSA: Simlipalgarh forests. ANDHRA: Godavari banks. TAMILNADU: Palghat hills; Achenkovil; Chingleput; Nilgiri; Devikolam; Madurai; Ootacamund. KERALA: Trivandrum; Malabar Attaquadi hills; South Kanara; Jalpad. MYSORE: Coorge. BOMBAY: Castle-Rock. ANDAMANS: Logajada; South Andamans: Rangu Chang hill Jungle.

Earlier records: Throughout the Indian region; Japan; Tropical Australia; New Caledonia; Madagascar; Malayasia to Polynesia.

Altitude : 10-3000 m.
Vernacular name : Assamese call it *"Hati Dhekia"*.
Note: Although Moore (1857-1862) enumerated numerous Indian species, Beddome (1863) believed that all of them belonged to one and the same species.



Figs. 1-16 : 1-8. *Angiopteris evecta* : 1. Young pinnate frond. 2. An adult bipinnate to tripinnate frond. 3-5. Variation in pinnae-shape. 6. Part of the fertile pinnule showing sporangia united in groups and recurrent veins. 7. Proximal part of the spore. 8. Distal part of the spore. 9-13. *Marattia fraxinea*: 9. An adult bipinnate frond. 10. Young pinnate frond. 11. A pinnule. 12. Part of the fertile pinnule showing synangium. 13. Distal part of the spore. 14-16. *Christensenia aesculifolia*: 14. Palmately compound frond (after *Holttum*, 1954). 15. Venation an sor enlarged (after *Holttum*, 1954). 16. Distal part of the spore.

Originally, *A. evecta* was found in Tahiti. On the basis of the relative breadths of pinnules and the recurrent 'false' veins, Holttum (1954) recognised 2 species in Malaya.

Marattia Swartz, Prodr. Fl. Ind. Occ. 128. 1788.

Calanthers Thouin, Acad. Sci. Paris. 1786, not properly published.

Type-species: *Marattia alata* Swartz, Prodr. 128. 1788.

Adult stem globose, frond bipinnate or tripinnate, veins free; sori dorsal on frond and vein, each composed of a short double row of sporangia tightly fused into a synangium, which splits over the vein exposing the ventral face of the sporangia (loculi), each of which then opens by a ventral longitudinal slit (*Copeland,* 1947).

Marattia fraxinea Smith, Pl. Ic. ined. 2, t. 48. 1790; C. Chr. Index Fil. 414. 1906; Bedd., Handb. Ferns Brit. India 460, t. 286. 1883; Ferns South India 27, t. 79, 1863.

Synonym: *M. sorbifolia* Sw., Syn. 168. 1806.

It grows in moist shady situations by the side of water. Rhizome large and globose; stipes *ca.* 30-70 cm long and 2-6 cm thick, with deciduous scales or swollen in the lower portion; notchy at age with scattered spinulose points. Fronds bipinnate (Fig. 9) (young fronds simply pinnate, Fig. 10) or sometimes tripinnate. *Ca.* 5 m long; pinnae *ca.* 30-60 cm long; pinnules (Fig. 11) 2-3 cm apart, shortly stalked, *ca.* 15-20 cm × 1-3 cm (a specimen *viz. Beddome* 103 received from Central National Herbarium, Calcutta, measures 20 cm × 5 cm and veins simple to twice forked) dark green, glabrous, base unequal, linear oblong, margin serrate, apex acuminate and strongly toothed, texture, coriaceous, rachis of the pinnae sometimes slightly winged; veins simple or forked, raised on both the surfaces.

Fertile pinnae not contracted, synangia submarginal in close rows, the receptacle linear, medial with 6-12 capsules on each side (Fig. 12); an obscure, fimbriated, inferior, linear-elliptic involucre often present. Spores (Fig. 13) *amb.* circular to subcircular, *ca.* 23-25 μ in diameter, with verrucoid protuberances on the exine. Rare. *Fertile*: May-October.

Distribution in India: The species is restricted to South India in its Indian range and occurs in Tamilnadu (Madurai, Kodaikanal; Tinnevelly; Vellimalai; Tirunelvelli; Anamalai hills and Kerala (Trivandrum).

Altitude: 1000-2000 m.

Earlier records: South India, Ceylon; according to Beddome (1883), it occurs all round the world in the tropics and a little beyond, in the Southern Zone.

Christensenia Maxon, Proc. Biol. Soc. Washington 18: 239. 1905.

Kaulfussia Blume, Enum. Pl. Jav. 2: 260. 1820, non Dennstedt 1818, nec. Nees 1820.

Macrostoma Griffith, Asiatic Res. 19: 110. 1836.

Type-species: *Christenseni aesculifolia* (Blume) Maxon, Proc. Biol. Soc. Washington 18: 240. 1905.

Nomenclature: *Kaulfussia* Blume is illegitimate, being a later homonym of *Kaulfussia* Dennstedt (Polygalaceae) and *Kaulfussia* Nees (Compositae) and *Macrostoma* is later homonym of *Macrostoma* Hedwig. 1806 (Convolvulaceae).

Rhizome creeping; frond palmate (rarely with a single leaflet) venation reticulate; sporangia fused into circular synangia, scattered over the lower surface; each opens by a slit toward the centre of the synangium. (*Copeland,* 1947).

Christensenia aesculifolia (Blume) Maxon, Proc. Biol. Soc. Washington 18: 240. 1905.

Basinym: *Aspidium aesculifolium* Blume, Enum. Pl. Jav. 2: 143. 1828.

Synonyms: *Kaulfussia aesculifolia* (Blume) Blume, Enum. Pl. Jav. 2: 260. 1828; Bedd., Handb. Ferns Brit. India 462, t. 287. 1883.

K. assamica Griffith, Asiat. Res. 19: 108, t. 18. 1836.

Rhizome* creeping, fleshy with successive stipes, growing in rocky shady places. Stipes green, fleshy, herbaceous *ca.* 25-40 cm long. Fronds simple when young and palmately compound at age consisting of 3-5 leaflets (Fig. 14), shortly stalked arising from the top of the stipe, under-surface whitish, the middle leaflet largest *ca.* 20 × 12 cm, oblong to elliptic, base cuneate, texture thin and herbaceous, margin entire or undulate, apex acuminate, whereas the other leaflets smaller and obliquely elliptic; main lateral veins strongly marked, curved, venation (Fig. 15) reticulate with free vein-lets included in aerioles.

*Rhizome is not illustrated as we could not borrow the specimens from Assam Herbarium for the 2nd time, in spite of repeated requests.

Synangia at vein junctions in two or more irregular rows, between the main veins and each consisting of 10-20 laterally jointed sporangia in a circular group and dehiscing inwards towards the central depression. Spores (Fig. 16) *amb.* circular 18-20μ in diameter with sharply spinescent exine. Rare and scarce.

Fertile: December.

Distribution in India: ASSAM: Lakhimpur: Jeypur, *Deka* s.n. collected on 29.12.1948.

Earlier records: North India, Assam, Cachar, Chittagong hills; Malay Islands and Philippines.

We have examined about 300 sheets of the family Marattiaceae received from the Central National Herbarium, Calcutta and the other four Regional Herbaria at Shillong, Coimbatore, Poona and Dehra Dun. Only two sheets of *C. aesculifolia* bearing young sori and collected only once in December, 1948 from Assam were available to us. The second author (G.P.) during his collection tours over six years in Assam and N.E.F.A., could not collect the species even once between 1956-1962. This may indicate that the specimens on which Beddome (1883, p. 462) based his report are not available in India and the species is extremely rare in our fern flora. The spore (Fig. 17) is drawn from a Malayan specimen, received from the Central National Herbarium, Calcutta.

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*Not seen in original.