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REDISCOVERY OF PRONEPHRIUM THWAITESII (THELYPTERIDACEAE), A LITTLE KNOWN AND LONG LOST FERN

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SUMMARY

Pronephrium thwaitesii, known only from two collections from Ceylon and one from South India, all made more than a century ago and not found any more in these localities, is reported from Silent Valley (Malabar, South India) and described. It is a sterile hybrid possibly between *P. triphyllum* and *Christella parasitica* (not *Trigonospora ciliata* or *P. articulatum* as hitherto suggested).

INTRODUCTION

Pronephrium thwaitesii (Hook.) Holttum is a rare and little known tropical fern (Thelypteridaceae) which has been collected only thrice and that too over a century and a quarter ago (Holttum, 1971, 1972; Sledge, 1981). Originally described by Hooker (1857–1859) under the name *Meniscium thwaitesii* based on a herbarium specimen at Kew Herbarium, collected by Thwaites (*no. 3145*) from Central Provinces of Ceylon, it has never been collected again from the type locality; a duplicate of Thwaites' collection is at the Herbarium of the Museum National d'Histoire Naturelle, Paris. During 1854–1855 Gardner collected a few samples from nearby localities (Udapusselawa, Bogawantalawa, Matale East) and these are deposited at Cambridge University Herbarium and Peradeniya Herbarium (Ceylon). The taxon has never been collected thereafter from Ceylon. However, soon afterwards Beddome (1864) reported *P. thwaitesii* from South India; his herbarium at Kew (Holttum, pers. comm.) includes specimens collected from 'Tinnevelley Hills' and also from 'Western slopes of Nilgiris, between Walaghat and Silent Valley' (apparently western slopes of Sispara as mentioned in his Handbook). According to Holttum (1972: 123) 'No specimens have been collected since about 1880'; currently the taxon is presumed to have become extinct. During a floristic study of the botanically unexplored wet evergreen forests of Silent Valley (Malabar, South India), we came across extensive patches of this rare taxon growing luxuriantly on the banks of Kunthipuzha River where the tributary Valiaparathode merges with the river (altitude 800 m) as also near Walakkad (altitude 1,200 m) close to the mouth of Kundamsalapuzha, another

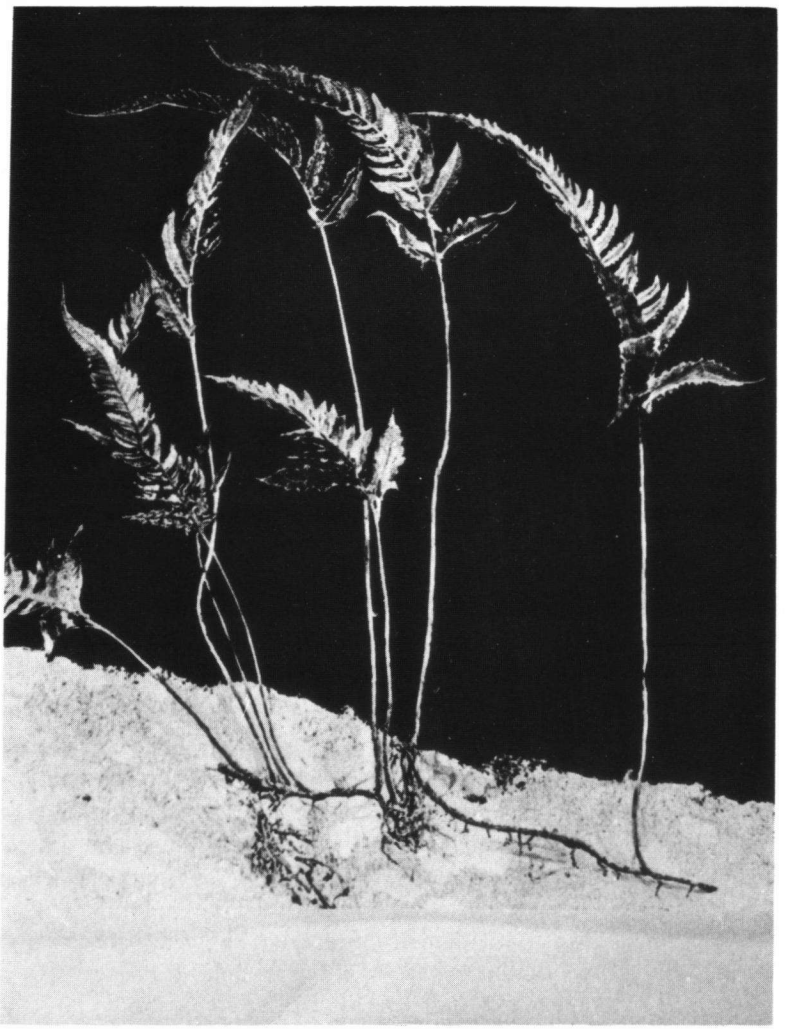

Fig. 1. A fertile plant of *Pronephrium thwaitesii* (Hook.) Holttum, growing on open rocky substratum on banks of Kunthipuzha River in Silent Valley, Malabar, South India.

tributary. Since there only exists meagre descriptions of this taxon in literature, a more detailed description is provided here. Voucher specimens are deposited at the Calicut University Herbarium and duplicates at the Indian National Herbarium, Calcutta (CAL) (*Nayar & Geeverghese K 10669*) and the Rijksherbarium, Leiden (L).

Silent Valley is the southwestern quarter of an extensive forest land (c. 39,000 ha) on the southern slope bordering Palghat Saddle of Western Ghats of South India, and lies between 11°5′ and 11°15′ N latitude and 76°25′ and 76°40′ E longitude. The

area is rather steeply sloped to the southwest, the northern regions being at c. 1,800 m altitude and the southern at c. 700 m, rising precipitously from the Palghat plains (altitude c. 100 m). A small river, Kunthipuzha, bisects Silent Valley, originating as three rivulets, all originating from near the eastern border. The terrain is rugged, with the streams and rivulets forming deep gorges, and supports an exceptionally dense wet evergreen forest. The annual rainfall is c. 575 cm, most of which is received during June–August; there is a dry season extending from December to May. Average temperature varies with altitude, ranging from 12–25° C in the northern parts and 15–40° C in the southern parts.

TAXONOMY

Pronephrium thwaitesii (Hook.) Holttum – **Fig. 1–14.**

P. thwaitesii (Hook.) Holttum, Blumea 20 (1972) 122; Sledge, Bull. Br. Mus. Nat. Hist., Bot. 8 (1981) 47. – *Meniscium thwaitesii* Hook., Fil. Exot. (1859) t. 83; Bedd., Ferns S. India (1864) t. 223; Handb. Ferns Br. India (1883) 399.

A small terrestrial fern forming large colonies on banks of rivers in exposed or semi-exposed, rocky, more or less dry areas, rooting in crevices of boulders on flat ground away from the water course but in regions which get inundated during floods.

Rhizome long creeping, 3–4 mm thick, branched, epigeal, blackish, having a prominent black cylindrical sclerenchyma strand in the pith associated with each meristele, and clothed by paleae and hairs. *Hairs* acicular, straight (fig. 12), stiff, sparse and brownish on older regions but dense and whitish in younger regions. *Paleae* (fig. 11) basally attached, dark brown, 5–7 by 1 mm, narrowly lanceolate, faintly cordate at base and long acuminate with a uniseriate tip crowned by a subglobose, nearly hyaline, glandular cell (fig. 10); margin (fig. 13) bearing a few (3–5) uniseriate cells (200–400 μm), long hairs similar to the terminal region of the palea; many straight acicular hairs occur on margin and outer surface. *Fronds* 10–15 mm apart. *Stipe* erect, smooth, swollen and blackish at base but greenish and 1.5–2.5 mm thick upwards, 20–30 (sterile frond)/30–45 (fertile frond) cm long, densely paleaceous at base but sparsely so upwards, and covered all over with whitish, prominently hooked, acicular hairs (up to 0.5 mm long). *Sterile lamina* spreading, deltoid-ovate with short acuminate apex, 12–20 by 5–10 cm, densely covered by spreading acicular hooked hairs, and 1-pinnate with subopposite, unequal-sided (basiscopic side broader) pinnae. Basal pair of *pinnae* largest, 50–90 by 10–20 mm, short stalked, oblong-lanceolate, subfalcate, broadest below the middle, slightly narrowed to both ends and having a broadly cuneate base and abruptly tapered acuminate apex (tapered region having entire margin and 10–15 mm long); margin lobed 1/4 way or less (acroscopic basal lobe longest) into rounded or oblong, non-uniform lobes (up to 5 by 2.5–3 mm, entire) with a narrow (convex on upper surface) sinus membrane in between. One to three pairs of pinnae next to the basal pair similar but much smaller and sessile (at least the upper pair having base adnate to rachis), and 4–10 pairs

Fig. 3. Ventral view of fertile lamina of *Pronephrium thwaitesii* (Hook.) Holttum.

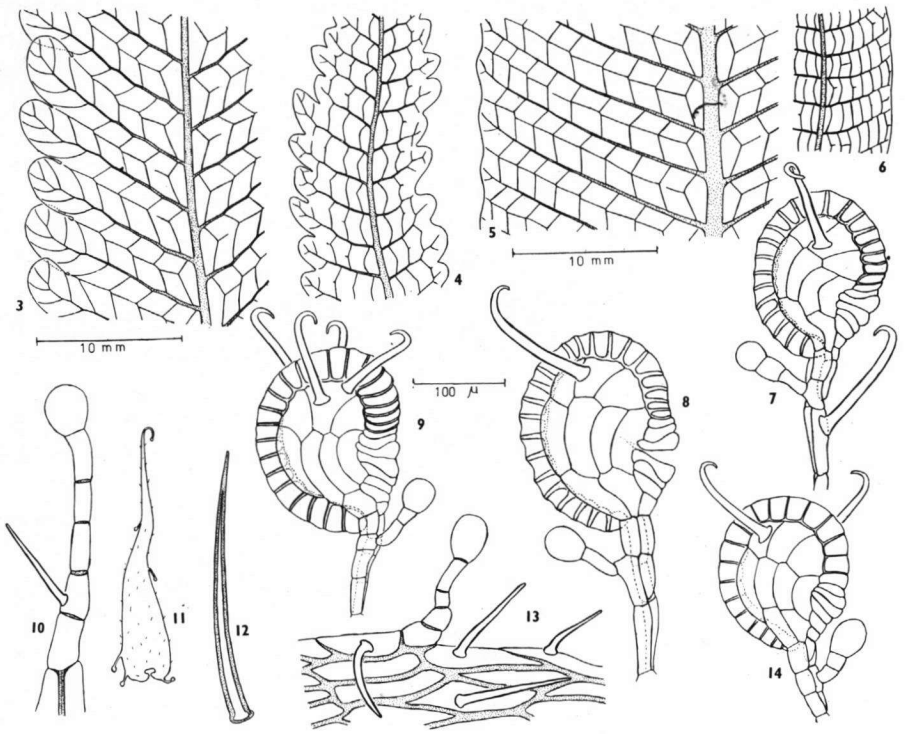

Fig. 3–14. Venation, sporangia and dermal appendages of *Pronephrium*. — 3–6: Venation pattern of sterile (3, 5) and fertile (4, 6) pinnae of *P. thwaitesii* (3, 4) and *P. triphyllum* (5, 6). — 7–13: *P. thwaitesii*: 7–9. immature sporangia; 10. apical region of palea; 11. palea from rhizome; 12. hair on rhizome; 13. portion of marginal region of palea. — 14: *P. triphyllum*, immature sporangium.

which follow markedly smaller (larger ones 40 by 5–6 mm, but progressively smaller upwards) having nearly entire or irregular margin, adnate with rachis at base, faintly auricled on acroscopic base, and with nearly parallel sides and broadly rounded apex. Anterior region of lamina beyond these pinnae is 5–10 by 2–2.5 cm, oblong-lanceolate, with broadly cuneate symmetrical base, and rather abruptly tapered at apex into a narrow acuminate region (15–20 cm); margin deeply pinnatifid into narrow falcate lobes (2–3 mm broad, apex rounded) in the basal half but progressively less dissected upwards; marginal lobes not uniform, occasional ones being longer or shorter than the rest. *Lamina* herbaceous, bearing hooked acicular hairs sparsely all over lower surface and in addition slightly larger hairs on midrib and veins on both surfaces (denser towards margin). *Fertile lamina* (fig. 2) 20–30 by 5–10 cm and with pinnae narrower and less dissected; the two basal pairs of pinnae narrowly lanceolate, broadest at or above middle and with shallowly lobed margin (lobing deeper on basiscopic side) with the basal lobes on both sides larger; pinnae beyond these much smaller, falcate,

narrow and followed by the pinnatifid anterior pinna-like apex of frond. *Midrib* of pinnae raised on both surfaces; main lateral veins corresponding with marginal lobes of pinna, faintly zigzag, 2–3 mm apart, at 60–70° in sterile pinnae but at c. 90° in fertile, faintly raised on both surfaces. Lateral *veinlets* 5–8 pairs in the broader pinnae, united (except those in the marginal lobes) in goniopteroid manner (fig. 3); excurrent veinlets (except occasionally a few) in the sterile fronds uniting end to end and ending at the marginal sinus; excurrent veinlets very short and not confluent in fertile fronds (fig. 4). *Sori* elongate along the confluent lateral veinlets and exindusiate. *Sporangial stalk* often bearing a non-secretory club-shaped hair (up to 100 μm long; on the second cell from capsule; having a slender 1–2 cell long stalk and a swollen, subglobose, hyaline terminal cell) and occasionally a hooked acicular hair in addition (fig. 7); annulus 18–20(–24) cells long; sporangial capsule bearing usually one (up to 4) hooked acicular hairs next to annulus at anterior end; aborted small sporangia occur mixed, and these may bear up to 6 acicular hairs. *Spores* commonly not formed, the spore mother cells aborting, but occasional spores differing widely in size are met with which are monolete, 35 by 50 μm (on average) when acetolysed, planoconvex in lateral view and with golden-brown smooth exine enveloped by a light brown perine which is adherent to exine, sparsely spinulose and bearing small rugula-like crowded folds.

DISCUSSION

Pronephrium thwaitesii is regarded by Holttum (1971, 1972) as a hybrid having *P. triphyllum* (Sw.) Holttum as one of the parents; the unevenness characteristic of *P. thwaitesii* in the length of pinnae and lobes (some markedly shorter and some longer than nearby ones) is a frequent character of hybrids. Holttum (1972) records another similar fern from Assam (*J. Day s.n.*, 1880) which also is regarded as a local hybrid of *P. triphyllum*. He, however, could not verify whether sporangia are fertile or not in *P. thwaitesii*, since material available to him had only young sporangia. Initially he suggested *Trigonospora ciliata* (Benth.) Holttum as the other parent involved, but later (Holttum, 1972) changed his view, suggesting that it would be another *Pronephrium* having lobed pinnae (like *P. articulatum* and *P. gardneri*). Recently Sledge (1981) refuted Holttum's view, since he found that sporangia and spores are well formed in the three herbarium specimens at Peradeniya Herbarium he examined. Also, according to him hybridisation between the suggested parents is unlikely as 'no station is known in which *P. triphyllum* and *P. thwaitesii* occur together' and this applies also to *P. articulatum* and *P. gardneri* 'neither of which has ever been collected in any of the areas from which *P. thwaitesii* has been recorded' (Sledge, 1981: 48).

A careful examination of abundant material collected over an area of c. 10 km along Kunthipuzha River in Silent Valley reveals that, though sporangia are well formed and appear to contain spores, they do not in fact contain normal spores; sporangial content consists mostly of crumbled masses of spore mother cells though occasional bilateral spores varying much in size and some diads suggesting incomplete cell division occur mixed with aborted spore mother cells. The condition remains the

same for the past four years in samples of *P. thwaitesii* from Silent Valley cultivated in Calicut University Botanical Garden. Also, all four taxa (*Trigonospora ciliata, Pronephrium thwaitesii, P. triphyllum, P. articulatum*) occur in the Silent Valley area, though not intermixed but occupying different ecological niches.

The present study indicates that *P. thwaitesii* is a hybrid as suggested by Holttum, and *P. triphyllum* is one of the parents as it is the only thelypteridaceous fern of the same area which shares with *P. thwaitesii* its 1) slender, elongated, creeping rhizome, 2) hooked acicular foliar hairs, 3) acicular hairs on sporangial capsule (fig. 14), 4) venation pattern (figs. 5, 6) in which nearly all secondary veinlets unite in pairs forming a composite tertiary vein in the sterile pinnae and nearly devoid of tertiary veins in fertile pinnae, and 5) exindusiate sori elongated along the confluent secondary veinlets. In addition to the characteristic peculiarity of uneven pinnae and lobes, the abortion of spore mother cells in sporangium and consequent sterility clearly indicate hybridity.

It seems, however, unlikely that the other parent is *Trigonospora ciliata*, though *T. ciliata* and *P. triphyllum* occur in the Silent Valley area. The marked difference in habitat alone would preclude chance hybridization of these taxa. *Pronephrium triphyllum* is restricted to densely shaded areas which are unlikely to get flooded even during heavy rains and have alluvial soil which is abundantly moist all the year round; the rhizome grows buried in the soil. *Trigonospora ciliata*, on the other hand, is restricted to shaded, boulder-filled or rocky beds of mountain streams and grows in such situations where its roots can reach flowing water even during the dry season, and during the wet season is flooded by the swift flowing current of the stream; the rhizome is fully above the ground, thick, erect, stump-like and covered by a spongy mass of roots. It does not thrive away from flowing water and at the same time does not grow on the banks of rivers and larger rivulets (possibly because these banks scarcely provide situations which are shaded and also are close to flowing water during summer). Morphologically *P. thwaitesii* is somewhat intermediate between *P. articulatum* and *P. triphyllum* indicating the possibility of *P. articulatum* being one of the parents. However, *P. articulatum* is a large fern growing near water courses in shaded humid areas, having wet loose soil; it has an epigeal, erect, stump-like, thick rhizome bearing clusters of roots and a crown of large frons. In contrast *P. thwaitesii* grows restricted to exposed dry rocky areas near river banks, away from flowing water but likely to get inundated during the floods. The habitat is decidedly more harsh and prone to desiccation than the habitats of all the other taxa mentioned above.

I suggest the possibility that the second parent of *P. thwaitesii* is *Christella parasitica* (Linn.) Lév., which grows abundantly in the locality where *P. thwaitesii* is found and also in localities where *P. triphyllum* grows. It is a fern which can withstand exposure and desiccation of substratum. Also, like *P. thwaitesii*, it possesses a creeping epigeal rhizome and markedly lobed pinnae. In addition, *Christella parasitica* is known to hybridise freely in nature (Panigrahi & Manton, 1958), though there are no records of hybridisation between *Christella* and *Pronephrium*. Also, both *P. triphyllum* and *C. parasitica* are tetraploids in South India (Abraham et al., 1962; Panigrahi & Manton, 1958).

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