

The Species of the Genus *Aglaomorpha* Schott (Polypodiaceae) in Thailand

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ABSTRACT.– *Aglaomorpha coronans* (Wall. ex Mett.) Copel. has been known as the only *Aglaomorpha* species in Thailand for the last 15 years. This study finds that four species may be recognised. Two species, namely *A. drynarioides* (Hook.) M.C. Roos and *A. heraclea* (Kunze) Copel., are reported for the first time from peninsular Thailand. Finally, *Aglaomorpha acuminata* (Willd.) Hovenkamp is a new name for the species previously known as *Photinopteris acuminata* (Willd.) C. V. Morton. A key to species and line drawings of *Aglaomorpha* in Thailand are given. The distribution of species is discussed.

KEY WORDS: *Aglaomorpha*, Polypodiaceae, peninsular Thailand

INTRODUCTION

The genus *Aglaomorpha* Schott belongs to the fern family Polypodiaceae. This is a genus of a large-sized fern of tropical Asia, comprising about 15 species (Roos, 1986). Of these, 14 species were recognized in Malesiana regions (Hovenkamp et al., 1998). Previously, the genus *Aglaomorpha* Schott together with a number of small or monotypic genera, for example *Drynariopsis* Copel., *Holostachyum* Copel., *Photinopteris* J. Sm., *Merinthosorus* Copel., *Pseudodrynaria* C. Chr. and *Thayeria* Copel. were considered to be related to drynarioid fern taxa (e.g. Copeland, 1947; Holttum, 1954; Pichi Sermolli, 1977; Ching, 1978). Their differences were usually based on

the presence or absence of a single character, for example a coenosorus, small sori, or a peculiar frond base (Hovenkamp et al., 1998). In this paper the genus *Aglaomorpha* is used in the broad sense proposed by Roos (1986).

In Thailand, Tagawa and Iwatsuki (1989) recognized a single species of *Aglaomorpha* Schott, i.e. *A. coronans* (Wall. ex Mett.) Copel. In the last 15 years, extensive surveys of pteridophytes have been made in some previously poorly-botanized areas of the country. These comprehensive surveys resulted in adding species new to science and new records to Thailand (e.g. Boonkerd and Pollawatn, 2000; Boonkerd et al., 2004). The intention of this research is to explore the species of *Aglaomorpha* Schott from both the existing herbarium specimens and newly collected specimens from various floristic regions with special reference to peninsular Thailand.

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MATERIALS AND METHODS

Herbarium specimens of all species, both wild and cultivated plants, were examined for the taxonomic descriptions. Specimens from the following herbaria were used: BCU, BK, BKF, BM, K and L. Herbaria are abbreviated according to the Index Herbariorum (Holmgren and Holmgren, 2005). The type specimens have been studied. Species determinations are based on a key to the species and descriptions in Hovenkamp et al. (1998). A description below is based on Thai materials. The synonyms of each taxon are listed. The map of the species distribution in Thailand is based on localities in Flora of Thailand, volume 3 (Tagawa and Iwatsuki, 1989) and the existing herbarium specimens from the above herbaria.

TAXONOMIC ACCOUNT

Aglaomorpha

Aglaomorpha Schott, Gen. Fil. ad t. 19. 1836; Alderw., Malayan Ferns Suppl. 418. 1917; Copel., Univ. Calif. Publ. Bot. 16: 116. 1929; Backer & Posth., Varenfl. Java 231. 1939; Ching, Sunyatsenia 5: 262. 1940; Tardieu & C. Chr. in Fl. Gèn. I.-C. 7, 2: 488. 1941; Copel., Gen. Fil. 201. 1947; Holttum, Revis. Fl. Malaya 2: 185. 1954; Copel., Fern Fl. Philipp. 493. 1960; De Vol in Fl. Taiwan 1 [Pterid.] 211. 1975; Pic.Serm., Webbia 31: 379. 1977; Roos, Drynarioideae 227. 1985; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1: 211. 1990; Tagawa & K. Iwats. in Fl. Thail. 3(4): 550. 1989; Hovenkamp et al., Fl. Mal., Ser. II, 3: 10. 1998.

Photinopteris J. Sm., J. Bot. (Hook.) 3: 403. 1841; Hook. & Bauer, Gen. Fil. t. 92. 1842; Fée, Acrostichum 24, 102. 1844-1845; C. Presl, Epim. Bot. 190. 1849; Fée, Gen. Filic. 61. 1850-1852; Bedd., Ferns Brit. India t. 211. 1866; Copel., Polypod. Philipp. 134. 1905; Philipp. J. Sc., Bot. 6: 140. 1911; Univ. Calif. Publ. Bot. 16: 122.

1929; Backer & Posth., Varenfl. Java 234. 1939; Ching, Sunyatsenia 5: 262. 1940; Tardieu & C. Chr. in Fl. Gèn. I.-C. 7, 2: 502. 1941; Holttum, Revis. Fl. Malaya 2: 187. 1954; Copel., Fern Fl. Philipp. 495. 1960; Pic. Serm., Webbia 31: 379. 1977; Tagawa & K. Iwats. in Fl. Thail. 3, 4: 552. 1989.

Merinthosorus Copel., Philipp. J. Sc., Bot. 6: 92. 1911; Univ. Calif. Publ. Bot. 16: 122. 1929; Ching, Sunyatsenia 5: 262. 1940; Copel., Gen. Fil. 202. 1947; Holttum, Revis. Fl. Malaya 2: 186. 1954; Pic. Serm., Webbia 31: 379. 1977.

Aglaomorpha subg. *Pseudodrynaria* C. Chr., Index Filic. Suppl. 3: 13. 1934.

Pseudodrynaria C. Chr. in Verdoorn, Manual Pterid. 548. 1938; Ching, Sunyatsenia 5: 262. 1940; 6: 10. 1941; Copel., Gen. Fil. 201. 1947; De Vol in Fl. Taiwan 1 [Pterid.] 214, pl. 75. 1975; Pic.Serm., Webbia 31: 379. 1977.

Medium to large epiphytes or lithophytes; rhizome thick, fleshy; covered with thin narrow pseudopeltate scales, appressed or patent. Fronds monomorphic or dimorphic, subcoriaceous to coriaceous, with or without a dilated large humus-collecting base, lamina deeply pinnatifid or pinnate; venation anastomosing, forming series of areoles between secondary veins with included simple or forked free veinlets, costa and main vein of each pinna prominently raised on both surfaces. Fertile parts usually terminal, similar to sterile or much contracted from linear to filiform. Sori small, in one to many rows between the secondary veins, or in one row on either side of the primary vein, rounded, elongate, elliptic or quadrangular, sometimes forming a coenosorus.

Key to the Species

- 1a. Fronds 1-pinnate, stalked, internally dimorphic; fertile pinnae strongly contracted, acrostichoid ***A. acuminata***
- 1b. Fronds pinnatifid, sessile **2**

- 2a. Fertile pinnae strongly contracted, confined to apical portion of fronds
 *A. drynarioides*
- 2b. Fertile pinnae similar to sterile pinnae 3
- 3a. Sori more or less elongate, in a single row between the veins, one in each main areole; rhizome scales without thickened midrib
 *A. coronans*
- 3b. Sori rounded, in many irregular rows between the veins, many in each main areole; rhizome scales with thickened midrib
 *A. heraclea*

***Aglaomorpha acuminata* (Willd.) Hovenkamp**
 (Fig. 1)

Aglaomorpha acuminata (Willd.) Hovenkamp, Fl. Mal., Ser. II, 3: 13. 1998.

Acrostichum acuminatum Willd., Sp. Pl. ed. 5: 116. 1810, basionym, non *Acrostichum acuminatum* Poir. in Lam., Encycl. Méth. Suppl. 1: 120. 1810.

Photinopteris humboldtii C. Presl, Epim. Bot. 192. 1851.

Photinopteris acuminata (Willd.) C. V. Morton, Contr. U. S. Nat. Herb. 38: 31. 1967; Tagawa & K. Iwats. in Fl. Thail. 3, 4: 552. 1989. Type: Herb. Willdenowii 19539, Philippines (holo: B).

Aglaomorpha speciosa (Blume) M. C. Roos, Blumea 31: 153. 1985.

Lomaria speciosa Blume, Enum. Pl. Javae Fil. 202. 1828.

Photinopteris speciosa (Blume) C. Presl, Epim. Bot. 264. 1849; Tardieu & C. Chr. in Lecomte, Fl. Gén. I.-C. 7, 2: 502. 1941; Holttum, Revis. Fl. Malaya 2: 187. 1954; Hennipman, in Blumea 22, 1: 51. 1974.

Polypodium speciosum (Blume) Christ [non Blume 132. 1828]. Type: Blume s.n., 1824, Java (holo: L!).

Rhizome long creeping, 1.2-1.8 cm in diam., glaucous, phyllopods 2-9 cm apart, not elevated, densely scaly in young part; scales patent, linear, gradually narrowing from base to apex, about 6-8 by 0.5-1.2 mm, brown with dark base, toothed at margin. *Fronds* internally



FIGURE 1. *Aglaomorpha acuminata* (Willd.) Hovenkamp, a fertile frond

dimorphic, stipes up to 1-10 cm long, with two rows of extremely reduced pinnae, stramineous or faintly purple. *Lamina* pinnate, up to 80 by about 25 cm or more; partially dimorphic; sterile pinnae in lower portion of fronds, 4-15 pairs, about 3 cm apart from the next ones, distinctly stalked, with a nectary at the base of stalk, articulated to rachis, oblong to oblong ovate, acuminate at apex, equally cuneate at base, entire, up to 22 by 11 cm, the lower two or three pairs reduced, the upper ones gradually becoming smaller; veins more or less raised on both surfaces, venation drynarioid; coriaceous, green, paler below, glabrous; fertile pinnae in upper part of fronds, 4-7 pairs, linear, up to 15-20 by 0.5-0.7 cm, stalked or nearly sessile. *Sporangia* covering the whole under surface of the fertile pinnae except on costa and on narrow marginal strands.

Thailand.- SOUTH-EASTERN: *Prachin Buri*: Khao Yai, Ch. Charoenphol et al 4354 (BKF), T. Boonkerd 1753 (BCU); *Trat*: Khao Kuap; PENINSULAR: *Surat Thani*: Bandon; *Nakhon Si Thammarat*: Khao Luang, T. Boonkerd & R. Pollawatn 504 (BCU); *Songkhla*: Boripat Fall, J. F. Maxwell 84-59 (BKF).

Distribution.- Indochina and W. Malaysia.

Ecology.- On muddy rocks or on branches of trees in evergreen forest at 200-700 m altitude.

***Aglaomorpha coronans* (Wall. ex Mett.)**

Copel.

(Fig. 2)

Aglaomorpha coronans (Mett.) Copel., Univ. Calif. Publ. Bot. 16: 117. 1929; Tagawa, Acta Phytotax. Geobot. 8: 234. 1939; Tardieu & C. Chr. in Fl. Gèn. I.-C. 7, 2: 488, f. 57: 3, 4. 1941; M.C. Roos, Drynarioideae 236. 1985; Hovenkamp et al., Fl. Mal., Ser. II, 3: 15, f. 1h. 1998.

Polypodium coronans [Wall., Cat. n. 288. 1829, nom. nud.] Mett., Farngatt. I. Polypodium 121, t. 3, f. 40, 41. 1856; Hook., Fil. Exot. pl. 91. 1859; Hook., Sp. Fil. 5: 95. 1864; Copel., Philipp. J. Sc., Bot. 6: 140. 1911.

[*Phymatodes coronans* C. Presl, Tent. Pterid. 198. 1836, nom. nud.]

Drynaria coronans [J. Sm., J. Bot. (Hook.) 3: 399. 1841, nom. nud.] T. Moore, Index Filic. II 345, pl. 63A. 1862; Bedd., Ferns Brit. India t. 13. 1865; J. Sm., Hist. Fil. 108. 1878; Bedd., Handb. Ferns Brit. India 338, f. 187. 1883.

Pseudodrynaria coronans Ching, Sunyatsenia 5: 262. 1940; 6: 10. 1941; Copel., Gen. Fil. 201. 1947.

Pleopeltis coronans Alderw., Bull. Dép. Agric. Indes Néerl. 27: 11. 1909. Type: not traced.

Drynaria esquirolii C. Chr., Bull. Gèorg. Bot. 23: 139. 1913.

Rhizome creeping, thick, usually more than 2.5 cm in diam., phylloids 6-10 cm apart, not

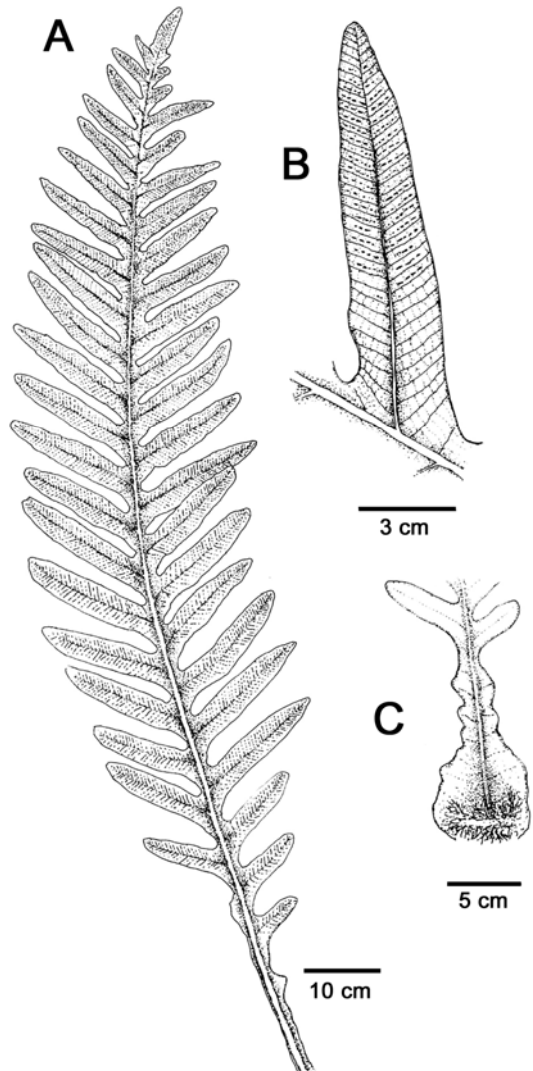


FIGURE 2. *Aglaomorpha coronans* (Mett.) Copel. **A.** Frond. **B.** Fertile lobes showing sori. **C.** Base of a frond

elevated, densely scaly throughout; scale patent, brown, linear, 10-15 by 0.5-1 mm, sharply toothed at margin. *Fronds* monomorphic sessile, elliptic, 65-180 cm long by 20-40 cm wide, lobed almost to rachis; lobes continuing with wings less than 1 cm broad; the base of fronds broadly rounded to cordate, up to 20 cm broad, subentire or shallowly lobed, brown; lobes of the upper part of frond ascending, usually more than 10 pairs, linear-subtriangular, apex acute to acuminate, margin entire, 15-26.5 by 1.5-4.5 cm, lobes articulated

to midrib; veins raised on both surfaces, venation drynarioid, or complicatedly reticulate, main areoles quadrangular, smaller areoles with free included veinlets, coriaceous, green and glossy, glabrous; midrib grooved on upper surface, raised on lower surface. *Sori* more or less elongate, 0.1-0.3 mm long, in several rows between lateral main veins and margin, one in each main areole, slightly sunken.

Thailand.- NORTHERN: *Chiang Rai*: Khun Korn Waterfall Forest Park, P. Ratchata 89 (BCU); *Chiang Mai*: between Pa Mon and Sop Aep, E. Hennipman 3471 (BKF); Doi Inthanon, T. Sørensen et al 3338 (BKF); San Kam Paeng, Lita M. Banoc 49 (BKF); *Lampang*: Jae Sawn National Park, J. F. Maxwell 95-1209 (BKF); Khun Tan, T. Boonkerd 615 (BCU); *Tak*: Huai Krasa, B. Hansen & T. Smitinand 12965 (BKF); Doi Musoe; Phu Hin Rong Kla National Park, W. Rattanathirakul 63 (BCU); *Nakhon Sawan*: Doi Musae Agric. Exp. Station, E. Hennipman 3067 (BKF); NORTH-EASTERN: *Phetchabun*: Nam Nao National Park, G. Murata et al., T-51613 (BKF); *Loei*: Phu Luang, M. Tagawa et al., T-1830 (BKF); Phu Kradueng, T. Smitinand & P. Suvanakes 324, M. Tagawa et al., T-378, T-387, T. Shimizu et al. T-23177 (BKF); *Khon Kaen*: Phu Khieo, G. Murata et al., T-49604 (BKF); EASTERN: *Chaiyaphum*: Nam Prom, C. F. van Beusekom et al., 4197 (BKF); SOUTH-EASTERN: *Prachin Buri*: Khao Yai National Park, E. Hennipman 3995, T. Shimizu et al., T-18174, K. Larsen et al., 240, C. Phengklai 649 (BKF); Khao Keaw, W. Khwaiphan 008 (BCU); *Chanthaburi*: Khao Soi Dao, T. Seelanan 22 (BCU); SOUTH-WESTERN: *Kanchanaburi*: Thong Pha Phum, A. Sathapattayanon 121, 126, 311 (BCU); *Prachuap Khiri Khan*: Huai Yang Waterfall National Park, Y. Yuyen 54 (BCU); PENINSULAR: *Nakhon Si Thammarat*: Khao Luang, E. Hennipman 3838, 3891; M. Tagawa et al., T-5286 (BKF); *Trang*: Khao Chong, M. Tagawa et al., T-6817 (BKF); *Phangnga*: Khao Phota Luang Kao, R. Geesink & T. Santisuk 5158 (BKF).

Distribution.- Himalayas to Indochina and Malaysia.

Ecology.- Lithophytes or forming a ring shaped-basket around tree-trunks in evergreen forest in the mountainous area, altitude ranging from 600-1,250 m.

Note.- Dilated frond base sometimes slightly developed in some plants.

***Aglaomorpha drynarioides* (Hook.) M.C. Roos**
(Fig. 3)

Aglaomorpha drynarioides (Hook.) M.C. Roos, *Blumea* 31: 153. 1985; *Drynarioideae* 242. 1985; Hovenkamp et al., *Fl. Mal.*, Ser. II, 3: 16. 1998.

Acrostichum drynarioides Hook., *Sp. Fil.* 5: 284. 1864; Baker, *Syn. Fil.* 425. 1868.

Photinopteris drynarioides Bedd., *Ferns Brit. India* t. 325. 1869; *Handb. Ferns Brit. India* 442, f. 270. 1883.

Dryostachum drynarioides Kuhn in *Miq.*, *Ann. Mus. Bot. Lugd.-Bat.* 4: 296. 1869.

Polypodium drynarioides H. Christ, *Farnkr. Erde* 117. 1897, nom. illeg., non Griseb.

Merinthosorus drynarioides Copel., *Philipp. J. Sc., Bot.* 6: 92. 1911; *Univ. Calif. Publ. Bot.* 16: 122. 1929; *Gen. Fil.* 202. 1947; *Holtum, Revis. Fl. Malaya* 2: 186. 1954. Type: Norris s.n., (holo: K!), Malaya, Penang.

Rhizome creeping, thick, usually more than 1.5 cm in diam., phylloids 6-8 cm apart, not elevated, densely scaly throughout; scale patent, red-brown, linear, 10-15 by 0.5-1.2 mm, sharply toothed at margin. *Fronde*s internally dimorphic, sessile, 65-150 cm long by 15-35 cm wide, lobed almost to rachis; lobes continuing with wings less than 1 cm broad; the base of fronds broadly rounded to cordate, up to 15 cm broad, subentire or shallowly lobed; lobes of the upper part of frond ascending, sterile lobes usually more than 10 pairs, linear-subtriangular, apex acute to acuminate, margin entire, 8-20 by 2-4.5 cm. *Fertile lobes* confined to upper portion of lamina, 4-6 pairs, linear, coenosori, 10-25 by 0.3-0.5 cm,

Thailand.- PENINSULAR: *Narathiwat*: Budo-Su-ngai Padi National Park, T. Boonkerd & R. Pollawatn 340 (BCU).

Distribution.- Malaysia to Pacific.

Ecology.- Epiphytes on tree trunk in primary forest.

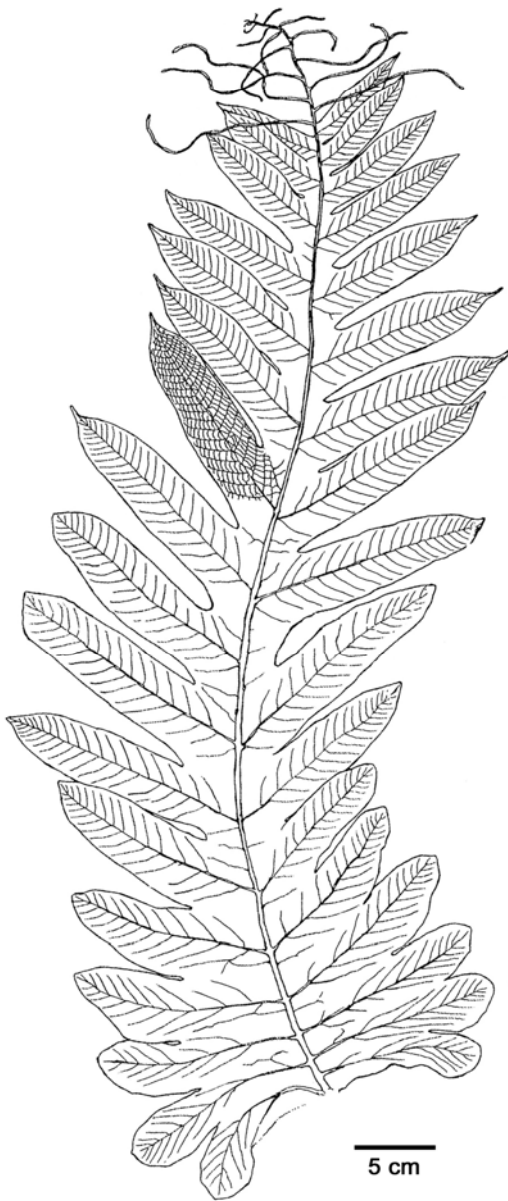


FIGURE 3. *Aglaomorpha drynarioides* (Hook.) M.C. Roos, a fertile frond

***Aglaomorpha heraclea* (Kunze) Copel.**

(Fig. 4)

Aglaomorpha heraclea (Kunze) Copel., Univ. Calif. Publ. Bot. 16: 117. 1929; Backer & Posth., Varenfl. Java 232. 1939; Holttum, Revis. Fl. Malaya 2: 185. 1954; Dansk Bot. Ark. 20: 21. 1961; M.C. Roos, *Drynarioideae* 238. 1985; Hovenkamp et al., Fl. Mal., Ser. II, 3: 17, f. 1i. 1998.

Polypodium heracleum Kunze, Bot. Zeitung (Berlin) 6, 7: 117. 1848; Mett., Farngatt. I. Polypodium 117, t. 3, 52. 1856; Hook., Gard. Ferns pl. 1. 1862; Sp. Fil. 5: 93. 1864; Baker, Syn. Fil. 366. 1868; Racib., Pterid. Buitenzorg 116. 1898; Copel., Polypod. Philipp. 133. 1905; Philipp. J. Sc., Bot. 6: 140. 1911; Sarawak Mus. J. 2: 407. 1917; Brause, Bot. Jahrb. Syst. 56: 204. 1920.

Drynaria heraclea T. Moore, Index Filic. II 346. 1862; J. Sm., Ferns Brit. & For. 103. 1866; Hist. Fil. 108. 1875.

Pleopeltis heraclea Alderw., Bull. Dép. Agric. Indes Néerl. 27: 11. 1909.

Drynariopsis heraclea Ching, Sunyatsenia 5: 262. 1940; Copel., Gen. Fil. 201. 1947; Holttum, Revis. Fl. Malaya 2: 185. 1954; Copel., Fern Fl. Philipp. 492. 1960. Type: Zollinger 977, Java, Prov. Bogor, Mt Balang (B, n.v.).

Rhizome creeping, whitish-green, thick, up to 5 cm in diam., phyllopois 8-10 cm apart, not elevated, clothed with dense scales throughout; scale patent, dark brown, linear, 10-30 by 0.5-1.5 mm, margin toothed, apex long-filiform. *Fron*ds monomorphic, sessile, 100 to 250 cm long, 40-70 cm wide, lobed to 1-2 cm of the midrib; lobes continuing with wings less than 1 cm broad; the base of fronds broadly rounded to cordate, up to 30 cm broad, subentire or shallowly lobed, brown, lobes of the upper part of frond ascending, usually more than ten pairs, linear-subtriangular, apex acute to acuminate, margin entire, 20-35 by 5-12 cm; subcoriaceous, green, glabrous. *Sori* rounded, usually along lateral main veins of upper lobes,

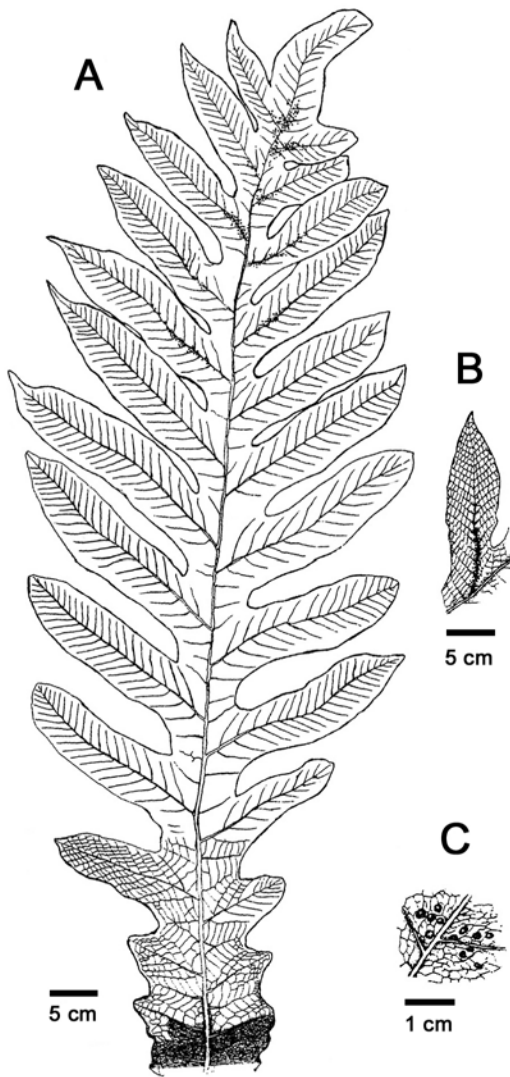


FIGURE 4. *Aglaomorpha heraclea* (Kunze) Copel. A. Fertile frond. B. Venation pattern. C. Part of a fertile lobe

up to 2 mm diam., in many rows between midrib and margin, many in each main areole, terminal on a free veinlet in an areole or on anastomosing veins, slightly sunken.

Thailand.- PENINSULAR: *Narathiwat*: Budo-Su-ngai Padi National Park, T. Boonkerd & R. Pollawatn 209 (BCU).

Distribution.- Malaysia to the Solomon Islands.

Ecology.- Epiphytes on tree trunk in primary forest, in shady or exposed places.

DISCUSSION

Of the 4 species of *Aglaomorpha* occurring in Thailand, *A. coronans* has the widest distribution. It is found in Bangladesh, India (Uttar-Pradesh, Sikkim, Assam, Minipur), Nepal, Bhutan, China (Yunnan, Guangsu, Guizhou, Guangdong, Hainan), Ryukyu Island, Myanmar, Thailand, Laos, Vietnam, Penang, Malay Peninsula (Ho, 1991; Iwatsuki, 1992; Roos, 1986). However, it is not found in Taiwan (De Vol and Kuo, 1980). In Thailand, this species occurs throughout the country (Fig. 5), especially in the mountainous areas, however its southernmost record is at Khao Chong, Trang Province (Tagawa and Iwatsuki, 1989). Holttum (1954) also noted that *A. coronans* is found north of Malaysia and might occur in Malaysia as well. Later, Bidin (1987) has found *A. coronans* and noted that this species has its southern limit in Langkawi Islands, Malaysia.

Aglaomorpha acuminata is found from Thailand, Laos, Vietnam, Malay Peninsula, Sumatra, Singapore, Java, Borneo (Kalimantan, Sarawak, Sabah), Philippines, and Celebes. In Thailand, this species is rather rare, since there are only a small number of herbarium specimens at BCU and BKF. They were collected from Khao Yai National Park in South-Eastern Thailand, Khao Luang National Park and Rataphum Falls in peninsular Thailand (Fig. 5). The small number of herbarium specimens of this species is probably in part due to being overlooked by many plant collectors because this fern species has the sterile frond similar to a compound leaf of some flowering plants and easily mistaken; fertile fronds are more distinctive. In addition, *A. acuminata* is often found in the crowns of old trees or on the top of tall rocks where it is difficult to notice from below (Holttum, 1954).

The existence of *A. heraclea* and *A. drynarioides* at Budo-Su-ngai Padi National Park in Narathiwat Province is in agreement with the present distribution of these species in the Malay Peninsula (Roos, 1986). In addition, Holttum (1954) in his comprehensive book on

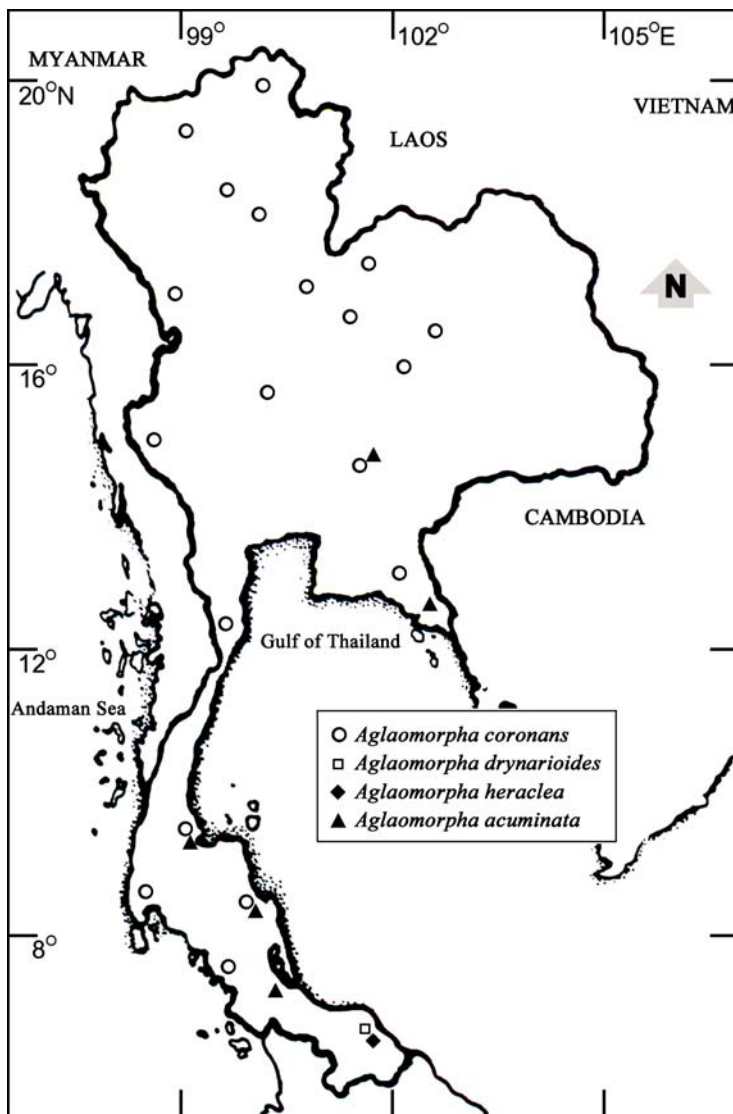


FIGURE 5. Distribution of the *Aglaomorpha* species in Thailand

Malayan ferns frequently noted that the ferns of Malaya usually extend northwards to peninsular Thailand, especially to Pattani, Yala and Narathiwat Provinces. Iwatsuki (1973) added that the southernmost Thailand (Pattani, Yala and Narathiwat Provinces) belongs floristically to the area of Malaya. He also pointed out that more than 100 species of Thai pteridophytes occur in the peninsular area and have the typical distribution of the so-called Malaysian element. These species extend to central,

southeastern and southwestern Thailand, but are absent from the region north of the central plain. So, it is pertinent to note that *A. heraclea* and *A. drynarioides* are members of the Malaysian element.

Aglaomorpha is confined to Asia. *Aglaomorpha heraclea* and *A. drynarioides* are among the largest epiphytic ferns known (Hennipman et al., 1990). The two species just reported here as new records for the Pteridophyte Flora of Thailand, despite their

large size and the presumed difficulty of overlooking them in the field, have nevertheless been missed in previous surveys. This implies that more comprehensive studies and intensive surveys of pteridophytes need to be carried out in other areas of Thailand, especially the poorly-botanized areas of the peninsular Thailand.

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