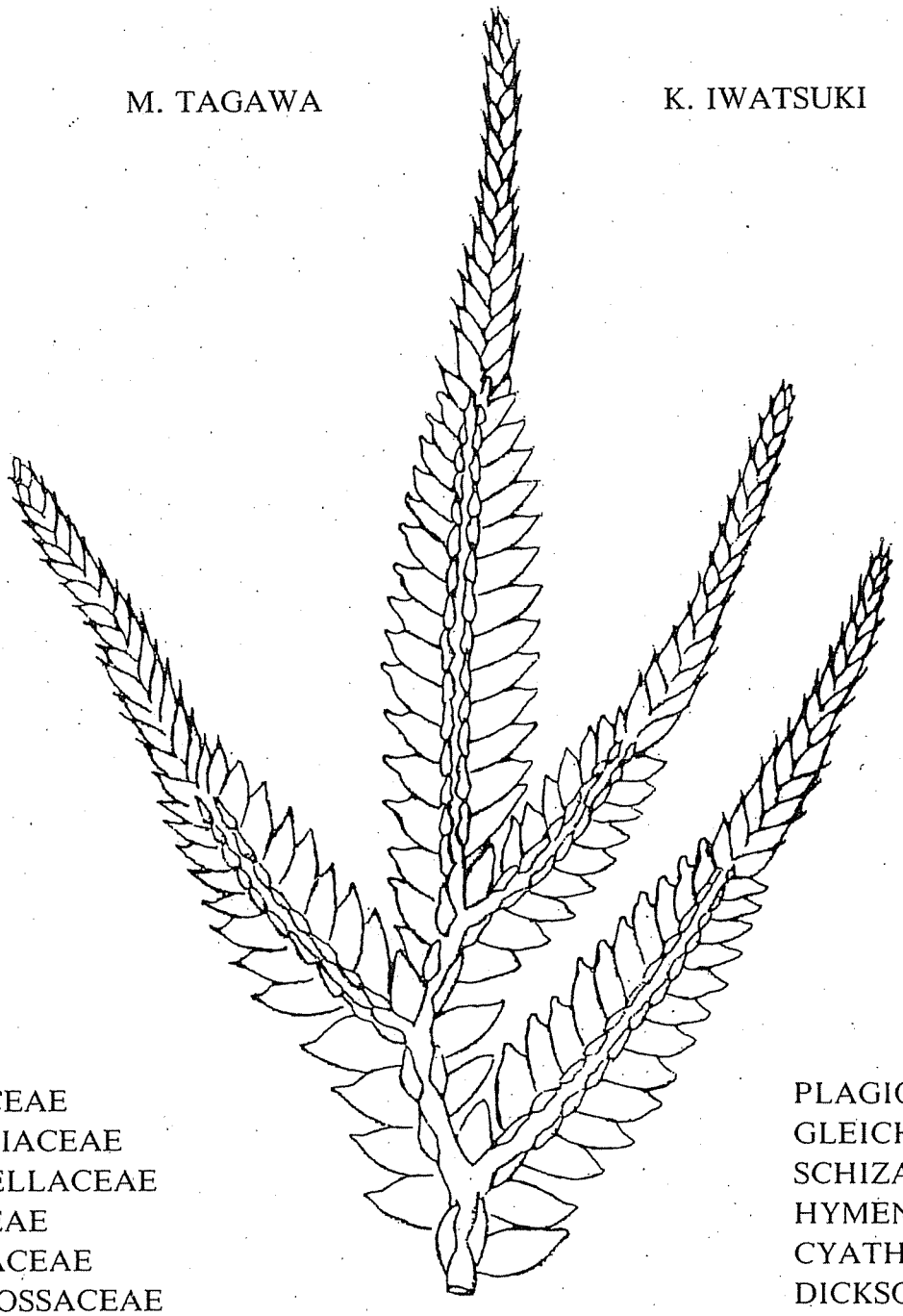
# FLORA OF THAILAND

**VOLUME THREE** **PART ONE**

PTERIDOPHYTES

M. TAGAWA K. IWATSUKI



PSILOTACEAE
LYCOPODIACEAE
SELAGINELLACEAE
ISOETACEAE
EQUISETACEAE
OPHIOGLOSSACEAE
MARATTIACEAE
OSMUNDACEAE
PLAGIOGYRIACEAE
GLEICHENIACEAE
SCHIZAEACEAE
HYMENOPHYLLACEAE
CYATHEACEAE
DICKSONIACEAE
DENNSTAEDTIACEAE

# FLORA OF THAILAND



## VOLUME THREE PART ONE

June 1979

PRINTED IN THAILAND AT THE TISTR PRESS, BANGKOK
BY SIRI NANDHASRI 1979

## INTRODUCTION

The pteridophytes of Thailand have, until recently, been little studied compared with those of neighbouring Indochina and Malaya. In the last few years, however, a great number of specimens has been collected and we are here enumerating more than 620 species from Thailand. This account is based on a study of most of the existing herbarium specimens collected from Thailand, as well as the field surveys of the authors themselves. The pteridophytes of neighbouring areas were also examined in herbaria, and were actually observed in the field in Nepal, N.E. India, Malaya, N. Sumatra and in Luzon by one of the authors.

Under each species, where appropriate, the following works are cited: Beddome, Handbook of the Ferns of British India (1883) with Supplement (1892): Lecomte, Flore Générale de l'Indo-Chine 7.2 (1939–51); Holttum, Revised Flora of Malaya 2(1955) with corrections and additions in 2nd edition (1968). Furthermore, all the literature actually treating the ferns of Thailand is cited; other literature is excluded except for necessary nomenclatural references. The descriptions are based on plants from Thailand unless otherwise noted.

Geographical notes on the pteridophytes of Thailand were published in: K. Iwatsuki, Phytogeographyof thepteridophytes in northern Thailand (Acta Phytotax. Geobot. 25: 69–78. 1972); and Phytogeography of the pteridophytes in Peninsular Thailand (Amer. Fern J. 63: 129–134. 1973).

### KEY TO THE FAMILIES OF THAI PTERIDOPHYTES

The following key to the families of pteridophytes known from Thailand is based on the Thai material alone and does not necessarily cover genera and species not found in Thailand. A more detailed discussion on the classification at the rank of family is given in: M. Tagawa & K. Iwatsuki, Families and Genera of the Pteridophytes known from Thailand, Mem. Fac. Sci. Kyoto Univ. Biol. 5: 67–88. 1972.

1. Roots and leaves not developed, plants consisting of dichotomously branched stem and rhizome **1. Psilotaceae**

1. Roots and leaves developed, or roots absent in some species
   2. Leaves microphyllous, univeined, stele without any leaf gaps
      3. Stems without differentiation into nodes and internodes
         4. Leaves lacking ligules; isosporous **2. Lycopodiaceae**

4. Leaves with ligules; heterosporous
5. Land plants; stems elongate bearing small leaves and rhizophores **3. Selaginellaceae**
5. Aquatic plants; stems tuberous bearing long leaves **4. Isoetaceae**
3. Stems differentiated into nodes and internodes, bearing whorled leaves (sphenophylls) at nodes **5. Equisetaceae**
2. Leaves macrophyllous, with variously branched veins, a leaf-gap usually present at base of each leaf-trace
6. Vernation erect, i.e. leaves not coiled in bud
7. Terrestrial ferns; sporangia with walls consisting of several layers of cells, eusporanglate in origin; spores isosporous **6. Ophioglossaceae**
7. Aquatic ferns, floating on water surface; sporangia basipetal in globose, indusiate sori, without annulus, leptosporangiate; spores heterosporous
8. Roots wanting, submerged leaves present; floating leaves more than 7 mm long **33. Salviniaceae**
8. Roots present; leaves all floating, minute, many **34. Azollaceae**
6. Vernation circinate, i.e. leaves coiled in bud
9. Annulus none or not consisting of a single row of cells
10. Terrestrial ferns
11. Leaves glabrous; stipes succulent, with stipule-like outgrowths at base **7. Marattiaceae**
11. Leaves chaetopteroid, i.e. bearing only hairs; stipes not succulent, with stipular expansions covered with glandular hairs at base **8. Osmundaceae**
10. Aquatic ferns, rooting in mud
12. Spores isosporous; lepidopteroid, i.e. bearing scales **19. Parkeriaceae (Ceratopteris)**
12. Spores heterosporous; chaetopterois, i.e. bearing only hairs **32. Marsileaceae**
9. Annulus distinct, consisting of a single row of cells
13. Laminae one cell thick apart from midribs of segments, without stomata **12. Hymenophyllaceae**
13. Laminae throughout more than one cell thick, the epidermis with stomata
14. Annulus of sporangia transverse; sporangia solitary or maturing simultaneously in a sorus
15. Annulus medial; sporangia a few in each sorus, without indusia **10. Gleicheniaceae**
15. Annulus apical; sporangium solitary, subtended by an outgrowth, the so-called pseudo-indusium. **11. Schizaeaceae**
14. Annulus oblique or longitudinal; sporangia in a sorus, or on fertile leaves in acrostichoid condition, maturing not simultaneously but basipetally or without any regular order
16. Annulus of sporangia oblique, continuous
17. Fronds pinnate to decompound
18. Fronds glabrous, dimorphic; base of stipes enlarged **9. Plagiogyriaceae**
18. Rhizome and fronds bearing hairs and/or scales; fronds not dimorphic; stipes without swollen bases
19. Lepidopteroid, i.e. bearing scales; sori dorsal on veinlets, without indusia or with a thin cup-shaped indusium **13. Cyatheaceae**
19. Chaetopteroid, i.e. bearing only hairs; sori terminal on veinlets, marginal, protected by an indusium consisting of two concave flaps **14. Dicksoniaceae**
17. Fronds simple or dichotomously forked into two lobes; chaetopteroid, i.e. bearing only hairs
20. Fronds not dimorphic; sori punctiform or elongate along veinlets **28. Dipteridaceae**
20. Fronds dimorphic; fertile laminae linear-lanceolate, acrostichoid, i.e. covered entirely with sporangia **29. Cheiropleuriaceae**
16. Annulus of sporangia longitudinal, interrupted
21. Sori round or oblong
22. Stipes and/or pinnae articulated
23. Sori with indusia
24. Rhizome dorsiventral in construction **17. Davalliaceae**
24. Rhizome radial in construction **18. Oleandraceae**

23. Sori without indusia
25. Fronds tripinnate **17. Davalliaceae (Araiostegia)**
25. Fronds simple, pinnatifid or pinnate **30. Polypodiaceae**
22. Neither stipes nor pinnae articulated
26. Chaetopteroid, i.e. bearing only hairs **15. Dennstaedtiaceae**
26. Lepidopteroid, i.e. bearing scales
27. Usually terrestrial; fronds medium-sized to larger, pinnate to pinnately decompound; spores bilateral
28. Stipes with several vascular bundles **25. Dryopteridaceae**
28. Stipes with one or two vascular bundles
29. Stipes with a single U-shaped or V-shaped vascular bundle **16. Lindsaeaceae**
29. Stipes with two hippocampus-type bundles, uniting upwards to form U-shaped in cross section
30. Setose hairs present on various parts of fronds; rhizome scales hairy **26. Thelypteridaceae**
30. Coarse multiseptate hairs present or absent on axes of fronds, setose hairs absent; rhizome scales glabrous **27. Athyriaceae**
27. Usually epiphytic; fronds smaller, simple to pinnate, rarely decompound, often setose hairy; spores tetrahedral **31. Grammitidaceae**
21. Sori not round, or sporangia in coenosori
31. Sori in marginal cup
32. Stipes not jointed to rhizome; chaetopteroid, i.e. bearing only hairs **15. Dennstaedtiaceae**
32. Stipes jointed to rhizome; lepidopteroid, i.e. bearing scales **17. Davalliaceae**
31. Sori dorsal or marginal, not in marginal cup, or sporangia in coenosori
33. Sporangia protected by reflexed margin
34. Sori not elongate along margin **19. Parkeriaceae**
34. Sori elongate along margin **21. Pteridaceae**
33. Sporangia not protected by reflexed margin
35. Sporangia in elongate sori
36. Sori with indusia
37. Sori marginal **16. Lindsaeaceae**
37. Sori dorsal
38. Sori oblique to costae
39. Two bundles in stipes united upwards into a single strand, X-shaped in cross section; scales clathrate **22. Aspleniaceae**
39. Two bundles in stipes united upwards into a single strand, U-shaped in cross section; scales not clathrate **27. Athyriaceae**
38. Sori elongate parallel to costae **23. Blechnaceae**
36. Sori without indusia
40. Trunks distinct, usually more than 1 m tall **23. Blechnaceae (Brainea)**
40. Trunks absent, or small
41. Stipes not jointed to rhizome
42. Fronds simple, entire or rarely forked at apex
43. Sori in grooves, with paraphyses; spicular idioblasts present among epidermal tissues **20. Vittariaceae**
43. Sori without paraphyses; no spicular idioblasts among epidermal tissues
44. Sori elongate parallel to costae; fronds with stellate hairs **31. Grammitidaceae (Scleroglossum)**
44. Sori oblique; fronds lacking hairs **30. Polypodiaceae (Loxogramme)**
42. Fronds pinnate or pinnately compound
45. No setose hairs on fronds; stipes containing several bundles oblong in cross section
46. Spores tetrahedral **19. Parkeriaceae**
46. Spores bilateral **25. Dryopteridaceae**

45. Setose hairs present on various parts of fronds; stipes containing two hippocampus-type bundles **26. Thelypteridaceae**

41. Stipes jointed to rhizome **30. Polypodiaceae**

35. Sporangia in coenosori

47. Rhizome not dorsiventral; scandent or mangrove plants **21. Pteridaceae**

47. Epiphytic or terrestrial plants with dorsiventral rhizome

48. Veins free, or anastomosing into sagenioid venation, i.e. the veins uniting to form areoles, without any included veinlets or including the free veinlets directed away from the midribs of pinnae, or with sinus teeth **24. Lomariopsidaceae**

48. Venation drynarioid, i.e. the main veins are connected by regular cross veins approximately at right angle to them, the cross veins form the main areoles of the venation, and within these are smaller areoles, which usually contain very few free veinlets **30. Polypodiaceae**

# PSILOTACEAE

A family consisting of a single genus.

## 1. PSILOTUM

Sw., Syn. Fil.: 117. 1806.

Stems consisting of rhizomes and aerial stems, both branching dichotomously, without roots or leaves; branches of aerial stems bearing scaly projections; synangia consisting of three sporangia, borne on ridges of the branches and bearing forked scaly projections at base; spores isosporous, bilateral.

Widely distributed in the tropics and subtropics. The delimitation of the species varies with different authors; we recognize two wide-spread species, both occurring in Thailand.

### KEY TO THE SPECIES

1. Branches triangular in cross-section, bearing scaly projections on the ridges **1. P. nudum**
1. Branches complanate, bearing scaly projections on their edges **2. P. complanatum**

**1. Psilotum nudum** (Linn.) Beauv., Prod. Aethéog.: 112. 1805; Tagawa & K. Iwats., Southeast As. St. 5: 26. 1976.—*Lycopodium nudum* Linn., Sp. Pl.: 1100. 1753.—*Psilotum triquetrum* Sw., Syn. Fil.: 117. 1806; Hosseus, Beih. Bot. Centr. 28(2): 367. 1911; Bonap., Not. Ptérid. 14: 70. 1923; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 596. f. 64. 4–5. 1951; Larsen, Dansk Bot. Ark. 23: 59. 1963.

*Rhizome* creeping, dichotomously branching at irregular intervals, 0.5–1.5 mm in diameter, densely beset with brown to dark brown rhizoids. *Aerial stems* fasciculate, erect, patent, or pendulous, 10–60 cm in height, green, glabrous, dichotomously branching several times in upper portion, grooved, with several distinct ridges 0.5–1.5 mm in diameter. *Scaly projections* small, to 1 mm long, oval with subulate apex, irregularly and sparsely borne on ridges. *Synangia* borne adaxially to the projections, glabrous, about 2 mm in diameter, green at first, yellow when mature, with lemon-yellow or paler spores.

Thailand.—NORTHERN: Chiang Rai, Chiang Mai (Mae Rim, Doi Inthanon, Om Koi), Tak (Lan Sang); NORTH-EASTERN: Loei (Wang Saphung), Khon Kaen (Phu Wieng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri

(Si Racha), Chanthaburi (Pong Nam Ron, Soi Dao); SOUTH-WESTERN: Kanchanaburi (Ban Kaeng Liang), Prachuap Khiri Khan (Huai Yang); PENINSULAR: Chumphon (Ko Wieng, Bang Son), Surat Thani (Ko Pha-ngan), Nakhon Si Thammarat (Khao Luang).

Distribution.—Tropics and subtropics throughout the world (type from India), north to Quelpaert.

Ecology.—Usually epiphytic on mossy tree-trunks in dense forest or in light shade at low to medium altitudes.

**2. Psilotum complanatum** Sw., Syn. Fil: 188, 414. t. 4. f. 5. 1806; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 16. 1971. Fig. 1: 7–8.

Similar to *P. nudum* but differs in: plants larger, sometimes more than 1 m long, aerial stems and branches flattened, about 1.8–3 mm broad, 0 2 mm thick, with distinct midribs.

Thailand.—PENINSULAR: Surat Thani (Ko Pha-ngan).

Distribution.—Pantropic (type from Jamaica).

Ecology.—Epiphytic on tree-trunks in light shade.

# LYCOPODIACEAE

Two genera: *Lycopodium* with some 180 species throughout the world, sometimes split into several genera, and *Phylloglossum* with a single species *P. drummondii*, in Australia and New Zealand, differing from *Lycopodium* in the vegetative structure, sometimes considered as a permanently embryonic form.

## 1. LYCOPODIUM

Linn., Sp. Pl.: 1100. 1753.

Sporophytes differentiated into roots, stems, and leaves; stems elongate, dichotomous or sympodial; leaves microphyllous, each with a single vein, without ligules, arranged in spirals (in all Thai species) or in whorls; sporangia solitary at base of the upper surface of sporophyll; cones distinct or not; spores isosporous, tetrahedral.

KEY TO THE SPECIES

1. Cones not distinct; sporophylls hardly smaller than the sterile leaves
 2. Leaves serrate at margin — **1. L. serratum**
 2. Leaves entire at margin
  3. Stems less than 3 mm in diameter; leaves adpressed or subpatent
   4. Stems 2–3 mm in diameter; leaves about 1.3 mm broad; veins indistinct — **2. L. carinatum**
   4. Stems 1–1.5 mm in diameter; leaves 2–5 mm broad; veins more or less distinct below — **3. L. hamiltonii**
  3. Stems to more than 5 mm in diameter; leaves patent and squarrose — **4. L. squarrosum**
1. Cones distinct; sporophylls much smaller than the trophophylls
 5. Cones erect
  6. Epiphytic plants, plant pendulous
   7. Leaves linear to ovate subdeltoid, acuminate to pointed at apex
    8. Leaves linear, to 1.5 mm broad — **5. L. piscium**
    8. Leaves oblong-lanceolate to ovate -subdeltoid, 1–1.5 cm long, 4–7 mm broad — **6. L. phlegmaria**
   7. Leaves ovate to suborbicular, round to very moderately acute at apex — **7. L. nummularifolium**
  6. Terrestrial plants; stems creeping, bearing erect branched stems — **8. L. clavatum**
 5. Cones pendulous — **9. L. cernuum**

**1. Lycopodium serratum** Thunb., Fl. Jap.: 341. t. 38. 1784; Alston in Fl. Gén. I-C. 7(2): 548. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 26. 1967—*Lycopodium serratum* var. *longipetiolatum* Spr., Monogr. 2: 18. 1850. Fig. 1: 9–11.

*Stems* ascending or subcreeping at base, with several erect branches, 10–20 cm in heights, dichotomously branching a few times in upper part, sometimes bearing

gemmae near the apex. *Leaves* elliptic to narrower, acuminate at apex, petiolate, 2–3 cm long, 3–5 mm broad at middle portion, patent, irregularly serrate at margin; veins distinct, raised above; texture thin chartaceous, deep green. *Sporophylls* lanceolate, smaller, 3–5 mm long, usually on upper portion of plants but forming no distinct cones.

Thailand.—NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—E. Asia (type from Japan) to Australia; also recorded from Mexico and Cuba (introduced?)

Ecology.—Terrestrial on humus-rich ground usually in dense evergreen forest above 1000 m alt.

Notes.—The tropical plants of this species differ from the typical Japanese plants in petiolate larger leaves and have been referred to var. *longipetiolatum,* but the size and form of the leaves are so variable that are unable to recognize this form as a distinct taxon.

**2. Lycopodium carinatum** Desv. in Lamk., Enc. Suppl. 3: 555. 1813; Christ, Bot. Tidsskr. 24: 113. 1901; Alston in Fl. Gén. I.-C. 7(2): 550. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 27. 1967.

*Stems* pendulous, to more than 50 cm long, dichotomously branching a few times, 2–3 mm in diameter near base. *Leaves* narrowly lanceolate, subulate at apex, narrowing towards the base, sessile to 1.3 cm long, 1.3 mm broad, entire, adpressed or nearly so; veins indistinct; texture chartaceous. *Sporophylls* slightly different from the trophophylls, oblong subdeltoid, to 5 mm long, 1.5 mm broad, placed only on the apical portion or sometimes downwards to middle portion, not forming distinct cones.

Thailand.—SOUTH-EASTERN: Chon Buri (Si Racha, Hup Bon Hills), Chanthaburi (Taruang), Trat (Ko Chang); PENINSULAR: Ranong (Khao Thalu, Muang Laen, Thung Kha), Surat Thani (Ko Samui), Phangnga, Nakhon Si Thammarat (Khao Luang).

Distribution.—Malesia (type from 'India orientalis') and Polynesia, north to S. China, Indochina, Taiwan and S. Ryukyus.

Ecology.—Epiphytic on mossy tree-trunk in dense evergreen forest up to 900 m alt.

Vernacular.—Hang nu (หางหนู), hang pia chek (หางเปียเจ็ก), soi nari (สร้อยนารี) (South-eastern).

Notes.—Thai collections may prove to be var. *laxum* (Presl) Christ in Reinecke, Bot. Jahrb. 23: 365. 1896, though we are not sure at present about varietal segregation.

**3. Lycopodium hamiltonii** Spr., Syst. Veg. 5: 429. 1828; C. Chr., Contr. U.S. Natn. Herb. 26: 335. 1931; Alston in Fl. Gén. I.-C. 7(2): 549. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 27. 1967.

*Stems* usually pendulous, 20–50 cm long, dichotomously branching a few times, 1–1.5 mm in diameter near base. *Leaves* ascending or subadnate, rarely subpatent, lanceolate but rather variable in form and size, acute to acuminate at apex, narrowing towards sessile or very shortly stalked base, those on middle or lower part the largest, 1–1.5 cm long, 2–5 mm broad, entire; veins more or less distinct beneath; texture softly chartaceous to thicker, green to yellowish green. *Sporophylls* usually smaller than the trophophylls, to 7 mm long, 1.5 mm broad, usually gathered in apical portion, forming no distinct cones, the fertile stems usually about 1/3 in thickness of the sterile ones.

Thailand.—NORTHERN: Chiang Mai (Doi Chiang Dao, Khun Mae Lan, Khun Kong San, Doi Suthep, Doi Inthanon), Mae Hong Son (Doi Khun Huay Pong), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Sisawat); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Himalaya (type) to S. China and S. Japan, also in Indo-china and Taiwan.

Ecology.—On mossy tree-trunks, on mossy rock, or on moist muddy rocks usually in dense evergreen forest above 700 m alt.

Notes.—This is an extremely variable species especially in Thailand. Some plants bear oblong subpatent leaves with nearly distinct fertile portions (cones) similar to *L. phlegmaria,* but others have adpressed narrower leaves with less distinct fertile portions as in the case of *L. carinatum.*

**4. Lycopodium squarrosum** Forst., Fl. Ins. Austr. Prod.: 479. 1786; Alston in Fl. Gén. I.-C.7(2): 550. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 27. 1967.

*Stems* to 70 cm or more in length, dichotomously branching a few times, usually up to 5 mm in diameter near base. *Leaves* dense, usually patent and squarrose, linear lanceolate, acuminate at apex, hardly narrowing towards the sessile base, to 1.3 cm long, 1–2 mm broad at the broadest portion, entire, the basal leaves smaller, more sparse, upper ones usually narrower; veins visible on both surfaces; texture coriaceous, green. *Sporophylls* more or less smaller, or sometimes not different from the trophophylls, forming no distinct cones but slender apical fertile portions.

Thailand.—NORTHERN: Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); EASTERN: Nakhon Ratchasima (Khao Laem); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Phriu), Trat (Dan Chumphon); SOUTH-WESTERN: Kanchanaburi (Klang Dong, Song Tho); PENINSULAR:

Surat Thani (Ban Kop Kaep), Phangnga (Bang To), Nakhon Si Thammarat (Khiriwong).

Distribution.—Madagascar, Seychelles, Mascarene Islands, tropics of Asia and Oceania (type from Tahiti), north to E. Himalaya.

Ecology.—On tree-trunks or on muddy rocks in dense evergreen forest usually near streams at lower or middle altitudes.

Vernacular.—Chong nang khli (ช้องนางคลี) (Northern); hang khang (หางค่าง) (Peninsular).

Notes.—The specific delimitation of this gigantic species is rather difficult and some of the Thai specimens may belong to a form known as *L. ulicifolium* Vent ex Sw., Syn. Fil: 177. 1806.

**5. Lycopodium piscium** (Hert.) Tagawa & K. Iwats., Acta Phytotax. Geobot. 22: 103. 1967; Southeast As. St. 5: 27. 1967.—*Urostachys piscius* Hert., Ind. Lycopod. 75. 1949, based on *Lycopodium pinifolium* Bl., En. P. Jav.: 264. 1828, non Kaulf. 1824.; Tagawa & K. Iwats., Southeast As. St. 3(3): 70. 1965.

Similar to *L. hamiltonii* but different from it by: leaves very narrow, linear, at most 1.5 mm broad, the margin often involute; fertile portion slender, about 1 mm in diameter, sporophylls much smaller than the trophophylls.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

Distribution.—Malesia (type from Java).

Ecology.—On mossy tree-trunks in dense evergreen forest below 800 m alt.

**6. Lycopodium phlegmaria** Linn., Sp. Pl.: 1101. 1753; Alston in Fl. Gén. I.-C. 7(2): 551. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 27. 1967; Acta Phytotax. Geobot. 23: 51. 1968.

*Stems* pendulous, dichotomously branching in irregular intervals, to more than 100 cm long, 2–5 mm in diameter near the base. *Leaves* patent, oblong-lanceolate to ovate-subdeltoid, acuminate at apex, round to roundly truncate at base or rarely cordate, subsessile or very shortly stalked, 1–1.5 cm long, 4–7 mm broad, entire; veins more or less visible; texture coriaceous, green to yellowish green. *Cones* distinct, located at apex of sterile branches, dichotomously branching a few times, slender, 1–2 mm in diameter, 4–15 cm long; sporophylls ovate subdeltoid, adpressed, about 1 mm long.

Thailand.—NORTHERN: Lampang, NORTH-EASTERN: Loei (Wang Saphung, Phu Luang, Phu Kradung), Nong Khai; SOUTH-EASTERN: Prachin Buri (Khao Yai), Chon Buri (Hup Bon Hills), Chanthaburi (Khao Soi Dao); PENINSULAR: Chumphon (Tha San), Surat Thani (Song Phi Nong), Phangnga (Khao Thong Lang), Krabi

(Ko Pu, Nai Sa, Nai Chong), Phuket (air port), Nakhon Si Thammarat (Khao Luang), Phatthalung (Khao Soi Dao, Khao Pok), Satun (Thung Nui, Tarutao), Yala (Betong.)

Distribution.—Old World tropics (type from Ceylon), north to S. Japan.

Ecology.—On mossy-tree trunks or on rocks in shade and in dense mossy forest at medium or higher altitudes.

Vernacular.—Chong nang khli (ช้องนางคลี่) (South-western); klet nakkharat (เกล็ดนาคราช) (North-eastern); raya (ระย้า) (Peninsular); yom doi (ยมโดย) (Central).

Notes.—Alston (1951) suggested that the epithet for this species was not correct. It is retained, however, pending full investigation.

**7. Lycopodium nummularifolium** Bl., En. Pl. Jav.: 263. 1828; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 51. 1968. Fig. 1: 4–6.

*Stems* pendulous, 1–1.5 mm in diamter near the base, irregularly branching dichotomously, to more than 60 cm long. *Leaves* ascending, ovate to suborbicular, round to very moderately acute at apex, round at sessile base, 0.6–1 cm long, 0.6 cm broad, entire; veins visible on both surfaces; texture thick, fleshy, green. *Cones* at the apex of vegetative branches which become slender in transition to the cones, 1-1.5 mm in diameter, to 15 cm long, a few times dichotomously branching; sporophylls smaller, adpressed, ovate with acute apex, to 1 mm long, often crisped on the lower surface in the dried condition.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khiriwong, Khao Luang), Narathiwat (Waeng), Yala (Betong, Khao Kalakhiri).

Distribution.—Malesia (type from Java) to Polynesia.

Ecology.—On tree-trunks in evergreen forest at lower to middle altitudes.

Vernacular.—Raya klet hoi (ระย้าเกล็ดหอย) (Peninsular).

**8. Lycopodium clavatum** Linn., Sp. Pl.: 1101. 1753; Alston in Fl. Gén. I.-C. 7(2): 553. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 28. 1967.

*Main stems* creeping, subterranean, irregularly branching, bearing sparse narrow leaves, 3–4 mm in diameter; aerial stems ascending to erect, branching dichotomously a few times, bearing dense leaves, 0.5–1 cm in diameter including the leaves. *Leaves* patent, curved in upper part, linear to linear-lanceolate, acuminate at apex ending in long caducous membranous setae, 4–6 mm long, 0.5–1 mm broad, entire, sessile; veins hardly visible; texture coriaceous, green or yellowish green. *Cones* on the erect stalks; stalks 7–15 cm long, bearing adpressed linear leaves rather sparsely, producing a few cones at each apex with short stalks; cones cylindrical, erect, 3–8 cm long, 4–5 mm in diameter; sporophylls oblong-ovate, acuminate at apex with setaceous membrane, edges transparent, membranous, dentate, about 2.5 mm long, 1.5 mm broad.

Thailand.—NORTHERN: Chiang Mai (Doi Inthanon); NORTH-EASTERN: Loei (Phu Kradung); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Cosmopolitan (type from 'Europae').

Ecology.—On wet ground in open areas usually near summit of higher mountains.

Vernacular.—Kut khon (กูดขน) (Northern); sam roi yot (สามร้อยยอด) (Peninsular).

Notes.—The distribution of this species ranges from tropical regions to cold temperate regions, and successive clinal variation is observed in various features, though the ecological variation is so high that no taxonomic significance can be recognized for any of these variations. The Thai plants belong to a form called var. *divaricatum* by various authors.

**9. Lycopodium cernuum** Linn., Sp. Pl.: 1103. 1753; Christ, Bot. Tidsskr. 24: 113. 1901; Alston in Fl. Gén. I.-C. 7(2): 548. 1951; Tagawa & K. Iwats., Southeast As. St. 3(3): 71. 1965; 5: 28. 1967; Acta Phytotax. Geobot. 23: 51. 1968.

*Stems* of two kinds, creeping and erect; main erect stems to more than 50 cm tall, bearing many branches densely covered with leaves (not so dense on lower portion), 3–4 mm in diameter; lateral branches 3–5 mm in diameter, densely covered with leaves, usually about 10 cm long, copiously branching. *Leaves* linear, pointed at apex, 3–5 mm long, to 0.5 mm broad, entire, patent and recurved in upper portion; texture thick but soft, yellowish green. *Cones* solitary or two at each apex of the branches, pendulous, 5–10 cm long, about 3 mm in diameter; sporophylls ovoid, acuminate at apex, with minute projections at margin.

Thailand.—NORTHERN: Chiang Rai (Doi Tung, Kiu Thap Yang, Mae Lao, Doi Phacho), Chiang Mai (Doi Chiang Dao, Wang Tao, Doi Suthep, Mae Rim), Lampang (Mae Tam), Phitsanulok (Thung Salaeng Luang), Tak (Doi Musoe); NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Kanchanaburi (Wang Ka); PENINSULAR: Chumphon (Bang Son), Surat Thani (Ban Don), Satun (Tarutao), Nakhon Si Thammarat (Thung Song, Ron Phibun), Trang (Khao Chong, Thale Song Hong, Sam Roi Yot), Songkhla (Saba Yoi), Narathiwat (Bacho, Nikhom Waeng), Yala (Gunong Ina, Ban To, Padang Besar).

Distribution.—Tropics and subtropics throughout the world (type from India.)

Ecology.—On mountain slopes, dry ground to marshy places, usually in open places at various altitudes, from sea level to 1200 m alt.

Vernacular.—Khut khon (กูดขน) (Northern); ya kan phiang (หญ้าก้านเพียง), yaeng yae (แหยงแย้) (North-eastern); slap (สลาบ), dok hin (ดอกหิน) (South-eastern); rang kai (รังไก่), ruai kai (รวยไก่), sam roi yot (สามร้อยยอด) (Peninsular).

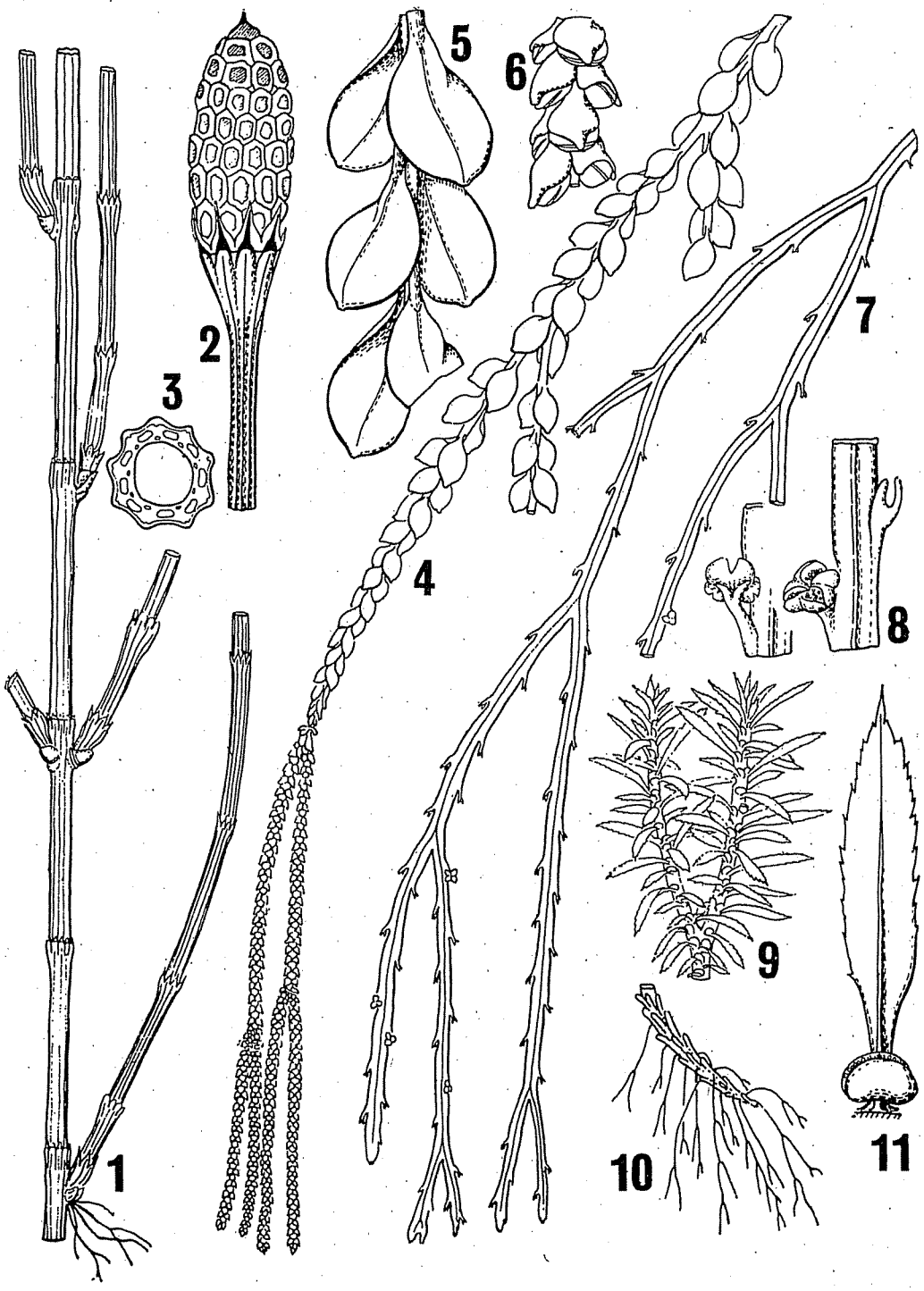



Figure 1. 1–3: *Equisetem debile* 1, portion of aerial shoot, natural size; 2, strobilus, x 3; 3, cross section of aerial stem, x 7.5. 4–6: *Lycopodium nummularifolium* 4, portion of pendulous stems with long strobili, natural size; 5, sterile axis, x 2.5; 6, fertile axis, x 6. 7–8: *Psilotum complanatum* 7, portion of pendulous stems with sporangia, natural size; 8, portion of the same stems, x 3. 9–11: *Lycopodium serratum* 9, portion of upright stems with sporangia, natural size; 10, lowest portion of stem with roots, natural size; 11, leaf with sporangia, x 5.

# SELAGINELLACEAE

The range of this family is mainly in the tropical regions of both Old and New Worlds. There are about 600 species included in a single genus.

Literature: The specific classification of *Selaginella* was treated by A.H.G. Alston for various regions. Chinese species in Bull. Fan Mem. Inst. Biol. 5: 261–304. 1934; species from the Malay Peninsula in Gard. Bull. S.S. 8: 41–62. 1934; Indian species including the Burmese in Proc. Natn. Inst. Sci. India 11: 211–235. 1945; Indochinese species including Thai representatives in Lecomte, Fl. Gén. I.-C. 7(2): 555–594. 1951. The following nomenclature of the species is based chiefly on the cards of Alston in C.F. Reed, *Index Selaginellarum* in Mem. Soc. Brot. 18: 1–287. 1966.

## 1. SELAGINELLA

Beauv., Mag. Enc. 4: 478. 1804.

Stems elongate, bearing leaves and rhizophores, branching dichotomously or pinnately, usually of foliar appearance; rhizophores geotropic, dichotomously branching, bearing roots in the earth; leaves microphyllous, monomorphic and spirally arranged, or as in all Thai species dimorphic arranged in four rows, the ventral two patent or ascending, larger, the dorsal two smaller, adpressed to stems, directed distally; sporophylls uniform and arranged spirally forming cylindrical spikes, uniform and arranged in four rows forming squarroid spikes, or dimorphic and arranged in four rows, the dorsal and ventral rows unequal; heterosporous, with tetrahedral spores.

In the following enumeration of Thai species, we follow Alston for the specific concepts, though there is much to be done in elucidating the classification of this genus. The significant taxonomic features will be found in the position of the rhizophores, the habit of the stems, the size, form and direction of the ventral leaves, cilia and dentation as well as the occurrence of false-veins and white margins in the leaves, the form, especially of the apex of the dorsal leaves, heterophylly of the spikes, cilia on the sporophylls, and so on. Some specimens are left unidentified owing to their incompleteness, and some taxonomic features should be re-examined in the field in relation to ecology.

Twenty-nine species are known from Thailand.

KEY TO THE SPECIES

1. Sporophylls of spikes uniform
 2. Branches pubescent
  3. Main erect stems dichotomous; leaves entire **2. S. pubescens**
  3. Main erect stems not dichotomous, bearing runners; leaves dentate to ciliate at margin **3. S. biformis**
 2. Branches glabrous
  4. Stems rooting at base only, densely tufted, forming pseudo-trunks of about 20 cm tall; xerophytic plants **15. S. tamariscina**
  4. Stems not densely tufted, without pseudo-trunks; not xerophytic
   5. Stems scandent, or growing indefinitely, stems rooting at apex to form new plants
    6. Stems scandent; ventral leaves not ciliate; dorsal leaves much smaller than the ventral ones
     7. Sporophylls strongly acuminate, ovate-lanceolate, about 3.5 mm long (Northern to Central and South-Eastern) **5. S. helferi**
     7. Sporophylls acute, broadly ovate, about 1 mm long (Peninsular to South-Eastern and South-Western) **6. S. willdenowii**
    6. Stems growing indefinitely, the main stems rooting at apex to form new plants; ventral leaves ciliate; dorsal leaves nearly as large as the ventral leaves. **4. S. siamensis**
   5. Stems not scandent nor growing indefinitely; plants less than 70 cm long
    8. Main erect stems dichotomous **1. S. ostenfeldii**
    8. Main erect stems not dichotomous
     9. Stems stoloniferous **7. S. griffithii**
     9. Stems not stoloniferous
      10. Ventral leaves at base of main stems distant, erect, adpressed
       11. Ventral leaves entire or nearly so
        12. Main lateral branches, or pinnae, ovate; ventral leaves dentate at apex **12. S. delicatula**
        12. Main lateral branches, or pinnae, lanceolate; ventral leaves entire
         13. Main lateral branches pinnate **8. S. wallichii**
         13. Main lateral branches bipinnate **9. S. inaequalifolia**
       11. Ventral leaves ciliate or ciliolate
        14. Dorsal leaves white-margined **17. S. argentea**
        14. Dorsal leaves not white-margined **16. S. involvens**
      10. Ventral leaves at base of main stems usually near to the next ones or even overlapping, spreading
       15. Dorsal leaves acuminate, white-margined; ventral leaves ovate-lanceolate
        16. Stems usually suberect, rooting at base only, or rarely on upper portion as well; ventral leaves on higher axes usually patent **13. S. repanda**
        16. Stems prostrate, rooting throughout; leaves adpressed to the stems even in the higher axes **14. S. vaginata**
       15. Dorsal leaves usually long mucronate
        17. Leaves smooth
         18. Stems subdichotomously branching; ventral leaves denticulate, round at base **10. S. intermedia**
         18. Stems pinnately branching; ventral leaves ciliate, enlarged at base **18. S. roxburghii**
        17. Leaves scabrous or strigose on upper surface
         19. Stems rooting at base only **11. S. trachyphylla**
         19. Stems prostrate, rooting throughout **19. S. strigosa**
1. Sporophylls of spikes dimorphic
 20. Dorsal leaves obovate, broadest above the middle
  21. Stems suberect, bearing rhizophores only in lower portion **20. S. pennata**
  21. Stems prostrate, bearing rhizophores nearly throughout the plants **21. S. bisulcata**
 20. Dorsal leaves ovate, elliptic, or lanceolate, broadest below the middle
  22. Plants larger, usually more than 25 cm long; main branches more than 5 mm broad including leaves

23. Stems suberect; ventral leaves entire or at most dentate at basal portion only **22. S. ornata**
23. Stems prostrate; ventral leaves dentate or ciliate
24. Edges of the ventral leaves densely ciliate with long setae at lower portion; dorsal leaves ovate to suborbicular **23. S. amblyphylla**
24. Edges of the ventral leaves dentate; dorsal leaves oblong **24. S. monospora**
22. Plants smaller, usually to 25 cm long; main branches less than 5 mm broad including leaves
25. Ventral leaves entire to denticulate
26. Dorsal sporophylls acuminate
27. Sporophylls ciliate **25. S. minutifolia**
27. Sporophylls dentate **26. S. lindhardtii**
26. Dorsal sporophylls round to obtuse at apex
28. Ventral sporophylls denticulate **27. S. tenuifolia**
28. Ventral sporophylls ciliate **28. S. chrysorhizos**
25. Ventral leaves ciliate near base **29. S. kurzii**

**1. Selaginella ostenfeldii** Hieron., Bull. Herb. Boiss. 2. 5: 721. 1905; Hosseus. Beih. Bot. Centr. 28(2): 367. 1911; Alston in Fl. Gén. I.-C. 7(2): 567. f. 67. 1–7. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 29. 1967.—*Selaginella pungentifolia* v.A.v. Ros., Bull. Jard. Bot. Buit. 2.1: 20. 1911.

*Rhizome* creeping, about 3 mm in diameter, densely covered with scaly leaves; leaves on rhizome brown, oblong, round at apex, fimbriate at margin; main stems erect, forked at 15–50 cm above rhizome, 1–3 mm in diameter near base, sparsely bearing the leaves, stramineous, glabrous; both branches of the forked stem pinnate; main lateral branches tripinnate, the ultimate branches 2–5 mm broad. *Ventral leaves* patent or ascending, oblong subquadrangular, falcate, acute at apex, subcordate at base, 1–3.5 mm long, 0.5–1.2 mm broad; the margin more or less involute, bearing setae of more than 0.3 mm in length; texture soft herbaceous, green to deep green; dorsal leaves narrowly ovate, acuminate at apex round to cuneate at base, ciliate at margin, to 2 mm on main lateral branches. *Spikes* about 1.2 mm in diameter; sporophylls ovate with long acuminate apex, densely ciliate.

Thailand.—NORTHERN: Chiang Mai (Doi Suthep, Mae Klang, Doi Inthanon, Ban Klang, Mae Lan, Bo Luang), Mae Hong Son (Mae La Noi), Lampang (Doi Phalat, Huay Thak, Mae Ngao, Mae Mo), Lamphun (Doi Khun Tan), Phrae (Mae Ban), Tak (Lan Sang, Rahaeng, Wang Chao—type), Nakhon Sawan (Ban Takhli); NORTH-EASTERN: Loei (Phu Kradung); SOUTH-WESTERN: Kanchanaburi (Khao Tong), Prachuap Khiri Khan (Khao Nam Tok, Hua Hin, Thap Sakae); PENINSULAR: Surat Thani (Khao Pak Chong).

Distribution.—Burma (Shan State and Moulmein) and Indochina (Cochinchina and Cambodia).

Ecology.—Terrestrial on rather dry slope in deciduous or mixed forest at lower to middle elevation (to 1400 m alt. on Doi Inthanon).

Vernacular.—Phak khwa (ผักคาว) (Northern); moi sao kae (มอยสาวแก่) (North-eastern).

N o t e s.—It is interesting to trace the gradual changes from the scaly leaves on the rhizome to the green leaves on the foliose portions. On the lower portions of erect stems, there are green leaves oblong in outline with fimbriate margins. The upper leaves are acute with entire margins bearing long setose hairs.

**2. Selaginella pubescens** (Wall. ex Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 225. 1843; Hosseus, Beih. Bot. Centr. 28(2): 367. 1911; Alston in Fl. Gén. I.-C. 7(2): 569. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 29. 1967.—*Lycopodium pubescens* Wall. ex Hook. & Grev. in Hook., Both. Misc. 1: 383. 1831.—*Selaginella fulcrata* auct. non (D. Don) Spring: Hieron., Bull. Herb. Boiss. 2. 5: 721. 1905; C. Chr., Contr. U.S. Natn. Herb. 26: 335. 1931. Fig. 2: 1–5.

Similar to *S. ostenfeldii* but different from the latter in: stems pubescent; leaves entire, not ciliate; dorsal leaves oblong, longitudinally attached to the stem.

T h a i l a n d.—NORTHERN: Chiang Mai (Mae Klang, Ban Klang), Phrae (Ban Tak Tawan), Tak (Rahaeng, Lan Sang, Wang Chao, Tha Chang Tai); PENINSULAR: Phatthalung.

D i s t r i b u t i o n.—Burma (type) and Indochina (?)

E c o l o g y.—Terrestrial on rather dry mountain slopes in deciduous or mixed forest at lower altitudes.

V e r n a c u l a r.—Fuai nok (เฟื่อยนก) (Central).

N o t e s.—The above two species, which sometimes grow in the same place, are similar to each other having erect dichotomous main stems and oblong scaly leaves with fimbriate margins on the rhizome. The hairs on *S. pubescens* are very short on the basal portions of erect stems, and the rhizome is practically glabrous.

**3. Selaginella biformis** A.Br. ex Kuhn, Forsch. Gaz. 4. Bot. 6: 17, 19. 1889; Alston in Fl. Gén. I.-C. 7(2): 570. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 30. 1967 Fig. 2: 6–8.

*Stems* erect or decumbent, rooting only at base for the erect plants, plants about 25 cm tall; main stems about 2 mm in diameter near base, sparsely bearing leaves, pubescent on lower surface or glabrescent in lower portion; lateral branches bipinnate to tripinnate, densely pubescent below; ultimate branches about 3 mm in breadth. *Runners* branching from the main stems, rooting and forming new erect plants at the apex, bearing rhizophores throughout. *Leaves* on basal portion of erect stem uniform, sparse and not imbricate; ventral leaves ascending, oblong subdeltoid, gradually narrowing and falcate towards acute apex, cordate at base, 2–3 mm long, 0.7–1.5 mm broad; edges dentate or ciliate near base, texture herbaceous to softly papyraceous, green; dorsal leaves asymmetrically oblong, mucronate at apex, dentate or ciliate at margin. Spikes about 1 mm in diameter; sporophylls uniform, ovate subtriangular with long mucronate apex, about 1.5 mm long, 1 mm broad.

T h a i l a n d.—NORTHERN: Chiang Rai, Chiang Mai (Doi Phu Pa, Huay Tong), Nan (Pha Sing), Phrae (Mae Sai), Phitsanulok (Thung Salaeng Luang, Salaeng

Haeng), Tak (Ban Musoe); NORTH-EASTERN: Phetchabun (Phu Miang, Pine Grove), Loei (Phu Luang, Phu Kradung); EASTERN: Nakhon Ratchasima (Si Khiu); CENTRAL: Nakhon Nayok (Khao Yai).

D i s t r i b u t i o n.—Assam, Burma, S. China, Indochina and Malesia throughout (type from the Philippines).

E c o l o g y.—Terrestrial on rather dry ground or on humus rich floor or dense forest in light shade at 500–1200 m alt.

V e r n a c u l a r.—Foen phaeng (เฟินแผง) (North-eastern).

**4. Selaginella siamensis** Hieron., Bot. Tidsskr. 24: 113. 1901; Alston in Fl. Gén. I.-C. 7(2): 560. f. 65, 6–10. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 28. 1967.—*Selaginella reptans* Ridl., J. Str. Br. Roy. As. Soc. 80: 155. 1919, non Sodiro 1893.—*Selaginella ridleyana* Kümm., Magyar Bot. Lapok 26: 100. 1938.

*Stems* long, growing indefinitely, climbing up bushes or procumbent, irregularly rooting to form new plants at apex, 1.5–2 mm in diameter, rather closely bearing brownish monomorphic leaves, glabrous; rhizophores stout, to more than 0.5 mm in diameter; lateral branches tripinnate, ovate to oblong subtriangular in outline; ultimate branches 2–2.5 mm wide. *Ventral leaves* ascending, ovate-oblong, acute to mucronate with long aristae at apex, cordate at base, to 3 mm long, 1.5 mm broad; edges ciliate throughout with white setae of about 0.1 mm in length, texture softly papyraceous, green, or sometimes reddish; dorsal leaves nearly the same as or smaller than ventral ones in size, asymmetrically oblong to suborbicular with long pale tails at apex, ciliate at margin. *Spikes* usually 5-8 mm long, about 1.2 mm in diameter; sporophylls uniform, ovate-subtriangular with long tail.

T h a i l a n d.—NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Khun Khong), Lampang, Phitsanulok (Thung Salaeng Luang, Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang—type); SOUTH-WESTERN: Kanchanaburi (Thung Kang Yang Hills); PENINSULAR: Satun (Rawai).

D i s t r i b u t i o n.—Indochina and Malaya (?)

E c o l o g y.—Terrestrial on rather dry ground or on rocks in light shade or in open areas at 1000–1800 m alt.

V e r n a c u l a r.—Phak nok yung (ผักนกยูง) (North-eastern).

N o t e.—This species is distinct in its creeping stems, with dorsal and ventral leaves similar to each other.

**5. Selaginella helferi** Warb., Monsunia 1: 107, 121. 1900; Alston in Fl. Gén. I.-C. 7(2): 582. 1951; Tagawa & K. Iwats., Southeast As. St. 3(3): 71. 1965: 5: 31. 1967.—? *Selaginella willdenowii* auct. non (Desv.) Baker: C. Chr., Contr. U.S. Natn. Herb. 26: 335. 1931. Fig. 2: 9–12.

*Stems* scandent, sometimes forming bushes of more than 2 m in height, 1–3 mm or rarely to more than 5 mm in diameter, very sparsely bearing leaves; branches to more than 70 cm long, tripinnate, glabrous; leaves borne sparsely on the main branches but densely on the lateral branches. *Ventral leaves* patent, oblong, more or less falcate, acuminate at apex, round to subtruncate at sessile base, usually bearing small auricles forming pale hooks at acroscopic base, 2.5–4 mm long, to 1.5 mm broad, distinctly margined with cartilaginous membrane, entire, glabrous; dorsal leaves adpressed, falcate, acuminate at apex, 0.7–2.3 mm long. *Spikes* solitary at apex of lateral branchlets, about 2 mm in diameter; sporophylls ovate-lanceolate, about 3.5 mm long, 1.5–2 mm broad, acuminate at apex.

Thailand.—NORTHERN: Chiang Rai (Doi Tung, Nam Mae Kok, Doi Phacho), Chiang Mai (Fang, Doi Chiang Dao, Doi Suthep, Doi Phra Dieng), Nan (Pha Sing), Phitsanulok (Thung Salaeng Luang), Tak (Mae Sot, Doi Musoe, Rahaeng); NORTH-EASTERN: Loei (Phu Luang); CENTRAL: Saraburi (Muak Lek); SOUTH-EASTERN: Chon Buri (Si Racha).

Distribution.—Assam, Burma (type), S. China (Kweicho & Kwangsi), and Indochina.

Ecology.—Climbing up bushes in evergreen forest at 400–1600 m alt. in monsoon areas.

Vernacular.—Ya rong hai (หญ้าร้องไห้) (Peninsular).

**6. Selaginella willdenowii** (Desv.) Baker, Gard. Chron. 783, 950: 1867; Alston in Fl. Gén. I.-C. 7(2): 581. 1951; Tagawa & K. Iwats., Southeast As. St. 3(3): 71. 1965; 5: 30. 1967.—*Lycopodium willdenowii* Desv. in Lamk., Enc. Suppl. 3: 540, 552. 1814. Fig. 2: 13–14.

Similar to *S. helferi,* but differing in: margin of leaves not or inconspicuously cartilaginous; sporophylls ovate, acute at apex, about 1 mm in length and breadth, herbaceous in texture.

Thailand—SOUTH-EASTERN: Chanthaburi (Ban Huay Ta); SOUTH-WESTERN: Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Chumphon, Surat Thani (Ko Tao, Ko Phangan, Ban Don), Phangnga (Thap Put), Phuket, Krabi (Ao Luk), Nakhon Si Thammarat (Thung Song, Khiriwong, Khao Luang, Ronphibun), Trang (Khao Chong), Phatthalung, Satun, Pattani (Bukit), Narathiwat (Bajo Falls), Yala (Bannang Sata).

Distribution.—Burma, Indochina, Malaya, Sumatra, Java (type) and the Philippines.

Ecology.—Forming thickets among undergrowths in evergreen forest lower than 500 m alt. in southern provinces.

Vernacular.—Rang kai (รังไก่) (Peninsular).

**7. Selaginella griffithii** Spring, Bull. Acad. Roy. Sci. Brux. 10: 145. 1843; Alston in Fl. Gén. I.-C. 7(2): 574. 1951.

*Main stems* erect, sparsely bearing uniform leaves, 1–2.5 mm in diameter, elongate, stoloniferous; lateral branches many, close to each other, submonopodially bipinnate, glabrous. *Ventral leaves* oblong, falcate and narrowing towards acute apex, entire, asymmetrically subcordate at base, to 5 mm long, 2 mm broad on upper portion of main stems, smaller in higher axes, close to each other except for the lower portion of the main stem, with distinct pseudoveins at both sides of veins; edges with narrow cartilaginous membrane, dentate, or ciliate near basal portion, often involute, texture soft papyraceous, dark green, paler beneath; dorsal leaves elliptic with long tails at apex, dentate at margin, smaller; stolons bearing leaves sparsely. *Spikes* usually 1 mm in diameter; sporophylls oblong-subtriangular, acuminate at apex, to 2 mm long, 1 mm broad, minutely dentate.

Thailand.—SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Krabi (Ko Lanta), Phuket (Khao Phra), Trang (Khao Chong), Satun (Khuan Kalong).

Distribution.—S. Burma (type), Indochina (Cambodia & Cochinchina) and Malaya (Langkawi).

Ecology.—Terrestrial on moist ground near streams in dense evergreen forest at lower altitudes.

Vernacular.—Ya rang kai tua mia (หญ้ารังไก่ตัวเมีย) (Peninsular).

**8. Selaginella wallichii** (Hook. & Grev.) Spring in Mart., Fl. Bras. 1(2): 124. 1840; Alston in Fl. Gén. I.-C. 7(2): 579. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 30. 1967.—*Lycopodium wallichii* Hook. & Grev. in Hook., Bot. Misc. 2: 384. 1831. Fig. 2: 15–16.

Plants to more than 50 cm in height. *Stems* erect, commonly 2–3 mm in diameter near base; lateral branches narrowly oblong-lanceolate, about 15 cm long, 5 cm wide bearing 15–30 pairs of branches below distinct terminal ones; pinnae of lateral branches up to 8 mm apart, ascending, forming angles of about 45° to axes, linear-lanceolate, up to 2.5 cm long, 5 mm wide. *Ventral leaves* narrowly oblong, falcate, aciculate at apex, margined with narrow cartilaginous membrane, entire, about 3 mm long, to 1 mm broad, ascending, forming angles of about 60° to axes; dorsal leaves adpressed to 1.5 mm long, acuminate at apex. *Spikes* to more than 3 cm long, up to 1.3 mm in diameter; sporophylls oblong-subtriangular, long-acuminate at apex, about 1.4 mm long, 0.8 mm broad.

Thailand.—PENINSULAR: Ranong (Nam Chuet), Surat Thani (Ban Kop Kaep), Nakhon Si Thammarat (Khiriwong, Khao Luang), Yala.

Distribution.—S. Burma, Indochina, Malaya (type), Sumatra and Borneo.

Ecology.—Terrestrial usually in wet places near streams at lower altitudes.

**9. Selaginella inaequalifolia** (Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 145. 1843.—*Lycopodium inaequalifolium* Hook. & Grev. in Hook., Bot. Misc. 2: 391. 1831.

Similar to *S. wallichii* but differing in: lateral branches bipinnate, narrowly oblong, 4–7 cm wide, pinnae of lateral branches usually more than 1 cm apart; main stems dark in upper portion; leaves light green, drying brown, coarse in texture.

Thailand.—NORTHERN: Tak (Doi Musoe).

Distribution.—Madras (type), Assam and Burma.

Ecology.—In moist shady place near rivulet in moist evergreen forest at medium altitudes.

**10. Selaginella intermedia** (Bl.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 144. 1843; Alston in Fl. Gén. I.-C. 7(2): 565. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 29. 1967.—*Lycopodium intermedium* Bl., En. Pl. Jav.: 269. 1828.—*Lycopodium atro-viride* Wall. ex Hook. & Grev., Ic. Fil. t. 39. 1831.

Plants creeping. *Main stems* 2–3 mm in diameter, bearing dorsal and ventral leaves rather sparsely near base, subdichotomously branching: ultimate branchlets narrowing towards apex, about 7 cm long, to 1.2 cm wide. *Ventral leaves* patent or slightly ascending, oblong, more or less falcate, acuminate, or in some cases moderately acute, at apex, widened at base, to 6 mm long, 2 mm broad, with transparent edges, minutely denticulate at margin; pseudoveins present at both sides of veins, though in some specimens obscure; dorsal leaves imbricate, ovate-oblong with long acuminate apex, to 1.5 mm long except the needle-like apices or about 1 mm in length, dentate at margin. *Spikes* to more than 5 cm long, about 1.5 mm in diameter; sporophylls oblong subdeltoid, acuminate at apex, about 1.5 mm long, 1 mm broad, dentate at margin.

Thailand.—NORTHERN: Lampang; NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR: Chumpon (Khao Tong), Ranong (Khao Phota Chong Dong), Phangnga (Khao Katha Khwam, Khao Nang Hong), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Songkhla (Namtok Khao Kaeo), Pattani (Bukit), Narathiwat (Bajo Waterfall, Sg. Padi).

Distribution.—Burma (Tenasserim), Indochina, Malaya, Sumatra, Java (type), Borneo and Celebes.

Ecology.—Terrestrial on humus rich ground or rather dry slopes at low to medium altitudes.

Vernacular.—Hi moi sao kae (หีมอยสาวแก่) (North-eastern).

Notes.—This species is similar to *S. doederleinii* Hieron. of China and Japan but differing in the larger size of the plants as well as of the leaves and stems, in the thicker texture with more deeply green colour of the upper surface of the leaves, and in the presence of false veins between the veins and the edge of the leaves The branching of the stems is dichotomous, though that of the other species is pinnate.

**11. Selaginella trachyphylla** A.Br. ex Hieron. in Pflanzenfam. 1(4): 693. 1902; Alston in Fl. Gén. I -C. 7(2): 564. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 29. 1967.

Similar to *S. intermedia* but differing in: ventral leaves smaller, up to 3.5 mm long, 1.3 mm broad, scabrous on upper surface, soft in texture, green.

Thailand —SOUTH-EASTERN: Chanthaburi (Makham); PENINSULAR: Ranong (La-un), Nakhon Si Thammarat (Khao Luang).

Distribution.—China (type from Hongkong) and Indochina.

Ecology.—Terrestrial on rather dry slope in dense forest at low to medium altitudes.

**12. Selaginella delicatula** (Desv.) Alston, J. Bot. 70: 282. 1932; in Fl. Gén. I.-C. 7(2): 576. 1951; Tagawa & K. Iwats., Southeast As. St. 3(3): 71. 1965; 5: 30. 1967.—*Lycopodium delicatulum* Desv. in Lamk., Enc. Suppl. 3: 554. 1814.

Plants to more than 60 cm long, 25 cm wide, erect or ascending. *Stems* 1–3.5 mm in diameter near base, stramineous, very sparsely bearing leaves, pinnately branching upwards; lateral branches bipinnate, up to 15 cm long, 8 cm wide. *Ventral leaves* slightly ascending, oblong, slightly falcate, acuminate to aciculate at apex, cuneate at acroscopic and subcordate or auricled at basiscopic bases, up to 2.5 mm long, 1.5 mm broad; dorsal leaves narrowly oblong, more or less falcate, mucronate at apex; texture herbaceous or softer, yellowish green; edges narrowly margined with cartilaginous membrane, subentire or very minutely dentate. *Spikes* about 1.2 mm in diameter; sporophylls subdeltoid, long-acuminate at apex, round to subcordate at base, to 2 mm long, 0.8 mm broad, entire or very minutely dentate at margin.

Thailand.—NORTHERN: Chiang Mai (Chiang Dao, Ping Khong, Ban Mae Chia, Doi Suthep, Mae Klang), Mae Hong Son (Mae La Noi); NORTH-EASTERN: Phetchabun (Phu Miang); CENTRAL: Nakhon Nayok (Nang Rong), Saraburi (Muak Lek); SOUTH-EASTERN: Chanthaburi (Makham); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Tha Ko); PENINSULAR: Ranong (Khao Thalu), Surat Thani (Ko Tao, Surat), Phangnga (Thap Put), Nakhon Si Thammarat (Khiriwong, Khao Luang), Trang (Khao Chong, Nam Tai), Satun, Yala.

Distribution.—India to S. China and Taiwan, Indochina, Malesia (lectotype by Alston from Pisang Isl., Malaya).

Ecology.—Terrestrial on rather dry ground or mountain slopes in light shade or rarely on muddy rocks in dense forest below 500 m alt.

Vernacular.—Kut pha (กูดผา) (Northern); phak kut hin (ผักกูดหิน) (South-eastern).

**13. Selaginella repanda** (Desv.) Spring in Gaud., Voy. Bonité Bot. 1: 329. 1846; Alston in Fl. Gén. I.-C. 7(2): 561. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 29. 1967.—*Lycopodium repandum* Desv. in Lamk., Enc. Suppl. 3: 558. 1814.

Plants to 25 cm tall. *Main stems* rooting near the base, 0.8–1.3 mm in diameter, bearing uniform brown leaves rather closely, branching throughout; lateral branches largest in middle or upper portion, pinnate or bipinnate; ultimate branches 2–3 mm wide. *Ventral leaves* oblong, narrowing towards moderately acute apex, subcordate at base, to 2.5 mm long, 1.5 mm broad, edges with white cartilaginous membrane, dentate or ciliate near basal portion, texture soft papyraceous, green to deep green; dorsal leaves oblong, or narrower with long-acuminate apex, dentate to ciliolate. *Spikes* about 1 mm in diameter; sporophylls ovate-subtriangular with long tails at apex, white-margined, minutely dentate at margin.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Phra Diang), Lamphun (Doi Khun Tan), Tak (Doi Musoe, Lan Sang, Rahaeng); NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Wang-Djo, Nang Rong Waterfalls); SOUTH-EASTERN: Prachin Buri (Ban Ban Hills), Chon Buri (Si Racha); SOUTH-WESTERN: Kanchanaburi (Erawan Falls, Sai Yok, Thung Kang Yang Hills, Wangka, Tha Ko); PENINSULAR: Surat Thani (Tha Phet).

Distribution.—N. India, S. China to Taiwan, Indochina and western Malesia (type from the Philippines).

Ecology.—Terrestrial on rather dry slopes in mixed or deciduous forest up to 2000 m alt.

**14. Selaginella vaginata** Spring, Mém. Acad. Roy. Sci. Belg. 24: 87. 1850.

*Stems* procumbent, bearing rhizophores throughout, 0.4–0.6 mm in diameter; leaves dense on the stem throughout, dimorphic. *Ventral leaves* oblong, moderately acute at apex, unequally cordate at base, long ciliate at basal half, dentate or ciliolate at apical half, distinctly white-margined, 2–3 mm long, to 1.5 mm broad, often curled up and embracing the stems; dorsal leaves narrowly oblong, long-acuminate at apex, ciliate and white-margined at margin, 1.5–2 mm long including the aristae of about 0.5 mm in length, to 0.5 mm broad. *Spikes* 1–1.5 mm in diameter; sporophylls uniform, oblong-subtriangular, long-acuminate at apex, about 2 mm long, to 1 mm broad, ciliate and white-margined.

Thailand.—NORTHERN: Chiang Mai (Doi Chiang Dao).

Ecology.—On limestone cliffs in open areas on rocky mountain range.

Distribution.—N. India (type) to Burma.

**15. Selaginella tamariscina** (Beauv.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 136. 1843; Alston in Fl. Gén. I.-C. 7(2): 559. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 28. 1967.—*Stachygynandrum tamariscinum* Beauv., Mag. Enc. 9. 5: 483. 1804.

Pseudo-trunks to more than 10 cm long, 2 cm in diameter, consisting of intermingled roots, rhizophores and stems, bearing stems in tuft near apex; lateral branches bi- to tri-pinnate, strongly involute in dried condition to 20 cm tall; ultimate branches 2–3 mm wide. Ventral leaves asymmetrically elliptic, long acuminate at apex, round

at base, 1.5-2 mm long; edges minutely dentate, texture papyraceous to subcoriaceous, deep green on upper surface, paler underneath, veins distinct beneath; dorsal leaves asymmetrically ovoid, long-acuminate with long tails at apex, dentate at margin. *Spikes* about 2 mm in diameter; sporophylls ovate-subtriangular, long-tailed at apex, dentate at margin.

Thailand.—NORTHERN: Chiang Mai (Doi Chiang Dao).

Distribution.—E. Asia, north to E. Siberia, Manchuria and Hokkaido in N. Japan, south to Philippines and Lombok (type from 'India orientalis'). This is one of the rare representatives of the temperate species in Thailand, but is known in Indochina rather commonly at low altitudes.

Ecology.—In crevices of dry exposed limestone cliffs at about 2000 m alt., known only in one locality.

Vernacular.—Dok hin (ดอกหิน) (Northern).

**16. Selaginella involvens** (Sw.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 136. 1843, emend. Hieron., Hedwigia 50: 2. 1911; Alston in Fl. Gén. I.-C. 7(2): 573. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 30. 1967.—*Lycopodium involvens* Sw., Syn. Fil.: 182. 1806.— *Lycopodium caulescens* Wall. ex Hook. & Grev. in Hook., Bot. Misc. 2: 382. 1831.

*Stems* in two portions, rhizomes and erect stems; rhizomes creeping under moss or in earth, sparsely bearing brown leaves, 1.5–2 mm in diameter; main erect stems 15–40 cm long, bearing more or less adpressed uniform leaves in lower portion; lateral branches tripinnate, glabrous; ultimate branches 1.5–2 mm in breadth. *Ventral leaves* elliptic or ovate-oblong with falcate upper portion, acute at apex, round to cordate at base, about 1.5 mm long, 0.7 mm broad; edges entire or minutely dentate near acroscopic base, texture papyraceous, yellowish green, sometimes reddish; dorsal leaves elliptic, aciculate at apex, minutely dentate at margin. *Spikes* about 1 mm in diameter; sporophylls ovate-subtriangular with long apex, about 1 mm in length, with minute teeth at edges.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Pha Mon, Mae Klang, Doi Inthanon), Phitsanulok (Phu Miang), Tak (Khao Phra Wo); EASTERN: Chaiyaphum; CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Ko Chang, Ko Kut); PENINSULAR: Trang (Khao Chong).

Distribution.—Ceylon, India, Burma, China, Indochina, S. Korea, Japan (type) to Taiwan, Borneo, Celebes and Flores.

Ecology.—On dry mountain slopes or on rocks in light to dense forest.

Vernacular.—Foen phaeng (เฟินแผง) (North-eastern).

**17. Selaginella argentea** (Wall. ex Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 137. 1843; Alston in Fl. Gén. I.-C. 7(2): 571. 1951; Tagawa & K. Iwats., Southeast As. St. 3(3): 71. 1965.—*Lycopodium argenteum* Wall. ex Hook. & Grev. in Hook., Bot. Misc. 2: 384. 1831.

Similar to *S. involvens* but differing in: plants larger, to more than 60 cm tall; ventral leaves ciliate; dorsal leaves ciliate, with distinct white margin 0.05 mm broad; leaves on stems more sparsely placed, patent even in dried condition.

Thailand.—NORTHERN: Chiang Mai (Fang, Doi Chiang Dao, Doi Suthep), Lampang, Phitsanulok (Thung Salaeng Luang); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Wang Ka, Kha Thalai), Prachuap Khiri Khan; PENINSULAR: Satun (Nam Tok Boriphat), Trang (Khao Chong).

Distribution.—Burma, Malaya (type from Penang) and Indochina (Laos & Cambodia).

Ecology.—Terrestrial or epiphytic on tree-trunks in dense evergreen forest up to about 1500 m alt.

Vernacular.—Kapkae (กับแก้), phokha ti mia (พ่อค้าตีเมีย) (Northern).

**18. Selaginella roxburghii** (Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 288. 1843; Tagawa & K. Iwats., Southeast As. St. 5: 29. 1967.—*Lycopodium roxburghii* Hook. & Grev. in Hook., Bot. Misc. 2: 390. 1831.—*Selaginella* sp.; Tagawa & K. Iwats., Southeast As. St. 3(3): 71. 1965.

Plants to more than 50 cm long. *Main stems* thick, to 3 mm in diameter near base, bearing rhizophores only on basal portion, or often on the upper portion as well, with leaves dimorphic nearly to the base; lateral branches many, simple to bipinnate; ultimate branches up to 7 mm broad. *Ventral leaves* patent, elliptic, falcate and narrowing towards acute apex, unequally subcordate at base, 2.5–4.5 mm long, to 2 mm broad, usually with distinct false veins; edges minutely dentate, or ciliate in lower half, texture soft papyraceous, green, paler beneath; dorsal leaves smaller, ovate to suborbicular, about 1 mm long with apical tails of about the same length, ciliate. *Spikes* up to 1.5 mm in diameter; sporophylls ovate with long apical tails, dentate.

Thailand—NORTHERN: Chiang Mai (Fang, Doi Chiang Dao, Doi Suthep, Mae Klang); NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Narathiwat (Sg. Padi).

Distribution.—Malaya (type) and Sumatra.

Ecology.—Terrestrial on rather dry ground in light shade at low to medium altitudes.

Notes.—Alston (1951) recorded *S. commutata* from Annam and described *S. petelotii* from the same region. *S. roxburghii* is so variable that we are not sure at

present whether it is distinct from those two species or not. The northern plants referred to this species are delicate in texture, and further comparison is necessary to settle the specific position.

**19. Selaginella strigosa** Bedd., Kew Bull. 1911: 192; Tagawa & K. Iwats., Acta Phytotax. Geobot. 26: 169. 1975. Fig. 2: 20–22.

*Stems* prostrate, usually less than 0.5 mm in diameter, bearing leaves rather remotely throughout; rhizophores many on lower part of stem. *Ventral leaves* rather remote, not overlapping each other, with the space between them more than their breath, oblong-ovate, acute at apex, unequally round at base, dentate to ciliolate at margin, 2.5–4.5 mm long, to 1.8 mm broad, green, paler beneath, strigose on upper surface; dorsal leaves ovate to oblong with mucronate apex, dentate and white-margined, to 1.2 mm long with tails of nearly the same length, 1 mm broad, the upper surface strigose or smooth. *Spikes* small, solitary, terminal at the ultimate branches; sporophylls oblong-subtriangular with long-acuminate apex, white-margined and dentate.

Thailand.—PENINSULAR: Yala (Kuelong Waterfalls).

Ecology.—At low altitudes.

Distribution.—Malaya (type).

**20. Selaginella pennata** (Don) Spring, Bull. Acad. Roy. Sci. Brux. 10: 232. 1843; Alston in Fl. Gén. I.-C. 7(2): 585. 1951; Tagawa & K. Iwats., Southeast As. St. 31. 1967.—*Lycopodium pennatum* Don, Prod. Fl. Nepal.: 18. 1825.—*Selaginella bisulcata* auct. non Spring: Hosseus, Beih. Bot. Centr. 28(2): 367. 1911.

Plants about 30 cm long; *Main stems* suberect, 2–3 mm in diameter, sparsely bearing leaves and bearing rhizophores usually only in lower part; main branches oblong, bisulcate; ultimate branches to 8 mm broad. *Ventral leaves* oblong, patent, round or minutely mucronate at apex, unequally round at base, about 3.5 mm long, 1.5 mm broad for those on main branches, shortly ciliate at margin; texture thin, herbaceous, light green; dorsal leaves obovate, broadest at upper $\frac{1}{3}$, mucronate at apex with mucro about 0.7 mm in length, unequally cuneate at base, 1.5 mm long excluding mucro, those on the main branches 0.8 mm broad. *Spikes* with dimorphic sporophylls, to more than 2 cm long, about 5 mm broad; ventral sporophylls oblong-subtriangular, acuminate at apex, densely long ciliate with pale downy hairs of more than 0.5 mm in length; dorsal sporophylls like the ventral trophophylls, smaller in size, acute to acuminate at apex.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Fang, Doi Chiang Dao, Doi Buak Ha, Doi Kiu Lom, Sop Aep), Mae Hong Son (Mae La Noi), Phrae (Mae Ban), Nan (Pha Sing), Phitsanulok (Thung Salaeng Luang), Tak (Doi Musoe); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Kanchanaburi (Bangkasi, Sai Yok).

Distribution.—N. India (type) and Burma.

Ecology.—Terrestrial on moist mountain slopes usually near streams in light shade or in evergreen forest at medium altitudes.

Vernacular.—Ya non bua (หญ้าหนอนเบื่อ), kut hom (กูดหอม) (Northern).

**21. Selaginella bisulcata** Spring, Mém. Acad. Roy. Sci. Belg. 24: 259. 1850; Tagawa & K. Iwats., Southeast As. St 5: 31. 1967.

Similar to *S. pennata* but differing in: stems prostrate, bearing rhizophores also in distal portion; dorsal leaves acute to mucronate at apex.

Thailand.—NORTHERN: Chiang Mai (Doi Chiang Dao).

Distribution.—N. India (type), Burma and Yunnan.

Ecology.—Terrestrial on rather dry slopes in light shade at about 1800 m alt. on Doi Chiang Dao, known only from one collection.

**22. Selaginella ornata** (Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 232. 1843; Alston in Fl. Gén. I.-C. 7(2): 588. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 31. 1967.—*Lycopodium ornatum* Hook. & Grev. in Hook., Bot. Misc. 3: 108. 1833.

Plants suberect, to 30 cm in height. *Main stems* to more than 1.5 mm in diameter, bearing leaves rather remotely near the base, branching subdichotomously or pinnately, bearing rhizophores usually in lower part but rarely also on middle or upper portion; ultimate branches up to about 5 mm wide. *Ventral leaves* oblong subquadrangular, moderately acute at apex, cordate at acroscopic and cuneate at basiscopic bases, about 4 mm long, those on main branches 1.7 mm broad; edges entire or dentate at acroscopic base, texture papyraceous or thicker, deep green, paler beneath; dorsal leaves ovate, long-mucronate at apex with mucro about 0.7 mm in length, round at base, to 1.5 mm long excluding mucro, those on the main branches 1 mm broad, imbricate, dentate. *Spikes* one or two on an ultimate branch, about 3 mm wide; ventral sporophylls ovate-subtriangular with long-acuminate apex and dentate margin; dorsal sporophylls oblong-subdeltoid, gradually narrowing towards acute apex, about 2 mm long, 1 mm broad.

Thailand.—SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Trang (Khao Chong).

Distribution.—Indochina (Tonkin & Cambodia) and western Malesia (type from Sumatra) to the Philippines and the Flores.

Ecology.—Terrestrial on rather dry mountain slopes in dense evergreen forest.

**23. Selaginella amblyphylla** Alston, Bull. Fan Mem. Inst. Biol. 5: 287. 1934; in Fl. Gén. I.-C. 7(2): 588. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 31. 1967. Fig. 2: 17–19.

Plants to more than 30 cm long. *Stems* prostrate, bearing rhizophores throughout, about 1 mm in diameter, with leaves closely set almost to the base; main branches oblong to oblanceolate, bipinnate; ultimate branches to 6 mm wide. *Ventral leaves* patent, oblong, gradually narrowing and falcate towards the round to moderately acute apex, asymmetrically subcordate at base, about 4.5 mm long, 1.5 mm broad for those on main branches; edges entire, densely hairy on basal portion with pale setae of 0.7 mm in length, texture papyraceous or thinner, deep green, paler beneath, with distinct false veins at both sides of the midribs; dorsal leaves ovate to suborbicular, long-mucronate at apex with mucro of nearly 1 mm in length, those on main branches about 1.5 mm both in length and in width excluding mucro, dentate or ciliate. *Spikes* about 2 mm wide; ventral sporophylls similar to dorsal trophophyll, subtriangular with round base, about 2 mm in length, ciliate.

Thailand.—NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Ban Mae Klang, Doi Suthep, Doi Inthanon—type), Lampang (Mae Mo); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); EASTERN: Nakhon Ratchasima (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Krabi (Ko Lanta), Satun.

Distribution.— Burma and Yunnan.

Ecology.—Terrestrial on humus-rich mountain slopes in dense evergreen forest at medium to higher altitudes.

**24. Selaginella monospora** Spring, Mém. Acad. Roy. Sci. Belg. 24: 135. 1850; Alston in Fl. Gén. I.-C. 7(2): 507. 1951; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 48. 1968.

Similar to *S. amblyphylla* but differing in: ventral leaves oblong, gradually narrowing towards obtuse apex, usually about 1.5 times longer than broad, the edges dentate but never ciliate; dorsal leaves oblong to ovate oblong, dentate; sporophylls long-acuminate at apex, ciliolate.

Thailand.—NORTHERN: Chiang Mai (Doi Chiang Dao); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—N. India (type), S. China, Burma and Indochina.

Ecology.—Terrestrial on exposed ground or on mossy rocks in exposed ridge or near summit.

**25. Selaginella minutifolia** Spring, Mém. Acad. Roy. Belg. 24: 239. 1850; Alston in Fl. Gén. I.-C. 7(2): 591. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 31. 1967.

Small plants of less than 10 cm long. *Main stems* to 0.7 mm in diameter bearing leaves about 3 cm apart; main branches simple to bipinnate; ultimate branches 1.5–2.5 mm wide. *Ventral leaves* patent to ascending, oblong, round to moderately acute at apex, unequally round at base, those on the main branches about 2 mm long,

1.8 mm broad; edges distinctly white-margined, dentate, texture thinly herbaceous, yellowgreen; dorsal leaves elliptic with long-acuminate apex with acumen 0.3 mm in length, cuneate at base, denticulate and white-margined. *Spikes* about 1.5 mm broad; sporophylls dimorphic, dentate to ciliate, white-margined.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep), Phitsanulok (Thung Salaeng Luang); PENINSULAR: Ranong (La-un), Trang (Khao Chong).

Distribution.—Burma (type), Malaya, and Indochina (Cambodia & Cochinchina).

Ecology.—Terrestrial on rather dry sandy slopes or on moist cliffs in mixed forest.

Vernacular.—Kut yi (กูดยี) (Northern).

**26. Selaginella lindhardii** Hieron., Bull. Herb. Boiss. 2. 5: 723. 1905; Alston in Fl. Gén. I.-C. 7(2): 592. 1951.

Plants small, to 10 cm long. *Main stems* to 1 mm in diameter, bearing the branches nearly to the base, bearing leaves about 2 mm apart; main branches bipinnate; ultimate branches to 2.5 mm wide. *Ventral leaves* oblong, slightly narrowing towards moderately acute apex, unequally round at base, about 2 mm long, those on the main branches 1 mm broad, patent or ascending; edges dentate, thick, texture thin, yellow-green; dorsal leaves elliptic with long tails, narrowly round at base, dentate. *Spikes* about 1.5 mm broad; sporophylls dimorphic, oblong-subtriangular with round base and long-acuminate apex, dentate.

Thailand.—NORTHERN: Tak (Rahaeng—type); CENTRAL: Krung Thep; SOUTHWESTERN: Ratchaburi (Ang Hin).

Distribution.—Endemic.

Ecology.—Terrestrial in bamboo forest or on shady brick-walls at low altitudes.

**27. Selaginella tenuifolia** Spring, Mém. Acad. Roy. Sci. Belg. 24: 253. 1850; Alston in Fl. Gén. I.-C. 7(2): 592. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 31. 1967.

Plants small, up to 10 cm long. *Main stems* slender, with leaves 5 mm apart, bearing branches in the middle to upper portions; lateral branches a few times forked; ultimate branches up to 5 mm wide. *Ventral leaves* patent, oblong subdeltoid, moderately acute at apex, unequally cordate at base, about 3 mm long, those on main branches 1.3 mm broad; edges dentate, narrowly cartilaginous, texture thin; dorsal leaves elliptic with long-acuminate apex and cuneate base, subentire. *Spikes* about 3 mm wide; dorsal sporophylls elliptic, round at apex, similar to ventral trophophyll but smaller; ventral sporophylls subdeltoid with round base and long-acuminate apex, denticulate.

Thailand.—NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao), Lamphun (Doi Khun Tan), Phrae (Mae Ban).

Distribution.—N. India (type) to Burma and Laos.

Ecology.—Terrestrial on rather dry slopes in not so dense forest at 900–1200 m alt.

**28. Selaginella chrysorrhizos** Spring, Mém. Acad. Roy. Sci. Belg. 24: 251. 1850; Alston in Fl. Gén. I.-C. 7(2): 593. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 32. 1967.

Plants small, up to 12 cm long. *Main stems* up to 1 mm in diameter, bearing branches nearly to the base; main branches bipinnate; ultimate branches to 2.5 mm wide. *Ventral leaves* patent, oblong, round to moderately acute at apex, unequally round at base, those on the main branches about 1.8 mm long, 0.7 mm broad; edges dentate, white-margined, texture thin, yellow-green; dorsal leaves elliptic, cuneate at base, long-acuminate at apex, dentate. *Spikes* about 2 mm broad; dorsal sporophylls similar to the ventral trophophylls but smaller; ventral sporophylls subdeltoid to nearly circular with long apical tails, ciliate.

Thailand.—NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Mae Klang), Lamphun (Doi Khun Tan), Phitsanulok (Thung Salaeng Luang, Phu Miang), Tak (Doi Musoe); NORTH-EASTERN: Loei (Phu Kradung).

Distribution.—Assam (type), Burma and Indochina (Vietnam & Laos).

Ecology.—Terrestrial on clayey slopes or on muddy rocks in forest at medium altitudes.

**29. Selaginella kurzii** Baker, J. Bot. 23: 249. 1885; Alston in Fl. Gén. I.-C. 7(2): 593. 1951; Tagawa & K. Iwats., Southeast As. St. 5: 32. 1967.

Plants commonly up to 12 cm long, but sometimes up to 25 cm. *Main stems* bearing the branches nearly to the base, about 0.7 mm in diameter, erect, bearing rhizophores on the basal portion. *Ventral leaves* ascending, often adpressed on the main stems and the main branches, subdeltoid, moderately acute to acuminate at apex, cordate at base, to more than 2 mm long, 1 mm broad, ciliate at least near the base; texture herbaceous, light green; dorsal leaves acuminate at apex, ciliate, white-margined. *Spikes* about 1.2 mm in diameter; ventral sporophylls smaller, oblong-subtriangular, directed parallel to the axis, ciliate, white-margined; dorsal sporophylls patent or ascending, larger.

Thailand.—NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon, Mae Klang), Lamphun (Doi Khun Tan), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Khon Kaen (Pha Nok Khao); EASTERN: Nakhon Ratchasima (Sikhiu); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Kanchanaburi (Plati).

Distribution.—Assam to Burma (type) and Malaya.

Ecology.—Terrestrial on dry mountain slopes or on moist clayey slopes in forest at medium altitudes.

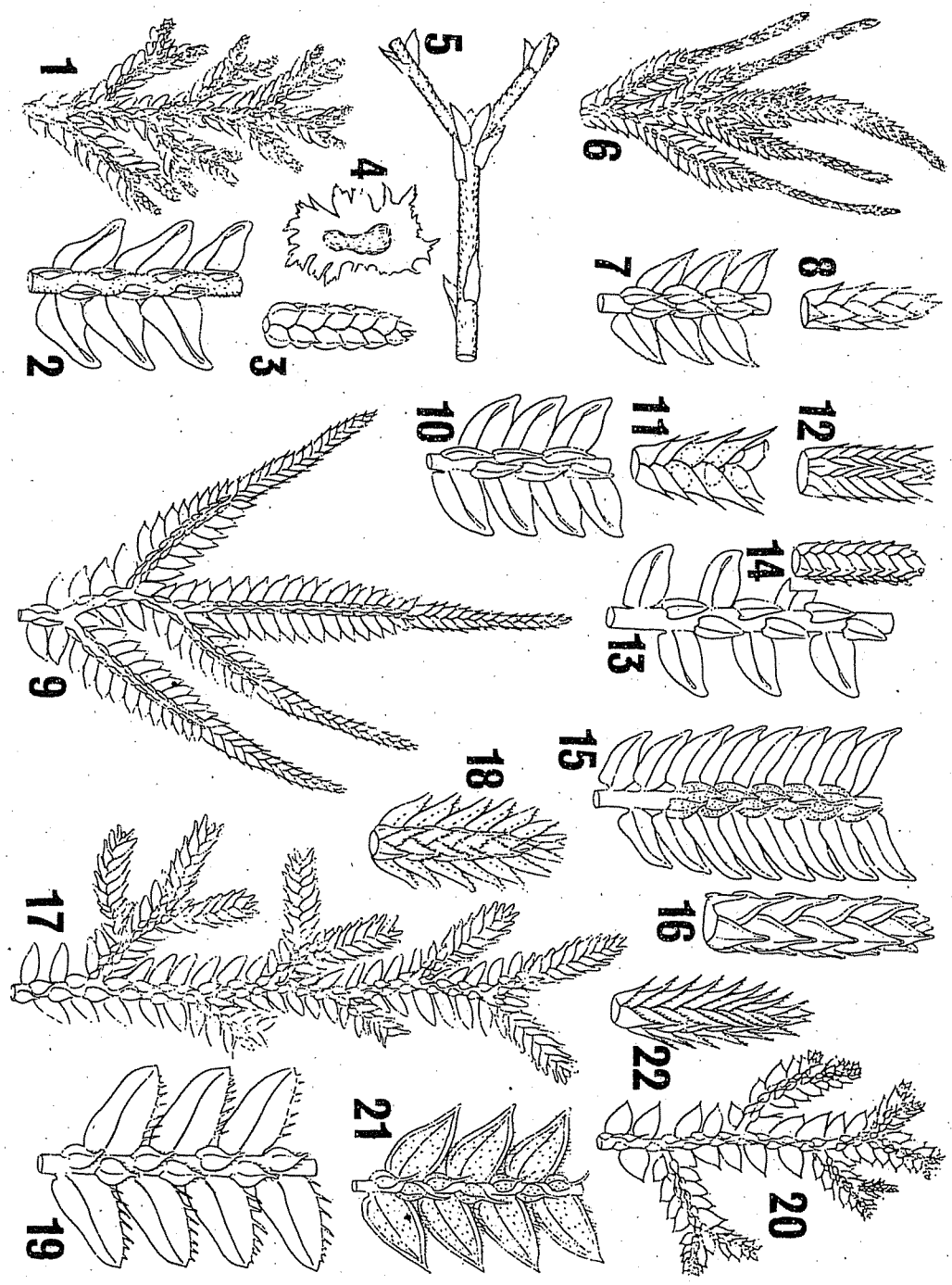



Figure 2. 1–5: *Selaginella pubescens* 1, portion of stems, x 1.5; 2, sterile axis, x 3; 3, fertile axis, x 6; 4, leaf on the creeping stems, x 10; 5, erect stems, x 3. 6–8: *Selaginella biformis* 6, portion of erect stem, x 1.5; 7, sterile axis, x 3; 8, fertile axis, x 6. 9–12: *Selaginella helferi* 9, portion of stem, 1.5; 10, sterile axis, x 3; 11, fertile axis bearing megasporangia, x 3; 12, fertile axis bearing microsporangia, x 3. 13–14: *Selaginella wildenowii* 13, sterile axis, x 3; 14, fertile axis, x 3. 15–16: *Selaginella wallichii* 15, sterile axis, x 3; 16, fertile axis, x 6. 17–19: *Selaginella amblyphylla;* 17, portion of stem, x 2; 18, fertile axis, x 5; 19, sterile axis, x 5. 20–22: *Selaginella strigosa;* 20, portion of stem, x 1.5; 21, sterile axis, x 3; 22, fertile axis, x 6.

# ISOETACEAE

There are two aquatic genera included in this family: *Isoetes* of some 70 species throughout the world and *Stylites* with two species confined to Peru Andes.

## 1. ISOETES

Linn., Sp. Pl.: 110. 1753.

Water plants; stems tuberous, growing thicker by an unusual secondary growth, bearing a tuft of slender leaves at apex, having the apical growth point at bottom of the hollowed apex, with numerous roots underneath, divided into two or three small lobes (cells); leaves microphyllous, broad at base, ligulate and soriferous, linear upwards; sporangia solitary in wide hollow under ligules, large, covered by the velum or not, divided irregularly into several small lobes (cells); spores heterosporous, monoecious, tetrahedral.

There is only one species with two collections known from Thailand.

**1. Isoetes coromandelina** Linn. f., Suppl. Pl.: 447, 1781; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 595. f. 64. 1–3. 1951; Larsen, Dansk Bot. Ark. 23: 59. 1963.

*Stems* with three small lobes (cells), dark in colour; leaves many, linear with broader basal portion, 10–20 cm long, pale green, membranous, glabrous; ligule usually about $\frac{1}{3}$ of sporangia in length, very thin, transparent, subtriangular, narrow; velum absent.

Thailand.—SOUTH-WESTERN: Kanchanaburi (Ban Kao).

Distribution.—Ceylon, India (type) to Indochina (Vietnam).

Ecology.—In paddy fields at about 70 m alt.

# EQUISETACEAE

There is only one living genus including about 25 species growing on wet ground in the temperate regions; only one species is known from Thailand.

## 1. EQUISETUM

Linn., Sp. Pl.: 1060. 1753.

Plants usually monomorphic, or rarely dimorphic, usually growing in marsh; stems with nodes and internodes, empty, the surface with grooves and ridges, the nodes bearing roots, branches, and leaves in whorls; leaves sphenophyllous, uninervate, usually small, fused to the next ones to form a sheath at each node, the upper portion free forming the teeth; cones consisting only in the sporangiophores, terminal on stems or branches; sporangiophores hexagonal, peltate, bearing several sporangia; spores isosporous, mixed with the elators.

There is only one species known from Thailand.

**1. Equisetum debile** Roxb. ex Vauch., Monog. Prel.: 387. 1822; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 546. 1951; Larsen, Dansk Bot. Ark. 23: 59. 1963; Tagawa & K. Iwats., Southeast As. St. 5: 32. 1967. Fig. 1: 1–3.

*Fronds* monomorphic, to more than 1 m tall; main stems with 8–25 grooves, (0.2–) 4–7 mm in diameter, dark towards base, bearing (0–) 2–5 branches at the nodes; sheath about 8 mm long, with the teeth up to 7 mm in length, green or brown at above portion; teeth pale green to brown, caducous. *Cones* solitary, terminal on the stems or their branches, about 1 cm long, oblong, cuspidate at apex, subsessile.

Thailand.—NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Saket, Doi Mae Klang, Doi Inthanon, Mae Rim, Bo Luang), Lampang (Muang Ngao); NORTH-EASTERN: Phetchabun (Lom Sak, Nam Nao); EASTERN: Chaiyaphum; SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat; SOUTH-WESTERN: Kanchanaburi (Song Tho, Kha Thalai).

Distribution.—India (type) to S. China, Indochina and Taiwan, through Malesia to Polynesia.

Ecology.—Terrestrial on wet ground along streams in open areas or in light shade at low to medium altitudes.

Vernacular.—Ya nguak (หญ้าเงือก), ya thot bong (หญ้าถอดปล้อง), ya hu nuak (หญ้าหูหนวก) (Northern).

# OPHIOGLOSSACEAE

This is a single family of the Ophioglossales generally accepted as including three genera, though some consider that each of these three genera represent a distinct family, containing several genera.

Literature: Clausen, R.T.: A Monograph of the Ophioglossaceae. Mem. Torrey Bot. Club 19(2): 1–177. 1938.

KEY TO THE GENERA

1. Trophophyll simple or forked near the apex, with reticulate venation; sporophyll unbranched; sporangia half immersed, forming synangia **1. Ophioglossum**
1. Trophophyll compound, with free venation; sporophyll branched; sporangia terminal on very short stalks, solitary
2. Trophophyll tripartite, each branch with a terminal lobe and one or two pairs of lateral lobes; fertile spikes with short branches; sporangia opening by a longitudinal slit **2. Helminthostachys**

2. Trophophyll pinnate to more compoundly divided; fertile spikes with many long branches; sporangia opening by transverse slit **3. Botrychium**

## 1. OPHIOGLOSSUM

Linn. Sp. Pl.: 1062. 1753; Clausen, Mem. Torrey Bot. Club 19(2): 111. 1938; Copel., Gen. Fil. 11. 1947.

Rhizome short, erect; trophophyll simple or forked a few times near the apex; venation reticulate; spikes simple, with two rows of sporangia which are joined together almost completely, each opening by a transverse slit.

There is an opinion that this genus represents a distinct family, containing four genera: *Rhizoglossum, Ophioglossum, Ophioderma* and *Cheiroglossa*. They are treated here as subgenera, following the current opinion that the family Ophioglossaceae should be considered in the broad sense. Clausen (1938) enumerated 27 species for this genus from throughout the world, though the specific boundaries are not so clear for some species.

KEY TO THE SPECIES

1. Terrestrial; trophophyll entire (§*Ophioglossum*)
2. Rhizome tuberous; trophophyll with distinct costae, venation with main areoles and including smaller ones — **1. O. costatum**
2. Rhizome cylindrical; trophophyll without distinct costae, areoles of one kind
3. Trophophyll linear lanceolate, to 2.5 mm broad — **2. O. gramineum**
3. Trophophyll ovate to oblong, 1.5–5 cm broad — **3. O. petiolatum**
1. Epiphytic; trophophyll usually forked near the apex (§*Ophioderma*) — **4. O. pendulum**

**1. Ophioglossum costatum** R.Br., Prod.: 163. 1810; Holtt., Rev. Fl. Malaya 2nd ed. 2: 629. 1968; Wieffer., Blumea 12: 323. 1964; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 16. 1971.—*Ophioglossum fibrosum* Schum., Kongl. Dansk. Vid. Nat. 4: 226. 1829; Bedd., Handb : 465. t. 289. 1892.—*Ophioglossum pedunculosum* auct. non Desv.: Clausen, Mem. Torrey Bot. Club 19(2): 140 1938; Holtt., Rev. Fl. Malaya 2: 39. f. 1. 1955. Fig. 3: 6–7.

*Rhizome* tuberous, to 1 cm in diameter, 7 mm tall, bearing numerous fleshy roots. *Fronds* about 18 cm long, 3 on a rhizome; phyllomophore to 30 cm long; trophophyll oblong-lanceolate, acute at apex, narrowly cuneate at base, 4.5–6.5 cm long, 1.3–1.8 cm broad; costae distinct on both surfaces; veins reticulate, main areoles 3 or 4 rows at each side of costae, smaller areoles many, often with included free veinlets; texture rather fleshy, softly herbaceous; sporophyll simple, with stalks of about 10 cm in length; spikes to 4.5 cm long. *Sporangia* about 0.5 mm in diameter; spores dark, with rather roughly reticulate exospores.

Thailand.—NORTHERN: Mae Hong Son; EASTERN: Nakhon Ratchasima (Khao Yai).

Distribution.—Pantropic (?) (type from Australia).

Ecology.—Terrestrial in mixed deciduous forest at about 400 m alt.

Notes.—Thai specimens have tuberous rhizomes and roughly reticulate exospores. In African plants referred to this species, however, the exospores have a fine reticulum.

**2. Ophioglossum gramineum** Willd., Nov. Acad. Erf. 2: 18. t. 1. f. 1; Wieffer. Blumea 12: 324. 1964.

*Rhizome* subglobose, bearing several fleshy roots and 1–2 (for Thai plants, up to 10 for foreign ones) fronds simultaneously. *Fronds* 6–8 cm long; phyllomophore 1–3 cm long; trophophyll linear-lanceolate, acute at apex, narrowly cuneate at sessile base, 1.2–2.2 cm long, to 2.5 mm broad, costules not distinct; veins reticulate forming very long-stretched areoles without included veinlets; texture papyraceous; sporophyll simple, with stalks 2–4 cm long; spikes 1–1.2 cm long.

Thailand.—CENTRAL: Saraburi (Sam Lan forest).

Distribution.—Probably pantropic.

Ecology.—Open, wet, bare rock surface with about 2 cm of wet substrate in deciduous forest.

Note.—Only once collected in Thailand. This falls in var. *gramineum*.

**3. Ophioglossum petiolatum** Hook., Exot. Fl. 1: t. 56. 1823; Clausen, Mem. Torrey Bot. Club 19(2): 134. 1938; Tard. & C. Chr. in Fl. Gén.. I.-C. 7(2): 7. f. 1, 3–4. 1939; Ching, Fl. Reip. Pop. Sin. 2: 10. pl. 1. f. 6. 1959.—*Ophioglossum reticulatum* auct. non Linn.: Bedd., Handb.: 465. f. 290. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 7. 1939.

*Rhizome* cylindrical, 2–4 mm in diameter, to 1.2 cm long, bearing many roots. *Fronds* 12–25 cm long, 1 or 2 on a rhizome; phyllomophore to 10 cm long; trophophyll variable in size and form, ovate to oblong, round to moderately acute at apex, or acute in some cases, cuneate, round or more commonly deeply cordate at base, 1.5–6.5 cm long, 1.5–5 cm broad; costae not differentiated; veins reticulate, areoles visible, many, free included veinlets often present, simple or branched; texture softly herbaceous, rather fleshy; sporophyll simple, with stalks of 6–12 cm in length; spikes 1.5–4.5 cm long. *Sporangia* up to 0.5 mm in diameter; spores dark, exospores with fine reticulum, seemingly smooth.

Thailand.—NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep), Mae Hong Son, Lampang (Ngao), Kamphaeng Phet; NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Krung Thep; SOUTH-EASTERN: Chanthaburi (Khao Soi Dao Pong Namron); SOUTH-WESTERN: Kanchanaburi (Hin Dat); PENINSULAR: Surat Thani (Ban Don).

Distribution.—Pantropic (type: cult. at Liverpool, originated from W. Indies).

Ecology.—Terrestrial in open grassy ground or on mountain slopes in light shade at low to medium altitudes.

Notes.—Thai specimens are really variable in size and form of the trophophyll, though the spore character is rather constant.

**4. Ophioglossum pendulum** Linn., Sp. Pl. ed. 2: 1518. 1763; Bedd., Handb.: 465. f. 291. 1883; Clausen, Mem. Torrey Bot. Club 19(2); 116. f. 22. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 9. 1939; Holtt., Rev. Fl. Malaya 2: 40. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 32. 1967; Acta Phytotax. Geobot. 23: 51. 1968.—*Ophioderma pendula* (Linn.) Presl, Suppl. Tent. Pterid.: 56. 1845; Ching, Fl. Reip. Pop. Sin. 2: 10. 1959.

*Rhizome* horizontal, up to 3 cm long, fleshy, bearing a few fronds. Phyllomophore short, not distinct from trophophyll, up to 20 cm long; trophophyll long and strap-shaped, sometimes bifurcate a few times, 50–100 cm long including the stipes,

round to acute at apex, entire, at most 4 cm broad; venation distinct, reticulate forming narrow areoles usually without included veinlets, costae not differentiated; sporophyll arising from middle part of the sterile fronds, simple, with stalks up to 7 cm long; spikes up to 30 cm long. *Sporangia* to 3 mm in diameter; exospores with fine reticulum, seemingly smooth.

Thailand.—NORTHERN: Chiang Rai, Phitsanulok (Nakhon Thai); NORTHEASTERN: Loei (Dan Sai, Hup Bon); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Yala (Khao Kalakhiri).

Distribution.—Palaeotropic (type from India).

Ecology.—Epiphytic on tree-trunks in mixed or evergreen forest at medium altitudes.

Notes.—In size and form of trophophyll this epiphytic species varies to some extent according to the habitat and the age of the plants, though any taxonomic segregation is not possible.

## 2. HELMINTHOSTACHYS

Kaulf. Flora 1822: 103; Clausen, Mem. Torrey Bot. Club 19(2): 108. 1938; Copel., Gen. Fil. 13. 1947.

Rhizome creeping, fleshy; trophophyll tripartite, each branch with a terminal lobe and a few pairs of lateral lobes; venation free; sporophyll with stalks usually longer than the sterile lobes, bearing crowded short lateral branches with sporangia; sporangia sessile, round, opening by a longitudinal slit.

The only species of this genus occurs in Thailand.

**Helminthostachys zeylanica** (Linn.) Hook., Gen. Fil.: t. 47b. 1840; Bedd., Handb.: 467. f. 292. 1883; E. Smith, J. Siam. Soc. Nat. Hist. Suppl. 8: 9. 1929; Clausen, Mem. Torrey Bot. Club 19(2): 108. f. 20. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 10. f. 1, 1–2. 1939; Holtt., Rev. Fl. Malaya 2: 42. f. 2. 1955; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 85. 1958; Ching, Fl. Reip. Pop. Sin. 2: 26. pl. 1. f. 7–8. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 32. 1967.—*Osmunda zeylanica* Linn., Sp. Pl.: 1063. 1753.

*Rhizome* creeping, up to 7 mm in diameter, bearing the numerous fleshy roots and a frond in each year. *Phyllomophore* 20–40 cm long, fleshy, green or purplish brown; trophophyll up to 20 cm long, 30 cm wide, tripartite, each with a terminal lobe and one or two pairs of sessile lateral lobes, rachis winged; lobe oblong to oblong-lanceolate, round to acute at apex, cuneate and more or less decurrent at base, up to 20 cm long, 5 cm broad; veinlets once or twice forked, all free; texture softly herbaceous. *Sporophyll* with stalks up to 15 cm in length, placed at base of tripartite trophophyll, spikes up to 20 cm long; with numerous short branches bearing round sessile sporangia.

Thailand.—NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao), Lampang (Ngao); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); SOUTH-EASTERN: Chanthaburi (Khao Sabap); SOUTH-WESTERN: Kanchanaburi (Hin Dat, Sai Yok, Khao Sok, Kroeng Kawia); PENINSULAR: Ranong, Surat Thani (Ko Tao, Bang Bao), Phangnga (Ko Ra), Nakhon Si Thammarat (Chawang, Thung Song), Trang (Chum Khet), Narathiwat (Waeng, Sg. Padi).

Distribution.—Palaeotropics, from Ceylon (type) and Assam to New Caledonia and Queensland.

Ecology.—Terrestrial on humus-rich slopes in light shade at low or medium altitudes.

Vernacular.—Kut chong (กูดจ๋อง), kut sang (กูดซัง), kut tin hung (กูดตีนฮุ้ง), phak tin kwang (ผักตีนกวาง), (Northern); tin nok yung (ตีนนกยูง) (South-eastern, Peninsular); phak nok yung (ผักนกยูง) (Eastern).

## 3. BOTRYCHIUM

Sw., Schrad. J. Bot. 1800(2): 8, 110. 1801; Clausen, Mem. Torrey Bot. Club 19(2): 22. 1938; Copel., Gen. Fil.: 12. 1947.

Rhizome short, erect; trophophyll pinnately decompound; veins all free; sporophyll pinnately divided with many long branches; sporangia opening by a transverse slit.

According to a minority opinion, this genus should be placed in a family rank by itself, with three genera: *Sceptridium, Botrychium* and *Osmundopteris*. These three are treated here as subgenera following current usage. In Thailand only the following species, belonging to *Osmundopteris*, is known.

**Botrychium lanuginosum** Wall. ex Hook. & Grev., Ic. Fil. 1: t. 79. 1831; Clausen, Mem. Torrey Bot. Club 19(2): 96. f. 19. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 11. 1939; Ching, Fl. Reip. Pop. Sin. 2: 18. pl. 2. f. 7. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 32. 1967.—*Botrychium virginianum* var. *lanuginosum* (Wall. ex Hook. & Grev.) Bedd., Handb.: 471. f. 295. 1883.

*Rhizome* very short, erect, bearing fleshy roots, with a frond in each year in addition to a bud including a young shoot for the next year. *Phyllomophore* green or pale castaneous, fleshy, bearing stipule-like scales at base, downy hairy; trophophyll quadripinnate, oblong-subdeltoid, acute to acuminate at apex up to 30 cm long, 25 cm wide; lateral pinnae with 3 or more in opposite or alternate pairs below indefinite terminal ones, patent or slightly ascending, or the basal one somewhat deflexed, ultimate segments moderately acute or obtuse, with gross dentation formed by the apex of veinlets; texture coarse, fleshy, bearing pale downy hairs on axes as well as on laminar surfaces; sporophyll placed on rachis higher than at least the basal pair of

lateral pinnae, with stalks 6–12 cm in length, spikes bi- or tripinnate, axes all downy hairy. *Sporangia* sessile on ultimate axes of spikes, globose.

Thailand.—NORTHERN: Chaing Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon).

Distribution.—N. India (type from Nepal) to China and Taiwan, south to Ceylon, Tonkin, Philippines, Java and Sumatra.

Ecology.—Terrestrial on rather dry mountain slopes in thickets or in muddy crevices of cliffs in light shade, at medium altitudes, locally abundant. The habitat of this species on Doi Chiang Dao is different from that on Doi Inthanon. On a huge limestone cliff, Doi Chiang Dao, this species is known only in the muddy crevices of calcareous rock, and no leaves are observed in winter. On Doi Inthanon, on the contrary, it is a common terrestrial on grassy slopes, and the plants still persist in December. The Chiang Dao plants are more slender, though no taxonomic distinction is recognizable between them.

# MARATTIACEAE

The genera are generally included in a single family of the Marattiales, though there are opinions to split it into several families. Three genera are known in Thailand.

KEY TO THE GENERA

1. Fronds large, bipinnate; veins all free
 2. Sporangia contiguous but not fused — **1. Angiopteris**
 2. Sporangia fused into synangia — **2. Marattia**
1. Fronds smaller, simple to 5-partite; veins anastomosing — **3. Christensenia**

## 1. ANGIOPTERIS

Hoffm., Comm. Soc. Reg. Gott. 12: 29. 1796.; Copel., Gen Fil.: 14. 1947.

Rhizome short, massive, bearing several large fronds in a tuft; stipes fleshy, green, swollen at base, with scattered whitish streaks at both sides; fronds bipinnate; pinnae and pinnules swollen at base; veins all free; sori with two close rows of sporangia; sporangia dehiscing along slits on the side facing the veins.

The specific classification is still in confusion for this genus, and we cannot at present use any of the specific names with certainty; we tentatively retain the name generally applied to Malesian plants. Recently, Ching described a series of species in this genus from East Asia, but the characteristics on which he based them seem to be rather trivial. The branching of the fronds, size and form of the pinnules, condition of the false veinlets, position and size of sori are usually taken into account to distinguish the species, though these features are variable to some extent even in the various fronds on the same stock.

**Angiopteris evecta** (Forst.) Hoffm., Comm. Soc. Reg. Gott. 12: 29. t. 5. 1796; Bedd., Handb.: 460. f. 285. 1883; Christ, Bot. Tidsskr. 24: 112. 1901; C. Chr., Bot. Tidsskr. 32: 425. 1916; Holtt., Rev. Fl. Malaya 2; 44. f. 3. 1955; Dansk Bot. Ark. 20: 15. 1961; 23: 228. 1965.—*Polypodium evectum* Forst., Fl. Ins. Austr. Prod.: 81. 1786.—*Angiopteris crassipes* Wall. ex Presl, Suppl. Tent. Pterid.: 23. 1845; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 9. 1929; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 20. 1939.—*Angiopteris helferiana* Presl, Suppl. Tent. Pterid.: 22. 1845; C. Chr., Contr. U.S. Natn. Herb. 26: 329. 1931.—*Angiopteris* sp.; C. Chr., Contr. U.S. Natn. Herb. 26: 329. 1931; Tagawa & K. Iwats., Southeast As. St. 3(3): 72. 1965, 5: 33. 1967.

This is common throughout Thailand usually in shade.

Vernacular.—Wan kip ma (ว่านกีบม้า), wan kip raet (ว่านกีบแรต) (Central); kip ma lom (กีบม้าลม), kip raet (กีบแรต) (Northern); duku (ดูกู) (Malay/Peninsular).

Uses.—Rhizome used in local medicine.

## 2. MARATTIA

Sw., Prod. Fl. Ind. Occ.: 128. 1788; Copel., Gen. Fil.: 15. 1947.

Rhizome short, erect; stipes fleshy, swollen at base; fronds bipinnate; veins all free; sori one row near the margin of the pinnules; sporangia fused to synangia.

Some sixty species are credited to this genus ranging through the tropics of both worlds, extending to South Africa and New Zealand. Only one collection has ever been made in Thailand.

**Marattia sambucina** Bl., En. Pl. Jav.: 256. 1828; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 28. f. 5, 3–5. 1939; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 175. 1969.

*Rhizome* and stipe unknown for the Thai plants. *Laminae* oblong, slightly narrowing towards lower part, bipinnate, about 40 cm long, 20 cm wide; upper part of rachis and costae winged; pinnae oblanceolate, up to 13 cm long, 3.5 cm wide, shortly stalked; pinnules larger in posterior ones, elliptic, acute to long acuminate at apex, round to cuneate at base, sessile, usually 1.5 cm long, 0.5 cm broad, but in largest ones about 3 cm long, 1 cm wide, the terminal pinnules usually much longer, margin distinctly serrate; texture subcoriaceous; veins simple, 7–12 (–20) in pairs, all free. *Synangia* oblong, one for each veinlet, at middle portion between costules and margin of pinnules.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Vietnam and Malesia (type from Java), not recorded from Malay Peninsular.

Ecology.—At 1500 m alt., no other information available.

## 3. CHRISTENSENIA

Maxon, Proc. Biol. Soc. Washington 18: 239. 1905; Copel., Gen. Fil: 16. 1947.

Rhizome creeping, bearing close fronds; stipes green and fleshy; fronds simple or with 3–5 leaflets palmately arranged, the middle ones the largest; veins anastomosing; sori at vein junction, each consisting of a circular group of 10–20 sporangia joined together laterally, dehiscing inwards towards the central depression.

A single species, split by some authors into five, is credited to this genus, and known in Thailand by a single collection.

**Christensenia aesculifolia** (Bl.) Maxon, Proc. Biol. Soc. Washington 18: 240. 1905; Holtt., Rev. Fl. Malaya 2: 45. f. 4. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 110. 1968.—*Aspidium aesculifolium* Bl., En. Pl. Jav.: 143. 1828.—*Kaulfusia aesculifolia* Bl., En. Pl. Jav. 260. 1828; Bedd., Handb.: 462. f. 287. 1883.—*Christensenia assamica* (Griff.) Ching, Acta Phytotax. Sin. 7: 202. 1958; Fl. Reip. Pop. Sin. 2: 65. pl. 3. f. 7–10. 1959.

*Rhizome* short, fleshy, bearing a few fronds at apex. *Stipes* up to 60 cm long; laminae pedate with 3–5 leaflets; middle leaflets elliptic, acute at apex, narrowly cuneate at base, up to 25 cm long, 8 cm broad, entire; the other lobes elliptic, smaller in size than the middle ones, sessile or very short stalked; costae and main lateral veins distinctly raised; veins copiously anastomosing, often with included free veinlets. *Sori* at vein junction in two or more irregular rows between the main veins.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Assam to Java (type), not recorded from Indochina.

Ecology.—On moist sandy slopes near streams in dense moist evergreen forest at about 800 m alt.

# OSMUNDACEAE

## 1. OSMUNDA

Linn., Sp. Pl.: 1063. 1753; Copel., Gen. Fil.: 21. 1947.

Fronds pinnate to bipinnate, dimorphic as a whole or as to the pinnae; fertile fronds or pinnae lacking green laminae, caducous.

A cosmopolitan genus of some fifteen species, three of which are known in Thailand.

This genus is subdivided into three subgenera, which are so distinct from each other that they are sometimes ranked as genera:

*Osmunda*—Rhizome ascending; fronds green only in summer, herbaceous, bipinnate; pinnae and pinnules not articulated to axes. Five species in the temperate to subtropical regions of both hemispheres.

*Osmundastrum* (Presl) Presl—Rhizome very short creeping; fronds green only in summer, herbaceous, pinnate with deeply pinnatifid pinnae; pinnae indistinctly articulated to rachis. Two species in the Himalayan regions, East Asia and in North America.

*Plenasium* Presl—Rhizome ascending to erect; fronds evergreen, chartaceous, pinnate with narrow, subentire or shallowly lobed pinnae; pinnae jointed to rachis; middle or lower pinnae fertile. Several species in tropical and subtropical Asia.

### KEY TO THE SPECIES

1. Pinnae herbaceous to softly papyraceous, deeply pinnatifid, indistinctly articulated to rachis (§*Osmundastrum*) **1. O. cinnamomea**
1. Pinnae chartaceous to coriaceous, subentire or shallowly lobed at margin, articulated to rachis (§*Plenasium*)
   2. A few sterile pinnae below the fertile ones; sterile pinnae smaller, usually less than 15 cm long, 1.2 cm broad, shallowly but distinctly lobed at margin; all veins running from the main veins **2. O. angustifolia**
   2. No sterile pinnae below the fertile ones; sterile pinnae larger, usually more than 15 cm long, 1.2 cm broad, subentire; the basal posterior veinlets usually directly springing from costa **3. O. vachellii**

**1. Osmunda cinnamomea** Linn., Sp. Pl.: 1066. 1753; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 32. 1939; Ching Fl. Reip. Pop. Sin. 2: 80. 1959, with var. *asiatica* and var. *fokiense;* Tagawa & K. Iwats., Southeast As. St 5: 33. 1967

*Fronds* congested at apex of rhizome, dimorphic; young fronds covered with reddish brown hairs. *Sterile fronds* yellowish green, covered densely with downy hairs when young but glabrescent in adult form; stipes about 40 cm long, stramineous; laminae bipinnatifid, lanceolate, gradually narrowing towards acute apex, one or two basal pinnae slightly short and deflexed, 50-60 cm long, about 12 cm wide; lateral pinnae with the angle of 60° to rachis, nearly straight, deeply pinnatifid, acute at apex, cordate at sessile base, linear-lanceolate, 6–8 cm long, up to 1.5 cm wide; ultimate segments oblong, oblique, round at apex, entire, up to 8 mm long, 5 mm broad, glabrous. *Fertile fronds* shorter, soon fading after the maturation of sori.

Thailand.—NORTH-EASTERN: Loei (Phu Kradung).

Distribution.—Eastern N. America, E. Asia south to Vietnam and Upper Burma.

Ecology.—Terrestrial on wet sandy ground by streams in open grassy areas at about 1200 m alt.

Vernacular.—Hatsadaeng (หัสแดง) (North-eastern)

Use.—Fibrous roots esteemed for orchid cultivation.

Notes.—The Asiatic plants are different from the American ones in having blackish hairs mixed with whitish ones at the base of the fertile fronds, but this is not adequate to separate the Asiatic plants as a different variety.

**2. Osmunda angustifolia** Ching, Acta Phytotax. Sin. 8: 131, 160. f. 10. 1959; Fl. Reip. Pop. Sin. 2: 84. 1959; Tagawa & K. Iwats. Southeast As. St. 5: 34. 1967.

*Fronds* congested at apex of rhizome. *Stipes* stramineous, short, up to 25 cm long; laminae pinnate with a distinct apical pinna, moderately acute at apex, a few pairs of basal pinnae slightly shortened; lateral pinnae linear, gradually narrowing both towards acute apex and towards shortly stalked base, less than 15 cm long, 1.2 cm broad, the margin slightly waved, the sinus usually less than 1 mm in depth; the veins two or three times dichotomously branching; texture papyraceous to softly coriaceous, fresh green in colour; a few middle pinnae fertile, contracted, brown after shedding the spores.

Thailand.—NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradung); SOUTH-EASTERN: Trat (Ko Chang).

Distribution.—Hainan (type), Hongkong, China (Kwangtung) and Taiwan (?)

Ecology.—On sandy banks or on wet rocks usually along streams in dense forest or in half shaded areas at medium altitude.

Notes.—This is distinguished from *O. banksiifolia* (Pr.) Kuhn, Ann. Lugd. Bat. 4: 299. 1869 of Eastern Asia by the smaller size of the plants. The sterile pinnae are less than 12 cm long, 8 mm broad, though more than 15 cm and 12 mm in *O. banksiifolia.* The breadth of the pinnae is the only reliable indicator to separate *O. angustifolia* from *O. banksiifolia.* The sterile pinnae are numerous and closely placed together in *O. angustifolia* but there are no other distinct features to distinguish *O. angustifolia* from *O. banksiifolia.*

Vernacular.—Hatsadam (หัสดำ) (North-eastern).

**3. Osmunda vachellii** Hook., Ic. Pl.: t. 15. 1837; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 31. f. 2, 2-3. 1939; Ching, Fl. Reip. Pop. Sin. 2: 84: pl. 4. f. 5-6. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 33. 1967.

*Rhizome* short, suberect, with fronds in tuft, covered with downy, pale brown hairs when young. *Stipes* stramineous, 40–50 cm long, 5–7 mm in diameter, glabrous or with persistent downy hairs; laminae lanceolate, moderately acute at apex, up to 1 m long, to 35 cm or more in width, with numerous lateral pinnae and a terminal pinna; lateral pinnae with angles of 45–70° to rachis, straight, linear, gradually narrowing to acuminate apex, cuneate and shortly stalked at base, stalks less than 5 mm in length, margin entire or very slightly waved, the biggest ones more than 20 cm long 1.5 mm broad, coriaceous in texture; costae distinct especially on the under surface, the veins two or three times dichotomously branching, basal posterior veinlets usually running directly from the costae; several lower pairs of pinnae fertile, distinctly contracted, blackish brown after the spores have been shed.

Thailand.—NORTHERN: Chiang Mai (Doi Inthanon); NORTH-EASTERN: Loei (Phu Kradung); PENINSULAR: Trang (Khlong Ton), Songkhla (Surin), Satun.

Distribution.—S. and SW. China (type from Macao), Hongkong and Indochina (Vietnam and Cambodia).

Ecology.—Wet ground or sandy stream-beds in open areas or in light shade at medium altitudes.

Vernacular.—Hatsadam (หัสดำ) (Northeastern); kasodu (กาซอดี) (Karen/ Northern).

Notes.—This is a close ally of *O. javanica* Bl., En. Pl. Jav.: 252. 1828 of Malesia and is distinguished by having no sterile pinnae below the fertile ones and by the smaller size of the plants. In *O. javanica* a few pairs of sterile pinnae are usually placed below the fertile ones. However, there is a variation of the position of the fertile pinnae also in another related species, *O. banksiifolia,* in which the fertile pinnae are usually at the middle of the fronds but rarely they are placed at the base. Smitinand 2087 & 2238 are referred to this species, but these have a single pair of sterile pinnae below five pairs of fertile pinnae. From these facts, *O. vachellii* seems to be not so distinct from *O. javanica.* The material available is, however, all referable to the former species, and the current discrimination between the two species is followed here. *O. javanica* occurs in Malesia, and Malayan plants are referable to this species: Bedd., Handb.: 447. f. 274. 1883; Holtt., Rev. Fl. Malaya 2: 47. f. 5. 1955.

# PLAGIOGYRIACEAE

A single genus is included in this family whose systematic position is not yet certain.

Literature: Copeland, E.B.: The Genus Plagiogyria. Phil. J. Sci. 38: 377–417. pl. 1–15. 1929; Ching, R.-C.: The fern genus Plagiogyria on the mainland of Asia. Acta Phytotax. Sin. 7: 105–154. pl. 28–40. 1958.

## 1. PLAGIOGYRIA

(Kunze) Mett., Abh. Senkenb. Naturf. 2: 275. 1858; Copel., Gen. Fil.: 93. 1947.

Rhizome short, erect or ascending, bearing a rosette of fronds; stipes not jointed to rhizome, bearing broad stipule-like flaps at base, having a row of raised wart-like aerophores on each side of ridges; fronds simply pinnate, dimorphic; veins parallel, all free, distinct on both surfaces of sterile fronds; fertile fronds with longer stipes and narrower pinnae; sporangia along veins, covering the whole under surface of fertile pinnae except for the midribs and thin edges, protected when young by the reflexed edges; annulus oblique, complete; spores tetrahedral.

Copeland (1929) enumerated 32 species in the world, and Ching (1958) 33 from the Asiatic mainland, including Japan, Taiwan and Hainan. In Thailand only two have been collected.

### Key to the species

1. No aerophores at base of pinnae; pinnae all broadly joined to the wing of rachis **1. P. adnata**
1. A prominent aerophore at base of each pinna; pinnae not adnate, broadly cuneate to round at base **2. P. communis**

**1. Plagiogyria adnata** (Bl.) Bedd., Ferns Brit. India: t. 51. 1865; Handb.: 127. f. 65. 1883; Copel., Phil. J. Sci. 38: 396. 1929; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 74. 1939; Holtt., Rev. Fl. Malaya 2: 111. 1955; Ching, Acta Phytotax. Sin. 7: 120, 145. 1958; Fl. Reip. Pop. Sin. 2: 96. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 44. 1967.—*Lomaria adnata* Bl., En. Pl. Jav.: 205. 1828.

*Rhizome* short, erect or ascending, naked, bearing a tuft of fronds. *Sterile fronds:* stipes 18–25 cm long, stramineous or darker, flat on abaxial surface of upper

part, wide and flat at base and excreting mucilages when young; laminae oblong-lanceolate, 20–30 cm long, 10–15 cm wide; rachis like the upper part of stipes, winged except for basal part; lateral pinnae 20–25 in pairs, ascending in upper ones, patent at middle and deflexed at basal ones, lanceolate, caudately acuminate at apex, subtruncate or decurrent to wings of rachis at base, minutely serrate at margin, the serration distinct at apical region, up to 8 cm long, 1.3 cm wide; texture herbaceous, green, veins forked, reaching to the margin, distinct on both surfaces. Fertile fronds taller; stipes about 35 cm long, quadrangular in section; pinnae about 15 in pairs, 1–1.5 cm apart, shortly stalked, linear, to 5 cm long, 3 mm broad.

Thailand.—NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

Distribution.—Burma, S. China, Vietnam, Malaya, Sumatra to the Philippines, Java (type), extending north to southern edge of Japan through Taiwan and the Ryukyus.

Ecology.—On sandy slopes in dense evergreen forest at 1100–1500 m alt.

**2. Plagiogyria communis** Ching, Acta Phytotax. Sin. 7: 122, 147. pl. 35. 2. 1958; Fl. Reip. Pop. Sin. 2: 98. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 44. 1967.—*Lomaria pycnophylla* auct. non Kunze: Hosseus, Beih. Bot. Centr. 28(2): 365. 1911.—*Plagiogyria pycnophylla* auct. non (Kunze) Mett.: Bedd., Handb.: 129. 1883; Copel., Phil. J. Sci. 38: 390. 1929, p.p. Fig. 3: 5.

*Rhizome* short, erect or ascending, bearing a tuft of fronds, naked. *Sterile fronds:* stipes about 30 cm long, dark brown, bearing aerophores in two rows almost to the flat and wide base; laminae oblong-lanceolate, about 80 cm long, 30 cm wide; pinnae about 40 in pairs, sessile, middle ones patent, straight, lanceolate, gradually narrowing towards attenuate apex, round to broadly cuneate at base, distinctly toothed at margin, to 15 cm long, 1.5 cm broad, lower pinnae a little reduced in size reflexed, widely spaced, falcate upper ones gradually becoming smaller; texture subcoriaceous, deep green, veins forked, all free, each veinlet ending at apex of marginal tooth.

Thailand.—NORTHERN: Chiang Mai (Doi Inthanon).

Distribution.—N. India, Upper Burma and S.W. China (Szechuwan & Yunnan—type).

Ecology.—At edge of marsh in deep shade near the summit of Doi Inthanon, known only in one locality at about 2500 m alt.

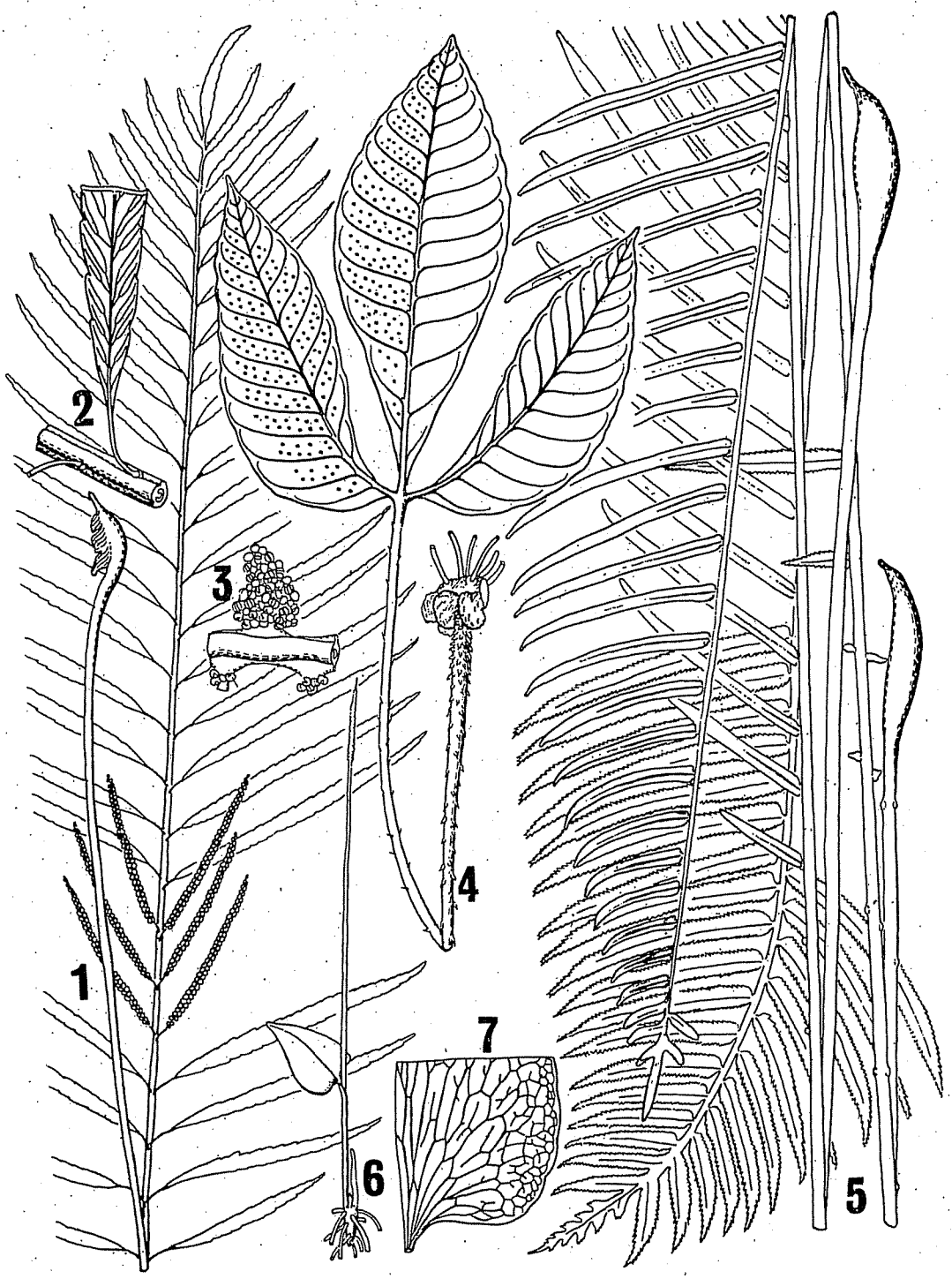



Figure 3. 1–3: *Osmunda angustifolia* 1, frond, x 1/3; 2, portion of sterile pinna, x 1.5; 3, portion of fertile pinna, x 5. 4: *Christensenia aesculifolia* plant, x 1/3. 5: *Plagiogyria communis;* fertile and sterile fronds, x 1/3. 6–7: *Ophioglossum costatum* 6, plant, x 1/2; 7, venation of laminae, x 1.5.

# GLEICHENIACEAE

Two genera are included in this family. *Gleichenia* and *Dicranopteris* are further subdivided into a few subgenera; they consist in about 150 and 10 tropical species respectively, including 8 in Thailand.

Literature: Holttum, R. E.: On the taxonomic subdivision of the Gleicheniaceae, with description of new Malaysian species and varieties. Reinwardtia 4: 257–280 1957; Gleicheniaceae. Fl. Malesiana ser. 2. 1: 1–36. 1959.

KEY TO THE GENERA

| | |
|---|---|
| 1. Veins simple or once forked; scales present, hairs stellate | **1. Gleichenia** |
| 1. Veins forked more than once; scales lacking, hairs branching | **2. Dicranopteris** |

## 1. GLEICHENIA

J. E. Smith, Mem. Acad. Turin. 5: 419. 1793; Copel., Gen. Fil.: 26. 1947.—*Sticherus* Presl, Tent. Pterid.: 51. 1836; Copel., Gen. Fil.: 27. 1947.—*Hicriopteris* Presl, Epim. Bot.: 26. 1849; Copel., Gen. Fil.: 28. 1947.

Terrestrial perennials; rhizome creeping, bearing peltate scales and stellate and simple hairs; the branching system of fronds various; veins all free; sori with 2–5 large sporangia, naked; sporangia with oblique and complete annulus, mixed with simple or forked paraphyses.

There are about 150 species assigned to this genus mainly from the tropics and subtropics throughout the world. Holttum (1957) distinguishes three subgenera: *Gleichenia* with bipinnate ultimate branches and round segments bearing one sorus for each segment, including 10 palaeotropic species; *Diplopterygium* with bipinnate ultimate branches and elongate segments bearing several forked veins on the costules, each acroscopic branch having one sorus, including about 20 species in the Sino-Himalayan region to Polynesia; and *Mertensia* with simply pinnatifid ultimate branches, consisting of about 120 species mainly in the southern hemisphere. In Thailand only five species are known for this large genus, representing all three subgenera.

KEY TO THE SPECIES

1. Ultimate branches bipinnatifid
2. Ultimate segments (lobes of leaflets) ovate-subdeltoid, nearly as long as wide; sorus one to each segment (§*Gleichenia*) **1. G. microphylla**
2. Ultimate segments elongate; sorus one to each acroscopic branch of forked veins, many to each segment (§*Diplopterygium*)
3. Scales on resting buds narrow, with short oblique setae at margin; leaflets about 4 cm apart, all bent backwards
4. Stipular leaflets having lobes similar to the segments of pinnules **2. G. norrisii**
4. Stipular leaflets much divided, with very narrow acuminate lobes **3. G. blotiana**
3. Scales on resting buds broader, edges fringed with spreading pale hairs; leaflets 2–3 cm apart **4. G. longissima**

1. Ultimate branches simply pinnatifid (§*Mertensia*) **5. G. truncata**

**1. Gleichenia microphylla** R.Br., Prod.: 161.1810; Holtt. in Fl. Mal. II. 1: 7. f. 1 a-e,2. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 48. 1968.—*Gleichenia semivestita* Labill., Sert. Austr. Cal. 8. t. 2. 1824; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 45. f. 7, 2–3. 1939.—*Gleichenia microphylla* var. *semivestita* (Labill.) v. A. v. Ros., Handb. Suppl.: 80. 1917; Holtt., Rev. Fl. Malaya 2: 65. f. 15. 1955.

*Rhizome* creeping, about 3 mm in diameter, bearing fronds remotely, scaly; scales narrow, dark brown with paler fringed margin. *Stipes* and rachis castaneous, scaly with pale hairy scales or glabrescent; fronds dichotomously branched; pinnae sessile, oblong with acute apex, bipinnatifid, commonly about 15 cm long, 8 cm wide; pinna-rachis and costae beneath densely scaly with dark brown hairy scales; pinnules linear, deeply lobed nearly to costae, about 4 cm long, 3 mm wide, 4–7 mm apart; ultimate segments ovate-subdeltoid, round at apex, about 1.2 mm long, 1 mm broad, the margin entire, usually reflexed; texture chartaceous, green, glabrescent, veins simple, hardly visible. *Sori* with a few sporangia, surrounded by brown hairs.

Thailand.—PENINSULAR: Phangnga (Khao Katha Khwam).

Distribution.—Vietnam, Malaya, throughout Malesia to Australia (type), New Caledonia and New Zealand.

Ecology.—On open ground at about 1000 m alt.

**2. Gleichenia norrisii** Mett. ex Kuhn, Linnaea 36: 165. 1869; Bedd., Handb.: 2. 1883; Holtt., Rev. Fl. Malaya 2: 67. 1955; in Fl. Mal. II. 1: 15. f. 6. 1959; Dansk Bot. Ark. 20: 16. 1961.

*Rhizome* widely creeping, bearing fronds remotely, about 5 mm in diameter, scaly throughout ; scales bright brown, lanceolate, long-acuminate at apex, toothed at margin, to 5 mm long, 0.7 mm broad. *Stipes* thick, to more than 1 m long, stramineous to pale green, scaly at base with the scales like those on rhizome, sparsely scaly upwards with scales like those on the main axes; rachis scales oblong-lanceolate, up to 5 mm long, 0.5 mm broad, concolourously dark brown, hairy; pinnae a few in opposite pairs, bipinnatifid, oblong-lanceolate, acuminate at apex, to 150 cm long,

25–40 cm wide; leaflets up to 20 cm long, 3 cm wide, shortly stalked, about 4 cm apart, all reflexed, basal leaflets not stipuliform, or with broad blunt lobes; scales on resting buds 2–3 mm long, narrow, brown, with short oblique concolourous setae at margin; lobes narrowly oblong, patent, round to moderately acute at apex, larger ones about 1.5 mm long, 5 mm broad, separated by sinus less than 1 mm in width; veinlets once or twice forked, distinct on both surfaces, dark brownish stellate hairs often present on lower surface of veins and laminae. *Sori* dorsal on acroscopic branch of veinlets, round.

Thailand.—CENTRAL: Nakhon Nayok (Khao Yai); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Malaya (type), Sumatra and N. Borneo.

Ecology.—Forming thicket on mountain slopes along streams in or at edge of dense forest at about 1100 m alt.

**3. Gleichenia blotiana** C. Chr., Bull. Mus. Natn. Hist. Nat. Paris II. 6: 103. 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 48. f. 7, 1. 1939; Holtt., in Fl. Mal. II. 1: 17. 1959; Rev. Fl. Malaya ed. 2. 2: 630. 1968—*Hicriopteris blotiana* (C. Chr.) Ching, Sunyatsenia 5: 279. 1940; Fl. Reip. Pop. Sin. 2: 124. 1959.—*Gleichenia norrisii* auct. non Mett. ex Kuhn: Tagawa & K. Iwats., Southeast As. St. 5: 35. 1967, p.p. Fig. 4: 4–9.

Similar to *G. norrisii* but differs in: stipular leaflets much divided, with very narrow acuminate lobes; scales on rachis-apex dark fringed; dark stellate hairs dense on the laminae underneath.

Thailand.—NORTH-EASTERN: Loei (Phu Kradung).

Distribution.—S. China to Taiwan, Indochina (type) and Malaya (once collected on Cameron Highlands).

Ecology.—Along stream in dense evergreen forest at about 1200 m alt.

**4. Gleichenia longissima** Bl., En. Pl. Jav.: 250. 1828; Holtt., Rev. Fl. Malaya 2: 67. 1955; in Fl. Mal. II. 1: 13. f. 4 b-g, 5. 1959.—*Gleichenia norrisii* auct. non Mett. ex Kuhn: Tagawa & K. Iwats., Southeast As. St. 5: 35. 1967, p.p.

Similar to *G. norrisii* but differs in: scales on resting buds broader, 1 mm or more in length, nearly black, edges fringed with spreading pale hairs 0.5 mm long; stipular leaflets much divided, with narrow acuminate lobes; leaflets close, 2–3 cm apart, not bent backwards.

Thailand.—NORTH-EASTERN: Phetchabun (Phu Miang); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Krabi (Phanom Bencha).

Distribution.—Throughout Malesia (type from Java) to Polynesia and Australia.

Ecology.—On rather dry slopes in clearings at medium altitude.

**5. Gleichenia truncata** (Willd.) Spr., Syst. Veg. 4: 25. 1827; Holtt. in Fl. Mal. II. 1: 20. f. 7 a–b, 9. 1959.—*Mertensia truncata* Willd., Kongl. Vet. Ak. Nya Handl. 25: 169. t. 5-A. 1804.—*Gleichenia laevigata* (Willd.) Hook., Sp. Fil. 1: 10. 1844; Christ, Bot. Tidsskr. 24: 112. 1901; C. Chr., Bot. Tidsskr. 32: 349. 1916; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 51. 1939; Holtt., Rev. Fl. Malaya 2: 71. 1955.

*Rhizome* unknown for Thai plants. *Main rachis* high-climbing; resting buds covered with brown, short-fringed scales; stipular leaflets at base of primary branch and at its first fork, deltoid, deeply lobed or the basal lobes again lobed, up to 2.7 cm long; rachis branches repeatedly forked, all branches, except the basal segments, leafy throughout, each branch 7.5–12 cm long; lobes patent, adnate at base hardly decurrent to the next ones, usually irregular in length even on the same branch, up to 3.5 cm long, 2 mm broad, the margin entire, revolute, not glaucous beneath. *Sori* with 3–5 sporangia, surrounded by stellate hairs, medial.

Thailand.—SOUTH-EASTERN: Trat (Ko Chang).

Distribution.—Vietnam and throughout Malesia.

Ecology.—Climbing ferns growing on stream banks at about 50–600 m alt.

## 2. DICRANOPTERIS

Bernh., Schrad. Neues J. 1(2): 26, 28. 1806; Copel., Gen. Fil.: 28. 1947.

Rhizome creeping; fronds pinnate or pseudodichotomous; veins forked at least twice; hairs on young parts of plants multicellular, variously branched, scales wanting; sporangia 8–15 or more in a sorus.

About 10 species are known throughout the tropical and subtropical regions, four of them, including two varieties, being native to Thailand.

### KEY TO THE SPECIES AND VARIETIES

1. The two branches at each fork equal
   2. Costules more than 5 mm apart, spores monolete — **1. D. curranii**
   2. Costules less than 5 mm apart, spores trilete — **4. D. linearis var. linearis**
1. The branches at a fork in many cases unequal
   3. Costules more than 1 cm apart — **2. D. splendida**
   3. Costules less than 7 mm apart
      4. At each fork, except primary and ultimate ones, one branch leafy and without accessory branch, the other branch not leafly and with an accessory branch — **3. D. speciosa**
      4. At each fork, except an ultimate one, a pair of accessory branches present — **4. D. linearis**
         5. Accessory branches not always present at ultimate fork

6. Branches at each fork of a lateral branch system usually equal; lower surface more or less persistently hairy especially on costules, not or little glaucous underneath; accessory branches attached just at the fork var. **linearis**
6. Branches at successive forks alternately unequal; lower surface quite glabrous and pale glaucous; accessory branches attached 3–5 mm above the fork var. **subpectinata**
5. Accessory branches always present at ultimate fork var. **tetraphylla**

**1. Dicranopteris curranii** Copel., Phil. J. Sci. 81: 4. 1952; Holtt., Reinwardtia 4: 274. 1957; in Fl. Mal. II. 1: 31. 1959; Rev. Fl. Malaya ed. 2. 2: 630. 1968; Tagawa & K. Iwats., Southeast As. St. 3(3): 72. 1965; 5: 35. 1967.—*Gleichenia linearis* var. *malayana* (Christ) v.A.v. Ros., Handb.: 59. 1908; Holtt., Rev. Fl. Malaya 2: 70. 1955.

*Rhizome* long-creeping, 3–5 mm in diameter, bearing fronds usually more than 10 cm apart, densely hairy throughout; hairs dark brown, stiff. *Stipes* stramineous, to more than 1 m long below the first fork, the dormant apex of rachis densely hairy. *Pinnae* 2 or 3 times forked with equal branches; branches sessile or very shortly stalked, oblong or narrowly oblong, acuminate at apex, gradually narrowing towards base, 20–40 cm long, 8–12 cm wide; ultimate segments linear, round or retuse at apex, entire and sometimes reflexed at margin, to 7 cm long, 5 mm broad, the costules 5–8 mm apart; veins pinnate, veinlets simple, not raised, texture chartaceous or leathery, green, glabrous. *Sori* medial or costular, dorsal at basal acroscopic veinlets.

Thailand.—CENTRAL: Nakhon Nayok (Khao Yai); PENINSULAR: Ranong (Muang Laen), Trang (Khao Chong), Yala (Bannang Sta).

Distribution.—Malesia (type from Luzon).

Ecology.—On rather dry slopes in open areas at edge of forest at low or medium altitudes.

**2. Dicranopteris splendida** (Hand.-Mazz.) Tagawa, Acta Phytotax. Geobot. 8: 164. 1939; Ching, Fl. Reip. Pop. Sin. 2: 121. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 35. 1967.— *Gleichenia splendida* Hand.-Mazz., Akad. Anz. Akad. Wien 1924: 81; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 50. 1939.—*Dicranopteris ampla* Ching & Chiu, Acta Phytotax. Sin. 8: 132. 1959; Ching, Fl. Reip. Pop. Sin. 2: 117. 1959.

*Rhizome* long-creeping, about 4 mm in diameter, densely hairy with shining brown stiff hairs. *Stipes* about 50 cm long, stramineous or brown, glabrescent. *Pinnae* twice forked; ultimate lobes bearing no accessory branches, narrowly oblong, 30–45 cm long, up to 17 cm wide; ultimate segments linear, round to moderately acute at apex, entire and usually flat at margin, to 10 cm long, 1 cm broad; costules 1–1.3 cm apart; veins pinnate, distinct on both surfaces, texture rigid, green, glabrous lower surface glaucous. *Sori* more than one row at each side of costules.

Thailand.—PENINSULAR: Krabi (Phanom Bencha), Nakhon Si Thammarat (Khao Luang).

Distribution.—Khasia, Upper Burma, S. and SW. China, and Indochina. Khao Luang is the southern limit of the distribution of this species; not recorded from Malesia.

Ecology.—On clayey slopes along paths in half-shaded places at edge of deep primitive forest at medium altitudes.

**3. Dicranopteris speciosa** (Presl) Holtt., Reinwardtia 4: 273. 1957; in Fl. Mal. II. 1: 32. f. 12 d, 15 c-d. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 36. 1967.—*Hicriopteris speciosa* Presl, Epim.: 27. 1851.—*Gleichenia opposita* v.A.v. Ros., Bull. Jard. Bot. Buit. II. 11: 13. 1913; Holtt., Rev. Fl. Malaya 2: 70. f. 14 f. 1955.

*Rhizome* widely creeping, 3–5 mm in diameter, glabrescent or hairy at apex, bearing fronds remotely. *Stipes* brown to pale castaneous, up to 1 m long below the first fork, sparsely hairy or glabrescent. *Primary rachis-branches* several times unequally forked; ultimate branches narrowly lanceolate, up to 25 cm long, 8 cm wide; ultimate segments linear, up to 4 cm long, 3 mm broad, round to retuse at apex, entire at margin; veins pinnate, veinlets distinct on both surfaces, texture rigid, green, glaucous on lower surface. *Sori* in a single rather irregular row at each side of costules.

Thailand.—PENINSULAR: Trang (Khao Chong), Phatthalung (Khao Den).

Distribution.—Malaya (type), Sumatra and Moluccas.

Ecology.—On dry slopes along highways in open areas at about 100 m alt.

**4. Dicranopteris linearis** (Burm.f.) Underw., Bull. Tor. Bot. Club 34: 249. 1907; C. Chr., Contr. U.S. Natn. Herb. 26: 330. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 49. 1939; Holtt., Reinwardtia 4: 275. 1957; in Fl. Mal. II. 1: 33. f. 12, 14 f-i: 1959; Dansk Bot. Ark. 20: 16. 1961; 23: 228. 1965; Ching, Fl. Reip. Pop. Sin. 2: 118. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 73. 1965; 5: 36. 1967.—*Polypodium linearis* Burm.f., Fl. Ind.: 235. t. 67. f. 2. 1768.—*Gleichenia linearis* (Burm.f.) Clarke, Tr. Linn. Soc. II. Bot. 1: 428. 1880; Bedd., Handb.: 4. f. 1. 1883; Christ, Bot. Tidsskr. 24: 111. 1901; C. Chr., Bot. Tidsskr. 32: 349. 1916; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 49. 1939; Holtt., Rev. Fl. Malaya 2: 68. f. 16. 1955.

*Rhizome* widely creeping, hairy. *Primary rachis-branches* usually twice or thrice forked, the two branches at each fork nearly equal; ultimate branches 15–30 cm long, 4–7 cm wide; ultimate segments linear, entire, round at apex, up to 4 mm broad; texture firm, lower surface slightly glaucous, glabrescent, veins more or less prominent on lower surface and hairy.

There are several varieties included in this species. Among them the following three are known from Thailand.

1. var. **linearis**

T h a i l a n d.—NORTHERN: Chiang Rai (Mae Ton, Doi Chang, Doi Tung, Doi Phacho), Chiang Mai (Doi Chiang Dao, Doi Hua Mot, Doi Suthep), Lampang (Thoen), Lamphun (Doi Khun Tan); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); SOUTH-EASTERN: Prachinburi (Khao Yai), Chanthaburi (Makham, Khao Sabap), Trat (Ko Chang); PENINSULAR: Ranong (Muang Laen), Chumpon (Ban Thung Maha), Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Thung Song), Phuket (Ko Mak), Trang (Khao Chong), Yala (Bannang Sta, Padang Besar).

D i s t r i b u t i o n.—Tropical and subtropical regions in the Old World (type from Ceylon), north to Central Japan.

E c o l o g y.—In clearings usually at edge of forest in open or half-shaded places at low to medium altitudes.

V e r n a c u l a r.—Kiku kachoei (กี๊กุกะเจ้ย) (Karen/Northern); kut pit (กูดปิ๊ด), kut muk (กูดหมึก) (Northern); kut taem (กูดแต๋ม), chon lek (โจ้นเหล็ก), chon (โชน) (Peninsular); kuekae (กือแก), ruesae (รือแซ) (Malay/Peninsular).

2. var. **tetraphylla** (Rosenst.) Nakai, Bull. Natn. Sci. Mus. Tokyo 29: 67. 1950; Holtt. in Fl. Mal. II. 1: 36. f. 12 b. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 36. 1967.—*Gleichenia linearis* var. *tetraphylla* Rosenst., Rep. Sp. Nov. 13: 213.1914.

Accessory branches always present at bases of the ultimate forks.

T h a i l a n d.—NORTH-EASTERN: Loei (Phu Kradung).

D i s t r i b u t i o n.—S. China (Kwangtung, Hainan), Indochina and Sumatra (type).

E c o l o g y.—On rather dry clearing at edge of forest by the river at 1100–1200 m alt.

3. var. **subpectinata** (Christ) Holtt., Reinwardtia 4: 277. 1957; in Fl. Mal. II. 1: 35. f. 12 c, 16. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 36. 1967.—*Gleichenia subpectinata* Christ, Bot. Tidsskr. 24: 111. 1901.—*Gleichenia linearis* var. *subpectinata* (Christ) C. Chr., Bot. Tidsskr. 32: 349. 1916.—*Gleichenia linearis* var. *alternans* auct. non Mett.: Holtt., Rev. Fl. Malaya 2: 70. f. 14 e. 1955.

Lower surface of fronds glabrous and glaucous.

T h a i l a n d.—NORTHERN: Lampang; SOUTH-EASTERN: Trat (Ko Chang-type); PENINSULAR: Trang (Khao Chong).

D i s t r i b u t i o n.—Malaya, Borneo, Sumatra, and their neighbouring islands.

E c o l o g y.—On rather dry slopes in open areas at edge of forest at low altitudes.

## 11. SCHIZAEACEAE

There are four living genera in this primitive family of the series Marginales of the leptosporangiate ferns. Two of them are native to Thailand.

Literature: Holttum, R. E., : Schizaeaceae. Fl. Mal. II. 1: 37–61. 1959.

### KEY TO THE GENERA

| | |
|---|---|
| 1. Leaves polystichous, erect, simple or dichotomous, grass-like; spores bilateral | **1. Schizaea** |
| 1. Leaves monostichous, twining, of indefinite growth; spores tetrahedral | **2. Lygodium** |

## 1. SCHIZAEA

J.E. Smith, Mem. Acad. Turin. 5: 419. 1793; Copel., Gen. Fil.: 23. 1947.

Rhizome oblique or shortly creeping; leaves polystichous, simple or forked, grass-like; sporangia in special lobes terminal on the costae, in two distinct rows, partly protected by the indusium-like recurved margins.

About 30 species are known in tropical and southern temperate regions. Two of them are recorded from Thailand.

### KEY TO THE SPECIES

| | |
|---|---|
| 1. Fronds repeatedly dichotomous | **1. S. dichotoma** |
| 1. Fronds simple | **2. S. digitata** |

1. **Schizaea dichotoma** (Linn.) J.E. Smith, Mem. Acad. Turin. 5: 422. t. 9. 1793; Bedd., Handb.: 452. f. 278. 1883; Christ, Bot. Tidsskr. 24: 112. 1901; C. Chr., Bot. Tiddsskr. 32: 349. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 8. 1929; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 43. 1939; Holtt., Rev. Fl. Malaya 2: 50. f. 6. 1955; in Fl. Mal. II. 1: 41. f. 1, 2, 4 a–d. 1959; Dansk Bot. Ark. 20: 15. 1961, 23: 228. 1965.—*Acrostichum dichotomum* Linn., Sp. Pl.: 1068. 1753.—*Schizaea biroi* Richter, Math. Term. Ert. 29: 1074. t. 10. 1915; Ching, Fl. Reip. Pop. Sin. 2: 115. 1959.

*Rhizome* creeping, deep in the earth, densely covered with shining brown hairs. *Stipes* 10–30 cm long, narrowly winged except for the basal portion. *Fronds* 7–20 cm long and wide, branching dichotomously 2–6 times, first branches like the upper part of stipes, the distal branches with wider wings to form narrow laminae of about 3–4 mm in width. *Sporangia-bearing lobes* at apex of the distal branches, 5–10 pairs, forming distinct sorophores of 2–5 mm long, the lowest lobes 3–4 mm long, upper ones gradually becoming smaller.

Thailand.—EASTERN: Nakhon Ratchasima (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha), Trat (Ko Chang, Ko Kut); PENINSULAR: Phangnga (Takuapa), Surat Thani (Ko Tao, Ko Pha-ngan), Nakhon Si Thammarat (Chawang), Songkhla, Trang (Khao Chong), Satun (Tarutao), Narathiwat (Bacho Falls).

Distribution.—Tropics of Old World (type from Cochinchina), north to the Ryukyus, west to Madagascar, and southeast to Polynesia, New Zealand and Australia.

Ecology.—On open grass land or in light shade at low altitudes.

Vernacular.—Tan klom (ตานกล่อม), tan phrao (ตานพร้าว), tan san (ตานส้าน), wan dok din (ว่านดอกดิน) (Peninsular); ya hang ma ba (หญ้าหางหมาบ้า) (South-eastern); misa rima (มีซารีมา), purasae (ปูราแซ) (Malay/Peninsular).

**2. Schizaea digitata** (Linn.) Sw., Syn. Fil.: 150, 380. t. 4. f. 1. 1896; Bedd., Handb.: 452. f. 279. 1883; Christ, Bot. Tidsskr. 24: 112 1901; C. Chr., Bot. Tidsskr. 32: 349. 1916; Bonap., Not. Ptérid. 13: 101. 1921; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 42. f. 6, 4–5. 1939; Holtt., Rev. Fl. Malaya 2: 51. f. 7. 1955; in Fl. Mal. II. 1: 41. f. 3 a–e. 1959; Dansk Bot. Ark. 20: 15. 1961; 23: 228. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 85. 1958; Ching, Fl. Reip. Pop. Sin. 2: 114. pl. 7. f. 1–6. 1959.—*Acrostichum digitatum* Linn., Sp. Pl.: 1068. 1753.

*Rhizome* short, creeping or ascending, deep in the earth. *Fronds* 4–10 on one stock, erect, unbranched, grass-like when sterile, 15–35 cm long, winged except for the base, the widest portion about 5 mm; costae prominent on lower and slightly grooved on upper surfaces, glandular hairs abundant below. *Sporangia-bearing lobes* 7–20 at apex of fronds, equal, 2–5 cm long, about 1.2 mm broad.

Thailand.—SOUTH-EASTERN: Chanthaburi (Makham), Trat (Khao Saming, Ko Chang, Ko Kut); PENINSULAR: Ranong (Khao Nom Sao, Muang Laen), Surat Thani (Bang Bao, Ban Kop Kaep, Ban Na, Khanthuli), Phangnga (Kasum), Songkhla (Khao Pak), Satun (Adang), Narathiwat (Bacho), Yala (Mae Wing, Ban Chana).

Distribution.—Tropical Asia (type from Ceylon), north to S. China (Kwangtung, Hainan & Taiwan) and Micronesia.

Ecology.—Terrestrial in light shade at low altitudes.

Vernacular.—Tan bit (ตานบิด), tan sai (ตานทราย) (Peninsular).

## 2. LYGODIUM

Sw., Schrad. J. Bot. 1800(2): 106. 1801; Copel., Gen. Fil.: 24. 1947; Alston & Holtt., Reinwardtia 5: 11. 1959.

Rhizome creeping, hairy but without scales; leaves monostichous, twining, of indefinite growth, the fronds usually a few metres long; primary rachis-branches short, the apex dormant and covered with hairs, each bearing a pair of secondary branches; secondary rachis-branches bearing leaflets in a pinnate arrangement, or dichotomously branching bearing digitately lobed leaflets; sterile leaflets entire, toothed or lobed; veins free, or reticulate in some foreign species; fertile leaflets fringed along their edges with short narrow lobes, each lobe bearing two rows of sporangia, each attached to a short vein and covered by a small indusium.

These ferns are characterized by their climbing habit; rhizomes are under ground, and the fronds of indefinite growth climb up trees, sometimes to several metres, in open or half-shaded places. About 40 species are known from tropical and subtropical regions, seven in Thailand.

### Key to the species

1. Secondary rachis-branches pinnate with 10–15 pairs of leaflets; axis terete and wingless throughout **1. L. polystachyum**
1. Secondary rachis-branches pinnate with a few leaflets, or dichotomous; every axis winged to some extent
2. Primary rachis-branches distinct, usually more than 4 mm long; rhizome creeping
3. Secondary rachis-branches simply pinnate; leaflets articulated at base **2. L. microphyllum**
3. Secondary rachis-branches bipinnate; leaflets not articulated **3 L. japonicum**
2. Primary rachis-branches indistinct; rhizome short-creeping, fronds close together
4. Secondary rachis-branches regularly pinnate, with 3–5 pairs of leaflets
5. Lateral leaflets larger towards base of secondary branch, basal ones stalked and auricled or with obliquely spreading lobes
6. Leaflet-stalks not thickened at base, thinly hairy; ultimate lobes up to 15 cm long, 2.5 cm broad **4. L. flexuosum**
6. Every junction of higher axes and leaflet-stalks articulated, densely hairy throughout; ultimate lobes up to 20 cm long, 4 cm broad **5. L. giganteum**
5. Leaflets all about equal, not auricled nor branched at base; leaflet-stalks thickened at their junction with lamina **6. L. salicifolium**
4. Secondary rachis-branches simple or dichotomously branched; leaflets palmately branched, never thickened at apex of stalks **7. L. circinatum**

**1. Lygodium polystachyum** Wall. ex Moore, Gard. Chron. 1859: 671; Bedd., Handb.: 458. f. 284. 1883; Bonap., Not. Ptérid. 14: 70. 1923; E. Smith, J. Siam Soc. Nat: Hist. Suppl. 8: 8. 1929; C. Chr., Contr. U.S. Natn. Herb. 26: 329. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 40. 1939; Holtt., Rev. Fl. Malaya 2: 56. f. 10. 1955; in Fl. Mal. II. 1: 46. f. 5 c, 8 a–c. 1959; Dansk Bot. Ark. 20: 16. 1961; Ching, Fl. Reip. Pop. Sin. 2: 110. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 72. 1965; 5:34. 1967.

*Rhizome* shortly creeping, densely covered with black hairs. *Fronds* climbing, sometimes more than 3 m tall; stipes 25–40 cm long, brown, densely hairy throughout, up to 4 mm diam., terete, wingless; hairs on stipes as well as on rachis setose, stiff, patent, multicellular, brown or paler, up to 2 mm long; rachis like the upper part of stipes, slender, paler, hairs less dense and short, terete; pinnae numerous, 10–20 cm apart; primary rachis-branches very short, usually 2–3 mm, the apex densely, covered with brown hairs, dormant but occasionally a little protruding in the lower pinnae; secondary rachis-branches 20–30 cm long, densely hairy with short unicellular hairs, wingless; leaflets 10 or more in pairs on secondary branches, with short stalks of 2 mm or so, oblong-subdeltoid, acute to moderately so at apex, subtruncate at base, indistinctly articulated at the junction of stalk and laminar part, pinnately lobed to half way, hairy on veins and margin, at most 7 cm long and 2.5 cm wide at basal widest portion; ultimate lobes round at apex, entire. *Sporangia-bearing lobes* narrow, 1.5–2 mm wide, 3–7 mm long; indusia densely covered with long pale hairs.

Thailand.—NORTHERN: Chiang Rai (Doi Tung, Nam Mae Kok), Chiang Mai (Doi Chiang Dao, Huai San, Doi Suthep, Doi Buak Ha, Tha Ko), Lampang, Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Phetchabun (Phu Miang); SOUTH-EASTERN: Chon Buri (Si Racha); CENTRAL: Nakhon Nayok; SOUTH-WESTERN: Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Chumphon, Surat Thani (Khao Tha Phet, Huai Mut, Ban Don, Ko Tao), Nakhon Si Thammarat (Ronphibun, Lan Saka), Phuket (Thalang), Songkhla (Khao Pak), Trang (Khao Chong), Narathiwat (Bacho)

Distribution.—Assam, Burma, SW. China (Kwangsi & Yunnan), Indochina and Malaya (type).

Ecology.—Climbing, usually on dry grassy slopes in mixed forests at low or medium altitudes.

Vernacular.—Kut khua (กูดเถือ), kut kong (กูดก้อง) (Northern); liphao (ลิเภา), liphao yong (ลิเภาย่อง) (Peninsular).

Uses.—Stems used in making handbags and hats.

**2. Lygodium microphyllum** (Cav.) R.Br., Prod.: 162. 1810; Bedd., Handb.: 455. f. 282. 1883; Christ, Bot. Tidsskr. 24: 112. 1901; Holtt. in Fl. Mal. II. 1: 47. f. 5 e–f, 6, 7. 1959; Dansk Bot. Ark. 20: 16. 1961; Rev. Fl. Malaya ed. 2. 2: 630. 1968; Tagawa & K. Iwats., Southeast As. St. 5: 34. 1967; Acta Phytotax. Geobot. 23: 51. 1968.—*Ugenia microphylla* Cav., Ic. Descr. Pl. 6: 76. t. 595. 1801.—*Lygodium scandens* Sw., Schrad. J. Bot. 1800(2): 106. 1801; C. Chr., Bot. Tidsskr. 32: 349. 1916; Contr. U.S. Natn. Herb. 26: 329. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 41. 1939; Holtt., Rev. Fl. Malaya 2: 58. f. 12. 1955; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 85. 1958; Ching, Fl. Reip. Pop. Sin. 2: 109. 1959.

*Rhizome* widely creeping, irregularly branching, 2–3 mm in diameter, densely covered with blackish brown hairs. *Fronds* climbing, sometimes to several metres; stipes about 10 cm long, dark stramineous, glabrescent, very narrowly winged in the

upper part; rachis like the upper part of stipes, stramineous, glabrescent narrowly winged throughout; pinnae numerous, 5–10 cm apart; primary rachis-branches, 5 mm or so long, the apex densely covered with brown hairs, dormant but occasionally protruding to some extent; secondary rachis-branches 5–8 cm long, glabrescent, narrowly winged; leaflets several in pairs on secondary rachis-branches, with distinct stalk 2–3 mm, deltoid to oblong-subdeltoid, gradually narrowing towards moderately acute apex, subtruncate or broadly cuneate at more or less auricled base, entire at margin, glabrescent, 1.5–3 cm long, about 1 cm broad. *Sporangia-bearing lobes* narrow, protruding at margin of segments, 3–7 mm long, about 1 mm broad; indusia serrate at margin, glabrous.

Thailand.—NORTHERN: Chiang Mai (Tat Noi, Doi Suthep), Lampang (Mae Tam, Ban Du); NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Makham, Khao Sabap), Trat (Ban Saphan Hin, Ko Chang); PENINSULAR: Surat Thani (Ban Don, Ko Samui, Khun Thale), Songkhla (Hat Yai), Yala (Bannang Sta.)

Distribution.—Tropics of the Old World (type from Luzon), from Africa to Melanesia and Australia, north to the Ryukyus and south to New South Wales.

Ecology.—Climbing on bushes or on branches of tall trees, usually on dry slopes in open areas at low or medium altitudes.

Vernacular.—Kachot nu (กะฉอดหนู) (South-eastern); liphao yung (ลิเภายุ่ง) (Peninsular).

Notes.—The young plants look very like *L. japonicum,* bearing oblong-subdeltoid pinnules to more than 5 cm in length.

**3. Lygodium japonicum** (Thunb.) Sw., Schrad. J. Bot. 1800(2): 106. 1801; Bedd., Handb.: 457. 1883; C. Chr., Contr. U.S. Natn. Herb. 26: 329. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 37. 1939; Holtt. in Fl. Mal. II. 1: 51. f. 8 d–f. 1959; Ching, Fl. Reip. Pop. Sin. 2: 113. pl. 8. f. 1–4. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 34. 1967.—*Ophioglossum japonicum* Thunb., Fl. Jap.: 328. 1784.—*Lygodium microstachyum* Desv., Berl. Mag. 5: 308. 1811; Ching, Fl. Reip. Pop. Sin. 2: 112. pl. 8. f. 5–8. 1959.—*Lygodium japonicum* var. *microstachyum* (Desv.) Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 38. 1939.—*Lygodium flexuosum* auct. non (Linn.) Sw.: Holtt., Dansk Bot. Ark. 20: 15. 1961, p.p.

*Rhizome* creeping, densely covered with blackish brown hairs. *Fronds,* climbing; stipes up to 30 cm, stramineous, densely pubescent near the base, sparsely hairy upwards, about 1.5 mm diam., very narrowly winged except the very base; hairs at base of stipes brown, downy; rachis like the upper part of stipes, rather densely hairy on the upper side; pinnae numerous, less than 10 cm apart; primary rachis-branches distinct, 3–15 mm long, densely hairy, the apex dormant but occasionally protruding; secondary rachis-branches up to 20 cm long, densely hairy on the upper and very sparsely so on the lower sides, distinctly winged throughout; the two main branches of large fronds bipinnate, deltoid to suborbicular in outline; tertiary leaflets of lower

rachis-branches palmate with 5–7 lobes, the middle lobe longer, tertiary leaflets of higher parts trilobed or hastate, the lobes actually biserrate at margin, obtuse to subacute at apex; stalks of leaflets to 3 mm long, without articulation, with distinct wings; costae winged throughout, hairy; veins on both surfaces hairy with long downy pale brownish hairs. *Sporangia-bearing lobes* protruding at margin of the lobes of tertiary leaflets which are usually smaller than those without sporangia, 3–8 (–12) mm long, about 1.5 mm broad; indusia hairy at margin.

Thailand.—NORTHERN: Chiang Mai (Ban Klang, Fang, Doi Chiang Dao, Doi Noi, Doi Makena, Ping Khong, Doi Suthep, Mae Klang, Doi Phracha), Tak (Doi Ka); NORTH-EASTERN: Loei (Phu Kradung); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Hindat, Ban Kao), Prachuap Khiri Khan.

Distribution.—Ceylon, Himalaya to China north to Chekiang, Korea, Japan (type), Indochina, throughout Malesia east to New Guinea; also naturalized in the United States.

Ecology.—On dry open grass fields or on mountain slopes in deciduous forest at low or medium altitudes.

Vernacular.—Ngo-ngae (งอแง) (Northern).

Notes.—This is a very variable species. In comparison with the typical Japanese form, Thai plants are smaller (seldom 1 m high), have shorter rhizome (at least when growing on dry rocky slopes), and have a denser indumentum, especially when growing in dry situations. Such plants are rather difficult to distinguish from *L. flexuosum,* especially its smaller form.

**4. Lygodium flexuosum** (Linn.) Sw., Schrad. J. Bot. 1800(2): 106. 1801; Bedd., Handb.: 457. f. 283. 1883; Hosseus, Beih. Bot. Centr. 28 (2): 367. 1911; C. Chr., Contr. U.S. Natn. Herb. 26: 329. 1931; Tard. & C. Chr., in Fl. Gén. I.-C. 7(2): 38. 1939; Holtt., Rev. Fl. Malaya 2: 57. f. 11. 1955; in Fl. Mal. II. 1: 53. f. 9 e–f. 1959; Dansk Bot. Ark. 20: 15. 1961; 23: 228. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 85. 1958; Ching, Fl. Reip. Pop. Sin. 2: 111. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 35. 1967.—*Ophioglossum flexuosum* Linn., Sp. Pl.: 1063. 1753.—*Lygodium dichotomum* auct. non Sw.: Ostenf., Bull. Herb. Boiss. II. 5: 721. 1905.

*Rhizome* short, densely covered with dark brown hairs. *Fronds* climbing, usually several metres tall; stipes 50 cm or more long, stramineous with dark brown basal portion, minutely hairy or glabrescent, narrowly winged on the upper part; rachis winged throughout, puberulous on the upper surface between the wings, stramineous; primary rachis-branches very short, up to 5 mm, the apex dormant, covered with downy pale brown hairs; secondary rachis-branches pinnate to bipinnate, oblong to subdeltoid in outline, usually with acute apex, 10–25 cm long, 7–12 cm wide; tertiary leaflets of lower branches palmate, the base distinctly cordate, those of the distal part of plants trilobed, hastate, or simple, the base of lobes distinctly cordate, the ultimate lobe up to 15 cm long, 2.5 cm broad, acute to moderately acute at apex, distinctly serrate at margin, with distinct stalk at base, the stalks up to 1 cm long,

winged, sparsely hairy, without articulation or with a small thickening at base of laminar part; lamina herbaceous, glabrous above, veins sometimes sparsely hairy below. *Sporangia-bearing lobes* protruding at margin of tertiary leaflets, up to 1 cm long, 1.5 mm broad; indusia glabrous.

Thailand.—NORTHERN: Chiang Rai (Doi Chang, Chiang Khong, Chiang Kham, Tha Ko), Chiang Mai (Doi Phahom Pok, Mae Chaem, Doi Chiang Dao, Ban Huai Bong, Doi Suthep, Doi Chom Chaeng, Ping Khong, Doi Makena, Mae Klang, Pang Bo), Mae Hong Son (Mae La Noi, Mae Sarieng), Lampang (Doi Pang La, Huai Thak), Lamphun (Doi Khun Tan, Li), Phrae (Mae Ban), Nan (Pha Sing), Tak (Rahaeng, Bhumiphol Dam, Lan Sang), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung), Khon Kaen (Pha Nok Khao, Phu Wiang); EASTERN: Nakhon Ratchasima (Lat Bua Khao); SOUTH-EASTERN: Prachin Buri (Ban Ban Hills); CENTRAL: Krung Thep, Nakhon Nayok (Khao Yai, Wang Chao), Saraburi (Khao Lon); SOUTH-WESTERN: Kanchanaburi (Bang Kasi, Sai Yok, Ban Kao), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Chumphon, Nakhon Si Thammarat (Thung Song), Phangnga.

Distribution.—Ceylon (type), N. India, SW. and S. China, Hongkong, Ryukyus and Taiwan, southwards to Queensland through Malesia and Melanesia.

Ecology.—Climbing on shrubs or on branches of tall trees in open areas or in deciduous or mixed forest, fairly common at low or medium altitudes.

Vernacular.—Kut kong (กูดก้อง); kut doi (กูดดอย), kut ngot ngaet (กูดงอดแงก), kut phae (กูดแพะ), kut yong (กูดย่อง) (Northern); moi mae mai (หมอยแม่หม้าย) (Eastern); kachot (กะฉอด), taphao khuen hon (ตะเภาขึ้นหน) (South-western); tin mangkon (ตีนมังกร), tin takhap (ตีนตะขาบ) (Central); liphao yai (ลิเภาใหญ่), saiphan phi (สายพานผี), (Peninsular); thu kai kho (ทุไก่โค) (Karen/South-western); ribu basa (ริบูบะซา) (Malay/Peninsular).

Uses.—Stems used in making handbags and hats.

**5. Lygodium giganteum** Tagawa & K. Iwats., Acta Phytotax. Geobot. 22: 97. f. 1. 1967; Southeast As. St. 5:35. 1967.—*Lygodium flexuosum* auct. non (Linn.) Sw.: Holtt., Dansk Bot. Ark. 20: 15. 1961, p.p.; Tagawa & K. Iwats., Southeast As. St. 3(3):72. 1965. Fig. 4: 10–13.

*Rhizome* very short-creeping, bearing fronds close together, the apex and bases of stipes densely covered with dark brown hairs. *Fronds* very large, climbing to more than 2 m; stipes at most 20 cm long, stramineous to dark, densely pubescent throughout, very narrowly winged; rachis like upper part of stipes, 2–4 mm diam., densely pubescent; primary rachis-branches 8–15 mm long, the apex dormant, covered with densely brown hairs; secondary rachis-branches pinnate to bipinnate, up to 25 cm long and wide; in larger ones tertiary rachis-branches with a few leaflets, forming a pentagonal outline, tertiary leaflets palmately 5-lobed to hastate, with large central lobes, deeply cordate at base, round or very moderately acute at apex;

axes of branches of secondary and of higher orders stramineous, densely pubescent with pale unicellular hairs, with distinct articulation at every junction; ultimate lobes larger, oblong-subdeltoid to oblong, round at apex, irregularly and slightly dentate at margin, herbaceous to softly papyraceous, up to 20 cm long, 4 cm broad, the stalks very narrowly winged, articulate at base of lamina, up to 15 mm long; veins forked three to four times, all free; both surfaces of lamina as well as veins hairy. *Sporangia-bearing lobes* protruding at margin of the ultimate lobes, 2–8 mm long, about 1.2 mm broad; indusia hairy.

Thailand.–NORTHERN: Chiang Rai (Chiang Khong, Doi Phacho, Doi Chang), Chiang Mai (Doi Chiang Dao, Fang, Mae Taeng, Pang Bo, Ping Khong, Doi Suthep, Tha Ko, Mae Klang, Doi Inthanon—type), Mae Hong Son (Mae Sariang), Tak (Doi Musoe).

Distribution.—Upper Burma and Yunnan.

Ecology.—On dry slopes in thickets, usually in deciduous forest at low or medium altitudes.

Notes.—In hairiness and articulation at base of ultimate segments (without actual function as abscission zone) this is similar to *L. salicifolium* and rather difficult to distinguish from the latter in the Burma-Yunnan region. The pattern of division of the fronds is like that of *L. flexuosum* but it is a much larger species; smaller forms differ from *L. flexuosum* in more dense hairs, distinct articulation, and thicker texture of lamina.

**6. Lygodium salicifolium** Presl, Suppl. Tent. Pterid.: 102. 1845; C. Chr., Bot. Tidsskr. 32: 349. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 8. 1929; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 41. 1939; Holtt. in Fl. Mal. II. 1: 51. f. 6. 10, 13 a–b. 1959; Dansk Bot. Ark. 20: 16. 1961; 23: 228. 1965; Rev. Fl. Malaya ed. 2. 2: 630. 1968; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 85. 1958; Ching, Fl. Reip. Pop. Sin. 2: 111. pl. 7. f. 7–9. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 72. 1965; 5: 34. 1967; Acta Phytotax. Geobot. 23: 51. 1968.—*Lygodium flexuosum* auct. non (Linn.) Sw.: Christ, Bot. Tidsskr. 24: 112. 1901; Holtt., Rev. Fl. Malaya 2: 57. 1955, p.p.—*Lygodium circinatum* auct. non (Burm.f.) Sw.: Christ, Bot. Tidsskr. 24: 112. 1901; Hosseus, Beih. Bot. Centr. 28(2): 367. 1911; C. Chr., Bot. Tidsskr. 32: 349. 1916; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 85. 1958.

*Rhizome* shortly creeping, densely covered with blackish brown hairs. *Fronds* very large, climbing, to several metres tall; stipes stramineous, minutely pubescent, very narrowly winged or with a distinct line at both sides; rachis like the upper part of stipes, 1.5–2.2 mm diam.; primary rachis-branches very short, up to 4 mm long, the apex dormant, covered with brown hairs; secondary rachis-branches pinnate, with about 4 pairs of leaflets and a terminal usually deeply lobed one; tertiary leaflets oblong-lanceolate, moderately acute at apex, cordate, subhastate or in extreme form 5-lobed at base, minutely dentate at margin, typically 10 cm long, 2.5 cm broad; stalks of leaflets distinct but wanting in smaller leaflets, up to 1.2 cm long, with a

distinct junction at base of laminae; lamina herbaceous to soft papyraceous, fresh green, almost glabrous on both surfaces except the hairy margin; every axis higher than the secondary rachis-branches with narrow but distinct wings, pubescent throughout, somewhat swollen at every junction. *Sporangia-bearing lobes* protruding at margin of tertiary leaflets, 2–5 mm long, about 1.2 mm broad; indusia glabrous.

Thailand.—NORTHERN: Chiang Rai (Doi Tung, Doi Chang, Nam Mae Kok), Chiang Mai (Doi Chiang Dao, Doi Suthep, Tha Ko), Phrae (Huai Ton Yang, Mae Sai); NORTH-EASTERN: Loei (Phu Luang); EASTERN: Nakhon Ratchasima; CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Makham, Khao Sabap), Chon Buri (Ban Bung), Trat (Laem Ngop, Ko Chang); SOUTH-WESTERN: Kanchanaburi (Kroeng Kawia, Sai Yok), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Surat Thani (Ban Don, Ko Tao), Phangnga (Khao Nang Hong), Nakhon Si Thammarat (Thung Song, Ronphibun, Khiriwong), Trang (Khao Chong), Phatthalung, Satun (Tarutao), Narathiwat (Bacho Falls, Sg. Kolok), Yala (Bannang Sta).

Distribution.—Assam to Yunnan, Indochina, Hainan, Taiwan, throughout Malesia (type from Singapore), southeast to New Guinea and Micronesia.

Ecology.—On rather dry mountain slopes in tropical evergreen forest at low or medium altitudes.

Vernacular.—Kut khue (กูดคือ), saiphan phi (สายพานผี), u taphao (อู่ตะเภา) (Northern); kachot (กะฉอด), kachot nu (กะฉอดหนู) (South-eastern); yan i-phao (ย่านอีเภา) yan yai phao (ย่านยายเภา) (Peninsular); libu (ลีบู) (Malay/Peninsular).

Uses.—Stems used in making handbags and hats.

Notes.—Some collections consisting of juvenile plants have been referred to the following species, but *L. salicifolium* is distinct from *L. circinatum* in the presence of articulation and hairs on axes.

**7. Lygodium circinatum** (Burm.f.) Sw., Syn. Fil.: 153. 1806; Bedd., Handb.: 455. f. 281. 1883; Holtt., Rev. Fl. Malaya 2: 55. f. 9. 1955; in Fl. Mal. II. 1: 59. f. 5 d, 14. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 51. 1968.—*Ophioglossum circinatum* Burm.f., Fl. Ind.: 228. 1768.

*Rhizome* shortly creeping, densely covered with blackish hairs. *Fronds* large, climbing to several metres; stipes brownish stramineous, hairy on the lower part, narrowly winged on upper part; rachis 2–5 mm diam., glabrous, with very short wings (or ridges); primary rachis-branches very short, less than 2 mm long, the apex dormant and somewhat sunken, covered with pale brownish hairs; secondary rachis-branches 2–8 cm long, sometimes branching once dichotomously; sterile leaflets with 2–7 lobes palmately divided with cuneate base, the lobes gradually narrowing towards acute apex, entire at margin, up to 20 cm long, more than 2 cm broad, sometimes fertile on the upper part; lamina softly papyraceous, glabrous except sparsely hairy main veins, sometimes warty; fertile leaflets similar in the branching system to the sterile ones, narrower, less than 1 cm broad. *Sporangia-bearing lobes* protruding, numerous at margin of tertiary leaflets, 2–5 mm long, about 1.2 mm broad; indusia glabrous.

Thailand.—PENINSULAR: Surat Thani (Ko Pha-ngan, Ban Don), Phangnga (Ko Khian), Narathiwat (Sg. Padi), Yala (Bo Hin, Bannang Sta).

Distribution.—Ceylon, NE. India, throughout Malesia (type from Java) to Micronesia and the Solomons.

Ecology.—In light shade in tropical evergreen forest at low or medium altitudes.

Vernacular.—Liphao hang kai (ลิเภาหางไก่) (Peninsular); ribu (รีบู) (Malay/ Peninsular).

Uses.—Stems used in making handbags and hats.

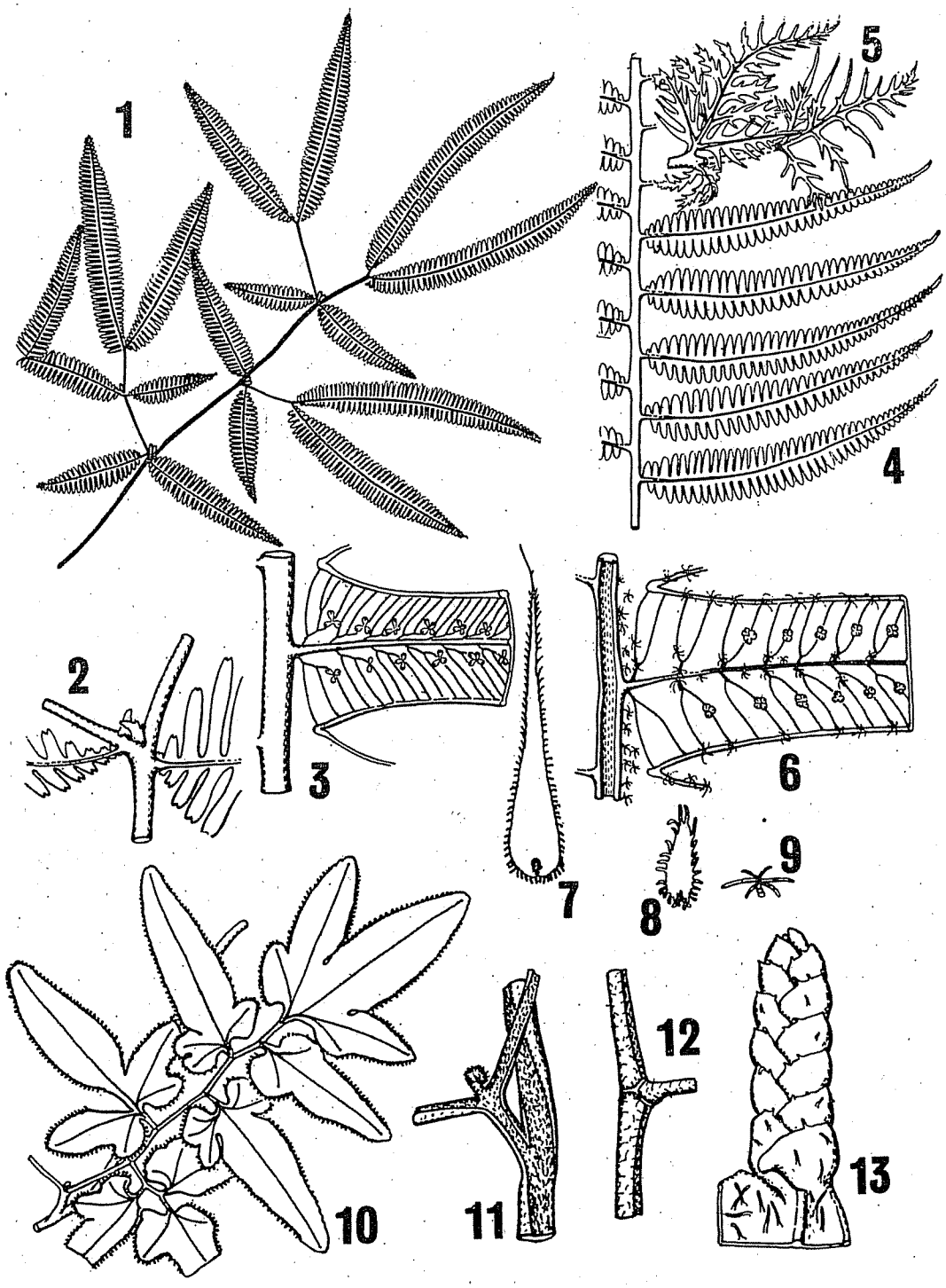



Figure 4. 1–3: *Dicranopteris linearis* var. *subpectinata* 1, portion of frond, x 1/6; 2, portion of fork and accessary branches, natural size; 3, portion of pinnule, x 5. 4–9: *Gleichenia blotiana* 4, portion of fertile pinna, x 1/4; 5, stipular leaflet, natural size; 6, portion of fertile lobe, x 5; 7 & 8, rachis on resting buds, x 10; 9, stellate hair on fertile lobe, x 20. 10–13: *Lygodium giganteum* 10, portion of fertile pinna, x 1/4; 11, forking of rachis, x 1.5; 12, articulation of pinnule base, x 2.5; 13, fertile lobe, x 10.

See Vol 4 : 610

## 12. HYMENOPHYLLACEAE

This is a well defined and distinct family, including about 800 species in the tropics and southern hemisphere of both the Old and the New Worlds. Many species are extremely reduced in size, hence specific discrimination is somewhat difficult. Like the bryophytes almost all the filmy ferns are well adapted to tropical rain forests, and they are similar to the mosses in various respects: small fronds are typically one cell thick in laminar parts, having no stomata; some species lack roots but have root hairs for absorption; the fronds of some epiphytic species curl up when dry, but they can tolerate desiccation for long period, and soon revive when the atmosphere becomes moist; the leaves can absorb water all over their surfaces, filmy ferns can live only with dropping water, mist or dew and the water conducting tissues are not so well differentiated as in the other ferns.

Thirty-eight species have been known in Thailand: in the Northern and North-Eastern regions, only a limited number of species are recorded, and most are from the Peninsula, especially its tropical rain forests. Most species are widely distributed in Southeast Asia.

There are two alternative systems of generic classification: one is the system to divide the filmy ferns into two genera, *Trichomanes* with tubular involucre and *Hymenophyllum* with bivalvate involucre; the other to classify them into 34 genera defined by Copeland (1938, 47). The system with two genera has long been accepted, though there are some questions as to the naturalness of the genera, and Morton (1968) proposed a modification to this system. On the other hand, Copeland's system give convenient circumscriptions and most of his genera seem to be natural. In the following enumeration of species, the latter arrangement is adopted, enumerating 15 genera from Thailand. The species from Thailand, at any rate, fall quite naturally within the genera defined by Copeland, though further study is much needed to settle the system of the Hymenophyllaceae on a world-wide scale.

Literature: Copeland, E.B.: Trichomanes. Phil. J. Sci. 51: 119–280 with 61 pls. 1933; Hymenophyllum. Ibid. 64: 1–188. with 89 pls. 1937; Genera Hymenophyllacearum. Ibid. 67: 1–110 with 11 pls. 1938. All the Old World species known at the time were dealt with in these monographs with detailed illustration. Morton, C.V.. The Genera, Subgenera, and Sections of the Hymenophyllaceae. Contr. U.S. Natn. Herb. 38: 153–214. 1968. Notes are given to the systematics of this family

KEY TO THE GENERA

1. Receptacles included; involucre bivalvate, deeply cleft nearly to the base; rhizome slender, wiry, glabrescent
2. Margin of lobes entire — **1. Mecodium**
2. Margin of lobes toothed — **2. Hymenophyllum**
1. Receptacles extruded; involucre tubular with bilabiate, truncate or dilated mouth
3. False veinlets absent
4. Rhizome slender; fronds remote
5. Involucre cleft to halfway — **3. Meringium**
5. Involucre not deeply cleft
6. Hairy axial pads covering the fronds underneath — **8. Pleuromanes**
6. Hairy axial pads wanting
7. Marginal cells elongate and thick-walled — **9. Reediella**
7. Marginal cells not especially elongate nor thick-walled
8. Fronds dichotomous or digitate in appearance, axes not proliferous, often hairy at margin — **4. Microtrichomanes**
8. Fronds flabellate to pinnate, glabrous at margin
9. Rhizome very slender; fronds smaller, flabellate to pinnate; axes usually proliferous — **5. Gonocormus**
9. Rhizome not so slender; fronds medium-sized, pinnate; axes never proliferous — **6. Trichomanes**
4. Rhizome stout or fronds clustered
10. Fronds pinnate
11. Rhizome long-creeping; fronds remote — **6. Trichomanes**
11. Caudex erect; fronds clustered — **13. Cephalomanes**
10. Fronds bipinnatifid or more compound
12. Segments stiff and very narrow with 1–4 rows of cells at each side of midribs — **14. Macroglena**
12. Segments soft or broader
13. Fronds soft in texture, internal cell walls straight
14. Rhizome creeping — **6. Trichomanes**
14. Rhizome short, ascending to erect, bearing fronds in a tuft — **7. Callistopteris**
13. Fronds harsh in texture, internal cell walls coarsely pitted — **15. Selenodesmium**
3. False veinlets present
15. Marginal hairs present — **12. Didymoglossum**
15. Marginal hairs absent
16. Fronds pinnately divided or decompound — **10. Crepidomanes**
16. Fronds simple or lobed — **11. Microgonium**

## 1. MECODIUM

(Copel.) Copel., Phil. J. Sci. 67: 17. 1938; Gen. Fil: 33. 1947.—*Hymenophyllum* subgen. *Mecodium* Copel., Phil. J. Sci. 64: 93. 1937.

Rhizome long creeping, wiry, sparsely hairy; fronds remote, pinnately compound; each ultimate lobe with a single veinlet, entire but sometimes crisped at margin; sori solitary, terminal on ultimate segments; involucre bivalvate, deeply cleft nearly to the base; receptacles capitate to clavate, included.

About 100 species are included in this genus from the tropics and southern hemisphere, one ranging northwards to Amur, Saghalien and British Columbia. In Thailand 6 species are known.

KEY TO THE SPECIES

1. Axes glabrous
 2. Receptacles filiform to capitate; involucre triangular to subdeltoid, longer than wide or rarely reniform with the length nearly the same as the width
  3. Wings of axes flat or undulate
   4. Lips of involucre entire or at most slightly crenate — **1. M. polyanthos**
   4. Lips of involucre toothed — **2. M. productum**
  3. Wings of axes crisped
   5. Fronds 4–7 cm long; receptacles filiform to clavate — **3. M. javanicum**
   5. Fronds 2–4 cm long; receptacles columnar — **4. M. riukiuense**
 2. Receptacles capitate; involucre distinctly wider than long — **5. M. badium**
1. Axes persistently hairy — **6. M. exsertum**

**1. Mecodium polyanthos** (Sw.) Copel., Phil. J. Sci. 67: 19. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 37. 1967.—*Hymenophyllum polyanthos* (Sw.) Sw., Schrad. J. Bot. 1800(2): 102. 1801; Bedd.. Handb.: 30. 1883; Copel., Phil. J. Sci. 64: 97. pl. 46–47. 1937; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 54. 1939; Holtt., Rev. Fl. Malaya 2: 81. f. 23. 1955; Dansk Bot. Ark. 20: 17. 1961; 23: 229. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 85. 1958.—*Trichomanes polyanthos* Sw., Prod. Fl. Ind. Occ.: 137. 1788.

*Rhizome* slender, less than 0.2 mm diam., with hairy rootlets. *Stipes* (1–) 2–3 cm long, wingless except the uppermost part, sparsely hairy especially in the younger parts, the rootlets densely hairy, the hairs brown, up to 1 mm long. *Fronds* very variable both in size and form, lanceolate, oblong-lanceolate, oblong or subdeltoid, acute to acuminate at apex, 3–8 cm long, 1.5–3.5 cm wide, usually tripinnatifid, light green, herbaceous; rachis winged throughout, wings very narrow, entire, flat; pinnae less than 10 in pairs, the largest one in the middle of the frond, reducing in size both upward and downward, the larger ones oblong-subdeltoid or oblong-lanceolate, somewhat falcate; ultimate segments linear or narrowly lanceolate, round to obtuse at apex, the margin entire and flat, usually about 0.8 mm broad. *Sori* scattered usually on the upper parts of fronds; involucre subdeltoid or rarely reniform, about 1 mm in length, usually longer than the breadth, deeply divided; lips round or moderately acute, entire or slightly crenate; receptacles clavate, included. *Cell walls* thin, straight, rarely rather thick.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung, Phu Tong); CENTRAL: Nakhon Nayok (Khao Khieo); SOUTH-EASTERN: Chanthaburi (Khao Sabap), Trat (Khao Kuap); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai); PENINSULAR: Chumphon (Langsuan, Pang Wa), Surat Thani (Khao Nong, Ban Don), Nakhon Si Thammarat (Khao Luang).

Distribution.—Tropics or subtropics throughout the world (type from Jamaica), north to central Japan.

Ecology.—Epiphytic on tree trunks or on mossy rocks in light or deep shade, common at medium or higher altitudes.

Notes.—This is a very variable species, and Copeland (1937) enumerated 22 synonyms and the numbers are still increasing in later papers. In Thailand also there are various forms showing aberrant features. On the higher mountains in Northern province, there is a form similar to *M. paniculiflorum* (Presl) Copel. with the larger sori aggregated near the apex of the fronds. The size of sori is, however, not distinctly wider than the breadth of the ultimate segments and the Thai plants are different from the typical form of *M. paniculiflorum* growing in Borneo.

**2. Mecodium productum** (Kunze) Copel., Phil. J. Sci. 67: 20. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 38. 1967.—*Hymenophyllum productum* Kunze, Bot. Zeit. 6: 305. 1848; Copel, Phil. J. Sci. 64: 113. pl. 54. 1937; Holtt., Rev. Fl. Malaya 2: 83. f. 26. 1955. Fig. 5: 1.

*Rhizome* slender, about 0.5 mm diam. *Stipes* remote, glabrous but hairy at the very base, 3–5 cm long, the upper half winged with flat or slightly undulate wings. *Fronds* oblong to oblong-lanceolate, acute at apex, tripinnate to quadripinnatifid, herbaceous, green to deep green, glabrous throughout, (5–) 10–13 cm long, up to 5 cm wide; rachis like the upper part of stipes, slightly zigzag in upper part, winged throughout by flat wings 0.4–0.8 mm wide; pinnae up to 10 in pairs, the basal ones triangular-rhomboid, acute at apex, at the base subtruncate anteriorly and cuneate posteriorly, short stalked, up to 4.5 cm long, 2 cm wide; pinnules about 5 in pairs, with 5–10 segments; upper pinnae gradually becoming smaller; ultimate segments narrow, entire and flat at margin, obtuse to retuse at apex, 0.8–1.2 mm broad, the uppermost usually elongate up to twice as long as the normal ones. *Sori* extruded, lobes constricted below the base of involucre; involucre bilabiate, divided down almost to the base, just triangular, long acuminate at apex, round at base, 1.2–1.8 mm long, less than 1 mm wide; the lips toothed; receptacles clavate to somewhat columnar, included. *Cell walls* thin, straight.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Malaya, Sumatra, Borneo, Java (type), Philippines and north to Taiwan.

Ecology.—On mossy tree trunks in dense tropical evergreen forest at medium or higher altitudes.

**3. Mecodium javanicum** (Spr.) Copel., Phil. J. Sci. 67: 20. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 38. 1967; Acta Phytotax. Geobot. 23: 51. 1968.—*Hymenophyllum javanicum* Spr., Syst. Veg. 4: 132. 1827; Bedd., Handb.: 32. 1883; Copel., Phil. J. Sci. 64: 120. pl. 59. 1937; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 54. 1939; Holtt., Rev. Fl. Malaya 2: 83. f. 24. 1955.

*Rhizome* laxly branched, about 0.5 mm diam. *Stipes* remote, naked but the very base hairy, 2.5–4.5 cm long, winged except for the basal portion with undulate or crisped wings. *Fronds* oblong-subdeltoid, acute to moderately acute at apex,

tripinnate to quadripinnatifid, glabrous, 4–7 cm long, to 4 cm wide at the widest basal portion; pinnae 5 or more in pairs, the basal ones to 3 cm long, 2 cm wide, oblong-subdeltoid, moderately acute to round at apex, broadly cuneate to round at base, stalked, the upper ones gradually smaller upwards, oblong in outline; ultimate segments narrow, round to obtuse at apex, entire but undulate or crisped at margin, 0.6–1 mm broad, to 4 mm long, decurrent onto every axis forming distinct, waved or crisped wings of 0.8 mm or so. *Sori* scattered usually on the apical parts of pinnae: involucre subdeltoid to oblong, 1.2–1.6 mm long, to 1 mm broad, the lips finely toothed, receptacles clavate to filiform, wholly included in the involucre. *Cell walls* thin, straight.

Thailand.—PENINSULAR: Krabi (Phanom Bencha), Ranong (Khao Phota Chongdong), Surat Thani (Khao Nong), Phangnga (Khao Katha Khwam, Khao Bangto), Nakhon Si Thammarat (Khao Luang), Trang (Khao Sung), Yala (Khao Kalakhiri).

Distribution.—Throughout the tropics of Asia (type from Java) and Oceania.

Ecology.—On mossy tree trunks in dense tropical evergreen forest, rather common at medium or higher altitudes.

**4. Mecodium riukiuense** (Christ) Copel., Phil. J. Sci. 67: 21. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 38: 1967.—*Hymenophyllum riukiuense* Christ, Ann. Cons. Jard. Bot. Genève 4: 208. 1900; Copel., Phil. J. Sci. 64: 123. pl. 61. 1937. Fig. 5: 2.

*Rhizome* less than 0.2 mm diam., laxly branched, the rootlets densely hairy. *Stipes* dark, glabrous, 1–2 cm long, slender, winged throughout with crispate wings up to 0.6 mm wide on one side. *Fronds* oblong to oblong-subdeltoid, acute at apex, tripinnate to quadripinnatifid, herbaceous, green to dark green, glabrous, 2–4 cm long, 1–3 cm wide at basal widest portion; pinnae five or more in pairs, the basal ones triangular-rhomboid to oblong with a few pinnules, round at apex, cuneate at base, upper ones gradually becoming smaller; rachis like the upper parts of stipes, slender, somewhat zigzag, winged throughout; ultimate segments narrowly lanceolate, entire but more or less waved at margin, obtuse to retuse at apex, 0.6–1 mm broad, longer ones more than 4 mm long, the base decurrent to form the crispate wings of every axis. *Sori* usually aggregated at the apical part of frond; involucre bilabiate, 0.8–1.3 mm long, longer than wide, the lips toothed to fimbriate; receptacles columnar. *Cell walls* thin and entire.

Thailand.—NORTH-EASTERN: Loei (Phu Luang, Phu Kradung.)

Distribution.—Southern edge of Japan to the Ryukyus (type).

Ecology.—On moist rocks in primary forest near river at medium or higher altitudes.

**5. Mecodium badium** (Hook. & Grev.) Copel., Phil. J. Sci. 67: 23. 1938; Ching, Fl. Reip. Pop. Sin. 2: 137. pl. 10. f. 1–6. 1959; Tagawa & K. Iwats., Southeast As. St.

5: 38. 1967.—*Hymenophyllum badium* Hook. & Grev., Ic. Fil.: t. 76. 1828; Copel., Phil. J. Sci. 64: 144. pl. 76. 1937; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 53. 1939; Holtt., Rev. Fl. Malaya 2: 83. f. 25. 1955; Dansk Bot. Ark. 20: 16. 1961.—*Hymenophyllum javanicum* var. *badium* (Hook. & Grev.) Bedd., Handb.: 33. 1883.

*Rhizome* wiry, the rootlets densely hairy, 0.8 mm diam. *Stipes* hard, naked, up to 1 mm diam., less than 10 cm long, winged except the basal portion, the wings entire, more or less crisped or almost flat, gradually narrowing downwards. *Fronds* variable to some extent in size and form, usually oblong, occasionally broader or narrower, acute at apex, tripinnate to quadripinnatifid, (5–) 10–13 (–25) cm long, at most 7 cm wide; rachis like the upper part of stipes, winged throughout, wings up to 1.2 mm broad, entire, nearly flat, waved or crisped; pinnae to 10 in pairs, the larger ones oblong to oblong-lanceolate, acute or moderately acute at apex, to 4 cm long, 1.5 cm wide, upper ones gradually smaller; ultimate segments narrowly oblong or somewhat elongate, round to obtuse at apex, entire and flat at margin, 1 mm or broader, the wings of costae and the higher axes not crisped. *Sori* many on a frond; involucre orbicular-reniform, divided to the very base, 1.5– 2.5 mm long, somewhat broader; lips round, entire but occasionally undulate; receptacles capitate, included. *Cell walls* thin and uniform, rarely a little thicker.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao, Pong Namron); PENINSULAR: Krabi (Phanom Bencha), Nakhon Si Thammarat (Khao Luang, Thap Chang, Khiriwong), Phatthalung (Khao Luang).

Distribution.—N. India (type from Nepal) and S. China, southwards throughout Malesia, north to S. Japan.

Ecology.—On mossy tree trunks or on damp rocks usually in dense tropical evergreen forest, rather common at various altitudes.

**6. Mecodium exsertum** (Wall. ex Hook.) Copel., Phil. J. Sci. 67: 23. 1938; Ching, Fl. Reip. Pop. Sin. 2: 136. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 38. 1967.—*Hymenophyllum exsertum* Wall. ex Hook., Sp. Fil. 1: 109. pl. 38A. 1844; Bedd., Handb.: 30. f. 16. 1883; C. Chr., Contr. U.S. Natn. Herb. 26: 330. pl. 24. 1931; Copel., Phil. J. Sci. 64: 153. pl. 83. 1937; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 53. 1939; Holtt., Rev. Fl. Malaya 2: 86. f. 28. 1955; Dansk Bot. Ark. 20: 17. 1961; 23: 228. 1965. Fig. 5: 13.

*Rhizome* wiry, hairy throughout, laxly branched, about 0.3 mm diam. *Stipes* remote, hairy on the abaxial side, (1.5–) 3–5 cm long, sometimes winged on the upper part. *Fronds* very variable in shape and size, oblong-ovate, oblong or oblong-lanceolate, round to acute at apex, tripinnatisect, (2–) 7–10 cm long, (1–) 2.5–4 cm wide; rachis like the upper part of stipes, hairy throughout, more densely on abaxial side, winged throughout by flat wings, wings of the upper part broader, to 0.8 mm on both sides; pinnae many, more than twelve in pairs on lower fronds, oblong to oblong-

lanceolate, slightly falcate, round to moderately acute at apex, at most 2.5 cm long, 1 cm wide; pinnules with a few to several segments, in larger ones pinnately decompound; ultimate segments to 1.5 mm long, 1 mm broad, entire and flat; hairs on every axis, rather sparse on upper axis, brown, up to 2 mm long. *Sori* usually on upper side of pinnae, dispersing from near rachis outward, the base constricted; involucre bilabiate; lips subtriangular, moderately acute, entire and flat, to 2 mm long, 1 mm broad; receptacles clavate. *Cell walls* rather thick, coarsely pitted.

Thailand.—NORTHERN: Chiang Rai (Doi Tung, Doi Phacho), Mae Hong Son (Doi Khun Huai Pong), Chiang Mai (Doi Phahom Pok, Doi Suthep, Doi Inthanon, Doi Chang), Lamphun (Doi Khun Tan), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Khao Kuap); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai); PENINSULAR: Krabi (Phanom Bencha), Ranong (Khao Phota Chongdong), Nakhon Si Thammarat (Khao Luang), Trang (Khao Sung, Khao Chong).

Distribution.—N. India (type from Nepal), S. China, Upper Burma, Indochina, south to Malaya.

Ecology.—On mossy tree trunks in tropical evergreen forest at medium or higher altitudes.

## 2. HYMENOPHYLLUM

J.E. Smith, Mém. Acad. Turin. 5: 418. 1793; Copel., Phil. J. Sc. 67: 37. 1938; Gen. Fil.: 34. 1947.

Rhizome slender, wiry; fronds pinnately compound, the margin of segment toothed; sori at apex of ultimate segments; involucre bivalvate, deeply cleft to the base; receptacles not extruded.

In this restricted sense, only about 25 species belong to this genus, distributed evenly throughout the world, common in the south, rather rare in the tropics and extending northwards to Scotland, Norway and Japan. In Thailand only one species is known.

**Hymenophyllum barbatum** (van den Bosch) Baker, Syn. Fil.: 68. 1867; Copel., Phil. J. Sci. 64: 84. pl. 43. 1937; Ching, Fl. Reip. Pop. Sin. 2: 157. pl. 11. f. 5–8. 1859; Tagawa & K. Iwats., Southeast As. St. 5: 37. 1967.—*Leptocionium barbatum* van den Bosch, Ned. Kruid. Arch. 5(2): 146. 1863.

*Rhizome* about 0.2 mm diam., covered with stiff brownish hairs when young. *Stipes* 1.5–2.5 cm apart, narrowly winged in the upper part, rather densely hairy, 0.8–2.5 cm long. *Fronds* bipinnatifid to tripinnatifid, oblong to oblong-lanceolate,

moderately acute at apex, gradually narrowing or broadly cuneate to base, 3–8 cm long, at most 2.5 cm wide; rachis distinctly winged, rather densely hairy on the underside; pinnae linear-subdeltoid, acute at apex, unequally cuneate at base, the largest 1.5 cm long and 0.5 cm wide; ultimate segments linear-oblong, usually about 1.5 mm wide, distinctly toothed and flat or crisped at margin like the wings of the rachis; every axis rather distinct, hairy on the underside. *Sori* in the apices of short segments; involucre bilabiate almost to the base, the lips round to acute, serrate at margin; receptacles clavate, included.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Suthep, Doi Inthanon, Doi Hua Mot), Phitsanulok (Phu Miang), Tak (Ban Musoe); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Prachin Buri (Khao Yai), Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang).

Distribution.—N. India to Japan (type) south to Taiwan and Vietnam.

Ecology.—On mossy tree trunks or on moist rocks in tropical evergreen forest.

Notes.—This species is fairly variable in various features. In some cases *H. barbatum* is similar to *Mecodium exsertum* in habit and this may indicate a close relationship between these two species, which have the same kind of hair on the lower surface of the axes.

## 3. MERINGIUM

Presl, Hymen.: 116. pl. 83B. 1843; Copel. Phil. J. Sci. 67: 39. 1938; Gen. Fil.: 35. 1947.

Rhizome filiform, long-creeping, wiry, hairy; fronds distant, pinnately decompound; rachis winged throughout or terete at lower portion; ultimate segments toothed at margin, flat or crisped; cell walls usually thick and coarsely pitted; involucre obconic bilabiate at upper part; receptacles long extruded.

Some 60 species in the tropics throughout the world, six of them from Thailand.

### KEY TO THE SPECIES

1. Rachis terete in basal portion, wings of upper part of rachis, if any, narrow and flat
   2. Fronds lanceolate to ovate; lips entire — **1. M. meyenianum**
   2. Fronds deltoid, long-stipitate; lips denticulate
      3. Internal cell walls thin; lips acute — **2. M. bontocense**
      3. Internal cell walls thick and pitted; lips moderately acute — **3. M. holochilum**
1. Rachis winged throughout, with more or less crisped wings
   4. Fronds 3–8 cm long; wings somewhat crisped; ultimate segments denticulate to crisped but usually flat — **4. M. denticulatum**
   4. Fronds 1–2 (–3.5) cm long; wings strongly crisped; ultimate segments sharply toothed and conspicuously crisped, not in a plane — **5. M. acanthoides**

4. Fronds about 1 cm long; wings not crisped; ultimate segments denticulate, flat **6. M. blandum**

**1. Meringium meyenianum** Presl, Hymen.: 116. pl. 8B. 1843; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 51. 1968.—*Hymenophyllum meyenianum* (Presl) Copel., Phil. J. Sci. 64: 25. pl. 8. 1937.—*Didymoglossum serrulatum* Presl, Hymen.: 115, 140. 1843.—*Hymenophyllum serrulatum* (Presl) C. Chr., Ind. Fil: 367. 1905; Holtt., Rev. Fl. Malaya 2: 78. f. 19. 1955.—*Hymenophyllum smithii* Hook., Sp. Fil. 1: 97. t. 35B. 1844; Bedd., Handb.: 34. 1883.

*Rhizome* slender, covered with stiff brownish hairs. *Stipes* terete, without wings, with caducous hairs, 1.5–3 cm long; fronds very variable, tripinnatifid, oblong-lanceolate to oblong-ovate, acute at apex, gradually narrowing towards base, 4–10 cm long, 1.5–3.5 cm wide; rachis winged except in the basal part, hairy; pinnae sessile, round to acute at apex, unequally cuneate at base; ultimate segments of each pinnule few, linear, round to moderately acute at apex, irregularly toothed and flat at margin; pale green in colour, the axes dark. *Sori* at the apices of short basal acroscopic segments in the upper part of fronds; involucre tubular with bilabiate mouth, the lips acute, entire.

Thailand.—PENINSULAR: Ranong (La-un), Yala (Gunong Ina).

Distribution.—Throughout Malesia (type from Philippines).

Ecology.—On mossy tree trunks or on moist rocks in deep shade in evergreen forests, rather rare.

**2. Meringium bontocense** (Copel.) Copel., Phil. J. Sci. 67: 41. 1938.; Tagawa & K. Iwats., Southeast As. St. 5: 36. 1967.—*Hymenophyllum bontocense* Copel., Phil. J. Sci. 64: 33. pl. 12. 1937. Fig. 5: 15.

*Rhizome* slender, hairy on the young part. *Stipes* slender, wingless or very narrowly winged in the upper part, hairy, 1–2 cm long; rachis winged in the upper part, hairy. *Fronds* oblong to oblong-lanceolate, round or very moderately acute at apex, bipinnate, 4–6 cm long, 1.3–2.2 cm wide; pinnae 6–8 in pairs, sessile, the upper ones gradually reducing in size, the larger ones oblong-ovate in outline, round to obtuse at apex, unequally cuneate at base; ultimate segments of pinna 5–8, round at apex, sharply serrate at margin, about 1.5 mm broad; green in colour; cell walls thin. *Sori* at apices of short acroscopic segments, usually on the basal ones only; involucre obconic, with bilabiate mouth, the lips acute, entire.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution—Only known from Luzon (type), and this locality in Thailand.

Ecology.—On moist rocks in dense hill evergreen forest, at about 1650 m alt.

**3. Meringium holochilum** (van den Bosch) Copel., Phil. J. Sci. 67: 41. 1938; Ching, Fl. Reip. Pop. Sin. 2: 149. 1959.—*Didymoglossum holochilum* van den Bosch, Pl. Jungh. 1: 561. 1856.—*Hymenophyllum holochilum* (van den Bosch) C. Chr., Ind. Fil.: 362. 1905; Copel., Phil. J. Sci. 64: 34. p . 14. 1937; Holtt., Rev. Fl. Malaya 2: 77. f. 17. 1955. Fig. 5: 4.

*Rhizome* slender, bearing rather sparse pale brown hairs. *Stipes* hairy, wingless or very narrowly winged on upper portion with a row of cells on each side, 1–1.5 cm long. *Fronds* oblong, round to moderately acute at apex, 3–4 cm long, up to 1.7 cm wide, bipinnatifid to tripinnatifid; rachis slender, hairy beneath, wingless or very narrowly winged in lower portion with usually flat and not toothed wings; pinnae 5–9 in alternate pairs, oblong to ovate, with 2–7 segments; segments usually simple, rarely forked or trilobed; ultimate segments oblong, round at apex, distinctly toothed but not crisped, to 1.5 mm broad. *Sori* solitary, on basal acroscopic lobes of pinnae; involucre with tuberous base and bivalvate upper portion, cleft to half-way, about 2 mm long, 1 mm broad; lips subdeltoid, moderately acute at apex, subentire or slightly waved.

Thailand.—PENINSULAR: Ranong (Khao Nom Sao), Nakhon Si Thammarat (Khao Luang).

Distribution.—Malesia (type from Java).

Ecology.—On trees in tropical evergreen forest at about 900 m alt.

**4. Meringium denticulatum** (Sw.) Copel., Phil. J. Sci. 67: 42. 1938; Ching, Fl. Reip. Pop. Sin. 2: 150. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 37. 1967; Acta Phytotax. Geobot. 23: 51. 1968.—*Hymenophyllum denticulatum* Sw., Schrad. J. Bot. 1800(2): 100. 1801; Bedd., Handb.: 34. 1883; Copel., Phil. J. Sci. 64: 41. pl. 15. 1937; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 57. 1939; Holtt., Rev. Fl. Malaya 2: 79. 1955.

*Rhizome* slender, bearing stiff, brownish hairs. *Stipes* narrowly winged almost to the base, hairy when young, 1–3 cm long. *Fronds* bipinnate to tripinnatifid, oblong-lanceolate to oblong-subdeltoid, acute at apex, narrowly cuneate (usually in larger fronds) to subtruncate (in smaller ones) at base, 3–8 cm long, 2–3 cm wide; pinnae oblong-ovate to lanceolate, round at apex, unequally cuneate at base, usually with less than 10 segments; ultimate segments linear-oblong, round to obtuse at apex, sharply toothed at margin, decurrent at base to form wings of axes, to 5 mm long, 1.3 mm broad; the wings of rachis and costae (sometimes the ultimate segments also) toothed and crisped to varying degree; cell walls rather thick, coarsely pitted. *Sori* apical on short acroscopic segments, usually near rachis in the upper part of fronds; involucre obconic, tubular with bilabiate mouth, with accessory wings, the lips round to moderately acute, serrate at margin.

Thailand.—PENINSULAR: Ranong (La-un, Khao Nom Sao), Nakhon Si Thammarat (Khao Luang, Thung Song), Narathiwat (Sg. Padi), Yala (Khao Kala-

khiri, Ban Chana).

Distribution.—Ceylon and N. India through Malesia (type from Java) to Fiji, north to the Ryukyus.

Ecology.—On mossy tree trunks in dense tropical evergreen forest.

**5. Meringium acanthoides** (van den Bosch) Copel., Phil. J. Sci. 67: 42. 1938; Ching, Fl. Reip. Pop. Sin. 2: 151. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 37. 1967; Acta Phytotax. Geobot. 23: 51. 1968 —*Didymoglossum acanthoides* van den Bosch, Pl. Jungh. 1: 16. 1856.—*Hymenophyllum acanthoides* (van den Bosch) Rosenst., Bull. Jard. Bot. Btzg. II. 2: 25. 1911; Copel., Phil. J. Sci. 64: 45. pl. 17. 1937; Holtt., Rev. Fl. Malaya 2: 20. 1955. Fig. 5: 5.

*Rhizome* slender, covered with brownish hairs when young. *Stipes* 1–3 cm apart, winged, 0.7–1.5 cm long. *Fronds* variable in size and form, bipinnate to tripinnatifid, oblong-subdeltoid, moderately acute at apex, broadly cuneate to subcordate at base, 1–2 cm long and wide (at most 3.5 cm long in the largest ones); rachis winged; pinnae with several segments, ovate to oblong, round at apex, unequally cuneate at base; ultimate segments round or obtuse at apex, 1 mm or so wide, the margin sharply toothed and conspicuously crisped, the fronds never extending in a plane. *Sori* at apices of short acroscopic segments, usually in apical part of fronds; involucre tubular with bilabiate mouth, winged, also with a few accessory wings, the lips round and sharply toothed.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang), Yala (Betong).

Distribution.—Tropics of Asia, Java (type), to New Guinea, north to Taiwan.

Ecology.—On mossy tree trunks or on moist mossy rocks in tropical evergreen forest at low to medium altitudes.

**6. Meringium blandum** (Racib.) Copel., Phil. J. Sci. 67: 43. 1938.—*Hymenophyllum blandum* Racib., Pterid. Buit.: 20. 1898; Copel., Phil. J. Sci. 64: 50. pl. 18. 1937.

*Rhizome* long-creeping, wiry, very slender, about 0.1 mm diam., naked. *Stipes* terete, usually about 2 mm long, hairy at base. *Fronds* pinnate-bipinnatifid in plan but digitate in appearance, with about 10 segments, suborbicular to oblong-ovate in outline, typically about 1 cm in both length and width; ultimate segments round at apex, about 0.8 mm broad, the margin denticulate, flat; pale green in colour, axis dark. *Sori* not known in Thai material; solitary on segments; involucre with tuberous base and bivalvate lips, cleft to half-way, about 1.6 mm long, less than 1 mm broad; lips subdeltoid, moderately acute at apex.

Thailand.—PENINSULAR: Phangnga.

Distribution.—W. Malesia (type from Java).

Ecology.—Evergreen mountain forest.

## 4. MICROTRICHOMANES

Copel., Phil. J. Sci. 67: 35. 1938; Gen. Fil.: 34. 1947.

Rhizome very slender, wiry; fronds usually small, seemingly digitate or flabellate, in principle pinnately branching or dichotomous in some foreign species; ultimate segments entire, setiferous at margin or sometimes on costae and surfaces as well, or quite glabrous in some species; cell walls thin; involucre cup-shaped with entire lips; receptacles extruded.

About 10 species are referred to this genus, but its status is rather doubtful. To elucidate the classification of the filmy ferns as a whole, it is very important to know the species of this genus in much more detail (Cf. K. Iwatsuki, Fern Gaz. 11: 115–124. 1975); only one species has ever been collected in Thailand.

**Microtrichomanes digitatum** (Sw.) Copel., Phil. J. Sci. 67: 36. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 41. 1967.—*Trichomanes digitatum* Sw., Syn. Fil.: 370 422. 1806; Bedd., Handb.: 39. f. 19. 1883; Copel., Phil. J. Sci. 51: 159. pl. 7. f. 3–4. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 66. 1939; Holtt., Rev. Fl. Malaya 2: 94. f. 32. 1955. Fig. 5: 6.

*Rhizome* long-creeping, hairy, hairs caducous, pale brownish, up to 1 mm long. *Stipes* like rhizome, hairs caducous, terete, wingless except in the uppermost part, 2–4 cm long. *Fronds* rather irregular in outline, almost circular to oblong, every axis winged to form the segments just the same as the ultimate segments, to 5 cm long, 4 cm wide; ultimate segments linear-lanceolate, usually slightly falcate, round to obtuse at apex, 1.5–2 mm broad, usually 1 cm or so in length but occasionally elongate to the length of more than 2 cm, flat and setiferous at margin. *Sori* sunk in the apices of the ultimate segments; involucre cup-shaped with seemingly bilabiate mouth, 2 mm long including mouth, 1 mm diam, the mouth as broad as the ultimate segments.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Widely known in the Old World tropics: Madagascar, Mauritius, Malaya, Borneo, Java, Philippines and Samoa; type from 'Ins. Franciae et Borboniae'.

Ecology.—On muddy rocks in dense tropical evergreen forest, known only on Khao Luang, locally abundant there.

Notes.—The Southeast Asiatic form may be separable from the East African type at the rank of subspecies.

## 5. GONOCORMUS

van den Bosch, Hymen. Jav.: 7. 1861; Copel., Gen. Fil.: 38. 1947.

Rhizome filamentous, generally not distinctly different from stipes and rachis, all axes typically proliferous; fronds small, flabellate or pinnate, segments narrow and entire or broad and incised, glabrous; cell walls thin; involucre elongate, the mouth dilated, entire; receptacles extruded.

The species of this genus are ill defined and are difficult to circumscribe. Some authors recognize about 10 species and the others only 2 or 3. For Thailand the following 3 species are listed here rather tentatively.

### KEY TO THE SPECIES

1. Segments usually more than 0.3 mm broad; involucre with dilated mouth; fronds pale green to green
   2. Axes not or rarely proliferous; fronds flabellate to pinnately decompound **1. G. saxifragoides**
   2. Axes copiously proliferous; fronds pinnately decompound **2. G. prolifer**
1. Segments to 0.2 mm broad; involucre with hardly dilated mouth; fronds dark green in living condition **3. G. siamensis**

**1. Gonocormus saxifragoides** (Presl) van den Bosch, Hymen. Jav.: 9. 1861.—*Trichomanes saxifragoides* Presl, Hymen.: 16, 39. 1843; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 2. 1929; Sledge, J. Linn. Soc. Bot. 60: 298. 1968.—*Trichomanes parvulum* Bl., En. Pl. Jav.: 223. 1828, non Poir. 1808; Bedd., Handb.: 39. f. 18. 1883; Copel., Phil. J. Sci. 51: 145. pl. 5. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 65. 1939.—*Trichomanes minutum* auct. non Bl.: Holtt., Rev. Fl. Malaya 2: 96: 1955.—*Gonocormus minutus* auct. non (Bl.) van den Bosch: Copel., Phil. J. Sci. 67: 57. 1938; Ching, Fl. Reip. Pop. Sin. 2: 175. pl. 12. f. 1–6. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 40. 1967.

*Rhizome* long-creeping, very slender, covered with dark brownish hairs, the hairs caducous. *Stipes* slender, wingless, about 1 cm long. *Fronds* seemingly flabellate to bipinnate, irregularly branching dichotomously or with short main axis, about 1 cm long, often wider than long, not or rarely proliferous; ultimate segments with a single veinlet, about 0.8 mm wide, round to moderately acute at apex, the margin entire, thickened and somewhat curved inwardly. *Sori* at apices of ultimate segments; involucre tubular, winged, the mouth conspicuously dilated.

Thailand.—NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); PENINSULAR: Surat Thani (Ko Tao), Phangnga (Khao Katha Khwam), Phuket (Khao Phra).

Distribution.—Old World tropics (type from Luzon), east to Polynesia and north to Japan.

E c o l o g y.—On mossy tree trunks or on rather dry muddy rocks, fairly common in mixed or evergreen forest at various altitudes.

**2. Gonocormus prolifer** (Bl.) Prantl, Hymen.: 51. 1875; Ching, Fl. Reip. Pop. Sin. 2: 178. pl. 12. f. 7. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 40. 1967; Acta Phytotax. Geobot. 23: 52. 1968.—*Trichomanes proliferum* Bl., En. Pl. Jav.: 224. 1828; Bedd., Handb.: 39. 1883; Copel., Phil. J. Sci. 51: 150. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 66. 1959; Holtt., Rev. Fl. Malaya 2: 97. f. 33. 1955.—*Gonocormus teysmanni* van den Bosch, Hymen. Jav.: 10. pl. 5. 1861; Tagawa & K. Iwats., Southeast As. St. 5: 40. 1967.

*Rhizome* long-creeping, slender, sparsely covered with dark hairs. *Stipes* slender, wingless, glabrescent, 1–3 cm long. *Fronds* flabellate to oblong, usually pinnate in plan or seemingly dichotomous, to 4 cm or more long, 1–2.5 cm wide; rachis proliferous, the proliferation repeated several times; ultimate segments linear, round to moderately acute at apex, more or less recurved at margin. *Sori* sunk at apices of segments; involucre tubular, winged, the mouth dilated.

T h a i l a n d.—NORTH-EASTERN: Loei (Phu Luang); EASTERN: Nakhon Ratchasima (Khao Lotung); SOUTH-EASTERN: Prachin Buri (Khao Yai), Trat (Ko Kut); SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang); PENINSULAR: Krabi (Ko Pu), Ranong (Khao Phota Chongdong), Nakhon Si Thammarat (Khao Luang), Trang (Khao Sung Khao Chong), Narathiwat (Bacho Falls), Yala (Khao Kalakhiri, Betong).

D i s t r i b u t i o n.—Throughout Malesia (type from Java).

E c o l o g y.—On wet mossy rocks near streams or on mossy tree trunks; fairly common in tropical evergreen forest at medium or higher altitudes.

N o t e s.—*Gonocormus teysmannii* is distinguished by the larger fronds with less frequent proliferation and pinnately decompound plan of pinnation of fronds with oblong to oblong-lanceolate outline. It is possible to separate the specimens into two groups by these features, though the specific distinction is doubtful. Here they are treated as conspecific, pending a final decision from further studies.

**3. Gonocormus siamensis** Tagawa & K. Iwats., Acta Phytotax. Geobot. 22: 99. f. 3. 1967; Southeast As. St. 5: 40. 1967.

*Rhizome* creeping, about 0.2 mm diam., more or less densely covered with brownish straight hairs about 0.5 mm long. *Stipes* terete, slender, 1–1.5 cm long, very narrowly winged only on the uppermost part bearing brownish caducous bristles at the very base, rarely proliferous near base. *Fronds* oblong in outline, usually gradually narrowing towards acuminate or moderately acute apex, the base cuneate to round, bipinnatifid, 1.5–5 cm long, less than 2 cm wide; pinnae to ten pairs, digitately acute at apex, cuneate at base, to 15 mm long, 3 mm wide, upper ones

gradually merging into pinnatifid apex of lamina; pinnules simple or lobed into two to five segments, the segments acute or nearly so at apex, entire, narrow, 0.1–0.2 mm broad, with 10–15 rows of longer cells. *Sori* axial, about 12 mm long, 0.5 mm diam., tubular, the mouth subtruncate or hardly dilated, broadly winged on both sides with wings of about 0.2 mm in breadth.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang-type).

Distribution.—Sumatra (Atjeh).

Ecology.—On mossy rocks in dense hill evergreen forest at 1600 m alt.

Notes.—Describing this species as new, we misobserved the proliferation of the lower part of the stipes. However, this species is still distinct from *G. prolifer* in its much more finely dissected fronds and their deep green colour. In this species the ultimate segments are usually 2–3 mm long, 0.1–0.2 mm broad, but in *G. prolifer* they are hardly more than 1 mm in length and 0.3–0.5 mm in breadth. *G. siamensis* is known only in the type locality and on Gunong Kemiri in North Sumatra, in a rather restricted area there though abundant in individuals. In the living condition, *G. siamensis* is deep green and the cell-contents are fill the cells. In the other species, on the contrary, plants are yellowish green or pale green in appearance and the cells have large vacuoles.

## 6. TRICHOMANES

Linn., Sp. Pl.: 1907. 1753.—*Vandenboschia* Copel., Phil. J. Sci. 67: 51. 1938; Gen. Fil.: 37. 1947.

Rhizome short- to long-creeping, rather thick, usually densely hairy; fronds more or less remote, pinnately compound, small to medium in size; ultimate segments entire at margin, usually glabrous; involucre cup-shaped with long extruded receptacles.

*Trichomanes* Linn. is here limited to the narrow concept indicated by the above description, corresponding to *Vandenboschia* Copel. nom. superfl. As pointed out by Holttum (1955) and Morton (1968), the type of *Trichomanes* may be *T. speciosum,* and some 25 species, mostly tropical, belong to the genus in this restricted sense. Three species are native to Thailand.

### KEY TO THE SPECIES

1. Rhizome climbing on trees or cliffs: fronds simple pinnate **1. T. auriculatum**
1. Rhizome creeping on rocks or on sandy ground; fronds pinnately decompound
   2. Fronds close together; wings of axes narrower than the ultimate segments **2. T. maximum**
   2. Fronds well spaced; wings of axes as wide as or wider than the ultimate segments, pinnules not so deeply cut **3. T. birmanicum**

**1. Trichomanes auriculatum** Bl., En. Pl. Jav.: 225. 1828; Bedd., Handb.: 44. 1883; Copel., Phil. J. Sci. 51: 223. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 69. 1939; Holtt., Rev. Fl. Malaya 2: 105. f. 41. 1955.—*Vandenboschia auriculata* (Bl.) Copel., Phil. J. Sci. 67: 55. 1938: Ching, Fl. Reip. Pop. Sin. 2: 181. pl. 13. f. 1–2. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 43. 1967; Acta Phytotax. Geobot. 23: 52. 1968.

*Rhizome* very long, climbing to several metres, 1.2–1.8 mm diam., densely hairy on the ventral side. *Stipes* 2–5 cm apart, very narrowly winged in the upper parts, hairy when young, usually less than 2 cm in length; fronds simply pinnate, linear-lanceolate, acuminate at apex, gradually narrowing towards base, 20–30 cm long, 3–5 cm wide; pinnae sessile, rhomboid to oblong, oblique, round at apex, truncate acroscopically and cuneate basiscopically at base, to 3 cm long, 1.5 cm broad, lobed to varying degree, the incisions reaching a quarter of the way or nearly to the costae, the margin of lobes serrate, each tooth containing a single veinlet; green to deep green. *Sori* terminal on veinlets; involucre tubular with dilated mouth, sessile, narrowly winged, about 2 mm long, 0.6 mm diam.; receptacles long extruded, slender, curved.

Thailand.—NORTH-EASTERN: Loei (Phu Kradung); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Chumphon (Ban Kraya), Surat Thani (Khao Nong), Nakhon Si Thammarat (Khao Luang), Pattani (Bacho), Trang (Khao Chong), Yala (Ban Chana).

Distribution.—N. India to Japan, southwards to Malesia throughout (type from Java) to New Guinea.

Ecology.—Climbing on tree trunks or on cliffs usually in dense mountain forest rather common at various altitudes.

**2. Trichomanes maximum** Bl., En. Pl. Jav.: 228. 1828; Bedd., Handb. Suppl.: 10. 1892; Copel., Phil. J. Sci. 51: 217. pl. 38. f. 1–4. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 72. 1939; Holtt., Rev. Fl. Malaya 2: 107. f. 43. 1954.—*Vandenboschia maxima* (Bl.) Copel., Phil. J. Sci. 67: 54. 1938; Ching, Fl. Reip. Pop. Sin. 2: 182. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 73. 1965; 5: 44. 1967; Acta Phytotax. Geobot. 23: 52. 1968.

*Rhizome* creeping, thick, 2 mm or more diam., densely covered with stiff dark brownish hairs when young. *Stipes* rather close to each other, stramineous, very narrowly winged in the upper part, hairy at base, 10–20 cm long. *Fronds* oblong-subdeltoid, acute at apex, one or two pairs of basal pinnae smaller than the next above forming round outline at base, 15–25 cm long, 10–15 cm wide, finely decompound to quadripinnatifid; rachis narrowly winged throughout, wings entire and flat; pinnae oblong subdeltoid to oblong-lanceolate, acute to acuminate at apex, unequally cuneate and stalked at base, larger ones 10 cm long, 3 cm wide; ultimate segments about 0.5–0.7 mm broad, at a narrow angle to the next larger division of the frond, round to moderately acute at apex, often curved inwardly; the wings of various axes

narrower than the ultimate lobes, entire, flat. *Sori* on short axillary lobes usually near the pinna- or pinnule-rachis; involucre tubular, with short stalk and dilated mouth, narrowly winged, about 2 mm long, 0.7 mm diam., the mouth 1 mm or more diam.

Thailand.—PENINSULAR: Ranong (Khao Phota Chongdong), Surat Thani (Khao Khieo range), Phangnga (Khao Katha Khwam, Kapong), Nakhon Si Thammarat (Khao Luang, Huai Suai-Nai), Trang (Khao Chong), Pattani (Bacho), Yala (Khao Kalakhiri, Klong Chana.)

Distribution.—In the tropics of E. Asia (type from Java) and Polynesia.

Ecology.—On moist muddy rocks or on wet sandy ground near streams in dense gloomy forest, rather common at various altitudes.

**3. Trichomanes birmanicum** Bedd., Ferns Br. Ind. Suppl.: 3. pl. 349. 1876; Handb.: 43. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 70. 1939.—*Vandenboschia birmanica* (Bedd.) Ching in Ching & Wang, Acta Phytotax. Sin. 8: 135. 1959; Fl. Reip. Pop. Sin. 2: 185. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 44. 1967.—*Trichomanes radicans* auct. non Sw.: Bedd., Handb.: 43. 1883; Copel., Phil. J. Sci. 51: 213. pl. 35. f. 1–2. 1933, p.p.; Holtt., Rev. Fl. Malaya 2: 107. 1955; Dansk Bot. Ark. 20: 18. 1961. Fig. 5: 7.

*Rhizome* long-creeping, more than 1 mm diam., densely covered with dark brownish hairs. *Stipes* more than 1 cm apart, distinctly winged almost to the base, hairy when young, 2.5–5 cm long. *Fronds* oblong-lanceolate, acute at apex, round to cordate at base, 6–10 cm long, 2–4 cm wide, tripinnatifid; rachis winged throughout, the wings more than 0.5 mm broad on each side, entire and flat; pinnae subdeltoid (larger ones) to ovate (upper ones), moderately acute at apex, broadly cuneate to subtruncate at base, stalks shortly winged, in larger ones about 2 cm long and wide; ultimate segments narrow, about 0.3 mm broad, acute at apex; not so deeply dissected, wings of various axes usually broader than the ultimate lobes; dark green in colour. *Sori* on short axial segments, usually on basal acroscopic portions of pinnules or on secondary pinnules; involucre tubular with little-dilated mouth and short stalk, about 1.5 mm long, 0.7 mm diam.

Thailand.—NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Suthep, Doi Inthanon), Mae Hong Son (Mae La Noi), Lampang (Mae Tia), Phrae; NORTH-EASTERN: Loei (Phu Kradung); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai).

Distribution.—Burma (type form Moulmein), S. China, N. Indochina and Japan.

Ecology.—On wet sandy ground or on moist muddy rocks usually in evergreen forest near streams, rather rare, at medium to high altitudes.

Notes.—*T. birmanicum* is a form in warm temperate regions of Asia and

differs in size, and especially in the thickness of rhizome from the closely allied *T. radicans* Sw., which is of wide distribution throughout tropics and subtropics.

## 7. CALLISTOPTERIS

Copel., Phil. J. Sci. 67: 64. 1938; Gen. Fil.: 40. 1947.

Rhizome short, ascending to erect, bearing a tuft of fronds, hairy near apex; stipes densely hairy with patent, multicellular, bright brown bristles; laminae finely dissected to quadripinnatifid; ultimate segments one-nerved, entire; sori cup-shaped; receptacles long extruded.

A genus of five species in Southeast Asia and Polynesia, closely related to *Trichomanes* s.str. and to *Nesopteris* Copel. of the same region. Only one species is once collected in Thailand.

**Callistopteris apiifolia** (Presl) Copel., Phil. J. Sci. 67: 65. 1938; Ching, Fl Reip. Pop. Sin. 2: 194. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 178. 1970.—*Trichomanes apiifolium* Presl, Hymen.: 108, 136. 1843; Bedd., Handb. Suppl.: 11. 1892; Copel., Phil. J. Sci. 51: 227. pl. 42. f. 1. 1933.

*Rhizome* stout. *Stipes* stramineous to darker, to 13 cm long; hairs reddish brown to darker, bright, patent, stiff, multicellular, to 5 mm long. *Fronds* tripinnate to quadripinnatifid, to 25 cm long, 8 cm wide, oblong-lanceolate, acute at apex, roundly cuneate at base; rachis dark stramineous to brownish, densely hairy with shorter and darker bristles, wingless or very narrowly winged in upper portion, easily broken; pinnae usually more than 1 cm apart, narrowly elliptic, more or less falcate, acute at apex, truncate acroscopically and cuneate basiscopically at base, up to 6 cm long, 1.5 cm wide; pinna-rachis narrowly winged throughout, glabrous; pinnules oblong, round at apex, unequally cuneate at base, up to 1.5 cm long, 5 mm wide; ultimate segments linear, round to moderately acute at apex, entire; cell walls thin, smooth, sometimes the pagina clathrate. *Sori* on short branches, usually at distal side of pinnules; involucre cup-shaped, about 1 mm long and diam., with truncate mouth; receptacles long extruded.

Thailand.—PENINSULAR: Krabi (Phanom Bencha).

Distribution.—S. Japan (Yakushima), Ryukyu, Nicobar, Taiwan, throughout Malesia (type from Luzon) to Fiji, not in Malaya.

Ecology.—On rocks in evergreen forest at about 1100 m alt.

## 8. PLEUROMANES

Presl, Epim.: 258. 1849; Copel., Phil. J. Sci. 67: 55. 1938; Gen. Fil.: 38. 1947.

Rhizome long-creeping, filiform, hairy; fronds pinnate, with entire segments,

the submarginal strands two cells thick, undersurface of ultimate segments glaucous, hairy; involucre obconic, with entire margin; receptacles filiform, long extruded.

A small genus related to *Trichomanes* s. str.; it contains three species, one of which occurs in Thailand.

**Pleuromanes pallidum** (Bl.) Presl, Epim.: 258. 1849; Copel., Phil. J. Sci. 67: 56. 1938; Ching, Fl. Reip. Pop. Sin. 2: 172. pl. 14. f. 5–8. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 41. 1967; Acta Phytotax. Geobot. 23: 52. 1968.—*Trichomanes pallidum* Bl., En. Pl. Jav.: 225. 1828; Bedd., Handb.: 41. 1883; Copel., Phil. J. Sci. 51: 141. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 67. 1939; Holtt., Rev. Fl. Malaya 2: 97. 1955; Dansk Bot. Ark. 20: 17. 1961.

*Rhizome* wiry, about 0.3 mm diam., covered with light brownish hairs. *Stipes* dark stramineous, hairy at the base, 1.5–4 cm long, without wings. *Fronds* bipinnate to subtripinnatifid, oblong to somewhat irregular in outline about 5 cm long, 1.5 cm wide, somewhat variable in size; pinnae oblong to oblong-lanceolate, round to acute at apex, cuneate at sessile base; ultimate segments linear-lanceolate, acute at apex, entire and flat at margin; undersurface of laminar part covered with powder, glaucous in appearance, densely covered with stellate or filiform hairs; marginal cells extremely modified. *Sori* terminal on short acroscopic axial lobes; involucre cup-shaped to tubular, subdeltoid, about 1.5 mm long, the lips slightly dilated.

Thailand.—NORTH-EASTERN: Loei (Phu Kradung); PENINSULAR: Krabi (Phanom Bencha), Surat Thani (Khao Nong, Khao Khieo range), Nakhon Si Thammarat (Khao Luang), Trang (Khao Sung), Yala (Gunong Ina).

Distribution.—From Ceylon to Polynesia (type from Java), north to Taiwan.

Ecology.—Pendulous on moist muddy rocks in dense forest at medium altitudes.

## 9. REEDIELLA

Pich.-Ser., Webbia 24: 718. 1970.—*Crepidopteris* Copel., Phil. J. Sci. 67: 57. 1938; Gen. Fil.: 39. 1947. non Sternb. 1838.—*Crepidophyllum* Reed, Amer. Fern J. 38: 88. 1948.

Rhizome long-creeping, filiform; fronds pinnately compound, with winged rachis; ultimate segments entire at margin, one or two rows of marginal cells elongate and thick-walled; involucre tubular, winged, with expanded entire mouth; receptacles extruded.

This is a small natural genus of the *Trichomanes* s. str. group. There are about 5 species in Malesia and Polynesia: in Thailand only one species is known.

**Reediella humilis** (Forst.f.) Pich.-Ser., Webbia 24: 719. 1970.—*Trichomanes humile* Forst.f., Fl. Ins. Austr. Prod.,: 84. 1786: E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 2. 1929; Copel., Phil. J. Sci. 51: 164. pl. 12. 1933; Holtt., Rev. Fl. Malaya 2: 98. f. 34. 1955.—*Crepidopteris humilis* (Forst.f.) Copel., Phil. J. Sci. 67: 59. 1938; Ching, Fl. Reip. Pop. Sin. 2: 174. pl. 15. f. 8–9. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 73. 1965; 5: 41. 1967.—*Crepidophyllum humile* (Forst.f.) Reed, Amer. Fern J. 38: 89. 1948.

*Rhizome* slender, irregularly branching, densely covered wtih short, dark brownish hairs. *Stipes* hairy at base, winged upper part, at most 1 cm long. *Fronds* rather irregularly pinnately compound, usually bipinnate, oblong to ovate-lanceolate, moderately acute to round at apex, gradually narrowing to cuneate base, at most 3 cm long and 1.5 cm wide; pinnae 2–6 in pairs, ill-differentiated; ultimate segments linear-lanceolate, round to obtuse at apex, 0.8–1.2 mm broad, decurrent to costa and rachis forming wings; two rows of marginal cells elongate parallel to margin, two to four times as long as wide, with cross walls running obliquely downwards and inwards from margin. *Sori* at the first acroscopic branches of the primary segments; involucre tubular to campanulate, less than 1.5 mm long, copiously winged and immersed in segments; mouth dilated and expanded broadly, almost circular as seen from above.

Thailand.—PENINSULAR: Ranong (Khlong Kamphuan), Phuket (Thalang), Phattalung (Khlong Khiri Khao), Trang (Khao Chong).

Distribution.—Sumatra to Tahiti (type), north to Taiwan.

Ecology.—On muddy rocks near the river in dense evergreen forest at low altitudes.

## 10. CREPIDOMANES

Presl, Epim.: 258. 1849; Copel. Phil. J. Sci. 67: 58. 1938; Gen. Fil.: 39. 1947.

Rhizome long-creeping, filiform, hairy, usually rootless; fronds dwarfed and digitate to medium sized and pinnately compound, the ultimate segments or lobes entire at margin; false veinlets present either marginal or oblique; involucre obconic to campanulate, winged, with bilabiate mouth; receptacles extruded.

More than a dozen species belong here, from the Old World tropics, Madagascar to Tahiti, north to Japan. The presence of false veinlets is a distinctive key-character to recognize a group of genera centered on *Crepidomanes*. In Thailand we recognize here 8 species.

### KEY TO THE SPECIES

1. Mouth of involucre dilated, not bilabiate — **1. C. christii**
1. Mouth of involucre bilabiate
2. Submarginal false veinlets absent, or if present incomplete

3. Fronds digitate in appearance, to 2 cm long; sori extruded on narrow constriction **2. C. megistostomum**
3. Fronds pinnate, more than 3 cm long; sori not constricted at base **3. C. latealatum**
2. Submarginal false veinlets present
4. Submarginal false veinlets interrupted, other striae many
5. Fronds usually more than 3 cm long; segments more than 0.8 mm broad **4. C. bilabiatum**
5. Fronds 1.5–2 cm long; segments about 0.6 mm broad **6. C. brevipes**
4. Submarginal false veinlets continuous or rarely interrupted, other striae few or none
6. Marginal cells in two rows; ultimate segments usually more than 0.7 mm broad
7. Fronds usually more than 3 cm long, pinnate in plan **5. C. bipunctatum**
7. Fronds less than 2 cm long, appearing digitate in plan in smaller plants but pinnatifid to pinnate in full grown plants **7. C. latemarginale**
6. Marginal cells in one row; ultimate segments to 0.7 mm broad **8. C. kurzii**

**1. Crepidomanes christii** (Copel.) Copel., Phil. J. Sci. 67: 60. 1938; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 52. 1968.—*Trichomanes christii* Copel., Phil J. Sci. 1. Suppl.: 251. 1906; 51: 185. pl. 21. 1933; Holtt., Rev. Fl. Malaya 2: 100. f. 37. 1955.

*Rhizome* long-creeping usually on branches of tree, slender, densely covered with blackish hairs, about 0.3 mm diam. *Stipes* not so remote, 1–5 cm apart, 0.5–1.3 cm long, hairy. *Fronds* tripinnatifid, ovate to oblong in outline, acute to moderately acute at apex, gradually narrowing downwards, 4–6 cm long, 2–3 cm wide; pinnae about 10 in pairs, oblong to oblong-lanceolate, round at apex, broadly cuneate at sessile base, the largest ones 2 cm long, 0.8 cm wide; pinnules with 2 to 4 segments; segments lanceolate, round to moderately acute at apex, entire but undulate at margin, about 0.6 mm broad, with a single vein; false veinlets marginal, continuous or interrupted, with two rows of marginal cells, oblique false veinlets few if any. *Sori* one to a segment, usually in apical part of fronds; involucre tubular with dilated mouth, about 1 mm long, 0.8 mm diam., the mouth distinctly dilated, about 1.5 mm diam.

Thailand.—SOUTH-WESTERN: Kanchanaburi (Chedi Sam Ong); PENINSULAR: Ranong (Khlong Kamphuan, Khao Phota Chongdong), Yala (Gunong Ina, Ban Pla Hat, Betong).

Distribution.—Sumatra and Malaya to the Philippines (type from Mindoro).

Ecology.—On branches of trees in evergreen forest at low altitudes.

**2. Crepidomanes megistostomum** (Copel.) Copel., Phil. J. Sci. 67: 60. 1938.—*Trichomanes megistostomum* Copel., Phil. J. Sci. 51: 191. pl. 23. f. 4–6. 1933.

*Rhizome* wide-creeping, filiform with numerous rhizoids. *Stipes* short, winged upper part. *Fronds* almost digitate in appearance, bluntly quadrangular in outline, round at apex, cuneate at base, about 2 cm long including stipes of 5–8 mm in length,

1 cm wide, bipinnatifid or subdigitate, pinnae with 2–4 segments; segments round at apex, entire at margin, about 1 mm in breadth, the base decurrent to rachis, continuing to the wings on the upper part of stipes; false veinlets short, oblique or somewhat elongate between costa and margin of segments, submarginal ones wanting. *Sori* solitary, terminal on the ultimate segments, extruded on narrow constriction, cup-shaped, about 1.5 mm long; the mouth of involucre bilabiate.

Thailand.—NORTHERN: Phitsanulok (Thung Salaeng Luang); PENINSULAR: Phangnga (type).

Distribution.—Endemic.

Ecology.—On wet rocks in tropical evergreen forest at about 500 m alt.

Notes.—The description given above is based on the Thung Salaeng Luang Plants.

3. **Crepidomanes latealatum** (van den Bosch) Copel., Phil. J. Sci. 67: 60. 1938; Ching, Fl. Reip. Pop. Sin. 2: 165. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 42. 1967.—*Didymoglossum latealatum* van den Bosch, Ned. Kruid. Arch. 5: 138. 1863; Copel., Phil. J. Sci. 51: 192. pl. 25–26. 1933.—*Trichomanes latealatum* (van den Bosch) Christ, Verh Nat. Ges. Basel 11: 424. 1896; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 64. 1939; Holtt., Rev. Fl. Malaya 2: 101. 1955; Dansk Bot. Ark. 20: 17. 1961.—*Trichomanes bipunctatum* var. *latealatum* (van den Bosch) Clarke, Tr. Linn. Soc. II. Bot. 1: 49. 1880; C. Chr., Contr. U.S. Natn. Herb. 26: 330. 1931.—*Trichomanes plicatum* (van den Bosch) Bedd., Ferns Br. Ind.: t. 285. 1868; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 65. 1939; Holtt., Dansk Bot. Ark. 23: 229. 1965; Sledge, J. Linn. Soc. Bot. 60: 305. 1968.—*Trichomanes bipunctatum* var. *plicatum*. (van den Bosch) Bedd., Handb.: 42. 1883.—*Didymoglossum plicatum* van den Bosch, Ned. Kruid. Arch. 5: 139. 1863.

Similar to *C. bipunctatum* but differs in the lack of submarginal false veinlets, the other striae numerous, oblique.

Thailand.—NORTHERN: Chiang Rai (Doi Tung, Doi Phacho) Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon), Mae Hong Son (Doi Khun Huai Pong), Tak (Ban Musoe), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH EASTERN: Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Song Tho), Prachuap Khiri Khan (Khao Luang); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

Distribution.—Widely known in N. India (type), S. China and in SE. Asia.

Ecology.—On mossy tree trunks or on mossy or muddy rocks in moist dense forest, common at various altitudes.

Notes.—As to the difference between *C. latealatum* and *T. plicatum*, we cannot

give any conclusion, but the plants so named in Himalayan and Malesian regions seem to be all conspecific.

**4. Crepidomanes bilabiatum** (Nees & Bl.) Copel., Phil J. Sci. 68: 59. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 41. 1967.—*Trichomanes bilabiatum* Nees & Bl., Nova Acta 11: 123. t. 13. f. 2. 1823; C. Chr., Bot. Tidsskr. 32: 34. 1916; Copel., Phil. J. Sci. 51: 179. pl. 18. f. 5–6. 1933; Holtt., Rev. Fl. Malaya 2: 99. f. 36. 1955; Dansk Bot. Ark. 23: 229. 1965.

Close to *C. bipunctatum* but different in the submarginal false veinlets uneven and often interrupted, the marginal cells sometimes more than 2 in rows, the other oblique striae many.

Thailand.—SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

Distribution.—Western Malesia (type from Java).

Ecology.—On moist rocks along streams usually in spray in dense evergreen forest.

Notes.—In definition this is distinguished from *C. bipunctatum* by having oblique false veinlets in addition to nearly continuous submarginal false veinlet, but the variation of the latter species suggests that the condition of the submarginal false veinlets is not so constant as to warrant a discrimination of the species. *C. bilabiatum* is said to have larger fronds with shorter, round, and hardly spreading lips of involucre, but the variation of the other species includes both the conditions described.

**5. Crepidomanes bipunctatum** (Poir.) Copel., Phil. J. Sci. 67: 59. 1938; Ching, Fl Reip. Pop. Sin. 2: 162. pl. 12. f. 8. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 74. 1965; 5: 41. 1967; Acta Phytotax. Geobot. 23: 52. 1968.—*Trichomanes bipunctatum* Poir. in Lamk., Enc. 8: 69. 1808; Bedd., Handb.: 41. 1883; C. Chr., Bot. Tidsskr. 32: 340. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 2. 1929; Copel., Phil. J. Sci. 51: 177. pl. 18. f. 1–4. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 63. 1939; Holtt., Rev. Fl. Malaya 2: 99. f. 35. 1955; Dansk Bot. Ark. 20: 17. 1961; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958.—*Trichomanes pyxidiferum* auct. non Linn.: Christ, Bot. Tidsskr. 24: 103. 1901.—*Trichomanes filicula* auct. non Bory: Christ, Bot. Tidsskr. 24: 103. 1901.

*Rhizome* about 0.7 mm diam., covered with dark brownish hairs. *Stipes* (0.5–) 2–3 cm long, winged almost to the base, bearing short hairs. *Fronds* variable in shape and size, ovate to oblong, round to acute at apex, tripinnatifid, usually 4–8 cm long, 3–5 cm wide, often dwarfed with sori; pinnae 5–8 in pairs, the larger ones 1.5–3 cm long, 1–1.5 cm wide, shortly stalked or sessile in the upper ones; pinnules oblong to subdeltoid, with about 10 segments; ultimate segments linear-lanceolate, at a narrow angle to each other, acute at apex, entire and flat at margin; false veinlets marginal, continuous, occupying two rows of marginal cells, the other striae few. *Sori* on the

apices of short axillary lobes; involucre tubular, 1–1.8 mm long, winged, the mouth bilabiate, the lips round to acute, as wide as long.

Thailand.—NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); EASTERN, Nakhon Ratchasima (Pak Thong Chai, Kathok, Ban Thakum); SOUTH-EASTERN: Chanthaburi (Taruang, Khao Sabap, Makham, Phriu waterfall), Trat (Ko Chang, Dan Chumpon, Ko Kut); SOUTH-WESTERN: Kanchanaburi (Khlong Wa); PENINSULAR: Krabi (Phanom Bencha), Chumphon (Tha Ngo, Tha San, Langsuan), Ranong (La-un, Khao Phota Chongdong), Surat Thani (Khlong Nam Wing, Ban Kop Kaep, Ko Tao, Ban Don), Nakhon Si Thammarat (Khao Luang, Ao Luk), Phuket (Ko Talibong, Thalang), Phatthalung (Khlong Hin Khao), Trang (Khao Chong), Satun (Khuan Kalong, Nam Tok Boripat, Thung Nui), Narathiwat (Sg. Padi) Yala (Khao Kalakhiri, Bannang Sta, Muang Wing).

Distribution.—Old World tropics (type from Madagascar).

Ecology.—On mossy or muddy rocks or on mossy tree trunks in dense forest at various altitudes.

**6. Crepidomanes brevipes** (Presl) Copel., Phil. J. Sci. 67: 60. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 42. 1967.—*Didymoglossum brevipes* Presl, Hymen.: 139. 1843.—*Trichomanes brevipes* (Presl) Baker, Syn. Fil.: 84. 1867; Copel., Phil. J. Sci. 51: 182. pl. 20. 1933.

*Rhizome* slender, densely covered with dark brownish hairs, bearing the fronds about 1 cm apart. *Stipes* short, 0.2–0.6 cm long, winged in the upper part. *Fronds* bipinnatifid, ovate to oblong-ovate, moderately acute at apex, cuneate at base, 1.5–2 cm long, 0.7–1 cm wide; pinnae with 2–5 segments, costae and costules with broad wings; ultimate segments round to acute at apex, entire and flat, about 0.6 mm wide, decurrent onto axes forming wings; false veinlets many, short and oblique, or submarginal and interrupted. *Sori* at apices of the short acroscopic segments; involucre tubular, winged, with bilabiate mouth, the lips round at apex, about one-third of the length of the involucre.

Thailand.—PENINSULAR: Krabi (Ban Keng), Trang (Khao Chong).

Distribution.—Borneo, Philippines (type), New Guinea and Micronesia.

Ecology.—On moist rocks near streams in dense evergreen forest.

Notes.—This species stands intermediate between *C. bipunctatum* and *C. latemarginale*, especially in the construction of the false veinlets and size of plants.

**7. Crepidomanes latemarginale** (Eaton) Copel., Phil. J. Sci. 67: 60. 1938; Ching, Fl. Reip. Pop. Sin. 2: 164. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 42. 1967.—*Trichomanes latemarginale* Eaton, Proc. Am. Acad. 4: 111. 1858; Copel., Phil. J. Sci. 51: 189. pl. 24. 1933, p.p. major; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 63. 1939; Holtt., Rev. Fl. Malaya 2: 101. 1955.—*Trichomanes nanum* auct. non van den Bosch:

Christ, Bot. Tidsskr. 24: 103. 1901,—*Trichomanes parvulum* auct. non Poir.: E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 2. 1929.

*Rhizome* very slender, densely covered with short brownish hairs. *Stipes* about 0.5–1 cm apart, 2–4 mm long, very narrowly winged in the upper part, hairy especially in the basal part. *Fronds* almost circular to oblong-subdeltoid in outline, less than 2 cm long, 1.2 cm wide, often digitate in appearance but typically pinnate in branching; segments 5–12, linear-lanceolate, round to moderately acute at apex, entire but sometimes obscurely crisped at margin, with a single vein, 1–1.2 mm wide; false veinlets marginal, continuous, with two rows of marginal cells outside the false veinlets. *Sori* sunk in the apices or segments; involucre tubular with bilabiate mouth, about 1 mm long, 0.8 mm diam., the mouth just wider than the segments.

Thailand.—NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ko Tao), Trang (Palian).

Distribution.—Assam to S. China (type from Hongkong) including Taiwan, south to Malaya.

Ecology—On muddy or mossy rocks in mixed or in evergreen forest at medium altitudes.

Notes.—Kerr 19103 from Trang has numerous oblique striae other than the submarginal veinlets, and the lips of involucre are very short.

**8. Crepidomanes kurzii** (Bedd.) Tagawa & K. Iwats., Acta Phytotax. Geobot. 26: 169. 1975.—*Trichomanes kurzii* Bedd., Ferns Br. Ind.: t. 286. 1868; Handb.: 40. f. 20. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 62. 1939; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 177. 1970.—*Crepidomanes nanophyllum* Tagawa, Acta Phytotax. Geobot. 9: 142. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 42. 1967.—*Trichomanes latemarginale* Eaton, Proc. Am. Acad. 4: 111. 1859; Copel., Phil. J. Sci. 33: 189. 1933, p.p.—*Crepidomanes* sp.: Tagawa & K. Iwats., Southeast As. St. 5: 74. 1965, p.p. Fig. 5: 10.

Small dwarf plants. *Rhizome* very slender, densely covered with dark brownish hairs. *Stipes* short, less than 2 mm long, narrowly winged almost to the base, hairy. *Fronds* pinnate to bipinnatifid, oblong to subdeltoid but without definite shape, round to moderately acute at apex, broadly cuneate to subtruncate and often very shortly decurrent at base, at most 0.8 mm long, 0.5 mm wide; ultimate segments 3 to 12, linear-lanceolate, round to acute or sometimes acuminate at apex, to 3 mm long, 0.7 mm broad, decurrent onto axes; intramarginal false veinlets continuous, with one row of marginal cells, other striae wholly wanting. *Sori* a few, sunk in the apex of the segments to the point of separation of the mouth; involucre funnel-shaped to campanulate, the mouth slightly dilated, with entire and round lips, not typically bilabiate.

Thailand.—PENINSULAR: Trang (Khao Chong).

Distribution.—Burma (type) and Taiwan.

Ecology.—On damp rocks near the river in dense forest at low altitudes, known only in one locality.

## 11. MICROGONIUM

Presl, Hymen.: 19. pl. 6. 1843; Copel., Phil. J. Sci. 67: 61. 1938; Gen. Fil.: 39. 1947.

Rhizome long-creeping, filiform, hairy, rootless; fronds small, simple, entire or lobed, or sometimes bifid, glabrous, with pinnate or flabellate veins; false veinlets present, sometimes continuous to veins; involucre cup-shaped with expanded mouth; receptacles extruded.

Some 20 species distributed in the tropics of both worlds; four species are known from Thailand.

KEY TO THE SPECIES

1. Fronds much less than 1 cm long
   2. Fronds simple and lanceolate, or dichotomous or pinnatifid, main veins distinct throughout **1. M. parvifolium**
   2. Fronds circular or roundly oblong, simple, main veins sometimes obsolete near apex **2. M. motleyi**
1. Fronds to 1–2.5 cm or longer
   3. Submarginal false veinlets absent **3. M. sublimbatum**
   3. Submarginal false veinlets present **4. M. bimarginatum**

**1. Microgonium parvifolium** (Baker) Tagawa & K. Iwats., Acta Phytotax. Geobot. 26: 169. 1975.—*Hymenophyllum parvifolium* Baker, J. Linn. Soc. Bot. 9: 340. pl. 8. f. E. 1866; Bedd., Handb.: 28. f. 14. 1883.—*Trichomanes parvifolium* (Baker) Copel., Phil. J. Sci. 51: 211. 1933; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 178. 1970.—*Microgonium minutifolium* Tagawa & K. Iwats., Acta Phytotax. Geobot. 22: 98. f. 2. 1967; Southeast As. St. 5: 39. 1967.—*Crepidomanes* sp.: Tagawa & K. Iwats., Southeast As. St. 3(3): 74. 1965, p.p. Fig. 5: 9.

*Rhizome* ca. 0.15 mm diam., densely covered with brownish hairs 0.1–0.2 mm long. *Stipes* terete, 0.5–1.5 mm long, more slender than rhizome, glabrous or with caducous hairs like those on rhizome. *Fronds* small, at most 6 mm long including stipes, simple and lanceolate, or dichotomous or pinnatifid in plan, simple lamina or ultimate segments oblong-lanceolate, round at apex, entire on margin, 1.5–3 mm long, 0.7–1 mm broad, with a simple distinct veins; pseudo-veinlets several on a segment, oblique; laminar cells 25–40 μ diam., cell walls thick but straight. *Sori* solitary, terminal on ultimate segment, involucre obconic, tubular, 0.8–1.2 mm long, irregularly hairy with coarse hairs about 0.1 mm long; the mouth bilabiate, about 0.5 mm long, subtriangular, moderately acute at apex.

Thailand.—SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Trang (Khao Chong).

Distribution.—Burma (Moulmein-type).

Ecology.—On damp rocks in moist places in dense forest at medium or high altitudes.

Notes.—This is a small species with simple fronds or lobes having a subentire margin. In these features it is comparable with *Crepidomanes kurzii,* and quite distinct from *M. sublimbatum.*

**2. Microgonium motleyi** van den Bosch, Hymen. Jav.: 5. t. 1. 1861; Tagawa & K. Iwats., Southeast As. St. 5: 39. 1967.—*Trichomanes motleyi* van den Bosch, Ned. Kruid. Arch. 5: 145. 1861; Bedd., Handb.: 36. 1883; Copel., Phil. J. Sci. 51: 201. pl. 30. f. 1–4, 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 61. 1939; Holtt., Rev. Fl. Malaya 2: 92. f. 30. 1955.—*Trichomanes nanum* auct. non van den Bosch: Christ, Bot. Tidsskr. 24: 103. 1901.

*Rhizome* creeping on base of tree, about 0.1 mm diam., densely hairy with short dark brownish hairs. *Fronds* almost sessile or on very short hairy stipes, simple, imbricate, circular or orbicular-oblong, the margin entire and plane, at most 4 mm in every direction; costae short, at most halfway to the apex of frond, without any branching; false veinlets many, simple or branched. *Sori* one on a frond, in a sinus at end of short main vein, deeply immersed; involucre tubular with dilated mouth, less than 1 mm long, 0.4 mm broad, the mouth up to 1 mm diam.

Thailand.—NORTHERN: Tak (Doi Musoe); PENINSULAR: Chumphon (Khlong Wa), Surat Thani (Sawi), Phangnga (Khao Katha Khwam, Khao Bangto), Phuket (Khao Phra), Trang (Khao Chong).

Distribution.—Malaya and Borneo (type).

Ecology.—On basal part of tree trunks in dense primary forest at low altitudes.

**3. Microgonium sublimbatum** (K. Müll.) van den Bosch, Hymen. Jav.: 6. t. 2. 1861; Tagawa & K. Iwats., Southeast As. St. 5: 39. 1967.—*Trichomanes sublimbatum* K. Müll., Bot. Zeit. 12: 737. 1854; C. Chr., Bot. Tidsskr. 32: 340. 1916; Copel., Phil. J. Sci. 51: 198. pl. 28. f. 1–2. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 62. 1939; Holtt., Rev. Fl. Malaya 2: 92. f. 29. 1955.

*Rhizome* about 0.2 mm diam., densely hairy; hairs brown, simple, less than 0.4 mm long. *Fronds* usually 5–10 mm apart, simple, the margin obscurely lobed at most a quarter way to costae, oblong to linear-oblong, round to obtuse at apex, gradually narrowing downwards to subtruncate to cuneate base, 1–2.5 cm long, less than 1 cm broad; stipes less than 3 mm long, very narrowly winged except the basal 1–2 mm, densely hairy like the rhizome; lateral veins 3–4 in pairs, simple or forked; false veinlets oblique, parallel to the lateral veins, long, ending just within the

margin, usually several to fifteen lines between the adjacent lateral veins, without marginal veins. *Sori* 1 to 5 on the apical part of frond, terminal on the lobes; involucre tubular with dilated mouth, completely immersed in frond, 1.5–2 mm long, less than 1 mm diam., the mouth up to 2 mm diam.

Thailand.—NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Dan Chumphon, Khao Saming, Ko Chang); PENINSULAR: Krabi (Phanom Bencha), Chumphon (Khlong Kamphuan), Phangnga (Bangto), Satun (Khao Khieo range), Nakhon Si Thammarat (Khao Luang), Trang (Khao Soi Dao).

Distribution.—SE. Asia generally (type from Java), Assam to New Guinea.

Ecology.—On muddy surface of rocks usually in moist gloomy forest at high altitudes.

Notes.—This is also variable, as seen in Kerr 16874 in which are included the various sizes of fronds: the larger ones are typical for this species attaining more than 1 cm long with 2–4 sori at apex, though smaller ones are similar to *M. parvifolium* in appearance, up to 4 mm long and 1 mm broad in soriferous fronds. Even in such smaller ferns, however, the false veinlets run throughout from midribs to margin of fronds having no shorter oblique striae among them.

**4. Microgonium bimarginatum** van den Bosch, Hymen. Jav.: 7. 1861; Ching, Fl. Reip. Pop. Sin. 2: 160. pl. 8. f. 7. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 73. 1965; 5: 39. 1967; Acta Phytotax. Geobot. 23: 51. 1968.—*Trichomanes bimarginatum* van den Bosch, Ned. Kruid. Arch. 5: 143. 1861; Copel., Phil. J. Sci. 51: 208. pl. 33. f. 1–4. 1933; Holtt., Rev. Fl. Malaya 2: 92. 1955; Dansk Bot. Ark. 20: 17. 1961.

*Rhizome* irregularly branching, about 0.2 mm diam., densely covered with brownish hairs 0.3–0.4 mm long. *Fronds* 0.5–2 cm apart, simple, lobed to one-third (or very rarely to a half) way to costae, oblong to oblong-lanceolate, round to obtuse at apex, round to cuneate at base, the margin more or less crisped, 1.5–2 (–2.5) cm long, 6–8 (–10) mm broad; stipes 2–4 mm long, densely hairy; lateral veins a few to several in pairs, usually forked (or in larger fronds trifurcate); oblique false veinlets many, long, the marginal one continuous with a single row of marginal cells outside the strand, joining the ends of oblique ones. *Sori* one to several on the apical part of frond, terminal on the lateral veins; involucre tubular with dilated mouth, immersed in frond, 1.5–2 mm long, less than 0.8 mm diam., the mouth to 1.8 mm diam.

Thailand.—PENINSULAR: Surat Thani (Khao Nong), Phangnga (Khao Bangto), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Yala (Khao Kalakhiri).

Distribution.—Widely distributed in SE. Asia and Australia, Ceylon (type) to Samoa and Queensland.

Ecology.—On muddy surface of rocks usually in dense forest at various altitudes.

## 12. DIDYMOGLOSSUM

Desv., Prod.: 330. 1827; Copel., Phil. J. Sci. 67: 76. 1938; Gen. Fil.: 42. 1947.

Rhizome filiform, long-creeping, bearing dense hairs, rootless; fronds small, simple to pinnate, setiferous at margin; false veinlets present, usually oblique, many; sori marginal; involucre elongate with bilabiate mouth; receptacles extruded.

The presence of the false veinlets indicates the relationship of this genus to *Microgonium* Presl, though the hairs on fronds may show another affinity to *Microtrichomanes* Copel. There are more than 20 species, mainly from the New World tropics; one is known from Thailand.

**Didymoglossum exiguum** (Bedd.) Copel., Phil. J. Sci. 67: 78. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 40. 1967.—*Hymenophyllum exiguum* Bedd., Ferns Br. Ind.: t. 275. 1868.—*Trichomanes exiguum* (Bedd.) Baker, Syn Fil.: 464. 1874; Bedd., Handb.: 37. 1883; Copel., Phil. J. Sci. 51: 205. pl. 32. f. 1–2. 1933; Holtt., Rev. Fl. Malaya 2: 94. f. 31. 1955. Fig. 5: 12.

*Rhizome* slender, less than 0.1 mm diam., densely covered with brownish hairs. *Fronds* simple, lanceolate or oblong-lanceolate, round or moderately acute at apex, cuneate at base, 5–7 (–10) mm long, less than 3 mm broad, the margin subentire, hairy with brownish stellate hairs; costae simple, continuous to the apex, not branching; false veinlets numerous, oblique, variously branching. *Sori* solitary at the apex of frond, half immersed; involucre tubular with dilated mouth, about 1.5 mm long, 0.7 mm diam., the mouth 0.8 mm diam.

Thailand.—SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

Distribution.—Ceylon (type), S. India and Malaya.

Ecology.—On moist mossy rocks in dense evergreen forest.

## 13. CEPHALOMANES

Presl, Hymen.: 17. pl. 5. 1843; Copel., Phil. J. Sci. 67: 66. 1938; Gen. Fil.: 40. 1947.

Rhizome stout, short, erect; fronds simply pinnate; pinnae unequal-sided, usually rhomboid in outline, subentire or serrate at margin, harsh in texture; involucre cylindrical, with truncate mouth; receptacles long extruded.

About 10 species are known in the tropics from India to Polynesia. One is native to Thailand.

**Cephalomanes javanicum** (Bl.) van den Bosch, Hymen. Jav.: 30. t. 22. 1861; Ching, Fl. Reip. Pop. Sin. 2: 189. pl. 14. f. 1–4. 1959; Tagawa & K. Iwats., Southeast As. St.

3(3): 74. 1965; 5: 43. 1967; Acta Phytotax. Geobot. 23: 52. 1968.—*Trichomanes javanicum* Bl., En. Pl. Jav.: 224. 1828; Bedd., Handb.: 44. f. 21. 1883; Christ, Bot. Tidsskr. 24: 103. 1901; C. Chr., Bot. Tidsskr. 32: 340. 1916; Copel., Phil. J. Sci. 51: 246. pl. 52. f. 1. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 68. 1939; Holtt., Rev. Fl. Malaya 2: 102. f. 38. 1955; Dansk Bot. Ark. 20: 17. 1961.

*Rhizome* erect, bearing many wiry roots and a tuft of fronds. *Stipes* wingless, dark stramineous, covered with dark brownish hairs, 0.8–1.2 mm in diameter, 5 cm or more long. *Fronds* pinnate, lanceolate in outline, gradually narrowing both upwards and downwards, 10–20 cm long, 2.5–4 cm wide; rachis very narrowly winged, sparsely hairy; pinnae many, with very short stalks, oblong-lanceolate, round at apex, unequally cuneate at base, serrate at margin, up to 2.5 cm long, 0.8 cm broad. *Sori* on acroscopic side of the upper pinnae, 2 to 5 on each pinna; fertile pinnae deeply cut on both sides of each sorus, sorus placed at apex of a lobe and the tips of involucre on the line of the edges of pinnae; involucre tubular, truncate at mouth, narrowly winged, thick in texture, 2 mm long, 1 mm diam.; receptacles very long extruded.

Thailand.—SOUTH-EASTERN: Chanthaburi (Phriu waterfall, Khao Sabap), Trat (Ko Chang, Ko Kut, Ko Khlum); PENINSULAR: Ranong (Lam Liang, Muang Laen), Surat Thani (Ban Don), Phangnga (Takua Pa), Phuket (Ko Lanta Yai), Trang (Khao Chong), Yala (Bacho, Ban Chana, Bannang Sta).

Distribution.—SE. Asia generally (type from Java).

Ecology.—On sandy slopes or on wet muddy rocks by streams in dense evergreen forest at low or medium altitudes.

## 14. MACROGLENA

Copel., Phil. J. Sci. 67: 82. 1938; Gen. Fil.: 44. 1947.

Rhizome short-creeping, stout, hairy, with wiry roots; fronds pinnately decompound, finely dissected, the laminae reduced to narrow wings of the axes containing a few rows of cells; cell walls thick, coarsely pitted; involucre elongate or cup-shaped with truncate mouth; receptacles elongate, extruded.

About twelve species belong to this genus in the Old World tropics. Two of them are known in Peninsular Thailand.

### KEY TO THE SPECIES

1. Ultimate segments very narrow, setaceous, with less than two rows of cells at each side of veins, placed not in one plane **1. M. meifolia**
1. Ultimate segments broader, with 2–4 rows of larger cells at each side of veins, arranging almost in one plane **2. M. gemmata**

**1. Macroglena meifolia** (Bory ex Willd.) Copel., Phil. J. Sci. 67: 83. 1938.—*Trichomanes meifolium* Bory ex Willd., Pl. Sp. 5: 509. 1810; Copel., Phil. J. Sci. 51: 265. 1933; Holtt., Rev. Fl. Malaya 2: 103. 1955. Fig. 5: 8.

*Rhizome* 1.2–1.5 mm diam., rather densely covered with bright brownish setose hairs. *Stipes* rather close, stiff, very narrowly winged, dark brown, hairy when young, 0.7–1 mm diam., to 8 cm long. *Fronds* oblong-lanceolate, acute at apex, cuneate at base, 7–17 cm long, 2.5–5 cm wide, finely dissected to quadripinnate, second and third branching not in a plane and fronds more or less cubic in form; rachis very narrowly winged, the wings with a single row of cells; pinnae ascending, oblong in outline, round at apex, cuneate to subtruncate at base, in larger ones more than 2 cm long, 1 cm wide, shortly stalked; ultimate segments very narrow, with less than two rows of cells at each side of veins, setaceous, straight. *Sori* at apices of short segments usually near pinna-rachis; involucre cup-shaped, less than 1 mm long, 0.7 mm diam., the mouth truncate; receptacles extruded, slender.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Widely distributed throughout the tropics of the Old World (type from Reunion).

Ecology.—Terrestrial on humus-rich floor of dense forest at medium altitudes.

**2. Macroglena gemmata** (J. Smith ex Baker) Copel., Phil. J. Sci. 67: 84. 1938; Tagawa & K. Iwats., Southeast As. St. 5: 43. 1967.—*Trichomanes gemmatum* J. Smith ex Baker, Syn. Fil.: 87. 1867; Bedd., Handb. Suppl.: 10. 1892; Copel., Phil. J. Sci. 51: 269. pl. 61. f. 2. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 69. 1939; Holtt., Rev. Fl. Malaya 2: 104. f. 40. 1955.

Similar to *M. meifolia* differing in: rachis and stipes very narrowly winged; the ultimate segments broader, with 2–4 rows of cells at each side of veins, placed almost in a plane; the laminar cells larger in size.

Thailand.—PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.—Malaya (type) and Borneo.

Ecology.—On moist clayey slope in dense forest at high altitudes.

Vernacular.—Luklui (ลุกลุย) (Peninsular).

## 15. SELENODESMIUM

Copel., Phil. J. Sci. 67: 80. 1938; Gen. Fil.: 42. 1947.

Rhizome short, creeping to erect; stipes hairy, the hairs setose, deciduous; fronds pinnately compound with dissected pinnules, firm in texture; cell walls thick, coarsely pitted; involucre elongate, with entire mouth; receptacles extruded.

About 10 species are credited to this genus known throughout the tropics of both worlds. One occurs in the southern part of Thailand.

**Selenodesmium obscurum** (Bl.) Copel., Phil. J. Sci. 67: 81. 1938; Ching, Fl. Reip. Pop. Sin. 2: 191. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 44. 1967; Acta Phytotax. Geobot. 23: 52. 1968.—*Trichomanes obscurum* Bl., En. Pl. Jav.: 227. 1828; Copel., Phil. J. Sci. 51: 233. pl. 43–44. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 69. 1939; Holtt., Rev. Fl. Malaya 2: 108. f. 44. 1955; Dansk Bot. Ark. 23: 229. 1965.—*Trichomanes siamense* Christ, Bot. Tidsskr. 24: 103. 1901; C. Chr., Bot. Tidsskr. 32: 417. 1916.—*Selenodesmium siamense* (Christ) Ching & Wang, Acta Phytotax. Sin. 8: 138. 1959; Ching, Fl. Reip. Pop. Sin. 2: 191. pl. 15. f. 6–7. 1959.—*Trichomanes rigidum* auct. non Sw.: Bedd., Handb.: 44. 1883; Christ, Bot. Tidsskr. 24: 103. 1901.

*Rhizome* very short, creeping or ascending, bearing many wiry roots and stipes, covered with dark hairs, 1–1.2 mm diam. *Stipes* stiff, stramineous, wingless, covered with brownish hairs, the hairs dense at base, 0.7–1.3 mm in diameter, sometimes more than 10 cm long but often dwarfed. *Fronds* oblong-subdeltoid or oblong-ovate, gradually narrowing towards acute apices, broadly cuneate or subtruncate at base, the larger ones more than 15 cm long, 8 cm wide, tripinnatifid, or more finely dissected; rachis narrowly winged, pinnae with very short stalks, oblong-lanceolate, acute at apex, cuneate at base, up to 5 cm long, 1.5 cm wide; pinnules with several segments, the bases decurrent to form narrow wings of costae; texture coarse, dark green in colour. *Sori* apical on apical segments, cup-shaped, 1.2 mm long, 1 mm diam., winged, the mouth truncate.

Thailand.—NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Ranong (Khao Nom Sao, Khao Phota Luang Kaeo), Nakhon Si Thammarat (Khao Luang), Satun, Yala (Ban Chana, Khao Kalakhiri).

Distribution.—Widely distributed in the tropics of the Old World (type from Java.)

Ecology.—On wet sandy ground near streams in dense evergreen forest at high altitudes.

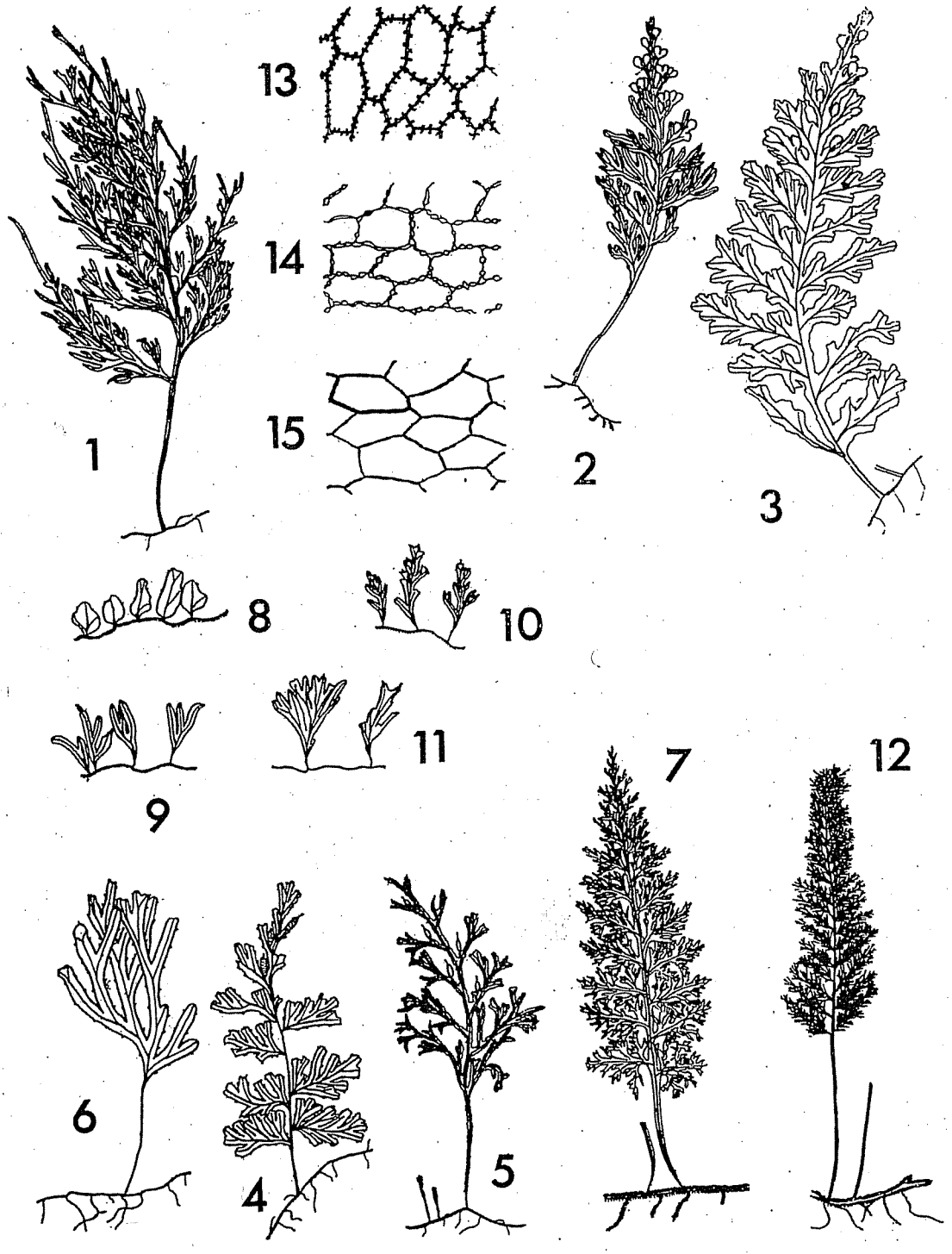



Figure 5. 1: *Mecodium productum*, x 1/2. 2: *Mecodium riukiuense*, natural size. 3: *Hymenophyllum barbatum*, natural size. 4: *Meringium holochilum*, natural size. 5: *Meringium acanthoides*, natural size. 6: *Microtrichomanes digitatum*, natural size. 7: *Trichomanes birmanicum*, natural size. 8: *Macroglena meifolia*, x 1/2. 9: *Microgonium parvifolium*, natural size. 10: *Crepidomanes kurzii*, natural size. 11: *Crepidomanes megistostomum*, natural size. 12: *Didymoglossum exiguum*, natural size. 13–15: cell walls, x 300; 13, *Mecodium exsertum*, 14, *Hymenophyllum barbatum*, 15, *Meringium bontocense*.

## 13. CYATHEACEAE

About 700 species belong to this family in the strict sense, from the tropics and subtropics throughout the world. The circumscription of the family varies according to different authors: some separate, others include Protocyatheaceae and Dicksoniaceae. In Thailand there is no representative of Protocyatheaceae, and Dicksoniaceae is treated here as a distinct family.

Literature: Holttum, R.E. & U. Sen: Morphology and Classification of the Tree Ferns.—Phytomorphology 11: 406–420. 1961. In this paper Holttum classified Cyatheaceae in the broadest sense into four subfamilies and nine genera.—Tryon, R.: The Classification of the Cyatheaceae.—Contr. Gray Herb. Harv. Univ. 200: 3–53. 1970. Contrary to Holttum, Tryon excluded Dicksoniaceae and classified his Cyatheaceae into eight genera. The above two systems differ considerably ,and we here follow Holttum as to the conception of genera and Tryon for the delimitation of the families.

### CYATHEA

J.E. Smith, Mém. Acad. Turin. 5: 416. 1793; Copel., Gen. Fil.: 95. 1947.—*Gymnosphaera* Bl., En. Pl. Jav.: 242. 1828; Copel., Gen., Fil.: 98. 1947.—*Sphaeropteris* Bernh., Schrad. J. Bot. 1800(2): 122. 1801; Tryon, Contr. Gray Herb. Harv. Univ. 200: 17. 1970.—*Alsophila* R.Br., Prod.: 158. 1810; Tryon, Contr. Gray Herb. Harv. Univ. 200: 25. 1970.

Terrestrial tree ferns; stem erect, tall, to 10 m or more in height, scaly, bearing rosette of fronds at apex; fronds usually larger, bearing both scales and hairs, pinnately compound, veins usually free; sori round, dorsal on veinlets, on distinct receptacles; indusia distinct or wanting; annulus oblique, complete: spores tetrahedral.

Among 25 Asiatic species enumerated by Holttum (1965, Kew Bull. 19: 463–487), excluding those from Malesia where 191 species are recognized, seven were recorded in Thailand. Here there is one additional record from our region.

#### KEY TO THE SPECIES

1. Scales at base of stipes never setose, ferrugineous at margin; fronds underneath not glaucous
2. Sori with indusia
3. Lower surface of costae and costules hairy — **1. C. chinensis**
3. Lower surface of costules scaly

4. Indusium entirely covered by base of sorus; paraphyses longer than sporangia **4. C. latebrosa**
4. Indusium not entirely covered by base of sorus; paraphyses shorter than sporangia
5. Pinna-rachis and costae scaly **2. C. spinulosa**
5. Pinna-rachis and costae hairy and scaly **3. C. borneensis**
2. Sori without indusia
6. Pinnules distinctly stalked, subentire or very shallowly serrate **5. C. podophylla**
6. Pinnules sessile or nearly so, lobed to more than 1/3 way towards costae **6. C. gigantea**
1. Scales at base of stipes setose; not ferrugineous at margin; fronds glaucous underneath **7. C. contaminans**

**1. Cyathea chinensis** Copel., Phil. J. Sci. 3: 355. 1909; Holtt., Kew Bull. 19: 466. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 45. 1967.—*Amphicosmia brunoniana* auct. non (Hook.) Bedd.: Bedd., Handb.: 10. 1883.—*Cyathea brunoniana* auct. non (Hook.) Clarke & Baker: Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 86. 1939.—*Alsophila costularis* Baker, Kew Bull. 1906: 8; Tryon, Contr. Gray Herb. 200: 31. 1970, non *Cyathea costularis* Bonap. 1917. Fig. 6: 1–3, 6.

*Trunks* up to 5 m or more tall. *Stipes* about 50 cm long, dark purplish near base, brownish upwards, with rather dense short spines throughout, warty; scales linear, to 3.5 cm long, 1.5 mm broad, shining dark brown, stiff, the edges narrow, paler, ferrugineous, soon abraded; main rachis smooth, glabrescent, light brown; largest pinnae about 50 cm long, 13 cm wide, narrowly oblong, basal pinnae a little reduced; pinna-rachis pale beneath, bearing pale crisped hairs; pinnules more than 30 in pairs, sessile, patent, lanceolate, acuminate at apex, broadly cuneate or subtruncate at base, about 8 cm long, 1.3 cm wide, about 1.5 cm apart, lobed almost to costae leaving laminae 1 mm broad, lobes oblique, falcate, round to moderately acute at apex, crenate-serrate at margin, about 7 mm long, 3 mm broad; costae and costules hairy throughout on lower surface, scales few, pale, more or less convex, hardly bullate; texture papyraceous, light green, paler beneath; veins simple or forked. Sori close to costules; receptacles large; indusia in mature sori reflexed as broad pale brown scales, irregular and abraded at margin.

Thailand —NORTHERN: Chiang Rai (Doi Phacho).

Distribution.—E. Himalayas, Yunnan (type) and Indochina.

Ecology.—On moist slopes at edge of lower montane forest at about 1200 m alt.

Uses.—Fibrous trunk used for orchid media.

**2. Cyathea spinulosa** Wall. ex Hook., Sp. Fil. 1: 25. t. 12C. 1844; Bedd., Handb.: 6. f. 3. 1883; Suppl. 2. 1892; Holtt., Kew Bull. 19: 471. 1965.—*Amphicosmia decipiens* (Scort.) Bedd., Ferns Br. Ind. Suppl.: 1 .1876; Handb.: 10. 1883; Suppl.: 2. 1892.—*Alsophila decipiens* Scort. in Bedd., Ferns Br. Ind.: t. 311. 1869.

*Trunks* about 3 m or more tall. *Stipes* dark purplish, distinctly spiny near base; scales shining dark brown, stiff, their bases later develop into spines; lateral pinnae numerous, a few basal pinnae reduced; pinna-rachis bearing scales; pinnules broadly

cuneate at subsessile base, acuminate at apex, about 8 cm long, 1.8 cm wide; ultimate segments toothed distally; costae underneath scaly but not hairy, scales pale brown; costules and lower surface of lamina minutely pubescent. *Sori* near costules, indusia hemitelioid, i.e. cup-shapedwith apical portion of sori naked.

Thailand.—NORTHERN: Chiang Mai (Doi Inthanon).

Distribution.—E. Himalaya (type), S. India, Burma, SW. China, Taiwan, and S. Japan.

Ecology.—In deep shade usually in moist places in the lower montane forest at about 700 m alt. When the forests are cut down, this species cannot survive the resulting dry condition.

Uses.—Fibrous trunk used for orchid media.

**3. Cyathea borneensis** Copel., Phil. J. Sci. 6: 135. 1911; Holtt., Fl. Mal. II. 1: 110. 1963; Dansk Bot. Ark. 23: 229. 1965; Kew Bull. 19: 469. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 45. 1967.—*Cyathea obtusata* Rosenst., Med. Rijksherb. 31: 1. 1917; Holtt., Rev. Fl. Malaya 2: 121. 1955.

*Trunks* to 2 m or more tall. *Stipes* about 10 cm long, with short spines throughout, scaly at base, dark purplish or brownish; scales linear, up to 2 cm long, 1 mm broad, dark brown, shining, edges ferrugineous, narrow, soon abraded; pneumathodes 1 cm or more in length, in a single row with a short distance between each other; main rachis with short spines at base only, smooth or warty, pale brown; lower pinnae distant, more than 10 cm apart, reduced to 5 cm long or so, variable in form; longest pinnae about 50 cm long, 18 cm wide, caudately acuminate at apex; pinna-rachis brown or paler, purplish at basal portion, sparsely hairy with pale crisped hairs and bearing very sparse pale brown scales; pinnules more than 25 pairs, larger ones 2.5 cm apart, very shortly stalked, patent, straight or more or less falcate, lanceolate, gradually narrowing towards acuminate apex, truncate at base, about 10 cm long, 2 cm wide, lobed almost to costae, remaining decurrent lamina 0.2–1 mm broad; lobes oblique, falcate, round at apex, serrate at margin, about 1 cm long, 4 mm broad; costae sparsely scaly beneath with entire, acuminate, dark, usually flat scales; thinly papyraceous, veins forked, distinct on both surfaces. *Sori* close to costules; receptacles swollen; indusia thin, flat, on costular side of receptacles, usually under matured sori, but visible.

Thailand.—EASTERN: Buri Ram (Bo Rai); CENTRAL: Nakhon Nayok (Khao Yai); PENINSULAR: Chumphon (Khao Tong, Thasan), Surat Thani (Khao Nong), Nakon Si Thammarat (Khao Luang, Ronphibun), Satun (Klong Thom, Khao Khieo).

Distribution.—Cambodia, Burma, Malaya and Borneo (type).

Ecology.—On rather dry ground near rivers in light shade in tropical evergreen forest at 400–1800 m alt. or in lower montane forest at high altitudes, 1000–1600 m alt.

Vernacular.—Maha sing kham (มหาสิงคำ) (Northern); kut ton (กูดต้น), maha sadam (มหาสะดำ) (Peninsular).

Uses.—Fibrous trunk used for orchid media.

**4. Cyathea latebrosa** (Wall. ex Hook.) Copel., Phil. J. Sci. 4: 52. 1909; Tard. & C. Chi. in Fl.Gén I.-C. 7(2): 85. 1939; Holtt., Rev. Fl. Malaya 2: 120. f. 48. 1955; Dansk Bot. Ark. 20: 18. 1961; Fl. Mal. II. 1: 115. 1963; Kew Bull. 19: 472. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 45. 1967.—*Alsophila latebrosa* Wall. ex Hook., Sp. Fil. 1: 37. 1844; Bedd., Handb.: 11. 1883; Tryon, Contr. Gray Herb. 200: 32. 1970.

*Trunks* 3–5 m or more tall. *Stipes* 30–40 cm long, with very short spines, yellowish brown to darker, scaly at base; scales linear, to 2 cm long, 1.2 mm broad, dark brown, shining, stiff, the edges paler, ferrugineous, soon abraded; pheumathodes in a single row, separated or continuous, smooth, glabrescent or hairy on upper surface; lower pinnae reduced to 10 cm long, irregular in form, rather distant, larger pinnae about 40 cm long, 14 cm wide, narrowly oblong, caudately acuminate at apex; pinna-rachis warty beneath, hairy and sparsely scaly on upper surface; pinnules more than 25 pairs, larger ones about 1.6 cm apart, oblong-lanceolate, gradually narrowing towards acuminate apex, subtruncate at base, sessile, to 7 cm long, 1.7 cm wide, lobed nearly to costa; lobes oblique, falcate, round at apex, entire or slightly serrate at margin, to 1 cm long, 3 mm broad; costae hairy on upper surface, costae and costules scaly beneath with elongate, flat, brown scales in basal part, with pale bullate scales in distal part; texture papyraceous, deep green, paler beneath, veins forked or distal ones simple. *Sori* close to costules; indusia small; scales at costular side of receptacles, hidden by mature sori.

Thailand.—NORTHERN: Chiang Mai (Doi Suthep); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR: Chumphon (Thasan), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong, Khao Sung), Narathiwat (Sg. Padi), Yala (Muang Wieng, Khao Kalakhiri).

Distribution.—Cambodia, Hainan, Malaya (type), Sumatra and Borneo.

Ecology.—On mountain slopes usually in dense tropical evergreen forest below 1000 m alt.

Vernacular.—Kut ton (กูดต้น), kut phrao (กูดพร้าว) (Northern); maha sadam (มหาสดำ) (South-eastern).

Uses.—Fibrous trunk used for orchid media.

**5. Cyathea podophylla** (Hook.) Copel., Phil. J. Sci. 4: 33. 1909; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 81. 1939; Holtt., Dansk Bot. Ark. 20: 18. 1961; Kew Bull. 19: 475. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 46. 1967.—*Alsophila podophylla* Hook., J. Bot. 9: 334. 1857; Second. Cent. Ferns: t. 66. 1861; Tryon, Contr. Gray Herb. 200: 32. 1970.—*Alsophila kohchangensis* C. Chr., Bot. Tidsskr. 32: 417. 1916.—*Alsophila glabra* auct. non (Bl.) Copel.: Bonap., Not. Pterid. 14: 417. 1923

*Trunks* up to 1 m tall. *Stipes* about 50 cm or more long, dark purplish, polished, warty, shortly spiny, scaly near base; scales to 3 cm long, 2.5 mm broad, brown, stiff, shining, edges ferrugineous, narrow, dark, nearly black; pneumathodes in a single row, interrupted; main rachis castaneous, minutely scaly; lower pinnae not reduced, up to 60 cm or more long, up to 23 cm wide; pinna-rachis hairy on upper surface, minutely scaly beneath; pinnules about 25 in pairs with lobed terminal pinnae, shortly stalked, patent or ascending, more or less falcate, lanceolate, gradually narrowing towards caudately acuminate apex, broadly cuneate at base, up to 12 cm long, 1.7 cm broad, subentire at margin or very shallowly serrate at least at distal portion; costae hairy on both surfaces scaly underneath with dark ferrugineous margin, not bullate; papyraceous, green, veins pinnate, veinlets simple, all free. *Sori* close to main veins, naked; receptacles not so swollen.

Thailand.—NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR: Surat Thani (Khao Nong), Nakhon Si Thammarat (Khao Luang), Phangnga (Takua Pa).

Distribution.—S. China (type), Indochina, Taiwan and the Ryukyus.

Ecology.—On mountain slopes usually near streams in shade at 800–1200 m alt.

Vernacular.—Maha sadam (มหาสะดำ) (Peninsular.)

Uses.—Fibrous trunk used for orchid media.

Note.—*A. kohchangensis* was based on a Ko Chang plant which was fully fertile but small in size. In *C. podophylla* even the small plants are soriferous, when the pinnae are only pinnatisect. *A. kohchangensis* seems to have been based on such plants and is a form of *C. podophylla*.

**6. Cyathea gigantea** (Wall. ex Hook.) Holtt., Gard. Bull. S.S. 8: 318. 1935; Rev. Fl. Malaya 2: 128. f. 53. 1955; Dansk Bot. Ark. 20: 18. 1961; Fl. Mal. II 1: 124. 1963; Kew Bull. 19: 476. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 74. 1965; 5: 46.1967.—*Alsophila gigantea* Wall. ex Hook., Sp. Fil. 1: 53. 1844; Tryon, Contr. Gray Herb. 200: 32. 1970.—*Alsophila glabra* auct. non. (Bl.) Copel.: Bedd., Handb.: 14. 1883; C. Chr., Bot. Tidsskr. 32: 341. 1916; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 83. 1939.

*Trunks* up to 2 m or more tall. *Stipes* up to 50 cm or more long, nearly black or deep castaneous, polished, densely covered with spreading scales; scales up to 1.5 cm long, 2 mm broad, dark brown to nearly black, shining, stiff, edges ferrugineous, rather broad, pale; pneumathodes small, in a single row, distinct; main rachis castaneous to nearly black, minutely scaly, smooth; pinnae up to 70 cm or more long, 25 cm wide, acuminate at apex; pinna-rachis hairy on upper surface, sparsely warty or scaly beneath, dark at base, paler towards apex; pinnules about 2.5 cm apart, patent or ascending, straight or slightly falcate lanceolate, caudate-acuminate at apex, cordate

at base, very shortly stalked, up to 12 cm long, 2 cm wide, lobed to more than 1/3 way towards costae; lobes round subdeltoid, round at apex, oblique, falcate, serrate at margin, up to 4 mm broad, with narrow sinus; texture thin, papyraceous, green, veins pinnate, veinlets simple, all free. Sori close to costule or medial, naked.

T h a i l a n d.—NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Kang Kaet, Doi Suthep, Doi Inthanon, Fang), Tak (Doi Musoe); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chanthabuii (Khao Soi Dao, Khao Sabap), Trat (Ko Chang, Ko Kut); SOUTH-WESTERN: Kanchanaburi (Wangka); PENINSULAR: Ranong (Muang Laen, Khao Nom Sao), Surat Thani (Ban Don, Khao Nong, Klong Ton), Phangnga (Takua Pa), Nakhon Si Thammarat (Khao Luang, Chawang Nok Nang), Satun, Yala (Ban Chana).

D i s t r i b u t i o n.—E. Himalaya (type), S. India, Ceylon, Burma, S. China, Indochina, Malaya, Sumatra and W. Java.

E c o l o g y.—On mountain slopes usually in dense tropical evergreen forest, lowland and in lower montane forest to about 1300 m alt.

V e r n a c u l a r.—Maha sadam (มหาสะดำ) (South-eastern); maha sadaeng (มหาสะแดง) (Peninsular); kut ngong (กูดโง่ง), kut yong (กูดโย่ง), kut hang nok yung (กูดหางนกยูง) (Northern); khasudo (คาซูโด) (Karen/Northern).

U s e s.—Fibrous trunk used for orchid media.

N o t e.—This species is sometimes confused with *C. glabra,* from which it is distinct in having sessile or very shortly stalked pinnules, the lobes more triangular, more deeply lobed, distinctly serrate at margin, and the scales without marginal teeth. *C. glabra* is known in western Malesia, but not from Thailand.

**7. Cyathea contaminans** (Wall. ex Hook.) Copel., Phil. J. Sci. 4: 60. 1909; Tard. & C Chr. in Fl. Gén. I.-C. 7(2): 86. 1939; Holtt., Rev. Fl. Malaya 2: 119. 1955; Fl. Mal. II. 1: 135. 1963; Kew Bull. 19: 485. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 74. 1965; 5: 46. 1967.—*Alsophila contaminans* Wall. ex Hook., Sp. Fil. 1: 52. t. 18. f. 2. 1844.—*Alsophila glauca* (Bl.) J. Smith, J. Bot. 3: 419. 1841; Bedd., Handb.: 12 1883, p.p.—*Sphaeropteris glauca* (Bl.) Tryon, Contr. Gray Herb. 200: 21. 1970.—*Chonophora glauca* Bl., En. Pl. Jav.: 243. 1828, non *Cyathea glauca* Bory 1804.

*Trunks* up to 10 m or more tall. *Stipes* up to 60 cm or more long, stout, strongly thorny, purplish, glaucous, scaly near base; scales light brown to paler, to 4 cm long, 3 mm broad, thin, bearing short darker setae at margin; main rachis spiny, glaucous or brown, glabrescent; pinnae up to 80 cm or more long, 30 cm wide, lower ones slightly reduced in size; pinna-rachis light brown or paler, spiny beneath, glabrescent or hairy on upper surface; pinnules about 2.5 cm apart, lanceolate, acuminate at apex, subtruncate at base, sessile, patent, almost straight, up to 15 cm long, 2.5 cm wide, deeply lobed almost to costa, a few lowest segments quite free; segments oblique, falcate, round to moderately acute at apex, up to 1.5 cm long, 4.5 mm broad, 5–6 mm apart, crenate at margin; costae and costules glabrous or very sparsely hairy near apices

of pinnules, scales rarely residual, small, pale, not bullate; papyraceous, green, glaucous beneath, veins forked, distinct beneath. *Sori* nearer to costules than to edges of lobes, exindusiate; receptacles large, prominent.

Thailand.—PENINSULAR: Phangnga (Khao Katha Khwam), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun (Khao Khieo range, Kuan Kalong).

Distribution.—N. India and Malesia generally (type from Malaya).

Ecology.—On mountain slopes or stream banks in dense tropical evergreen forest or in open areas at low altitudes.

Vernacular.—Hua ai pet (หัวอ้ายเป็ด) (Central).

Uses.—Fibrous trunk used for orchid media.

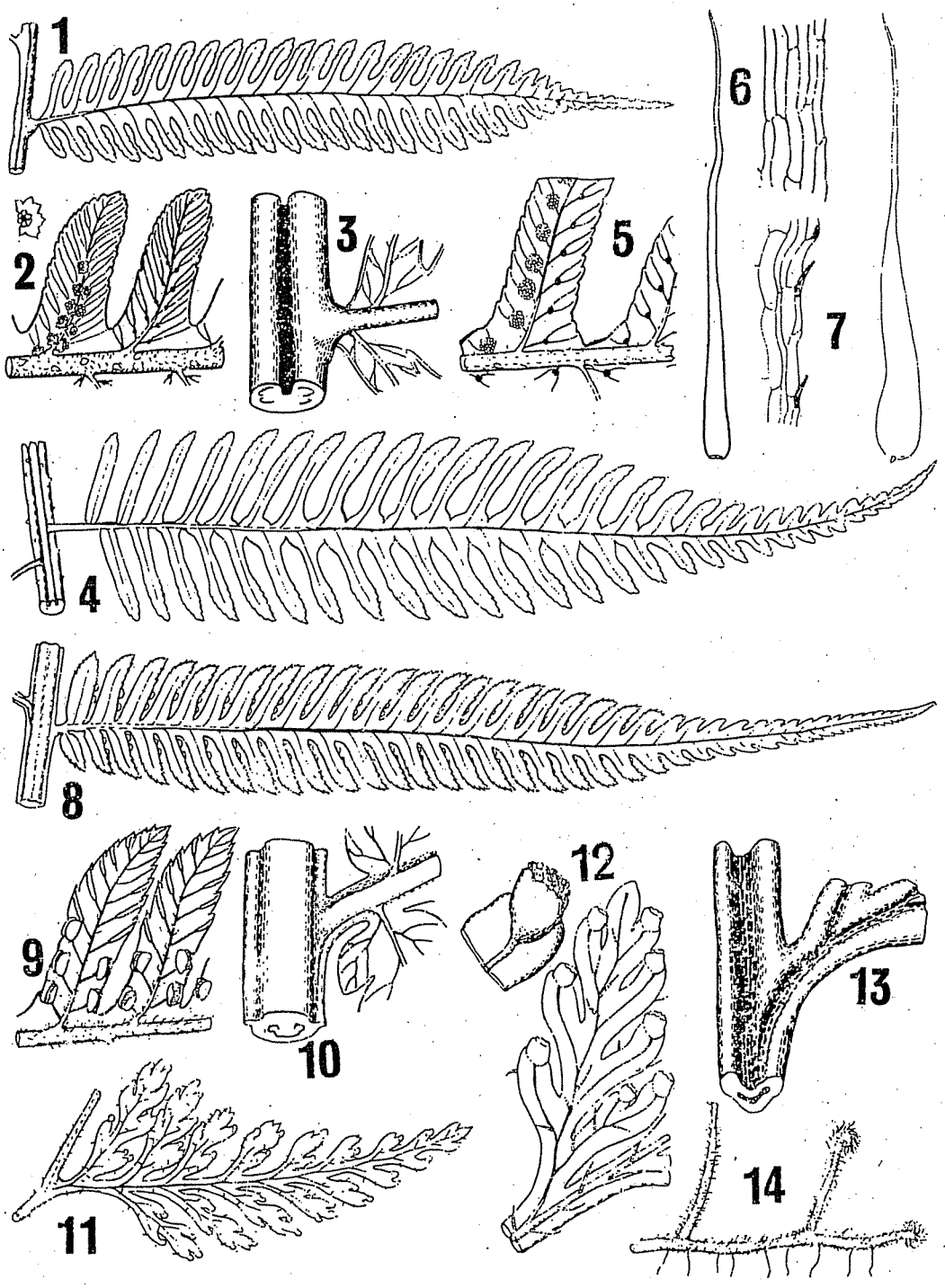



Figure 6. 1–3 & 6: *Cyathea chinensis* 1, fertile pinnule of 2nd lowest portion, adaxial view, natural size; 2, fertile lobe and indusium enlarged, showing venation and soral position, x 3; 3, base of middle size pinnule, adaxial view, hairs and scales removed, x 5; 6, left, single scale of stipe base, x 2; right, scale margin enlarged, x 30. 8–10: *Cibotium barometz* 8, fertile pinnule of 2nd lowest position, adaxial view, natural size; 9, fertile lobe, x 3; 10, base of middle size pinnule, adaxial view, hairs removed, x 5. 11–14: *Dennstaedtia scabra* 11, fertile pinnule of 2nd lowest position, adaxial view, x 2; 12, one lobe and indusium enlarged, x 5 & x 20; 13, base of pinnule, hairs removed, x 10; 14, creeping rhizome with two young fronds, x 1/2.

## 14. DICKSONIACEAE

This is usually interpreted as one of the most primitive families among the higher leptosporangiate ferns and comprises such genera as *Tyrsopteris, Dicksonia, Cystodium, Cibotium,* and *Culcita.* In a recent paper by Holttum and Sen, Phytomorphology 11: 406–420. 1961, however, the old concept of Mettenius was revived reducing this family to the Cyatheaceae, after a detailed discussion on comparative morphology. Here, we do not pursue this topic, and tentatively follow Bower and his successors who separate Dicksoniaceae from Cyatheaceae. In Thailand there is only one genus, *Cibotium,* in which a single wide-spread species is found.

### CIBOTIUM

Kaulf., Enum.: 229. 1824; Copel., Gen. Fil.: 49. 1947.

Rhizome massive, densely covered with golden yellow long hairs; stipes stout, not jointed to rhizome, densely hairy at base; fronds very large, more than 3 m tall including stipes, pinnately decompound; ultimate segments acute at apex; veins forked, all free; sori terminal on veins submarginal, protected by two indusia.

Several species are known in Hawaii, Central America, Mexico and Southeast Asia. The Asiatic species is by some authors split into three species, but all the material seem to be conspecific.

**Cibotium barometz** (Linn.) J. Smith, Lond. J. Bot. 1: 437. 1842; Bedd., Handb.: 24. f. 8. 188; Christ, Bot. Tidsskr. 24: 111. 1901; C. Chr., Bot. Tidsskr. 32: 341. 1916; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 78. f. 10, 6–7. 1939; Holtt., Rev. Fl. Malaya 2: 114. f. 45. 1955; Dansk Bot. Ark. 20: 18. 1961; 23: 229. 1965; Fl. Mal. II 1: 165. f. 33, a-c. 1963; Ching, Fl. Reip. Pop. Sin. 2: 197. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 45. 1967; Acta Phytotax. Geobot 23: 52 1968.—*Polypodium barometz* Linn., Sp. Pl.: 1092. 1753. Fig. 6: 8–10.

*Rhizome* massive, prostrate, very densely covered with golden yellow hairs. *Stipes* thick, sometimes attaining to 2 cm diam., more than 1.5 m long in larger ones, densely covered with shining, golden yellow, long (more than 4 cm long in some larger ones), slender or warty hairs at base, the hairs on upper parts not so dense, brown to darker, setose, gradually becoming shorter upwards; lamina large, up to 2 m in length, more than 1 m in width, bipinnate; pinnae many, the largest ones up to 75 cm long, 25 cm wide, with numerous pinnules; pinnules deeply pinnatifid through-

out, very shortly stalked or subsessile at posterior parts of pinnae, linear-lanceolate, gradually narrowing towards acuminate apex, broadly cuneate to subtruncate at base, 10–15 cm long, 1.5–2.5 cm wide; ultimate segments oblong, oblique to subfalcate, acute at apex, shallowly but distinctly dentate at margin, glaucous in lower surface, 0.8–1.4 cm long, about 3 mm broad, with intervals of 4 mm between the adjacent costules; costae and costules covered with pale, entangled, flaccid, appressed hairs below; veins distinct, once (or twice in larger lobes) forked, sparsely hairy below. *Sori* terminal on usually unbranched lower veins, parallel to edge of lobes, protected by two indusia; outer indusia round, inner ones elongate at maturity, oblong.

T h a i l a n d.—NORTHERN: Chiang Rai (Doi Tung, Mae Nam Kok, Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Hua Mot), Lampang, Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradung); EASTERN: Nakhon Ratchasima (Khao Laem); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR: Yala (Gunong Ina).

D i s t r i b u t i o n.—Himalayas to S. China and Taiwan, south to W. Malesia, north to the Ryukyus.

E c o l o g y.—On open hill slopes and stream banks in tropical evergreen forest at 500–800 m alt., and in lower montane forest at 1000–1500 m alt.

V e r n a c u l a r.—Kut phipa (กูดผีป่า), kut phan (กูดพาน) (Northern); khon kai noi (ขนไก่น้อย) (North-eastern); hatsadaeng (หัสแดง) (Eastern); la-ong faifa (ละอองไฟฟ้า), wan kai noi (ว่านไก่น้อย) (Central); kut sua (กูดเสือ), pho si (โพสี), ninla phosi (นิลโพสี) (Peninsular).

U s e s.—Locally used for medicine, especially silky hairs on buds used for fresh wound.

## 15. DENNSTAEDTIACEAE

In Thailand there are five genera of this family. *Orthiopteris* has been found in Malaya but not in Thailand.

KEY TO THE GENERA

1. Sori round, solitary at apex of veinlet, indusiate or naked
 2. Sori indusiate; indusia cup-shaped at least in appearance
  3. Sori marginal, protected by cup-shaped indusium formed by the fusion of an indusium and a minute tooth **1. Dennstaedtia**
  3. Sori submarginal or dorsal; indusia thin, cup-shaped, attached by base and sides **2. Microlepia**
 2. Sori naked, or rarely protected when young by reflexed marginal flaps **3. Hypolepis**
1. Sori elongate along margin of lobes, protected by thin reflexed edge of lobes
 4. Veins free; indusia in two layers, inner ones thinner, attached just below the receptacles **4. Pteridium**
 4. Veins reticulate; inner indusia wanting **5. Histiopteris**

### 1. DENNSTAEDTIA

Bernh., Schrad. J. Bot. 1800(2): 124. 1801; Copel., Gen. Fil.: 50. 1947.

Terrestrial ferns of moderate to larger size; rhizome long-creeping, dorsiventral, solenostelic, covered with rather stiff hairs; stipes erect, grooved on upper surface, hairy; fronds usually pinnately decompound, pinnae and pinnules sometimes articulate, hairy or glabrous; axes grooved with raised edges, decurrent on those of the next order, hairy; veins all free; sori terminal on veins, marginal, two parts of indusia connate to form a cup which is usually reflexed towards the lower surface of lamina.

About 70 species are included in this genus from the warmer parts of the world, north to Japan and the United States and south to Chile and Tasmania. Only one species is present in Thailand.

**Dennstaedtia scabra** (Wall. ex Hook.) Moore, Ind. Fil.: 307. 1861; Bedd., Handb.: 24. f. 12. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 91. f. 11, 3–4. 1939; Ching, Fl. Reip. Pop. Sin. 2: 204. pl. 16. f. 1–2. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 49. 1968.—*Dicksonia scabra* Wall. ex Hook., Sp. Fil. 1: 80. t. 28 B. 1844. Fig. 6: 11–14.

*Rhizome* wide-creeping, hairy, about 4 mm diam.; hairs pale brown, articulated, 2–4 mm long. *Stipes* shining castaneous, hairy throughout, grooved on the upper surface of upper parts, the base dark, up to 40 cm long; lamina oblong-subdel-

toid, acuminate at apex, quadripinnate, 30–40 cm long, up to 25 cm wide; rachis orange to brown, grooved on upper surface, hairy or a little prickly; lateral pinnae largest at base, gradually reducing in size upwards; the basal pair of pinnae subtriangular with large basal acroscopic pinnule, the next few broadly lanceolate, long-tailed at apex, unequally cuneate at stalked base; larger pinnules oblong, acuminate at apex, cuneate and stalked at base, up to 6 cm long, 2.5 cm wide; costae and costules grooved but interrupted, hairy throughout; ultimate segments oblong, oblique, round to subacute at apex, unequally cuneate at sessile base, up to 1.5 cm long, 8 mm wide, lobed to $\frac{2}{3}$ way towards costules; lobes rotundate, oblique or spathulate, obscurely undulate at margin; papyraceous or softer, yellow green to green, hairy on under surface of main veins and on upper surface of veins and veinlets. *Sori* marginal; indusia cup-shaped.

Thailand.—NORTHERN: Chiang Mai (Doi Inthanon).

Distribution.—India (type) to Burma and China, Indochina, Taiwan, Philippines, Borneo (var. *tenuisecta*) and Celebes, north to Japan.

Ecology.—At summit on the highest moutain in Thailand in *Sphagnum*-bog; usually growing on gentle moutain slopes in rather open forest in Japan.

Note.—This is a common species from Himalayas to Japan, and is a representative of the warm temperate element in Thailand.

## 2. MICROLEPIA

Presl, Tent. Pterid.: 124. 1836; Copel., Gen. Fil.: 51. 1947.

Rhizome creeping, solenostelic, covered with short hairs; stipes rather close, hairy; lamina pinnate to pinnately decompound, the ultimate pinnules usually obliquely incised in most cases hairy; axes grooved, grooves decurrent to those of the next order, veins all free; sori terminal on veins, usually close to margin of lobes; indusia attached by sides and base, rather thin, thus half cup-shaped, often hairy.

This is very close to *Dennstaedtia*, especially in vegetative features, differing in the soral construction: the marginal sori of *Dennstaedtia* are submarginal or dorsal, and the covering is thinner like the indusia of the superficial sori.

About 50 species are known in the tropics of the Old World, extending north to Japan and south to New Zealand and Madagascar. One polymorphic species, *M. speluncae*, is known throughout the tropics of both worlds. In his Flora, Ching (1959) enumerated 57 species of this genus from China as well as suggesting the occurrence of two Tonkin species in China. Among these 59 species, 32 are newly described in that Flora. In his extensive key to the species, the size of various parts and degree of hairiness are often used to distinguish the species; but, as we have noted, these features are extremely variable and hardly indicative of species in *Microlepia*,

especially for the group of *M. speluncae* which is split by Ching into numerous 'species'. Although the wide-spread *M. speluncae* should be studied further in detail, twelve species are accepted in the Thai flora.

KEY TO THE GENERA

1. Fronds simply pinnate
 2. Pinnae more than 25 in pairs, serrate at margin **1. M. hookeriana**
 2. Pinnae less than 20 in pairs, lobed more than $\frac{1}{3}$ way towards costa **2. M. calvescens**
1. Fronds bipinnate or more compound
 3. Fronds bipinnate–tripinnate
  4. Lamina 40–70 cm long, pinnules to 3 cm long
   5. Texture herbaceous; veins not so distinct on lower surface of lobes **3. M. herbacea**
   5. Texture subcoriaceous; veins on lower surface of lobes distinctly raised, paler than the lamina **4. M. strigosa**
  4. Lamina 80–130 cm long, larger pinnules more than 5 cm long
   6. Lower surface of lamina densely hairy
    7. Plants medium-sized; larger pinnules to 12 cm long; texture papyraceous **9. M. puberula**
    7. Plants larger; larger pinnules more than 15 cm long; texture softly papyraceous **10. M. kurzii**
   6. Lower surface of lamina not or hardly hairy
    8. Larger pinnules more than 12 cm long; soriferous lobes triangular, acute at apex; sori about 1.5 mm broad **11. M. platyphylla**
    8. Larger pinnules up to 9 cm long; soriferous lobes ovate, round at apex; sori about 1 mm broad **12. M. ridleyi**
 3. Fronds tripinnate or more compound
  9. Rachis of pinnae strigose; veins distinctly raised on lower surface of lobes
   10. Fronds quadripinnate, secondary pinnules acute, sharply incised, stipes long **5. M. firma**
   10. Fronds tripinnate–quadripinnatifid, secondary pinnules obtuse, entire or subentire
    11. Pinnules pinnate, moderately acute to acute at apex, with obtuse secondary pinnules; veins and veinlets underneath strigose, patent **6. M. trapeziformis**
    11. Pinnules less dissected especially in distal part, round to moderately acute at apex; the hairs on veins and veinlets underneath soft, more or less adpressed **7. M. taiwaniana**
  9. Rachis of pinnae pilose with soft spreading hairs or almost glabrous; veins not so distinct on lower surface of lobes **8. M. speluncae**

**1. Microlepia hookeriana** (Wall. ex Hook.) Presl, Epim.: 95. 1849; Bedd., Handb.: 62. f. 32. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 93. 1939; Ching, Fl. Reip. Pop. Sin. 2: 211. pl. 19. f. 1–5. 1959; Holtt., Dansk Bot. Ark. 20: 24. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 71. 1967.—*Davallia hookeriana* Wall. ex Hook., Sp. Fil. 1: 172. t. 47 B. 1846.—*Scyphularia hookeriana* (Wall. ex Hook.) J. Smith, Hist. Fil.: 261. 1875; Tagawa, J. Jap. Bot. 26: 187. 1951. Fig. 7: 1–2.

*Rhizome* long-creeping, densely covered with setose bright brown hairs about 2 mm long, 3.5–5 mm diam. *Stipes* 2–5 cm apart, erect, 12–20 cm long, stramineous or darker, densely covered with hairs like those on rhizome but shorter, more or less grooved on the upper surface; lamina pinnate, gradually narrowing towards acuminate apex, narrowly oblong, up to 50 cm long, 15 cm wide; rachis like the upper parts of stipes, distinctly grooved on the upper surface and densely hairy throughout; lateral pinnae usually more than 25 in pairs, close except for a few lower ones which are

somewhat shorter, remote and deflexed, all sessile, linear, slightly falcate, gradually narrowing towards acute apex, serrate at margin, broadly cuneate posteriorly and auricled anteriorly at base. the largest 12 cm long, 1.3 cm broad; terminal pinnae distinct, gradually narrowing upwards, up to 15 cm long; herbaceous, deep green, veins once forked, hairy on veins beneath and on both surfaces of costa. *Sori* terminal on veinlets, at margin of pinnae; indusia cup-shaped, less than 1 mm broad, 0.5 mm long, glabrous.

T h a i l a n d.—NORTHERN: Chiang Rai (Doi Phacho); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); EASTERN: Nakhon Ratchasima (Khao Laem); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Phangnga (Khao Bangto), Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.—E. Himalaya (type) and Upper Burma to S. China, Tonkin, Taiwan and Ryukyus, southwards to Borneo, Sumatra and Java.

E c o l o g y.—On rather dry ground in shade or sandy ground along streams in tropical evergreen forest at 700–1200 m alt.

N o t e.—This species is distinct from other members of *Microlepia* in its pinnate fronds with shallowly incised subsessile pinnae whose bases are auricled acroscopically or sometimes basiscopically as well, in distinct apical pinnae, in parallel veins forked at least twice.

**2. Microlepia calvescens** (Wall. ex Hook.) Presl, Epim.: 95. 1849; Ching, Fl. Reip. Pop. Sin. 2: 214. pl. 16. f. 8–9. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 71. 1967.—*Davallia calvescens* Wall. ex Hook., Sp. Fil. 1: 172. t. 48 B. 1846.—*Microlepia marginalis* var. *calvescens* (Wall. ex Hook.) Bedd., Handb.: 64. 1883.—*Microlepia marginata* var. *calvescens* (Wall. ex Hook.) C. Chr., Ind. Fil.: 208. 1905; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 94. 1939.—*Microlepia marginata* auct. non (Houtt.) C. Chr.: Holtt., Dansk Bot. Ark 23: 233. 1965. Fig. 7: 3.

*Rhizome* long-creeping, about 4 mm diam., densely covered with bright blackish-brown hairs of 2 mm or sometimes more. *Stipes* 2–5 cm apart, stramineous, hairs at base like those on rhizome, minutely pubescent upwards, grooved on upper surface, 50 cm or more long; lamina oblong-lanceolate, acuminate at apex, 50–70 cm long, up to 30 cm wide, pinnate to bipinnatifid; rachis grooved on upper surface, densely pubescent throughout, stramineous or darker beneath; lateral pinnae more than twelve in pairs, the upper ones gradually reducing in size to form an indistinct apical pinna, the larger ones straight, more or less ascending, linear-lanceolate, gradually narrowing towards long caudate-acuminate apex, distinctly stalked, cuneate anterioly and very narrowly cuneate posteriorly at base, lobed about halfway or almost completely to costa; costa densely pubescent; lobes oblong, oblique, subfalcate, acute at apex, obscurely waved at margin, up to 1.3 cm long, 0.8 cm broad; papyraceous, green, glabrous above, minutely hairy beneath, veins pinnate, main veins usually zig-zag. *Sori* terminal on veinlets, 1–1.5 mm from the margin of lobes; indusia cup-shaped, hairy.

Thailand.—NORTHERN: Chiang Rai, Chiang Mai (Doi Suthep, Mae Raem), Lampang, Phitsanulok (Thung Salaeng Luang, Salaeng Haeng); NORTH-EASTERN: Phetchabun (Phu Miang, Lom Kao), Loei (Phu Luang, Phu Kradung); SOUTH-WESTERN: Kanchanaburi (Klang Dong); PENINSULAR: Phangnga (Khao Bangto).

Distribution.—E. Himalaya (type), Upper Burma, China (Yunnan & Kwangsi), Taiwan and Vietnam; also recorded from Java.

Ecology.—On rather dry but usually humus-rich slopes in tropical evergreen forest at 750–1200 m alt.

Note.—Among the features to separate this species from its closest relative, *M. marginata* (Houtt.) C. Chr., are the distinctly stalked pinnae and sparse hairs throughout the plant. The bases of the middle lateral pinnae are in this species constantly more deeply cut than those of the lower ones, and scarcely auricled at base. *M. marginata* is distributed widely in the Sino-Japanese region, and *M. calvescens* is found in the southern part of that area.

**3. Microlepia herbacea** Ching & C. Chr. ex Tard. & C. Chr., Not. Syst. 6: 6. pl. 1. f. 1–2. 1937; in Fl. Gén. I.-C. 7(2): 97. f. 12, 1–2. 1939; Ching, Fl. Reip. Pop. Sin. 2: 219. 1959; Holtt., Dansk Bot. Ark. 23: 233. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 72. 1967.—*Microlepia trichosora* Ching, Fl. Reip. Pop. Sin. 2: 358. 1959.—*Microlepia herbacea* var. *trichosora* (Ching) Serizawa, J. Jap. Bot. 47: 46. 1972, p.p. Fig. 8: 1.

*Rhizome* long-creeping, densely covered with stiff blackish brown hairs, about 4 mm diam. *Stipes* stramineous, densely hairy at base, glabrescent or minutely pubescent above, up to 50 cm long; lamina oblong-lanceolate, gradually narrowing towards attenuately acuminate apex, round or cuneate at base, bipinnate, about 50 cm long, 30 cm wide; rachis stramineous, distinctly grooved on the upper surface, densely hirsute throughout; lateral pinnae usually more than 10 in pairs, upper ones gradually reducing in size not forming a distinct apical pinna, larger ones distinctly stalked, straight or subfalcate, ascending, pinnate, lanceolate, gradually narrowing towards caudately acuminate apex, broadly cuneate at base, up to 20 cm long, 4 cm wide; costa grooved, densely pubescent; pinnules oblong or roundly quadrangular, round or moderately acute at apex, cuneate at sessile base, lobed to ⅓ way to costules, the larger ones 2 cm long, 1.2 cm wide; ultimate lobes quadrangular, round or obtuse at apex, with a few distinct teeth at margin, sinus very narrow; herbaceous, mid- to light green, glabrous except the underside of veins, orm inutely or rather densely hirsute on the lamina underneath. *Sori* terminal on basal acroscopic veinlets, at bottom of sinus between lobes, small; indusia cup-shaped, hairy.

Thailand.—NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Inthanon); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai).

Distribution.—Vietnam (type); Ching notes that this probably grows in Kwangsi and Hainan.

Ecology.—On rather dry slopes with humus in tropical evergreen forest at high altitudes.

Note.—Thai specimens are smaller in size than Indochinese plants. As the sori are very scattered, almost all of them are placed at the ends of basal acroscopic veinlets, and in this respect our material do not accord well with the figure given by Tardieu-Blot and C. Christensen (1937).

**4. Microlepia strigosa** (Thunb.) Presl, Epim.: 95. 1849; Bedd., Handb.: 67. 1883; Tard. & C. Chr. in Fl. Gén. I.C. 7(2): 98. 1938; Holtt., Rev. Fl. Malaya 2: 310. f. 177. 1954; Dansk Bot. Ark. 20: 24. 1961; Ching, Fl. Reip. Pop. Sin. 2: 222. pl. 17. f. 5–8. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 72. 1967.—*Trichomanes strigosum* Thunb., Fl. Jap.: 339. 1784. Fig. 8: 2.

*Rhizome* wide-creeping, about 5 mm diam., densely covered with yellow brown setose hairs about 2 mm long. *Stipes* stramineous or brownish, densely pubescent especially in the grooves on upper surface or glabrescent in older ones, up to 40 cm long; lamina bipinnate, or tripinnatifid in larger fronds, 40–70 cm long, 25–35 cm wide, ovate-oblong to oblong-lanceolate, acuminate at apex; rachis like the upper part of stipes, distinctly grooved on upperside, the groove not joined to that of pinna-rachis, densely pubescent below; lateral pinnae sometimes more than 20 in pairs, a few lower ones a little reduced or not, the upper ones gradually reducing in size, the largest ones straight, ascending, distinctly stalked, linear-subtriangular, gradually narrowing towards long-caudate acuminate apex, cuneate at base, up to 20 cm long, 4 cm wide; the largest pinnules oblong to oblong-subdeltoid; oblique, moderately acute at apex, subtruncate anteriorly and very narrowly cuneate posteriorly at base, deeply lobed to pinnatisect, up to 2 cm long, 1 cm wide, sessile or petiolulate; ultimate lobes round to spatuliform, obscurely undulate at margin; veins pinnate, veinlets forked, distinct on undersurface of lobes, paler, hairy, softly chartaceous; deep green above, glabrous except on veins. *Sori* between the crenae of lobes, submarginal; indusia rather broadly cup-shaped, small, less than 1 mm broad, hairy.

Thailand.—NORTHERN: Chiang Mai (Doi Khun Huai Pong, Doi Suthep, Doi Inthanon, Doi Hua Mot), Lampang; EASTERN: Nakhon Ratchasima (Bu Phram); PENINSULAR: Chumphon (Khao Tong), Yala (Khao Kalakhiri).

Distribution.—Himalayas to Ceylon and Polynesia, northwards to Japan (type).

Ecology.—On mountain slopes usually in dense tropical evergreen forest at middle or higher altitudes.

**5. Microlepia firma** Mett. ex Kuhn, Linnaea 36: 146. 1869; Sledge, Kew Bull. 11: 529. 1956; Ching, Fl. Reip. Pop. Sin. 2: 231. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 72. 1967.—*Microlepia hirta* auct. non (Kaulf.) Presl: C. Chr., Contr. U.S Natn. Herb. 26: 332. 1931.

*Rhizome* thick, long-creeping, about 7 mm diam., very densely covered with setose shining deep brown hairs of about 3 mm long. *Stipes* about 1 cm apart, more than 5 mm diam., stramineous, densely hairy at base, sparsely hairy upwards or glabrescent in the older ones, up to 80 cm long; lamina quadripinnatifid, oblong-subdeltoid, acute to acuminate at apex, up to 70 cm long, 50 cm wide; rachis like the upper part of stipes, hairy on the under surface, more densely upwards; pinnae more than 10 in pairs, the upper ones gradually reducing in size, the lowest ones the largest, the larger, 10–15 cm apart, with stalks of more than 3 cm, subtriangular, acuminate at apex, cuneate at base, up to 25 cm long, 20 cm wide; costa grooved on upper surface, hairy beneath; the larger pinnules oblong-subdeltoid to oblong-lanceolate, slightly falcate, gradually narrowing towards caudately acute apex, unequally cuneate and distinctly stalked at base, up to 12 cm long, 5 cm wide, the distal pinnules smaller in size, less dissected and sessile; costules strigose-hairy on the under-side: larger ultimate segments pinnatisect, acute to acuminate at apex, the smaller subentire to entire, round at apex; the ultimate lobes oblong to spatulate, obscurely undulate or entire, round at apex; veins pinnate, raised on both surfaces, hairy underneath, chartaceous, deep. green above and green below. *Sori* at sinus between the teeth of ultimate segments somewhat raised on the upper surface; indusia cup-shaped densely hairy.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Inthanon)

Distribution—E. Himalaya (type) to SW. China (Yunnan) and Upper Burma, also in Ceylon.

Ecology.—On clayey soil in dense lower montane forest above 1800 m alt.

**6. Microlepia trapeziformis** (Roxb.) Kuhn, Chaetopt.: 347. 1882; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 96. 1939; Holtt., Rev. Fl. Malaya 2: 313. f. 181. 1955; Sledge, Kew Bull. 11: 526. 1956 Ching, Fl. Reip. Pop. Sin. 2: 229. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 72. 1967.—*Davallia trapeziformis* Roxb., Calc. J. 4: 516. 1844. Fig. 7: 5.

*Rhizome* creeping, glabrescent or covered with hairs at apex, to 1 cm diam. *Stipes* stramineous, a little swollen at base, glabrous throughout, 60–80 cm long; lamina oblong with long-acuminate apex, tripinnate–quadripinnatifid, up to 70 cm long, 50 cm wide; rachis like the upper parts of stipes, more or less hairy on underside, glabrous on the grooved upperside; the larger pinnae subdeltoid to oblong-subdeltoid, long acuminate at apex, with stalks more than 1 cm long, up to 30 cm long, 15 cm wide, the upper pinnae gradually reduced in size; costae at angle of 45° to rachis, densely hairy on underside, glabrous on grooved upperside; the larger pinnules oblong-subdeltoid, acuminate at apex, unequally cuneate at base, shortly but distinctly stalked; ultimate segments of larger pinnules oblong, oblique or spatulate, round at apex, unequally cuneate at sessile base, subentire or lobed; veins pinnate, more or less distinct on both surfaces, distinctly strigose-hairy beneath, glabrous on laminar surface, deep green above and green below. *Sori* between crenae of lobes, slightly intramarginal; indusia cup-shaped, hairy.

T h a i l a n d.—NORTHERN: Chiang Mai (Doi Khun Huai Pong, Doi Chiang Dao, Doi Suthep, Doi Inthanon), Mae Hong Son (Mae La Noi), Lampang; SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai).

D i s t r i b u t i o n.—Ceylon, E. Himalaya to SW. China, Indochina, southwards to Malaya, Sumatra and Java.

E c o l o g y.—On mountain slopes in dense lower montane forest at 1300–2200 m alt.

N o t e.—Morton, Contr. U.S. Natn. Herb. 38: 313. 1974, discussed on the types of this and the allied species, though he missed to elucidate the taxonomic difference between *M. trapeziformis* and *M. puberula*.

**7. Microlepia taiwaniana** Tagawa, Acta Phytotax. Geobot. 10: 199. 1941; Tagawa & K. Iwats., Southeast As. St. 5: 72. 1967. —*Microlepia trapeziformis* auct. non (Roxb.) Kuhn: Tagawa & K. Iwats., Southeast As. St. 3(3): 82. 1965. Fig. 7: 6.

Different from *M. trapeziformis* as noted in key.

T h a i l a n d.—NORTHERN: Chiang Rai, Chiang Mai (Doi Suthep).

D i s t r i b u t i o n.—Taiwan (known only from the type collection).

E c o l o g y.—On moist ground or along streams in dense tropical evergreen forest at 400–1000 m alt.

N o t e s.—The variation of this species in Thailand suggests that it may be a form of the preceding species.

**8. Microlepia speluncae** (Linn.) Moore, Ind. Fil.: 93. 1857; Bedd., Handb.: 67. 1883; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 3. 1929; C. Chr., Contr. U.S. Natn. Herb. 26: 332. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 99. 1939; Sledge, Kew Bull. 11: 524. 1956; Ching, Fl. Reip. Pop. Sin. 2: 243. 1959; Holtt., Rev. Fl. Malaya 2: 314. 1955; Dansk Bot. Ark. 20: 24. 1961; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 54. 1968.—*Polypodium speluncae* Linn., Sp. Pl.: 1093. 1753.—*Microlepia hancei* Prantl, Arb. Bot. Gart. Breslau 1: 35. 1892; Ching, Fl. Reip. Pop. Sin. 2: 236. 1959.—*Microlepia speluncae* var. *hancei* (Prantl) C. Chr. & Tard., Not. Syst. 6: 9. 1937; in Fl. Gén. I.-C. 7(2): 100. 1939; Holtt., Rev. Fl. Malaya 2: 315. f. 182. 1955.—*Microlepia pilosula* Presl ex Prantl, Arb. Bot. Gart. Breslau 1: 36. 1892; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 97. 1939; Ching, Fl. Reip. Pop. Sin. 2: 245. 1959.—*Microlepia speluncae* var. *pubescens* (Hook.) Sledge, Kew Bull. 11: 525. 1956; Tagawa & K. Iwats., Southeast As. St. 3(3): 81. 1965; 5: 72. 1967.—*Microlepia speluncae* var. *villosissima* C. Chr., Gard. Bull. S.S. 4: 399. 1929; Holtt., Rev. Fl. Malaya 2: 315. 1955; Dansk Bot. Ark. 20: 24. 1961. Fig. 7: 7, 8.

*Rhizome* wide-creeping, almost naked in the older part, deep brown, more than 7 mm diam. *Stipes* stramineous or brownish, pubescent or glabrescent, 50–70 cm long; lamina large, tripinnate to quadripinnatifid, up to 70 cm long, 50 cm wide; rachis stramineous to brownish, grooved on upper surface, more or less hairy;

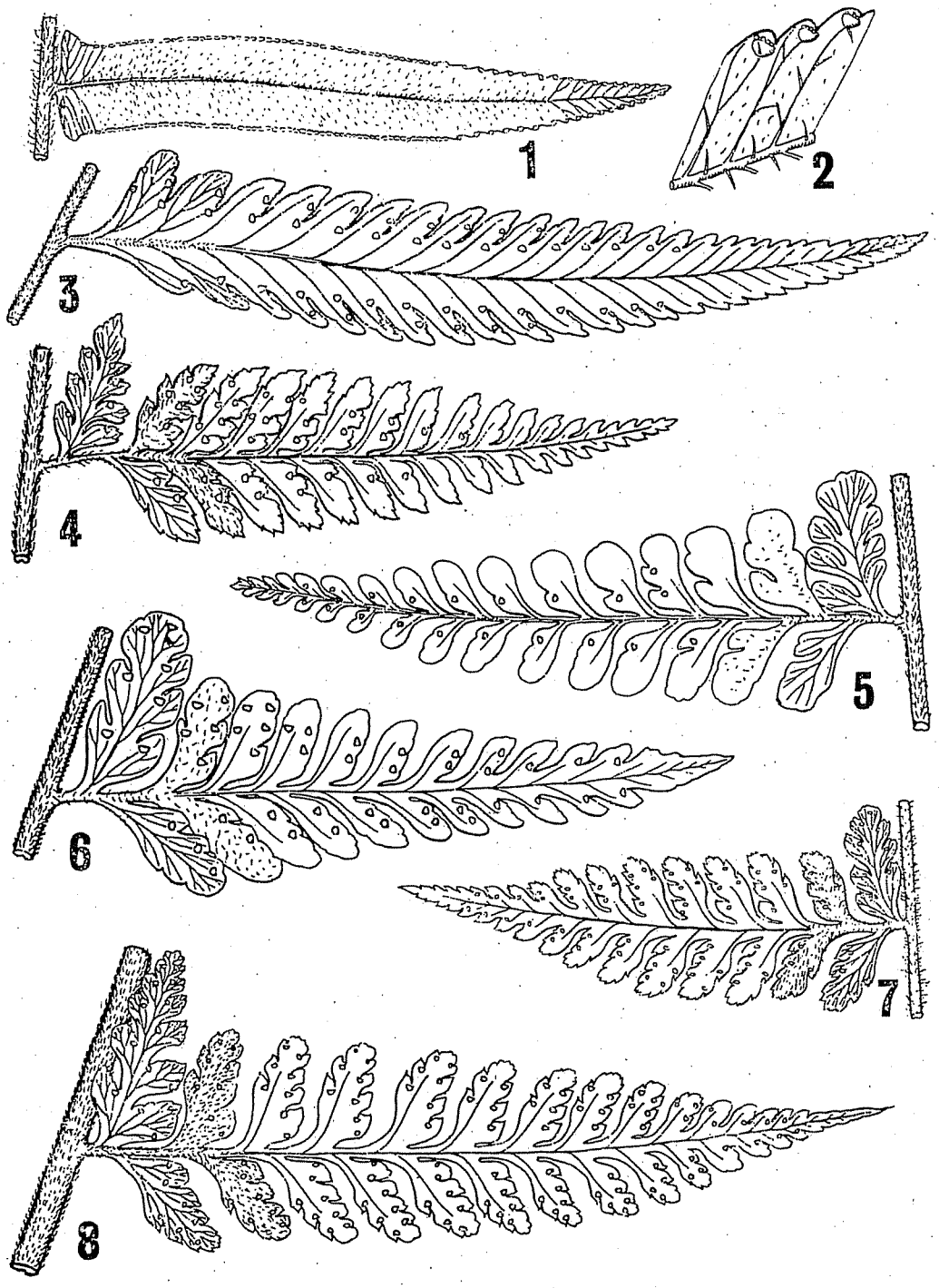



Figure 7. 1–2: *Microlepia hookeriana* 1, middle size pinna, natural size; 2, portion of pinna near pinna-apex, x 3. 3: *Microlepia calvescens* middle size pinna, natural size. 4: *Microlepia firma* middle size pinnule, x 1.5. 5: *Microlepia trapeziformis* large pinnule, x 1.5. 6: *Microlepia taiwaniana* larger pinnule, x 1.5. 7: *Microlepia speluncae* var. *speluncae* large pinnule, x 1.5. 8: *Microlepia speluncae* var. *pubescens* larger pinnule, x 1.5.

larger pinnae oblong-subtriangular, broadly cuneate at base, broadest at lower second or third pinna, gradually narrowing towards caudately acuminate apex, with more than 20 pinnules, about 60 cm long, 20 cm wide; costa grooved on upper surface, more or less hairy, upper pinnae gradually reducing in size; larger pinnules oblong-subtriangular or oblong-lanceolate, gradually narrowing towards apex, unequally cuneate at base, up to 15 cm long, 3 cm wide, distinctly stalked, apical secondary pinnules (segments) a little protruding; segments lobed to pinnatisect, oblong to subquadrangular, round to acute at apex, unequally cuneate at sessile base, typically 1.5–2 cm long, 6–8 mm wide; ultimate lobes round or spathulate, round to acute at apex, entire or undulate at margin of larger ones; softly papyraceous to papyraceous, deep green above, green below, variously hairy on axes or on laminar surfaces; veins pinnate, veinlets once or twice forked, indistinct on both surfaces, variously hairy. *Sori* a little within the margin of lobes, small; indusia cup-shaped, hairy.

T h a i l a n d.—NORTHERN: Chiang Rai (Doi Tung, Mae Nam Kok, Doi Phacho), Chiang Mai (Doi Chiang Dao, Doi Suthep, Mae Suai, Doi Inthanon, Wang Tao), Mae Hong Son (Mae Sariang), Lampang, Tak (Huai Krasa, Ban Musoe, Lan Sang); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao); PENINSULAR: Chumphon (Lam Lieng, Khao Thalu), Surat Thani (Ko Tao), Phuket (Khao Thong Lang), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun, Narathiwat (Waeng, Bacho Falls), Yala (Bannang Sta).

D i s t r i b u t i o n.—Pantropic according to the current delimitation of the species.

E c o l o g y.—Usually on moderate, rather dry slopes in open areas or in light shade, most commonly at edge of thickets, up to 1200 m alt.

V e r n a c u l a r.—Kut phi (กูดผี), kut yi (กูดยี), hora phak kut (โหราผักกูด) (Central); chon (โชน) (South-western); neraphusi (เนระพูสี) (Peninsular).

N o t e.—The size of plants and form of pinnae and pinnules are variable, and we cannot recognize any positive relation between morphological variation and habitat. Holttum (1955) distinguished two varieties, var. *hancei* and var. *villosissima,* according to the hairiness, and Sledge (1956) followed him, recognizing three varieties. In Thailand the forms with glabrous and hairy laminar surfaces can hardly be separated into different taxa.

**9. Microlepia puberula** v.A.v. Ros., Bull. Jard. Bot. Buit, II. 11: 17. 1913; Holtt., Rev. Fl. Malaya 2: 312. f. 179. 1955; Dansk Bot. Ark. 20: 24. 1961; 23: 233. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 73. 1967; Acta Phytotax. Geobot. 23: 54. 1968. Fig. 8: 3.

*Rhizome* creeping, thick, densely hairy at apex, glabrescent in the older part. *Stipes* stramineous, 60–100 cm long, almost glabrous throughout; lamina oblong-subtriangular or oblong with moderately acute apex, bipinnate-tripinnatisect, almost the same length as stipes, up to 50 cm wide; rachis stramineous or brown, grooved

on the upper surface, rather densely pubescent on the upper portion; lateral pinnae less than 10 in pairs, the lower ones more than 15 cm apart, upper ones gradually reduced in size, the basal largest ones oblong-subtriangular, gradually narrowing towards caudately acuminate apex, distinctly stalked at base, up to 30 cm long, 20 cm wide; costae like the upper parts of rachis, densely hairy throughout; larger pinnules oblong-subtriangular, long caudate at apex, unequally cuneate at base, basal acroscopic lobes large, basiscopic ones smaller than the next anterior ones, pinnatisect, stalked at base, 8 cm long, 3 cm wide; costules densely hairy on both surfaces; ultimate lobes oblong, oblique, or spatulate in larger ones, entire or obscurely undulate at margin, round at apex; veins rather distinct and hairy below, less so above, green, papyraceous to chartaceous, hairy on the under surface of laminar parts. *Sori* at or a little within the margin of lobes; indusia shallowly cup-shaped, hairy.

Thailand.—NORTHERN: Chiang Mai (Doi Suthep); SOUTH-WESTERN: Kanchanaburi (Song Tho); PENINSULAR: Yala (Betong).

Distribution.—W. Malesia.

Ecology.—On rather dry slope in tropical evergreen forest or sometimes in open areas at low altitudes.

Note.—This and the following three species form a distinct group among *Microlepia,* usually large in size, bipinnate-tripinnatifid in pinnation bearing large, less-lobed pinnules. *M. platyphylla* and *M. ridleyi* are described as having glabrous fronds, but in cultivation *M. platyphylla* has minute transparent hairs densely covering the young leaves. The juvenile leaves look like those of *Davallia* or *Rumohra adiantiformis.*

**10. Microlepia kurzii** (Clarke) Bedd., Handb.: 66. 1883; Ching, Fl. Reip. Pop. Sin. 2: 238. 1959.—*Davallia kurzii* Clarke, Trans. Linn. Soc. Bot.: 446. 1880.

Similar to *M. puberula,* differing in: plants larger, larger pinnules more than 15 cm long, texture thinner, soft herbaceous, with segments distinctly cartilaginous at margin.

Thailand.—NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Chiang Dao), Lampang.

Distribution.—Upper Burma (type) and Yunnan.

Ecology.—On rather dry slopes in lower montane forest at middle altitudes.

**11. Microlepia platyphylla** (Don) J. Smith, Lond. J. Bot. 1: 472. 1842; Bedd., Handb.: 66. f. 33. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 99. 1939; Ching, Fl. Reip. Pop. Sin. 2: 226. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 81. 1965; 5: 73. 1967.—*Davallia platyphylla* Don, Prod. Fl. Nepal.: 10. 1825. Fig. 8: 5.

*Rhizome* creeping, very thick, the apex densely covered with hairs. *Stipes* thick, stramineous, glabrous throughout, more than 1 m long; lamina very large,

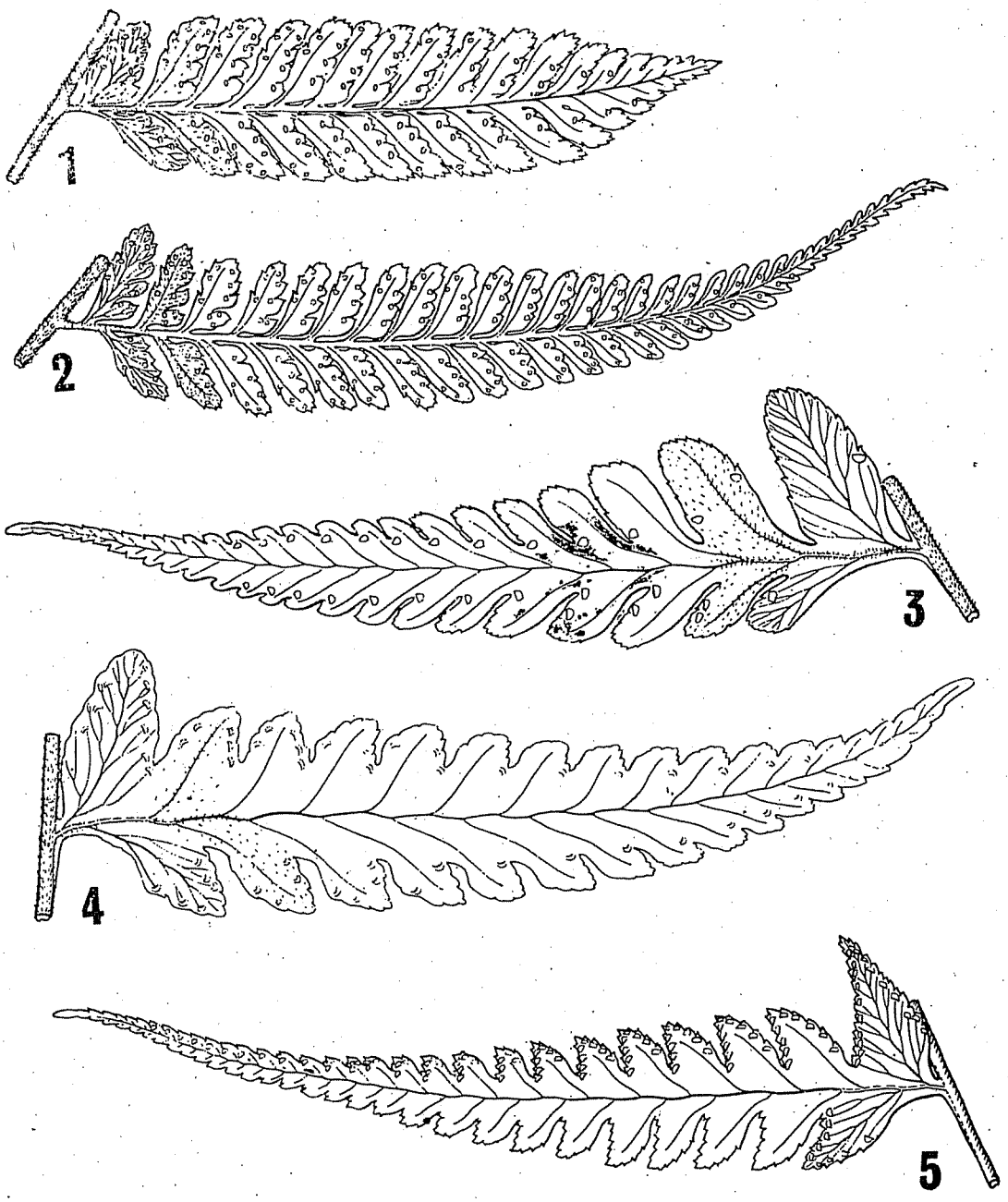



Figure 8. 1: *Microlepia herbacea,* small pinna, natural size. 2: *Microlepia strigosa,* small pinna, natural size. 3: *Microlepia puberula,* middle size pinnule, x 1.5. 4: *Microlepia kurzii,* middle size pinnule, x 1.5. 5: *Microlepia platyphylla,* middle size pinnule, natural size.

bipinnate, subtriangular in outline, 80–130 cm long; rachis like the upper part of stipes, glabrous; lateral pinnae remote from each other, the upper ones gradully reducing in size, the larger ones distinctly stalked, oblong-subtriangular, caudate-acuminate at apex, up to 60 cm long, 25 cm wide; costae grooved on the upper surface, hairy in grooves; larger pinnules linear-subtriangular, gradually narrowing towards long-caudate apex, the base unequally cuneate and with the stalks more than 1.5 cm in length, more than 15 cm long, 4 cm wide; costules distinct and naked on the underside, indistinct but densely hairy on the upperside; ultimate lobe oblong-subtriangular, acute or moderately so at apex, undulate at margin; veins pinnate, veinlets forked, distinct on lower surface, both surfaces of segments glabrous, green in colour, chartaceous. *Sori* terminal on veinlets, each in a marginal dentation, a little inside the margin; indusia shallowly cup-shaped, glabrous.

Thailand.—NORTHERN: Chiang Mai (Kong San, Doi Chiang Dao, Doi Suthep), Lamphun (Doi Khun Tan).

Distribution.—Ceylon, Himalaya (type) to SW. China, Taiwan, Indochina and Philippines.

Ecology.—Usually on wet ground along small streams in light shade in tropical evergreen forest, rather rare, 900–1600 m alt.

Vernacular.—Hora khao nua (โหราเขาเนื้อ), hora phak kut (โหราผักกูด) (Central); hora khao krabu (โหราเขากระบือ) (South-western).

Note.—In older plants the veins are glabrous, but in very young stage the veins are hairy on both surfaces with setose pale long hairs, and sparsely pubescent on lower surface. This is observed in cultivation at Kyoto on plants taken from Doi Suthep and make us doubtful about separating *M. kurzii* and *M. platyphylla*.

**12. Microlepia ridleyi** Copel., Phil. J. Sci. 11C: 39. 1916; Holtt., Rev. Fl. Malaya 2: 313. f. 180. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 54. 1968.

*Rhizome* thick, up to 1 cm diam., short-creeping, hairy. *Stipes* up to 50 cm or more long, thick at base, minutely hairy, more or less puberulous with bases of fallen hairs; fronds large, subtriangular in outline, bipinnate–tripinnatifid, up to 70 cm long, 60 cm wide or larger; lowest pinnae the largest, narrowly oblong-subdeltoid, up to 40 cm long, 12 cm wide, distinctly stalked, the upper ones gradually becoming smaller; rachis and costae grooved, minutely hairy, costae very narrowly winged or wingless, veins not distinctly raised, dark, minutely pubescent or glabrescent; larger pinnules lobed to 4/5 way towards costules, stalked, narrowly cuneate basiscopically at base, long acuminate at apex, up to 9 cm long, 2 cm wide (except for the auricled base); lobes round at apex, entire or minutely serrate, up to 6 mm broad; herbaceous or firmer, glabrous or very sparsely pubescent. *Sori* at end of the acroscopic veinlets of the vein group, near margin or a little inside, small, about 1 mm wide; indusia hairy.

Thailand.—PENINSULAR: Yala (Betong).

Distribution.—Malaya (type) and Borneo.

Ecology.—Terrestrial in humus rich ground near streams in lowland tropical evergreen forest.

## 3. HYPOLEPIS

Bernh., Schrad. Neues J. 1: 34. 1806; Copel., Gen. Fil.: 57. 1947.

Rhizome long-creeping, solenostelic, hairy; stipes usually covered with hairs; fronds pinnately compound, usually herbaceous or papyraceous, hairy or glabrous, the apex sometimes growing to indefinite length; veins always free; sori round, terminal on veinlets, usually near the margin of lobes, lacking indusia or protected by thin reflexed margin of lobes.

This is close to *Dennstaedtia* as shown by the vegetative features. The construction of the indusia is different from the latter, but there are many examples where naked sori are derived from indusiate ones. In the mode of growth of leaves, *Hypolepis* is similar to *Histiopteris* and *Pteridium*.

About 50 species are known in tropical and subtropical regions. Only one species is recorded from Thailand.

**Hypolepis punctata** (Thunb.) Mett. ex Kuhn, Fil. Afr.: 120. 1868; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 101. f. 11. 1–2. 1939; Holtt. Rev. Fl. Malaya 2: 318. 1955; Ching, Fl. Reip. Pop. Sin. 2: 248. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 73. 1967.—*Polypodium punctatum* Thunb., Fl. Jap.: 337. 1784. Fig. 9: 1–3.

*Rhizome* long-creeping, blackish, densely hairy at apex, glabrous on the older part, 3–4 mm diam. *Stipes* stramineous with dark brown base, puberulous, 35–50 cm long; laminae oblong, acute at apex, widest at base, tripinnate–quadripinnatifid, 40–70 cm long, up to 40 cm wide; rachis like the upper part of stipes, stramineous, grooved on upper surface, hairy, the hairs multicellular, coarse, the bases remaining as minute prickles; lower lateral pinnae subopposite, oblong-subtriangular, acute at apex, 30 cm long, up to 20 cm wide, upper pinnae gradually reducing in size; larger pinnules oblong-subtriangular, acuminate at apex, stalked and subtruncate at base, up to 10 cm long, 3 cm wide; costules grooved, hairy throughout; secondary pinnules oblong, round at apex, truncate and sessile at base, up to 2 cm long, 0.5 cm wide, lobed to $\frac{2}{3}$ way towards costules; ultimate lobes round, oblique, dentate at margin, veins pinnate, hairy but indistinct on both surfaces, papyraceous, green above. *Sori* terminal on veinlets, near the margin of lobes, naked.

Thailand.—NORTHERN: Chiang Mai (Doi Chiang Dao, Mae Lui); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradung).

Distribution.—Tropics of the Old World generally, northwards to Japan (type) and Korea and southwards to New Zealand.

Ecology.—On marshy ground or on wet sandy slopes in open areas or in light shade in lower montane forest at 1000–1400 m alt.; usually invading recent clearings.

## 4. PTERIDIUM

Gled. ex Scopoli, Fl. Carn. ed. 1.: 169. 1760, nom. cons.; Tryon, Rhodora 43: 1. 1941; Copel., Gen. Fil.: 59. 1947.

Rhizome long-creeping, deep in earth, solenostelic, hairy; fronds tripinnate to quadripinnatifid at base, the apex growing for a considerable period; axes grooved, the grooves decurrent to those in the next higher order; veins all free except for the soral commissure; sori submarginal, linear; indusia formed in two parts, the thin reflexed edge of the leaflets and thin membrane attached just below the receptacles.

Both Tardieu-Blot & Christensen (1939) and Holttum (1955) separated *P. esculentum* as a distinct species, but we here follow Tryon in reducing this genus to a single species, dividing it into two subspecies and several varieties. In Thailand there is one variety in each subspecies.

**Pteridium aquilinum** (Linn.) Kuhn in Deck., Reis. Ost.-Afr. 3(3): 11. 1879; C. Chr., Contr. U.S. Natn. Herb. 26: 333. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 136. 1939; Tryon, Rhodora 43: 12. 1941; Holtt., Rev. Fl. Malaya 2: 389. f. 225. 1955; Dansk Bot. Ark. 20: 26. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 78. 1967.—*Pteris aquilina* Linn., Sp. Pl.: 1075. 1753; Bedd., Handb.: 115. 1883.—*Pteris esculenta* Forst., Pl. Escul.: 74. 1786.—*Pteridium esculentum* (Forst.) Nakai, Bot. Mag. Tokyo 39: 108. 1825; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 138. f. 17, 1. 1939; Holtt., Rev. Fl. Malaya 2: 390. f. 226. 1955; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958.

*Rhizome* long-creeping, covered with fine pale brown hairs. *Stipes* long, more than 1 m long, thick, dark brown to black in hypogeal parts, stramineous upwards, densely covered with pale brown hairs; lamina tripinnate to quadripinnatifid at base, the apex growing for a considerable period, up to 1 m or more both in length and width; rachis, costae and costules grooved on upper surface, the grooves decurrent to those in the next higher order; basal pair of pinnae larger, almost comparable with rest of lamina in size, up to 70 cm long, 40 cm wide, or rather narrower; ultimate leaflets small and narrow, subcoriaceous, usually covered with pale brown hairs, veins free, forked, raised beneath, hairy. *Sori* linear, submarginal, the apices of veins joined by vascular commissure, thus forming long continuous receptacles; indusia formed in two parts, one consisting of the thin reflexed edge of the leaflets, the other thin, almost transparent membrane attached just below the receptacles.

Distribution of species.—Cosmopolitan.

Ecology.—Usually growing in open areas, up to 2000 m alt., common throughout Thailand, the two varieties sometimes growing side by side; sometimes forming a big thicket at edge of forest, or recent clearing in sunny places. This is one of the acidiphilous plants and common in pine forest but rather rare in limestone areas. The rhizomes run deeply underground, and can produce bud after fire. This species as a whole is distributed throughout the temperate and tropical regions and is usually known as bracken. The young leaves are edible, and starch is available from rhizome.

Among twelve varieties recognized by Tryon, two are known in Thailand.

KEY TO THE VARIETIES

1. Pinnules sessile, segments contiguous, terminal lobes small or indistinct, rachis hairy in the groove above (ssp. *aquilinum*) **a. var. wightianum**
1. Pinnules short stalked, segments rather widely spaced, terminal lobes more or less distinct, rachis glabrous or nearly so (ssp. *caudatum*) **b. var. yarrabense**

Subsp. **aquilinum.**

a. var. **wightianum** (Ag.) Tryon, Rhodora 43: 22. pl. 650. f. 1 & pl. 651. f. 3. map 2. 1941; Tagawa & K. Iwats., Southeast As. St. 3(3): 82. 1965; 5: 78. 1967.—*Pteris recurvata* Wall. ex Ag. var. *wightiana* Ag., Rec. Pterid.: 50. 1839.—*Pteridium aquilinum* (Linn.) Kuhn, l.c.; Tard. & C. Chr., l.c.; Holtt., l.c. Fig. 9: 4, 6.

Thailand.—NORTHERN: Chiang Rai (Doi Tung, Doi Phacho), Chiang Mai (Doi Chiang Dao, Pang Ton, Doi Suthep. Doi Phahom Pok, Huai San, Chom Thong), Lamphun (Doi Khun Tan), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Kradung).

Distribution.—Himalayas to Malesia and Taiwan.

Vernacular.—Kut kia (กูดเกี๊ยะ) (Northern); chon (โชน), chon yai (โชนใหญ่) (Peninsular); lue-san (ลือซัน) (Malay/Peninsular).

Subsp. **caudatum**

b. var. **yarrabense** Domin, Bibl. Bot. 85(1): 161. f. 32. 1914; Tryon, Rhodora 43: 63. pl. 650. f. 16 & pl. 653. f. 2. map 10. 1941; Tagawa & K. Iwats., Southeast As. St. 5: 79. 1967.—*Pteridium esculentum* (Forst.) Nakai, l.c.; Tard. & C. Chr., l.c.; Holtt., l.c.—*Pteris aquilina* var. *esculenta* (Forst.) Bedd., Handb.: 116. 1883. Fig. 9: 5, 7.

Thailand.—NORTHERN: Chiang Mai (Bo Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang): PENINSULAR: Chumphon (Bang Son), Surat Thani (Ban Don).

Distribution.—Himalaya through Malesia to Australia.

Vernacular.—Kut kin (กูดกิน) (Northern).

Uses.—Young fronds are locally cooked to substitute vegetable.

## 5. HISTIOPTERIS

(Ag.) J. Smith., Hist. Fil.: 294. 1875; Copel., Gen. Fil.: 60. 1947.—*Pteris* Sect. *Histiopteris* Ag., Rec. Pterid.: 76. 1839.

Rhizome long-creeping, solenostelic, covered with thick hairs; stipes long, usually very dark purplish, polished; rachis grooved on upper surface; fronds larger, growing indefinitely at apex, bipinnate to tripinnate, with opposite pinnae and pinnules; veins anastomosing, areoles without free included veinlets; herbaceous, usually glaucous beneath; sori submarginal, linear, covered by the reflexed margin of lobes, without inner indusia.

This genus resembles *Pteridium* and *Hypolepis* in the hairy rhizome and the continuous growth of frond apex, but differs having reticulate venation. Compared with *Pteridium, Histiopteris* is further distinct in its less complex rhizome construction and in the absence of inner indusia.

Copeland (1947) recognizes seven species for this genus, all in the tropical regions. One pantropic species is known in Thailand.

**Histiopteris incisa** (Thunb.) J. Smith, Hist. Fil.: 295. 1875; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 139. f. 17, 2–3. 1939; Holtt., Rev. Fl. Malaya 2: 391. f. 227. 1955; Dansk Bot. Ark. 23: 237. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 79. 1967.—*Pteris incisa* Thunb., Prod. Fl. Cap.: 171. 1800.—*Lithobrochia incisa* (Thunb.) Presl, Tent. Pterid.: 149. 1836.; Bedd., Handb.: 120. f. 62. 1883. Fig. 9: 8–10.

*Rhizome* long-creeping, covered with dark hairs. *Stipes* long, up to 1 m or more in length, dark purplish, shining; fronds bipinnate to quadripinnatifid, up to 2 m or more in length, climbing with well spaced opposite pinnae and pinnules; rachis, costae and costules grooved on upper surface, a pair of reduced stipule-like pinnules usually present at base of each pinnae; pinnae up to 70 cm long, 30 cm wide; pinnules up to 20 cm long, 7 cm wide; veins copiously anastomosing, rather distinct below. *Sori* continuous at edge of lobes, linear, submarginal, covered by the reflexed edge of lobes.

Thailand.—NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); PENINSULAR: Ranong (Khao Kanta), Krabi (Phanom Bencha), Nakhon Si Thammarat (Khao Luang).

Distribution.—Pantropic.

Ecology.—On rather dry exposed slopes usually at edges of lower montane forest at medium altitudes.

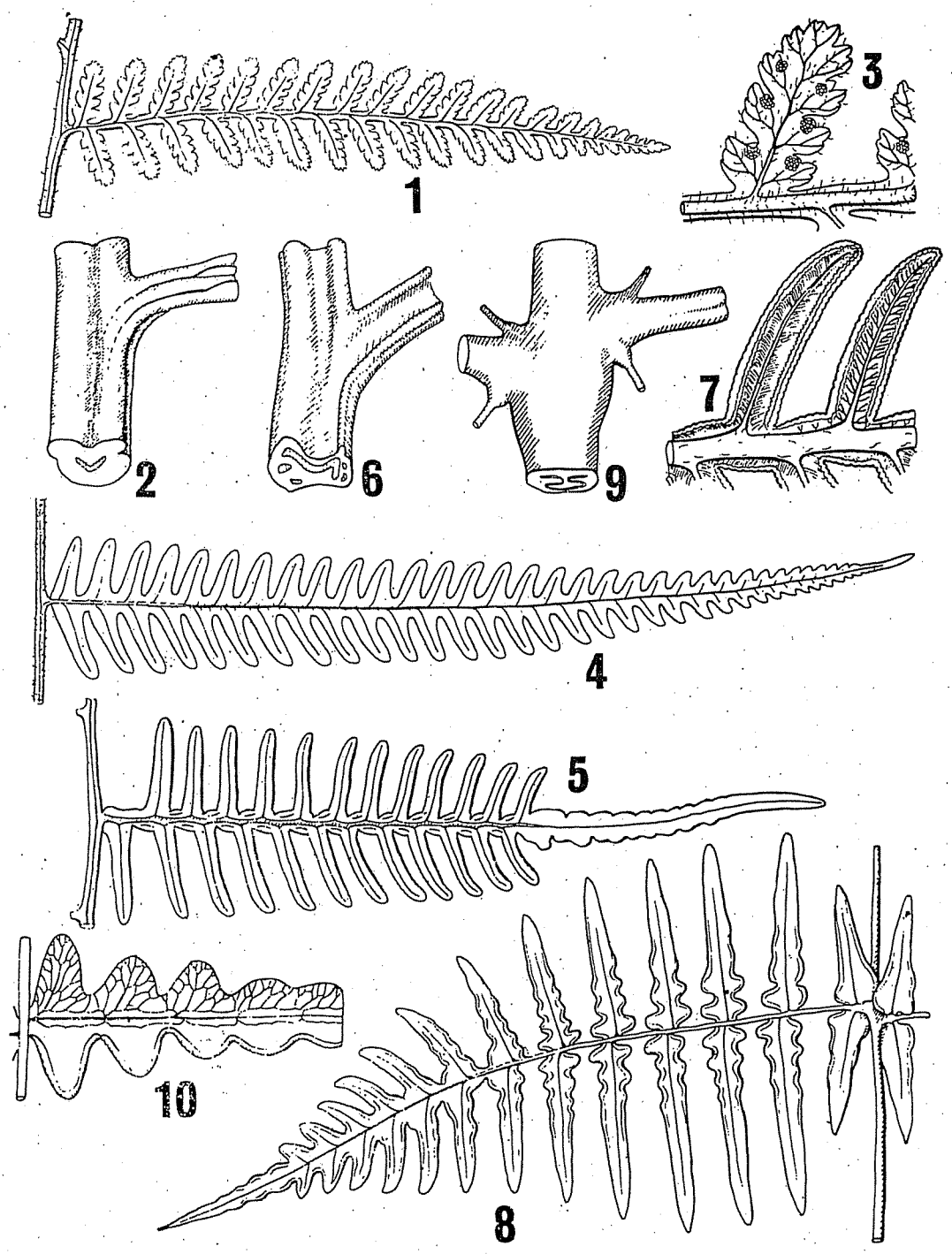



Figure 9. 1/3: *Hypolepis punctata* 1, middle size pinnule, adaxial view, natural size; 2, base of pinnule, hairs removed, x 10; 3, fertile lobe, x 3. 4–7: *Pteridium aquilinum* 4, var. *wightianum,* small pinnule, natural size; 5, var. *yarrabense,* small pinnule, adaxial view, natural size; 6, var. *wightianum,* base of pinnule, hairs removed, x 5; 7, var. *yarrabense,* lobes, x 5. 8–10: *Histiopteris incisa* 8, small pinnule, x 1/2; 9, base of pinnule, x 5; 10, portion of lobe, x 2.

## FLORISTIC REGIONS AND PROVINCES OF THAILAND

I. *N* (NORTHERN)
- 1 Mae Hong Son
- 2 Chiang Mai
- 3 Chiang Rai
- 4 Phayao
- 5 Nan
- 6 Lamphun
- 7 Lampang
- 8 Phrae
- 9 Uttaradit
- 10 Tak
- 11 Sukhothai
- 12 Phitsanulok
- 13 Kamphaeng Phet
- 14 Phichit
- 15 Nakhon Sawan

II. *NE* (NORTH-EASTERN)
- 16 Phetchabun
- 17 Loei
- 18 Udon Thani
- 19 Nong Khai
- 20 Sakon Nakhon
- 21 Nakhon Phanom
- 22 Kalasin
- 23 Maha Sarakham
- 24 Khon Kaen

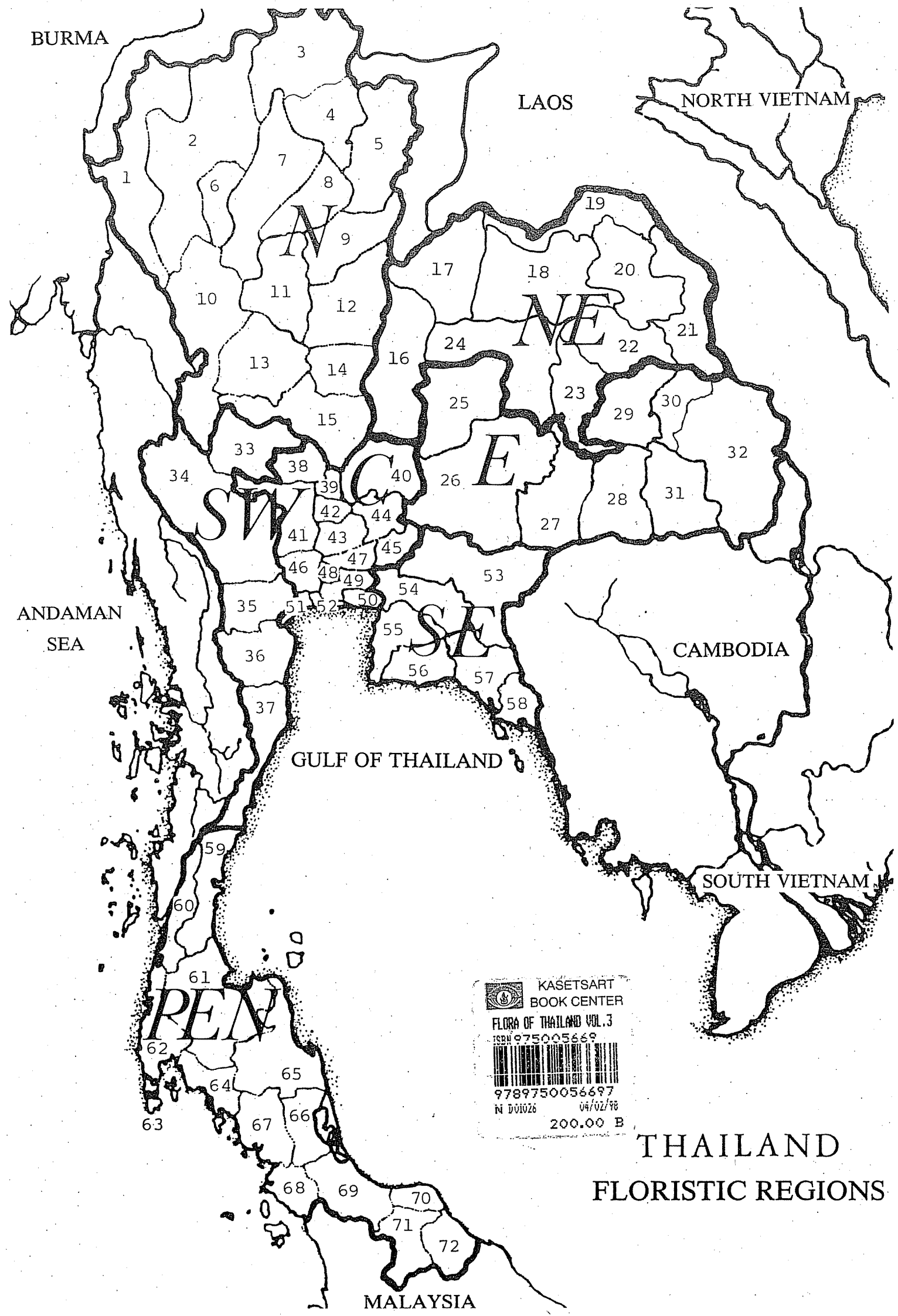
III. *E* (EASTERN)
- 25 Chaiyaphum
- 26 Nakhon Ratchasima
- 27 Buri Ram
- 28 Surin
- 29 Roi Et
- 30 Yasothon
- 31 Si Sa Ket
- 32 Ubon Ratchathani

IV. *SW* (SOUTH-WESTERN)
- 33 Uthai Thani
- 34 Kanchanaburi
- 35 Ratchaburi
- 36 Phetchaburi
- 37 Prachuap Khiri Khan

V. *C* (CENTRAL)
- 38 Chai Nat
- 39 Sing Buri
- 40 Lop Buri
- 41 Suphan Buri
- 42 Ang Thong
- 43 Phra Nakhon Si Ayutthaya
- 44 Saraburi
- 45 Nakhon Nayok
- 46 Nakhon Pathom
- 47 Pathum Thani
- 48 Nonthaburi
- 49 Krung Thep Maha Nakhon (Bangkok)
- 50 Samut Prakan
- 51 Samut Songkhram
- 52 Samut Sakhon

VI. *SE* (SOUTH-EASTERN)
- 53 Prachin Buri
- 54 Chachoengsao
- 55 Chon Buri
- 56 Rayong
- 57 Chanthaburi
- 58 Trat

VII. *PEN* (PENINSULAR)
- 59 Chumphon
- 60 Ranong
- 61 Surat Thani
- 62 Phangnga
- 63 Phuket
- 64 Krabi
- 65 Nakhon Si Thammarat
- 66 Phatthalung
- 67 Trang
- 68 Satun
- 69 Songkhla
- 70 Pattani
- 71 Yala
- 72 Narathiwat






# THAILAND
## FLORISTIC REGIONS