FLORA OF THAILAND

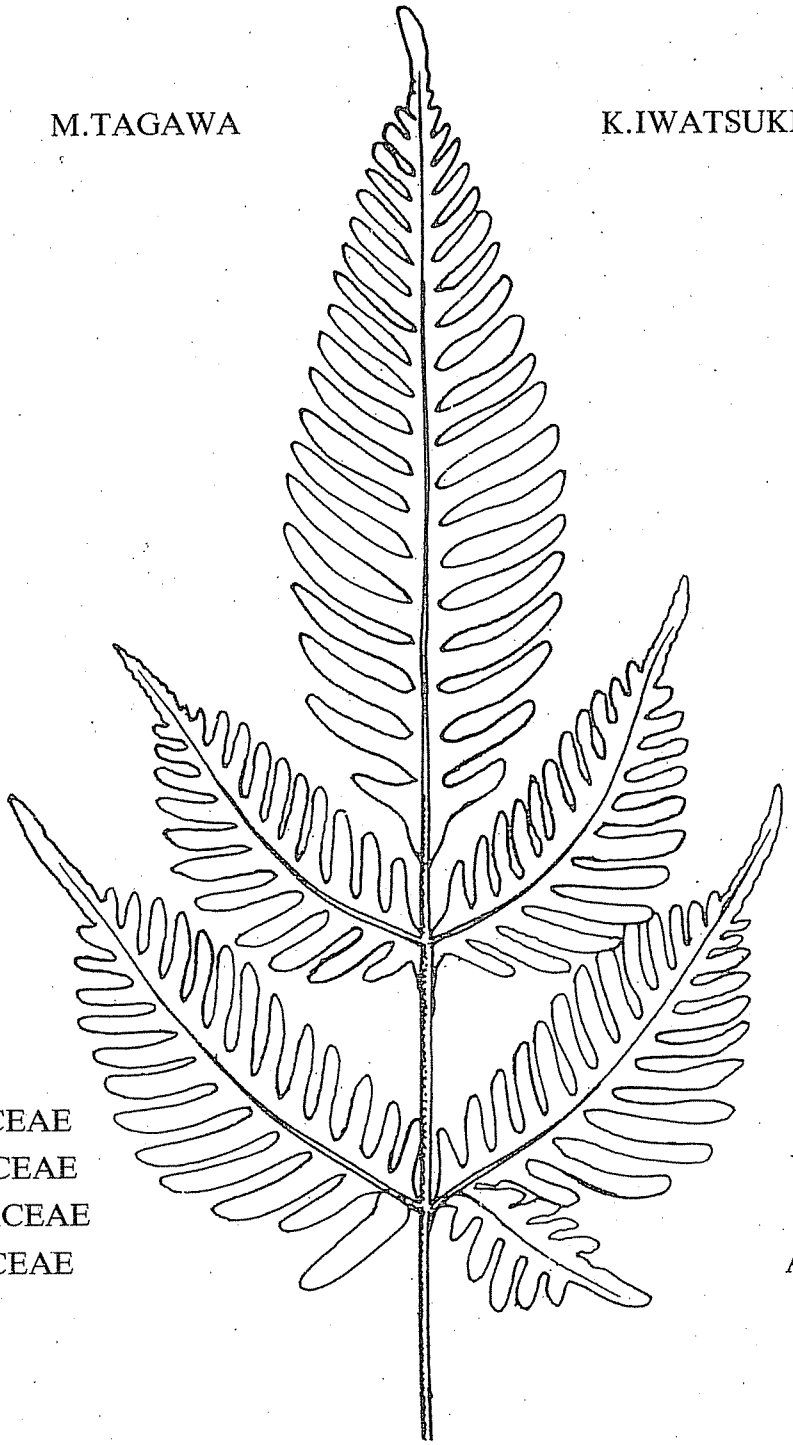
VOLUME THREE

PART TWO

PTERIDOPHYTES

M.TAGAWA

K.IWATSUKI



LINDSAEACEAE
DAVALLIACEAE
OLEANDRACEAE
PARKERIACEAE

VITTARIACEAE
PTERIDACEAE
ASPLENIACEAE

FLORA OF THAILAND

VOLUME THREE PART TWO

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16. LINDSAEACEAE

This family is pantropic, and extends beyond the tropics into Japan, Australia, S. Africa and eastern S. America. It contains more than 200 species in six genera, some three quarters of them in the large and diversified genus *Lindsaea*.

Kramer (1972) has recently revised the family and he was able to examine the types of most species names. There are therefore considerable differences between his names and those used by Holttum (1955). The present account follows Kramer, who has examined most of the material used.

Literature.— Kramer, K.U. : The Lindsaeoid Ferns of the Old World VI. Continental Asia, Japan and Taiwan, Gard. Bull. Sing. 26: 1– 48. 1972.

KEY TO THE GENERA

1. Frond pinnate to bipinnate; pinnae of pinnate frond or pinnules of bipinnate frond dimidiate or not dimidiate; veins free or anastomosing; sori uniting the apices of many veins, or on fewer vein-ends with the sides of the indusium free **1. Lindsaea**
1. Frond pinnate to finely divided; ultimate division not dimidiate; veins free, except when united by sori; sori at end of simple veins or uniting the apices of 2—3 veins, with indusium laterally entirely or largely adnate to the lamina.
   2. Frond pinnate to bipinnate; pinnae or pinnules much longer than wide; sori all at ends of single veins **2. Tapeinidium**
   2. Frond tripinnate to quadripinnate ; pinnules usually short, or if long the sori unting the ends of a few veins **3. Sphenomeris**

1. LINDSAEA

Dryand., Trans. Linn. Soc. 3: 39. 1797; Copel., Gen. Fil. : 52. 1947; Kramer, Blumea 15 : 557. 1967.— *Isoloma* J. Smith, J. Bot. 3: 414. 1841; Copel., Gen. Fil.: 55. 1947.

Rhizome creeping, terrestrial or climbing, covered with hairs or scales, or with both. Frond simply pinnate to bipinnate, usually with dimidiate pinnae or pinnules, veins free or anastomosing, herbaceous to papyraceous, glabrous. Sori usually marginal, terminal on veinlets, joining the apex of veins to form fusion-sori along the margin of lobes; indusia opening outwardly.

About 150 species are known in the tropics of both worlds, extending north to Japan and south to New Zealand and Tasmania. There are 62 species in Malesia, and 18 in Thailand.

Kramer (1967) subdivided the genus into two subgenera and thirteen sections, adding an additional section later (1972). The two subgenera are: *Lindsaea* with essentially terrestrial, short to moderately long creeping rhizomes with radially symmetric or almost symmetric stele; and *Odontoloma* with epiphytic or scandent, wide-creeping rhizomes with strongly dorsiventral stele. Thai species are represented in both subgenera.

Some species of *Lindsaea* are of very restricted occurrence in Thailand : four are confined to one locality, namely *L. napaea, L. parallelogramma, L. odorata,* and *L. divergens,* and two to two localities, *L. integra* and *L. cultrata.* Populations are generally not very dense, except in species like *L. ensifolia* and *L. odorata* (on Phu Kradueng). This may be related to the factors which prevent the cultivation of this genus.

KEY TO THE SPECIES

1. Rhizome short, terrestrial or on rocks. Frond close together (Subgen. *Lindsaea)*
 2. Pinnae not articulate to rachis
  3. Frond simply pinnate with generally not dimidate pinnae and reticulate veins, or bipinnate with pinnae gradually larger below (Sect. *Schizoloma*)
   4. Veins more or less anastomosing
    5. Frond simply pinnate ; pinnae with parallel margins ; veins copiously anastomosing forming more than two rows of areoles at each side of costa **1. L. ensifolia**
    5. Frond simply pinnate to bipinnate with the pinnae gradually narrowing towards apex ; veins laxly anastomosing to form costal areoles, otherwise free **2. L. heterophylla**
   4. Veins all free except those joined by sori
    6. Sterile as well as fertile fronds bipinnate . Sori interrupted at margin of fertile lobes
     7. Pinnules of lower pinnate pinnae and upper simple pinnae more or less dimidiate
      8. Lateral pinnules of lower pinnate pinnae becoming smaller towards distal end usually with distinct apical pinnules **3. L. chienii**
      8. Apical pinnules of lower pinnate pinnae large and triangular **4. L. javanensis**
     7. Pinnules of lower pinnate as well as upper simple pinnae not dimidiate; lateral pinnules of lower pinnate pinnae becoming smaller towards distal ones without distinct apical pinnules **5. L. bouillodii**
    6. Sterile frond usually simply pinnate. Sori more or less continuous along margin of fertile lobes **6. L. orbiculata**
  3. Frond simply pinnate with dimidiate pinnae, or bipinnate with a few lateral pinnae resembling simply pinnate frond
   9. Frond bipinnate, or simply pinnate and bipinnate frond together on the same plants
    10. Veins more or less anastomosing (Sect. *Synaphlebium)*

11. Upper edge of leaflets (i.e. pinnules of bipinnate form or pinnae of simply pinnate frond) lobed
12. Stipe stramineous; veins irregularly anastomosing
13. Leaflets hardly narrowed to apex, 4—6 mm wide. Stipe abaxially angular to base. Sori interrupted **7. L. malayensis**
13. Leaflets a little narrowed to apex, 3—4 mm wide. Stipe abaxially flat or convex, and laterally biangular. Sori continuous or interrupted **8. L. napaea**
12. Stipe more or less castaneous or purplish, sometimes stramineous; veins regularly anastomosing
14. Outer edge of leaflets not lobed. Sori continous with less lobed margin of leaflets **9. L. cultrata**
14. Outer edge of leaflets lobed . Sori interrupted with deeply lobed margin of leaflets **10. L. parallelogramma**
11. Upper edge of leaflets quite entire, base narrowly cuneate **11. L. integra**
10. Veins all free except those joined by sori ; leaflets entire. Sori continuous (Sect. *Lindsaea*) **12. L. doryphora**
9. Frond all simply pinnate ; veins all free except those joined by sori
15. Pinnae more or less half-crescent shape ; rachis round beneath. Spores bilateral (Sect. *Osmolindsaea*) **13. L. odorata**
15. Pinnae more or less quadrangular ; rachis quadrangular in section. Spores tetrahedral (Sect. *Stenolindsaea*) **15. L. lucida**
2. Pinnae articulate to rachis (Sect. *Isoloma)* **14. L. divergens**
1. Rhizome long-creeping, climbing on tree-trunks (Subgen. *Odontoloma*)
16. Frond usually simply pinnate ; rachis quadrangular in cross section. Sori more or less interrupted (Sect. *Odontoloma*)
17. Sori many, short, on single veins or uniting 2 – 3 veins **16. L. repens**
17. Sori continuous towards base, broken only towards apex **17. L. oblanceolata**
16. Frond bipinnate, or rarely simply pinnate ; rachis rounded below, leaflets always quite entire. Sori continuous (Sect. *Pseudolancea*) **18. L. parasitica**

1. Lindsaea ensifolia Sw., Schrad. J. Bot. 1800(2): 77. 1801; Christ, Bot. Tidsskr. 24: 110. 1901; Hosseus, Beih. Bot. Cent. 28(2): 365. 1911; Holtt., Dansk Bot. Ark. 23: 234. 1965; Tagawa & K.Iwats., Southeast As. St. 5: 74. 1967; Kramer in Fl. Mal. II. 3: 211. 1971; Gard. Bull. Sing. 26: 32. 1972.—*Schizoloma ensifolium* (Sw.) J. Smith, J. Bot. 3: 414. 1841; Bedd., Handb.: 80. f. 41. 1883; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 3. 1929; Tard. & C. Chr. in Fl. Gén. I.-C.7(2): 129. f. 15, 1-2. 1939; Holtt., Rev. Fl. Malaya 2: 346. f. 200. 1955; Dansk Bot. Ark. 20: 25. 1961; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958; Ching, Fl. Reip. Pop. Sin. 2: 273. pl. 23. f. 1—6. 1959.—*Lindsaea griffithianum* Hook., Sp. Fil. 1: 219. t. 68 B. 1846.—*Schizoloma griffithianum* (Hook.) Fée, Gen. Fil.: 108. 1852; C. Chr., Bot. Tidsskr. 32: 345. 1916.—*Diplazium bantamense* auct. non Bl.: Christ, Bot. Tidsskr. 24: 108. 1901.

Rhizome creeping, 3 – 5 mm diam., bearing fronds close together or up to 2 cm apart, brown to darker, scaly at least apically; scales linear, up to 2.5 mm long, 0.3 mm broad, brown, slightly shining. *Stipe* stramineous or castaneous at least at base. *Lamina* simply pinnate, ovate to oblong-lanceolate in outline, lateral pinnae 3 – 7 pairs, linear-lanceolate, caudately acuminate at apex, cuneate, rounded or subtruncate at base, very shortly stalked, entire at margin, up to 20 cm long, 2 cm broad, rather variable, smaller ones about 5 mm broad; terminal pinnae like lateral ones, subcoriaceous; veins anastomosing forming 2 – 4 rows of areoles at each side of costa, distinct beneath. *Sori* continuous along margin; indusia firm, nearly reaching the edges.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Suthep, Buak Ha), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Nong Khai (Phon Phisai); EASTERN: Ubon Ratchathani; CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Rayong (Khao Chamao), Chanthaburi (Khao Sabap, Makham, Phriu), Trat (Ko Chang, Ko Kut, Tha San falls, Ban Saphan Hin); SOUTH-WESTERN: Kanchanaburi (Khao Ngi Yai); PENINSULAR: Krabi, Ranong (Ko Chong Lat), Surat Thani (Ko Tao, Ban Don), Phuket (Ko Boi Noi), Nakhon Si Thammarat (Tha Samet), Trang (Tahbum), Satun, Yala (Ban Malao, Ban Chana).

D i s t r i b u t i o n.— Old World tropics from W. Africa (type from Mauritus) to Australia and Polynesia, north to the Ryukyus.

E c o l o g y.— Terrestrial on rather dry slopes or on sandy ground, or rearely on rocks, usually in open areas or in light shade, fairly common and locally abundant throughout Thailand at low to medium altitudes below 1400 m.

V e r n a c u l a r.— Hang nok kaling (หางนกกะลิง) (Central).

N o t e.— Extremely variable as for the form and size of fronds especially in the different habitats; in open sunny places, pinnae become less than 5 mm broad, but in shady places they are more than 2.5 cm broad in the fertile condition; the bases of pinnae are usually broadly cuneate but sometimes narrow or auricled to some extent. Three subspecies are recognized but all the forms in Thailand belong in fundamental characteristics to subsp. *ensifolia*.

2. **Lindsaea heterophylla** Dryand., Trans. Linn. Soc. 3: 41. pl. 8 f. 1. 1797; Bedd., Handb.: 77. 1883; Christ, Bot. Tidsskr. 24 : 110. 1901; Tagawa & K. Iwats., Southeast As. St. 5: 75. 1967; Kramer in Fl. Mal. II. 1: 210 f. 17 – 18. 1971; Gard. Bull. Sing. 26: 31. 1972. — *Schizoloma heterophyllum* (Dryand.) J. Smith, J. Bot. 3: 414. 1841; Bedd., Handb.: 80. 1883; C. Chr., Bot. Tidsskr. 32: 345. 1916; Holtt.,

Rev. Fl. Malaya 2: 345. 1955; Ching, Fl. Reip. Pop. Sin. 2: 273. p. 23. f. 7–11. 1959.

Rhizome short-creeping, bearing fronds close together, about 5 mm diam., densely scaly at apex; scales linear, up to 2.5 mm in length, 2–3 cells broad at base, brown, more or less bright. *Stipe* brown to purplish, paler above, scaly at base, grooved on upper surface, round beneath, up to 30 cm long. *Lamina* simply pinnate to bipinnate, up to 25 by 20 cm; lower pinnae pinnate, linear-subtriangular to narrowly subdeltoid, stalked; upper pinnae simple, subsessile, linear-lanceolate with entire margin, acuminate at apex, cuneate to subtruncate at base; pinnules larger ones like the upper pinnae; smaller ones fan-shaped or ovate, entire, all herbaceous, green; veins anastomosing to form a row of areoles at each side of costa, otherwise free except for those united by sori. *Sori* continuous, not interrupted; indusia firm, hardly reaching the margin of pinnae or pinnules.

Thailand. — NORTHERN: Chiang Mai (Doi Suthep); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN:Trat (Ko Chang, Ko Kut); PENINSULAR: Surat Thani (Ko Phangan).

Distribution.— Madagascar, S. India, Ceylon, Indochina, S. China, W. and N. Central Malesia throughout (type from Malacca), north to the Ryukyus.

Ecology.— On rather dry slopes in evergreen forests, not in open areas, at various altitudes from sea level to about 1200 m.

Note.— This species is also variable in pinnation, size and form of plants and in texture. In light shade the plants become smaller with small pinnae, less divided and rather thick in texture, venation is rarely anastomosing in such small plants.

3. **Lindsaea chienii** Ching, Sinensia 1: 4. 1929; Fl. Reip. Pop. Sin. 2: 270. 1959; Kramer, Gard. Bull. Sing. 26: 19. f. 7. 1972. —*Lindsaea tenera* var. *chienii* (Ching) Tard. & C. Chr., Not. Syst. 5: 266. 1936; in Fl. Gén. I.- C.7 (2): 127. 1939.— *Lindsaea tenera* auct. non Dryand.: Tagawa & K. Iwats., Southeast As. St. 5: 75. 1967, p.p.

Rhizome short-creeping, about 2 mm diam.; scales linear, about 2 mm long, 2 or 3 cells, broad at base, brown, more or less bright. *Stipe* castaneous to nearly black, quadrangular in cross section, up to 25 cm long. *Lamina* bipinnate, or rarely pinnate in small sterile fronds, oblong-subtriangular; lateral pinnae 1–3 pairs, basal ones largest, shortly stalked, linear, up to 10 by 2.5 cm; terminal pinnae large, up to 12 by 3 cm; pinnules of lateral pinnae oblong, inner and lower edges straight, or

more or less dimidiate, meeting in cuneate base, outer and upper edges entire or lobed in larger ones, forming round apex, up to 1.5 cm by 4 mm, those of terminal pinnae oblong to subquadrangular, lower edges dimidiately curving, inner edge close or imbricate to rachis, upper edge more or less lobed, up to 1.8 by 0.8 cm, subcoriaceous; veins free except those united by sori, distinct on both surfaces. *Sori* marginal along outer and upper edges of pinnules, continuous in smaller ones, but usually interrupted.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Suthep); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— S. China (type), Annam, Taiwan, northwards to S. Japan.

E c o l o g y.— Terrestrial on rather dry or clayey slopes in evergreen forests at 1000 − 1500 m alt.

V e r n a c u l a r.— Kut hang nok yung (กูดหางนกยูง) (North-eastern).

4. Lindsaea javanensis Bl., En. Pl. Jav.: 219. 1828; Tard. & C. Chr. in Fl. Gén. I.- C.7(2): 124. 1939; Tagawa & K. Iwats., Southeast As. St. 5: 75. 1967; Kramer in Fl. Mal. II. 1: 208. 1971; Gard. Bull. Sing. 26: 25. 1972. —*Schizoloma javanense* (Bl.) Holtt., Rev. Fl. Malaya 2: 349. f. 202. 1955. —*Lindsaea flabellata* var. *gigantea* Hook., Sp. Fil. 1: 211. t. 63 C. 1864. —*Lindsaea tenera* var. *gigantea* (Hook.) Holtt., Gard. Bull. S.S. 5: 65. 1930.

This is rather close to *L. chienii* differing in : terminal pinnules larger, subdeltoid or rhombic, acuminate at apex, cuneate at base, shallowly lobed at margin, bearing sori at oblique apex of lobes.

T h a i l a n d.—NORTH-EASTERN : Loei (Phu Kradueng); CENTRAL : Nakhon Nayok (Khao Yai); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Assam, Burma, Indochina and W. Malesia (type from Java), north to the Ryukyus and southern edge of Japan.

E c o l o g y.— Terrestrial on mountain slopes at medium altitudes.

N o t e.— Kramer notes that the continental form of this species is closer to *L. chienii* than the Malesian form. In some larger forms *L. javanensis* is similar to *L. heterophylla* but is easily distinguished by its free venation. There is an opinion that this is merely a young form of the preceding, but we have observed in the field, both in Thailand and in Japan, that the plants are fully mature.

5. Lindsaea bouillodii Christ, Not. Syst. (Paris) 1: 59.1909; Kramer in Fl. Mal. II. 1 : 204. f. 21. 1971; Gard. Bull. Sing. 26 : 28. 1972.— *Lindsaea tenera* auct. non Dryand.: Tard. & C. Chr. in Fl. Gén. I.- C.7(2): 126. 1939.— *Lindsaea orbiculata* var. *tenera* auct. non (Dryand.) Bedd.: Bedd., Handb.: 75. 1883.— *Schizoloma tenerum* auct. non (Dryand.) Holtt.: Holtt., Rev. Fl. Malaya 2 : 348. f. 201. 1955.— *Lindsaea cambodiensis* auct. non Christ: Kramer, Blumea 15: 563. 1968; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 54. 1968. Fig.10.2.

This is another species close to *L. chienii* differing in: pinnules of pinnate pinnae as well as upper simple pinnae narrowly cuneate, forming angles of 30°–45°, lower edge never dimidiate, straight, or very slightly roundly curved outwards; the margin of lobes less interrupted and sori more continuous, with up to three breaks in each pinnule; lateral pinnae of lower pinnate pinnae becoming smaller towards distal portion and apical pinnules being not so distinct, upper simple pinnae not much larger than lateral pinnules of lower pinnate pinnae.

T h a i l a n d.—PENINSULAR: Surat Thani (Ko Phangan), Krabi (Khao Phanom Bencha), Nakhon Si Thammarat (Khao Luang), Yala (Gunong Ina).

D i s t r i b u t i o n.—Indochina (type), Hainan, and Malesia.

E c o l o g y.—Terrestrial or on rocks in evergreen forests at low to medium altitudes (500–1100 m).

N o t e.— In definition we may distinguish this from the preceding species and from the variety of the following one, but there are various intermediate forms hardly referable to any of them. In some specimens determined to this species, we cannot overlook the presence of dimidiate pinnules, especially in simple upper pinnae. The distal pinnules of the lower pinnate pinnae are much smaller in some specimens identified as *L. chienii* and have the larger apical pinnules in a frond on the same stock.

6. Lindsaea orbiculata (Lamk.) Mett. ex Kuhn, Ann. Lugd. Bat. 4: 279. 1869; Bedd., Handb.: 75. 1883; Christ, Bot. Tidsskr. 24: 110. 1901; C. Chr., Bot. Tidsskr. 32: 345. 1916; Tard. & C. Chr. in Fl. Gen. I.- C.7(2): 125. 1939; Ching, Fl. Reip. Pop. Sin. 2: 264. 1959; Tagawa & K. Iwats., South-East As. St. 5: 74. 1967; Kramer in Fl. Mal. II. 1: 206. f. 15. 1971; Gard. Bull. Sing. 26: 21. 1972.—*Adiantum orbiculatum* Lamk., Enc. 1: 41. 1783. —*Schizoloma orbiculatum* (Lamk.) Kuhn, Chaetopt.: 346. 1882; Holtt., Rev. Fl. Malaya 2: 344. f. 199. 1955; Dansk Bot. Ark. 20: 25. 1961.

Rhizome short-creeping, about 1.5 mm diam., scaly throughout; scales linear, up to 2 mm long, 2–3 rows of cells at base, brown. *Frond* dimorphic. *Sterile frond*: stipe up to 4 cm long, brown to castaneous, paler above, grooved on upper surface, round beneath; lamina simply pinnate, 4–6 cm long, up to 2 cm wide;

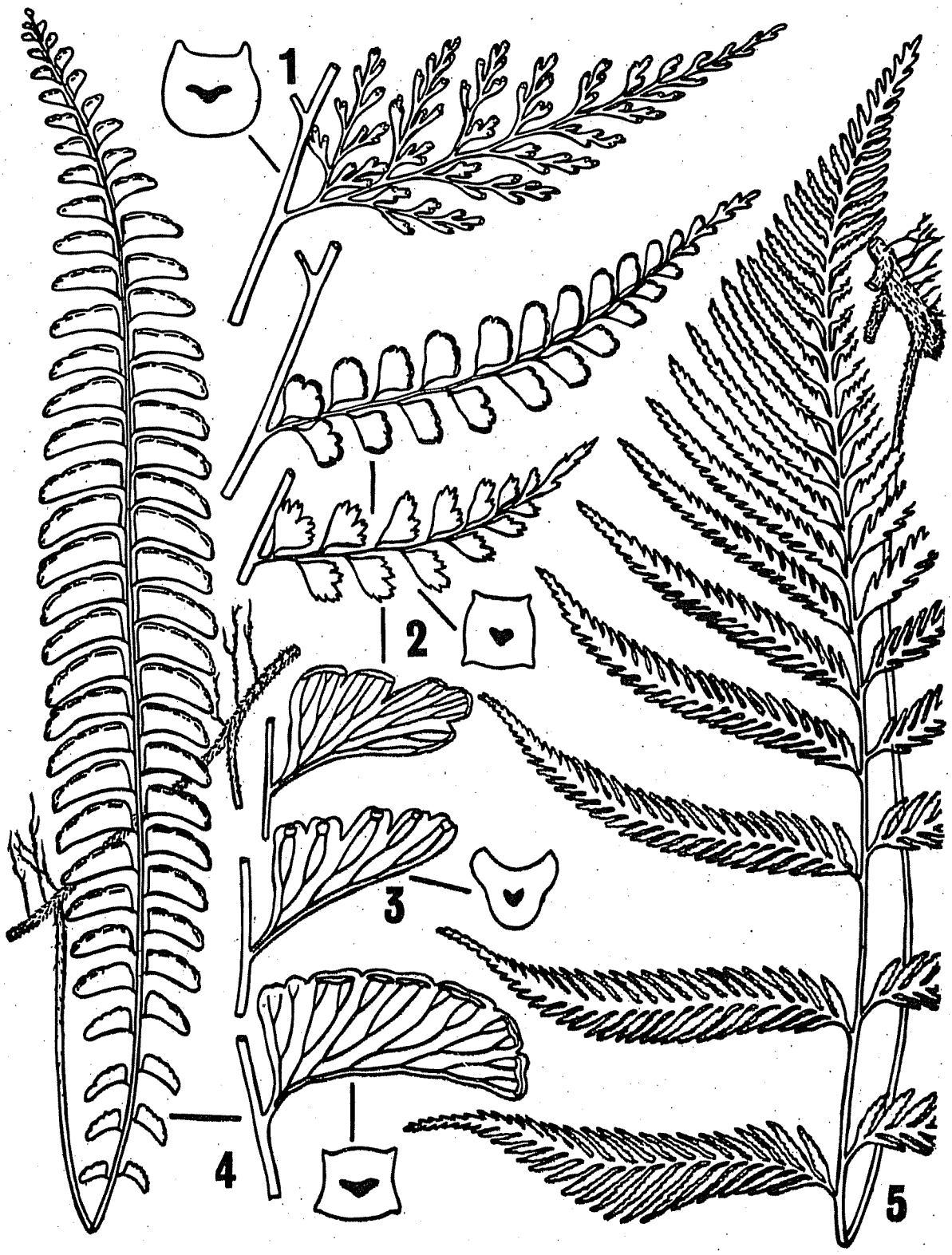

Figure 10. 1: *Sphenomeris chinensis* var. *divaricata*; middle size pinna, natural size, and cross section of rachis (top left). 2: *Lindsaea bouillodii*; fertile pinna (top) and sterile pinna (above), both natural size, cross section of rachis (right), fertile pinnule (below), x 3. 3: *Lindsaea odorata*; fertile pinna, x 3, and cross section of rachis. 4: *Lindsaea oblanceolata*; plant (left), x 0.8 , fertile pinna (bottom right), x 2 , and cross section of rachis. 5: *Tapeinidium luzonicum*; plant, x 0.5.

pinnae sessile, up to 10 pairs, almost fan-shaped, lower and inner edges straight or a little bending, meeting at right angles, the other edges round, serrate at margin; texture herbaceous, veins all free, distinct on both surfaces. *Fertile frond* : stipe much longer, up to 30 cm long; lamina narrowly subtriangular, simply pinnate or bipinnate with a few lateral pinnae, up to 18 cm long, at most 5 cm wide at base; lateral pinnae very shortly stalked, simply pinnate with 1—10 pairs of almost fan-shaped pinnules; terminal pinnae like the laminae of simply pinnate fronds, linear, up to 15 by 2.5 cm; lower pinnules of terminal pinnae almost fan-shaped, upper ones oblong. *Sori* continuous along upper and outer edges; indusia firm, not reaching the edge.

KEY TO THE VARIETIES

1. Fertile frond pinnate, or bipinnate with a few lateral pinnae — **a.** var. **orbiculata**
1. Fertile frond bipinnate nearly to the apex — **b.** var. **commixta**

a. var. **orbiculata**

T h a i l a n d.— EASTERN : Chaiyaphum (Thung Kamang); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN : Trat (Ko Chang, Ko Kut); PENINSULAR : Surat Thani (Ko Phangan), Trang (West Tahbum).

D i s t r i b u t i o n.— Assam, S. China, Indochina, W. and Central Malesia (type from Malacca), extending north to S. Japan through Taiwan and the Ryukyus; also recorded from Burma.

E c o l o g y.— On clayey slopes, often on banks of rivers in light shade or in evergreen forests.

b. var. **commixta** (Tagawa) Kramer in Fl. Mal. II. 1: 207. 1971; Gard. Bull. Sing.26: 22. f. 8. 1972.— *Lindsaea commixta* Tagawa, Acta Phytotax. Geobot. 6: 37. f. 3,H—J. 1937; Ching; Fl. Reip. Pop. Sin. 2: 268. 1959.

Different from the typical form in: fertile frond bipinnate nearly to the apex, the apical pinnae not distinct.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Suthep); NORTH-EASTERN: Loei (Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n.— Ceylon, Himalayas, Burma, S. China, Indochina, Taiwan, northwards to S. Japan (type) and southwards to the Philippines and Java.

E c o l o g y.— Terestrial on rather dry clayey ground in evergreen forests at medium altitudes, 900−1200 m alt.

7. Lindsaea malayensis Holtt., Gard. Bull. S.S. 5: 69. f. 8. 1930; Rev. Fl. Malaya 2: 335. f. 194. 1955; Kramer in Fl. Mal. II. 1: 217. 1971; Gard. Bull. Sing. 26: 33. 1972.— *Lindsaea davalloides* auct. non Bl.: Tagawa & K. Iwats., Southeast As. St. 5: 74. 1967.

Rhizome short-creeping, bearing close stipes, about 2.5 mm diam., scaly near apex; scales linear, up to 2.5 mm long, brown to darker. *Stipe* stramineous, dark brown at base, quadrangular in section, up to 30 cm long. *Lamina* simply pinnate or bipinnate with one or two lateral pinnae; rachis pale, quadrangular in section; lateral pinnae like simply pinnate laminae or terminal pinnae of bipinnate laminae, linear, pinnate, subsessile, ascending, up to 20 by 2.3 cm, widest on above at middle; terminal pinnae usually larger, up to 25 by 2.5 cm; pinnules (or pinnae of simply pinnate fronds) sessile, more than 30 pairs, close, inner and upper edges straight, lower edge gradually curved to moderately acute apex, oblong-subdeltoid in outline, up to 12 by 6 mm, subcoriaceous; veins irregularly anastomosing, more or less distinct on both surfaces. *Sori* separated into 3 or 4 pieces by shallow sinus at upper edge; indusia narrow, not reaching the margin of pinnules.

T h a i l a n d.— SOUTH-EASTERN : Trat (Khao Kuap); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.—Malaya (type).

E c o l o g y.—On humus-rich floors of dense evergreen forests at medium altitude.

8. Lindsaea napaea v. A. v. Ros., Bull. Jard. Bot. Buit. II. 20: 19. t. 3. 1915; Holtt., Rev. Fl. Malaya 2 : 330. f. 189. 1955; Kramer in Fl. Mal. II. 1: 217. 1971; Gard. Bull. Sing. 26: 33. 1972.

Rhizome short-creeping, about 1.5 mm diam., bearing close fronds, sparsely scaly with short (usually up to 1 mm long), narrow, brown scales. *Stipe* stramineous, dark at base, up to 18 cm long. *Lamina* simply pinnate, or more frequently bipinnate with one or two pairs of lateral pinnae, quite similar to the simply pinnate fronds; lateral pinnae subsessile or shortly stalked, more or less curving upwards, narrowly oblong, slightly narrowing towards base, gradually narrowing towards long-acuminate apex, up to 12 by 2.5 cm; terminal pinnae

somewhat larger than lateral ones; pinnules oblong or subquadrangular, patent to broadly oblique, lobed to $\frac{1}{4}$ way on upper edge, rounded and more or less lobed at apex, dimidiately straight or slightly curved at lower edge, crenate at base, up to 13 by 5 mm, thin but firm; veins visible on both surfaces, but not raised, anastomosing or free in smaller pinnules. *Sori* narrow, up to 1.5 mm long; indusia firm, almost reaching the margin of lobes.

Thailand.— PENINSULAR : Trang (Khao Sung).

Distribution.— Malay Peninsula, Sumatra, and Lingga Is. (type).

Ecology.— Terrestrial in evergreen forests at about 700 m alt., only once collected in Thailand: KERR 15227 (BK, BM, K).

9. Lindsaea cultrata (Willd.) Sw., Syn. Fil .: 119. 1806; Kramer, Blumea 15: 565. 1968; in Fl. Mal. II. 1: 222. 1971; Gard. Bull. Sing. 26: 35. 1972.—*Adiantum cultratum* Willd., Phytogr.: 14. t. 10. f. 2. 1794.—*Lindsaea decomposita* Willd., Sp. Pl. 5: 425. 1810; Holtt., Rev. Fl. Malaya 2: 333. f. 192. 1955.—*Schizoloma lobatum* auct. non (Poir.) Bedd.: Bedd., Handb.: 77. 1883.

Similar to *L. malayensis,* differing in: stipe dark-stramineous or more or less castaneous; frond simply pinnate to bipinnate; pinnules less deeply lobed, lower edge horizontal or decurved; veins distinct on lower surface, rather regularly anastomosing to form 4—8 areoles oblique to lower edge; sori continuous along the margin of fertrile lobes or rarely interrupted.

Thailand.— SOUTH-EASTERN : Chanthaburi (Khao Phra Bat); PENINSULAR: Satun.

Distribution.— S. India, (type?), Ceylon, Malay Peninsula, Sumatra, Java, and Borneo.

Ecology.— Terresrtrial in evergreen forests at low altitude.

10. Lindsaea parallelogramma v. A. v. Ros., Bull., Jard. Bot. Buit. III. 5: 212. 1922., Holtt., Rev. Fl. Malaya 2: 335. f. 193. 1955; Kramer in Fl. Mal. II. 1: 220. f. 29. 1971; Gard. Bull. Sing 26: 35. 1972.

Close to *L. cultrata,* differing in: stipe dark purplish throughout; pinnules smaller, up to 15 by 5 mm, many, close, distinctly parallelogram shaped; inner edge more or less divergent from rachis; upper edge straight, obliquely lobed to about a half way, the lobes 4 to 5 in number, outer edge bilobed.

T h a i l a n d.— PENINSULAR: Satun (Khlong Ton).

D i s t r i b u t i o n.— Malay Peninsula and Lingga Is. (type).

E c o l o g y.— Terrestrial in evergreen forests at about 400 m alt.; only once collected in Thailand: KERR 14497 (BK, BM, K).

11. Lindsaea integra Holtt., Gard. Bull. S.S. 5: 67. f. 6. 1930; Kramer in Fl. Mal. II. 1: 223. f. 32. 1971; Gard. Bull. Sing. 26: 35. 1972.— *Lindsaea nitida* auct. non Copel.: Holtt., Rev. Fl. Malaya 2: 333. f. 191. 1955.

Rhizome short-creeping, bearing close fronds, with small scales. *Stipe* stramineous or slightly purplish on under side, quadrangular in section, up to 25 cm long. *Frond* simply pinnate or bipinnate with one or two lateral pinnae like terminal one but smaller in size; pinnae of bipinnate fronds or simple fronds linear-lanceolate, gradually narrowing towards acute apex, up to 15 cm long, 2—3 cm wide; pinnules to 25 pairs, gradually becoming smaller upwards, oblique, ascending, straight to rounded at upper edge, rounded at apex, straight or a little curved at lower edge, narrowly cuneate at base, subsessile or very shortly stalked in larger ones, up to 15 by 6 mm, herbaceous; veins less visible, irregularly anastomosing. *Sori* at upper edge and apex, nearly continuous or rarely interrupted; indusia firm, reaching the edge of leaflets.

T h a i l a n d.— PENINSULAR : Satun, Yala (Ban Chana).

D i s t r i b u t i o n.— Malaya (type), Sumatra and Borneo.

E c o l o g y.— On rocks by streams at low altitude.

12. Lindsaea doryphora Kramer, Blumea 15: 566. 1968; in Fl. Mal. II. 1: 227. f. 35. 1971; Gard. Bull. Sing. 26: 38. 1972.— *Lindsaea lancea* auct. non (Linn.) Bedd.: Bedd., Handb.: 75. 1883, p.p.— *Lindsaea scandens* var. *terrestris* Holtt., Rev. Fl. Malaya 2: 327. 1955; Dansk Bot. Ark. 20: 25. 1961.

Rhizome terrestrial, short to rather long-creeping, scaly; scales bright brown, up to 1.5 mm long, stiff. *Stipe* stramineous, up to 30 cm or more long, usually longer than fronds.*Lamina* usually bipinnate, or rarely with simply pinnate fronds on the same plants, 15—35 cm long, up to 20 cm wide; pinnae up to 6 pairs, ascending, oblong-lanceolate, moderately acute at apex, very shortly stalked, 10—20 by 3—5cm; pinnules 15—20 pairs, dimidiate and crescent-shaped, rounded at upper edge to apex, truncate at acroscopic base and dimidiate and curved at lower edge, 1.5—2.5 cm long, up to 1 cm broad; terminal pinnae like lateral ones, usually larger in size, chartaceous; veins all free, more or less visible on both surfaces. *Sori*

continuous along margin of lobes on upper edge as well as at apex, a little inside the margin; indusia thin, not reaching the margin of lobes.

Thailand.— PENINSULAR: Satun (Khlong Ton), Surat Thani (Ban Don), Nakhon Si Thammarat (Ronphibun), Narathiwat (Sg. Padi), Yala (Betong).

Distribution.— Burma (Tenasserim), Malaya, Borneo (type), W. Java and the Philippines.

Ecology.— Terrestrial or on rocks in evergreen jungles at low to medium altitudes.

13. Lindsaea odorata Roxb., Calc. J. Nat. Hist. 4: 511. 1844; Kramer in Fl. Mal. II. 1: 228. 1971; Gard. Bull. Sing. 26: 40. 1972.— *Lindsaea cultrata* auct. non (Willd.) Sw.: Bedd., Handb.: 72. f. 36. 1883; Christ, Bot. Tidsskr. 24: 110. 1901; C. Chr., Bot. Tidsskr. 32: 345. 1916; Tard. & C. Chr. in Fl. Gén. I.-C.7(2): 120. 1939; Holtt., Rev. Fl. Malaya 2: 328. f. 188. 1955; Dansk Bot. Ark. 20: 24. 1961; Ching, Fl. Reip. Pop. Sin. 2: 260. pl. 22. f. 1–7. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 74. 1967. Fig. 10.3.

Rhizome short-creeping, 1.0–1.2 mm diam., bearing stipes 2–5 mm apart, dark brown; scales dense, hair-like, up to 3 mm long, dark brown to castaneous. *Stipe* up to 8 cm long, dark brown terete. Lamina simply pinnate, stramineous or faintly casteneous upwards, linear or linear-lanceolate, up ot 13 by 1.7 cm, gradually narrowing towards both apex and base; pinnae up to 20 pairs, more or less ascending, stalked, except on the upper ones; middle ones the largest, about 8 mm apart, oblong, round at apex, cuneate at base, up to 8 by 4 mm, lower edge roundly curved and entire, inner edge straight or curved, upper edge lobed to $\frac{1}{3}$, upper ones gradually upwards, shortly stalked or sessile, more ascending; lobes rounded, 1–2 mm broad, up to 2 mm in depth, thin; veins raised on both surfaces, free except when united by sori. *Sori* up to 1.5 mm long, interrupted by sinus between lobes; indusia firm, reaching the margin or lobes, the margin more or less irregular.

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

Distribution.—Tropics of the Old World, Madagascar and Ceylon to Australia, north to S. Japan (type from India).

Ecology.—On sandy rocks in stream-beds in dense evergreen forests at about 1200 m alt. on Phu Kradueng known only in one place in Thailand but abundant there.

14. Lindsaea divergens Hook. & Grev., Ic. Fil.: t. 226. 1831; Bedd., Handb.: 76. f. 38. 1883; Kramer in Fl. Mal. II. 1: 233. 1971; Gard. Bull. Sing. 26: 44. 1972. — *Isoloma divergens* (Hook. & Grev.) J. Smith, Hook. J. Bot. 3: 414. 1841; Holtt., Rev. Fl. Malaya 2 : 337. f. 195. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 49. 1968.

Rhizome short-creeping, nearly black, bearing close fronds, 2.5—3.5 mm diam., densely scaly at least at apex; scales linear, up to 2 mm long, 2 or 3 cells broad at base, dark brown to nearly black, shining, stiff. *Stipe* black, polished, grooved on upper surface, scaly throughout, 15—30 cm long, up to 7 cm wide; rachis like the upper part of stipe, rounded beneath. *Pinnae* close, to 50 pairs, sessile, jointed to rachis, patent or reflexed in lower ones, linear, rounded to moderately acute at apex, broadly cuneate at basiscopic, truncate at acroscopic bases, up to 30 by 4 mm, entire; the lower ones gradually reduced to auricles; terminal pinnae large, irregularly lobed at basal part, up to 5 cm long; subcoriaceous; veins pinnate, veinlets forked, free, except as joined by sori, hardly visible on either surface. *Sori* marginal, continuous along whole length; indusia firm, entire, hardly reaching the margin of pinnae.

T h a i l a n d.—PENINSULAR : Songkhla (Khao Kaeo).

D i s t r i b u t i o n.—Malaya (type), Sumatra, Borneo and Palawan.

E c o l o g y.—Terrestrial in evergreen forests at about 500 m alt.

N o t e.—This species belongs to section *Isoloma* which is maintained as a distinct genus by many authors on account of the polished black rachis, simply pinnate fronds with numerous lateral pinnae of almost equal size, and with articulation to rachis, subcoriaceous to coriaceous texture, continuous sori along margin of pinnae, and free veins.

15. Lindsaea lucida Bl., En. Pl. Jav.: 216. 1828; Tard. & C. Chr. in Fl. Gén. I. - C. 7(2): 122. 1939; Holtt., Rev. Fl. Malaya 2: 328. f. 187. 1955; Dansk Bot. Ark. 20: 24. 1961; Ching, Fl. Reip. Pop. Sin. 2: 263. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 74. 1967; Kramer in Fl. Mal. II. 1: 233. 1971; Gard. Bull. Sing. 26: 44. 1972.

Rhizome very short-creeping, about 1.5 mm diam., bearing stipes close together, scaly near apex, scales very narrow, up to 3 mm long, 0.2 mm broad, brown, shining. *Stipe* brown to castaneous and scaly at base, stramineous or pale-green and quadrangular in section upwards, 2—8 cm long. *Lamina* simply pinnate, linear, up to 30 by 2.8 cm; rachis like the upper part of stipes; pinnae close,

sessile; middle ones larger, patent, oblong to oblong-subdeltoid, 1.7 by 0.7 cm, the lower edge straight or curved, inner edge close to rachis, forming cuneate base with lower edge, rounded to moderately acute at apex; upper pinnae gradually becoming smaller, ascending, acute at apex, forming no terminal pinnae, lower ones more remote, smaller, patent or deflexed, herbaceous; veins distinct on both surfaces, free, except those joined by sori. *Indusia* narrow, thin, nearly reaching the margin of pinnae.

T h a i l a n d.—EASTERN : Buri Ram (Khao Krap); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khao Kluea, Makham, Khao Sabap), Trat (Ko Chang, Ko Kut); PENINSULAR : Ranong (Kamphuan), Phuket (Ko Lanta Yai), Satun (Khuan Kalong), Narathiwat (Waeng), Yala (Ban Chana, Bacho).

D i s t r i b u t i o n.—India, Burma, Indochina, S. China, Malaya, Sumatra to the Moluccas (type from Java).

E c o l o g y.—On rather dry or sandy ground near stremas in shade at low or medium altitudes.

16. Lindsaea repens (Bory) Thwaites & Hook., En. Pl. Zeyl.: 388. 1864; Bedd., Handb.: 74. 1883; Tard. & C. Chr. in Fl. Gén. I.-C.7 (2): 120. 1939; Kramer in Fl. Mal. II. 1: 237. f.43—45. 1971; Gard. Bull. Sing. 26: 45. 1972.—*Dicksonia repens* Bory, Voy. 2: 323. 1804.—*Lindsaea macraeana* (Hook. & Arn.) Copel., Bishop Mus. Bull. 59: 70. 1929; Holtt., Rev. Fl. Malaya 2: 324. f. 185. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 73. 1967.— *Davillia macraeana* Hook. & Arn., Bot. Beech. Voy.: 108. 1832.

var. **pectinata** (Bl.) Mett. ex Kuhn, Ann., Mus. Bot. Lugd. Bat. 4: 277. 1869; Kramer, Blumea 15: 568 et 11. cc.— *Lindsaea pectinata* Bl., En. Pl. Jav.: 217. 1828, not of later authors.

Rhizome long-creeping or climbing, 2.5—3 mm diam., bearing stipes 1—5 cm apart, brown; scales linear, about 3 mm broad, entire, brown, more or less shining. *Stipe* brown in lower and stramineous in upper parts, 1—2 cm long, quadrangular in section except for the basal portion. *Lamina* simply pinnate, linear, gradually acuminate at apex, gradually narrowing towards base, about 45 by 4 cm; rachis pale green in upper part; pinnae close, up to 50 pairs, sessile, middle ones the largest, slightly oblique, quadrangular of gradually narrowing towards apex, almost straight and entire at lower edge, inner edge straight, close to rachis, forming narrowly cuneate base with lower edge, rounded at apex, serrate at upper edge, up to 2.5 cm long, 8 mm broad; upper pinnae smaller and more spaced, deflexed; each serration at margin including a single veinlet or two, 0.5—1.5mm broad, to 1 mm deep, rounded; herbaceous; veins a few times forked, visible on both surfaces, free

except those united by sori. *Sori* usually of single veinlet, or joining of lobes, up to 1.5 mm long; indusia narrow, membranous, hidden under sori at maturity.

T h a i l a n d.—EASTERN: Buri Ram (Khao Krap); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

D i s t r i b u t i o n.—Mascarenes (type), tropics of Asia and Oceania to Hawaii, north to Sikkin and Assam, south to Queensland.

E c o l o g y.—Climbing on trees in dense evergreen forests usually at about 900 – 1500 m alt.

N o t e.—This is one of the polymorphic species, and the Thai plants all belong to var. *pectinata* according to the classification by Kramer : the range of this variety is in Sikkim, Assam, Ceylon, Indochina and W. to Central Malesia (type from Java).

17. Lindsaea oblanceolata v. A. v. Ros., Bull. Jard. Bot. Buit. II. 23 : 15. 1916; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 54. 1968; Kramer in Fl. Mal. 1 : 236. 1971; Gard. Bull. Sing. 26 : 46. 1972. —*Lindsaea pectinata* auct. non Bl.: Tard. & C. Chr. in Fl. Gén. I.- C.7(2): 124. 1939, p.p.; Holtt., Rev. Fl. Malaya 2 : 324. 1955 : Tagawa & K. Iwats., Southeast As. St. 5 : 93. 1967. Fig.10.4.

Rhizome long-creeping or climbing, $\frac{1}{2}$ mm diam., bearing stipes 1—5 cm apart, shining dark brown, scaly throughout; scales narrowly subtriangular, up to 3 by 0.5 mm, entire, brown, *Stipe* up to 6 cm long, castaneous to base, stramineous and quadrangular in section upwards. *Lamina* simply pinnate, linear or linear-lanceolate, up to 45 by 3.5 cm, gradually narrowing towards both apex and base; pinnae sessile, up to 50 or more pairs; middle ones larger, oblong or oblong-subdeltoid, up to 18 by 8 mm; lower edge straight or curved, patent or ascending, inner edge close to rachis, forming with lower edge nearly right angles at base, moderately acute to rounded at apex, moderately rounded at upper edge, serrate in sterile ones, serration less than 1 mm in depth, thin, herbaceous, green, but darker in dried specimens; veins distinct on both surfaces, all free except those joined by sori. *Sori* continuous along upper edge, or sometimes interrupted near rachis, placed a little inside the margin; indusia thin, not reaching the very margin of pinnae.

T h a i l a n d.—PENINSULAR : Surat Thani (Khao Luang), Nakhon Si Thammarat (Khao Luang), Yala (Gunong Ina).

D i s t r i b u t i o n.—Annam and Malesia throughout (type from Sumatra).

E c o l o g y.—Terrestrial on humus-rich floor of forest, on rotten wood, or on mossy tree-trunks in dense evergreen forests at 1000 – 1500 m alt.

18. Lindsaea parasitica (Roxb. ex Griff.) Hieron., Hedwigia 62 : 14. 1920; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 54. 1968; Kramer, Blumea 15 : 570. 1968; in Fl. Mal. II. 1 : 244. 1971; Gard. Bull. Sing. 26 : 47. 1972. —*Vittaria parasitica* Roxb. ex Griff., Calc. J. Nat. Hist. 4 : 510. 1844. —*Lindsaea scandens* Hook., Sp. Fil. 1 : 205. t. 63 B. 1846; Bedd., Handb.: 74. f. 37. 1883; Tard. & C. Chr. in Fl. Gén. I.-C.7(2): 121. 1939; Holtt., Rev. Fl. Malaya 2 : 235. f. 186. 1955. —*Lindsaea lancea* auct. non (Linn.) Bedd.: Bedd., Handb.: 75. 1883. —*Lindsaea borneensis* auct. non Hook.: Tagawa & K. Iwats., Southeast As. St. 5 : 74. 1967.

Rhizome very long, scandent, about 3.5 mm diam., castaneous, densely scaly; scales oblong-lanceolate, about 3 mm long, 1 mm broad at base, thin but firm, brown. *Stipe* about 10 cm long, castaneous and dark brown at base, stramineous upwards. *Lamina* bipinnate, about 35 by 23 cm, oblong in outline; rachis like the upper part of stipes, rounded in cross section; pinnae about 6 pairs, 3—5 cm apart, linear, very shortly stalked, up to 15 cm long, 1.8 cm wide; pinnules sessile, oblique, very close but hardly imbricate, the edge gradually curved outwards to meet the moderately acute to rounded outer edge, up to 20 by 8 mm, coriaceous, green, not shinning, paler beneath; veins all free except those joined by sori, hardly raised but distinct on both surfaces. *Sori* continuous on upper and outer edge, or rarely interrupted; indusia firm, entire, reaching the edge of pinnules.

T h a i l a n d.—PENINSULAR : Surat Thani (Ban Don, Ko Phangan), Nakhon Si Thammarat (Khao Luang), Yala (Gunong Ina).

D i s t r i b u t i o n.—W. Malaysia (type from Penang).

E c o l o g y.—On tree-trunks in dense evergreen forests at about 700 m alt.

N o t e.—Our Khao Luang materials are peculiar in having smaller pinnules up to 1.3 cm long, 6 mm broad, though not otherwise different from the typical form.

2. TAPEINIDIUM

(Presl) C. Chr., Ind. Fil.: 631. 1906; Copel., Gen. Fil.: 53. 1947; Kramer, Blumea 15 : 545. 1969. —*Microlepia* sect. *Tapeinidium* Presl, Epim.: 96. 1849.

Terrestrial ferns; rhizome creeping, scaly with narrow scales. Frond pinnate to bipinnate, usually not very large; pinnae many, becoming smaller upwards. Sori one-nerved, or very rarely with two veinlets, terminal on veins, submarginal; indusia firm, attached at base as well as the lower part of the sides; paraphyses (i.e. the hairs in sori) multicellular, uniseriate, filiform.

In his recent revision Kramer enumerated 17 species in Southeast Asia and Polynesia. The only collection from Indochina is of *T. gracile* (Bl.) v. A. v. Ros. which is not known in Thailand.

KEY TO THE SPECIES

1. Frond simply pinnate, pinnae crenate to serrate	**1. T. pinnatum**
1. Frond bipinnate to deeply pinnatifid	**2. T. luzonicum**

1. Tapeinidium pinnatum (Cav.) C. Chr., Ind. Fil.: 631. 1906; Bot. Tidsskr. 32: 345. 1916; Holtt., Rev. Fl. Malaya 2: 339. f. 196. 1955; Ching, Fl. Reip. Pop. Sin. 2: 8. 1959; Kramer, Blumea 15: 553. 1968; in Fl. Mal. II. 1: 193. 1971; Gard. Bull. Sing. 26: 8. 1972. — *Davallia pinnata* Cav., Ic. Descr. Pl.: 277. 1802. — *Microlepia pinnata* (Cav.) Bedd., Handb.: 64. 1883; Christ, Bot. Tidsskr. 24: 111. 1901.

Rhizome creeping, 2.5–3.5 mm diam., dark brown, bearing close fronds, densely scaly at apex; scales up to 3 by 0.3 mm, brown, rather stiff. *Stipe* up to 20 cm long, stramineous or brownish, scaly at base, grooved on adaxial surface of upper part. *Lamina* pinnate, about 40 by 20 cm; rachis stramineous or green, rarely purplish, grooved on upper surface, sharply triangular in cross section; pinnae sessile or basal ones very shortly stalked, more than 25 pairs, 2–3 cm apart in middle, linear, gradually narrowing to moderately acute apex, narrowly cuneate at base, up to 15 cm by 8 mm, shallowly incised to $\frac{1}{3}$ way to costa, subcoriaceous; veins one to each lobe, forked, hardly visible. *Sori* submarginal, terminal on veinlets, 1–3 in each lobe; indusia firm, shallowly half-cup-shaped, attached by base and sides.

Thailand.—SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Yala (Ban Mae Lao).

Distribution. —S. India, W. and Central Malesia (type from Philippines), north to Taiwan and the Ryukyus.

Ecology.—On sandy banks of streams in shade at low altitudes.

2. Tapeinidium luzonicum (Hook.) Kramer, Blumea 15: 552. 1968; in Fl. Mal. II. 1: 191. f. 11. 1971; Gard. Bull. Sing. 26: 8. 1972. — *Davallia luzonica* Hook., Sp. Fil. 1: 174. t. 60 B. f. 2, 3 & 5. 1845. — *Tapeinidium biserratum* auct. non (Bl.) v. A. V. Ros.: Holtt., Rev. Fl. Malaya 2: 339. f. 197. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 75. 1967. Fig. 10.5.

Rhizome creeping, about 4 mm diam., bearing fronds more than 1 cm apart, nearly black, densely scaly throughout; scales up to 4 by 0.3 mm, brown, shining, stiff. *Stipe* up to 40 cm long, stramineous or purplish, darker and scaly towards base, grooved on adaxial surface of upper part. *Lamina* bipinnate, about 35 by 30 cm; rachis like the upper part of stipes, pale green; lateral pinnae more than 20 pairs, lower several pairs larger, 3–6 cm apart, shortly stalked, lanceolate to oblong-lanceolate, caudately acuminate at apex, cuneate at base, up to 17 by 5 cm at widest middle portion; upper ones gradually becoming smaller; pinnules sessile, lanceolate to narrowly oblong, up to 3.5 cm long, 4 mm broad, shallowly lobed at margin, subcoriaceous; veins forked, hardly visible. *Sori* as in the preceding species.

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

Distribution.—W. and Central Malesia (type from Luzon).

Ecology.—On mountain slopes in dense evergreen forests & at about 1400 m alt.; known only in one locality.

3. SPHENOMERIS

Maxon, J. Wash. Acad. Sci. 3: 144. 1913, nom. cons.; Copel., Gen. Fil.: 54. 1947.

Terrestrial ferns; rhizome creeping, scaly with narrow shinning dark brown scales. Frond bipinnate to quadripinnate; ultimate segments cuneiform, uninervate or with once or twice forked veinlets. Sori terminal on veinlets, uninervate or more often uniting two to three veinlets, close to margin; indusia attached by base, opening outwardly.

This is closely related to *Lindsaea,* and distinct from *Tapeinidium,* as noted in the key to the genera. About a dozen species are credited to this genus from the warmer regions of both worlds; only 1 species is recorded from Thailand.

Sphenomeris chinensis (Linn.) Maxon, J. Wash. Acad. Sci. 3: 144. 1913; Kramer in Fl. Mal. II. 1: 182. f. 1—3 1971; Gard. Bull. Sing. 26: 4. 1972. — *Trichomanes chinense* Linn., Sp. Pl.: 1099. 1753.— *Adiantum tenuifolium* (Linn.) J. Smith, Bot. Voy. Herald: 430.1857;C.Chr.,Bot. Tidsskr.32:345.Lamk.,Enc. 1:44.1783.—*Stenoloma tenuifolium* (Lamk.) Fée, Gen. Fil.:330.1852; Christ, Bot. Tidsskr. 24:110.1901.—*Adiantum chusanum* Linn., Sp. Pl.: 1095. 1853. —*Odontosoria Chinensis* (Linn.) J. Smith, Bot. Voy. Herald: 430. 1857; C. Chr., Bot. Tidsskr. 32: 345. 1916.— *Sphenomeris chusana* (Linn.) Copel., Bishop Mus. Bull. 59: 69. 1929; Holtt., Rev. Fl. Malaya 2: 341. 1955;

Dansk Bot. Art. 20: 25. 1961; 23: 234. 1965; Tagawa & K. Iwats., Southeast As, St. 5: 75. 1967. —*Stenoloma chusanum* (Linn.) Ching, Sinensia 3: 337. 1933; Tard. & C. Chr. in Fl. Gén. I. – C. 7.(2): 130. 1939; Ching, Fl. Reip. Pop. Sin. 2: 275. 1959. Fig. 10. 1.

Rhizome short-creeping, bearing fronds close together, densely scaly; scales dark brown, up to 2 mm long,2–3 cells broad at base, stiff. *Stipe* stramineous, brownish in lower part, scaly at base, grooved on abaxial surface of upper part, up to 35 cm long. *Lamina* oblong to narrower, up to 40 by 15 cm, acuminate at apex, finely divided to quadripinnate; pinnae alternate, subtriangular, attenuately acuminate at apex, cuneate and stalked at base, gradually becoming smaller upwards, tertiary segments cuneate, lobed, subcoriaceous or thinner; veins usually two or three in each ultimate lobe, hardly visible. *Sori* terminal on a veinlet or uniting the apices of 2 – 3 veinlets, close to apex of lobes; indusia attached at base and basal part of both sides, nearly as long as laminae, toothed.

KEY TO THE VARIETIES

1. Ultimate segments gradually broadened from the base — **a.** var. **chinensis**
1. Ultimate segments abruptly spathulately broadened at the sorus, slightly narrowed at more or less rounded apex — **b.** var. **divaricata**

a. var. **chinensis**

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Chiang Dao, Mae Tuen, Bo Luang, Doi Inthanon); NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN : Trat (Ko Chang); PENINSULAR : Nakhon Si Thammarat (Khao Luang, Khiriwong), Surat Thani (Ban Don).

D i s t r i b u t i o n.—Warmer part of the Old World, Madagascar to Polynesia, north to Japan and Korea (type from China).

E c o l o g y.—On moist sandy rocks by streams in light shade to deep shade at about 1000 –1300 m alt.

b. var. **divaricata** (Christ) Kramer, Blumea 15: 572. 1968; in Fl. Mal. II. 1: 183. f. 1. 1971; Gard. Bull. Sing. 26: 5. 1972. — *Odontosoria chinensis* var. *divaricata* Christ, J. Bot. II. 2: 23. 1909. — *Stenoloma chusana* var. *tenuifolia* auct. non (Sw.) C. Chr.: Holtt., Rev. Fl. Malaya 2: 341. f. 198. 1955.

Different from var. *chinensis* in: the ultimate lobes longer and narrower, the soriferous apex usually dilated, uni- or bi-nerved.

T h a i l a n d. —NORTH-EASTERN : Loei (Phu Kradueng); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n. —E. Himalayas, SW. China, Burma, Indochina (type) and Malesia.

E c o l o g y.—Lower montane forests at about 1500 m alt.

Genera ed. 4 : 615

17. DAVALLIACEAE

The current system of this family has been based upon the series of studies made by Copeland (cf. Gen. Fil.: 85-90. 1947), and partly modified by the recent work by Holttum and U. & T. Sen (Kew Bull. 27: 217. 1972).

KEY TO THE GENERA

1. Rhizome scaly, bearing no hairs
   2. Frond hairy . **2. Davallodes**
   2. Frond glabrous
      3. Indusia attached by base and sides **3. Davallia**
      3. Indusia attached by base only, or rarely also by a little above the base, or exindusiate
         4. Frond coriaceous **4. Humata**
         4. Frond herbaceous **5. Leucostegia**
1. Rhizome scaly as well as hairy **1. Araiostegia**

1. ARAIOSTEGIA

Copel., Phil. J. Sci. 34: 240. 1927; Gen. Fil.: 85. 1947; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 178. 1970. nom. cons. — *Gymnogrammitis* Griff., Ic. Pl. As. 2: pl. 129. f. 1. 1849; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 117. 1939.

Rhizome long-creeping, scaly throughout; scales attached basally, concolorously brown, broad, mederately acute to acuminate, not aciculate. Stipe articulated to rhizome; rachis groove decurrent to those of costae and costules. Frond pinnately decompound, usually finely dissected, thin, glabrous. Sori round, terminal on short branch or veins, of dorsal in appearance by extreme shortening of branch, usually at base of the forked lobes, placed at sinus of forked veins; indusia small, usually nearly round, attached only by base, or wanting.

Among 12 species credited to this genus 5 are recorded from Thailand.

KEY TO THE SPECIES

1. Sori exindusiate **1. A. dareiformis**
1. Sori indusiate
   2. Rhizome-scales broad but gradually narrowing towards acuminate apex, at least the apical half patent. Rhizome more than 5 mm diam. The lowest pinnae more than 25 cm long **2. A. faberiana**

2. Rhizome-scales broad, ovate to oblong-subdeltoid with round to acute apex, usually imbricate and not patent. Rhizome 3—5 mm diam. The lowest pinnae less than 25 cm long
3. Ultimate segments more than 0.5 mm broad. Indusia usually broader than long, round to moderately acute at apex
4. Frond deltoid in outline, the lowest pinnae the largest. Indusia crescentic, attached only at the base, completely hidden under sori in maturity **3. A. imbricata**
4. Frond oblong or oblong-deltoid, the lowest pinnae not or hardly larger than the next above. Indusia covering the mature sori **4. A. pulchra**
3. Ultimate segments narrow, less than 0.5 mm broad. Indusia acuminate **5. A. pseudocystopteris**

1. Araiostegia dareiformis (Hook.) Copel., Univ. Calif. Publ. Bot. 12: 398. 1931. — *Polypodium dareiforme* Hook., 2nd Cent.: t. 24. 1860; Bedd., Handb.: 316. f. 169. 1883. — *Leucostegia dareiformis* (Hook.) Bedd., Ferns Br. Ind. Suppl.: 4. 1876; C. Chr., Contr. U.S. Nat. Herb. 26: 332. 1931. — *Gymnogrammitis dareiformis* (Hook.) Ching ex Tard. & C. Chr. in Fl. Gén. I.- C.7(2): 117. f. 14, 1-2. 1939; Ching, Fl. Reip. Pop. Sin. 2: 284. pl. 21. f. 3—6. 1959; Holtt., Dansk Bot. Ark. 20: 25. 1961. Fig.11.1.

Rhizome wide-creeping, about 5 mm diam., densely scaly; scales gradually narrowing from base towards tailed apex, 4—5 mm long, up to 1 mm broad, pale brown or brown in age with dark brown central portion, thin and ferrugineous. *Stipe* stramineous to brown, scaly at base, glabrous upwards. *Lamina* oblong, acute to acuminate at apex, tripinnate to quadripinnatifid, up to 25 by 15 cm; costae like the upper part of pinnae, winged in upper portion; pinnae about 10 pairs, alternate, oblong-subdeltoid, gradually narrowing towards acute apex, falcate, up to 10 by 5 cm, distinctly stalked; pinnules subdeltoid on short stalks, acute at apex, broadly cuneate at base, up to 3 by 2 cm; ultimate segments simple or forked, one-nerved, entire, acute at apex; herbaceous to softly papyraceous, deep green, glabrous. *Sori* dorsal on veinlets, one for each segment, exindusiate.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon, Doi Hua Mot), Phitsanulok (Phu Miang).

D i s t r i b u t i o n.—Himalayas (type from Khasia Hills), SW. China, Hainan and Tonkin.

E c o l o g y.—Epiphytic on mossy tree-trunks or on wet mossy rocks in gloomy dense forests at altitude above 1200 m.

V e r n a c u l a r.—Kut long (กูดลอง) (Northern).

2. Araiostegia faberiana (C. Chr.) Ching, Fl. Reip. Pop. Sin. 2: 293. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 76. 1967; Acta Phytotax. Geobot. 24: 180. 1970. — *Davallia clarkei* var. *faberiana* C. Chr., Acta Horti Gotheb. 1: 73. 1924. Fig. 11.2 .

Rhizome long-creeping, 5—7 mm diam., densely covered with scales throughout; scales oblong with long-tailed apex, up to 1 cm or more long, 4 mm broad, membranous, pale brown, margin subentire. *Stipe* on phyllopode about 1 cm high, stramineous or purplish or pale castaneous, up to 20 cm long. *Lamina* broadly subdeltoid, acuminate at apex, quadripinnatifid, about 50 cm long and broad; basal pinnae the largest, oblong, acuminate at apex, sometimes bearing reduced basal pinnules, up to 30 by 12 cm; upper pinnae gradually becoming smaller, rachis and costae sparsely scaly, stramineous; ultimate segments (4th pinnules) with a few lobes; lobes oblong, slightly falcate, acuminate at apex, entire, about 5 mm broad; herbaceous, light green. *Sori* usually at sinus between lobes of segments, up to 1.5 mm broad; indusia entirely covering the sori in maturity, thin, pale, round at apex.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Phahom Pok, Doi Suthep, Doi Inthanon).

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

E c o l o g y.—On mossy tree-trunks in dense hill evergreen forests at altitudes above 1900 m.

3. Araiostegia imbricata Ching, Fl. Reip. Pop. Sin. 2: 291, 377. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 180. 1970. Fig. 11.3.

Rhizome creeping, about 5 mm diam., densely scaly throughout; scales oblong, moderately acute at both ends, about 4 by 2 mm, entire, pale brown, darker in age. *Stipe* on scaly phyllopode (stipe base remaining as a scar after leaf-shedding) about 1 cm high, light green to stramineous, very sparsely scaly,18—25 cm long. *Lamina* oblong-subdeltoid, acute to acuminate at apex, quadripinnate,40—55 by 25—40cm; lateral pinnae more than 10 pairs, alternate, basal ones the largest, asymmetrically oblong-subtriangular, caudately acuminate at apex, truncate at base, about 20 by 15 cm; pinnules patent or broadly placed on costae, oblong-subdeltoid, acute to moderately and unequally acute at apex, unequally cuneate at base; ultimate segments with a few lobes; lobes entire, acute at apex, about 0.7 mm broad; herbaceous to softly papyraceous. *Sori* one for each ultimate segment, rather large, up to 1.2 mm diam.; indusia very small, up to 0.5 mm long, completely hidden under sori at maturity.

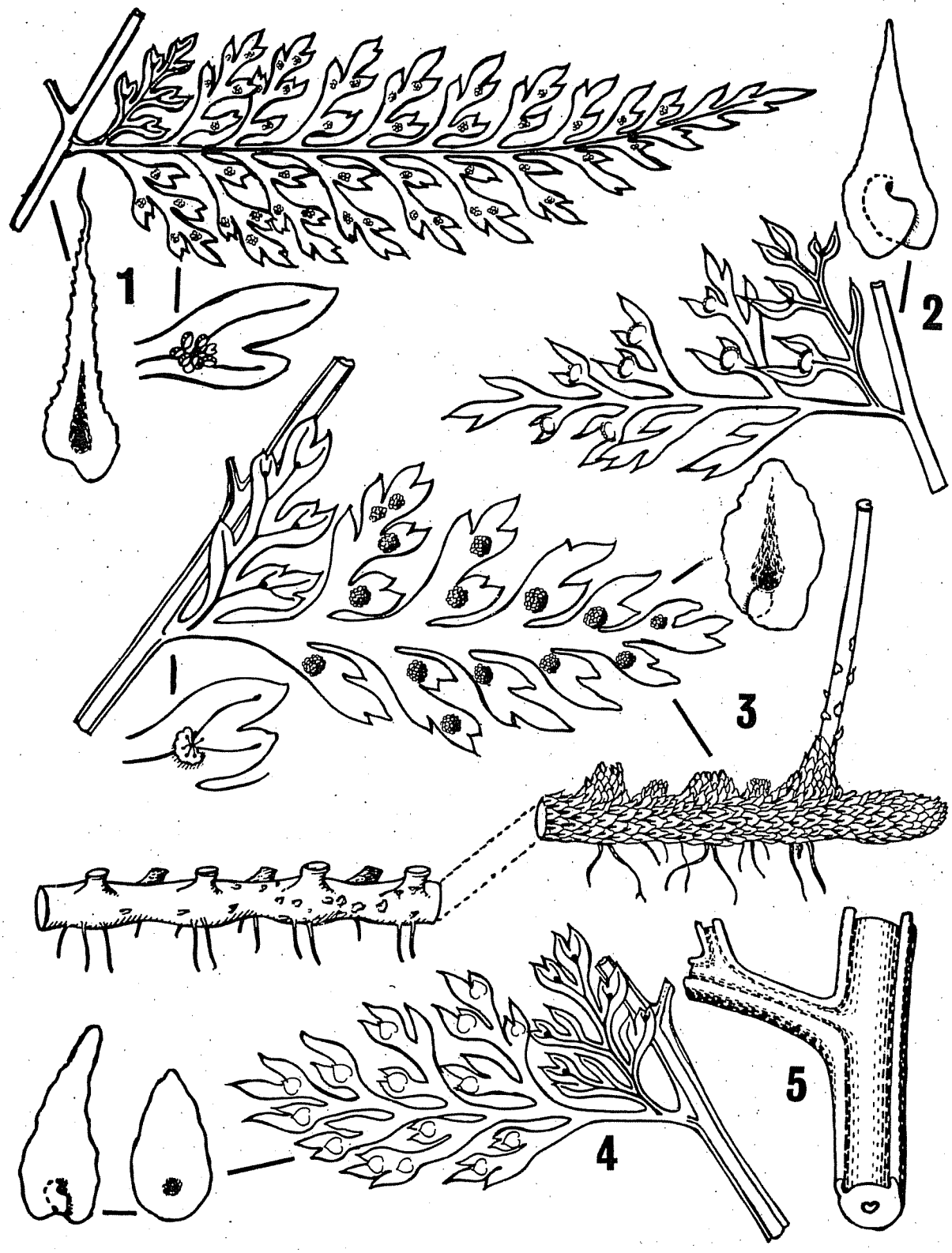

Figure 11. 1: *Araiostegia dareiformis*; small size pinna, x 2, and segment enlarged, showing sorus wanting in indusium, scale (left), x 10. 2: *Araiostegia faberiana;* 3rd order leaflet, x 4, and scale, x 4.3: *Araiostegia imbricata*; small size pinnule (left), x 4, and segment enlarged, showing indusium after sporangia removed, scale on rhizome (above), x 8; rhizome with phyllopodes (below), rather diagramatically showing, x 2. 4: *Araiostegia pseudocystopteris*; pinnule, x 5, and two types of scales, x 5. 5: Rachis construction of *Araiostegia*; basal part of pinna of *A. hymenophyllodes,* x 10, hairs omitted.

T h a i l a n d.—NORTHERN : Lamphun (Doi Khun Tan).

D i s t r i b u t i o n.— S.Yunnan (type)

E c o l o g y.— On mossy tree-trunks in dense evergreen forests at 900 – 1300 m alt.; known only in one locality in Thailand.

4. Araiostegia pulchra (Don) Copel., Phil. J. Sci. 34: 241. 1927; Ching, Fl. Reip. Pop. Sin. 2: 288. pl. 21. f. 9-10. 1959; Holtt., Dansk Bot. Ark. 20: 25. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 77. 1967; Acta Phytotax. Geobot. 24: 180. 1970. — *Davallia pulchra* Don, Prod. Fl. Nepal.: 11. 1825. — *Leucostegia pulchra* (Don) J. Smith, J. Bot. 1: 426. 1842; Bedd., Handb.: 52. f. 25. 1883; C. Chr., Contr. U.S. Nat. Herb. 26: 332. pl. 25. 1931; Tard. & C. Chr. in Fl. Gén. I.-C.7(2): 114. 1939.

Rhizome wide-creeping, about 5 mm diam.; scales dense, oblong, round at both edges, entire or undulate at margin, pale brown or a little darker in central attached portion, thin. *Stipe* jointed to phyllopode 1 cm high, stramineous, terete, sparsely scaly on lower part, up to 20 cm long. *Lamina* oblong to oblong-subtriangular, tri-to quadripinnate,15–30 by10–25 cm; lateral pinnae about 10 pairs, lower ones the largest, basal ones asymmetrically oblong-subtriangular, up to 15 by 8 cm, stalked; pinnules stalked, oblong, round to moderately acute at apex, broadly cuneate anteriorly and dimidiate posteriorly at base; secondary pinnules sessile, cuneate at base; larger ultimate segments with a few lobes, sessile, round to moderately acute at apex, cuneate at base, lobes about 0.5 mm broad, acute at apex; herbaceous to softly papyraceous, glabrous, yellow green to pale green. *Sori* terminal at veinlets, one for each lobe; indusia small, usually broader than long, round at apex, entire, membranous.

T h a i l a n d.—NORTHERN : Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Phahom Pok, Doi Suthep, Doi Hua Mot), Mae Hong Son (Bo Luang), Lamphun (Doi Khun Tan), Tak (Ban Musoe, Rahaeng); NORTH-EASTERN : Loei (Phu Luang); SOUTH-WESTERN : Kanchanaburi (Bo Rae).

D i s t r i b u t i o n.—Himalayas (type from Nepal) to Yunnan and Indochina.

E c o l o g y.—On mossy tree-trunks or rocks in dense evergreen forests at 900 – 2000 m alt.

V e r n a c u l a r.—Kut long (กูดลอง), kut yung (กูดยูง) (Northern).

5. Araiostegia pseudocystopteris (Kunze) Copel., Phil. J. Sci. 37: 241. 1927; Ching, Fl. Reip. Pop. Sin. 2: 287. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 181. 1970. — *Davallia pseudocystopteris* Kunze, Bot. Zeit. 1850: 68. — *Leucostegia pseudocystopteris* (Kunze) Bedd., Ferns Br. Ind. Suppl.: 4. 1876; Handb.: 54. 1883. Fig. 11.4.

Rhizome long-creeping, 3—4 mm diam.; scales oblong-ovate, round at apex, entire, appressed on the surface of rhizome, membranous, somewhat crisped. *Stipe* stramineous to pale castaneous, 8—15 cm long. *Lamina* subdeltoid to narrowly pentagonous in outline, acuminate at apex, up to 20 by 13 cm, quadripinnatifid; basal pinnae the largest, asymmetrically oblong-subtriangular, caudate acuminate at apex, broadly cuneate at base, stalked, up to 8 by 5 cm; upper pinnae narrowly oblong, gradually narrowing towards acute apex; pinnules quadrangular, round to moderately acute at apex, truncate at anterior and dimidiate at posterior bases, shortly stalked or subsessile; secondary pinnules pinnatifid, with sessile rhomboid segments; ultimate segments with a few acuminate entire lobes, papyraceous, rather thick, with yellow glands. *Sori* terminal on veinlets, usually at sinus between the ones of ultimate segments, small; indusia pale, thin, long-acuminate.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Chiang Dao).

D i s t r i b u t i o n.—Himalayas (type), Upper Burma and SW. China.

E c o l o g y.—Epiphytic on half-shaded tree-trunks or on rocks in wooded limestone areas at about 2000 m alt.

2. DAVALLODES

Copel., Phil. J. Sci. 3C: 33. 1980; Gen. Fil.: 87. 1947; Holtt., Kew Bull. 27: 245. 1972.

Rhizome long-creeping, densely covered with scales. Frond articulated to rhizome, pinnately decompound, herbaceous, hirsute at least on veins and axes of higher orders; axes raised on upper surface, forming no grooves; ultimate segments oblong or deltoid, more or less falcate, acuminate, entire. Sori dorsal on segments, terminal on short branches of veins; indusia thin, fixed by base or by base and sides.

The definition of this genus is in accordance with that of Copeland, who in 1947 included a dozen species, all from Malesia and the Sino-Himalayan regions. Two species are known in Thailand, one occurring in the Himalayas and the other in Malesia.

KEY TO THE SPECIES

1. Rhizome slender, up to 3 mm diam. Indusia round or moderately acute at apex (Northern region) **1. D. membranulosum**

1. Rhizome thick, more than 8 mm diam. Indusia acute to acuminate at apex (Peninsular region) **2. D. viscidulum**

1. Davallodes membranulosum (Hook.) Copel., Phil. J. Sci. 34: 245. 1927; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 115. f. 14,3–5.1939; Ching, Fl. Reip. Pop. Sin. 2: 282. pl. 21. f.7–8. 1959; Holtt., Dansk Bot. Ark. 20: 26. 1961. — *Davallia membranulosa* Wall. ex Hook., Sp. Fil. 1: 159. t. 53 A. 1846. — *Leucostegia membranulosa* (Hook.) J. Smith, Hist. Fil.: 84. 1875; Bedd., Handb.: 50. 1883. — *Araiostegia membranulosa* (Hook.) Holtt. ex T. & U. Sen & Holtt., Kew Bull. 27: 230. 1972.

Rhizome long-creeping, up to 3 mm diam.; scales when young with round peltate basal portion and subulate and long-tailed apical portion, up to 8 mm long, 1.8 mm broad at base, bicoloured with narrow brown central portion and white edges, ferrugineous, the edges gradually fading in age, thus the old scales linear and brown. *Stipe* stramineous, densely hairy throughout, scaly at base,5–12(17) cm long. *Lamina* widest at base, tripinnatifid; rachis grooved on upper surface, winged on upper part; pinnae nearly opposite in lower part, alternate in upper part, asymmetrically oblong-subdeltoid, acuminate, broadly cuneate at base, sessile, upper ones gradually becoming smaller, more than 15 pairs; pinnule sessile, narrowly oblong, round at apex, broadly cuneate at base, deeply pinnatifid, up to 17 by 7 mm; costae winged throughout, densely hirsute; ultimate segments oblong, falcate, moderately acute at apex, lobed; each lobe including a veinlet, herbaceous, hairy, green. *Sori* at end of veinlet, one for each lobe, medial; indusia thin, round to moderately acute at apex, white, hirsute.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep), Mae Hong Son (Bo Luang), Tak (Khao Phra Wo).

D i s t r i b u t i o n.—Himalayas (type) to Yunnan and Tonkin.

E c o l o g y.—Epiphytic on mossy tree-trunks or on moist mossy limestone in dense evergreen forests at high altitudes (600–2000 m).

N o t e.—In distribution, this species differs from the rest of the genus, and differs also in the scales, which are less aciculate. Holttum (1972) considered *D. membranulosum* would be better placed in *Araiostegia,* but this seems to be inappropriate.

2. Davallodes viscidulum (Kuhn) v. A. v. Ros., Bull. Jard. Bot. Buit. II. 1: 6. 1911; Tagawa & K. Iwats., Southeast As. St. 5: 77. 1967; Holtt., Kew Bull. 27: 247.1972. — *Davallia viscidula* Mett. ex Kuhn, Linnaea 36: 145. 1869. Fig. 12. 1.

Rhizome long-creeping, about 1 cm diam., green and fleshy when living; scales ovoid with long, aciculate apex, about 13 by 2 mm, dark brown with pale ferrugineous margin in basal appressed ovoid portion, the tails patent. *Stipe* up to 15 cm long, green to stramineous with castaneous lower surface, densely hirsute and sparsely scaly, on scaly phyllopode, 1 cm high. *Lamina* oblong, acute at apex, up to 45 by 25 cm, tripinnatifid; costae narrowly winged at upper portion; pinnae sessile, about 15 pairs, lower one to three pairs beconing smaller downwards, the largest ones patent, narrowly oblong with gradually narrowing or caudate apex, up to 13 by 5 cm; pinnules narrowly oblong, moderately acute, cuneate at base, sessile, more or less ascending; segments narrowly oblong, falcate, acute, lobed with several subdeltoid, acute lobes, herbaceous, light green, glabrous on laminar surface. *Sori* terminal on veinlets, at middle portion of lobes or basal acroscopic portion of segments; indusia pale brown, acuminate, glabrous.

T h a i l a n d.—PENINSULAR : Trang (Khao Chong).

D i s t r i b u t i o n.—Sumatra, Java (type), Borneo, Celebes and New Guinea.

E c o l o g y.—On rather dry rocks in dense forests on ridges at about 800 m alt.

3. DAVALLIA

J.E.Smith, Mem. Acad. Turin. 5: 414. 1793; Copel., Gen. Fil.: 87. 1947.

Rhizome long-creeping, usually thick, densely scaly with peltate or cordate scales. Stipe naked, articulated to rhizome. Lamina of fronds in Thai species finely dissected, usually deltoid, coriaceous to chartaceous, green, glabrous. Sori round, terminal on veins, usually close to margin; indusia attached by base and sides, cup-shaped.

Some 40 epiphytic species are known, mainly in the tropics of Asia, extending eastwards to Polynesia and westwards to SW. Europe. Ching (1959) attached much importance to such features as the size of fronds, dissection, size and form of indusia, and the texture of leaves. These features are, as noted in the enumeration, widely variable in this genus.

KEY TO THE SPECIES

1. False veinlets present between true veins
   2. Lamina narrowly deltoid, about twice as long as wide — **1. D. corniculata**
   2. Lamina broadly deltoid, as wide as long — **2. D. denticulata**
1. No false veins present
   3. Sori not or little longer than wide, sometimes wider than long. Rhizome-scales gradually narrowing towards apex
      4. Rhizome more than 8 mm diam.; rhizome-scales entire. Lamina more than 40 cm long — **3. D. divaricata**
      4. Rhizome 4–6 mm diam.; rhizome-scales ciliate. Lamina up to 25 cm long — **4. D. petelotii**
   3. Sori about twice as long as wide. Rhizome-scales abruptly narrowed above the base
      5. Rhizome 3–5 mm diam. — **5. D. trichomanoides**
      5. Rhizome more than 6 mm diam. — **6. D. solida**

1. Davallia corniculata Moore Ind. Fil.: 292. 1861: Holtt., Rev. Fl. Malaya 2: 359. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 76. 1967. – *Davallia epiphylla* auct. non SW.: Bedd., Handb.: 60. 1883. Fig. 12. 2

Rhizome long-creeping, about 3 mm diam., densely covered with scales, the surface waxy and glaucous; scales more or less patent, gradually narrowing from base towards apex, about 5 mm long, up to 0.8 mm broad, brown or red-brown, ciliate at margin. *Stipe* brown to pale brown, terete, glabrous, up to 20 cm long. *Lamina* narrowly subdeltoid, gradually narrowing upwards, up to 30 by 15 cm, tripinnatifid; basal pinnae with short stalk, subdeltoid, gradually narrowing from broadly cuneate base to apex, up to 10 by 5 cm; upper pinnae gradually becoming smaller; pinnules oblong, moderately acute to acuminate, cuneate at base, with acute lobes, sometimes up to 1 mm long, subcoriaceous, light green, brown in dried condition; veins pinnate, false veinlets present. *Sori* small, at margin of lobes; indusia about 0.3 mm long and wide.

T h a i l a n d.—PENINSULAR : Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Malaya, Sumatra and Java (type): There is a specimen from Bhotan among Beddome collections (BM) but the locality seems to be doubtful.

E c o l o g y.—On fallen tree-trunks in half-shaded places on ridges at about 1400 m alt.

N o t e.—This species is fairly distinct from *D. denticulata* in glaucous rhizome with patent broader scales, oblong or narrowly deltoid outline of fronds with the lowest pinnae hardly larger than the next above, and the occurrence in high altitutdes.

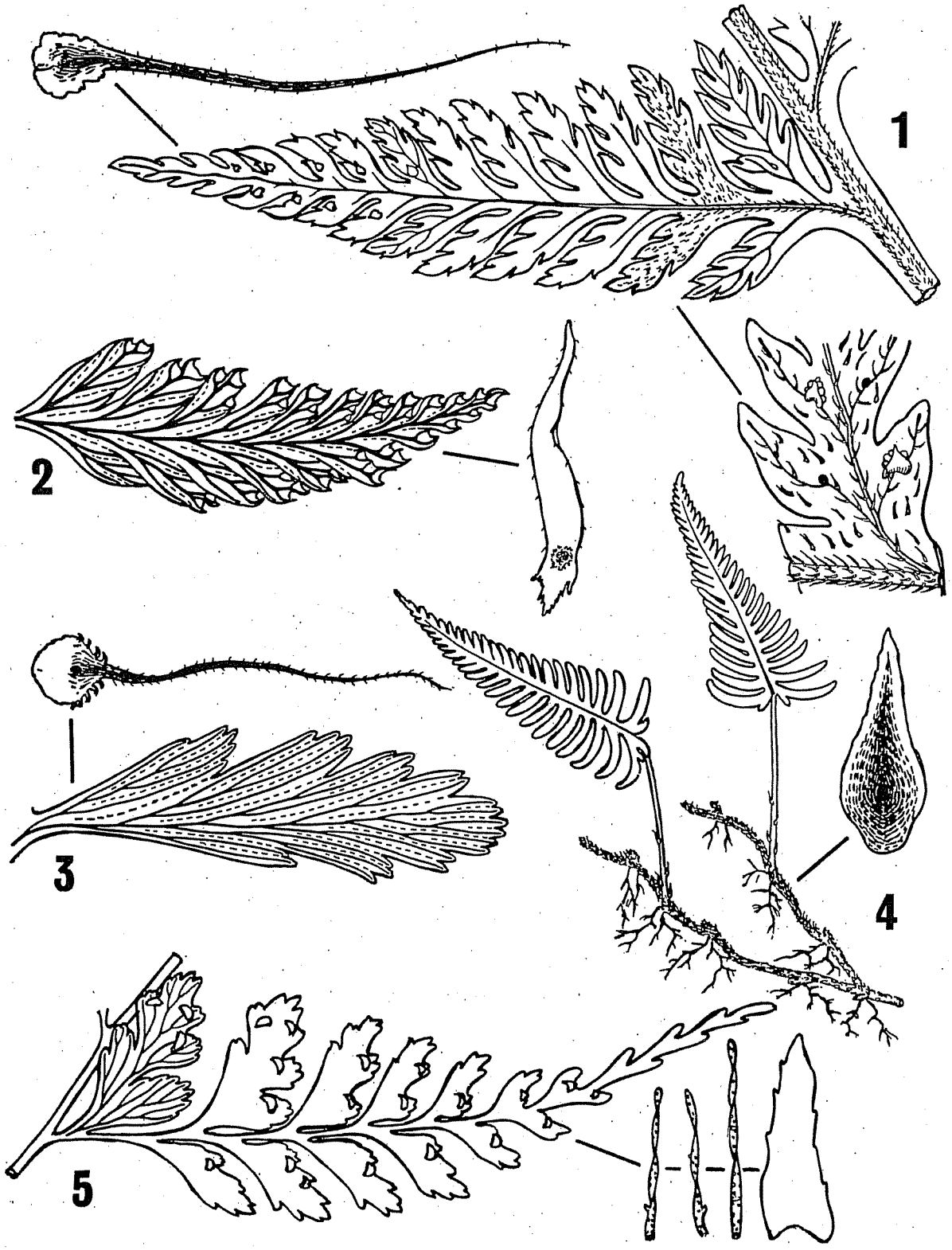

Figure 12. 1 : *Davallodes viscidulum;* pinnule, x 3, scale on rhizome (top left), x 10, venation and sori (below right), x 8. 2 : *Davallia corniculata;* fertile pinnule, showing veins and pseudoveinlets, x 4, scale on rhizome, x 6. 3 : *Davallia petelotii;* small sterile pinnule, showing long incurrent pseudoveinlets between veins, x 4, scale on rhizome, x 10. 4 : *Humata pectinata;* habitat, x 0.5, scale on rhizome, x 8. 5 : *Leucostegia immersa;* pinnule, x 2, hairs and scale on rhizome, x 50 & x 10.

2. Davallia denticulata (Burm.f.) Mett. ex Kuhn, Fil. Deck.: 27. 1867; C. Chr., Bot. Tidsskr. 32: 345. 1916; Tard. & C. Chr. in Frl. Gen. I.- C.7(2): 107. 1939; Holtt., Rev. Fl. Malaya 2: 359. f. 206. 1955; Dansk Bot. Ark. 23: 234. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958; Ching, Fl. Reip. Pop. Sin. 2: 298. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 82. 1965; Acta Phytotax. Geobot. 23: 54. 1968; T. & U. Sen & Holtt., Kew Bull. 27: 219. 1972. — *Adiantum denticulatum* Burm. f., Fl. Ind.: 236. 1768. — *Davallia elegans* Sw., Schrad. J. Bot. 1800(2): 87. 1801; Bedd., Handb.: 59. 1883; Christ, Bot. Tidsskr. 24: 110. 1901; Hosseus, Beih. Bot. Centr. 28(2): 364. 1911.

Rhizome long-creeping, about 5 mm diam., densely scaly throughout; scales ovate at base and abruptly narrowing to long, patent tails, the base up to 1.5 mm wide and long, more or less appressed, the tails up to 5 by 0.2 mm brown to dark brown, ciliate at margin. *Stipe* brown, terete, up to 40 cm long, glabrous. *Lamina* subtriangular, gradually narrowing towards acuminate apex, quadripinnatifid to quadripinnate, up to 60 by 50 cm; basal pinna subtriangular, broadly cuneate at base, stalked, up to 35 cm long, 30 cm wide; pinnules and secondary pinnules stalked or upper smaller ones subsessile, oblong to oblong-subdeltoid, moderately acute to acuminate, ultimate segments (3rd pinnules) oblong, oblique, round at apex, narrowly cuneate and decurrent at base, lobed at margin; lobes acute, about 0.4 mm broad, thin but fairly stiff, green; veins distinct on the lower surface; false veinlets present. *Sori* small, placed at very margin of lobes; indusia cup-shaped, up to 0.7 by 0.4 mm, variable in size and form.

T h a i l a n d.—NORTH-EASTERN : Loei (Phu Kradueng); CENTRAL : Nakhon Nayok (Wang Chao); EASTERN : Nakhon Ratchasima (Khao Lotueng); SOUTH-EASTERN : Chon Buri (Si Racha, Nong Kho), Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Sai Yok, Thung Kang Yang Hill, Tha Poh), Prachuap Khiri Khan (Bang Saphan); PENINSULAR : Surat Thani (Ban Don, Khao Lak, Kanchanadit), Nakhon Si Thammarat (Khao Luang), Ranong (Khao Phra Mi), Phangnga (Takua Thung), Trang (Khao Chong), Satun, Yala (Bannang Sata).

D i s t r i b u t i o n.—Widely distributed in the tropics of the Old World (type from Java), Madagascar to Polynesia and Australia, north to Laos, Hainan and Kwangtung.

E c o l o g y.—On dry rocks or on tree-trunks in evergreen forests or half-shaded places at altitudes below 200 m, or rarely 500 m.

V e r n a c u l a r.—Nakkharat (นาคราช) (Central, Peninsular).

3. Davallia divaricata Bl., En. Pl. Jav.: 237. 1828; Bedd., Handb.: 60. 1883; Tard. & C. Chr. in Fl. Gén. I.- C.7(2): 107. 1939; Holtt., Rev. Fl. Malaya 2: 362. f. 209. 1955; Dansk Bot. Ark. 23: 234. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 76. 1967. — *Araiostegia divaricata* (Bl.) Kato, Acta Phytotax. Geobot. 26: 158. 1975.

Rhizome creeping, thick, more than 0.8 mm diam., densely scaly throughout; scales linear-lanceolate, gradually narrowing towards long-tailed apex, up to 15 by 2 mm, entire, ciliate, brown to pale brown. *Stipe* castaneous to darker, up to 50 cm long, terete, minutely scaly, *Lamina* oblong, acuminate at apex, quadripinnate to quasipinnatifid, less divided in sterile fronds, up to 80 by 65 cm; basal pinnae the largest, narrowly deltoid, broadly cuneate at base, stalked, up to 40 by 30 cm; pinnules gradually narrowing from base to long caudate-acuminate apex, unequally cuneate at base, stalked; ultimate segments round to moderately acute, with acute entire lobes, subcoriaceous, glabrous; veins pinnate, without false veinlets. *Sori* small, terminal on veinlets, the edges 0.2-0.4 mm inside the margin of lobes, more or less sunken, appearing prominent on upper surface; indusia cup-shaped, up to 1.2 mm long, 0.7 mm diam.

T h a i l a n d.—EASTERN : Buri Ram (Khao Laem); CENTRAL : Nakhon Nayok (Khao Yai); PENINSULAR : Surat Thani (Khao Nong), Krabi (Ao Luek), Nakhon Si Thammarat (Khao Luang, Khiriwong), Yala (Khao Kala Khiri).

D i s t r i b u t i o n.—Burma, S. China, Indochina, Hainan, Taiwan, Malaya, Sumatra, Java (type) and New Guinea.

E c o l o g y.—On mossy tree-trunks or on rocks near streams in light shade or in clearing & on ridge & at low or medium altitudes.

4. Davallia petelotii Tard. & C. Chr., Not. Syst. 6: 4. pl. 1. f.5－7.1937; in Fl. Gén. I.- C.7(2): 104. f. 12,5－7.1939; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 49. 1968. Fig. 12.3

Rhizome long-creeping, 4—6 mm diam.; scales subulate with long, thread like tail, up to 10 by 0.8—1.2 mm at the broadest basal portion, hairy at margin, brownish or greyish in older ones. *Stipe* terete, brownish, rather polished, up to 25 cm long, 2－2.5 mm diam. at base, glabrous except for the scaly base. *Lamina* oblong-subdeltoid, acuminate at apex, tripinnate to quadripinnatifid; fertile frond about 25 by 20 cm; sterile fronds larger; the lowest pinna largest, round-subdeltoid, acuminate at apex, round at base with stalks of more than 1 cm in length, about 15 cm long in large sterile frond; secondary pinnae subdeltoid, acute,

cuneate at base, at most 7 by 5 cm, distinctly stalked; pinnules oblong-lanceolate or rhomboid, moderately acute, narrowly cuneate at base, duplo-serrate, pinnatifid or pinnatisect, glabrous on both surfaces, green but dark brownish in dried specimens: veins pinnate. *Sori* terminal on segments, about 1 by 0.8 mm, the mouth truncate or round.

T h a i l a n d.—NORTHERN : Phitsanulok (Thung Salaeng Luang).

D i s t r i b u t i o n.—Laos (type).

E c o l o g y.—River-banks at about 450 m alt.

5. Davallia trichomanoides Bl., En. Pl. Jav.: 238. 1828; Holtt., Rev. Fl. Malaya 2: 361. 1955; Dansk Bot. Ark. 20: 25. 1961; Tagawa & K.Iwats., Southeast As. St. 5: 76. 1967.

Rhizome long-creeping, 3—5 mm diam., densely scaly throughout; scales various as noted in the key to the varieties. *Stipe* stramineous, about 10 cm long. *Lamina* deltoid or roundly pentagonous, gradually narrowed from base to apex, about 18 cm long and wide, or up to 35 cm long, tripinnate to quadripinnatifid; basal pinnae the largest, gradually narrowed from base to acute apex, normally 10 by 6 cm, shortly salked; upper pinnae gradually smaller upwards; pinnules subsessile or larger ones very shortly stalked, moderately acute to acute at apex, cuneate at base; secondary pinnules sessile, round to moderately acute at apex, cuneate at base, lobed at margin; lobes acute at apex, subcoriaceous, glabrescent, green, paler beneath; veins pinnate, hardly distinct. *Sori* terminal on veinlets; indusia cup-shaped, up to 2 mm long, 0.7 mm diam.

There are two distinct varieties which are sometimes treated as species. As noted by Holttum (1955), the rhizome-scales of var. *trichomanoides* are somewhat variable in colour and hairiness, though those of var. *lorrainii* are stable and discriminative by themselves.

KEY TO THE VARIETIES

1. Scales gradually narrowing from peltate base to acuminate apex, bright brown, entire and nearly glabrous to short-hairy at margin. Ultimate segments lobed more than half-way towards midribs
a. var. **trichomanoides**

1. Scales abruptly narrowing above the base to form long tails, dark except for those on young rhizome, with long paler hairs at margin; hairs longer than the breadth of scales. Ultimate segments very shallowly lobed
b. var. **lorrainii**

a. var. **trichomanoides** — *Davallia bullata* Wall. ex Hook., Sp. Fil. 1: 169. t. 50 B. 1846; Bedd., Handb.: 61. f. 31. 1883.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Phahom Pok); PENINSULAR : Surat Thani (Ban Don).

D i s t r i b u t i o n.—Ceylon, Himalayas, Indochina (Tonkin) and Malesia (type from Java). Sometimes Japanese *D. mariesii* is confused with this, though they are distinct in rhizome-scales.

E c o l o g y.—On high mossy branchlets of trees in evergreen forests on ridges at low to medium altitudes.

b. var. **lorrainii** (Hance) Holtt., Rev. Fl. Malaya 2: 361. 1955; Dansk Bot. Ark. 23: 234. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958. — *Davallia lorrainii* Hance, Ann. Sci. Nat. 5: 254. 1866; Bedd., Handb.: 61. 1883; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 106. 1939.

T h a i l a n d.—NORTHERN : Chiang Rai (Doi Tung), Chiang Mai (Doi Suthep, Ban Chue Kai, Doi Pha Dam, Mae Rim), Lampang, Lamphun (Doi Khun Tan), Phitsanulok (Phu Miang), Tak (Ban Musoe); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); EASTERN : Nakhon Ratchasima (Khao Lotueng); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chon Buri (Si Racha), Rayong (Khao Chamao), Chanthaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Khao Ngi Yai); PENINSULAR : Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Ron Phibun).

D i s t r i b u t i o n.—Central Burma, Indochina and throughout Malesia (type from Malaya).

E c o l o g y.—On mossy rocks or bases of tree-trunks in light shade to dense evergreen forests at 800−1400 m alt.

6. Davallia solida (Forst.) Sw., Schrad. J. Bot. 1800(2): 87. 1801; Christ, Bot. Tidsskr. 24: 110. 1901; C. Chr., Bot. Tidsskr.32: 345. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 3. 1929; Tard. & C.Chr. in Fl. Gén. I.- C. 7(2): 104. 1939; Holtt., Rev. Fl. Malaya 2: 360. f. 207. 1955; Dansk Bot. Ark. 23: 234. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 54. 1968; T. & U. Sen & Holtt., Kew Bull. 27: 226. 1972. –*Trichomanes solidum* Forst., Prod.: 86. 1786.

Rhizome long-creeping, 6—12 mm diam., scaly throughout; scales oblong-subtriangular, gradually narrowing towards apex, 4—5mm long, apical part thin, pale brown, with dense hairs about 1 mm long, caducous, basal portion dark brown to nearly black, imbricate; old portion of rhizome covered by these basal portion of scales up to 3 mm in length. *Stipe* stramineous or sometimes brown, about 15 cm long. *Frond* subdeltoid, about 30 cm long and wide, tripinnate; lateral pinnae subopposite; basal pinnae the largest, oblong-subtriangular, with distinct stalk; pinnules stalked, oblong, cuneate at base, gradually narrowing towards acuminate apex; secondary pinnules (ultimate segments) narrowly oblong, sessile, narrowly cuneate at base, moderately acute at apex; axes distinctly grooved, grooves decurrent to each other; veins visible, but not raised. *Sori* terminal on veinlets, at margin of ultimate segments; involucre cup-shaped, up to 1.5 mm long, about twice as long as wide.

T h a i l a n d.—SOUTH-EASTERN : Chanthaburi (Pong Nam Ron, Makham, Khao Sabap), Trat (Ban Saphan Hin, Ko Chang); PENINSULAR : Surat Thani (Ko Tao, Khun Thale, Ban Don), Nakhon Si Thammarat (Tha Samet), Ranong (Khao Phra Mi), Phuket (Ban Krayae, Ko Kut), Trang (Khao Chong), Yala (Betong).

D i s t r i b u t i o n.—Widely known in Malesia and Polynesia, north to Indochina and S. China. Ching (1959) distinguished Chinese and Indochinese plants as *D. sinensis*.

E c o l o g y.—On tree-trunks or on rocks in half-shaded places or in some dense evergreen forests at altitudes below 300 m.

V e r n a c u l a r.—Phaya nakkharat (พญานาคราช) (Northern); wan nakkharat (ว่านนาคราช) (Central); neraphusi (เนระพูสี) (North-easten).

N o t e.—The sterile leaves are less dissected and thus the species is subdimorphic in appearance. The size and form of fronds as well as their dissection are to some extent variable, according to available light and moisture.

4. HUMATA

Cav., Descr. Pl.: 272. 1802; Copel., Gen. Fil.: 88. 1947.

Rhizome long-creeping, densely scaly with peltate scales, bearing stipes remotely. Stipe articulated to rhizome, grooved above. Lamina simple to tripinnatifid, coriaceous, glabrous. Sori round, terminal on veinlets, marginal; indusia attached only by base, or rarely by the sides a little above the base as well.

In general habit this genus is similar to *Davallia,* differing from it in the structure of indusia. This distinction is clear cut in Thailand, but there may be difficulties elsewhere. About 40 species are known mainly from Asian tropics; 5 species occur in Thailand.

KEY TO THE SPECIES

1. Frond not dimorphic
  2. Frond all deeply lobed
    3. Frond lobed almost to midrib or pinnate; lobes (or pinnae) with many secondary lobes
      4. Frond pinnate, or larger ones bipinnate-tripinnatifid at base; fertile frond narrower than sterile ones **1. H. vestita**
      4. Frond lobed to pinnate; fertile frond hardly narrower than sterile ones **2. H. repens**
    3. Lobes of lamina entire except for a single secondary lobe on each of the basal pair **3. H. pectinata**
  2. Frond simple and entire or a little lobed **4. H. angustata**
1. Frond dimorphic; sterile frond simple and entire; fertile ones deeply lobed **5. H. heterophylla**

1. Humata vestita (Bl.) Moore, Ind. Fil.: xcii. 1857; Holtt., Rev. Fl. Malaya 2: 370. f. 215. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 77. 1967. — *Davallia vestita* Bl., En. Pl. Jav.: 233. 1828.

Rhizome long-creeping, about 2 mm diam., densely scaly throughout; scales linear-lanceolate, acute at basal end, acuminate at apex, 6 – 9 mm by 1.2 mm, brown with paler margin. *Stipe* terete, very sparsely scaly or glabrescent, up to 15 cm long. *Lamina* oblong-subdeltoid, up to 14 by 11 cm, bipinnate to tripinnatifid in basal pinnae; basal pinna the largest, asymmetrically subtrinagular; upper pinnae linear-subtriangular, gradually becoming smaller upwards; pinnules oblong, oblique, round at apex, lobed or subentire, coriaceous, glabrous. *Sori* marginal, 1 – 5 on each pinnule; indusia round, up to 1 mm broad.

Thailand.—CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Trat (Ko Chang), Chanthaburi (Khao Phra Bat); SOUTH-WESTERN : Kanchanaburi (Khao Ngi Yai); PENINSULAR : Nakhon Si Thammarat (Khao Luang).

Distribution.—Malesia (type from Java).

Ecology.—On mossy tree-trunks in clearings on ridges at 1200 – 1400 m alt.

2. Humata repens (Linn.f.) Diels in Pflanzenfam. 1(4): 209. 1899; C. Chr., Bot. Tidsskr. 32: 345. 1916; Tard. & C. Chr. in Fl. Gén. I.- C.7(2): 111. f. 13, 1. 1939; Holtt., Rev. Fl. Malaya 2: 371. f. 216. 1955; Dansk Bot. Ark. 20: 26. 1961; 23: 235. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958; Ching, Fl. Reip. Pop. Sin. 2: 307. pl. 27. f. 1–5.1959; Tagawa & K.Iwats., Southeast As. St. 5: 77. 1967; Acta Phytotax. Geobot. 23: 54. 1968; U. & T. Sen & Holtt., Kew Bull. 27: 228. 1972. — *Adiantum repens* Linn.f., Suppl.: 446. 1781. — *Davallia repens* (Linn.f.) Kuhn, Fil. Deck.: 27. 1867, non Desv.; Christ, Bot. Tidsskr. 24: 111. 1901. — *Humata pinnatifida* Bedd., Handb. Suppl.: 12. 1892.

Rhizome long-creeping, about 1.5 mm diam., glabrous, densely scaly throughout; scales acuminate at basal edge, long-acuminate at apex, up to 7 by 1.2 mm, brown. *Stipe* stramineous, terete, up to 7 cm long, sparsely scaly. *Lamina* oblong-subdeltoid or roundly pentagonous, 2.5 – 10 by 2 – 7 cm; basal pinna the largest, oblong-subdeltoid, pinnatifid to pinnate; upper pinnae shallowly lobed or entire, sessile or adnate; basal pinnules of basal pinnae lobed in larger ones, coriaceous, glabrous. *Sori* marginal, small; indusia nearly semi-circular, entire and free except for the base to 1 mm broad.

T h a i l a n d.—NORTHERN : Mae Hong Son (Doi Pha Dam), Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon), Lampang, Lamphun (Doi Khun Tan), Phitsanulok (Phu Miang); NORTH-EASTERN : Loei (Phu luang, Phu Kradueng); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khao Sabap), Trat (Ko Chang, Khao Kuap); SOUTH-WESTERN : Prachuap Khiri Khan (Khao Luang); PENINSULAR : Surat Thani (Khao Nom Sao), Nakhon Si Thammarat (Khao Luang, Khiriwong), Phangnga (Takua Pa, Khao Phra Mi), Trang (Khao Chong), Yala (Gunong Ina, Khao Kala Khiri).

D i s t r i b u t i o n.—Widely distributed in the tropics of the Old World: Madagascar and Seychelles, Mascarene Islands, Himalayas to S. Japan (type), SE. Asia generally, through Malesia to Polynesia and Australia.

E c o l o g y.—On mossy tree-trunks or on rather dry rocks in half-shaded places in dense forests at 1000 – 1600 m alt.

V e r n a c u l a r.—Kut hom bai yoi (กูดห้อมใบย่อย) (Northern); kut thong (กูดทอง) (North-eastern); nakkharat tua mia (นาคราชตัวเมีย) (South-eastern).

N o t e.—This and the preceding species seem to be close to each other and differ in dissection of fronds; but the fronds of either species may be reduced in size and then the distinction is not clear.

3. Humata pectinata (Smith) Desv., Prod.: 323. 1827; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 109. 1939; Holtt., Rev. Fl. Malaya 2: 369. f. 214. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 49. 1968. — *Davallia pectinata* J.E. Smith, Mem. Acad. Turin. 5: 415. 1793. — *Humata parallela* Brack., Expl. Exp. 16: 229. 1854; Bedd., Handb.: 47. f. 22. 1883. — *Nephrodium gaimardiana* Gaud., Voy. Uranie.: 335. t. 12. f. 1. 1827. — *Humata gaimardiana* (Gaud.) J. Smith, Lond. J. Bot. 1: 425. 1842; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 3. 1929. Fig. 12. 4.

Rhizome long-creeping, about 1.5 mm diam., glabrous, densely scaly throughout; scales oblong-lanceolate, round to moderately acute at base, acuminate at apex, up to 6 by 1.3 mm, brown with pale ferrugineous margin. *Stipe* up to 15 cm long, sparsely scaly, terete. *Lamina* oblong, acuminate, round at base, up to 17 by 4.5 cm, lobed nearly to rachis; lobes rounded to moderately acute, entire or crenulate, each basal lobe bearing a few secondary lobes, coriaceous, glabrous. *Sori* along the margin of lobes, a little inside the margin; indusia round, up to 1 mm broad.

T h a i l a n d.—PENINSULAR : Surat Thani (Ko Tao), Narathiwat (Chatwarin Falls).

D i s t r i b u t i o n.—Malesia throughout, north to Cochinchina.

E c o l o g y.—On rocks in evergreen forests at about 300 m alt.

4. Humata angustata (Hook. & Grev.) J. Smith, J. Bot. 3: 416. 1841; Bedd., Handb.: 47. 1883; Holtt., Rev. Fl. Malaya 2: 367. f. 212. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 54. 1968. — *Davallia angustata* Wall. ex Hook. & Grev., Ic. Fil.: t. 231. 1831.

Rhizome long-creeping, about 2 mm diam., glaucous, densely scaly throughout; scales gradually narrowing from oblong base towards tailed apex, about 5 by 1 mm, brown to darker. *Stipe* up to 3 cm long, winged on upper part, stramineous to pale green. *Lamina* simple, linear, gradually narrowing towards acute apex, round at base, entire, up to 15 by 1.5 cm; coriaceous, hairy on midrib underneath; veins once or twice forked near midrib, all free. *Sori* terminal on veinlets, in one marginal row at each side of lamina; indusia round, up to 1 mm broad.

T h a i l a n d.—PENINSULAR : Songkhla (Khao Khieo), Yala (Betong).

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

E c o l o g y.—On mossy tree-trunks in dense forests.

5. Humata heterophylla (Smith) Desv., Prod.: 323. 1825; Bedd., Handb.: 46. 1883; Bonap., Not. Pterid. 14: 53. 1923; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 2. 1929; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 109. 1939; Holtt., Rev. Fl. Malaya 2: 366. f. 211. 1955. — *Davallia heterophylla* J.E. Smith, Mem. Acad. Turin. 5: 415. 1793.

Rhizome long-creeping, about 1.5 mm diam., bearing dimorphic fronds remotely, glaucous, densely scaly; scales gradually narrowing from oblong base towards long tails, up to 6 by 0.7 mm, tails usually patent, brown to darker. *Sterile frond*: stipe 0.5—2.5cm long, narrowly winged; lamina simple, oblong, acuminate at apex, round to cuneate at base, entire, 6—9 by 2—2.5 cm; coriaceous, naked; veins twice or thrice forked, all free. *Fertile frond* : stipe 1—2.5cm long, winged; lamina linear-lanceolate, gradually narrowing towards both ends, up to 9 by 1 cm, lobed to half way; lobes patent, round, wavy. *Sori* terminal on veinlets, 3—5 for each lobe, a little inside the edges; indusia up to 1 mm long, 2 mm broad, brown, entire.

T h a i l a n d.—PENINSULAR : Surat Thani (Tha Ko, Ko Tao), Phangnga, Krabi (Ban Keng), Nakhon Si Thammarat (Tha Samet, Khao Luang), Narathiwat.

D i s t r i b u t i o n.—Malesia throughout to the Pacific, north to Cochinchina.

E c o l o g y.—On branches of trees in dense forests .

V e r n a c u l a r.—Plai mon (ปลายมน) (Peninsular).

5. LEUCOSTEGIA

Presl, Tent. Pterid.: 94. 1836; Copel., Gen. Fil.: 86. 1947.

Terrestrial ferns; rhizome creeping, bearing both hairs and scales, with hairy roots all over the surface; rhizome-scales broad, not distinctly bicoloured, entire. Stipe articulated to rhizome. Frond pinnately decompound, herbaceous, pale green, glabrous, ultimate segments not narrow; rachis and costa grooved on upper surface. Sori round, large, with large indusia; indusia fixed at base or at base and sides, reaching or surpassing the margin of segments.

Thus confined the genus consists of only two species, both of which are known in Malesian and Polynesian regions, one extending northwards to Himalayas across Thailand. These two species are distinct in their sori: very broadly and attached only by base in *L. immersa,* and circular and attached both by base and sides in *L. pallida.*

Leucostegia immersa (Wall. ex Hook.) Presl, Tent. Pterid.: 95. t. 4. f. 11. 1836; Bedd., Handb.: 51. 1883; C.Chr., Contr. U.S. Nat. Herb. 26: 331. 1931; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 113. 1939; Holtt., Rev. Fl. Malaya 2: 352. 1955; Ching, Fl. Reip. Pop. Sin. 2: 296. pl. 26. f. 1-3. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 76. 1967. — *Davallia immersa* Wall. ex Hook., Sp. Fil. 1: 156. 1846.

Fig. 12.5.

Rhizome wide-creeping, bearing fronds remotely; hairs rather dense, golden-yellow, multicellular, wooly; scales narrowly lanceolate, up to 4 by 0.4 mm, light brown, membranous, entire at margin. *Stipe* stramineous or brownish on lower surface, scaly at base, glabrescent upwards, up to 30 cm long. *Lamina* oblong, acuminate at apex, quadripinnatifid, up to 40 by 25 cm; pinnae more than 10 pairs, the lowest the largest, with distinct petioles, lower ones asymmetrically oblong-subdeltoid, acuminate at apex, broadly cuneate at base, up to 15 cm long and wide; pinnules oblong to subdeltoid on stalks in larger ones, secondary pinnules oblong or narrower, with 1—6 segments; ultimate segments circular to oblong or terminal ones spathulate, coarsely dentate at margin; thin herbaceous, light green, glabrous. *Sori* terminal on veinlets, one to each segments; indusia circular, attached only by base, entire, 1.3—2mm broad, white to pale brown, glabrous.

Thailand.—NORTHERN : Chiang Rai (Doi Tung), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Pong Pa Po, Doi Suthep, Doi Inthanon, Sop Aep), Lamphun (Doi Khun Tan), Tak (Doi Musoe), Phitsanulok (Phu Miang); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); SOUTH-WESTERN: Kanchanaburi (Bo Rae); PENINSULAR : Surat Thani (Ban Don).

Distribution.—S. India, E. Himalayas (type), SW. China, Burma, Indochina, W. Malesia to the Philippines, north to Taiwan.

Ecology.—Terrestrial on mountain-slopes or in muddy crevices of rocks, or rarely low down on mossy tree-trunks, usually in dense evergreen forests or in half-shaded places at high altitudes (1100 — 1800 m).

Vernacular.—Kut Mak (กูดหมัก) (Northern).

18. OLEANDRACEAE

Four genera are usually placed in this family. Among them *Oleandra* is distinct in dorsal sori and is sometimes separated to form its own family. Oleandraceae is widely distributed, mainly in tropical regions.

KEY TO THE GENERA

1. Sori terminal on anterior branches of veins. Frond pinnate to bipinnate; pinnae articulated to rachis
   2. Stipe not articulated **1. Nephrolepis**
   2. Stipe articulated to rhizome **2. Arthropteris**
1. Sori dorsal on veins. Frond simple, stipe articulated **3. Oleandra**

1. NEPHROLEPIS

Schott, Gen. Fil. ad t. 3. 1834; Copel., Gen. Fil.: 90. 1947.

Rhizome usually short, erect or suberect, scaly, bearing a tuft of fronds, wiry roots, and slender stolons; scales peltate, appressed, small, bicoloured with pale edge; stolons spreading, usually forming buds; roots sometimes bearing tubers containing water. Lamina usually lanceolate or narrower in outline, pinnate, lower pinnae usually reducing downwards; pinnae sessile, articulated to rachis, usually unequal at base, more or less auricled at acroscopic base, subentire or slightly crenate; veins all free, ending in distinct hydathodes within margin. Sori terminal on anterior branches of vein-group, one for each crena, arranged in one row, or continuous along margin; indusia rotund-reniform, or continuous along margin.

About 30 species are known in the tropics throughout the world; 8 species are recorded in Thailand.

KEY TO THE SPECIES

1. Sori continuous, marginal **1. N. acutifolia**
1. Sori one to each vein-group, round, with reniform indusia
   2. Sori on small marginal lobes, one to each lobe **2. N. davallioides**
   2. Sori not on marginal lobes, arranged in one row on each side of costa
      3. Pinnae up to 3 cm long
         4. Lamina 50–80 cm long; pinnae shallowly serrate at margin, papyraceous **3. N. cordifolia**
         4. Lamina up to 45 cm long, the anterior base embracing the rachis; pinnae crenate at margin, herbaceous **4. N. delicatula**

3. Pinnae more than 5 cm long
   5. Pinnae not or a little auricled at base. Sori medial between costa and the margin of pinna **5. N. biserrata**
   5. Pinnae distinctly auricled at anterior base. Sori submarginal
      6. Plant scrambling with stout wiry runners. Pinnae round or moderately acute at apex **6. N. radicans**
      6. Runners slender. Pinnae usually acute at apex
         7. Epiphytic with pendulous fronds. Pinnae falcate, nearly glabrous **7. N. falcata**
         7. Terrestrial with erect fronds. Pinnae at most slightly falcate, densely scaly with hair-like rather irregular scales **8. N. hirsutula**

1. Nephrolepis acutifolia (Desv.) Christ, Verh. Nat. Ges. Basel 11: 243. 1895; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 5. 1929; Holtt., Rev. Fl. Malaya 2: 375. f. 218. 1955. — *Lindsaea acutifolia* Desv., Prod.: 312. 1827. — *Isoloma lanuginosa* J. Smith in Hook. & Bauer, Gen. Fil.: t. 102. 1842. — *Lindsaea lanuginosa* (J. Smith) Hook., Sp. Fil. 1: 210. t. 69 A. 1846; Bedd., Handb.: 77. 1883.

Rhizome unknown for Thai plants. *Stipe* about 10 cm long, scaly; scales appressed, up to 20 by 0.5 mm, gradually narrowing from base to apex, irregular at basal margin, otherwise entire, dark brown. *Lamina* linear-lanceolate, about 75 by 15 cm, pinnate; lateral pinnae more than 50 pairs, 1—2 cm apart; middle ones the largest, narrowly lanceolate, gradually narrowing towards acute apex, truncate or subcordate at base, sessile, more or less falcate, up to 8 by 1 cm in fertile ones, 1.3 cm broad in sterile ones, entire; chartaceous; veins hardly visible, forked near costa, all free. *Sori* marginal, continuous or rarely interrupted in apical region; indusia about 1 mm in breadth, forming lindsaeoid grooves for sporangia with margin of pinna, brown, thin but stiff, glabrous.

Thailand.—EASTERN : Nakhon Ratchasima (Pak Thong Chai); SOUTH-EASTERN : Prachin Buri (Nong Kho), Chon Buri (Si Racha), Chanthaburi (Laem Pradu); PENINSULAR : Surat Thani (Ko Tao, Ko Phangan), Nakhon Si Thammarat (Khao Luang), Phangnga (Takhua Pa).

Distribution.—Old World tropics generally from Africa (type) through SE. Asia to Polynesia.

Ecology.—In light shade at low altitudes.

Note.—At the end of veinlets on upper surface of frond are distinct hydathodes on which the excretions sometimes persist and form a continuous line of white dots along the margin of fronds. These are usually wrongly described as white scales covering the hydathodes.

2. Nephrolepis davallioides (Sw.) Kunze, Bot. Zeit. 1846: 460; Bedd., Handb. Suppl.: 81. 1892; Holtt., Rev. Fl. Malaya ed. 2. 2: 634. 1968. — *Ophioglossum acuminatum* Houtt., Nat. Hist. 14: 94. 1783. — *Aspidium davallioides* Sw., Schrad. J. Bot. 1800(2): 33. 1801. — *Nephrolepis acuminata* (Houtt.) Kuhn, Ann. Lugd. Bat. 4: 286. 1869, non Presl 1836; Holtt., Rev. Fl. Malaya 2: 378. f. 220. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 77. 1967. Fig. 13. 1.

Rhizome short-creeping, about 1 cm diam., bearing close fronds, densely scaly; scales gradually narrowing from round base to tailed apex, up to 2.5 by 1 mm, dark with brown ferrugineous margin. *Stipe* stramineous, up to 30 cm long, minutely appressed-scaly, grooved on upper surface. *Lamina* narrowly lanceolate, up to 1 m or more long, 30 cm wide, pinnate; lateral pinnae up to 50 pairs, basal ones shortened, lower ones sterile, up to 15 by 2 cm, entire, falcate at tip, upper ones fertile, up to 13 by 1.2 cm, lobed at margin, papyraceous; veins forked near costa, visible, all free. *Sori* one to each lobe at margin of fertile pinnae, terminal on anterior branch of veins, round; indusia usually round, about 1.5 mm broad.

T h a i l a n d.—PENINSULAR : Surat Thani (Khao Nong), Nakhon Si Thammarat (Khao Luang), Yala (Khao Kalakhiri).

D i s t r i b u t i o n.—Sumatra, Malaya to Celebes (type from Java).

E c o l o g y.—On rather dry rocks or on fallen tree-trunks in dense tropical rain forests or in clearings at medium altitudes (1000—1500 m).

N o t e.—This is another species distinguished by having a single sorus on each marginal lobe of the fertile pinnae. The intermediate condition between this and the dorsal position of sori common in the other members of this genus is found in *N. dicksonioides* of Malesia.

3. Nephrolepis cordifolia (Linn.) Presl, Tent. Pterid.: 79. 1836; Bedd., Handb.: 282. f. 144. 1883; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 289. f. 28,1—2. 1941; Holtt., Rev. Fl. Malaya 2: 379. 1955; Dansk Bot. Ark. 20: 26. 1961; Ching, Fl. Reip. Pop. Sin. 2: 315. pl. 28. f. 7—8. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 77. 1967. — *Polypodium cordifolium* Linn., Sp. Pl. 2: 1089. 1753.

Rhizome short, ascending to suberect, bearing a tuft of fronds, numerous wiry roots and stolons, densely scaly; scales acuminate at basal edge and long-tailed at apical edge, narrowly lanceolate, up to 7 by 0.8 mm broad, thin, pale brown. *Stipe* terete, up to about 10 cm long, scaly with narrow scales, stramineous or darker. *Lamina* linear-lanceolate moderately acute at apex, gradually narrowing

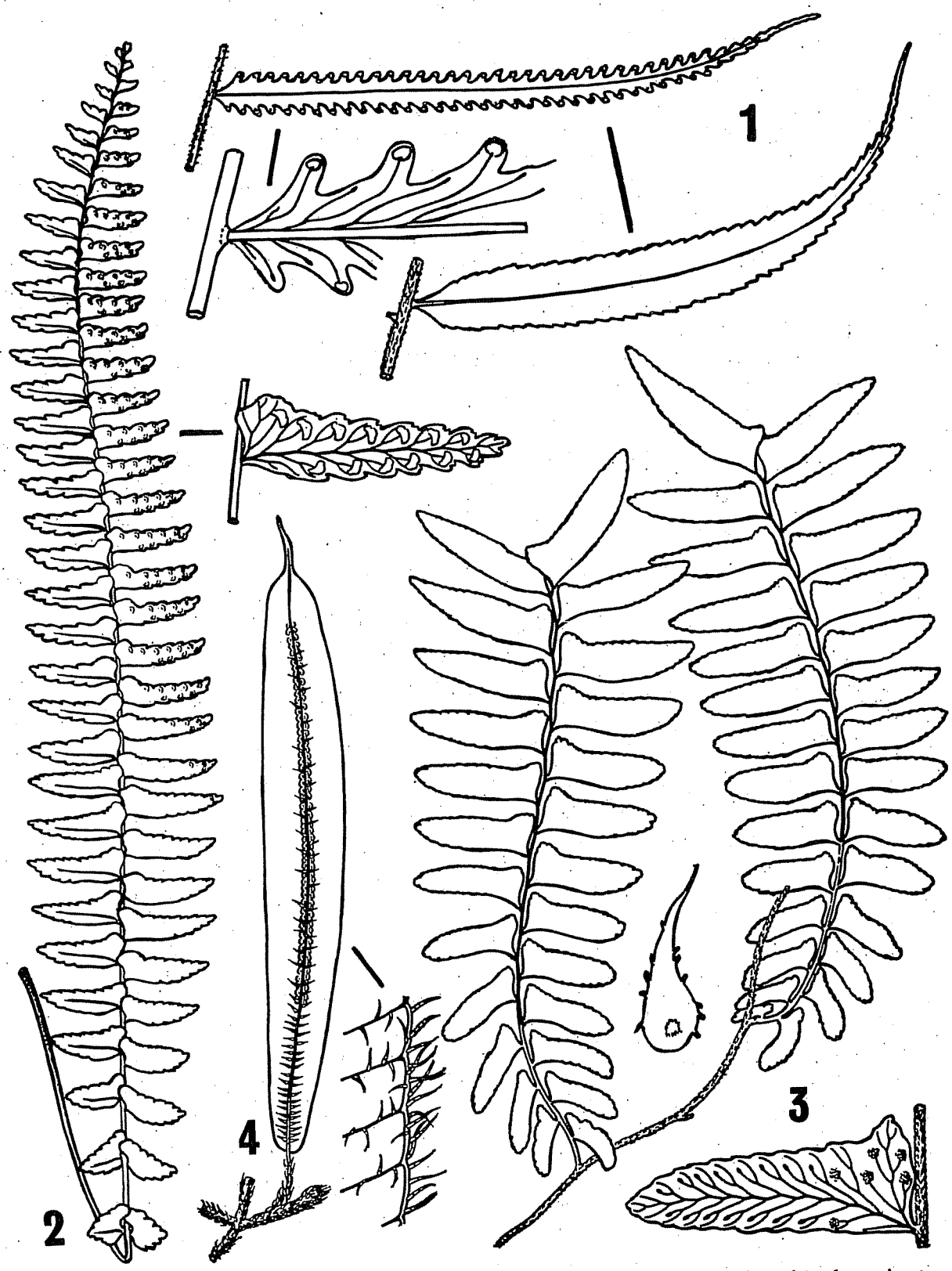

Figure 13. 1: *Nephrolepis davallioides*; fertile pinna (above), x 0.5 and the portion enlarged (scales omitted) x 2.5, sterile pinna (below), x 0.5. 2: *Nephrolepis delicatula*; frond, natural size, small size pinna, x 3. 3: *Arthropteris palisotii*; plant with sterile leaves, x 0.5; scale, x 0.25; fertile pinna (below), showing sori and soral position, x 2. 4: *Oleandra wallichii*; plant with small fertile leaf, x 0.5, margin of leaf (below right), x 10.

towards base, up to 80 cm or more long, 6 cm wide, pinnate; rachis grooved on upper surface, scaly above; lateral pinnae up to 100 pairs; middle ones larger, patent, acute to moderately acute at apex, truncate at base, auricled at anterior base, sessile, up to 3 cm by 7 mm, shallowly serrate at margin, papyraceous; veins visible on lower surface, forked near costa. *Sori* at middle to submarginal position between costa and margin of pinna, in one row; indusia broad, thin but stiff, large, brown, up to 2 mm broad.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Chiang Dao, Doi Suthep), Phitsanulok (Thung Salaeng Luang, Phu Miang); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN : Chanthaburi (Khao soi Dao).

D i s t r i b u t i o n.—Pantropic (type from America), north to Japan and south to New Zealand.

E c o l o g y.—Terrestrial on mountain slopes, on muddy or dry rocks, or on tall tree-trunks in light shade at 500– 1300 m alt.

U s e s.—This is commonly cultivated as an ornamental.

V e r n a c u l a r.—Kut soi (กูดสร้อย) (Northern).

4. Nephrolepis delicatula (Dcne.) Pichi-Ser., Webbia 23: 181. 1968. — *Nephrodium delicatulum* Dcne. in Jacqem., Voy. Ind. Bot. 4: 178. t. 179. 1844. — *Nephrolepis paucifrondosa* d'Almeida, J. Ind. Bot. Soc. 5: 51. f.1–5.1926; Holtt., Dansk Bot. Ark. 23: 235. 1965. Fig. 13. 2.

Rhizome short, erect, 1–2.5mm diam., bearing a few fronds, many wiry slender roots, and stolons, scaly; scales about 2.5 by 0.3 mm, pale brown, soft membranous. *Stipe* up to about 10 cm long, stramineous or darker, scaly with smaller rather irregular scales. *Lamina* linear-lanceolate, up to 45 by 6 cm, pinnate; rachis green, grooved on upper surface, minutely scaly above; lateral pinnae 50 or more pairs, 1–1.8cm apart; middle ones larger, gradually narrowing from base to acute apex, patent or falcate near apex, dimidiate at lower base, distinctly auricled and embracing the rachis at anterior base, up to 3 by 1 cm, crenate at margin, herbaceous; veins not distinct, forked, glabrous. *Sori* submarginal, arranged in one row; indusia broadly reniform, up to 1.3 mm broad.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Chiang Dao, Doi Suthep, Sop Aep), Phrae (Mae Ban), Mae Hong Son (Doi Pha Dam), Lamphun (Doi Khun Tan), Tak; NORTH-EASTERN : Loei (Phu Kradueng); SOUTH-WESTERN : Kanchanaburi (Sai Yok).

Distribution.—India (type), Burma and also in Yunnan.

Ecology.—On Doi Chiang Dao this species grows in muddy limestone crevices in thinly wooded places at 500—700 m alt., but on Doi Khun Tan on mossy rocks in evergreen forests on ridges at 1200—1300 m alt. For Kanchanaburi, Marcan's note reads on rocks at 300 m alt.

Note.—Compared with the preceding species, *N. delicatula* is distinct in its soft texture, smaller size of plants and rhizome, crenate pinnae, slender axes bearing scales of rather irregular form.

5. Nephrolepis biserrata (Sw.) Schott, Gen. Fil. ad t. 3. 1834; E. Smith, J. Siam Soc. Nat. Suppl. 8: 6. 1929; C. Chr., Contr. U.S. Nat. Herb. 26: 331. 1931; Holtt., Rev. Fl. Malaya 2: 380. f. 217. 1955; Dansk Bot. Ark. 20: 26. 1961; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958; Ching, Fl. Reip. Pop. Sin. 2: 316. pl. 28. f. 5—6. 1959. — *Aspidium biserratum* Sw., Schrad. J. Bot. 1800(2): 32. 1801. — *Aspidium acutum* Schkuhr, Kr. Gew. 1: 32. t. 31. 1806. — *Nephrolepis acuta* (Schkuhr) Presl, Tent. Pterid.: 79. 1836; Bedd., Handb.: 284. 1883; Hosseus, Beih. Bot. Centr. 28(2): 365. 1911; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 291. 1941.

Rhizome ascending or suberect, bearing a few fronds drooping at apex, numerous wiry roots, and stolons; scales gradually narrowing from base towards tailed apex, up to 5 mm or more long, 0.8 mm broad, brown, with hairy or irregular margin, thin and usually ferrugineous. *Stipe* up to 40 cm long, stramineous, densely scaly with narrower scales. *Lamina* large, usually more than 150 by 30 cm, lanceolate, narrowing towards both apex and base, pinnate; lateral pinnae up to 70 or more pairs; middle ones about 3 cm apart, larger, patent or slightly falcate at posterior end, linear-lanceolate, acuminate to caudate at apex, cuneate at base, sessile, serrate at margin of posterior part, up to 15 by 1.5 cm, thin but stiff; veins forked near costa, posterior branches sometimes forked again at middle part, minutely scaly on costa and even on laminar surface. *Sori* round, in one row at $\frac{1}{3}$ way from margin to costa; indusia reniform, round, about 1.5 mm diam.

Thailand.—NORTHERN: Chiang Rai, Chiang Mai (Doi Suthep, Ban Du); CENTRAL: Krungthep; SOUTH-EASTERN: Chon Buri (Si Racha), Trat (Ko Chang, Ban Saphan Hin, Khlong Yai); PENINSULAR: Surat Thani (Kho Tao), Nakhon Si Thammarat (Khao Luang), Songkhla (Rattaphum), Narathiwat (Waeng), Phangnga (Takua Thung), Trang (Khao Chong), Satun, Yala (Bannang Sata).

Distribution.—Pantropic (type from America). S. E.Asian plants are sometimes distinguished specifically from neotropical plants and called *N. acuta.* These two forms are hardly distinguishable, and they may be treated as conspecific pending further studies.

Ecology.—Usually terrestrial on rather dry mountain slopes.

6. Nephrolepis radicans (Burm.f.) Kuhn, Ann. Lugd. Bat. 4: 285. 1869; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 288. 1940; Holtt., Rev. Fl. Malaya 2: 381. 1955; Tagawa & K. Iwats.,Acta Phytotax. Geobot. 23: 54. 1967. — *Polypodium radicans* Burm.f., Fl. Ind.: 233. t. 66. f. 3. 1768. — *Nephrolepis volubilis* J. Smith,J. Bot. 3: 413. 1841; Bedd., Handb.: 284. 1883.

Rhizomed short, suberect,3—5mm diam., bearing a few fronds, a few thick wiry roots, and thick stolons; scales dense, gradually narrowing from round base to acute apex, distinctly bicoloured with dark brown central portion and pale thin edges, about 3 by 0.7 mm, appresed except for the narrow apical portion; runners slender at base, thickening to the size of stipe, climbing, producing frond-bearing stocks at irregular intervals, sparsely scaly. *Stipe* stramineous, up to 10 cm long, sparsely scaly. *Lamina* linear, up to 80 by 7 cm, narrowing towards both ends, pinnate; middle pinnae larger, slightly falcate, moderately acute or round at apex, auricled at acroscopic base, up to 4 by 1 cm in sterile ones, subentire or slightly serrate in fertile pinnae; lower pinnae small and distant, papyraceous; veins hardly visible. *Sori* submarginal, round; indusia about 1 mm diam.

Thailand.—PENINSULAR : Yala (Bannang Sata, Bukit).

Distribution.—Burma, Indochina and W.Malesia (type from Java) east to the Philippines.

Ecology.—Terrestrial in thickets at low altitudes.

Vernacular.—Paku laka (ปากูลากะ) (Malay/Peninsular).

7. Nephrolepis falcata (Cav.) C. Chr.,Dansk Bot. Ark. 9: 15. 1937; Tard. & C. Chr. in Fl. Gén.I.-C.7(2): 289. 1941; Holtt., Rev. Fl. Malaya 2: 381. f. 221. 1955; Dansk Bot. Ark. 23: 235. 1965; Ching, Fl. Reip. Pop. Sin. 2: 314. pl. 28. f. 1—2. 1959; Tagawa & K. Iwats.,Southeast As. St. 5: 78. 1967; Acta Phytotax. Geobot. 23: 55. 1968. — *Tectaria falcata* Cav., Descr. Pl.: 250. 1802. — *Nephrolepis exaltata* auct. non (Linn.) Schott: Christ, Bot. Tidsskr. 24: 109. 1901; Hosseus, Beih. Bot. Centr. 28(2): 366. 1911; C. Chr.,Bot. Tidsskr. 32: 345. 1916.

Rhizome short, suberect, about 5 mm diam., scaly; scales appressed, gradually narrowing from round base to acute apex, bicoloured with nearly black central portion and pale ferrugineous edge, up to 3 by 0.7 mm; runners few, slender at base, long and climbing, sparsely scaly. *Stipe* stramineous, scaly at lower portion, up to 20 cm long. *Lamina* up to 80 by 15 cm, gradually narrowing towards both ends, pinnate; lateral pinnae up to 50 or more pairs; middle ones 1.5-2 cm apart, larger, gradually narrowing from base towards apex, falcate, auricled acroscopically, round at basiscopic base, up to 8 by 1.3 cm, very slightly crenate; thin, glabrous. *Sori* round; indusia up to 8 mm diam.

T h a i l a n d.—NORTHERN : Chiang Mai (Chiang Dao), Lampang, Phitsanulok (Salaeng Haeng), Tak (Huai Krasa, Doi Musoe); EASTERN : Nakhon Ratchasima (Kathok), Chaiyaphum (Nam Phrom); CENTRAL : Krungthep; SOUTH-EASTERN : Prachin Buri (Krabin, Thung Pho), Chanthaburi (Khao Soi Dao), Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Kroeng Kawia); PENINSULAR : Satun (Boriphat Falls), Narathiwat (Sg. Padi).

D i s t r i b u t i o n.—Indochina to Malesia (type from Luzon)

E c o l o g y.—On rather dry rocks in dense forests at low to medium altitudes.

V e r n a c u l a r.—Kut hin (กูดหิน) (Peninsular).

8. Nephrolepis hirsutula (Forst.) Presl, Tent. Pterid.: 79. 1836; Tard. & C. Chr. in Fl. Gén. I.- C.7(2): 290. 1941; Holtt., Rev. Fl. Malaya 2: 382. f. 222. 1955; Ching, Fl. Reip. Pop. Sin. 2: 317. pl. 28. f.3–4.1959; Tagawa & K. Iwats., Southeast As. St. 5: 78. 1967. — *Polypodium hirsutulum* Forst., Prod.: 81. 1786. — *Nephrolepis exaltata* auct. non (Linn.) Schott: Bedd., Handb.: 282. 1883. — *? Nephrolepis acutifolia* auct. non (Desv.) Christ: Christ, Bot. Tidsskr. 24: 110. 1901.

Rhizome short, erect, bearing a tuft of fronds, a few wiry roots, and stolons; scales dense, appressed, gradually narrowing from round base to acute apex, bicoloured with dark brown central portion and pale ferrugineous edge, about 3 by 0.7 mm, hairy at margin; runners many, slender, hirsute. *Stipe* up to 30 cm long, scaly throughout. *Lamina* up to 50 by 30 cm, gradually narrowing towards both ends; lateral pinnae more than 60 pairs; the middle ones 2–2.5 cm apart, larger, gradually narrowing from base towards acute apex, distinctly auricled at anterior and round to slightly auricled at posterior bases, up to 15 by 2 cm, shallowly crenate at margin; herbaceous or thicker, very minutely scaly or costa, veins and both surfaces of lamina as well. *Sori* submarginal; indusia reniform, up to 1 mm diam.

T h a i l a n d.—NORTHERN : Chiang Mai (Fang); NORTH-EASTERN : Nong Khai; PENINSULAR : Chumphon (Ko Wiang), Nakhon Si Thammarat (Khao Luang, Khiriwong), Ranong (Khao Phota Chongdong), Krabi (Khao Sato), Satun, Yala (Bannang Sata).

D i s t r i b u t i o n.—Tropical Asia to the Pacific.

E c o l o g y.—On rather dry ground in light shade.

2. ARTHROPTERIS

J. Smith ex Hook.f., Fl. Nov.-Zeland. 2 : 53. 1854; Copel., Gen. fil. : 91. 1947; Holtt., Blumea 14: 226. 1966.

Rhizome long-creeping, scaly; scales small, peltate. Stipe articulated to rhizome. Lamina pinnate; pinnae articulated to rachis, oblique at base, lobed to pinnate, glabrous; veins free, ending in indistinct hydathodes. Sori round, terminal on anterior branches of veins; indusia rotund-reniform.

About 20 species are known from the tropics throughout the world.

Arthropteris palisotii (Desv.)Alston, Bol. Soc. Brot. II. 30: 6. 1956; Holtt., Blumea 14: 226. 1966; Rev. Fl. Malaya ed. 2. 2: 634. 1968.—*Aspidium palisotii* Desv., Ges. Naturf. Berl. Mag. 5: 320. 1811.—*Arthropteris obliterata* auct. non (R.Br.) J.Smith: E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8:6. 1929; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 287. f. 30,3– 4.1940; Ching, Fl. Reip. Pop. Sin. 2: 318. pl. 28. f. 9–11.1959. —*Aspidium ramosum* Beauv., Fl. d'Oware 2: 54. t. 91. 1811.—*Nephrolepis ramosa* (Beauv.) Moore, Ind. Fil.: 102. 1858; Bedd., Handb.: 284. f. 145. 1883. Fig. 13. 3.

Rhizome long-creeping, irregularly branching, about 1.5 mm diam., bearing distant fronds; scales small, reniform with tails, 2 by 0.7 mm, dark brown, appressed. *Stipe* on distinct phyllopode (a stipe base remaining as a scar after leaf-shedding) 2–3 mm high, 2–4 cm long, pubescent. *Lamina* linear-lanceolate, up to 40 by 7 cm, pinnate; middle pinnae larger, oblong, patent or ascending, round or moderately acute at apex, auricled at anterior and dimidiate at posterior bases, sessile, subentire or shallowly crenate at margin, up to 4 by 1 cm; rachis densely hairy; costa densely hairy above, sparsely beneath, texture softly papyraceous; veins more or less visible, forming acute angle with costa, forked. *Sori* in one row, submarginal or $\frac{1}{3}$ way from margin of pinna to costa; indusia rotund-reniform smaller, usually shrink in matured sori.

Thailand.—NORTHERN : Phrae (Mae Sai), Tak (Huai Krasa,Doi Musoe); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); PENINSULAR : Surat Thani (Ko Tao).

Distribution.—Old World tropics throughout, Africa (type) to the Pacific.

Ecology.—Epiphytic on tree-trunks or on rocks in semi-shaded places.

3. OLEANDRA

Cav., Ann. Hist. Nat. 1: 115. 1799; Copel., Gen. Fil.: 90. 1047.

Rhizome long-creeping, covered with peltate scales, bearing fronds widely spaced or in a tuft. Stipe with distinct articulation, leaving phyllopode (a stipe base remaining as a scar after leaf-shedding) of various heights. Lamina simple, entire, linear-lanceolate; veins usually once or twice forked near midribs, parallel and all free, close, ending in distinct hydathode. Sori dorsal on anterior branches of veins, close to midribs; indusia reniform.

There are about 40 species ranging throughout the tropics of both worlds; 4 species occur in Thailand.

KEY TO THE SPECIES

1. Rhizome long-creeping
   2. Rhizome-scales patent; edge of lamina densely hairy **1. O. wallichii**
   2. Rhizome-scales appressed; edge of lamina not or sparsely hairy
      3. Midrib of lamina underneath not scaly; phyllopode taller, 2—12 cm high; edge of lamina undulate **2. O. undulata**
      3. Midrib of lamina underneath scaly; phyllopode lower, less than 2 cm high; edge of lamina patent **3. O. musifolia**
1. Rhizome stiff, erect or suberect, forming thickets **4. O. pistillaris**

1. Oleandra wallichii (Hook.) Presl, Tent. Pterid.: 78. 1836; Bedd., Handb.: 287. f. 147. 1883; Tard. & C. Chr.in Fl. Gén. I.-C. 7(2): 284. 1940; Ching, Fl. Reip. Pop. Sin. 2: 321. 1959; Holtt., Dansk Bot. Ark. 20: 26. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 78. 1967. — *Aspidium wallichii* Hook., Exot. Fl. 1: t. 5. 1823. Fig. 13. 4.

Rhizome long-creeping, 3–4 mm diam., dark on surface, bearing 1–3 fronds in distant tufts, densely scaly throughout; scales not appressed, oblong with long tails, round at basal edge, about 6 mm long including tails of 4 mm, 0.7 mm broad, dark brown, entire, sparsely short-hairy at apical margin. *Stipe* dark brown to darker, 0.5–3 cm long, usually with scales and hairs, with phyllopode less than 1 cm high. *Lamina* linear-lanceolate, rather suddenly narrowed and cordate at apex, round at base, up to 35 by 4 cm, herbaceous, hairy, densely especially at margin; midrib raised below, densely scaly and hairy. *Sori* in one row on each side of midrib and close to it; indusia up to 1.5 mm in breadth, hairy.

Thailand.—NORTHERN : Chiang Mai (Doi Phahom Pok, Doi Inthanon); NORTH-EASTERN : Loei (Phu Kradueng).

Distribution.—Himalayas (type), Upper Burma, SW. China, Taiwan and Tonkin; recorded from Malesia but doubtful.

Ecology.—On mossy tree-trunks or on rather dry mountain-slopes in evergreen forests at 1300–2500 m alt.

2. Oleandra undulata (Willd.) Ching, Lingn. Sci. J. 12: 565. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 286. f. 30, 1–2. 1940; Holtt., Rev. Fl. Malaya 2: 384. f. 223. 1955; Dansk Bot. Ark. 20: 26. 1961; 23: 235. 1965; Ching, Fl. Reip. Pop. Sin. 2: 322. pl. 29. f. 1–4. 1959; Tagawa & K. Iwats., Southeast As. St. 5 : 78. 1967. — *Polypodium undulatum* Willd., Sp. Pl. 5: 155. 1810. — *Oleandra cumingii* Hook. & Bak., Syn. Fil.: 303. 1867; Bedd., Handb.: 288. 1883. — *Oleandra pubescens* Copel., Univ. Calif. Publ. Bot. 12: 397. pl. 52-a. 1931.

Rhizome long-creeping, 3–5 mm diam., bearing distant fronds, or rather closely on some portions, densely scaly throughout; scales appressed, oblong, round to moderately acute at basal edge, acuminate at apical edge, up to 7 by 1.3 mm, entire, brown, dark near attached points, long downy hairy. *Stipe* on tall phyllopode 2–12 cm high, stramineous, hairy, up to 20 cm or more long including phyllopode. *Lamina* simple, narrowly lanceolate, gradually narrowing towards both ends, up to 30 by 4.5 cm, the margin entire but more or less undulate, herbaceous to softly papyraceous; veins once or twice forked near midribs, costa and veins underneath as well as under surface of lamina hirsute but glabrous at margin of lamina. *Sori* in one regular row close to costa or rather irregularly arranged near costa, dorsal on acroscopic veinlets; indusia up to 2.2 mm broad, hirsute or glabrescent.

Thailand.—NORTHERN : Chiang Rai (Doi Pha Cho), Chiang Mai (Fang, Doi Chiang Dao, Doi Suthep, Doi Hua Mot, Ping Khong, Doi Saket, Mae Klang), Lampang (Ngao), Phrae; NORTH-EASTERN : Loei (Phu Kradueng, Phu Tong, Phu Luang); EASTERN : Chaiyaphum; SOUTH-EASTERN : Chanthaburi (Laem Sing, Khao Sabap), Trat (Khao Kuap); SOUTH-WESTERN : Kanchanaburi (Hat Phalom, Sai Yok); PENINSULAR : Ranong (Ko Phayam), Phangnga (Khao Phra Mi), Krabi (Ko Pu), Nakhon Si Thammarat (Thung Song).

Distribution.—Burma and S. China (type) to Malaya.

Ecology.—The habitats of this species are varied according to the localities: terrestrial on rather dry slopes in mixed forests,growing in crevices of rocks in open areas or in light shade, or on limestone hills in evergreen forests, or epiphytic on tree-trunks.

3. Oleandra musifolia (Bl.) Presl, Epim.: 42. 1849; Bedd., Handb.: 287. 1883; Tard. & C.Chr. in Fl. Gén. I.-C.7(2): 284. 1940; Ching, Fl. Reip. Pop. Sin. 2: 321. 1959; Holtt., Dansk Bot. Ark. 23: 235. 1965; Tagawa & K. Iwats.,Southeast As. St. 5: 78. 1967. — *Aspidium musifolium* Bl., En. Pl. Jav.: 141 1828.

Rhizome long-creeping, up to 5 mm diam., bearing a few fronds in scattered tufts, densely scaly throughout; scales appressed, lanceolate, round to moderately acute at basal edge, gradually narrowing from the broadest attached portion to tailed apex, about 7 by 1.2 mm, brown with dark attached point, paler and hairy at margin of apical portion. *Stipe* usually short, up to 5 cm including low phyllopode less than 1 cm tall, bearing both scales and hairs. *Lamina* linear-lanceolate, caudately acuminate at apex, gradually narrowing towards narrow and cuneate base, up to 80 by 5 cm, the margin entire and usually plane; midrib raised below, scaly with peltate, lanceolate, pale brown scales of up to 3 mm long, herbaceous, light green; veins once or twice forked near midrib, all free, ending just inside narrow cartilagineous margin. *Sori* irregular row near midrib; indusia up to 2 mm in breadth, glabrous.

Thailand. — NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Inthanon), Lamphun (Doi Khun Tan), Phrae (Mae Sai), Phetchabun (Phu Miang), Tak (Ban Musoe); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Khriti); PENINSULAR: Ranong (Khao Phota Chongdong), Phangnga (Khao Phra Mi).

D i s t r i b u t i o n.— Ceylon, Indochina to Malesia (type from Java).

E c o l o g y.— On tree-trunks, in crevices of rocks, or on *Sphagnum*-bog in sunny places in light shade at 1100—1500 m alt.

V e r n a c u l a r.— Thao nakkharat (เถานาคราช) (North-eastern).

4. **Oleandra pistillaris** (Sw.) C. Chr.,Ind. Fil. Suppl. III: 132. 1934; Holtt., Rev. Fl. Malaya 2: 386. f. 224. 1955; Tagawa & K. Iwats.Acta Phytotax. Geobot. 23: 49. 1968.— *Aspidium pistillare* Sw., Schrad. J. Bot. 1800(2): 30; 1801.— *Oleandra neriiformis* auct. non Cav.: Bedd., Handb.: 285. f. 146. 1883; Tard. & C. Chr.in Fl. Gén. I.- C. 7(2): 283; 1940.

Rhizome thick, up to 1 cm diam., stiff, erect or suberect, branching, forming bushes, bearing several fronds in groups, the groups separated remotely; scales appressed, imbricate, oblong, round to moderately cuneate at both edges, up to 5 by 1.8 mm, dark brown, younger ones bearing pale and hairy tails. *Stipe* short on phyllopode up to 5 mm high, scaly. *Frond* simple, oblanceolate, up to 40 by 3 cm, long-acuminate, gradually narrowing towards base, the margin subentire or a little wavy; midrib raised below, hairy and scaly or glabrescent; laminar surface hairy all over to glabrous, papyraceous, stiff, deep green. *Sori* in one irregular row usually close to midrib; indusia up to 2 mm broad.

T h a i l a n d.— SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang); PENINSULAR: Songkhla (Khao Khieo), Trang (Khao Soi Dao), Yala (Betong).

E c o l o g y.— On tree-trunks or forming bushes in forests at 700—1300 m alt.

V e r n a c u l a r.— Nakkharat (นาคราช) (Northern, Peninsular); wan nakkharat (ว่านนาคราช) (North-eastern, Peninsular); phaya ngu (พญางู) (North-eastern) nakho (นาฆอ)Malay/Peninsular).

N o t e.— This is close to *O.musifolia* and is difficult to distinguish by the fronds without rhizome. In *O. pistillaris* the fronds are oblong-lanceolate in outline with attenuate base, usually lacking the scales on midrib underneath, and the texture is papyraceous.

19. PARKERIACEAE

The enumeration of the genera of this family follows mainly Bower's Gymnogrammoid-ferns or Gymnogrammoideae of C. Christensen (1938). Most of the species of the family grow in open areas, and some are xerophytic.

Some 35 genera are included in this family of which the correct name is Parkeriaceae according to the rule of priority. This is more commonly known as Adiantaceae in a sense of Holttum (1947, 1955), not in the strict sense of Ching (1941, 1959). In Thailand there are 12 genera recorded as follows.

KEY TO THE GENERA

1. Aquatic plants — **1. Ceratopteris**
1. Terrestrial or epiphytic plants
2. **Frond simple**, entire or palmately lobed (or simply pinnate in foreign species of *Syngramma)*
3. **Sori superficial**, extending along veins
4. **Lamina** round to cuneate at base; veins forming at most one or two submarginal rows of areoles. Paraphyses usually with enlarged apical cell — **2. Syngramma**
4. Lamina cordate or subhastate at base; veins copiously anastomosing. Paraphyses wanting but linear scales mixed with sporangia — **5. Hemionitis**
3. Sori submarginal, protected by reflexed marginal flaps — **9. Doryopteris**
2. Frond pinnate or more amply divided
5. Sori superficial or submarginal
6. Sori superficial, without indusia
7. Lower surface of lamina without waxy powder
8. Sori forming a broad band midway between costa and margin of pinna — **3. Taenitis**
9. Rhizome long-creeping. Stipe sparsely hairy or glabrescent. Lamina herbaceous to softly papyraceous glabrescent — **4. Coniogramme**
9. Rhizome short. Stipe and rachis densely hairy. Lamina papyraceous to leathery, densely hairy — **6. Gymnopteris**
7. Lower surface of frond bearing waxy powder. Sporangia scattered — **7. Pityrogramma**
6. Sori at end of veins, usually protected by reflexed marginal flaps
10. Veins forming fertile commissure connecting the tips. Frond finely pinnately compound — **8. Onychium**
10. Veins everywhere free. Frond bipinnatifid to tripinnate
11. Margin of frond usually reflexed to form membranous flaps covering sori — **11. Cheilanthes**
11. Margin of frond flat or more or less revolute. Sori usually naked — **10. Notholaena**
5. Sori protected by and borne on reflexed margin of leaflets — **12. Adiantum**

1. CERATOPTERIS

Brongn., Bull. Soc. Phil. 1821: 186. 1822; Copel., Gen. Fil.:83. 1947.

Rhizome short, paleate with a few small scales. Frond pinnately decompound, glabrous throughout, dimorphic; fertile frond longer, finely divided; sterile frond with shorter and broader pinnules, sometimes proliferous; veins anastomosing without included veinlets. Sporangia elongate along the veins, occupying whole undersurface of fertile pinnules, protected by continuous reflexed margins.

This is a distinctive genus of rooted aquatic annuals. Correlated with this habit, it has certain peculiar features not shared with the common terrestrial ferns among the gymnogrammoid genera. It is sometimes considered to merit family rank, chiefly on account of its distinct soral character. However, *Ceratopteris* may be placed in a primitive position in the gymnogrammoid ferns, despite its peculiar features caused by the aquatic habitat.

One variable species is known throughout the warmer regions of the world.

Ceratopteris thalictroides(Linn.) Brongn., Bull. Soc. Phil. 1821: 186. 1822; Bedd., Handb.: 123. f. 63. 1883; Christ, Bot. Tidsskr. 24: 113. 1901; C. Chr.,Bot. Tidsskr. 32: 249. 1916; Tard. & C. Chr.in Fl. Gén. I.-C. 7(2): 194. f. 23, 2–3. 1940; Holtt., Rev. Fl. Malaya 2: 578. 1955; Dansk Bot. Ark. 20: 32. 1961; 23: 243. 1965; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 87. 1958; Tagawa & K. Iwats., Southeast As. St. 3(3): 88. 1965; 5: 107. 1967. — *Acrostichum thalictroides* Linn., Sp. Pl.: 1070. 1753. Fig. 14.1.

Rhizome short, erect, bearing a tuft of fronds, scaly; scales fuscous, thin entire, ovate and cordate at base. *Stipe* fleshy, green, up to 40 cm long. *Frond* dimorphic: sterile lamina bipinnatifid to tripinnatifid, subdeltoid to oblong, usually shorter than the fertile ones, 10–15 cm but in larger ones up to 35 cm long; rachis and pinna-rachis like the upper part of stipe, green; ultimate lobes linear, moderately acute at apex, glabrous; fertile lamina longer, up to 50 by 30 cm, more copiously divided; pinnules divided into linear lobes; ultimate lobes up to 5 cm long and about 2 mm broad. *Sporangia* on veins except on raised costae of ultimate segments, solitary, large with short stalks.

T h a i l a n d. — NORTHERN: Chiang Mai (Ban Sin Khao, San Sai, Fang, Ban Yang), Mae Hong Son (Mae Sariang), Phitsanulok (Thung Salaeng Luang); EASTERN: Buri Ram (Ban Chum Saeng); CENTRAL: Pathum Thani (Rangsit), Krungthep; SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khlong Sabap), Trat (Huai Raeng, Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok), Prachuap Khiri Khan (Bang Saphan); PENINSULAR : Surat Thani (Ban Don), Phatthalung, Satun (Bukit Raya).

D i s t r i b u t i o n.— Warmer regions throughout the world (type from Ceylon).

E c o l o g y.— Aquatic or subaquatic in paddy fields usually in open areas, common at low to medium altitudes throughout the country. This species is becoming rarer in the areas where herbicides are used, as in most parts of Japan: we are afraid that it will suffer similar damage in Thailand in near future.

V e r n a c u l a r. — Kut phao (กูดเพา) (Northern), kha khiat nam khem (ขาเขียดน้ำเค็ม) (South-eastern)

2. SYNGRAMMA

J. Smith, Lond. J. Bot. 4: 168. 1845; Copel., Gen. Fil.: 56. 1947.

Rhizome short-creeping, bearing crowded fronds, apex covered with dark purplish bristles. Stipe often castaneous, grooved on adaxial surface. Lamina simple (or simply pinnate in foreign species); frond or lobes entire or toothed at margin, coriaceous; veins anastomosing near margin. Sori elongate, usually along whole length of veins, naked; paraphyses often red, apical cells enlarged; spores tetrahedral.

This is a genus of about 25 species from Malesia to Polynesia. It is usually placed near *Coniogramme* and the other gymnogrammoid genera, and considered primitive as indicated by its solenostelic rhizome covered with bristles.

Syngramma alismifolia (Presl) J. Smith,Lond. J. Bot. 4: 168. t. 7–8. f. B. 1845; Bedd., Handb.: 389. f. 224. 1883; Tard. & C. Chr.in Fl. Gén. I.-C. 7(2): 188. 1940; Holtt., Rev. Fl. Malaya 2: 581. f. 342. 1955; Tagawa & K. Iwats.,Acta Phytotax. Geobot. 25: 18. 1971; Holtt., Kew Bull. 30: 329. 1975. — *Diplazium alismifolium* Presl, Rel. Haenk. 1: 49. t. 8. f. 3. 1825. Fig. 14. 4.

Rhizome short-creeping or ascending, up to 4 mm diam., bearing crowded fronds, covered with bristles; bristles stiff, dark brown to nearly black, shining, up to 3 mm long. *Stipe* up to about 30 cm long, bright dark brown, polished, bristle-like at base, glabrous upwards, grooved on abaxial surface. *Frond* simple, oblong, caudately acuminate at apex, round to cuneate at base, entire, broadest at $\frac{1}{5}$ way from base, 15-25 cm long, up to 9 cm broad, subcoriaceous, midrib grooved on upper surface, distinctly raised beneath, purple; veins forming an angle of 45°-60°

to midrib, simple, straight, forming one or two rows of areoles near the margin, hardly visible on lower surface, slightly raised on upper surface. *Sori* elongate along almost the whole length of the veins; paraphyses with bright red enlarged apical cells.

T h a i l a n d.— PENINSULAR: Surat Thani (Ban Don).

D i s t r i b u t i o n.— Malesia throughout (type from the Philippines), north to S. Indochina.

E c o l o g y.— On banks of streams near sea level; collected only once in Thailand: E. SMITH 2768, 2769, 2852 (all in K).

3. TAENITIS

Willd. ex Spr., Anl. Kennt. Gew. 3: 374. 1804; Copel., Gen. Fil.: 56. 1947; Holtt., Blumea 16: 87. 1968.

Rhizome creeping, the apex covered with black bristles. Stipe darker, grooved above. Frond simply pinnate with terminal pinnae similar to lateral (or simple in foreign species); pinnae simple, entire, papyraceous to coriaceous, glabrous; veins reticulate to form areoles without included free veinlets. Sori on a narrow longitudinal band about half-way between midrib and edge, all naked; paraphyses abundant, multicellular.

The limits of this genus have recently been revised by Holttum (1978), who included *Schizolepton* and *Holttumiella*. Thus it has fifteen species in the Old World tropics, from Ceylon and S. India to Fiji and N. Queensland.

Taenitis has sometimes been referred to the *Lindsaea* group, as by Christensen (1938), Tardieu-Blot & Christensen (1939) and Copeland (1947), perhaps as a result of its incorrect definition. With Holttum's circumscription of *Taenitis,* the boundary between lindsaeoid and gymnogrammoid ferns seems to be clear-cut, and the relationship of *Taenitis* may be *Syngramma,* a genus of real gymnogrammoid affinity.

Taenitis blechnoides (Willd.) Sw., Syn. Fil.: 24, 220. 1806., Bedd., Handb.: 410. f. 242. 1883; Christ, Bot. Tidsskr. 24: 104. 1901; C. Chr., Bot. Tidsskr. 32: 348. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 8. 1929; Tard. & C. Chr. in Fl. Gén. I.-C 7(2): 134. f. 16, 3—4. 1939; Holtt., Rev. Fl. Malaya 2: 586. f. 346. 1955; Dansk Bot. Ark. 20: 32. 1961; Blumea 16: 89. f. 1. 1968; Seidenf., Bull. Nat. Hist. Siam Soc. 19: 87. 1958; Ching, Fl. Reip. Pop. Sin. 2: 279. 1959; Tagawa & K. Iwats., Southeast As. St. 5: 107. 1967. — *Pteris blechnoides* Willd., Phytogr.: 13. t. 9. f. 3. 1794.

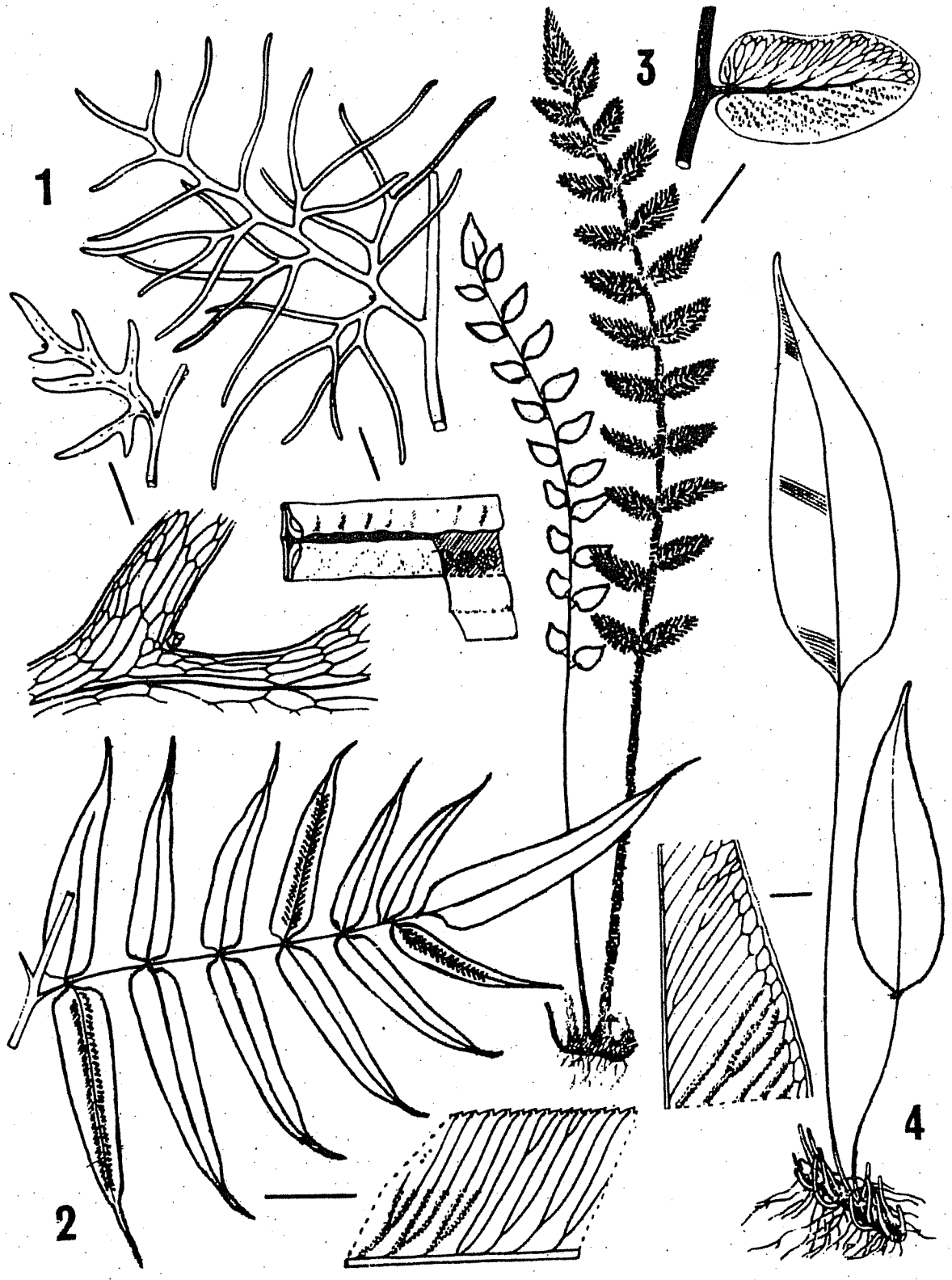

Figure 14. 1: *Ceratopteris thalictroides*; fertile pinna (right), x 0.5, and segment enlarged, showing indusia and sporangia, x 8; sterile pinna (below left), x 0.5, and segment enlarged, showing venation and gemma, x 3. 2: *Coniogramme procera*; large pinna, x 0.25, and part of pinnule, showing venation and sori, x 3. 3: *Gymnopteris vestita*; plant (left), x 0.25; pinna (right), showing venation and sori, hairs completely omitted, x 2.5. 4: *Syngramma alismifolia*; plant, x 0.3, and part of leaf, showing venation and sori, x 1.5.

Rhizome creeping, up to 5 mm diam., covered with bristles in apical portion; bristles dark brown to nearly black, shining, stiff, up to 3 mm long. *Stipe* stramineous to green upwards, castaneous in lower part, glabrous, in larger plants up to 60 cm long. *Lamina* simply pinnate, or simple one, up to 40 by 30 cm; groove of rachis decurrent to that on costae; lateral pinnae 1 – 8 pairs, alternate, linear, subfalcate, gradually narrowing towards both sides, caudately acuminate at apex, very narrowly cuneate at base, stalked (or upper ones sessile), entire or slightly undulate at margin, sometimes involute, up to 25 by 3 cm in fertile pinnae; sterile pinnae broader, up to 5 cm broad; costa distinctly raised on lower surface, sunken on upper surface; veins copiously reticulate without included veinlets; texture thickly papyraceous to chartaceous, glabrous. *Sori* midway between costa and the margin of pinna, rarely interrupted, 1 – 1.5 mm in breadth.

T h a i l a n d.—NORTHERN : Phitsanulok (Salaeng Haeng); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khombang, Makham, Khao Sabap), Trat (Huai Raeng, Ko Chang); PENINSULAR : Chumphon (Tha Ko), Surat Thani (Ko Tao, Khao Ram, Ban Don), Nakhon Si Thammarat (Thung Song, Khao Soon, Chawang), Narathiwat (Sg. Padi), Yala (Ka Hat, Bannang Sata). Ranong (Nam Chuet, Ko Surin), Phuket (Ko Pu), Trang (Khao Chong), Satun (Khuan Kalong, Ko Adang).

D i s t r i b u t i o n.—Tropics from Ceylon to Fiji (type from S. India)

E c o l o g y.—On rather dry ground in not so dense forests at low or rarely medium altitudes.

N o t e.—The sori are continuous and rarely interrupted in typically grown plants, though it is natural that there are some imperfectly matured fertile fronds with interrupted sori. There is a tendency for the fertile pinnae to become narrower, but the fertile and sterile fronds are not so distinct as to be called dimorphic. The narrower fertile pinnae are usually thicker in texture.

4. CONIOGRAMME

Feé, Gen. Fil.: 167. 1852; Copel., Gen. Fil.: 63. 1947.

Rhizome creeping, scaly; scales basally attached, thin, concolorous, entire. Stipe thick, pale green, glabrous. Lamina usually large, pinnate to tripinnate; leaflets subentire or serrulate, usually large, herbaceous to softly papyraceous, glabrous or pubescent; veins free, or anastomosing to form areoles without included free veinlets, ending in hydathodes. Sori elongate along veins, without indusia.

Coniogramme has large thin leaves and usually grows on humus-rich floor of dense mountain forests: features which distinguish it among the gymnogrammoid ferns. Sori superficially like those of *Syngramma,* but the large rhizome is covered with scales, not with bristles, and texture and general habit differ. The systematic position is left doubtful by various authors, but a gymnogrammoid affinity seems to be the most likely.

About 10 species are known, mainly in Asian tropics with a single representative in Mexico, Africa and Madagascar, respectively. Three species occur in Thailand.

KEY TO THE SPECIES

1. Frond simply pinnate; lateral pinnae up to three pairs **1. C. petelotii**
1. Frond bipinnate; basal pinnae pinnate or rarely bipinnate; lateral pinnae usually more than four pair
   2. Leaflets narrowly cuneate at base, usually stalked; veins forming angles of 30°—45° to midrib. Sori usually extending near to the margin **2. C. fraxinea** var. **serrulata**
   2. Leaflets truncate or very broadly cuneate at base, sessile or very shortly stalked; veins forming angles of 50°—70° to midrib. Sori usually placed nearer midrib than margin **3. C. procera**

1. Coniogramme petelotii Tard., Bull. Mus. Paris II. 5: 334. 1933; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 192. f. 22, 1-2. 1940. Tagawa & K. Iwats., Southeast As. St. 5: 107. 1967.

Rhizome creeping, up to 8 mm in diam., the apex covered with scales; scales linear, with long tails, 5—7 mm long, entire, glabrous, concolorously brown. *Stipe* stramineous, a little swollen at scaly base, minutely scaly upwards, 50—75 cm long, grooved on adaxial surface of the upper portion. *Lamina* oblong-oval, to 45 by 30 cm, simply inparipinnate with a few lateral pinnae; rachis scaly, grooved on upper surface; lateral pinnae 2 or 3 pairs, shortly stalked, oblong-lanceolate, falcate, acuminate at apex, cuneate to round at base, entire at margin, up to 25 by 8 cm; apical pinna like the lateral ones, a little larger, cuneate at base; costa distinctly raised on lower surface, shallowly grooved on upper surface, with minute scales; veins parallel, once or twice forked, very rarely reticulate, more or less distinct on upper surface, hydathodes about 1 mm from cartilagineous margin; herbaceous to a little fleshy, green on upper surface, paler beneath, glabrous. *Sporangia* along veins, from costa to $\frac{3}{4}-\frac{5}{6}$ way to margin.

T h a i l a n d.—NORTHERN : Chiang Mai (Doi Inthanon, Doi Khun Huai Pong).

Distribution.—Yunnan and Tonkin (type).

Ecology.—On wet sandy ground by streams in lower montane forests at about 1600 m alt.

2. Coniogramme fraxinea (D. Don) Diels in Pflanzenfam. 1 (4) : 262. 1899; Tard. & C. Chr. in Fl. Gén. I.-C.7 (2): 191. 1940; Holtt., Rev. Fl. Malaya. 2: 589. 1955. —*Diplazium fraxineum* D. Don, Prod. Fl. Nepal. : 12. 1825.—*Syngramma fraxinea* (D. Don) Bedd., Handb. : 386. f. 222. 1883.

var. **serrulata** (Bl.) Hieron., Hedwigia 57: 289. 1916; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 191. 1940; Tagawa & K. Iwats., Southeast As. St.5: 107. 1967.— *Gymnogramma serrulatum* Bl., En. Pl. Jav.: 113. 1828.

Rhizome creeping, thick, densely covered with scales. *Stipe* stramineous, up to 1 m or more long, 1 cm diam., usually smaller, densely scaly at base, sparsely clad with minute scales upwards. *Lamina* bipinnate, up to 80 by 60 cm; rachis and pinna-rachis like the upper part of stipe, stramineous, minutely scaly, grooved on upper surface, grooves decurrent; lateral pinnae 5–8 pairs, lower 3–5 pairs bipinnate, upper ones simple; pinnules of larger pinnae like the upper simple lateral pinnae and apical ones, the lowest anterior pinnules rarely trifoliate or pinnate; leaflets oblong or narrower or oblong-lanceolate, usually slightly falcate, caudate at apex, cuneate at stalked base, dentate at margin, 20–30 by 3–4.5 cm; the apical pinnae or pinnules sometimes larger, herbaceous, thin, glabrous; costa distinctly raised on lower surface, grooved on upper surface; veins a few times forked, hydathodes placed below the bottom of sinus.

Thailand.—NORTHERN : Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon), Lampang (Mae Tia), Tak (Doi Musoe); NORTH-EASTERN : Loei (Phu Luang); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao).

Distribution.— Laos, Sumatra and Java (type). The range of the species is in Ceylon, India (type), S. China to Taiwan, Indochina and Malesia to the Philippines.

Ecology.— On rather moist mountain slopes in dense evergreen forests at high altitudes.

Note.— This variety is distinguished from the type variety in having the margin of lobes serrulate. Material is inadequate to permit a detailed comparison.

3. Coniogramme procera Fée, Mém. Soc. Sci. Nat. Strasbourg 6(1): 22. 1865; Ching, Ic. Fil. Sin. 4: pl. 168. 1937; Tagawa & K. Iwats., Southeast As. St. 5: 107. 1967. Fig. 14. 2.

Rhizome creeping, thick, covered with scales. *Stipe* stramineous, thick, up to 50 cm long, 1 cm diam. near base, a little swollen and scaly at base, sparsely clad with minute scales or glabrescent upwards. *Lamina* bipinnate, oblong-subdeltoid in outline, up to 80 by 60 cm; Rachis and pinna-rachis like the upper parts of stipe, grooved on upper surface, glabrescent; lateral pinnae up to 10 pairs, lower 3–5 pairs pinnate, upper ones simple; leaflets narrowly oblong to oblong-subtriangular, caudate at apex, truncate or broadly cuneate or rarely subcordate at base, straight or more or less falcate, distinctly serrate at margin, (8–) 15–20 (–30) by (1.5) 2.5–3.5 (–4.5) cm, herbaceous, soft, glabrous; costa prominently raised on lower surface, grooved on upper surface; veins raised on lower surface, a few times forked, free, hydathodes placed in marginal teeth. *Sori* extending along veins, from costa to midway to margin, naked.

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

Distribution.— Himalaya (type), SW.China and Taiwan.

Ecology.— On wet floor of dense mossy-forests at about 2500 m on Doi Inthanon.

5. HEMIONITIS

Linn., Sp. Pl.: 1077. 1753; Copel., Gen. Fil.: 73. 1947.

Rhizome short, bearing a tuft of fronds, scaly; scales narrow, concolorous, attached basally. Stipe castaneous to nearly black, grooved on adaxial side. Frond simple or palmately lobed, dimorphic; lower surface of lamina covered with very small scales. Veins reticulate to form areoles without included free veinlets. Sori spreading along veins, naked, without paraphyses but with hair-like scales: spores tetrahedral.

There are seven species of this genus in the New World. We are not certain that the one Asiatic species is congeneric, though there is no particular difference in phenetic morphological features.

Hemionitis arifolia (Burm.f.) Moore, Ind. Fil.: 114. 1859; Bedd., Handb.: 413. f. 245. 1883; Tard. & C. Chr.in Fl. Gen. I.- C.7(2): 189. 1940; Holtt., Rev. Fl. Malaya 2: 596. 1955; Tagawa & K. Iwats.,Acta Phytotax. Geobot. 25: 19. 1971.—*Asplenium arifolium* Burm.f., Fl. Ind.: 231. 1768.

Rhizome short, suberect, covered with scales; scales narrow, concolorous, brown, 2–3 mm long, entire. *Stipe* deep castaneous to nearly black, grooved on adaxial surface, up to 20 cm long in fertile and up to 8 cm in sterile fronds, scaly or hairy throughout, hairs multicellular, coarse, up to 1.5 mm long. *Lamina* distinctly dimorphic; sterile lamina simple, narrowly ovate or oblong, round at apex, deeply cordate at base, entire. up to 7 by 4 cm; thickly papyraceous to chartaceous, bearing scales and hairs on lower surface, densely hairy at margin with short multicellular hairs; costa raised on lower surface, the veins reticulate without free veinlets, obscure; fertile lobes oblong-subdeltoid, up to 5 by 3 cm, moderately acute at apex, cordate at base, the two basal lobes triangular, moderately acute, entire; thinner than the sterile. *Sporangia* placed along veins, forming a network all over the lower surface, without any protection but scales mixed with sporangia.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Suthep), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Khon Kaen (Phu Wiang); SOUTH-EASTERN: Chon Buri (Si Racha); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Chawang).

D i s t r i b u t i o n.— Ceylon, S. & NE. India (type), S. China, Indochina, W. Malesia to the Philippines.

E c o l o g y.— On muddy rocks or terrestrial by paths in dense forests at low to medium altitudes below 600 m throughout the country but rather rare.

6. GYMNOPTERIS

Bernh., Schrad. J. Bot. 1: 297. 1799; Copel., Gen. Fil.: 75. 1947.

Rhizome short, creeping to suberect, densely covered with linear, downy scales and hairs. Stipe scaly at base, hairy throughout, castaneous, more or less polished. Lamina pinnate to more compound but not finely dissected, hairy throughout; veins all free. Sori diffuse, sporangia along veins, without indusia; spors tetrahedral.

Six species are credited to this genus: 2 in Sino-Himalayan region, 3 in tropical America, and one in Australia.

In Thailand only one collection has been made, and this species is not known in Burma nor in Indochina.

Gymnopteris vestita (Hook.) Underw., Bull. Torrey Bot. Club 29: 627. 1902; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 19; 1971.— *Gymnogramma vestita* Hook., Ic. Pl. 2: t. 115. 1837.— *Syngramma vestita* (Hook.) Moore, Ind. Fil.: lx. 1857; Bedd., Handb.: 386. f. 229. 1883. Fig. 14. 3.

Rhizome short-creeping, bearing fronds closely, densely covered with both scales and hairs; scales linear, about 0.1 mm broad, brown, like hairs: hairs downy, brown to paler, up to 5 mm long. *Stipe* up to 10 cm long, castaneous, densely covered with pale brown soft hairs. *Lamina* imparipinnate, narrowly elliptic, up to 8 by 2 cm; rachis like stipe, densely beset with paler appressed hairs; lateral pinnae about four pairs, nearly the same in size and form, ovate, acute at apex, round to cordate at base, about 1.5 by 1 cm, distinctly stalked, densely covered with a mat of hairs on both surfaces; veins a few times forked, all free. *Sori* dispersed along veins, naked.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao).

D i s t r i b u t i o n.— N. India (type) and SW. China.

E c o l o g y.— In rock crevices at about 2000 m alt. in limestone areas of Doi Chiang Dao, only once collected: KERR 6597 (BK, BM, K).

7. PITYROGRAMMA

Link, Handb. Gew. 3: 19. 1833; Copel., Gen. Fil.: 75. 1947.

Rhizome short, ascending, scaly; scales narrow, aciculate, brown. Stipe dark, polished. Lamina pinnately compound, herbaceous to papyraceous, the lower surface usually covered with waxy powder; veins all free. Sori along veins, without indusia, with no paraphyses; spores tetrahedral.

This in an American genus of about 40 species with a few in African tropics and one in Polynesia.

Pityrogramma calomelanos (Linn.) Link, Handb. Gew. 3: 20. 1833; Tard. & C. Chr. in Fl. Gén. I.-C.7(2): 189. f. 22, 3—4. 1940; Holtt., Rev. Fl. Malaya 2: 593. f. 348. 1955; Dansk Bot. Ark 20: 33. 1961; 23: 243. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 88. 1965; 5: 109. 1967; Acta Phytotax. Geobot. 23: 56. 1968.—*Acrostichum calomelanos* Linn., Sp. Pl.: 1072. 1753.—*Pellaea calomelanos* (Linn.) Link, Fil. Sp.: 61. 1841; Bedd., Handb.: 104. 1883.

Rhizome short, erect, bearing a tuft of fronds, covered with scales; scales bright brown, narrow, 3–6 mm long, thin, entire. *Stipe* up to 30 cm long, dark purple, polished, scaly on lower part, glabrous upwards, covered with white powder in young stage. *Lamina* oblong, with acuminate apex, bipinnate-tripinnatifid, 15–30 by 8–15 cm; rachis grooved on upper surface; lateral pinnae gradually smaller upwards; lower ones stalked, linear-subtriangular, acuminate to long-tailed at apex, up to 10 by 2.5 cm; pinna-rachis slender, grooved; grooves decurrent to those on rachis; pinnules oblong to oblong-lanceolate, cuneate at base, acute to acuminate at apex, lobed or pinnatisect in larger ones, up to 1.5 by 1 cm; lobes oblanceolate to spatulate, acute and dentate at apical portion, herbaceous, light green, glabrous but coated with white waxy powder; veins free, pinnate in larger ones, to several times forked. *Sporangia* placed along veins throughout the lower surface, without any protection.

T h a i l a n d.— NORTHERN: Chiang Mai (Wang Tao); Mae Hong Son (Mae Sariang); Tak (Ban Musoe); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Wangka, Bang Kasi); PENINSULAR: Nakhon Si Thammarat (Khao Luang, Wat Khiriwong) Narathiwat (Bacho Falls), Yala (Bukit, Betong, Bannang Sata), Phangnga (Khao Katha Khwam), Trang (Khao Chong), Satun (Khuan Kalong).

D i s t r i b u t i o n.— Pantropics (type from America); this may have been spread to the palaeotropics by man.

E c o l o g y.— On open mountain slopes in recently felled areas or along new roads at low or medium altitudes.

V e r n a c u l a r.— Foen ngoen (เฟินเงิน), Foen thong (เฟินทอง) (General).

U s e s.— Often cultivated as an ornamental.

N o t e.— The white powdery covering of the lower surface of fronds is a distinct feature of this species. It is cultivated widely as silver fern and the Asiatic plants are usually considered as those naturalized from cultivation.

8. ONYCHIUM

Kaulf., Jahrb. Pharm. 1820: 45; Ching, Lingn. Sci. J. 13: 493. 1934; Copel., Gen. Fil.: 1947.

Rhizome creeping, scaly. Lamina pinnately compound, with narrow segments; veins free; fertile segments with obliquely-parallel simple veinlets,

connected at margin by vascular commissures. Sori originating from the apices of veinlets, distinct at first but later extending along submarginal veinlets; indusia thin, grey, membranous, reflexed marginal flaps or lobes, completely covering the sori meeting with the opposite ones.

This genus is close to *Cryptogramma* of northern temperate or colder regions, but differs in having sori borne on the commissure connecting the apices of veinlets.

According to Ching (1934) there are nine species in this genus from tropical to warm temperate regions of the Old World; only 2 species occur in Thailand.

KEY TO THE SPECIES

1. Sori more than 10 mm long, densely covered with bright yellow wax	**1. O. siliculosum**
1. Sori less than 5 mm long, pale, without yellow wax	**2. O. contiguum**

1. Onychium siliculosum (Desv.) C. Chr.,Ind. Fil.: 468. 1906; Bot. Tidsskr. 32: 347. 1916; Ching, Lingn. Sci. J. 13: 495. 1934; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 169. f. 20, 4. 1940; Holtt., Dansk Bot. Ark. 20: 32. 1961; 23: 243. 1965. —*Pteris siliculosa* Desv., Berl. Mag. 5: 324. 1811. —*Onychium auratum* Kaulf., Enum.: 144. 1824; Bedd., Handb.: 96. f. 49. 1883; Christ, Bot. Tidsskr. 24: 106. 1901.

Rhizome short, ascending or creeping, densely covered with scales; scales linear, 5—7 mm long, thin but firm, entire, concolorously brown. *Stipe* stramineous, scaly at base,up to 30 cm long. *Lamina* quadripinnate, oblong-ovate, acuminate at apex, round at base, up to 35 by 10—25 cm; rachis glabrous, grooved on upper surface; lateral pinnae gradually reducing in size upwards, lower ones oblong–subdeltoid,caudately acuminate at apex, stalked at base, up to 20 by 8 cm; pinnules and secondary pinnules distinctly stalked; segments (4th divisions in lower pinnae) spatulate, oblique, sometimes slightly falcate, acute at apex, 6—10 by 1.5—2.5 mm, with a few lobes; ultimate lobes narrow, acute, entire, uninervate in sterile ones; herbaceous,perfectly glabrous on both surfaces, green to yellow green. *Fertile segments* larger, 10—30 by 1.5—2.5 mm, lower side covered by sporangia, completely protected by reflexed marginal flaps, densely coated with lemon yellow wax.

Thailand.— NORTHERN: Chiang Mai (Wang Tao, Doi Suthep, Om Koi), Mae Hong Son (Mae Sariang), Lamphun (Doi Khun Tan); NORTH-EASTERN: Phetchabun (Phu Miang); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Wangka).

Distribution.— India, SW. China (Yunnan), Taiwan, Indochina, Malesia throughout (type from Philippines?) to Polynesia.

Ecology. — On rather dry banks of new roads in open areas at 800–1000 m alt.

2. Onychium contiguum Hope, J. Nat. Hist. Soc. Bombay 13: 444. 1901; Ching, Lingn. Sci. J. 13: 498. 1934; Tagawa & K. Iwats. Southeast As. St. 5: 108. 1967. Fig. 15.1.

Rhizome creeping, bearing rather close-set stipes, densely covered with scales; scales narrow, brown to deep brown, thin but firm, entire, 3–6 mm long. *Stipe* stramineous except dark basal portion, black portion up to 5 cm long, grooved on adaxial surface, scaly at base, glabrous upwards, up to 20 cm long. *Lamina* oblong-subdeltoid, quadripinnate, 13–20 by 8–15 cm; rachis stramineous, grooved on upper surface, the grooves decurrent to those on pinna-rachis, glabrous; lateral pinnae largest at base, gradually becoming smaller upwards, basal acroscopic pinnule the largest; segments (4th division in larger pinnae) 2–5 lobed, spatulate; ultimate lobes lanceolate, acuminate at apex, entire, up to 2 by 0.5 mm, one-nerved; herbaceous to softly papyraceous, glabrous on both surfaces, green. *Fertile segments* 2–4 mm long, lower surface covered with sporangia, completely protected by reflexed marginal flaps.

Thailand.— NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Doi Hua Mot, Doi Inthanon).

Distribution.— N. India (type), SW. China and Taiwan.

Ecology.— On dry sandy slopes below limestone cliffs or in crevices of limestones in light shade.

Note.— This species is most closely related to *O. japonicum,* and was often united with it. *O. contiguum,* however, differs in finely pentapinnate fronds with each axis at a broad angle, in short sori less than 3 mm, and in comparatively long stipes dark at base. *O. japonicum* ranges from the Sino-Himalayan regions to Japan and southwards to the Philippines and Polynesia, but is not found in Thailand nor in Indochina.

9. DORYOPTERIS

J. Smith, J. Bot. 3: 404. 1841; 4: 162. 1841; Tryon, Contr. Gray Herb. Harv. Univ. 143: 11. 1942; Copel., Gen. Fil.: 71. 1947.

Rhizome creeping, scaly; scales narrow, not peltate, firm, with dark central bands. Stipe usually black and polished, terete throughout. Lamina simple to pinnatifid, basiscopically produced, coriaceous, glabrous; veins free except in sori, or copiously anastomosing to form uniform areoles without included veinlets. Sori marginal or nearly so, continuous on vascular commissure, protected by narrow reflexed margin of lobes; paraphyses filamentous, short.

This is largely an American genus of about 35 species, a few species extending to the Old World, and closely related to *Pellaea*. In Thailand the single species is rather unusual in its long-creeping rhizome and copious anastomoses in the venation.

Doryopteris ludens (Wall. ex Hook.) J. Smith, Hist. Fil.: 289. 1875; Bedd., Handb.: 120. f. 61. 1883; C. Chr., Contr. U.S. Nat. Herb. 26: 333. 1931; Tard. & C.Chr. in Fl. Gén. I.- C. 7(2): 176. f. 21, 1. 1940; Tryon, Contr. Gray Herb. 143: 60. pl. 8 B, map 11. 1942; Holtt., Rev. Fl. Malaya 2: 594. f. 349. 1955; Dansk Bot. Ark. 23: 243. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 109. 1967. —*Pteris ludens* Wall. ex Hook., Sp. Fil. 2: 210. 1858.

Rhizome long-creeping, about 3 mm diam., bearing distant stipes, covered with scales; scales linear-subulate, 3–4 mm long, distinctly bicolored, entire, glabrous. *Stipe* nearly black, polished, scaly at base, sparsely hairy upwards, 20–50 cm long. *Frond* dimorphic; sterile lamina smaller and less lobed, 15–20 by 10–20 cm, pinnatifid with usually 5 lobes, the apical lobe the largest, or in larger fronds with a few pairs of lobes, the basal lobes the largest, with a few secondary lobes; lobes oblong-subdeltoid to triangular, acute at apex, entire or slightly waved, with distinct main veins; veins copiously reticulate without included veinlets; papyraceous, glabrous. *Fertile lamina* up to 20 cm long and wide, subdeltoid in outline, deeply pinnatisect, usually with three pairs of lobes, the lowest pair the largest, usually with one or two secondary lobes; lobes linear or linear-subtriangular, caudately acuminate at apex, entire, 1–2 cm broad, up to 10 cm long; main veins distinct, black. *Sori* continuous along the margin of fronds, a very short interruption at apices of lobes, covered by thin reflexed margin.

T h a i l a n d .— NORTHERN: Chiang Rai (Doi Tham Tu Pu), Chiang Mai (Pong Nam Khao), Mae Hong Son (Doi Tan Ma Keng), Lampang (Mae Somai), Phrae (Ban Pak Tawan), Tak (Lan Sang), Nakhon Sawan (Mae Wong); NORTH-EASTERN: Loei (Phu Luang); EASTERN: Nakhon Ratchasima (Pak Thong Chai); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao, Pong Nam Ron); SOUTH-WESTERN: Kanchanaburi (Khao Nam Tok, Sai Yok, Thung Kang Yang Hills, Koeng Chada),

Ratchaburi, Prachuap Khiri Khan (Sam Roi Yot, Thap Sakae, Bang Saphan); PENINSULAR: Chumphon (Ko Wiang, Thap Li, Tha Ko), Nakhon Si thammarat (Thung Song), Phangnga (Khao Suang, Thap Put, Takua Thung), Satun, Yala (Bannang Sata), Trang (Nam Thai).

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

Ecology.—Terrestrial in tropical or evergreen forests at low or medium altitudes.

Vernacular.— Kaprok wao (กะปรอกว่าว) (South-eastern); kut hu kwao (กูดฮู้กวาว) (Northern); paen tako (แพนตาโก) (Peninsular); foen rachini (เฟินราชินี) (Central).

Note.— *D. concolor* (Langsd. & Fisch.) Kuhn is also known from tropical Asia, including Annam, but not Thailand. It differs in having bipinnatipartite fronds with free venation.

10. NOTHOLAENA

R. Br., Prod.: 145. 1810; Tryon, Contr. Gray Herb. 179: 6. 1956. — *Cheilanthes* Sw., Syn. Fil.: 5, 126. 1806; Copel., Gen. Fil.: 65. 1947, p.p.

Similar to *Cheilanthes,* different from it in lacking the modified reflexed margin of fertile lobes.

The centre of this genus is in the New World, and Tryon (1956) enumerated 58 American species. He gave no definition of this genus, for there were species grading into *Cheilanthes* and some into *Pellaea,* and no definition in words could circumscribe the 'genus' at present. *N. velutina* may be included tentatively according to current practice.

Notholaena velutina Tard. & C. Chr., Not. Syst. 6 : 167. f. 5—7. 1938; in Fl. Gén. I.-C. 7 (2) : 170. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 50. 1968. Fig. 15. 2.

Rhizome short, erect, bearing a tuft of living and older stipes, scaly at apex; scales not very dense, very narrow, consisting of a few rows of cells, nearly black with brown, ferrugineous edges, up to 2.5 mm by ca 0.1 mm. *Stipe* sparsely scaly in basal part, 7—10 cm long, dark purplish to nearly black, densely pubescent

Figure 15. 1: *Onychium contiguum*; middle size pinnule, x 5; scale on rhizome, x 20; basal part of pinna, showing rachis construction, x 8. 2: *Notholaena velutina*; upper portion of frond, gemma shown, natural size; small size pinna (above right), x 5; scale on stipe, x 50. 3: *Cheilanthes fragilis*; frond (right), natural size; scale, x 20; part of pinna (below), showing venation, marginal flaps and hairs, x 15. 4: *Cheilanthes subrufa*; frond (left), natural size; scale, x 40; part of pinna (bottom right), x 5.

throughout; hairs coarse, light brown, less than 1 mm, gradually becoming shorter upwards. *Lamina* lanceolate, the apex gradually narrowing, often ending in gemmae, up to 25 by 4 cm, tripinnatifid; rachis grooved on upper surface, dark brown throughout, hairy, gemmiferous; pinnae 1—1.7 cm remote, oblong-subdeltoid, round to moderately acute at apex, truncate to broadly cuneate at base, distinctly stalked; larger ones 2 by 1.5 cm; costa narrowly winged, hairy on both surfaces, rarely gemmiferous; pinnules about 5 pairs, narrowly oblong, slightly falcate in larger ones, basal one usually the largest; lobes about 5 pairs, round, entire, strongly revolute, veins frees; lamina densely hairy, hairs downy, straight, pale and translucent, 1 mm or so in length. *Sori* confined to the vein-ending but appearing to be more or less continuous along margin.

T h a i l a n d .— SOUTH-WESTERN: Prachuap Khiri Khan (Hua Hin, Huai Yang).

D i s t r i b u t i o n .— S. Indochina (type).

E c o l o g y .— On dry rocks among ferns in rather dense forests at low altitudes.

N o t e .— This is a species known in restricted areas, SW. Thailand and S. Indochina (Annam and Cambodia). In Huai Yang this is abundant and is collected repeatedly, though the species is reported to occur rather rarely in the other localities.

11. CHEILANTHES

Sw., Syn. Fil.: 5, 126. 1806; Copel., Gen. Fil.: 65. 1947, p.p. major. —*Aleuritopteris* Fée, Gen. Fil.: 153. pl. 12 B. f. 1—2. 1852; Copel., Gen. Fil.: 67. 1947.

Rhizome short, suberect to ascending, scaly. Stipe without articulation; axes grooved on adaxial surface, grooves decurrent. Frond pinnately divided; veins all free. Sori at end of veinlets, in appearance often continuous along the margin of lobes, protected by reflexed margin of lobes.

The limitation of this genus is hardly possible in a few words at present. The plants are usually xerophytic or saxiphilous, and about 130 species are known mainly from the New World. Several species are recorded from the Old World, though the classification is still obscure. The seven species rather tentatively enumerated from Thailand including the variable *C. farinosa*.

KEY TO THE SPECIES

1. Frond usually more than 5 cm long
  2. Stipe and rachis glabrous or scaly
    3. Lower surface of lamina not powdery; lower pinnae distinctly stalked
      4. Frond tripinnate, subdeltoid in outline — **1. C. tenuifolia**
      4. Frond bipinnate, linear-lanceolate in outline — **2. C. belangeri**
    3. Lower surface of lamina covered with waxy powder; pinnae all sessile
      5. Lower surface of costa and veins scaly
        6. Scales on underside of frond rather sparse, bicoloured or the smaller ones unicoloured — **5. C. subrufa**
        6. Scales on underside of frond dense, various in size and form, larger ones unicoloured, the apical portion like the articulated hairs — **6. C. rufa**
      5. Costa and veins not scaly underneath — **4. C. farinosa**
  2. Stipe and rachis densely pubescent throughout — **3. C. fragilis**
1. Frond delicate, up to 2.5 by 1.5 cm — **7. C. delicatula**

1. Cheilanthes tenuifolia (Burm.f.) Sw., Syn. Fil.: 129, 332. 1806; Bedd., Handb.: 92. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 173. 1940; Holtt., Rev. Fl. Malaya 2: 590. f. 347. 1955; Dansk Bot. Ark. 20: 33. 1961; 23: 243. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 108. 1967. —*Trichomanes tenuifolium* Burm.f., Fl. Ind.: 237. 1768.

Rhizome short, ascending, covered with scales; scales light brown, very narrow, entire, 3—4 mm long. *Stipe* castaneous, polished, slightly swollen and densely scaly at base, sparsely and minutely scaly upwards, 10—25 cm long, grooved on adaxial surface. *Frond* dimorphic; sterile lamina smaller, with stipe 8—12 cm in length, deltoid in outline. *Fertile lamina* tripinnate, or the larger quadripinnatifid, subdeltoid in outline, up to 20 by 8 cm; rachis and pinna-rachis scaly, grooved on upper surface; pinnae ten or more pairs, basal ones the largest, subtriangular, acute at apex; middle pinnae oblong-subtriangular; larger pinnules pinnatisect with a few pairs of lobes and a large terminal one, terminal lobes of pinnules like terminal pinnae and pinnules, oblong, round at apex, 5—10 by ca 3 mm, entire; ultimate lobes round or oval, 2—4 mm long, up to 1.5 mm broad, papyraceous, green; veins all free, obscure. *Sporangia* confined to the end of veins but appearing continuous at margin of lobes, when young protected by reflexed margin of lobes, edges uneven, pellucid.

T h a i l a n d.— NORTHERN: Chiang Mai (Chiang Dao, Doi Suthep, Mae Klang), Mae Hong Son (Mae Sariang, Doi Pha Dam), Lampang (Doi Phalat), Lamphun (Doi Khun Tan), Phrae (Mae Ban), Phitsanulok (Thung Salaeng Luang), Tak (Doi Musoe); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN:

Chanthaburi (Khao Sabap), Trat (Ko Chang); PENINSULAR: Chumphon (Tha Ko), Surat Thani (Bang Bao, Ban Don), Songkhla, Phangnga, Satun, Trang (Khao Chong), Yala (Bannang Sata).

Distribution.— Tropics of Asia and Oceania, from India and S. China through Malesia (type from India) to Polynesia, Australia and New Zealand.

Ecology.— On rather dry clayey banks of paths in mixed forests at low altitudes.

Vernacular.— Chon phi (โชนผี) (Peninsular).

2. Cheilanthes belangeri (Bory) C.Chr., Ind. Fil.: 172. 1905; Tard. & C.Chr. in Fl. Gén. I.- C. 7(2): 172. 1940; Holtt., Rev. Fl. Malaya 2: 591. 1955; Dansk Bot. Ark. 20: 33. 1961; 23: 243. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 108. 1967. — *Pteris belangeri* Bory in Bélanger, Voy. Bot. 2: 44. 1833. —*Cheilanthes varians* Hook., Sp. Fil. 2: 89. t. 103 A. 1852; Bedd., Handb.: 91. f. 47. 1883.

Rhizome short, erect, covered with scales; scales narrow, shining brown, 2—3 mm long, entire. *Stipe* castaneous, polished, 8—15 (—30) cm long, sparsely scaly on lower parts, minutely pubescent, grooved on adaxial surface. *Lamina* linear-lanceolate, bipinnatifid to bipinnate, 10—20 (—30) by 3—5 (—8) cm; lateral pinnae more than 15 pairs, 2—5 cm apart in lower fronds, closer in upper; lower pinnae larger, pinnate, up to 4 by 2 cm, oblong-subdeltoid, acuminate at apex, broadly cuneate and stalked at base; middle pinnae 10—25 by 5—10 mm, pinnatifid at base, oblong or lanceolate; pinnules oblong, oblique, subtruncate or broadly cuneate at base, round at apex, irregularly lobed in larger ones, apical pinnules of larger pinnae like upper ones, moderately acute or round at apex, entire at apical part; thickly papyraceous, yellow-green, glabrous on laminar surface; sometimes producing bulbils on lobes underneath; veins all free, hardly visible. *Sori* at margin of lobes, nearly continuous or interrupted, protected by reflexed margin of lobes to 0.7 mm in breadth.

Thailand.— NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Suthep, Mae Klang), Lampang, Phitsanuloke (Thung Salaeng Luang); NORTH-EASTERN: Nong Khai; SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Makham); PENINSULAR: Surat Thani (Ban Na), Satun, Yala (Bannang Sata).

Distribution.— N. India, S. China, Indochina and Malaya to the Philippines.

Ecology.— On clayey banks of paths or on muddy rocks in mixed forests or in open areas at low altitudes.

Vernacular.— Kachot khai (กะฉอดไข่) (South-eastern); kut ngot (กูดหงอด) (Northern).

3. Cheilanthes fragilis Hook., Fil. Exot.: t. 96. 1859; Bedd., Handb.: 91. 1883; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 19. 1971. Fig. 15. 3.

Rhizome short, erect, scaly; scales gradually narrowing towards acuminate apex, about 4 mm long, up to 0.5 mm broad, brown, central portion sometimes stiff and darker, entire. *Stipe* castaneous or darker, up to 10 cm long, scaly near base, densely pubescent throughout, hairs woolly but patent, dark, up to 0.5 mm long. *Lamina* bipinnatifid, oblong-lanceolate or narrower, up to 25 by 7 cm in fertile, up to 15 cm by 7 cm in sterile fronds; rachis pubescent throughout, grooved on upper surface; pinnae alternate, sessile, narrowly elliptic, acuminate at apex, subtruncate at base, or narrowly oblanceolate with moderately acute apex, up to 4 by 1 cm; costa castaneous, green in distal portion, pubescent or glabrescent; pinnules close to somewhat distant, patent to oblique, oblong, round to moderately acute at apex, adnate at base, entire or slightly waved at margin, softly papyraceous, hairy at margin but glabrous on surface; veinlets simple, hardly visible. *Sori* at apex of veinlets, protected by thin reflexed flaps.

Thailand.— NORTHERN: Chiang Mai, Tak (Khao Phra Wo).

Distribution.— Burma (Moulmein, type).

Ecology.— On limestone rocks on ridges of hills in teak jungles at 750—930 m alt.

4. Cheilanthes farinosa (Forssk.) Kaulf., Enum.: 212. 1824; Bedd., Handb.: 92. 1883; Suppl.: 21. 1892; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 171. 1940; Holtt., Rev. Fl. Malaya 2: 592. 1955; Dansk Bot. Ark. 20: 33. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 108. 1967. — *Pteris farinosa* Forssk., Fl. Aegypt.Arab.: 187. 1775.

Rhizome short, suberect or ascending, scaly; scales linear, 2—4 mm long, entire, bicoloured. *Stipe* nearly black, polished, sparsely scaly on lower parts, hairless, up to 20 cm long. *Lamina* variable in size and form, commonly subdeltoid, acuminate at apex, 15—20 by 7—12 cm, bipinnate; rachis and costa like the upper parts of stipe, grooved above, grooves decurrent; pinnae sessile, the lowest the largest, asymmetric with larger basal acroscopic pinnules; middle pinnae narrowly oblong, falcate, adnate at base, deeply pinnatisect; pinnules narrowly oblong, oblique, round at apex, subentire or lobed in larger ones, papyraceous; lower

surface coated with white waxy powder, without hairs and scales; veins all free. *Sori* terminal on veinlets, usually appearing continuous along the margin of lobes, protected by reflexed marginal flaps, the pellucid edges rather broad, crenate to fimbriate at margin, persistent.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Hua Mot, Doi Suthep, Mae Klang, Doi Inthanon), Lampang (Huai Thak), Lamphun (Doi Khun Tan), Tak (Lan Sang).

D i s t r i b u t i o n.— Tropics or warmer regions in both the Old (type from Arabia) and New Worlds.

E c o l o g y.— On rather dry rocks, sometimes on limestone cliffs, in light shade in mixed deciduous or evergreen forests usually at medium or high altitudes.

V e r n a c u l a r.— Kut ngoen (กูดเงิน) (Northern).

N o t e.— This is a so-called collective species with a wide range of distribution. There is variability in some features, such as: the size and form of plants, the coloration and density of waxy powder on underside of lamina (white to yellow), coloration of stipe (polished dark brown to nearly black), dissection of frond and the form of ultimate segments, size and form of rhizome scales, and so on.

5. Cheilanthes subrufa Bak.,Kew Bull. 1906: 8; Tard. & C. Chr.in Fl. Gén. I.- C. 7(2): 171. f. 21, 2—4. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 108. 1967, p.p. Fig. 15. 4.

Rhizome short, erect, covered with scales; scales linear, bicoloured, 3—5 mm long, up to 0.4 mm broad, entire. *Stipe* castaneous to nearly black, polished, not very densely scaly throughout, 12—20 cm long. *Lamina* bipinnatifid to bipinnatisect, oblong-oval to subdeltoid, acute to acuminate at apex, 8—15 by 5—8 cm; rachis winged on both sides except in the lower portion, scaly; lateral pinnae several pairs, opposite or nearly so, the lowest the largest, pinnately lobed, asymmetrically subdeltoid, falcate, up to 5 by 4 cm, sessile, basal acroscopic lobes the largest; middle pinnae narrowly oblong, lobed to midway between costa and margin, round at apex, adnate at base; larger pinnules oblong, oblique, slightly falcate, round at apex, subentire or lobed; herbaceous or thicker, green, with lemon-yellow to nearly white powderly wax on lower surface; lower surface of costa, veins and veinlets scaly; scales linear, brown, the larger bicoloured, up to 2 mm long. *Sori* at end of veinlets, appearing more or less continuous, or round, protected by reflexed margin of lobes; uneven pellucid edge persistent, reniform or continuous, fimbriate.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao).

D i s t r i b u t i o n.— Yunnan (type) and Tonkin.

E c o l o g y.— In crevices of rather dry limestone cliffs in open areas at high altitudes (1600–2100 m).

N o t e.— This is intermediate between *C. farinosa* and *C. rufa* as pointed out in the original description. In character of scales it is similar to Himalayan *C. albomarginata,* which is also variable in form and size of fronds.

6. Cheilanthes rufa D. Don,Prod. Fl. Nepal.: 16. 1825; Holtt., Dansk Bot. Ark. 20: 33. 1961. — *Cheilanthes subrufa* auct. non Bak.:Tagawa & K. Iwats., Southeast As. St. 5: 108. 1967, p.p.

Rhizome short, erect, scaly; scales linear-lanceolate, gradually narrowing towards attenuate apex, up to 3.5 by 0.4 mm, bicoloured with dark brown centre and brown to pale brown margins, entire. *Stipe* polished, nearly black, scaly throughout; scales variable in size, larger ones similar to those on rhizome, smaller ones linear, concolorously pale brown, internal walls of marginal cells sometimes projecting irregularly, the apical portion like the articulated hairs on frond margin. *Frond* elliptic in outline,round to moderately acute at apex, up to 11 by 5.5 cm, pinnatisect to bipinnatifid; pinnae sessile, papyraceous, densely covered with lemon-yellow waxy powder below, lower surface of every axis rather densely clad with small scales like those on stipe; margin of fronds cartilagineous, usually bearing pale projections like articulated hairs, especially the indusial marginal flaps. *Sori* and indusia as in the preceding species.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao).

D i s t r i b u t i o n.— Himalaya: Nepal (type) to Assam.

E c o l o g y.— In crevices of exposed limestone cliffs in mixed forests at medium altitudes (900–1100 m).

7. Cheilanthes delicatula Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 19. 1971.

Rhizome short-creeping, bearing close fronds, densely scaly; scales linear, up to 3 by 0.1 mm, bright brown. *Stipe* slender, about 0.2 mm in diameter, bright castaneous, polished, glabrous or rarely scaly with small hair-like scales 1.5–2.5 mm long. *Frond* oblong-subdeltoid,widest at base, acute at apex, about 2.5 by 1.5 cm, bipinnatifid; rachis castaneous, grooved on upper surface, raised below, glabrous, narrowly winged nearly to the base; pinnae patent or upper ascending,

opposite, adnate or decurrent at base, oblong to oblong-subdeltoid, round at apex, up to 10 by 5 mm, pinnatifid to pinnatisect; segments with one to four veinlets, lobes one-nerved, thin and glabrous; veins distinct on both surfaces with darker colour. *Sori* at apex of veinlets, with one to four sporangia; indusial flaps moderately acute to acuminate at apex, up to 0.7 by 0.5 mm, pale.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Inthanon, type).

D i s t r i b u t i o n.—Endemic.

E c o l o g y.— Without record of habitat; probably in crevices of rocks; known only by the type collection : PUT 3437 (BK, BM, K).

12. ADIANTUM

Linn., Sp. Pl.: 1094. 1753; Gen. Pl.: 560. 1754; Copel., Gen. Fil.: 78. 1947.

Rhizome creeping to erect, scaly with small scales. Stipe not jointed to rachis. Frond simple to pinnately decompound or pedate, usually with dimidiate or flabellate leaflets; soft to papyraceous, glabrous or hairy, rarely glaucous beneath; veins free or rarely anastomosing. Sori along veins on inner face of reflexed marginal flaps (false-indusia), thus protected between this flap and laminar surface; spores tetrahedral.

About 200 species are included in this large but well established genus usually from the warmer parts of both worlds. The most distinct feature is found in the soral construction: sporangia borne along the apical portion of veins on the inner face of sharply reflexed marginal flaps (false-indusia).

Ching revised the Chinese species of *Adiantum* (Acta Phytotax. Sin. 6: 301 –354. 1957). More careful comparison between Thai and Indochinese species is required.

KEY TO THE SPECIES

1. Frond simply pinnate
  2. Pinnae almost sessile
    3. Rachis hairy at least on upper surface
      4. Pinnae lobed more than half way towards costa, lobes narrow, each with a few veinlets; veins very prominent, with white setose hairs **1. A. caudatum**
      4. Pinnae lobed less than half way towards costa, lobes broader, each with several veinlets; veins not so prominent, with only brown hairs **2. A. zollingeri**
    3. Rachis perfectly glabrous **3. A. edgeworthii**

2. Pinnae with distinct stalk
5. Pinnae glabrous
6. Pinnae crescent-shape, more than 2 cm long
7. Rachis and stipe with distinct wings — **4. A. soboliferum**
7. Rachis and stipe without wings — **5. A. philippense**
6. Pinnae fan-shaped, cuneate at base, at most 2 cm long — **6. A. erylliae**
5. Pinnae hairy — **7. A. siamense**
1. Frond bipinnate or more compound
8. Frond bipinnate — **8. A. capillus-veneris**
8. Frond tripinnate
9. Rachis hairy at least on upper surface — **9. A. flabellulatum**
9. Rachis perfectly glabrous — **10. A. stenochlamys**

1. Adiantum caudatum Linn., Mant. Alt.: 308. 1771; Bedd., Handb.: 83. f. 44. 1883; Hosseus, Beih. Bot. Centr. 28(2): 363. 1911; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 3. 1929; Tard. & C. Chr.in Fl. Gén. I.- C. 7(2): 180. 1940; Holtt., Rev. Fl. Malaya 2: 599. f. 351. 1955; ed. 2. 2: 638. 1968; Dansk Bot. Ark. 20: 33. 1961; 23: 244. 1965; Ching, Acta Phytotax. Sin. 6: 313. 1957: Seidenf., Nat. Hist. Bull. Siam Soc. 19: 87. 1958; Tagawa & K. Iwats., Southeast As. St. 5: 109. 1967. — *Adiantum malesianum* Ghatak, Bull. Bot. Surv. Ind. 5: 73. f. 1, 4. 6–7. 1963; Holtt., Rev. Fl. Malaya ed. 2. 2: 638. 1968.

Rhizome short, erect, covered with scales; scales linear, 4–5 mm long, bicoloured. *Stipe* up to 15 cm long, castaneous to black purple, polished, densely hairy with long multicellular brown hairs, scaly at base. *Lamina* linear-lanceolate, pinnate, long-tailed at apex, up to 35 by 2.5–4 cm; rachis densely hairy on upper surface with paler stiff hairs, prolonged, leafless on apical part, rooting at tip; lateral pinnae gradually becoming smaller upwards, the lower ones smaller and reflexed; largest pinnae sessile, almost parallelogramm-shaped, round at apex, lower margin almost straight, upper margin nearly parallel to it, inner edge straight, to form narrowly cuneate base with lower margin, up to 20 by 7 mm, upper and outer margins deeply lobed to more than half the width of pinna, forming narrow lobes and narrow sinus; lobes including 2–5 veinlets, subtruncate and slightly toothed at apex, entire at margin; papyraceous, hairy on both surfaces, lower surface with short and long hairs, upper surface with stiff hairs; veins prominent. *Sori* on apices of lobes, the reflexed flaps narrow, hairy.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Mae Klang), Lampang (Khao Tham Pha Thai), Phrae (Mae Ban), Phitsanulok (Thung Salaeng Luang), Tak (Lan Sang, Ban Na); NORTH-EASTERN: Loei (Phu Luang, Pha Nok Khao), Nong Khai; EASTERN: Nakhon Ratchasima (Pak Thong Chai); CENTRAL: Saraburi (Muak Lek), Phra Nakhon Si

Ayutthaya; SOUTH-EASTERN: **Prachuap Khiri Khan (Ban Bueng Hills), Chon Buri (Si Richa), Chanthaburi (Pong Nam Ron);** SOUTH-WESTERN: **Kanchanaburi (Erawan Falls, Wangka, Khao Thalu, Ban Kao), Prachuap Khiri Khan (Bang** Saphan); PENINSULAR : Surat Thani (Khao Hua Khwai, Ko Tao, Ko Samui, Ko Paloei), Nakhon Si Thammarat (Thung Song), Phatthalung, Phangnga (Kasum), Satun, Pattani, Yala (Bannang Sata, Ban Sai Khao).

D i s t r i b u t i o n.— Tropics of the Old World in general, from Africa to Polynesia (type from India).

E c o l o g y.— On rather dry slopes or often on muddy limestone usually in dry deciduous forests at low altitudes throughout Thailand.

V e r n a c u l a r.— Kut namkhao (กูดน้ำข้าว) (Northern); tin tukkae (ตีนตุ๊กแก), hang nak bok (หางนาคบก) (Central).

2. Adiantum zollingeri Mett. ex Kuhn, Ann. Lugd. Bat. 4: 280. 1869; Tagawa & K. Iwats., Southeast As. St. 5: 109. 1967; Holtt., Rev. Fl. Malaya ed. 2. 2: 638. 1968. — *Adiantum caudatum* var. *subglabrum* Holtt., Rev. Fl. Malaya 2: 600. 1955. Fig. 16.3.

Rhizome short, erect, densely scaly at apex; scales up to 6 mm long, narrow, entire, bicoloured. *Stipe* up to 12 cm long, castaneous to nearly black, densely hairy with long, multicellular, brown hairs, scaly at base. *Lamina* linear, pinnate, gradually narrowing upwards, up to 30 by 4 cm; rachis hairy on upper surface, perfectly glabrous on lower surface, prolonged, sometimes leafless on upper part, often rooting at tip; upper lateral pinnae becoming smaller and more spaced; lower pinnae smaller and reflexed; larger pinnae sessile, nearly parallelogram-shaped, round at apex, lower margin almost straight, to form narrowly cuneate base with lower margin, up to 15 by 8 mm, upper and outer margins lobed at most to less than $\frac{1}{3}$ of width of pinnae, forming distinct sinus; lobes round or spathulate, round to subtruncate and slightly toothed at apex, each including 5 to 7 veinlets; papyraceous, almost glabrous or very sparsely hairy on veins and at margin of pinnae; veins rather indistinct on both surfaces. *Sori* on apices of lobes, reflexed flaps circular or elongate, glabrous or sparsely hairy.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Suthep, Ping Khong, Sop Aep, Mae Klang), Mae Hong Son (Mae La Noi), Lampang (Doi Phalat, Huai Thak), Lamphun (Doi Khun Tan), Phrae (Mae Ban), Tak (Lan Sang), Phetchabun (Nam Nao); NORTH-EASTERN: Loei (Phu Kradueng, Pha Nok Khao); EASTERN: Nakhon Ratchasima (Pak Chong); CENTRAL: Nakhon Nayok (Khao Yai);

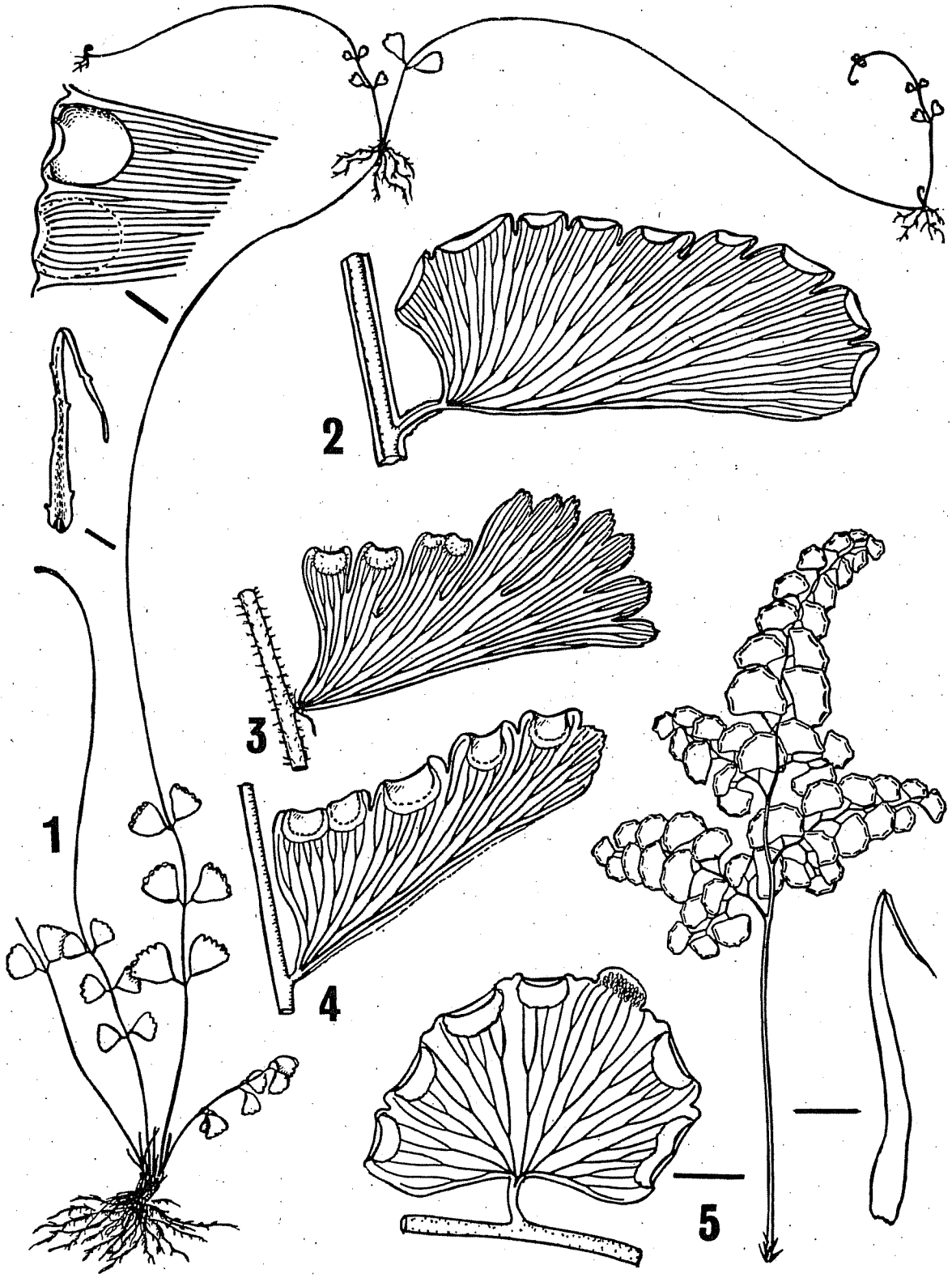

Figure 16. 1 : *Adiantum erylliae;* plant, x 0.5; scale (above), x 20; venation and marginal flap (top), x 6.2 : *Adiantum soboliferum;* fertile pinna, x 3.3 : *Adiantum zollingeri;* semi-fertile pinna, x 3.4 : *Adiantum edgeworthii;* fertile pinna, x 4.5 : *Adiantum stenochlamys;* middle size leaflet (left), x 4. ; frond, natural size; scale (right), x 20.

SOUTH-WESTERN: Uthai Thani (Huai Laeng), Kanchanaburi (Sai Yok, Kaeng Lawa, Khao Nam Tok, Thung Kang Yang Hills), Ratchaburi, Prachuap Khiri Khan (Sam Roi Yot, Thap Sakae, Khao Khlongwan); PENINSULAR: Surat Thani (Khao Phra Rahu, Khao Lak), Nakhon Si Thammarat (Khiriwong), Phangnga (Thap Put).

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

E c o l o g y.— On dry ground or on muddy limestone in deciduous or evergreen forests at low altitudes throughout Thailand.

V e r n a c u l a r.— Kut bai lek (กูดใบเล็ก) (Northern).

N o t e.— The hairiness is somewhat variable, especially on the pinnae. In some cases, pinnae are almost glabrous even in the young stages, though there are plants with hairy pinnae. The lobing of the pinnae is also fairly characteristic, not so deeply incised as in *A. caudatum*.

3. Adiantum edgeworthii Hook., Sp. Fil. 2: 14. t. 81 B. 1851; Bedd., Handb. Suppl.: 17. 1892; Ching, Ic. Fil. Sin. 3: t. 139. 1935; Acta Phytotax. Sin. 6: 315. 1957; Tagawa & K. Iwats., Southeast As. St. 5: 109. 1967. — *Adiantum caudatum* var. *edgeworthii* (Hook.) Bedd., Handb.: 84. 1883. Fig. 16. 4.

Rhizome short, erect, scaly at apex; scales narrow, 3—4 mm long, entire, bicoloured with black central portion and dark brown edge. *Stipe* up to 13 cm long, castaneous to bright blackish-purple, glabrous except scaly lower portion; scales on stipe like those on rhizome but concolorous brown. *Lamina* linear, simply pinnate, gradually narrowing upwards, up to 20 by 2 cm; rachis perfectly glabrous, usually prolonged, leafless on upper part, rooting at tip; lower pinnae hardly reduced; larger pinnae sessile, half-crescent-shaped to nearly parallelogram-shaped, round to moderately acute at apex, lower margin round, upper margin straight and lobed, inner edge straight, forming narrow cuneate base with lower margin, up to 10 by 5 mm, upper margin lobed to about $\frac{1}{3}$ of width of pinnae, forming distinct sinus; lobes round, moderately acute to subtruncate at slightly toothed apex; papyraceous to softly chartaceous, perfectly glabrous on both surfaces; veins rather indistinct. *Sori* on apices of lobes, reflexed flaps circular or elongate, glabrous.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Suthep, Doi Inthanon).

D i s t r i b u t i o n.— NE. India (type), Upper Burma, China (north to Manchuria), Tonkin, Taiwan, Philippines, Timor, and northwards to S. Japan.

E c o l o g y.— On muddy rocks in semi-shade or evergreen forests at 1600—1750 m alt.

N o t e.— Compared with the preceding two species known in lowlands, this montane species may indicate a northern geographical element. The characteristic feature of this species is the perfectly hairless fronds.

4. Adiantum soboliferum Wall. ex Hook., Sp. Fil. 2: 13. t. 74 A. 1851; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 181. 1940; Holtt., Rev. Fl. Malaya 2: 598. 1955; Ching, Acta Phytotax. Sin. 6: 820. 1957; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 87. 1958; Tagawa & K. Iwats., Southeast As. St. 5: 109. 1967. — *Adiantum caudatum* var. *soboliferum* (Hook.) Bedd., Handb.: 84. 1883. Fig. 16. 2.

Close to *A. philippense* but differs in: stipe, rachis and pinna-stalk with distinct wing, wing of pinna-stalk crisped, of the others flat, up to 0.7 mm broad; rachis and pinna-stalk rather densely hairy on upper surface; pinna-stalk shorter, 3—8 mm long; basal edges of leaflets not straight, forming cuneate base; veins more distinctly raised on lower surface.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tung, Doi Tham Tu Pu), Chiang Mai (Doi Chiang Dao), Lampang, Tak (Ban Na); NORTH-EASTERN: Loei (Phu Luang, Pha Nok Khao); EASTERN: Nakhon Ratchasima (Pak Chong); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Pong Nam Ron); SOUTH-WESTERN: Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Surat Thani (Khao Hua Khwai), Trang (Nam Tai), Satun (Bukit Bunga).

D i s t r i b u t i o n.— India (type), S. China, Taiwan, Indochina, throughout Malesia to the Pacific tropics.

E c o l o g y.— On rather dry ground in deciduous or evergreen forests at low or medium altitudes.

V e r n a c u l a r.— Ya hu khwak (หญ้าหูควาก) (Northern).

N o t e.— As noted above this is most closely related to *A. philippense*. On the other hand this is similar, as noted by Hooker, to the complex of *A. caudatum*, especially to *A. zollingeri* in the general appearance of pinnae, though different from them in winged and glabrous axes and also in glabrous thinner pinnae with distinct stalks.

5. Adiantum philippense Linn., Sp. Pl. 2: 1094. 1753; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 182. 1940; Holtt., Rev. Fl. Malaya 2: 598. f. 350. 1955; Dansk Bot. Ark. 20: 33. 1961; 23: 244. 1965; Ching, Acta Phytotax. Sin. 6: 318. 1957; Tagawa & K. Iwats., Southeast As. St. 5: 119. 1967. — *Adiantum lunulatum* Burm. f., Fl. Ind.: 235. 1768; Bedd., Handb.: 82. f. 43. 1883; Hosseus, Beih. Bot. Centr. 28(2): 363. 1911; Bonap., Not. Pterid. 14: 61. 1923.

Rhizome short, suberect, the apex covered with scales; scales linear, a little broader at base, entire, up to 3 mm long, bicoloured. *Stipe* bright castaneous to black, glabrous or sparsely scaly at basal portion, variable in size, usually about 10 cm long; scales on stipe like those on rhizome except in being concolorous brown. *Lamina* linear-lanceolate to oblong, pinnate, commonly 15 cm long but the larger more than 30 by 10 cm; rachis perfectly glabrous, occasionally prolonged, leafless on upper part, and rooting at tip, more commonly bearing an apical pinna like lateral ones; lateral pinnae large at base, slightly reduced in size upwards, distinctly stalked; stalks usually 5–10 mm but sometimes more than 2 cm long, with an angle of about 60° to rachis; leaflets crescent-shaped, usually 2–3 by 1–1.5 cm, the larger up to 5 cm long, in the upper leaflets the lower two edges meeting at stalks to form cuneate base; thin, softly herbaceous, glabrous on both surfaces; veins a little raised, outer edge of leaflets subentire, crisped or lobed to about $\frac{1}{4}$ of breadth of leaflets, sinus narrow, lobes round to subquadrangular, round to truncate at subentire or toothed apex. *Sori* at margin of leaflets, reflexed soral flaps elongate, usually 5–8 mm long, but up to 1.5 cm.

Thailand.— NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Fang, Doi Chiang Dao, Mae Klang, Doi Inthanon, Wang Tao, Doi Saket), Mae Hong Son (Mae La Noi, Bo Luang), Lampang (Huai Thak), Lamphun (Doi Khun Tan), Phitsanulok (Thung Salaeng Luang, Kaeng So Pha), Tak (Lan Sang, Ban Musoe, Wang Chao); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok, Krungthep; SOUTH-EASTERN: Prachin Buri, Chon Buri (Si Racha), Chanthaburi (Khao Sabap); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Wangka, Bang Kasi, Thung Kang Yang Hills, Tha Po); PENINSULAR: Nakhon Si Thammarat (Thung Song).

Distribution.— Throughout the tropics of the Old World (type from the Philippines).

Ecology.— On rather dry slopes or on muddy crevices of rocks in light shade or sometimes on humus-rich floor of dense montane forests; common at low to medium altitudes, rarely to 1400 m alt., very common except in Peninsular region.

Vernacular.— Kut hu khwak (กูดหูควาก), hua khwak (หัวขวาก), Ya khwak (หญ้าขวาก) phak kachot nu (ผักกะฉอดหนู) (South-eastern); hang chingcha (หางชิงช้า) (Peninsular).

Note.— Owing to its wide range of habitats, size and texture of this species are highly variable. Leaflets become larger and thinner in deep shade, and in open limestone areas the plants are somewhat dwarfed.

6. Adiantum erylliae C. Chr. & Tard., Not. Syst. 6: 172. f. 1-2. 1938; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 184. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 110. 1967. Fig.16.1.

Rhizome short, erect, rather densely covered with scales; scales linear, 3–4 mm long, indistinctly bicoloured with black centre and blackish-brown edge. *Stipe* bright brown to nearly black, 2–8 cm long, glabrous except for scaly basal portion, scales like those on rhizome but concolorous dark brown. *Lamina* simply pinnate, lanceolate to linear-lanceolate, gradually narrowing upwards, up to 15 by 3 cm; rachis glabrous throughout, often prolonged and rooting at tip; lateral pinnae distinctly stalked, stalks slender, 1.5–4 mm long; leaflets fan-shaped, up to 1.3 by 1.8 cm, basal two edges entire, straight or round, forming less than right angle, distal margin round, subentire, or lobed to the depth of $\frac{1}{5}$ of length of leaflets, middle sinus sometimes deep to midway, sinus narrow or a little wider, lobes round and subentire, papyraceous, glabrous; veins dichotomous, dense, a little raised. *Sori* round or a little wider, up to ten for each leaflets close to each other; pseudo-indusia 1.5–2 mm broad, up to 3 mm long.

T h a i l a n d.— NORTHERN: Chiang Mai (Mae Klang), Lampang, Tak (type); SOUTH-WESTERN: Kanchanaburi (Sai Yok); PENINSULAR: Surat Thani (Ko Phangan), Phangnga (Khao Katha Khwam, Khao Toei), Krabi (Ao Luek).

D i s t r i b u t i o n.— Tonkin and Cambodia.

E c o l o g y.— On dry slopes or in crevices of limestone caves in light shade at low altitudes.

N o t e.—This is a distinct species of the *A. philippense* group, and has affinity also to *A. capillus-junoris* in China. The form of leaflets, which is the most important key character, is somewhat variable: Khao Katha Khwam plant is a smaller plant with leaflets up to 8 mm long and wide; Khao Toei plant is thin in texture and the distal end of leaflets being round, and is probably a specimen of young plant; Sai Yok plant is again different in its leaflets which are orbicular-subdeltoid in outline and are up to 2.2 cm long and wide; it is more like *A. calillus-junoris,* but different in deep cleft round sori that are at most 3 mm long.

7. Adiantum siamense Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 20; 1971.

Rhizome short, erect, scaly at apex; scales linear, up to 2.5 mm long, at most 0.1 mm broad, nearly black with brownish edge when young. *Stipe* up to 6 cm long, dark castaneous to nearly black, polished, glabrous except for the scaly base. *Lamina* narrowly lanceolate, up to 20 by 3.5 cm; rachis thin, glabrous, sometimes

prolonged and proliferous; pinnae more than a dozen pairs, with stalks of 1–1.5 mm long; middle ones the largest, straight or curved in dimidiate lower edges, subtruncate in inner edge, forming angles of 60–90° to lower edge, round and lobed at apex, straight or slightly round and lobed at upper edge, 1.5 by 1 cm; lower ones smaller and more or less deflexed; lobes round or quadrangular, sinus to $\frac{1}{4}$ way between upper and lower edges, the middle sinus sometimes to half-way towards costa; softly papyraceous, glaucous beneath, sparsely hairy with 2–4 celled, brown, rather setose hairs up to 1.5 mm in length; veins dense, distinct on upper surface. *Sori* to seven for each leaflet, one for each lobe, separated from the next by sinus; indusia narrow, up to 2 mm long, 0.5 mm broad.

T h a i l a n d.— PENINSULAR: Nakhon Si Thammarat (Thung Song, type).

D i s t r i b u t i o n.— Endemic.

E c o l o g y.—On limestone cliffs in light shade at low altitudes near Thung Song, known only in this locality.

8. Adiantum capillus-veneris Linn., Sp. Pl.: 1096. 1753; Bedd., Handb.: 84. 1883; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 185. 1940, cum var. *laciniatum;* Holtt., Rev. Fl. Malaya 2: 600. f. 352. 1955; Dansk Bot. Ark. 23: 244. 1965.

Rhizome short, creeping, densely covered with scales; scales entire, narrow, brown, up to 3 mm long. *Stipe* bright blackish-purple to nearly black, glabrous except sparsely scaly basal part, 3–8 cm long. *Lamina* oblong-subdeltoid or narrower, round at apex, 5–12 by 3–5 cm, bipinnate; rachis slender, not prolonged, perfectly glabrous throughout; pinnae distinctly stalked, basal ones the largest, with a few pairs of leaflets, subtriangular, cuneate at base, up to 4 by 3 cm, the upper with a single leaflet almost the same as those of basal pinnae; leaflets with short but distinct stalks, fan-shaped, up to 1.5 cm long and wide; two basal edges entire, straight or a little recurved, forming less than right-angle; distal margin round, more or less lobed, sinus shallow or to almost the base of leaflets; lobes round, oblong or spatulate, round or subtruncate at subentire apex, softly herbaceous, or thinner; veins dichotomous, not raised, glabrous throughout. *Sori* round or a little elongate.

T h a i l a n d.— NORTHERN: Chiang Mai (Mae Ping Rapids), Lampang, Tak (Lan Sang); NORTH-EASTERN: Loei (Si Than); CENTRAL: Saraburi (Muak Lek); SOUTH-WESTERN: Kanchanaburi (Erawan Falls), Prachuap Khiri Khan (Ta Mong Lai); PENINSULAR: Chumphon.

D i s t r i b u t i o n.— Tropical, subtropical, and warm temperate regions throughout the world (type from S. Europe).

E c o l o g y.— In muddy crevices of cliffs or on mossy rocks by streams usually in spray in light shade at low altitudes.

V e r n a c u l a r.— Phak waen han (ผักแว่นหัน) (Eastern); kut pha (กูดผา) (Northern); foen kan dam (เฟินก้านดำ) (Central); Venus Hair, Maiden-hair Fern.

9. Adiantum flabellulatum Linn., Sp. Pl.: 1095. 1753; Bedd., Handb.: 88. 1883; C Chr.,Bot. Tidsskr. 32: 347. 1916; Tard. & C. Chr.in Fl. Gén. I.- C. 7(2): 186. 1940; Holtt., Rev. Fl. Malaya 2: 603. f. 354. 1955; Ching, Acta Phytotax. Sin. 6: 326. 1957. — *Adiantum bonii* Christ, J. Bot. 8: 150. 1894; Bot. Tidsskr. 24: 106. 1901, p. p.

Rhizome short, erect or ascending, or rarely creeping, bearing a dense tuft of fronds, covered with scales; scales linear, a little broader at basal portion, entire, 8 mm long, shining brown, concolorous. *Stipe* distinctly grooved on upper surface, bright blackish-brown to nearly black, scales on basal portion, hairy in grooves and glabrous elsewhere, 10–30 cm long, but sometimes up to 50 cm. *Lamina* pedate or tripinnate with a few pairs of bipinnate pinnae, up to 20 by 25 cm; upper pinnae and pinnules of the large pinnae similar, pinnate with more than 10 pairs of leaflets, linear, about 10 by 2 cm; rachis (of fronds, of pinnae and of pinnules of larger pinnae) like the upper part of stipe, distinctly grooved on upper surface, grooves decurrent to those of stipe, densely pubescent; leaflets fan-shaped, distinctly stalked with stalks densely hairy on upper surface; two basal edges forming broad cuneate base, up to 1.5 by 1.3 cm; distal margin round, serrate, rarely lobed, thin but firm, surfaces quite glabrous; veins not raised. *Sori* round to elongate, up to 5 mm long, a few to each leaflet.

T h a i l a n d.— NORTHERN: Chiang Mai (Mae Rim, Doi Chiang Dao), Phitsanulok (Thung Salaeng Luang, Salaeng Haeng); NORTH-EASTERN: Loei (Phu Kradueng); EASTERN: Chaiyaphum; SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Phetchaburi; PENINSULAR: Chumphon (Tha Ko).

D i s t r i b u t i o n.— India, Burma, SW. and S. China (type), Tonkin, Taiwan, throughout Malesia, and northwards to southern edge of Japan.

E c o l o g y.— On humus-rich ground in rather open forests at medium altitudes.

10. Adiantum stenochlamys Bak.,Ann. Bot. 5: 209. 1891; Tard. & C. Chr.in Fl. Gén. I.- C. 7(2): 187. 1940; Holtt.,Rev. Fl. Malaya 2: 602. f. 353. 1955; Ching, Acta Phytotax. Sin. 6: 328. 1957; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 50. 1968. — *Adiantum fragiliforme* C.Chr., Bot. Tidsskr. 32: 347. 1916. — *Adiantum*

suborbiculare v.A.v.Ros., Bull. Dept. Agric. Ind. Neerl. 18: 11. 1908; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 3. 1929. Fig. 16.5.

Close to *A. flabellulatum,* but differs in: stipe shorter, frond perfectly glabrous except for scaly rhizome and basal part of stipe, reflexed flaps of sori short-reniform, 5–8 to each pinnule.

T h a i l a n d.— PENINSULAR: Surat Thani (Ko Tao, Ko Phangan), Songkhla (Khao Khieo), Satun (Tarutao, Pulo Besi, Adang).

D i s t r i b u t i o n.— Indochina (type), Malaya, Borneo and Philippines.

E c o l o g y.— On wet rocks in forests usually at low altitudes near sea.

20. VITTARIACEAE

Seven or eight genera are usually referred to this family, and three of them are native to Thailand. Owing to the similarity of the frond-construction, it is rather difficult to recognize the specific differences in this family, and the classification is still far from complete.

KEY TO THE GENERA

1. Frond not grass-like, costa incomplete or wanting. Sori usually in more than two rows (or sometimes in two rows in *A. winitii),* often reticulate **1. Antrophyum**
1. Frond linear, costate. Sori in one or two rows
  2. Lateral veins anastomosing; texture coriaceous **2. Vittaria**
  2. Lateral veins simple; texture thinner **3. Vaginularia**

1. ANTROPHYUM

Kaulf., Enum.: 197. 1824; Copel., Gen. Fil.: 223. 1947.

Rhizome short-creeping, densely covered with clathrate scales. Frond broadly lanceolate or broader, rarely forked at apex; costa wanting or rarely partial; veins forming large elongate areoles without included veinlets. Sori elongate along veins, sometimes reticulate.

About 40 species in the Old World tropics, from Africa to Polynesia. As usually diagnosed *Antrophyum* is distinct from *Vittaria,* but the presence of such dwarfed species as *A. winitii* obscures the difference.

KEY TO THE SPECIES

1. Small plants; frond up to 3 cm long, 2 mm broad, forked at apex **1. A. winitii**
1. Plants more than 5 cm high, not forked at apex
  2. Paraphyses ribbon-like or capitate, not filamentous
    3. Paraphyses ribbon-like **2. A. stenophyllum**
    3. Paraphyses capitate
      4. Frond broadly lanceolate, acute at apex **3. A. parvulum**
      4. Frond obovate, distinctly cuspidate at apex **4. A. obovatum**
  2. Paraphyses filamentous **5. A. callifolium**

1. Antrophyum winitii Tagawa & K.Iwats., Acta Phytotax. Geobot. 23: 176. f. 13. 1969. Fig. 17. 1.

Rhizome short, erect or ascending, bearing a tuft of fronds, densely scaly; scales gradually narrowing from base towards hair-like apex, 2–3 by about 0.3 mm, distinctly clathrate with dark brownish to nearly black internal cell-walls, the margin appearing toothed due to thickening of internal cell-walls. *Frond* linear, up to 3 cm long, 2 mm broad, broadest at $\frac{1}{4}$ to $\frac{1}{4}$-way from apex, gradually narrowing towards base, the stipe not distinct, apex forked, or rarely forked twice, forming acute teeth usually unequal in size, sinus triangular, about 0.5 mm in depth; leathery, glabrous; costa not distinct, veins forming areoles. *Sori* linear, in longitudinal furrows, usually in one row near the margin on both sides of fronds; paraphyses many, ribbon-like, dark red.

T h a i l a n d.— NORTHERN: Chiang Rai (type).

D i s t r i b u t i o n.— Endemic; known by a single collection : WINIT 1114 (SING).

E c o l o g y.— Gregarious on bark of trees in semi-evergreen jungle at 520 m alt.

2. Antrophyum stenophyllum Bak. Kew Bull. 1898: 233; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 21. 1971. — *Antrophyum* sp.: Holtt., Dansk Bot. Ark. 20: 34. 1961.

Rhizome short, creeping, bearing close fronds, densely scaly throughout; scales oblong-lanceolate, long-acuminate at apex, serrate, about 2.5 by 0.8 mm, dark brown, more or less clathrate with dark cell-walls. *Stipe* indistinct. *Frond* narrowly oblanceolate, widest in apical $\frac{1}{3}$, gradually narrowing towards acute but not long-tailed apex, long-attenuate towards rhizome, up to 6.5 cm long, 7 mm broad; costa and veins hardly visible on both surfaces. *Sori* reticulate, immersed in grooves which are more or less raised on upper surface; paraphyses ribbon-like, curled, brown to darker.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Suthep).

D i s t r i b u t i o n.— Yunnan (type).

E c o l o g y.— Epiphytic by small streams in dense forests at about 1000 m alt.

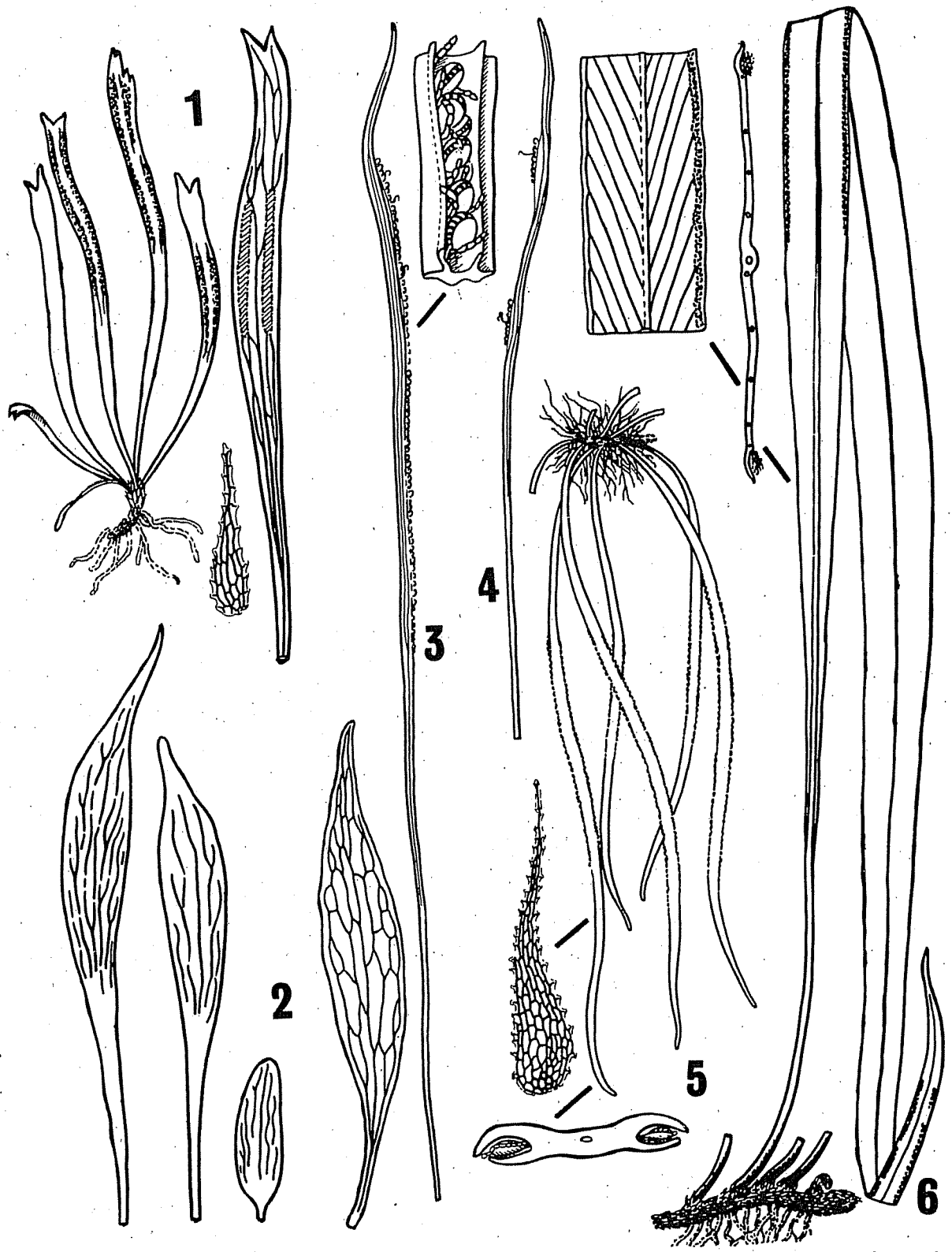

Figure 17. 1: *Antrophyum winitii* (drawn from the isotype specimen); plant (left), x 2; venation and soral position (right), x 4; scale (below), x 20. 2: *Antrophyum parvulum*; three types of fertile leaves (left), x 0.5; venation (right), natural size. 3: *Vaginularia paradoxa*; fertile frond, x 3; part of sori (top), x 20. 4: *Vaginularia trichoidea*; fertile frond, x 3. 5: *Vittaria sikkimensis*; plant, natural size; scale, x 15; cross section of leaf (bottom), x 20. 6: *Vittaria amboinensis*; plant, x 0.5; cross section of leaf, x 4; venation and sori, natural size.

3. Antrophyum parvulum Bl., En. Pl. Jav.: 110. 1828; Holtt., Rev. Fl. Malaya 2: 605. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 111. 1967. — *Antrophyum reticulatum* var. *parvulum* (Bl.) Bedd., Handb.: 403. 1883. Fig. 17.2.

Rhizome short, creeping, bearing a mass of roots and several fronds, densely scaly; scales very narrowly subtriangular, gradually narrowing towards caudate apex, greyish-brown, clathrate, irregularly toothed at margin, up to 5 by 1 mm. *Stipe* up to 3 cm long, indistinctly merging with the basal portion of frond; sparsely scaly, green. *Frond* oblanceolate, broadest above middle, acuminate to caudate at apex, gradually narrowing downwards to narrowly cuneate base and decurrent to stipe forming very narrow wings, up to 10 cm or more long, 2 cm broad, leathery, green to paler; costa distinct only in the lowest portion of fronds, veins copiously reticulate without included veinlets. *Sori* linear, or reticulate along the veins; paraphyses club-shaped.

Thailand.— NORTHERN: Chiang Mai (Doi Chiang Dao), Lamphun (Doi Khun Tan); NORTH-EASTERN: Loei (Phu Kradueng); PENINSULAR: Trang (Khao Chong), Yala (Bannang Sata).

Distribution.— Not precisely known, but perhaps wide in Malesia (type from Java). The Thai and Malayan plants accord very well with those of Java and Borneo. Long known from Taiwan and the Ryukyus.

Ecology.— On mossy tree-trunks or on moist muddy rocks in dense evergreen forests.

Note.— Usually on limestone in Malaya and Taiwan, but in Thailand epiphytic or on non-calcareous rocks.

4. Antrophyum obovatum Bak. Kew Bull. 1898: 233; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 202. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 111. 1967.

Rhizome short-creeping, bearing several fronds in a tuft, densely scaly; scales linear, gradually narrowing from base towards tailed apex, up to 7 by 1 mm, dark brown, densely toothed at margin. *Stipe* up to 8 cm long, dark green to dark brown, scaly in lower part. *Frond* obovate, broadest at about $\frac{1}{5}$ part from apex, cuspidate at apex, gradually narrowing downwards to narrowly cuneate base, up to 15 by 6 cm, entire but cartilagineous at margin, coriaceous to leathery, green, glabrous; costa indistinct, veins copiously anastomosing. *Sori* linear, in shallow furrows, usually anastomosing along veins; paraphyses short, club-shaped.

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

Distribution.— N. India, China (type), Indochina, Taiwan, and as far north as Japan.

Ecology.— On mossy tree-trunks in lower montane forests at about 1500 m alt.

5. Antrophyum callifolium Bl., En. Pl, Jav.: 111. 1828; Fl. Jav. Fil.: 83. t. 35. 1829; Tard. & C. Chr.in Fl. Gén. I.- C. 7(2): 204. 1940; Holtt., Rev. Fl. Malaya 2: 605. f. 356. 1955; Dansk Bot. Ark. 23: 244. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 89. 1965; 5: 110. 1967. — *Antrophyum reticulatum* auct. non (Forst.) Kaulf.: Bedd., Handb.: 401.f. 235. 1883; Christ, Bot. Tidsskr. 24: 104. 1901; C. Chr.,Bot. Tidsskr. 32: 348. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 7. 1929. — *Antrophyum semicostatum* auct. non Bl.: Bonap., Not. Pterid. 14: 63. 1923. — *Antrophyum* sp.: Holtt., Dansk Bot. Ark. 20: 34. 1961.

Rhizome short-creeping, bearing a few to several fronds in a tuft, scaly; scales narrowly subtriangular, gradually narrowing from base towards long-tailed apex, up to 5 by 0.8 mm, dark brown to blackish, sharply toothed at margin. *Stipe* short, indistinctly merging with the basal portion of frond, scaly.*Frond* variable in outline, usually oblong-lanceolate to broadly oblanceolate, gradually narrowing towards acuminate apex, gradually narrowing downwards, up to 30 by 8 cm, but soriferous even when less than 5 cm, leathery; costa distinct only in the lowest portion of fronds; veins more or less distinct, evenly anastomosing without included veinlets. *Sori* linear, anastomosing along veins, usually on the whole undersurface except for the lowest middle portion, i.e. near costa; paraphyses filamentous, long, numerous.

Thailand.— NORTHERN: Chiang Mai (Doi Suthep, Chiang Mai, Mae Taeng, Lamoo), Tak (Huai Krasa); NORTH-EASTERN : Nong Khai, Loei (Phu Luang, Phu Kradueng, Khao Huai Khae); CENTRAL: Nakhon Nayok (Khao Yai, Nang Rong falls); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao, Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Khao Sakan, Song Tho); PENINSULAR: Chumphon (Tha Ngo, Langsuan, Tako, Sapli), Surat Thani (Ko Tao, Ban Don, Ko Phangan), Nakhon Si Thammarat (Khiriwong, Khao Luang, Thung Song), Narathiwat (Sg. Padi), Phangnga (Thap Put), Phuket, Trang (Khao Chong), Satun, Yala (Bannang Sata).

Distribution.— Widely known from the tropics of the Old World (type from Java), although the exact boundary is not clear.

Ecology.— On muddy rocks or on mossy tree-trunks usually in dense evergreen forests at low or medium altitudes.

N o t e.— This is one of the so-called coenospecies defined only by the feature of filamentous paraphyses. The size and form of fronds is very variable.

2. VITTARIA

J.E. Smith, Mém. Acad. Turin 5: 413. pl. 9. f. 5. 1793; Copel., Gen. Fil.: 225. 1947.

Rhizome short-creeping, bearing a mass of roots and numerous close fronds, densely covered with clathrate scales. Frond linear, simple, entire, leathery; costa distinct to the apex of frond, with a few lateral veins forming areoles without included veinlets; sori in a single row at each side of costa, dorsal or in marginal flaps; paraphyses usually abundant.

Some 80 species are usually distinguished, though many of them are ill-defined, and can hardly be diagnosed on the construction of the fronds. The base of the classification of the Asiatic species was founded by Ching (Sinensia 1:175-192. 1931).

KEY TO THE SPECIES

1. Sori marginal or nearly marginal
   2. Costa flat or moderately raised above. Frond up to 2 cm broad
      3. Costa flat or hardly visible on lower surface
         4. Frond more than 20 cm long and 2.5 mm broad
            5. Frond more than 30 cm long, 0.5—2.3 cm broad. Sori immersed in two-lipped marginal grooves. Midrib more or less distinct above **1. V. elongata**
            5. Frond up to 40 cm long, 2.5—6 mm broad. Sori submarginal, immersed in grooves. Midrib hardly visible on both surfaces **2. V. ensiformis**
         4. Frond 3—12 cm long, up to 2 mm broad **3. V. sikkimensis**
      3. Costa more or less distinct on lower surface
         6. Frond 10—25 cm long, 2—3 mm broad **4. V. angustifolia**
         6. Frond up to 80 cm long, 1 cm broad **5. V. flexuosa**
   2. Costa strongly raised above. Frond usually more than 3 cm broad **9. V. scolopendrina**
1. Sori intramarginal, superficial. Frond more than 2 cm broad (except *V. taeniophylla)*
   7. Rhizome-scales dark brown to black, subulate, setose at margin. Margin of frond outside the sori less than 1.2 mm broad
      8. Rhizome-scales up to 7 mm long, blackish-brown to nearly black. Stipe about 15 cm long **6. V. amboinensis**
      8. Rhizome-scales 9—15 mm long, greyish-brown, with crisped apical portion. Frond subsessile, stipe indistinct **7. V. taeniophylla**
   7. Rhizome-scales dense, crisped, brown to dark brown, hyaline, hardly setose at margin. Margin of frond outside the sori more than 1.2 mm broad **8. V. forrestiana**

1. Vittaria elongata Sw., Syn. Fil.: 109, 302. 1806; Bedd., Handb.: 404. f. 238. 1883; Christ, Bot. Tidsskr. 24: 104. 1901; Hosseus, Beih. Bot. Centr. 28(2): 366. 1911; C. Chr.,Bot. Tidsskr. 32: 348. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 7. 1929; Ching, Sinensia 1: 179. 1931; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 197. 1940; Holtt., Rev. Fl. Malaya 2: 614. f. 360. 1955; Dansk Bot. Ark. 20: 34. 1961, Seidenf., Nat. Hist. Bull. Siam Soc. 19: 87. 1958; Tagawa & K. Iwats., Southeast As. St. 5: 111. 1967; Acta Phytotax. Geobot. 23: 56. 1968.

Rhizome short-creeping, bearing fronds closely or up to 1 cm apart, 3—5 mm diam., very densely scaly throughout; scales linear, gradually narrowing from cordate base towards long-tailed apex, up to 1.2 cm or more long, 1 mm broad, greyish-brown to dark, distinctly clathrate, minutely toothed at margin. *Stipe* usually short, indistinct from the lower portion of frond, green to darker. *Frond* linear, variable in size, 0.5—2.3 cm broad, up to 60 cm or more long, gradually narrowing towards both ends, coriaceous to leathery; costa usually distinct above on the lower portion; veins more or less visible, anastomosing to form a row of elongate oblique areoles at each side of midrib. *Sori* immersed in marginal two-lipped groove, usually along the whole margin of frond.

Thailand. — NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao), Tak, Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Nong Khai, Loei (Phu Kradueng); EASTERN: Nakhon Ratchasima (Pak Thong Chai); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Wang Ka); PENINSULAR: Surat Thani (Ban Don, Ko Tao, Khun Thale, Ko Samui), Nakhon Si Thammarat (Khao Luang, Thung Song), Satun (Ko Tarutao), Narathiwat (Waeng), Yala (Khao Kalakhiri, Ban Chana, Bla Hat).

Distribution.— Tropics of the Old World generally (type from 'India orientalis'), north to Sikkim, Hainan and southern edge of Japan.

Ecology.— Pendulous on mossy tree-trunks in light shade to dense forests at low to medium altitudes.

Note.— This is another variable species. In Thailand this species is not very abundant, and rather variable in size and form of fronds, although at most 60 cm long and usually shorter than on the larger plants from other countries.

2. Vittaria ensiformis Sw., Ges. Nat. Fr. Berl. Neu. Schr. 2: 134. t. 7. f. 1. 1799; Holtt., Rev. Fl. Malaya 2: 613. f. 359. 1955; Dansk Bot. Ark. 20: 34. 1961. —*? Vitaria hainanensis* C. Chr. ex Ching, Sinensia 1: 182. pl. 1. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7 (2) : 198. 1940.

Rhizome short-creeping, slender, 0.7—1.5 mm diam., densely covered with a mass of roots, scaly throughout; scales linear, gradually narrowing from base towards tailed apex, up to 7 by 0.7 mm, dark brown to nearly black, clathrate, minutely toothed at margin. *Stipe* usually indistinct, narrowly winged throughout. *Frond* linear, up to 40 by 2.5—6 mm, leathery; costa indistinct below or hardly visible on the lower portion, other veins indistinct, the margin sometimes inrolled. *Sori* immersed in deep grooves almost at margin, usually elongate along both margin of fronds.

T h a i l a n d.— SOUTH-EASTERN: Chanthaburi (Makham), Trat (Huai Raeng, Ko Chang); CENTRAL: Krung Thep; PENINSULAR: Krabi (Ko Pu), Surat Thani (Ko Tao, Ban Don), Phangnga (Khao Suang), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong, Khao Khao), Phuket, Satun (Khuan Kalong, Boriphat Falls), Pattani (Khok Pho, Ban Sai Khao).

D i s t r i b u t i o n.— Tropics of the Old World (type from Mascarene Islands), the boundary is not certain.

E c o l o g y.— On tree-trunks usually in dense evergreen forests at low or medium altitudes.

N o t e.— Distinguished from the preceding species by obscure costa, unstalked frond as well as the soral grooves not being at the margin. The position of soral grooves is not stable, some being almost marginal as in the case of *V. elongata,* and some others on the lower surface of fronds close to the margin. The costa is invisible, though more or less raised in thinner fronds. Fronds are variable from very narrowly linear to those like *V. elongata,* from which larger plants with nearly marginal soral grooves are scarcely distinct.

3. Vittaria sikkimensis Kuhn, Linnaea 36: 66. 1869; Bedd., Handb.: 406. f. 239. 1883; Ching, Sinensia 1: 180. 1931; Tard. & C.Chr. in Fl. Gen. I. -C. 7(2): 198. 1940; Holtt., Dansk Bot. Ark. 20: 34. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 111. 1967. Fig. 17. 5.

Rhizome short-creeping, slender, 0.7—1.5 mm diam., bearing many fronds successively, densely scaly throughout; scales linear, gradually narrowing towards hair-pointed apex, up to 4 by 0.6 mm, greyish-brown, clathrate, toothed at margin. *Stipe* indistinct, green to darker, winged throughout. *Frond* very narrow, broadest in upper part, gradually narrowing towards acute apex, narrowing downwards, 3—12 cm long, up to 2 mm broad, thinly coriaceous; costa indistinct, the margin flat or a little inrolled; veins anastomosting to form narrow areoles. *Sori* immersed in distinct groove near the margin of fronds, occupying almost the whole margin except very top and the lowest portion.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Suthep, Doi Inthanon), Phetchabun (Phu Miang): NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng).

D i s t r i b u t i o n.— Sikkim (type), Yunnan and Tonkin.

E c o l o g y.— On mossy tree-trunks or on moist rocks in lower montane forests at 1000–1600 m alt.

4. Vittaria angustifolia Bl., En. Pl. Jav.: 199.1828; Holtt., Rev. Fl. Malaya 2: 610. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 111. 1967; Acta Phytotax. Geobot. 23: 56. 1968. — *Vittaria ensiformis* auct. non Sw.: Tagawa & K. Iwats., Southeast As. St. 5: 111. 1967.

Rhizome creeping, usually about 1.5 mm diam., bearing fronds rather sparsely, densely scaly throughout; scales narrow, gradually narrowing from base towards hair-pointed apex, up to 6 by 0.7 mm, fuscous, clathrate, minutely toothed at margin. *Stipe* short, green or dark at the very base. *Frond* linear, 8–20 cm long, to 2 mm or more broad, usually curved and pendulous, acute at apex, gradually narrowing downwards and merging into very narrow wings of stipe, leathery; costa visible on upper surface or hardly so, the margin flat or inrolled. *Sori* immersed in deep groove almost at margin of fronds, usually limited to the upper half.

T h a i l a n d.— SOUTH-EASTERN: Chanthaburi (Khao Soi Dao, Khao Sabap); PENINSULAR : Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Krabi (Phanom Bencha), Yala (Khao Kalakhiri, Bla Hat).

D i s t r i b u t i o n.— Throughout Malesia (type from Java), east to New Caledonia.

E c o l o g y.— On tree-trunks, usually on old bark of trees, or on muddy rocks in dense evergreen forests at medium to high altitudes.

N o t e.— Usually a handsome pendulous plant in dense forests. Small soriferous plants are often difficult to distinguish from the preceding species.

5. Vittaria flexuosa Fee, 3^{me} Mem.: 16. 1852; Ching, Sinensia 1: 187. 1931; Tard. & C. Chr. in Fl. Gen. I. C.7(2): 199. 1940; C. Chr.,Contr. U.S. Nat. Herb. 26: 333. 1931; Holtt., Rev. Fl. Malaya 2: 611. 1955; Dansk Bot. Ark. 23: 244. 1965; Tagawa & K. Iwats., Sothteast As. St. 5: 111. 1969. — *Vittaria lineata* auct. non Sw.: Bedd., Handb.: 407. 1883; E. Smith,J. Siam Soc. Nat. Hist. Suppl. 8: 7. 1929.

Rhizome short, up to 4 mm diam., bearing close fronds, densely scaly; scales linear, gradually narrowing towards hair-pointed apex, up to 5 by 0.7 mm, brown to dark brown, clathrate, minutely toothed at margin. *Stipe* narrowly winged throughout, dark at the very base. *Frond* linear, usually inrolled at margin in dried condition, 15–45 (–80) by up to 1 cm, gradually narrowing towards long-tailed apex, gradually narrowing downwards into the narrow wings of stipe; costa strongly raised to the apex on lower surface, indistinct on upper surface, pale. *Sori* in submarginal grooves usually at $\frac{1}{5} - \frac{1}{4}$ way from margin to midrib, sometimes not wholly immersed, usually on upper half of frond except the very apex.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Chang), Chiang Mai (Doi Phahom Pok, Doi Suthep, Doi Inthanon), Lampang (Doi Luang), Tak (Ban Musoe), Phetchabun (Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Khao Kuap); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— E. Himalaya (type) to SW. and S. China and Indochina, north to Japan, south to Malaya.

E c o l o g y.— On tree-trunks or moist rocks usually in lower montane forests at more than 1000 m alt.

N o t e.— Distinguished by the raised costa on the lower surface of frond and the sori being constantly superficial, usually not on the very margin of frond.

6. Vittaria amboinensis Fee, 3^{me} Mém.: 14. t. 1. f. 1. 1852; Bedd., Handb.: 407. 1883; Ching, Sinensia 1: 189. 1931; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 199. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 112. 1967. — *Vittaria scolopendrina* auct. non (Bory) Thwait.: Holtt., Dansk Bot. Ark. 20: 34. 1961. Fig. 17. 6.

Rhizome short, about 3.5 mm diam., bearing a mass of roots, densely scaly throughout; scales subulate at apex, up to 7 by 1 mm, dark brown to blackish, clathrate, minutely toothed at margin. *Stipe* distinct, up to 15 cm or more long, dark castaneous on the lower portion, very narrowly winged almost to the very base. *Frond* linear-lanceolate, gradually narrowing towards acuminate apex, gradually narrowing downwards into wings of stipe, up to 70 cm long including stipe, up to 2 cm or more broad, the margin flat or sligtly recurved, coriaceous or thicker; costa distinctly raised on lower surface, distinct on upper surface; veins hidden. *Sori* superficial, submarginal, the submarginal laminar portion less than 1 mm wide, almost throughout the margin of frond except for the apex and lowermost portion.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Suthep), Tak (Ban Musoe); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); EASTERN: Nakhon Ratchasima (Khao Khieo); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Krabi (Phanom Bencha), Trang (Khao Chong).

D i s t r i b u t i o n.— Sikkim, Burma, Indochina, Amboina (type) and Java.

E c o l o g y.— On tree-trunks usually in evergreen forests at medium or high altitudes.

7. Vittaria taeniophylla Copel., Phil. J. Sci. 1. Suppl. 2: 157. 1906; Ching, Sinensia 1: 191. 1931. — *Vittaria doniana* Mett. ex Hieron., Hedwigia 57: 204. 1915; Ching, Sinensia 1: 192. 1931. — *Vittaria amboinensis* auct. non Fée: Ching, Sinensia 1: 189. 1931, as to Thai plant.

Similar to *V. amboinensis* but different from it in: rhizome scales up to 15 by 0.7 mm, greyish-brown, distinctly clathrate, thin, the apical portion crisped; stipe not distinct; frond decurrent nearly to the base of stipe, narrow, 0.8—2 cm broad.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Inthanon).

D i s t r i b u t i o n.— NE. Himalaya, Burma, Yunnan, Taiwan and the Philippines (type).

E c o l o g y.— On tree-trunks at about 2200 m alt., known by a single collection in Thailand: GARRETT 465 (K).

8. Vittaria forrestiana Ching, Sinensia 1: 191. pl. 6. 1931; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 200. f. 24, 1—2. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 112. 1967.

Rhizome short-creeping, about 3.5 mm diam., bearing a mass of roots and close fronds, densely scaly throughout; scales narrow, gradually narrowing from round base towards long-tailed apex, up to 1 cm or more long, 1.5 mm broad, dark brown, clathrate, minutely toothed at margin. *Stipe* short if any, winged throughout, not very distinct from the lower portion of frond, dark at the base. *Frond* linear-lanceolate, broadest at $\frac{1}{3}$ from apex, gradually attenuate towards both ends, caudately long-acuminate at apex, up to 30 by 2.5 cm; coriaceous or thicker, the margin more or less revolute in dried specimens; costa raised on the lower surface, visible on upper surface, veins obscure. *Sori* superficial, in a single row at each side of costa, marginal laminar portion outside the sori more than 1.5 mm broad.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Hua Mot, Doi Inthanon).

D i s t r i b u t i o n.— Yunnan (type), Indochina, and as far north as southern tip of Japan.

E c o l o g y.— On mossy tree-trunks in evergreen forests at high altitudes.

9. Vittaria scolopendrina (Bory) Thwaites & Hook., En. Pl. Zeyl.: 381. 1864; Bedd., Handb.: 408. f. 241. 1883; Ching, Sinensia 1: 189. 1931; Holtt., Rev. Fl. Malaya 2: 611. 1955. — *Pteris scolopendrina* Bory, Voy. 2: 323. 1804.

Rhizome short, creeping, about 4 mm diam., bearing close fronds, scaly; scales narrow, gradually narrowing towards hair-pointed apex, about 7 by up to 0.5 mm, dark brown to nearly black, clathrate, entire. *Frond* sessile, about 80 by 3 cm, gradually narrowing towards both ends; costa distinctly raised on upper surface, flat or slightly grooved beneath, chartaceous, fleshy, glabrous; veins ascending, usually visible on upper surface. *Sori* in shallow groove just inside the margin, up to 2 mm broad, the sterile margin usually inrolled to cover the sori; paraphyses branched, darkbrown.

T h a i l a n d.— PENINSULAR: Satun (Khao Khieo range), Nakhon Si Thammarat (Khiriwong).

D i s t r i b u t i o n.— Widely distributed in the Old World tropics, Madagascar to Samoa, but not found in Indonesia; type from Bourbon.

E c o l o g y.— On tree-trunks in evergreen forests at medium altitudes.

3. VAGINULARIA

Fée, Gen. Fil.: 50, 1851; Copel., Gen. Fil.: 226. 1947.

Rhizome filiform, short, bearing numerous filamentous fronds; rhizome scales narrow, distinctly clathrate, minutely toothed at margin. Frond very narrow, with a costa and a few lateral veins; veins all free; texture usually thin. Sori linear, usually in one row on lower surface of frond, sometimes protected by the narrow indusial flap attached along costa; paraphyses with swollen or club-shaped terminal cells.

Vaginularia differs from *Vittaria* by its free venation, but no areoles can be formed on the narrow frond of *Vaginularia*. The discriminating feature seems, therefore, to be correlated with the reduction in the size of fronds. This reduction proceeds further in *Monogramma*, in which no lateral veins are formed on the extremely narrow lamina. *Monogramma* is not represented in Thailand but *M. dareiformis* is found in Malaya. There are 6 species of *Vaginularia* s.str., only 2 species in Thailand.

KEY TO THE SPECIES

1. Frond very narrow, up to 0.5 mm broad. Sori continuous, rarely interrupted **1. V. paradoxa**
1. Frond filamentous, at most 0.3 mm broad. Sori at most 5 mm long, one to a few on a frond **2. V. tricholdea**

1. Vaginularia paradoxa (Fée) Mett., Ann. Lugd. Bat. 4: 174. 1869. — *Pleurogramma paradoxa* Fée, 3^{me} Mém.: 38. t. 4. f. 4. 1852. — *Monogramma paradoxa* (Fée) Bedd., Ferns Br. Ind. Suppl.: 24. 1876; Handb.: 375. f. 214. 1883; Holtt., Dansk Bot. Ark. 20: 34. 1961. Fig. 17. 3.

Rhizome short, slender, 0.3 mm diam., bearing close-set fronds, scaly throughout; scales narrowly subtriangular, hair-pointed, up to 2 mm or more long, 0.4 mm broad, dark brown, clathrate, minutely toothed at margin. *Stipe* not distinct. *Frond* very narrowly linear, up to 12 cm by 0.5 mm with a costa and several lateral veinlets; texture thin. *Sori* in a single row on the frond underneath, long-continuous or rarely interrupted.

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

Distribution.— Ceylon, throughout Malesia to Melanesia.

Ecology.— On trunks of old trees in dense evergreen forests at medium altitudes.

Vernacular.— Nuat mai (หนวดไม้) (Peninsular).

2. Vaginularia trichoidea Fée, 3^{me} Mém.: 54. 1852; Tagawa & K. Iwats., Southeast As. St. 3(3): 89. 1965; 5: 112. 1967. — *Monogramma trichoidea* (Fée) J. Smith ex Hook. & Bak. Syn. Fil. 375. 1868; Holtt., Rev. Fl. Malaya 2 : 616. f. 362. 1955. Fig. 17.4 .

Rhizome slender, about 0.2 mm diam., bearing close-set fronds, scaly throughout; scales narrowly subtriangular, hair-pointed, up to 2 by 0.4 mm, brown, clathrate, minutely toothed at margin. *Stipe* not distinct. *Frond* minute, filamentous, up to 6 cm long, 0.3 mm broad in sterile portion, thin, with a single costa and few short lateral veins in soriferous portion. *Sori* up to 5 mm long, 1.5 times broader than the sterile portion of frond, one to few on a single frond; paraphyses filamentous.

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

Distribution.— W. Malesia (type from the Philippines).

Ecology.— On muddy moist rocks by streams in dense evergreen forests at low or medium altitudes.

Vernacular— Nuat hin (หนวดหิน) (Peninsular).

21. PTERIDACEAE

Transferring *Pteridium* and *Histiopteris* to the Dennstaedtiaceae, there are three genera of Pteridaceae native to Thailand.

KEY TO THE GENERA

1. Sporangia in linear sori along margin of fronds — **1. Pteris**
1. Sporangia not in sori, scattered all over lower surface
  2. Mangrove ferns; veins copiously anastomosing — **2. Acrostichum**
  2. Epiphytic ferns; veins forming costal areoles, the other veins all free — **3. Stenochlaena**

1. PTERIS

Linn., Sp. Pl.: 1073. 1753; Gen. Pl.: 560. 1754; Copel., Gen. Fil.: 60. 1947.

Rhizome usually short, erect or creeping, scaly; scales usually small, concolorous or bicoloured with pale ferrugineous edges. Stipe, rachis and costa distinctly grooved on upper surface, the edges distinct, usually spinose on costa, the grooves decurrent into those in the next order. Frond in most cases bipinnatisect in opposite pairs, or in some cases simple, pinnate, tripartite, each basal pinna or branch with a pinnatisect or bipinnate branch; pinnatisect pinnae or pinnules usually bearing terminal lobes like the lateral ones or longer; veins pinnate in plan, in some species with costal and costular areoles, the others free except for the soral commissure, basal branch sometimes arising directly from costa. Sori continuous along margin of ultimate segments, indusiate; indusia formed by reflexed margin of lobes, usually transparent, glabrous.

A large variable genus, with most of its 250 species in tropical and subtropical regions. Among the 29 species in Thailand the polymorphic *P. biaurita* and the group of *P. cretica* need further study.

KEY TO THE SPECIES

1. Frond simple to trifoliolate, or tripartite
  2. Frond tripartite, each branch deeply bipinnatifid
    3. Veins free except as united in soral commissure — **3. P. longipes**
    3. Veins anastomosing
      4. Veins forming costal areoles only, other veins free — **4. P. wallichiana**
      4. Veins forming copious anastomoses, with costal and costular areoles as well as a row of areoles outside costal ones — **5. P. tripartita**

2. Frond simple or trifoliolate with simple linear branches **29. P. stenophylla**
1. Frond pinnate or pinnately decompound
5. Pinnae all simple, entire or at most serrate at apical margin, basal pinnae not branched
6. Lateral pinnae 8—12 mm broad, lower ones gradually much reduced **1. P vittata**
6. Lateral pinnae 1.5—3 cm broad, the lowest ones the longest or a little shorter than the next above **28. P. venusta**
5. Pinnae deeply lobed, or each of the lowest pinnae with one or a few branches near base
7. Frond distinctly dimorphic, pinnae of sterile frond deeply lobed, lateral pinnae of fertile frond with a single basiscopic branch only **2. P. ensiformis**
7. Frond not or hardly dimorphic, or fertile and sterile fronds differing in length of stipe and in width of pinnae or lobes, not in character of lobing
8. Veins anastomosing to form regular costal aceoles **6. P. biaurita**
8. Veins free except those united apically by soral commissure
9. Pinnae deeply lobed
10. Lobes of pinnae few, or rather irregularly arranged
11. Pinnae with a few lobes on both sides **11. P. heteromorpha**
11. Lobes of apical part of lamina widely spaced; connected by a broad uniform wing on either side of costa **15. P. dalhousiae**
10. Lobes of pinnae many, regularly arranged
12. Pinnules only on basiscopic side of costa **12. P. semipinnata**
12. Pinnules both sides of costa
13. Veins indistinct, with numerous short superficial lines between them; lateral pinnae 1—3 pairs
14. Lateral pinnae 1—2 pairs, basal pinnae with a pinnatisect branch almost the same as second basal pinna **16. P. grevilleana**
14. Lateral pinnae 2—3 pairs, pinnatisect branch of basal pinnae absent or much smaller than second pinna **17. P. phuluangensis**
13. Veins more or less distinct, short lines between veins lacking; pinnae usually more than 3 pairs
15. Stipe stramineous
16. Basal branches of veins meeting with those of the opposite groups at bottom of sinus **7. P. linearis**
16. Basal branches of veins running to the margin of segments above sinus
17. Lowest pinnae bearing no large basal pinnules **8. P. longipinnula**
17. Lowest pinnae bearing one or more larger pinnatisect basiscopic pinnules
18. Lateral pinnae up to 4 pairs **9. P. subquinata**
18. Lateral pinnae 4—7 pairs **10. P. sp.**
15. Stipe shining, castaneous or deeply purplish at least in lowest part
19. Plant more than 120 cm tall
20. Ultimate lobes round to obtuse or moderately acute at apex, 2.5—4.5 mm broad, sparsely hairy on upper surface of lamina **13. P. blumeana**
20. Ultimate lobes moderately acute to acute at apex, 5—7 mm broad, laminar surface glabrous **14. P. mertensioides**
19. Plant usually less than 100 cm tall
21. Lateral pinna 4—6 cm wide, with broadly winged stalks **18. P. tokioi**
21. Lateral pinna 1.5—4.5 cm wide
22. Scales concolorously brown, entire **20. P. bella**

22. Scales dark brown with pale ferrugineous edges
23. Basal pinnae without large basal pinnules; terminal pinnules distinct, not lobed, up to 5 cm long; costa rather densely hirsute beneath **19. P. decrescens**
23. Basal pinnae usually bearing larger pinnatisect basiscopic pinnules like upper lateral pinnae; pinnules becoming smaller towards apex forming no distinct terminal pinnules; costa pubescent or glabrescent beneath
24. Stipe castaneous throughout; lateral pinnae 2—5 pairs **21. P. nepalensis**
24. Stipe purple to castaneous at least at base; lateral pinnae usually 5—9 pairs, rarely less in number
25. Ultimate segments round at apex, the margin parallel towards base; indusia membranous, transparent; lowland plants **22. P. asperula**
25. Ultimate segments moderately acute at apex, dilated towards base; indusia thin but firm, pale brown; high mountain plants **23. P. aspericaulis**

9. Pinnae at most toothed, each basal pinna with one or a few basiscopic branches like pinnae; fertile pinnae narrower than sterile ones.
26. Sterile pinnae finely toothed throughout, 1—2 pairs below trifoliolate apical pinna **24. P. scabripes**
26. Sterile pinnae coarsely toothed towards apex, usually more than 2 pairs
27. Upper lateral pinnae broadly decurrent to rachis forming wings of the same breadth as lateral pinnae throughout rachis **25. P. multifida**
27. Rachis wingless except in the upper portion
28. Stipe stramineous or rarely castaneous; basal lateral pinnae without branches or with one only, up to 2 cm broad on sterile fronds **26. P. cretica**
28. Stipe more or less castaneous; basal lateral pinnae bearing one or two branches, 1.2—2.5 cm broad on sterile fronds **27. P. plumbea**

1. Pteris vittata Linn., Sp. Pl.: 1074. 1753; Tard. & C.Chr. in Fl. Gén. I.- C. 7(2): 143. 1939; Holtt., Rev. Fl. Malaya 2: 396. f. 230 1955; Dansk Bot. Ark. 20: 27. 1961; 23: 236. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 82. 1965; 5: 79. 1967. — *Pteris longifolia* auct. non Retz.: Bedd., Handb.: 106. f. 55. 1883; Christ, Bot. Tidsskr. 24: 106. 1901; C. Chr., Bot Tidsskr. 32: 348. 1916; Bonap., Not. Pterid. 14: 62. 1923.

Rhizome short, ascending, bearing a tuft of fronds, scaly; scales light brown, narrow, up to 5 mm long. *Stipe* up to 20 cm long, densely scaly on lower part, stramineous. *Lamina* imparipinnate, oblanceolate, widest at upper $\frac{1}{6}$ portion; pinnae simple, lower ones gradually becoming smaller downwards to mere auricles, middle or upper ones linear, nearly straight, up to 15 cm by 8—12 mm,

sessile and cordate at base, caudately long-acuminate at apex, serrate at non-soriferous margin; terminal pinnae usually much longer, up to 20 cm or more long, about 1 cm broad; rachis grooved on upper surface, minutely scaly; veins forked, free except when connected by soral commissure. *Sori* marginal, continuous along margin of pinnae; indusia thin, pale.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Kaeng Ka, Mae Klang), Mae Hong Son (Mae Sariang), Lampang, Tak (Lan Sang, Mae Sot, Doi Musoe); NORTH-EASTERN: Loei (Ban Nong Noen Thong); CENTRAL: Saraburi (Muak Lek); SOUTH-EASTERN: Chanthaburi, Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Erawan Falls, Song Tho, Chedi Sam Ong); PENINSULAR : Surat Thani (Ban Don), Phatthalung, Nakhon Si Thammarat (Ron Phibun), Phangnga (Thap Put), Songkhla, Trang, Satun, Yala (Bannang Sata).

D i s t r i b u t i o n.— Tropics and subtropics of the Old World (type from China), north to S.Japan.

E c o l o g y.— On rather wet sandy ground or on muddy rocks usually along rivers in shade below 800 m alt.

V e r n a c u l a r.— Kaching duphae (กะจิงดูแพะ) (Karen/ Northern); kut tat (กูดตาด), kut mak (กูดหมาก) (Northern).

2. Pteris ensiformis Burm.f., Fl. Ind.: 230. 1768; Bedd., Handb.: 107. 1883; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 4. 1929; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 149. 1940; Holtt., Rev. Fl. Malaya 2: 399. f. 231. 1955; Dansk Bot. Ark. 20: 27. 1961; 23: 235. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 79. 1967.

Rhizome short-creeping, bearing rather close fronds, about 5 mm diam., densely scaly; scales up to 4 by 0.7 mm, lanceolate with long tail, brown, entire. *Frond* distinctly dimorphic. *Sterile frond* : stipe 7 – 15 cm long, brown and scaly at base, stramineous upwards, grooved on abaxial surface; lamina oblong, acute at apex, tripinnatifid, about 15 by 7 cm; pinnae 2 – 5 pairs, opposite, with a few pairs of pinnules and large apical segments; pinnules simple to trifoliolate, the ultimate segments oblong to oblong-lanceolate, apex moderately acute or acuminate in larger ones, 1.5 – 4 (– 7) by 0.7 – 1 cm, minutely serrate at margin; veins ascending, forked, all free, firm, green. *Fertile frond* taller; stipe 20 – 55 cm long; lamina bipinnate at base, up to 30 by 20 cm; pinnae a few pairs, simple to trifoliolate, ultimate segments linear, 7 – 17 by 0.5 – 1 cm, caudately acuminate at apex, broadly cuneate to subtruncate at base, serrate at upper non-soriferous margin. *Sori* linear, submarginal, continuous almost from base to apex; indusia pale green.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Suthep, Kaeng Ka), Lampang, Tak (Lan Sang, Ban Na); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Khon Kaen (Pha Nok Khao), Nakhon Phanom; SOUTH-EASTERN: Chon Buri (Si Racha), Rayong (Ban Phe), Chanthaburi (Pong Nam Ron), Trat (Ko Chang); SOUTH-WESTERN: Uthai Thani (Kaen Pradu), Kanchanaburi (Klang Dong, Sai Yok), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Chumphon, Surat Thani (Ko Tao, Ko Samui), Nakhon Si Thammarat (Khao Luang, Chawang), Phatthalung, Pattani, Phangnga, (Ko Talibong, Khao Thong Thai), Krabi(Khao Nang Hong), Trang (Khao Chong), Satun, Yala (Bannang Sata).

D i s t r i b u t i o n.— Tropics of Old World, Ceylon (type) to Australia and Polynesia throughout Malesia, north to India, S. China, Indochina and the Ryukyus.

E c o l o g y.— On mountain slopes or on floor of usually tropical rain forests at low altitudes in Peninsular, or in dry evergreen forests at low to medium altitutdes in Northern to South-Eastern.

3. **Pteris longipes** D.Don, Prod. Fl. Nepal.: 15. 1825; Bedd., Handb.: 115. 1883; Tard. & C. Chr.in Fl. Gen. I. - C.7(2): 154. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3): 83. 1965; 5: 81. 1967.

Rhizome erect, sometimes more than 10 cm tall, bearing a few fronds in a tuft, scaly at apex; scales about 7 by 0.8 mm, concolorously brown to darker, entire. *Stipe* up to 1 m long, stramineous throughout, glabrescent upwards. lamina tripartite, middle branch longer, 35—55 cm long, up to 20 cm wide, deeply bipinnatisect, laterat branches smaller, up to 30 by 12 cm, bearing no secondary branch; pinnae linear-lanceolate, broadly cuneate at sessile base, caudately acuminate at apex, deeply pinnatisect nearly to costa, up to 10 cm long; fertile pinnae usually about 1.5 cm wide, sterile ones sometimes more than 2 cm; ultimate segments oblong, oblique, round to moderately acute at apex, serrate near tip, papyraceous, green, glandular hairy on upper surface; veins forked, all free, visible on both surfaces. *Sori* along margin of segment, from base nearly to apex; indusia brown, rather firm, up to 1 mm in breadth.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep), Phrae (Mae Sai), Tak (Ban Musoe); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n.— N. India (type), S. China, Tonkin and Taiwan, southwards to the Philippines.

E c o l o g y.— On mountain slopes usually in dense thickets in dry evergreen or lower montane forests at 700–1600 m alt.

N o t e.— In spite of the tripartite frond construction, this species has no close relationship to *P. wallichiana* as shown by the suberect rhizome, stramineous stipes, and large darker scales.

4. Pteris wallichiana Ag., Rec. Pterid.: 69. 1839; C. Chr., Contr. U.S. Nat. Herb. 26: 333. 1931; Tard. & C. Chr. in Fl. Gén. I. - C. 7(2): 160. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3): 83. 1965; 5: 81. 1967. — *Campteria wallichiana* (Ag.) Moore, Ind. Fil.: 221. 1861; Bedd., Handb.: 118. 1883.

Rhizome thick, short, erect, densely scaly at apex; scales oblong-subtriangrlar, up to 1 cm long, 4 mm broad at base, brown, concolorous, entire. *Stipe* thick, usually more than 1 m long, dark brown and scaly at base, pale castaneous or stramineous upwards, puberulous or glabrescent. *Lamina* tripartite, middle branch deeply bipinnatisect, up to 100 by 25 cm, lateral branches nearly as long as middle one, each bearing a large secondary bipinnatifid branch on lower side towards base, secondary branch sometimes with bipinnatifid branch; lateral pinnae up to 20 pairs in middle branch and about 15 in lateral branch, linear-lanceolate, caudately acuminate at apex, broadly cuneate at sessile base, up to 25 by 4.5 cm, deeply lobed almost to costa remaining wings about 1.5 mm broad; ultimate segments narrowly oblong, falcate, acute at apex, serrate at margin, herbaceous or thicker, yellow-green, glabrous; veins forming narrow costal areoles, the other veins forked, free, more or less visible on both surfaces. *Sori* continuous along margin from base to midway or sometimes to apical part of segments; indusia rather thick, pale green at outside and paler inwards, entire.

T h a i l a n d.— NORTHERN: Chiang Rai (Mae Kok), Chiang Mai (Doi Chiang Dao, Kaeng Ka, Doi Suthep, Doi Inthanon), Phrae (Mae Sai), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n.— N. India (type), S. China, Laos, S. Japan to Taiwan, south to Java, Celebes, and a variety in Samoa.

E c o l o g y.— Terrestrial in light shade or half-shaded places at low to medium altitudes.

V e r n a c u l a r.— Sam ngam (สามง่าม) (Eastern).

N o t e.— The distribution of this species in Malesia and Polynesia is rather doubtful for many specimens referred to this are *P. tripartita*. In appearance this, *P. longipes* and *P. tripartita* are similar to each other in having tripartite frond construction. In *Pteris,* however, the different types of frond have evolved in parallel in various species groups, and we cannot rely on this character alone for the recognition of phyletic affinity.

5. Pteris tripartita Sw., Schrad. J. Bot. 1800(2): 67. 1801; Bedd., Handb. Suppl.: 25. 1892; Christ, Bot. Tidsskr. 24: 107. 1901; C. Chr., Bot. Tidsskr. 32: 348. 1916; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 161. 1940; Holtt., Rev. Fl. Malaya 2: 408. f. 238. 1955. — *Pteris wallichiana* auct. non Ag.: Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 55. 1968.

Similar to *P. wallichiana* but distinctly different in venation: reticulation more copious forming one more row of areoles outside costal ones and a row of costular areoles as well; ultimate segments shorter, more sharply falcate, rounded at apex; stipe usually stramineous throughout or pale castaneous.

T h a i l a n d.— NORTHERN: Nakhon Ratchasima (Kathok); SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Phangnga (Thap Put), Yala (Betong, Kue Long Falls).

D i s t r i b u t i o n.— Very widely distributed in the tropics of the Old World (type from Java), southeast to Australia and Polynesia.

E c o l o g y.— Terrestrial, sometimes on calcareous gravelly slopes, at low altitudes.

6. Pteris biaurita Linn., Sp. Pl.: 1076. 1753; Christ, Bot. Tidsskr. 24: 106. 1901, as *P. quadriaurita* var.; C. Chr., Bot. Tidsskr. 32: 348. 1916; Contr. U.S. Nat. Herb. 26: 333. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 159. 1940; Holtt., Rev. Fl. Malaya 2: 407. f. 237. 1955; Dansk Bot. Ark. 20: 27. 1961; 23: 235. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 83. 1965; 5: 80. 1967. — *Campteria biaurita* (Linn.) Hook., Gen. Fil.: t. 65 A. 1841; Bedd., Handb.: 116. 1883. — *Pteris quadriaurita* var. *grevilleana* Christ, Bot. Tidsskr. 24: 106. 1901, p.p. excl. type. — *Pteris repandula* Link, Fil. Sp.: 56. 1841; Hosseus, Beih. Bot. Centr. 28(2): 366. 1911.

Rhizome short, erect, bearing a few fronds in a tuft, densely scaly at apex; scales up to 5 by 0.5 mm, nearly black margined by pale ferrugineous edges with toothed margin. *Stipe* up to 50 cm long, dark brown and scaly at apex, deeply bipinnatifid, up to 60 cm or more in length, 30 cm wide. *Pinnae* opposite or nearly so, up to 12 pairs, straight, ascending, linear-lanceolate, broadly cuneate at base, gradually narrowing towards acuminate apex, up to 20 by 5 cm, deeply lobed to $\frac{5}{6}$ way towards costa, basal pinnae bearing a long basiscopic pinnule just like lateral ones; ultimate segments oblong, falcate, rounded or moderately acute at apex, with rounded sinus, up to 7 mm broad, firm, green, glabrous; basal veinlets uniting with those of opposite groups forming arches close to costa, bearing a few branches on posterior side, the other veinlets forked, all free. *Sori* marginal, usually continuous along segments except at bottom of sinus and at apex; indusia thin, pale.

T h a i l a n d.— NORTHERN: Chiang Rai (Mae Lao, Doi Tung, Mae Kok, Pang Kia, Doi Pacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Wang Tao, Doi Suthep, Ban Mae Kom, Ban Nong Lu, Ban Yang), Lamphun (Doi Khun Tan), Phetchabun (Phu Miang), Tak (Huai Krasa, Mae Sot, Doi Musoe, Lan Sang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Wangka, Sai Yok, Kroeng Kawia); PENINSULAR: Surat Thani (Khao Luang), Nakhon Si Thammarat (Thung Song), Phangnga (Khao Thong Lang), Trang (Khao Chong).

D i s t r i b u t i o n.— Pantropic (type from tropical America).

E c o l o g y.— On mountain slopes in light shade or in lower montane forests at altitudes below 1400 m, usually a lowland species.

V e r n a c u l a r.— Kut hang khang (กูดหางค่าง) (Northern); phak kut khon khang phaya nak (ผักกูดขนคางพญานาค) (South-western).

N o t e.— The size and form of frond are very variable. The most important diagnostic feature is in the venation, anastomosing to form costal areoles.

7. Pteris linearis Poir. in Lamk., Enc. 5: 723. pl. 43. 1804; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 158. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 80. 1967.

Similar to the preceding species, differs in: basal pair of veinlets forked, the basiscopic branches meeting those of the opposite groups at bottom of sinus forming triangular loop, but seldom actually anastomosing.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Hua Mot, Sop Aep); SOUTH-WESTERN: Kanchanaburi (Wangka).

Distribution.— E. Africa (type from Bourbon) and tropical Asia generally, but accurate area is not certain.

Ecology.— On mountain slopes in lower montane forests in limestone region or in light shade at about 800–1800 m alt.

8. Pteris longipinnula Wall. ex Ag., Rec. Pterid.: 19. 1839; Bedd., Handb.: 112. 1883; Holtt., Rev. Fl. Malaya 2: 404. 1955.

Rhizome short, suberect, scaly; scales narrowly elliptic, distinctly bicoloured, the central portion dark brown, stiff, up to 3 by 0.4 mm, marginal portion pale brown, thin, composed of quadrangular cells and decaying from margin, 0.1 mm broad on each side. *Stipe* stramineous, slightly castaneous to purplish near base, 60–80 cm long, slightly grooved above and terete below, glabrous. *Lamina* oblong-ovate to ovate, acute at apex, about 45 by 30 cm, bipinnatisect; rachis hairy in grooves; lateral pinnae 3 pairs, all nearly equal in size and form, ascending, with short stalks 3–10 mm long, elliptic or narrowly so, round to broadly cuneate at base, the base decurrent to stalks, caudate at apex with apical segments up to 30 by 5 mm, up to 22 by 7.5 cm at middle portions; costa green, stramineous in dried specimens, grooved, bearing sparse slender spines; ultimate segments 20–25 pairs, narrowly elliptic, falcate, rounded at apex, up to 50 by 8 mm, the lower basal ones usually longer than upper ones, edges entire or undulate, thickened; veins simple or more commonly forked, basal posterior ones springing directly from costa. *Sori* linear, along margin of ultimate segments; indusia up to 0.7 mm broad, thin but firm, entire.

Thailand.— PENINSULAR: Surat Thani (Ban Don), Yala (Bannang Sata).

Distribution.— S. India, Malesia (type from Malaya). The circumscription and the range of this species are as yet not certain.

Ecology.— Terrestrial near marshes at low altitudes.

Note.— Holttum (1955) notes the variation of this species in Malaya in detail. Among the Thai specimens the Ban Don one accords very well with the typical form, while the other probably belongs to the variant b) of Holttum.

9. Pteris subquinata Wall. ex Ag., Rec. Pterid.:21. 1839; Tagawa & K. Iwats., Southeast As. St. 5: 80: 1967.— *Pteris quadriaurita* var. *subquinata* (Wall. ex Ag.) Bedd., Handb., Suppl.: 23. 1892.— *Pteris linearis* var. *fauriei* (Hieron.) C. Chr.& Tard., Not. Syst. 6: 140. 1938, p.p., excl. type; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 159. 1940, p.p. Fig. 18. 3.

Rhizome short, creeping or ascending, bearing a few close fronds, densely scaly at apex; scales linear, up to 7 by 0.7 mm, dark brown, entire, toothed at basal portion, firm. *Stipe* dark brown, scaly at base, stramineous and glabrescent upwards, 20—40 cm long, longer on fertile frond. *Lamina* ovate in outline, deeply bipinnatisect to bipinnate, up to 30 cm long and wide; rachis glabrescent, grooved on upper surface; lateral pinnae up to 4 pairs, opposite, oblong-lanceolate, more or less falcate, up to 20 by 6 cm, basal one or two pinnae bearing basal basiscopic pinnules just like upper lateral pinnae in size and form, terminal pinnae a little larger; pinnules linear-lanceolate, falcate, up to 30 by 7 mm in sterile and 5 mm in fertile ones, the base free or decurrent to the next ones with wings of costa less than 0.5 mm wide, firm, green; costa and costules glabrous beneath, veins once or twice forked, distinct on both surfaces. *Sori* continuous along margin of pinnules; indusia firm, lightbrown.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Inthanon).

D i s t r i b u t i o n.— Himalaya (type) to Laos (POILANE 1937).

E c o l o g y.— On rather dry slopes at foot of limestone cliffs in light shade at 1300—1600 m alt.

N o t e.— This distinct Himalayan species is not recorded from SW. China or from Upper Burma, but is common in Nepal. On Doi Chiang Dao it grows commonly in limestone gravel. It is difficult to give brief diagnostic features: rather wide pinnae less than 4 pairs, the rachis bending at the junction of the basal pinnae, every axis being pale green, and so on.

10. Pteris sp. aff. *P. longipinnula*; Tagawa & K. Iwats., Southeast As. St. 5: 83. 1967.

Rhizome short-creeping or ascending, bearing a few close fronds, densely scaly near apex; scales up to 2 by 0.5 mm, bicoloured with firm, dark brown, central portion and ferrugineous, pale brown edges. *Stipe* dark brown and scaly at base, stramineous and glabrescent upwards, 20—50 cm long. *Lamina* oblong-subdeltoid, 25—45 by 25—35 cm, deeply bipinnatisect to bipinnate, lateral pinnae up to 7 pairs, opposite or nearly so, linear-lanceolate, subtruncate at base, very shortly stalked in lower ones and sessile upwards, acute to caudately acuminate at apex, up to 25 by 5.5 cm, basal pinnae bearing large basiscopic pinnules like upper lateral pinnae, terminal pinnae like middle lateral pinnae; pinnules oblong-lanceolate, moderately acute at apex, decurrent to next ones with wings of costa less than 1 mm broad, up to 20 by 5 mm, papyraceous, deep green; rachis and costa minutely hairy or glabrescent beneath, veins visible on both surfaces. *Sori* continuous along margin of pinnules, usually at middle portion, about 1 cm or more long; indusia pale brown, herbaceous.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Inthanon).

E c o l o g y.— Terrestrial on floor of dense evergreen forests at about 2000 m alt.

N o t e.— This is a species close to *P. longipinnula* but smaller in size and much more delicate in texture. Stipe of this species is stramineous except for the dark brown basal portion, and the lateral pinnae are nearly opposite. The distal pinnules becoming smaller outwards, bearing no distinct apical ones.

11. Pteris heteromorpha Fée, Gen. Fil.: 127. 1852; Tard. & C. Chr. in Fl. Gén. I. - C. 7(2): 147. 1940; Holtt., Dansk Bot. Ark. 23: 235. 1965; Tagawa & K. Twats., Southeast As. St. 5: 82. 1967.— *Pteris cretica* var. *heteromorpha* (Fée) Bedd., Handb.: 106. 1883. Fig. 18. 1.

Rhizome short, erect, densely scaly at apex; scales linear, up to 5 mm long, concolorously brown, toothed at margin. *Stipe* stramineous or shining deep castaneous, 20 – 60 cm long. *Lamina* pinnate with irregularly lobed pinnae, usually broadly oblanceolate in outline but rather variable in form, 25 – 60 by 15 – 30 cm; rachis stramineous or deep castaneous, pubescent; lateral pinnae 3 – 8, simple and linear, rounded and sessile at base, entire, up to 20 by 8 – 10 mm, deeply lobed and rounded at sessile base, caudately acuminate at apex with unlobed apical portion, up to 25 by 7 cm, apical pinnae simple or irregularly lobed, up to 30 by 6 cm in lobed portion; ultimate segments irregular in size, form and position, usually long and regularly arranged on acroscopic side, sometimes dimidiate on basiscopic side and towards base and apex, usually more or less falcate, rounded to moderately acute, entire, 8 – 10 mm wide, length variable, softly leathery, green, pubescent on both sides; veins forked, more or less visible on both surfaces. *Sori* continuous along margin of simple pinnae or segments, interrupted only at apex of segments and at sinus; indusia white, thin but firm, narrow, less than 0.5 mm wide.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Sakon, Chiang Kham), Chiang Mai (Doi Chiang Dao, Doi Pae Poe, Doi Suthep, Sop Aep), Mae Hong Son (Bo Luang), Lampang, Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Sakon Nakhon; SOUTH-EASTERN : Chon Buri (Si Racha); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Kang Yang Falls) ; PENINSULAR : Krabi (Ban Keng).

D i s t r i b u t i o n.— Burma, Cochinchina, Luzon (type) and Celebes.

E c o l o g y.— On rather dry humus slopes in dry or evergreen forests at 500 – 900 m alt.

V e r n a c u l a r.— Kut on (กูดอ้อม) (Northern).

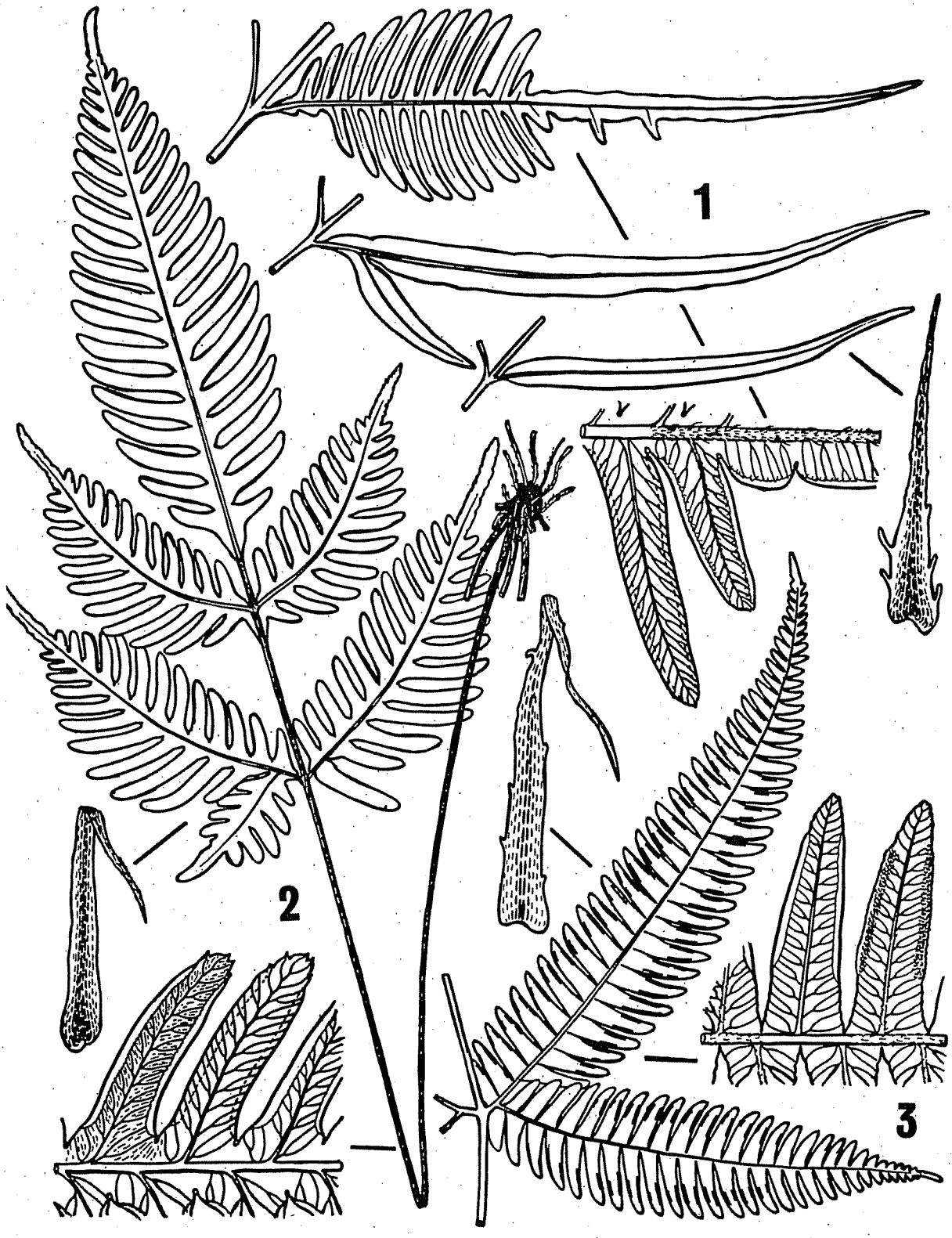

Figure 18. 1: *Pteris heteromorpha*; three types of pinnae, x 0.5; venation and indusia (below left), x 2; scale (below right), x 15. 2: *Pteris phuluangensis* (drawn from the holotype specimen); plant, x 0.5; scale, x 15; venation and indusia (below), left segment showing pseudoveinlets, x 2. 3: *Pteris subquinata*; the lowest pinna (left), x 0.5; scale (left above), x 15; venation and sori (right), x 2.

N o t e.— The status of this species is uncertain, for the pinnation of fronds is highly heteromorphic. Other examples in *Pteris* to have such an unstable frond construction are *P. inaequalis; P. dalhousiae,* and *P. scabripes.* which have no close relationship to each other. A specimen with three fronds collected in one stock (T 11781 from Thung Salaeng Luang) has one frond simply pinnate with 6 pairs of simple entire pinnae similar in appearance to *P. cretica;* the second has 7 pairs of pinnae each with 3 – 5 irregularly placed pinnules; and the third is a frond with 8 pairs of pinnatisect pinnae with more than 20 pairs of rather regularly placed lateral pinnules and long apical pinnules. The first and second leaves have stramineous stipes and the third castaneous ones.

12. Pteris semipinnata Linn., Sp. Pl.: 1076. 1753; Bedd., Handb.: 109. f. 58. 1883; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 151. 1940; Holtt., Rev. Fl. Malaya 2: 401. f. 232. 1955.

Rhizome short, ascending, covered with scales: scales narrow, bicoloured, the central portion dark brown, stiff, 3.5 by 0.2 mm, the marginal portion pale brown, ferrugineous, about a half the breadth of central portion. *Stipe* about 50 cm long, purplish or dark at basal portion, polished, glabrescent, narrowly grooved on upper surface. *Lamina* elliptic, up to 50 by 25 cm, bipinnatisect; lateral pinnae 4 – 7 pairs, bearing 3 – 6 basiscopic segments and long terminal ones, about 15 cm long, up to 6 cm wide, the acroscopic side entire, cuneate at base with short stalk; basiscopic lateral pinnules gradually becoming smaller distally, narrowing towards acute apex, dentate in sterile ones, up to 50 by 8 mm, apical segments up to 10 cm long; costa purple, polished, grooved on upper surface, papyraceous, deep green on upper surface, paler beneath; veins forked, all free, paler and visible on both surfaces. *Sori* linear, continuous along the margin nearly throughout the segments and acroscopic pinna-margin; indusia paler, stiff, nearly entire, up to 0.6 mm broad.

T h a i l a n d.— NORTHERN: Phitsanulok (Salaeng Haeng); EASTERN: Nakhon Ratchasima (Kathok).

D i s t r i b u t i o n.— S. China (type), Burma, Indochina, Malesia, north to southern edge of Japan.

E c o l o g y.—In evergreen forests at middle elevation.

N o t e.— Tardieu-Blot & Christensen (1940) reduced *P. dispar* to this species, but the Japanese species is distinct from *P. semipinnata* in having regularly bipinnatifid fronds with more than 10 pinnules on both sides of pinna-rachis, the pinnules being less than 5 mm broad. In *P. semipinnata* pinnules on the acroscopic side of pinnae are seldom seen and the pinnules are usually 5 – 8 mm broad.

13. Pteris blumeana Ag., Rec. Pterid.: 22. 1839; Tard. & C. Chr. in Fl. Gén. I. - C. 7(2): 157. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 81. 1967. — *Pteris quadriaurita* var. *blumeana* (Ag.) Bedd., Handb.: 112. 1883; Hosseus, Beih. Bot. Centr. 28(2): 366. 1911.— *Pteris quadriaurita* auct. non Retz.: Christ, Bot. Tidsskr. 24: 106. 1901; C. Chr., Bot. Tidsskr. 32: 348. 1916.

Rhizome short, erect, densely scaly at apex; scales linear, up to 8 by 0.8 mm, dark brown with pale ferrugineous margin. *Stipe* castaneous to purplish in lower part, stramineous or pale brown upwards, puberulous or glabrescent, up to 80 cm long.*Lamina* oblong with acute apex,deeply bipinnatisect to bipinnate, about 70 by 35 – 50 cm; lateral pinnae about 10 pairs, slightly ascending, nearly straight, lanceolate with truncate base, caudately acuminate at apex, up to 25 by 3 – 5.5 cm, basal pinnae bearing large basiscopic pinnules; rachis and costa grooved on upper surface, more or less hirsute; pinnules patent, straight or slightly falcate, narrowly oblong, rounded to obtuse or rarely moderately acute at apex, up to 30 by 2.5 – 4.5 mm, entire at margin, adnate and decurrent to the next ones by wings of costa less than 0.5 mm broad; long-spinous on upper surface of costa and costules, upper surface of lamina sparsely pubescent, green, papyraceous; veins forked, distinct on both surfaces. *Sori* continuous along margin of pinnules except at apex and sinus; indusia pale, thin, transparent.

T h a i l a n d.— NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao), Lampang, Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang); EASTERN: Nakhon Ratchasima (Phu Khieo, Phu Laen Kha); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang), Chanthaburi (Khao Sabap); SOUTH-WESTERN: Kanchanaburi (Kroeng Kawia, Thong Phaphum); PENINSULAR: Chumphon (Khao Tong), Yala (Bannang Sata).

D i s t r i b u t i o n.— India, Cochinchina and Malesia (type from Java).

E c o l o g y.— On usually dry mountain slopes in deep shade or on humus-rich ground in not very dense forests at low or medium altitudes (but to 1200 m alt. on Phu Luang)

V e r n a c u l a r.— Foen hiran (เฟินหิรัญ), foen alaba (เฟินอะลาบา) (Central).

N o t e.— In some plants a distinct white line is apparent along the costae, but no taxonomic significance can be given to this character, which occurs in other species.

14. Pteris mertensioides Willd., Sp. Pl. 5: 394. 1810; Holtt., Rev. Fl. Malaya 2: 404.

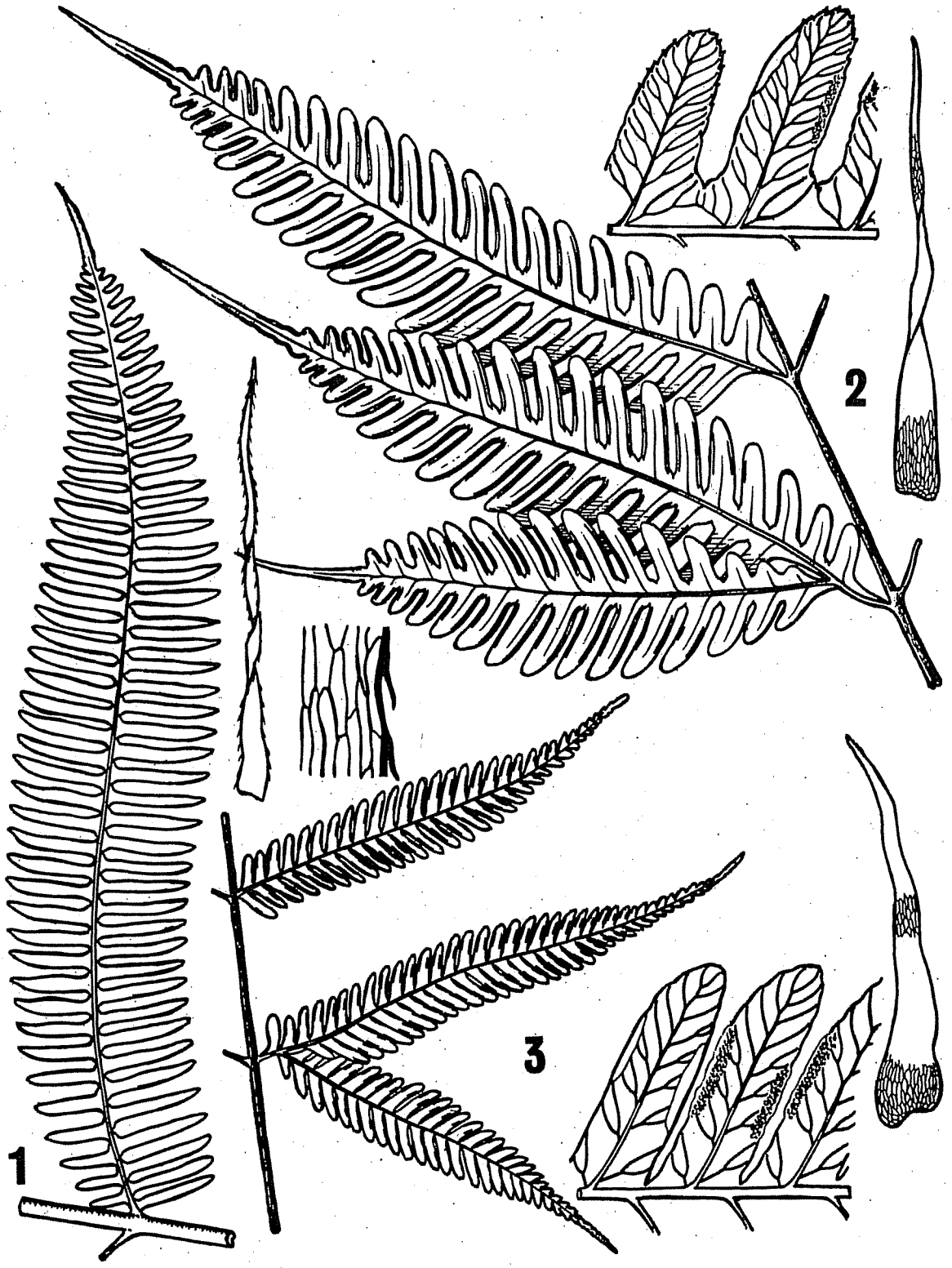

Figure 19. 1: *Pteris mertensioides*; lateral pinna, x 0.3; scale and the marginal part enlarged, x 8 & x 100. 2: *Pteris tokioi*; the lowest pinna with lateral one, x 0.5; venation and sori (above), x 1.5; scale, x 15. 3: *Pteris bella*; the lowest pinna with lateral one (left), x 0.5; venation and sori, x 3; scale (right), x 15.

1955; Tagawa & K. Iwats., Southeast As. St. 5: 81. 1967. — *Pteris patens* Hook., Sp. Fil. 2: 177. t. 137. 1858, non Kunze 1837 : Bedd., Handb., 114. f. 59. 1883. Fig. 19. 1.

Rhizome short, ascending, scaly; scales up to 10 by 0.5 mm, dark brown, more or less waved and curled up, sharply toothed at margin. *Stipe* stout, densely scaly and warty at base, puberulous or glabrescent upwards, up to 70 cm or more in length. *Lamina* up to 1 m or more long, 65 cm wide, deeply bipinnatisect to bipinnate; lateral pinnae nearly opposite, up to 15 or more pairs, linear-lanceolate, up to 45 by 4 – 8 cm, basal pinnae bearing large basiscopic pinnules; rachis and costa castaneous to purplish, grooved on upper surface, hairy beneath; pinnules lanceolate, moderately acute to acute at apex, adnate at base decurrent to the next ones with wings of costa less than 1 mm broad, or free in larger ones, up to 50 by 7 mm, papyraceous to softly chartaceous, green; veins usually twice forked, distinct on both surfaces. *Sori* continuous nearly all the margin of pinnules except at apex and sinus; indusia narrow, pale, thin.

T h a i l a n d.— PENINSULAR : Chumphon (Phato), Surat Thani (Ban Kop Kaep), Nakhon Si Thammarat (Khao Luang), Ranong (Muang Wing), Yala (Kuala Badong, Betong, Ban Chana).

D i s t r i b u t i o n.— Ceylon, S. India, Malesia (type from Amboina) to Polynesia.

E c o l o g y.— On damp slopes in tropical evergreen forests at low to medium altitudes.

V e r n a c u l a r.— Kut phi (กูดผี) (Peninsular).

N o t e.— This is a large species distinct in purplish colour of the axes throughout the plants. In some earlier collections we found it determined as *P. excelsa,* though this is much larger with larger pinnae more than 15 cm wide, and not purplish on rachis and costa. We cannot see any specimen of *P. excelsa* from Thailand.

15. Pteris dalhousiae Hook., Sp. Fil. 2: 170. t. 121 A. 1858; Bedd., Handb.: 110. 1883; Tard. & C. Chr. in Fl. Gen. I.- C. 7(2): 152. 1940; Holtt., Rev. Fl. Malaya 2: 401. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 50. 1968.

Rhizome short, erect, bearing a few fronds in a tuft, densely covered with scales at apex; scales up to 5 mm long, dark brown, entire. *Stipe* nearly black, scaly at base, glabrescent above, up to 40 cm long. *Lamina* up to 60 cm long, bipinnate;

lateral pinnae subopposite, 4 – 5 pairs, up to 30 cm or more long, bearing 5 or more basiscopic pinnules and sometimes with a few acroscopic lobes; costa with wings 5 mm throughout; lobes linear, caudately acuminate at apex, serrate at margin, up to 12 by 0.8 cm; lobed apical part of frond with widely spaced lobes connected by a broad wing of even width, the lowest ones to 15 cm long. *Sori* along margin of lobes.

T h a i l a n d.— SOUTH-EASTERN: Chanthaburi (Khao Ram); PENINSULAR: Surat Thani (Ban Kop Kaep, Ko Phangan), Songkhla, Yala (Bannang Sata).

D i s t r i b u t i o n.— Cambodia, Malaya (type), Sumatra and W. Java.

E c o l o g y.— Terrestrial in evergreen forests at low altitudes.

N o t e.— This is related to *P. semipinnata* but distinct from it by having the pinnae less in number and rather irregular in arrangement.

16. Pteris grevilleana Wall. ex Ag., Rec. Pterid.: 23. 1839; Bedd., Handb.: 112. 1883; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 153. 1940; Holtt., Rev. Fl. Malaya 2: 402. f. 235. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 80. 1967. —*Pteris ensiformis* var. *grevilleana* (Wall. ex Ag.) Bedd., Handb.: 108. 1883; Suppl.: 23. 1892.

Rhizome short, erect, scaly at apex; scales small, up to 3 by 0.5 mm, dark brown, entire. *Frond* dimorphic. *Sterile frond*: stipe shining, deep purple to pale castaneous, glabrescent upwards, 8 – 13 cm long, narrowly winged in upper portion; lamina ovate in outline, up to 15 by 10 cm, each consisting in a terminal pinna and one or rarely two pairs of lateral pinnae each bearing a large basiscopic pinnule almost as big as the pinna, thus seemingly pentaphyllous, terminal pinna deeply lobed to $\frac{4}{5}$ way towards midribs, acute at apex, cuneate and decurrent at base continuing to wings of stipes, up to 10 by 3.5 cm, lateral pinnae narrower, up to 7 by 2.5 cm, rounded to cuneate, the basiscopic projections up to 4 by 1.5 cm; pinnules or ultimate lobes oblong, rounded at apex, serrate at margin, up to 6 mm wide, softly papyraceous, deep green; veins forked, hardly visible. *Fertile frond* taller: stipe 25 – 30 cm long; lamina like sterile one or with and additional lateral pair of pinnae smaller is size than the lowest one, larger, up to 10 by 14 cm. *Sori* continuous along margin of lobes except at apex and at sinus; indusia pale brown, thin.

T h a i l a n d.— NORTHERN: Phitsanulok (Huai Ya, Salaeng Haeng); NORTH-EASTERN : Loei (Phu Luang); CENTRAL : Nakhon Nayok (Khao Yai); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang).

Distribution.— India (type) to S. China and W. Malesia, north to Taiwan and the Ryukyus.

Ecology.— On humus-rich mountain slopes in dense evergreen forests at medium altitudes.

Vernacular.— Ya rang kai (หญ้ารังไก่) (Peninsular).

17. Pteris phuluangensis Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 111. f. 7. 1968. — *Pteris* sp. aff. *P. grevilleana:* Tagawa & K. Iwats., Southeast As. St. 5: 80. 1967. Fig. 18.2.

Rhizome short, erect, scaly at apex; scales about 3 by 0.5 mm at base, linear-subtriangular, dark brown to nearly black with entire, brown, thinner edges. *Stipe* shining, deep castaneous to purplish, puberulous or glabrescent, up to 35 cm long on fertile fronds and 25 cm on sterile ones. *Frond* dimorphic with taller fertile fronds; lamina oblong-subdeltoid, deeply bipinnatisect, 15–23 by 12–22 cm at base; lateral pinnae 2–3 pairs, opposite or nearly so, 7–10 by 2.5–3.5 cm, oblong in outline, caudately acuminate at apex with unlobed long segments up to 3 cm long, broadly cuneate at sessile base, sometimes bearing basal basiscopic projections up to 5 by 3 cm; rachis shining, deep castaneous to purplish, hardly hirsute, spinous on upper surface; ultimate segments linear, lobed almost to costa, falcate, round to moderately acute at apex, serrate at margin, up to 30 by 6 mm, thinly papyraceous; veins forked, hardly visible on both surfaces, glabrous. *Sori* continuous along margin of ultimate segments except at sinus and towards apex; indusia thin, pale, up to 0.1 mm broad, irregular at margin.

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

Distribution.— Endemic.

Ecology.— On rather dry slopes in dry evergreen forests at about 800 m alt.

18. Pteris tokioi Masam., Trans. Nat. Hist. Soc. Formosa 25: 13. 1935; Tagawa & K. Iwats., Southeast As. St. 5: 82. 1967. — *Pteris excelsa* auct. non Gaud.: Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 154. 1940, p.p. Fig. 19.2.

Rhizome short-creeping, thick, bearing fronds closely, densely scaly at apex; scales shining-brown, concolorous, linear, up to 8 by 0.7 mm, entire. *Stipe* shining, deep castaneous to dark purple, 30–80 cm long, sparsely hirsute or glabrescent. *Lamina* oblong-ovate, bipinnatifid, 40–60 by 30–40 cm; lateral pinnae

4–6 pairs, opposite, oblong-lanceolate, rounded at base, the base with broadly winged stalks, cordately acuminate at apex, up to 25 by 6 cm, basal ones the largest, each bearing a large deeply lobed basal basiscopic branch just like upper lateral pinnae; ultimate segments narrowly oblong, falcate, rounded at apex, serrate at margin, up to 25 by 5 – 9 mm, papyraceous, dark green; veins forked, the basiscopic branch of basal ones running to sinus between ultimate segments, free except in soral commissure, visible on both surfaces. *Sori* continuous along margin of segments from base towards apex; indusia pale, thin, entire.

T h a i l a n d.— NORTHERN: Phetchabun (Phu Miang); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n.— Indochina, Taiwan (type) and southern edge of Japan.

E c o l o g y.— On humus-rich mountain slopes in lower montane forests at 1200 — 1500 m alt.

N o t e.— Tardieu-Blot and Christensen (1940) confused this with *P. excelsa,* in which species the plants are huge and the axes never become shining deep castaneous.

19. Pteris decrescens Christ, Bull. Acad. Géogr. Bot. 16: 244. 1906; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 152. 1940; Holtt., Dansk Bot. Ark. 20: 27. 1961; Tagawa & K. Iwats., Southeast As. St. 3(3): 83. 1965; 5: 81. 1967. — *Pteris hossei* Hieron., Hedwigia 55: 372. 1914. — *Pteris asperula* auct. non J. Smith ex Hieron.: Christ, Bot. Tidsskr. 20: 107. 1901. — *Pteris quadriaurita* var. *blumeana* auct. non Brouse: Hosseus, Beih. Bot. Cent. 28 (2): 366. 1910. — *Pteris aspericaulis* auct. non Wall. ex Ag.: C. Chr., Bot. Tidsskr. 32: 348. 1916. Fig. 20. 2.

Rhizome short, erect, bearing a few fronds in a tuft, densely scaly at apex; scales linear, about 5 by 0.2 mm, deep purplish-brown, shining, with thin, pale brown ferrugineous margin. *Stipe* deep castaneous or purplish, shining, puberulous upwards, 20–50 cm long. *Lamina* oblong-lanceolate, deeply bipinnatisect, 20–40 by 20–30 cm; rachis castaneous, more or less shining, grooved on upper surface, hirsute beneath; lateral pinnae less than 10 pairs, subopposite, oblong with apex long caudate (with apical segments up to 5 cm long), broadly cuneate at sessile base, 10–20 by 2.5–4.5 cm, shortly stalked; costa grooved and spinous on upper surface, hirsute beneath; pinnules narrow, round or moderately acute at apex, slightly ascending, close to each other, 3–4.5 mm broad, papyraceous; veins forked, ascending, visible on both surfaces. *Sori* continuous along margin of pinnules from base to midway or almost to apex; indusia pale brown, firm.

T h a i l a n d.— NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Doi Saket, Doi Suthep, Mae Klang, Doi Inthanon), Lamphun (Doi Khun Tan), Phitsanulok (Thung Salaeng Luang, Salaeng Haeng); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chon Buri (Si Racha), Trat (Ko Chang); PENINSULAR: Surat Thani (Ban Don).

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

E c o l o g y.— On mountain slopes in deep shade at medium or high altitudes.

20. Pteris bella Tagawa, Acta Phytotax. Geobot. 8: 166. 1939; Tagawa & K. Iwats., Southeast As. St. 5: 81. 1967. Fig. 19. 3.

Rhizome erect or ascending, bearing a tuft of fronds at apex, densely scaly; scales up to 8 by 0.8 mm, concolorously brown, entire. *Stipe* deep purplish, shining, scaly at base, glabrescent upwards, 20–55 cm long. *Lamina* oblong with acute apex, deeply bipinnatisect, 20–30 by 15–25 cm; rachis shining purple, glabrescent; lateral pinnae 5 or 6 pairs, opposite, lanceolate, caudately acuminate at apex, slightly narrowing towards subtruncate sessile base, up to 12 by 2.5 cm; costa stramineous, glabrescent; pinnules oblique, rounded at apex, entire at margin, adnate at base and decurrent to the costa with wings less than 0.5 mm broad, up to 13 by 4 mm, softly papyraceous, green; veins forked, raised beneath. *Sori* marginal, usually less than 7 mm long; indusia pale brown, thin.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Khun Huai Pong, Doi Inthanon), Mae Hong Son (Khun Mae Lan); NORTH-EASTERN: Loei (Phu Luang); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Taiwan (type).

E c o l o g y.— Terrestrial, usually on mountain slopes in lower montane forests at 1100–2200 m alt.

N o t e.— This species is distinguished by the concolorous rhizome scales. The Thai materials accord very well with the only known collection from Taiwan. The identity of Peninsular plants, although variants with thicker texture and wider lateral pinnae, is not in doubt.

21. Pteris nepalensis H. Ito in Hara, Fl. E. Himal.: 466. pl. 25. Fig. 20. 1.

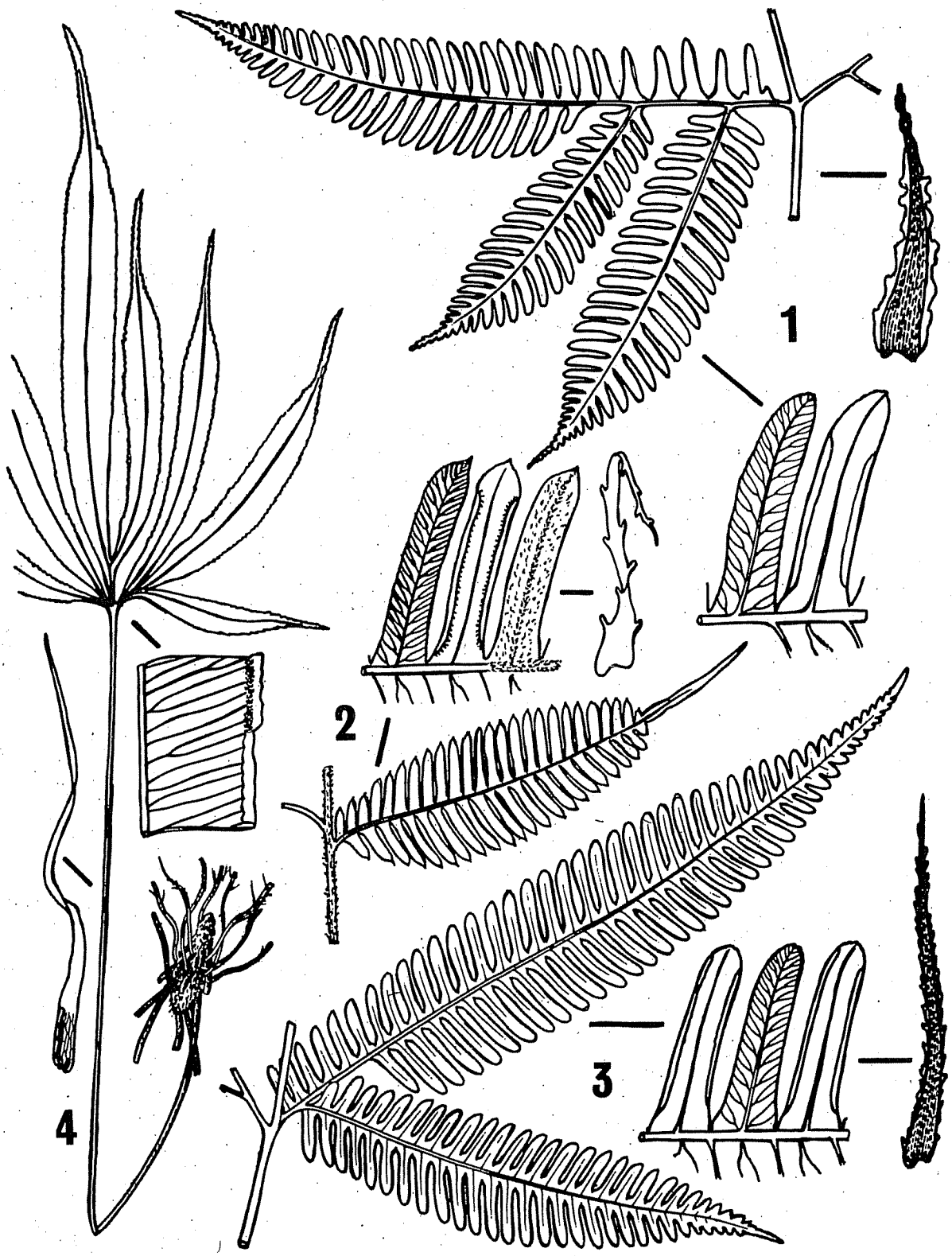

Figure 20. 1: *Pteris nepalensis*; the lowest pinna (left), x 0.5; scale (right), x 15; venation and indusia (below), x 2. 2: *Pteris decrescens*; the lowest pinna (right below), x 0.5; venation, indusia and hairs (above), x 2; scale, x 15. 3: *Pteris asperula*; the lowest pinna, x 0.5; venation and indusia, x 1.5; scale (right), x 15. 4: *Pteris scabripes*; plant with a sterile leaf, x 0.5; venation and sori, x 3; scale, x 20.

Rhizome short, erect, bearing a few fronds in a tuft, scaly at apex; scales narrow, brown central portion and pale brownish, ferrugineous margin, about 3 by 1 mm. *Stipe* about 30 cm long, castaneous or paler, scaly at base. *Frond* usually about 30 cm long and wide; lateral pinnae 2–5 (–6) in number, broadest at middle portion, slightly narrowing towards base, gradually narrowing towards caudate apex, rather remote on more or less castaneous rachis, the lowest ones the longest, shortly stalked, bearing one or two large pinnatifid basal pinnules, upper pinnae becoming smaller, sessile; segments about 20 pairs, rounded to moderately acute at apex, falcate, up to 2 by 0.5 cm; softly papyraceous, dully green; veins forked, distinct on both surfaces. *Sori* continuous along margin of segments throughout.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Inthanon).

D i s t r i b u t i o n.— E. Himalaya (type).

E c o l o g y.— Terrestrial on humus-rich ground in light shade near the top of mountain, about 2500 m alt.

N o t e.— Our Thai materials match well with the Himalayan type except for the smaller size and softer texture.

22. Pteris asperula J. Smith ex Hieron., Hedwigia 55: 362. 1914; Holtt., Rev. Fl. Malaya 2: 406. f. 236. 1955; Dansk Bot. Ark. 23: 235. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 80. 1967. Fig. 20. 3.

Rhizome short-creeping, bearing fronds close to each other; scales linear, up to 4 by 0.2 mm, brown with pale ferrugineous margin. *Stipe* about 50 cm long, castaneous and scaly at base, stramineous or pale castaneous upwards, glabrescent. *Lamina* about 40 by 30 cm, oblong in outline, acute at apex, deeply bipinnatifid; lateral pinnae 7–8 pairs, opposite, ascending and slightly falcate, up to 20 by 2.5–4.5 cm, basal pinnae the largest, bearing basal basiscopic pinnules like upper lateral pinnae; upper pinnae becoming smaller upwards; rachis and costa grooved on upper surface, sparsely hairy, pale castaneous or slightly purplish; pinnules very narrowly oblong, rounded at apex, decurrent to the next ones by wings of costa about 1 mm broad, 15–25 by 2.5–4 mm, papyraceous, green; veins forked, distinct on both surfaces. *Sori* along margin of pinnules almost from base to apex; indusia membranous, transparent.

T h a i l a n d.— NORTHERN: Phitsanulok (Thung Salaeng Luang); SOUTH-WESTERN: Kanchanaburi (Kroeng Kawia); PENINSULAR: Satun (Khuan Kalong).

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

E c o l o g y.— On rather dry banks of mountain paths in open areas at about 400 m alt.

N o t e.— The identification of the above material is not quite certain, as the coloration of axes does not accord with typical *P. asperula*. Copeland (1958) considered this species is endemic to the Philippines, but we follow Holttum (1955) in extending its range to include plants from Malaya and Thailand.

23. Pteris aspericaulis Wall. ex Ag., Rec. Pterid.: 22. 1839; Tagawa & K. Iwats., Southeast As. St. 5: 82. 1967. — *Pteris quadriaurita* var. *aspericaulis* (Wall. ex Ag.) Bedd., Handb.: 111. 1883.

Rhizome short, erect or ascending, densely scaly at apex; scales brown, up to 10 by 0.5 mm, with pale ferrugineous edges. *Stipe* castaneous to deep purplish, puberulous and minutely warty upwards, 30 – 40 cm long. *Lamina* oblong-subdeltoid, deeply bipinnatisect, 25 – 35 by 17 – 27 cm; lateral pinnae 5 – 12 pairs, sessile or very shortly stalked, ascending or subpatent, nearly straight or slightly falcate, in lower ones sometimes deflexed, linear-lanceolate, caudately acuminate at apex, up to 15 by 3 cm, basal ones usually the largest, each bearing one or rarely two basal basiscopic branches like upper pinnae; terminal pinnae like lateral ones, up to 13 by 4 cm; pinnules oblong, oblique, moderately acute at apex, dilated towards base, continuous with neighbouring ones by very narrow wings of costae; the spines on costae at base of costules prominent, usually more than 2 mm, papyraceous or firmer; veins forked, all free, visible on both surfaces. *Sori* continuous along margin of segments, usually from base upwards; indusia thin but firm, brown.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Inthanon).

D i s t r i b u t i o n.— N. India (type), Upper Burma and Yunnan.

E c o l o g y.— On humus-rich floor of dense evergreen forests or on muddy rocks near streams at high altitudes above 1500 m.

24. Pteris scabripes Wall. ex Ag., Rec. Pterid.: 11. 1839; Holtt., Rev. Fl. Malaya 2: 399. f. 233. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 82. 1967; Acta Phytotax. Geobot. 23: 55. 1968. Fig. 20. 4.

Rhizome short, erect; scales up to 5 mm long, thin but firm, deep brown. *Stipe* dark castaneous to deep purplish, sparsely scaly at base, puberulous upwards, 25—35 cm long on sterile frond, up to 50 cm on fertile one. *Lamina* with one or two opposite pairs of lateral pinnae and trifoliolate apical pinna; lateral pinnae simple, forked or trifoliolate, sessile or adnate, simple pinnae or branches linear-lanceolate, gradually narrowing towards base, caudately long-acuminate at apex, finely dentate at margin, the dentation evident at apical margin, in sterile up to 18 by 2 cm, in fertile up to 22 by less than 1 cm; rachis usually winged by the decurrent base of lamina, subcoriaceous, deep green; veins forked, nearly patent, close. *Sori* continuous along margin of long pinnae or pinnules; indusia pale brown, thin.

T h a i l a n d.— SOUTH-EASTERN: Chon Buri (Si Racha); PENINSULAR: Surat Thani (Ko Tao, Ban Don), Nakhon Si Thammarat (Khao Luang), Narathiwat (Bacho Falls).

D i s t r i b u t i o n.— Malaya (type).

E c o l o g y.— On rocky mountain-slopes in dense evergreen forests at low altitudes.

N o t e.— *P. scabripes* is close to *P. cretica,* but is distinguished by dark purplish polished stipe, and fewer lateral pinnae which are usually branched and more deeply toothed.

25. Pteris multifida Poir., Enc. 5: 714. 1804; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 148. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 175. 1969.

Rhizome short, creeping, bearing small blackish scales. *Stipe* stramineous, or darker near base, 4 – 15 cm long. *Lamina* bipinnate with long rarely forked pinnules, dimorphic; sterile frond less divided, rachis winged to form the same construction as segments; segments up to 1 cm broad, dentate at margin; fertile frond up to 60 cm long, with stipe and lamina almost equal; segments about 5 mm broad, simple or rarely forked, decurrent at base to form distinct wings on rachis but not on stipe. *Sori* linear, along the margin of lobes nearly throughout.

T h a i l a n d.— CENTRAL: Krung Thep.

D i s t r i b u t i o n.— Indochina, China, Japan and rather rarely in Ryukyus and Taiwan; once from Singapore; type was based on the specimen cultivated in the Botanic Garden, Paris.

E c o l o g y.— Only once collected on stone-walls in Krung Thep in 1921.

26. Pteris cretica Linn., Mant. Pl.: 130. 1767; Bedd., Handb.: 106. 1883; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 148. 1940; Holtt., Dansk Bot. Ark. 20: 27. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 82. 1967.

Rhizome short-creeping or ascending, bearing fronds closely, scaly at apex; scales brown, up to 5 mm long, entire. *Stipe* stramineous to castaneous or deep purple, nearly black and sparsely hairy at base, puberulous upwards, usually 10–30 cm or sometimes more than 50 cm long, those of fertile frond longer. *Lamina* more or less dimorphic, imparipinnate, 15–40 by 6–35 cm; lateral pinnae up to 7 pairs, narrowing towards base, caudately long-acuminate at apex, serrate at margin, sessile or shortly stalked at base, up to 23 by 2 cm in sterile and 1.2 cm in fertile ones, but commonly about 12 cm long, papyraceous to subcoriaceous, light green; veins ascending, forked, all free. *Sori* along the margin of pinnae; indusia firm, brown.

Thailand.— NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Doi Suthep), Lampang; NORTH-EASTERN: Phetchabun (Phu Miang), Khon Kaen; SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ko Tao, Ban Don), Krabi (Khao Phanom Bencha), Yala (Betong).

Distribution.— Tropics and subtropics throughout the World (type from Crete).

Ecology.— On mountain slopes in forests.

Vernacular.— Kut phi sue (กูดผีสือ) (Northern).

Note.— As described above, the stipes of Thai plants are often coloured castaneous or purplish in the upper part though the plants in Japan, China and N. India have the stipes stramineous except at the very base. Lateral pinnae are hardly forked except for the forked basalmost pinnae, though branching is less frequent than in *P. scabripes*.

27. Pteris plumbea Christ, Not. Syst. 1: 49. 1909; Tard. & C. Chr. in Fl. Gen. I.- C. 7(2): 150. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 82. 1967.

Rhizome short, erect; scales linear, up to 1.2 cm long, deep brown, more or less crisped. *Stipe* stramineous, scaly at base, puberulous upwards, 15–20 cm long in sterile frond, 30–40 cm in fertile one. *Lamina* pinnate, oblong-ovate in outline, 15–30 cm; lateral pinnae simple, forked or trifoliolate, usually more branched in fertile ones, narrowly cuneate at base, caudately acuminate at apex, sharply and minutely serrate at margin of sterile pinnae, up to 13 by 2.5 cm in sterile pinnae, up to 18 by 1.2 cm in fertile pinnae, shortly stalked or sessile in upper pinnae, chartaceous, deep green, glabrous; veins visible on lower surface. *Sori* continuous from base nearly to apex of pinnae; indusia thin but firm, brown.

T h a i l a n d.— NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ko Tao), Satun (Khao Khieo range).

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

E c o l o g y.— On rather dry mountain slopes in mixed forests at medium altitudes.

28. Pteris venusta Kunze, Bot. Zeit. 6: 195. 1848; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 145. 1940; Holtt., Dansk Bot. Ark. 23: 236. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 82. 1967. — *Pteris pellucida* auct. non Presl: Bedd., Handb.: 106. 1883; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 4. 1929; C. Chr., Contr. U.S. Nat. Herb. 26: 333. 1931.

Rhizome short, creeping or ascending, 7–10 mm diam., bearing close fronds, densely scaly at apex; scales linear, rather stiff, up to 5 mm long, dark brown to nearly black with paler edge, entire. *Stipe* dark brown and scaly at base, stramineous, castaneous above, puberulous or glabrescent, 50–80 cm long. lamina oblong, imparipinnate, up to 60 by 30 cm; rachis stramineous or castaneous beneath, winged in upper part, puberulous; lateral pinnae 3–7 pairs, never branching, sessile or shortly stalked in lower ones, adnate or decurrent downwards in upper ones, falcate, gradually narrowing towards cuneate base, caudate with long tail at apex, margin subentire or minutely serrate at apical portion, up to 30 cm or more long, 3 cm broad, terminal pinnae like the lower lateral pinnae but straight, chartaceous, veins close, visible on both surfaces. *Sori* continuous along the margin of pinnae except at base and towards apex; indusia thin but firm, pale brown.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tham Tu Pu), Chiang Mai (Doi Chiang Dao, Doi Saket, Doi Suthep, Doi Inthanon), Lampang, Lamphun (Doi Khun Tan), Tak (Lan Sang, Khao Phra Wo), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Khon Kaen (Kranuan); EASTERN: Nakhon Ratchasima (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha, Hup Bon), Prachin Buri (Ban Bueng Hills), Chanthaburi (Khao Soi Dao, Pong Nam Ron); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Kroeng Kawia, Song Tho).

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

E c o l o g y.— On rather dry mountain-slopes in forests at medium altitudes (300–900 m).

N o t e.— Among the species of *P. cretica* group in Thailand, this is distinct in having broader pinnae which never fork even in the basal pairs, and in the

decurrent base of the upper pinnae forming the wings of rachis but not continuous to the next lower pinnae. Stipes are usually paler and the sori are broader than those of *P. cretica*.

29. Pteris stenophylla Wall. ex Hook. & Grev., Ic. Fil.: t. 130. 1829; Tard. & C. Chr. in Fl. Gen. I.- C. 7(2): 145. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 79. 1967. — *Pteris pellucida* var. *stenophylla* (Hook. & Grev.) Bedd., Handb.: 107. 1883.

Rhizome very short-creeping, bearing numerous fronds in a tuft. *Stipe* up to 20 cm long, dark brown and scaly at base, stramineous or brownish on undersurface upwards, glabrescent. *Lamina* simple or bearing a pair of lateral pinnae just like the simple lamina, linear, up to 45 by 1.5 cm, fertile ones narrower, up to 1 cm broad, gradually narrowing upwards, the margin subentire and undulate in lower part, serrate upwards, the dentation oblique, rather sharp, papyraceous or thicker, green on upper surface, usually with pale strand along midribs; midribs raised on both surfaces, grooved on upper surface, glabrous; veins nearly patent or slightly ascending, simple or forked, reaching the margin. *Sori* along the margin of upper part of fertile fronds.

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

D i s t r i b u t i o n.— N. India (type) and Laos. Also recorded from Malesia but doubtful.

E c o l o g y.— On rather dry mountain slopes in dense evergreen forests at about 800 m alt.

2. ACROSTICHUM

Linn., Sp. Pl.. 1067. 1753; Gen. Pl.: 559. 1754; Copel., Gen. Fil.: 64. 1947.

Rhizome erect, large, scaly; scales large , attached at base, few- celled thick at base, central portion thick, edges pale, thin, entire. Stipe not jointed to rhizome, thick. Frond large, simply pinnate with distinct terminal pinnae; pinnae stalked, narrowly oblong to elliptic, fleshy; lower pinnae sterile, upper pinnae fertile with scattered sporangia on whole of under surface; veins close, forming smaller areoles without free included veinlets.

This is a small genus known throughout the tropics. The plants are large and grow usually in mangrove swamps, which suggests that they may be particularly specialized. The two species in Thailand are sometimes considered as one.

KEY TO THE SPECIES

1. Sterile pinnae rounded or truncate and shortly mucronate at apex	**1. A. aureum**
1. Sterile pinnae acuminate at apex	**2. A. speciosum**

1. Acrostichum aureum Linn., Sp. Pl.: 1069. 1753; Bedd., Handb.: 440. f. 268. 1883; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 162. f. 19–3. 1940; Holtt., Rev. Fl. Malaya 2: 409 f. 239. 1955; Dansk Bot. Ark. 20:27. 1961; Seidenf., Nat. Hist. Bull. Siam Soc. 19.86.1958; Tagawa & K. Iwats., Southeast As. St.3(3): 83. 1965; Acta Phytotax. Geobot. 23: 55. 1968.

Rhizome thick, erect, scaly; scales, about 4 by 1.5–2 cm, central portion thick and dark brown, edges thin, broad, pale, entire. *Stipe* up to 1 m long, thick, stramineous to pale castaneous, glabrous upwards, bearing on upper portion small spine-like remains of reduced glandular pinnae. *Frond* imparininnate, up to 4 m or more high including stipe, narrowly oblong to elliptic in outline; lateral sterile pinnae ascending, with stalks of up to 2.5 cm long, narrowly oblong, rounded to retuse and shortly mucronate at apex, cuneate to rounded and more or less irregular at base, entire at cartilagineous margin, 30–50 by 4–8 cm, coriaceous, glabrous; costa grooved above, distinctly raised below, veins raised below, hardly visible on upper surface, close, forming somewhat regularly arranged areoles up to 2 by 0.8 mm. *Fertile pinnae* only on upper portion, like the sterile ones but smaller. *Sporangia* scattered on whole of under surface of pinnae except on costa; paraphyses capitate, with small multilobed apical cells.

T h a i l a n d.—CENTRAL: Krung Thep, Samut Prakan; SOUTH-EASTERN: Chachoengsao (Bang Pakong); Phetchaburi (Sam Roi Yot), Prachuap Khiri Khan (Khlong Wan, Bang Saphan); PENINSULAR: Surat Thani (Khun Thale), Satun (Ko Tarutao), Trang (Kantang), Pattani.

D i s t r i b u t i o n.—Pantropic (type from tropical America).

E c o l o g y.—Common in mangrove swamps and tidal forests.

V e r n a c u l a r.—Prong thale (ปรงทะเล) (General.)

2. Acrostichum speciosum Willd., Sp. Pl. 5: 117. 1810; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 164. f. 19. 1–2. 1940; Holtt., Rev. Fl. Malaya 2: 410. f. 240. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 61. 1969. —*Chrysodium aureum* var. *schmidtii* Christ, Bot. Tidsskr 24: 104. 1901. —*Acrostichum aureum* var. *schmidtii* (Christ) C. Chr., Bot. Tidsskr. 32: 349. 1916.

Smimilar to the preceding species, differing only in: rhizome scales larger; plants smaller, up to 1.5 m tall; sterile pinnae acuminate at apex, cuneate at base.

T h a i l a n d.— SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Ranong (Kamphuan), Phangnga (Thong Lang).

D i s t r i b u t i o n.— Tropical Asia (type from India orientalis) to Australia.

E c o l o g y.— In mangrove swamps, collected only twice but probably more common.

V e r n a c u l a r.— Prong (ปรง) (South-eastern).

3. STENOCHLAENA

J. Smith, J. Bot. 3: 401. 1841; 4: 149. 1841; Holtt., Gard. Bull. S.S. 5: 251. 1932; Copel., Gen. Fil.: 161. 1947.

Epiphytic plants; rhizome creeping, green, scaly only at apex, not dorsiventral in construction; scales peltate, with uneven margin. Stipe not jointed to rachis. Frond simply pinnate, distinctly dimorphic; lateral pinnae jointed to rachis, sterile ones toothed at margin; fertile ones narrow, linear, with sporangia covering the whole undersurface, coriaceous; veins forming costal areoles, other veins free.

This is a tropical genus of four species ranging from Africa to Polynesia. *S. palustris* is the type of the genus and has the widest range.

Stenochlaena palustris (Burm.f.) Bedd., Ferns Br. Ind. Suppl.: 26. 1876; Handb.: 421. f. 253. 1883; Christ, Bot. Tidsskr. 24: 107. 1901; C. Chr., Bot. Tidsskr. 32: 346. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 8. 1929; Holtt., Gard. Bull. S.S. 5: 254. f. 1, 9– 16. 1932; Rev. Fl. Malaya 2: 412. f. 241. 1955; Dansk Bot. Ark. 20: 27. 1961; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 165. f. 19, 4. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3): 84. 1965; 5: 83. 1967. — *Polypodium palustre* Burm.f., Fl. Ind.: 234. 1768.

Rhizome long-creeping climbing on tree-trunks, green. *Stipe* up to 15 cm long. *Frond* about 40 –70 cm long, bearing pinnae of up to 15 pairs, opposite; sterile pinnae shortly stalked, articulate, about 15 by 3 cm, but variable in size, acuminate at apex, cuneate at base, pellucid at sharply and irregularly serrate margin; coriaceous, shining above; veins simple or forked, forming a row of narrow costal areoles. *Fertile pinnae* about 20 by 3 mm, with sporangia on the whole lower surface.

T h a i l a n d.— NORTH-EASTERN: Loei (Ban Na Luang); CENTRAL: Krung Thep; SOUTH-EASTERN: Chanthaburi (Makham, Pong Nam Ron), Trat (Ko Chang); PENINSULAR: Surat Thani (Ban Don, Ko Tao), Nakhon Si Thammarat (Khao Luang), Krabi (Ao Luk), Trang (Khao Chong).

D i s t r i b u t i o n.— N. and S. India (type), Indochina, throughout Malesia and Polynesia to Australia.

E c o l o g y.— Climbing on tree-trunks, or rarely terrestrial or on rocks in rather dry places in shade at low altitudes below 400 m.

V e r n a c u l a r.— Prong suan (ปรงสวน), phak kut daeng (ผักกูดแดง), phak kut mon (ผักกูดมอญ), phak yot daeng (ผักยอดแดง) (Central); paku mading (ปะกูมาดิง) (Malay/Peninsular); lamtheng (ลำเท็ง) (Peninsular); lam matheng (ลำมะเท็ง) (Eastern, South-western).

22. ASPLENIACEAE

In this flora, all the Thai species of the family are included in *Asplenium*, taking this genus in a broad sense.

1. ASPLENIUM

Linn., Sp. Pl.: 1078. 1753; Gen. Pl.: 560. 1754; Copel., Gen. Fil.: 163. 1947.

Rhizome short, erect or long-creeping; scales clathrate, glabrous. Frond simple to pinnately compound; veins free, of uniting at apex to form submarginal veins. Sori elongate along veins, superficial, with indusia of the same shape; spores bilateral, with perispore.

Nearly all the 700 species of family belong to this genus, including 35 Thai representatives.

KEY TO THE SPECIES

1. Frond simple
   2. Frond circular; stipe up to 10 cm long, darkpurple, polished, A pair of indusia opening towards one another **1. A. delavayi**
   2. Frond elongate; stipe shorter or with decurrent base of lamina. Indusia opening towards distal end
      3. Veins all free
         4. Midrib winged on lower surface; apex of frond proliferous **2. A. batuense**
         4. Midrib not winged; apex of frond not proliferous
            5. Margin of frond subentire, not toothed
               6. Lamina 1.7–4 cm broad; veins with angles of less than 30° to midrib **3. A. ensiforme**
               6. Lamina up to 8 cm broad; veins with angles of more than 45° to midrib **10. A. squamulatum**
            5. Margin of frond minutely toothed at least in the upper part
               7. Frond 35–60 cm long, 2–2.5 cm broad **11. A. scortechinii**
               7. Frond up to 30 cm long, 3.5 cm broad **12. A. salignum**
      3. Veins anastomosing at margin, joining the apices of veinlets
         8. Frond narrowly elliptic, broadest at middle and narrowing towards both ends
            9. Frond up to 20 cm or more broad. Sori close, often about 1 mm apart, usually reaching less than halfway from costa **4. A. nidus**
            9. Frond up to 7 cm broad. Sori usually more than 1.5 mm apart, usually occupying the whole length of veins except base and tip
               10. Frond acute at apex **5. A. phyllitidis**
               10. Frond acuminate at apex, long attenuate at base **6. A. simonsianum**

8. Frond spathulate, broadest in upper part
11. Stipe narrowly winged; wings less than 1.5 cm broad at middle
12. Scales 1 – 2.5 mm broad. Costa distinctly keeled on lower surface **7. A. grevillei**
12. Scales 2 – 4.5 mm broad. Costa hardly raised on lower surface **8. A. humbertii**
11. Stipe broadly winged; wings more than 2.5 cm broad at middle **9. A. antrophyoides**
1. Frond pinnate or more compound
13. Rhizome long-creeping. Frond pinnate; pinnae subdimidiate at acroscopic base
14. Sori more than 2.5 mm long, on middle or basal part of veins
15. Stipe and rachis dark purplish-brown, more or less polished. Sori commonly longer than 3 mm
16. Frond up to 9 cm wide, oblong in outline; the largest pinnae 2.5 – 3.5 cm long **18. A. unilaterale**
16. Frond up to 18 cm wide, widened towards base; the largest pinnae (4.5 –) 7 – 9 cm long **19. A. excisum**
15. Stipe and rachis dull grey-green, not polished. Sori short, usually up to 3 mm long **20. A. obscurum**
14. Sori up to 2 mm long, confined to lobes **21. A. cheilosorum**
13. Rhizome short, creeping, ascending or erect
17. Frond pinnate
18. Midrib of pinna not grooved above but usually raised
19. Frond more than 5 cm wide
20. Pinnae more than 8 cm long **12. A. salignum**
20. Pinnae up to 5 cm long
21. Pinnae crenately toothed at margin **13. A. tenerum**
21. Pinnae lobed to costa, apparently bipinnate **14. A. thunbergii**
19. Frond up to 4.5 cm wide **22. A. normale**
18. Midrib of pinna grooved above
22. Pinnae less than 1 cm long
23. Pinnae subentire or slightly lobed; rachis bearing branches at middle or above **23. A. siamense**
23. Pinnae lobed; rachis simple **36. A. exiguum**
22. Pinnae much longer
24. Lower pinnae extremely reduced, less than half as long as middle ones
25. Pinnae subequal at base; frond proliferous **24. A. longissimum**
25. Pinnae unequal at base; frond not proliferous **25. A. pellucidum**
24. Lower pinnae not or only slightly reduced
26. Pinnae less than 15 pairs
27. Pinnae entire or slightly undulate; rachis proliferous **26. A. paradoxum**
27. Pinnae toothed or lobed; rachis not proliferous
28. Pinnae up to 4.5 cm wide, toothed **27. A. macrophyllum**
28. Pinnae up to 1.5 cm wide, lobed towards base **28. A. falcatum**
26. Pinnae up to 30 pairs
29. Pinnae up to 10 cm or more long. Stipe sparsely scaly or glabrescent **29. A. caudatum**
29. Pinnae up to 8 cm long. Stipe and rachis scaly

30. Pinnae sessile, shallowly lobed. Scales bearing projections **30. A. crinicaule**

30. Pinnae stalked, lobed usually to half-way

31. Stipe and rachis dark green to brownish, not polished; scales entire. Pinnae up to 4 cm long **31 A. yoshinagae**

31. Stipe and rachis nearly black, polished or paler; scales bearing a few projections near base. Larger pinnae more than 4 cm long **32. A. perakense**

17. Frond bipinnate or more compound

32. Pinnae up to 3 cm long

33. Stipe glabrous. Lamina oblong-subdeltoid, herbaceous **16. A. varians**

33. Stipe densely scaly. Lamina narrowly elliptic, chartaceous to subcoriaceous **37. A. rockii**

32. Pinnae more than 3 cm long

34. Pinnae 3 –8 cm long

35. Ultimate segments linear, entire **14. A. thunbergii**

35. Ultimate segments oblong to spathulate **17. A. interjectum**

34. Pinnae up to 10 cm or more long

36. Frond tripinnatifid or more compound

37. Stipe green; sometimes gemmiferous **15. A. tenuifolium**

37. Stipe purplish to nearly black, shining; not gemmiferous **35. A. confusum**

36. Frond bipinnate

38. Stipe and rachis glabrous. Ultimate segments obtuse at apex **33. A. nitidum**

38. Stipe and rachis minutely scaly. Ultimate segments acute to moderately acute at apex **34. A. affine**

1. Asplenium delavayi (Franch.) Copel., Gen. Fil.: 165. 1947; Tagawa & K. Iwats., Southeast As. St. 5: 83. 1967. —*Scolopendrium delavayi* Franch., Bull. Soc. Bot. France 32: 29. 1885; Bedd., Handb. Suppl.: 41. 1892. Fig. 21.1.

Rhizome short, erect, densely scaly; scales narrow, up to 2.5 by 0.5 mm, gradually narrowing from base towards long-acuminate apex, nearly black with brown margin, clathrate. *Stipe* 5 – 10 cm long in fertile frond, up to 3.5 cm in sterile one, dark purplish, distinctly polished, grooved on upper surface, softly pubescent or glabrescent. *Frond* simple, nearly circular, rounded or rarely very moderately acute at apex, deeply cordate but seldom imbricate at base, up to 5 cm long and broad, sterile ones smaller, margin subentire to moderately crisped, chartaceous, grass-green on upper surface, paler below, glabrous; costa dark brown and polished like stipe only in lower $\frac{1}{3}$, the base of veins like stipe and then all the veins hardly visible on both surfaces, once or twice furcate, all free and nearly reaching the margin. *Sori* elongate along veins, usually from base to near apex; a pair of sori facing each other having their indusia attached laterally by their outer edges.

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

D i s t r i b u t i o n.— SW. China(type), Assam (CLARKE 41927E), Upper Burma and Tonkin.

E c o l o g y.— Only once collected in Thailand (TAGAWA et al. T-1084) on muddy crevices of calcareous rocks in dense forests at about 900 m alt.

N o t e.— The specimens collected in Yunnan are variable in size; the description given above is based on Thai materials.

A. delavayi is often compared with *Phyllitis,* which is defined by the strange construction of sori. As correctly pointed out by Copeland (1947), however, this soral condition may have been derived along several parallel courses. *A. delavayi* is a distinct species without any close allies, although the sorus of this species is apparently similar to that of the species referred to *Phyllitis.*

2. Asplenium batuense v. A. v. Ros., Bull. Dept. Agr. Ind. Néerl. 18: 13. 1908; Holtt., Rev. Fl. Malaya 2: 423. f. 244. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 85. 1965. —*Asplenium amboinense* auct. non Willd.: Bedd., Handb. Suppl.: 28. 1892. Fig. 21. 2, 4 & 5.

Rhizome short, creeping or ascending, sometimes climbing on trees, up to 1 cm diam., bearing rather close fronds, scaly; scales gradually narrowing from rounded base towards long-acuminate apex, up to 7 by 2 mm, dark brown, clathrate. *Stipe* about 3 cm long, stramineous, scaly. *Lamina* simple, about 45 by 7 cm (much larger in Malesian plants), broadest at middle or above, gradually narrowing downwards and suddenly truncate at base where the lamina is 1.5 cm broad at each side, acute at apex, usually proliferous near apex, entire; midrib distinctly raised below with wings, flat above; veins distinct, at wide angle to midrib, simple or forked; chartaceous. *Sori* on simple acroscopic branches of veins, leaving naked 2 –5 mm from midrib and 6 –8 mm from edges of frond, covering nearly the whole under surface of frond except for basal and apical portions; indusia about 1 mm broad, brown, firm.

T h a i l a n d.— PENINSULAR: Nakhon Si Thammarat (Khao Luang), Phatthalung (Khao Soi Dao), Yala (Betong).

D i s t r i b u t i o n.— Borneo, Sumatra (type), Java, Malaya and the adjacent islands.

E c o l o g y.— Epiphytic on tree-trunks in dense evergreen forests at medium altitudes (600–700 m).

Figure 21. 1: *Asplenium delavayi*; plant, x 0.5; fertile frond (above left), natural size; venation and sori (above right). x 2. 2: *Asplenium batuense*; plant, x 0.25; scale, x 5. 3: *Asplenium phyllitidis* ssp. *phyllitidis;* plant, x 0.25; scale, x 5. 4: Venation and sori; *A. batuense* (above) and *A. phyllitidis* (below), both natural size. 5: Frond pattern; *A. batuense* (left, gemma shown) and *A. phyllitidis* (right), both x 0.25.

3. Asplenium ensiforme Wall. ex Hook. & Grev., Ic. Fil.: t. 71. 1829; Bedd., Handb.: 141. f. 71. 1883; Hosseus, Beih. Bot. Cent. 28(2): 364. 1911; C. Chr., Contr. U.S. Nat. Herb. 26: 332. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 221. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 85. 1967.

Rhizome short, suberect, bearing fronds in a tuft, scaly at apex; scales gradually narrowing from base towards apex,dark brown, paler near margin, about 6 by 1 mm at base, entire, more or less clathrate. *Stipe* dark, indistinct from lamina, narrowly winged nearly to the base. *Frond* simple, entire or rarely irregularly waved at margin, spathulate, broadest in upper quarter, narrowing towards caudately acuminate apex, gradually narrowing and attenuate at base, about 30 by 1.7–4 cm, subcoriaceous, glabrous; midrib distinctly raised on both surfaces, grooved on upper surface; lateral veins ascending, forming angles of about 20° to midrib, forked near base, visible on lower surface, hardly so above. *Sori* oblique, elongate along acroscopic branches of veins, up to 3 cm long; indusia thin but firm.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Khun Huai Pong, Doi Chiang Dao, Doi Suthep, Doi Inthanon); NORTH-EASTERN: Loei (Phu Luang).

D i s t r i b u t i o n.— Ceylon, India (type), SW. China and Indochina, extending north to southern edge of Japan.

E c o l o g y.— On tree-trunks or on rocks in lower montane forests at high altitudes.

4. Asplenium nidus Linn., Sp. Pl.: 1079. 1753; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 4. 1929; C. Chr.,Contr. U.S. Nat. Herb. 26: 332. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 219. 1940; Holtt., Rev. Fl. Malaya 2: 419. 1955; Dansk Bot. Ark. 20: 28. 1961; 23: 236. 1965; Gard. Bull. Sing. 27: 147. 1974; Tagawa & K. Iwats., Southeast As. St. 3(3): 84. 1965; 5: 83. 1967. — *Thamnopteris nidus* (Linn.) Presl, Epim.: 68. 1849; Bedd., Handb.: 137. 1883.

Rhizome short, erect or ascending, stout, bearing a rosette of fronds, usually with a mass of roots on which are growing various epiphytes, scaly; scales brown to darker, memberanous, up to 2 cm long, 3 mm broad, clathrate. *Stipe* stramineous to dark, 2–5 cm long, scaly at base. *Frond* simple, up to 1 m or more long, 12–30 cm broad (but occasionally narrower, about 6 cm broad in soriferous ones), broadest at middle, gradually narrowing towards both apex and base, coriaceous, grass-green when living, paler below; midrib raised on upper surface, flat below, veins once or rarely twice forked, the first forking near midrib and then running parallel, uniting at apex to form submarginal veins about 0.5 mm inside leaf

margin. *Sori* elongate along veins, extending from near midrib half-way to the margin, uaually on every vein; indusia about 0.5 mm broad, with a space of 0.5 mm or wider between.

Two varieties are recognized as:

KEY TO THE VARIETIES

1. Frond up to 20 cm wide; apex gradually attenuate	**a. var. nidus**
1. Frond up to 30 cm wide; apex broadly rounded	**b. var. musifolium**

a. var. **nidus**

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Pacho), Chiang Mai (Doi Chiang Dao, Ban Du, Doi Suthep), Lampang; NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Nong Khai (Nong Kai Ploi); CENTRAL: Saraburi (Muak Lek); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao), Trat (Huai Raeng); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Wangka, Khao Nam Tok); PENINSULAR: Surat Thani (Ko Tao, Ko Phu), Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Throughout the Old World tropics (type from Java).

E c o l o g y.— Usually on tree-trunks or on rocks in dense forests or under heavy crowns of trees in light shade at various altitudes below 2000 m.

V e r n a c u l a r.— Katae tai hin (กะแตไต่หิน) (North-eastern); kaprok hua long (กะปรอกหัวลง), kaprok hang sing (กะปรอกหางสิงห์) (South-eastern).

N o t e.— This is a common species throughout Southeast Asia and variable in different features, though no practical classification has yet been given.

b. var. **musifolium** (Mett.) C. Chr., Ind. Fil.: 122. 1905; Holtt., Rev. Fl. Malaya 2: 419. 1955. — *Asplenium musifolium* J. Smith ex Mett., Farngatt. 6: 86. 1859; Holtt., Gard. Bull. Sing. 27: 149. 1974. — *Thamnopteris nidus* var. *musifolia* (Mett.) Bedd., Handb.: 139. 1883.

A variety with larger frond, up to 30 cm wide.

T h a i l a n d.— SOUTH-WESTERN : Prachuap Khiri Khan (Bang Saphan); PENINSULAR : Nakhon Si Thammarat.

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

E c o l o g y.— On tree-trunks in dense evergreen forests.

5. Asplenium phyllitidis D.Don, Prod. Fl. Nepal.: 7. 1825; Holtt., Rev. Fl. Malaya 2: 420. 1955; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958; Tagawa & K. Iwats., Southeast As. St. 5: 84. 1967; Holtt., Gard. Bull. Sing. 27: 152. 1974; K. Iwats., Acta Phytotax. Geobot. 29: 23. 1978. — *Asplenium nidus* var. *phyllitidis* (D.Don) v.A.v.Ros., Handb. Suppl.: 282. 1917; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 220. 1940. — *Thamnopteris nidus* var. *phyllitidis* (D.Don) Bedd., Handb.: 139. 1883. Fig. 21. 4 & 5.

Similar to *A. nidus,* differing from it in: rhizome-scales brown, broader; frond up to 80 by 7 cm (in exceptional cases up to 10 cm broad); midrib raised below; sori usually reaching more than half-way to margin, often occupying $\frac{3}{4}$ of the length of veins.

Two subspecies are recognized as:

KEY TO THE SUBSPECIES

1. Scales usually less than 7 mm long. Sori on almost all veins, including both branches of a vein which forks near costa; indusia narrower; spores smooth or reticulate. Plants of Northern region **a.** subsp. **phyllitidis**

1. Scales up to 12 mm or more long; sori usually on one branch of each vein; indusia broader; spores echinate; plants from Central, South-estern and Peninsular region **b.** subsp. **malesicum**

a. subsp. **phyllitidis** Fig. 21. 3.

T h a i l a n d.— NORTHERN: Tak (Huai Krasa), Lampang.

D i s t r i b u t i o n.— Himalaya (type).

E c o l o g y.— On mossy tree-trunks or on muddy rocks in dense evergreen forests at medium altitudes.

b. subsp. **malesicum** Holtt., Gard. Bull. Sing. 27: 153. 1974. — *Asplenium oblanceolatum* Copel., Phil. J. Sci. Bot. 9: 229. 1914.

T h a i l a n d.— CENTRAL: Nakhon Nayok (Khao Yai), Krung Thep; SOUTH-EASTERN: Prachuap Khiri Khan (Bang Saphan), Chanthaburi (Khao Sabap, Khao Soi Dao), Trat (Ko Chang); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Ron Phibun), Trang (Khao Chong), Satun.

D i s t r i b u t i o n.— Malaya and Sumatra (type) to New Guinea.

E c o l o g y.— On mossy tree-trunks on muddy rocks in dense montane forests or by streams at low to medium altitudes.

6. Asplenium simonsianum Hook., Ic. Pl. 10: t. 925. 1854; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 61. 1969; Holtt., Gard. Bull. Sing. 27: 152. 1974. — *Thamnopteris simonsiana* (Hook.) Moore, Ind. Fil.: L. 1857; Bedd., Handb.: 141. 1883.

Similar to *A. phyllitidis* but differs in: frond gradually narrowing towards acuminate apex, long-attenuate at base.

T h a i l a n d.— NORTHERN: Tak (Huai Krasa, Doi Musoe).

D i s t r i b u t i o n.— Assam (type).

E c o l o g y.— In moist evergreen forests by streams at medium altitudes.

N o t e.— This is close to the preceding species but still smaller, with fronds narrowing evenly towards both ends. Tardieu-Blot once recorded this species from Tonkin (Aspl. Tonkin.: 28. 1932), but referred the materials later to her new species *A. colaniae,* which is distinguished from *A. simonsianum* by long, narrowly winged or wingless stipes and the caudately acuminate apex of the fronds.

7. Asplenium grevillei Wall. ex Hook. & Grev., Ic. Fil.: t. 228. 1831; Christ, Bot. Tidsskr. 24: 108. 1901; C. Chr., Bot Tidsskr. 32: 346. 1916; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 217. 1940; Holtt., Dansk Bot. Ark. 20: 28. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 84. 1967; Holtt., Gard. Bull. Sing. 27: 153. 1974. — *Thamnopteris grevillei* (Wall. ex Hook. & Grev.) Moore, Ind. Fil.: L. 1857; Bedd., Handb.: 139. f. 70. 1883.

Rhizome short, erect, bearing several fronds in a tuft, covered with scales; scales brown, up to 4.5 by 2.5 mm, indistinctly clathrate, bearing hair-like projections at margin. *Stipe* dark brown to nearly black, very narrowly winged almost to the base, bearing small scales when young. *Frond* spathulate, broadest at middle to upper $\frac{2}{3}$, narrowing towards caudately acuminate apex, gradually narrowing towards attenuate base and then decurrent on stipe as wing, up to 25 cm long including stipe, up to 4.5 cm broad, the edges subentire or slightly undulate, papyraceous or thicker, green, paler below, minutely scaly when young, glabrescent; midrib green to darker, a little raised below, veins hardly visible on both surfaces, unusually once forked near midrib, joining at apex forming submarginal vein about 0.5 mm inside margin. *Sori* elongate along veins, extending from near midrib to about 5 mm from margin on the whole under surface; indusia about 0.7 mm broad.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tham Yup), Chiang Mai (Doi Chiang Dao), Phitsanulok (Thung Salaeng Luang, Salaeng Haeng);

NORTH-EASTERN: Khon Kaen (Pha Nok Khao); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Wangka); PENINSULAR: Chumphon (Khao Khlong, Chaiyaburi), Surat Thani (Ban Kop Kaep), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Pattani (Ban Sai Khao).

Distribution.—Burma (Tenasserim, type) and Indochina (Laos & Cochinchina).

Ecology.— Terrestrial in tropical evergreen forests at high and low elevations.

8. Asplenium humbertii Tard., Aspl. Tonkin 25. t. 2. f. 1—2 1932; Tard. & C. Chr. in Fl. Gén. I.-C.7(2): 218. 1940; Holtt., Gard. Bull. Sing. 27: 154. 1974; Tagawa & K. Iwats., Acta Phytotax. Geobot. 29: 23. 1978.

Similar to *A. antrophyoides,* different from it in: sterile frond narrowly decurrent to stipe, the wing about 3 mm at each side at middle portion of stipe.

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

Distribution.— Tonkin (type).

Ecology.— On wet limestone cliff in dense forests at about 500 m alt.

9. Asplenium antrophyoides Christ, Bull. Acad. Géogr. Bot. 20: 170. 1909; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 218. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 84. 1967; Holtt., Gard. Bull. Sing. 27: 154. 1974.

Rhizome short, ascending, bearing a few fronds in a tuft, scaly; scales brown, clathrate, up to 4 by 2 mm. *Stipe* green to stramineous, winged nearly to the base, glabrescent. *Frond* spathulate, gradually narrowing towards acuminate apex, rather abruptly narrowing from the broadest portion and broadly decurrent to wings of stipe, up to 60 cm long including stipe, 6 cm broad, the foliar portion about a half of whole length, subentire at margin; chartaceous, glabrous, green, paler below; midrib raised below, flat on upper surface, veins more or less visible on upper surface, usually forked near midrib, joining at apex to form submarginal veins about 0.5 mm inside margin. *Sori* elongate along vein, extending from near base to about 5 mm inside margin; indusia broad.

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

Distribution.— SW. China (type) and Indochina (Tonkin and Laos).

Ecology.— On moist limestone cliffs in dense forests at about 1900 m on Doi Chiang Dao.

10. Asplenium squamulatum Bl., En. Pl. Jav.: 174. 1828; Bedd., Handb. Suppl.: 27. 1892; Holtt., Rev. Fl. Malaya 2: 426. 1955; Tagawa & K. Iwats., Southeast As. St. 3(3): 84. 1965; 5: 86. 1967.

Rhizome short, creeping to suberect, scaly; scales up to 1.2 cm long, 1.3 mm broad, dark brown, clathrate, the margin paler, irregularly waved. *Stipe* dark green to brownish, up to 5 cm long and merging upwards with the decurrent base of frond, scaly throughout with small, brown, clathrate scales. *Lamina* simple, narrowly elliptic, long-acuminate at apex, broadest in upper $\frac{1}{4}$, then gradually narrowing towards attenuate base, 30–50 cm including stipe, up to 8 cm broad, subentire or slightly crisped at margin; leathery, green to dark green, with small scales on both surfaces when young; midrib distinctly raised below, minutely caducous scaly, flat and glabrous on upper surface; veins forming angles of about 45° or more with midribs, more or less visible on both surfaces, usually forked near midribs and free. *Sori* along simple or acroscopic branch of veins, from near midrib to about 1 cm from edge, occupying whole of under surface except basal portion; indusia up to 1 mm broad, thin but firm, not enrolling the sori, pale brown.

T h a i l a n d.— PENINSULAR: Trang (Khao Chong).

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

E c o l o g y.— On muddy rocks in dense evergreen forests at medium altitudes (about 600 m).

V e r n a c u l a r.— Kaprok hang sing (กะปรอกหางสิงห์) (South-eastern).

11. Asplenium scortechinii Bedd., J. Bot. 1887: 322; Handb. Suppl.: 27. 1892; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 220. 1940; Holtt., Rev. Fl. Malaya 2: 420. 1955; Dansk Bot. Ark. 20: 28. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 85. 1967. — *Asplenium annamense* Christ, J. Bot. 21: 232, 264. 1908; Tard., Aspl. Tonkin.: 28. pl. 1. f. 1–2. 1932.

Rhizome short, suberect, bearing a few to several fronds in a tuft, scaly near apex; scales oblong-lanceolate, gradually narrowing towards acute apex, about 7 by 3 mm, dark brown centrally, paler at edges, sometimes bearing irregular projections at margin, clathrate. *Stipe* not distinct from lamina, winged, stramineous or brownish. *Frond* simple, linear, up to 60 by 2.5 cm, broadest at middle, narrowing towards caudately long-acuminate apex, attenuate towards base, with shallow serration at margin at least in upper part or subentire; chartaceous, minutely scaly on midrib; midrib raised below, flat above, rather thick; lateral veins forming angles of 70–80° to midrib, simple or forked. *Sori* elongate along simple veins or

acroscopic branches of forked ones, from near midrib to about $\frac{2}{3}$ way towards edge of frond; indusia up to 1.3 mm broad, firm.

T h a i l a n d.— NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong, Khao Sung).

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

E c o l o g y.— On mossy tree-trunks or on mossy rocks usually in dense evergreen forests at 900–1600 m alt.

12. Asplenium salignum Bl., En. Pl. Jav.: 175. 1828; Holtt., Rev. Fl. Malaya 2: 421. f. 243. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 85. 1967. — *Asplenium mactieri* Bedd., J. Bot. 1883: 3; Handb. Suppl.: 27. 1892. — *Asplenium schmidtii* C. Chr., Bot. Tidsskr. 32: 346. 1916. — *Asplenium vulcanicum* auct. non Bl.: Christ, Bot. Tidsskr. 24: 108. 1901.

Rhizome short, ascending, scaly; scales appressed, narrowly subdeltoid, long-acuminate at apex, about 10 by 1.5 mm, dark brown and more or less clathrate centrally, the edges paler, thin-walled, irregularly margined, about 0.1 mm broad. *Stipe* 10–30 cm long, green to stramineous, darker towards base, wingless, glabrous or minutely scaly. *Lamina* simple to pinnate, simple frond like the terminal pinna of pinnate frond, up to 35 by 25 cm in pinnate form; lateral pinnae up to 3 pairs, shortly stalked or subsessile, linear, falcate, up to 20 by 2.2 cm, long-acuminate at apex, cuneate at base, entire, or minutely serrate above; terminal pinna and simple frond gradually narrowing towards long-acuminate apex, attenuate to cuneate at base, up to 30 by 3.5 cm, chartaceous, light green, glabrous or minutely scaly; midrib raised below, hardly so above, glabrous; veins forked near midrib, visible on both surfaces but not raised. *Sori* along acroscopic branches of veins, up to 7 mm long; indusia up to 0.7 mm broad, pale brown, thin but firm, persistent.

T h a i l a n d.— SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Surat Thani (Khao Nong), Phangnga (Nop Pring), Nakhon Si Thammarat (Khao Luang, Khiriwong), Satun (Boriphat Falls), Yala (Ban Chana).

D i s t r i b u t i o n.— S. China, Burma and Malesia (type from Java).

E c o l o g y.— On tree-trunks or on moist mossy rocks in humid places usually along streams in dense evergreen forests at low or medium altitudes (100–800 m).

N o t e.— Simple and pinnate fronds often co-exist on a single stock, and this species may indicate that the simple-fronded species are not phyletically distinct from the pinnately compound species. In simple form, this is very close to *A. scortechinii,* differing from it in shorter and proportionately broader fronds and acuter angles of sori, about 45° to midrib. This is also similar to *A. ensiforme,* but differs from it in usually toothed margin towards apex of pinnae. On the other hand, the pinnate form is similar to *A. tenerum* and the group of *A. serricula,* commonly khown as *A. wightianum.*

13. Asplenium tenerum Forst., Prod.: 80. 1786; Bedd., Handb.: 147. f. 74. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 226. 1940; Holtt., Rev. Fl. Malaya 2: 432. 1955; Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 3: 253. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 86. 1967; Acta Phytotax. Geobot. 23: 55. 1968. — *Asplenium tenerum* var. *retusum* C.Chr.: Tagawa & K.Iwats., Acta Phytotax. Geobot. 23: 50. 1968.

Rhizome short, ascending, up to 5 mm diam.; scales narrowing from base towards long-acuminate apex, about 5 by 1.2 mm, dark brown, clathrate, the edges bearing long projections. *Stipe* up to 15 cm long, dark green to dark brown, scaly throughout with smaller scales or glabrescent. *Frond* pinnate, usually widest at base, acuminate at apex, up to 27 by 8.5 cm; rachis winged throughout, minutely scaly when young, proliferous; lateral pinnae about 20 pairs, patent to slightly ascending, falcate, acuminate at apex, auricled and subtruncate at acroscopic base and subdimidiate to narrowly cuneate at basiscopic base, regularly serrate with a single veinlet in each tooth, up to 5 by 1.5 cm, the upper ones smaller; chartaceous, green, glabrescent; costa raised above, veins visible on both surfaces, simple or basal acroscopic ones forked; crenae at margin oblique, rounded at apex, one-nerved, about 2 by 1.3 mm. *Sori* elongate along veins, up to 4 mm long, from near costa to below sinus; indusia thin but persistent, up to 0.8 mm broad.

T h a i l a n d.— NORTHERN: Phitsanulok (Salaeng Haeng); SOUTH-EASTERN: Chanthaburi (Pong Nam Ron); PENINSULAR: Surat Thani (Pang Wan), Nakhon Si Thammarat (Khao Luang), Narathiwat (Sg. Padi), Trang (Khao Chong), Yala (Khao Kalakhiri, Khao Korewang).

D i s t r i b u t i o n.— Ceylon and S. India to Polynesia (type), north to Tonkin and Taiwan.

E c o l o g y.—On mossy tree-trunks or on rocks in dense evergreen forests at medium altitudes (500–1100 m).

14. Asplenium thunbergii Kunze, Linnaea 10: 517. 1836; Schelpe, J.S. Afr. Bot. 29: 92. 1963; Holtt., Rev. Fl. Malaya ed. 2. 2: 634. 1968. — *Asplenium decorum* Kunze, Bot. Zeit. 6: 176. 1848; Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 3: 276. 1965; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 50. 1968. — *Darea belangeri* Bory in Belang., Voy. Ind.-or. Bot. 2: 51. 1833. — *Asplenium belangeri* (Bory) Kunze, Bot. Zeit. 6: 176. 1848, non *A. belangeri* Bory, 1833: Bedd., Handb.: 161. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 243. 1940; Holtt., Rev. Fl. Malaya 2: 434. f. 252. 1955. Fig. 22. 4.

Rhizome short, suberect; scales subdeltoid with acuminate apex, up to 3 by 0.8 mm, dark brown to nearly black and clathrate in central portion, pale brown, thin-walled at edges with irregular small projections at margin. *Stipe* up to 7 cm long, green to brownish, minutely scaly or glabrescent. *Lamina* bipinnate-tripinnatifid, elliptic in outline, moderately acute at apex, subtruncate at base, up to 20 by 6 cm; rachis with the wings curved upwards and continuous to lamina; lateral pinnae about 15 pairs, shortly stalked with narrowly winged stalks, elliptic, round to obtuse at apex, auricled at acroscopic base, subdimidiate at basiscopic base, up to 4 by 1.5 cm; costa winged and just like the ultimate segments which are narrowly lanceolate, oblique, up to 7 by 1.2 mm, rounded at apex, entire, basal acroscopic ones once or twice forked, one-nerved, chartaceous, glabrous. *Sori* along veins, occupying posterior half of ultimate segments; indusia thin but firm, persistent, reaching the margin of segments, thus apparently bilobed opening outwards.

T h a i l a n d.— PENINSULAR: Phangnga (Khao Bangto), Nakhon Si Thammarat (Khiriwong).

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

E c o l o g y.— On trees or on mossy rocks in evergreen forests at medium altitudes (about 900 m).

15. Asplenium tenuifolium D.Don, Prod. Fl. Nepal.: 8. 1825; Bedd., Handb.: 159. f. 78. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 238. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 62. 1969.

Rhizome short, ascending to suberect, densely scaly; scales narrowly lanceolate, gradually narrowing from base towards apex, dark brown, clathrate, entire, about 4 by 0.8 mm. *Stipe* green or purplish, grooved above, scaly at base, glabrescent above, about 10 cm long. *Lamina* oblong-subdeltoid, rounded at base, acuminate at apex, up to 20 by 10 cm, quadripinnate to quadripinnatifid; rachis sometimes gemmiferous; lateral pinnae shortly stalked, unequally subtriangular, acuminate at apex, 10 by 2.5 cm, gradually becoming smaller upwards, basal ones a

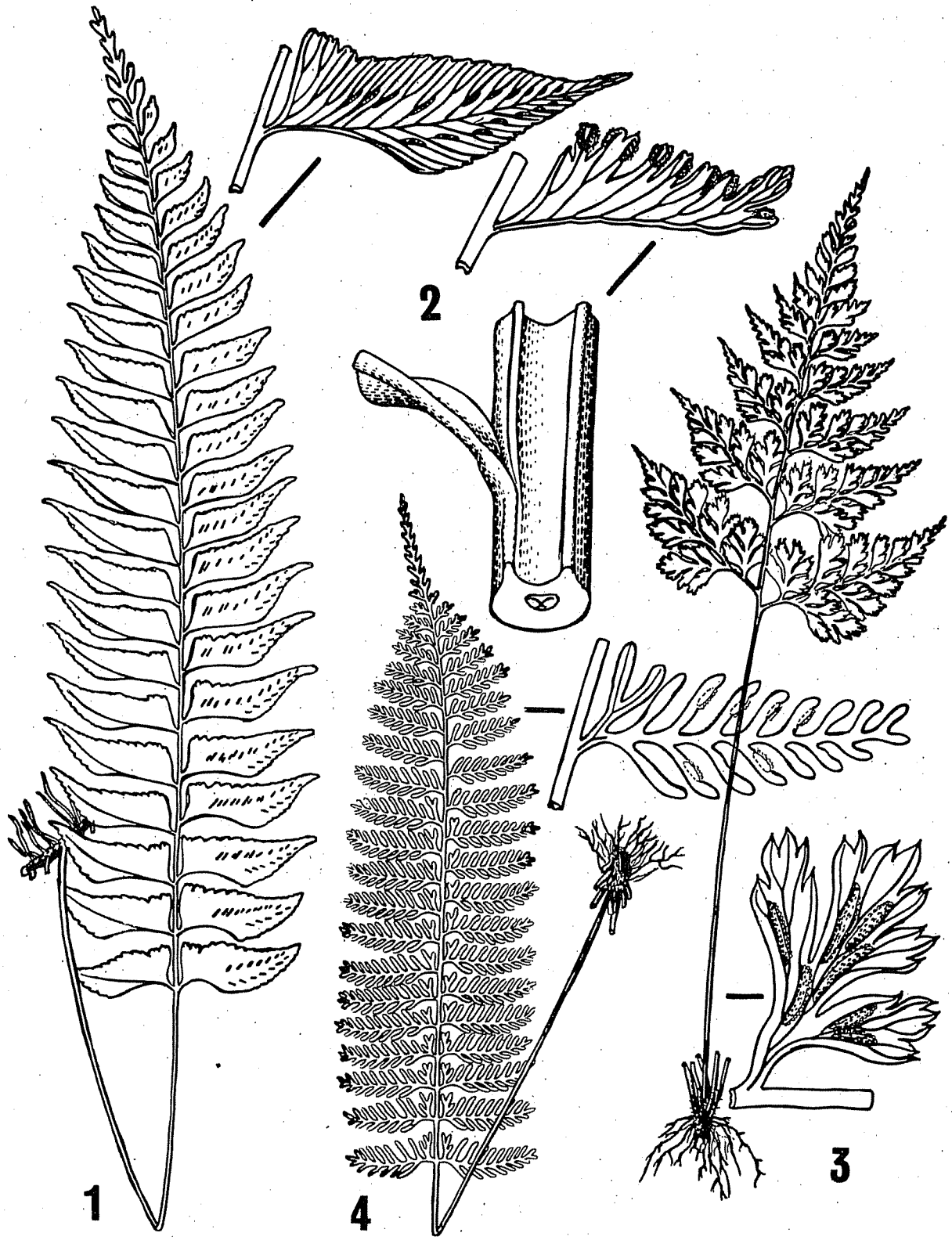

Figure 22. 1: *Asplenium obscurum*; plant, x 0.5; middle size pinna, natural size. 2: *Asplenium cheilosorum*; pinna, x 2; rachis construction, basal part of pinna, x 15. 3: *Asplenium interjectum*; plant, x 0.5; middle size pinnule, x 3. 4: *Asplenium thunbergii*; plant, x 0.5; small size pinna, x 2.

little smaller; pinnules ovate-subdeltoid, rounded to broadly cuneate at base, moderately acute to rounded at apex, up to 1.5 by 1 cm; secondary pinnules with a few lobed segments or a segment with a few lobes; ultimate lobes oblong, acuminate at apex, entire, about 1 mm broad, one-nerved; papyraceous, glabrous, light green. *Sori* one to each lobe, medial; indusia firm, pale green to whitish.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Inthanon); PENINSULAR: Chumphon (Bang Son).

D i s t r i b u t i o n.— Ceylon, S. India, E. Himalaya from Nepal (type) to Assam, SW. China, Indochina and Taiwan.

E c o l o g y.— Lower montane forests along streams in moist places.

16. Asplenium varians Wall. ex Hook. & Grev., Ic. Fil.: t. 172. 1829; Bedd., Handb.: 158. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 235. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 88. 1967.

Rhizome short, erect, bearing fronds in a tuft; scales narrowly elliptic, gradually narrowing towards apex, about 3.5 by 0.5 mm, dark brown, clathrate, entire. *Stipe* castaneous, or stramineous upwards, glabrous, grooved above, 2–3 cm long. *Lamina* oblong-subdeltoid, acute at apex, about 5 by 3 cm at base, bipinnatifid; rachis green, grooved above, glabrous; pinnae shortly stalked, with 3–6 segments below indistinctly dissected apical portion, about 2 by 1 cm; ultimate segments spathulate, round and toothed at apex, cuneate at base, herbaceous, green, glabrous; veins visible, each entering a tooth of ultimate segments. *Sori* 2 to 5 for each segment, up to 2 mm long, hardly confluent to each other; indusia enrolling the sori, thin but firm.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao).

D i s t r i b u t i o n.— S. Africa, Ceylon, S. India, Himalaya (type), China, Indochina, Japan and Hawaii.

E c o l o g y.— In moist muddy crevices of mossy limestone cliffs in dense forests at 1900–2000 m.

17. Asplenium interjectum Christ, Bull. Acad. Géogr. Bot. 11: 241. 1902; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 230. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 112. 1968. — *Asplenium* sp.; Holtt., Dansk Bot. Ark. 20: 29. 1961. Fig. 22. 3.

Rhizome short, creeping or ascending, densely scaly; scales narrowly elliptic, gradually narrowing towards acuminate but not hair-pointed apex, about 4 mm long, up to 0.7 mm broad, entire, nearly black, clathrate. *Stipe* purplish below, grooved on upper surface, up to 20 cm long. *Lamina* oblong-subdeltoid, widest at base, narrowing towards acuminate apex, up to 20 by 17 cm, bipinnate-tripinnatifid; pinnae up to 10 pairs, larger ones bipinnatifid, stalked, up to 8 by 3.5 cm, uper ones gradually becoming smaller and less dissected; rachis and costa pale green, grooved, glabrous; larger pinnules and upper pinnae deeply lobed with 2—5 segments, shortly stalked, up to 1.2 by 7 mm; ultimate segments oblong to spathulate, toothed at rounded to truncate apex, up to 5 by 3 mm, herbaceous to softly papyraceous, pale green to yellowish-green, glabrous; non-spore-bearing fronds shorter, thinner, usually not erect; veins distinct, a little raised. *Sori* 1 to 3 on each segment, 3—5 mm long, sometimes fusing to the neighbouring ones at maturity; indusia thin, ferrugineous.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao).

D i s t r i b u t i o n.— China (Kweichow, type) and Tonkin.

E c o l o g y.— On moist rocks usually on limestones in moist dense evergreen forests at 500—1600 m.

= Asplenium apogamum Murakami & Hatanaka

18. Asplenium unilaterale Lamk., Enc. 3: 305. 1786; Bedd., Handb.: 152. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 224. 1940; Holtt., Rev. Fl. Malaya 2: 438. 1955; Dansk Bot. Ark. 20: 29. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 84. 1967.

Rhizome long-creeping, 3—4 mm diam., bearing many roots on ventral and two rows of fronds on dorsal surfaces, scaly; scales gradually narrowing from base towards hair-pointed apex, up to 4 by 0.5 mm, dark brown to nigrescent, clathrate. *Stipe* close or up to 1 cm apart, castaneous to purplish, polished, scaly near the base, 10—25 cm long. *Frond* pinnate, lanceolate, broadest at basal $\frac{1}{5}$—$\frac{1}{8}$ portion, almost parallel or slightly narrowing upwards and then rather suddenly narrowing to caudate apex, 10—20 (—35) cm long, about 4 cm (sometimes up to 9 cm) wide; rachis terete throughout; pinnae usually 20—30 pairs, roundly quadrangular, posterior half of lower portion dimidiate, truncate and slightly auricled at acroscopic base, rounded at apex, lobed to $\frac{1}{5}$ way at upper and anterior half of lower margin, lobes rounded, oblique, moderately acute to rounded at apex, commonly 20 by 6 mm, sometimes up to 4 by 1 cm, a few lowest pairs shortly stalked, slightly smaller, more or less reflexed, thin, herbaceous, light green; veins visible. *Sori* 4—6 mm long; indusia herbaceous, pale, opening towards anterior side.

Thailand.— NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon), Lampang, Tak (Doi Musoe); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Pong Nam Ron, Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Wangka); PENINSULAR: Chumphon (Tha San), Ranong (Khao Phota Luang Kaeo, Tha Um), Trang (Khao Chong), Pattani (Bacho), Yala (Bannang Sata).

Distribution.— Widely distributed throughout the Old World tropics (type from Comoros), north to central Japan.

Ecology.— Terrestrial on wet sandy slopes on moist muddy rocks along streams in dense primeaval forests at 700—1800 m alt.

19. Asplenium excisum Presl, Epim.: 74. 1849; Holtt., Rev. Fl. Malaya 2: 439. f. 256. 1955; Dansk Bot. Ark. 20: 28. 1961; Tagawa & K. Iwats., Southeast As. St. 5: 84. 1967; K. Iwats., Acta Phytotax. Geobot. 27: 49. 1975.— *Asplenium unilaterale* f. *majus* C. Chr., B.P.Bishop Mus. Bull. 177: 67. 1943. — *Asplenium unilaterale* var. *majus* (C. Chr.) Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 3: 246. 1965.— *Asplenium unilaterale* auct. non Lamk.: Tard. & C. Chr. in Fl. Gén. I. - C. 7(2): 224. 1940, p.p.

Similar to *A. unilaterale* but different from it in: plants 30—40 cm long, 7—18 cm wide; pinnae larger, gradually becoming smaller upwards, the largest ones shortly stalked, a little falcate, up to 9 by 2 cm, acuminate at apex.

Thailand.— NORTHERN: Chiang Mai (Mae Ho, Doi Suthep), Lampang, Tak (Mae Sot, Ban Musoe), Phitsanulok (Thung Salaeng Luang, Huai Ya); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao, Pong Nam Ron).

Distribution.— Tropical Africa, Ceylon, S. India, Himalaya, Malesia throughout to Polynesia (type from Samoa) and Hawaii, north to Tonkin, S. China, Taiwan and the Ryukyus.

Ecology.— On wet ground or on wet muddy rocks usually along streams in dense forests at 300—1500 m alt.

Note.—It is elucidated that *A. unilaterale* s. lat. is a composite species. More detailed observation is necessary to conclude the systematic treatment of Thai plants. Cf. K. Iwats., Acta Phytotax. Geobot. 27:39—54.1975; N.Murakami & K. Iwats., J. Jap. Bot. 257—262. 1983.

20. Asplenium obscurum Bl., En. Pl. Jav.: 181. 1828; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 225. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3): 84. 1965; 5: 85. 1967. Fig. 22.1.

Similar to *A. excisum* but differing in: rhizome not so long, often green and fleshy; stipe and rachis green or brownish, never polished; lateral pinnae patent, little falcate, less widely spaced; sori short, usually up to 3 mm long, allantodioid or in more or less sausage-form.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Tung, Doi Phacho), Chiang Mai (Doi Suthep, Doi Inthanon), Lamphun (Doi Khun Tan).

D i s t r i b u t i o n.— Madagascar, Ceylon, S. India and E. Himalaya, Burma, Indochina, S. China, Taiwan, and throughout Malesia (type from Java).

E c o l o g y.— On wet sandy ground or on moist muddy rocks in evergreen forests at 900—1600 m alt.

21. Asplenium cheilosorum Kunze ex Mett., Abhandl. Senckenb. Naturf. Ges. 3: 177. t. 5. f. 12–13. 1859; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 223. 1940; Holtt., Rev. Fl. Malaya 2: 435. f. 253. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 84. 1967. — *Asplenium heterocarpum* Wall. ex Hook., Sp. Fil. 3: 132. t. 175. 1860; Bedd., Handb.: 153. f. 77. 1883; Hosseus, Beih. Bot. Centr. 28(2): 364. 1911. Fig. 22. 2.

Rhizome long-creeping, 2.5–4 mm diam., bearing two rows of alternate fronds closely on dorsal surface, scaly near apex; scales gradually narrowing from base towards long, hairy apex, up to 4 by 0.5 mm, clathrate, sometimes the cell-walls very thick. *Stipe* 8–18 cm long, purple, polished but dirty on the lower portion, more or less warty on upper portion. *Frond* pinnate, narrowly lanceolate in outline, subtruncate at base, attenuately acuminate at apex, 20–30 by up to 5 cm; pinnae up to 40 or more pairs, subquadrangular, dimidiate, the lower half very narrow, thus the midrib close to entire lower margin, rounded at apex, truncate at acroscopic base, lobed to $\frac{1}{5}$ way on upper margin, lobes rounded or forked at apex, about 1 mm broad, usually a lobe placed on each apical portion of lower margin, up to 25 by 8 mm, a few lower pairs slightly reduced or reflexed, shortly stalked, thin, pale green; veins distinct, all free. *Sori* confined to lobes, one or rarely two on each lobe, 1.5–2 mm long; indusia thin, opening outwardly.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi

Suthep, Doi Inthanon, Doi Hua Mot), Mae Hong Son (Mae La Noi), Phetchabun (Phu Miang); NORTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Ceylon (type), S. India, E. Himalaya, S. China, Burma, Indochina, Malaya, Borneo, Philippines, Taiwan and north to southern edge of Japan.

E c o l o g y.— On moist muddy rocks or terrestrial on wet sandy slopes usually along streams in lower montane forests at 1000 –1800 m alt.

22. Asplenium normale D.Don, Prod. Fl. Nepal.: 7. 1825; Bedd., Handb.: 144. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 225. 1940; Holtt., Rev. Fl. Malaya 2: 436. f. 254. 1955; Dansk Bot. Ark. 20: 28. 1961; 23: 236. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 86. 1967.

Rhizome short, erect, scaly; scales gradually narrowing from base towards hair-pointed apex, up to 4 by 0.7 mm, bicoloured, the central portion black, with longitudinal cells, the edges brown to dark brown. *Stipe* very deep castaneous to nearly black, more or less polished, up to 15 cm long, usually about 10 cm long, grooved with two low but distinct ridges on adaxial surface. *Frond* lanceolate to narrower, pinnate, slightly narrowing at base, gradually narrowing upwards, caudately acuminate at apex, up to 30 by 4.5 cm; rachis wingless throughout, viviparous; lateral pinnae up to 40 pairs, sessile, patent or slightly reflexed, oblong, rounded at apex, lobed to $\frac{1}{5}$ way on both margins, narrowly cuneate at basiscopic base, auricled and truncate at acroscopic base, about 20 by 6 mm; midrib rarely viviparous; veinlets simple or forked, not running to the very top of lobes. *Sori* up to 3 mm long; indusia thin.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Khun Huai Pong), Mae Hong Son (Khun Mae Lan); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Krabi (Khao Phanom Bencha), Nakhon Si Thammarat (Khao Luang), Songkhla (Khao Khieo).

D i s t r i b u t i o n.— Old World tropics throughout, north to Himalaya (type) and Japan.

E c o l o g y.— Terrestrial on rather dry slopes, humus-rich slopes or on *Sphagnum*-bog, on wet muddy rocks or in crevices of cliffs, or on mossy basal tree-trunks in lower montane forests usually at above 1000 m altitude.

N o t e.— Holttum referred this species to the group of *A. unilaterale (Hymenasplenium)*, though it differs from the latter in erect rhizome radial in construction, bicoloured scales and gemmiferous rachis.

23. Asplenium siamense Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 17. 1971. — *Asplenium trichomanes* var. ?: Holtt., Dansk Bot. Ark. 20: 29. 1961.

Rhizome short, ascending or suberect, bearing several living fronds and numerous stipes without pinnae, and appearing brush-like, densely scaly; scales gradually narrowing from base towards acuminate apex, about 2.5 by up to 0.4 mm, nearly black with brown edges which becoming fimbriate or soft hairy in age. *Stipe* very dark purple to nearly black, polished, glabrous but scaly at base, up to 4 cm long or in smaller fronds less than 1 cm. *Lamina* simply pinnate except for the decompound apical portion, 3—8 cm long, lower half of lamina pinnate, 6—10 mm wide, nearly parallel at edges; pinnae sessile, 2—5 mm apart, rounded at apex, a little ascending and nearly straight at basiscopic side, subtruncate at inner side, and shallowly lobed at acroscopic edge, 3—7 by 2—3 mm, fallen ones leaving minute scars on rachis; lobes rounded, with round sinus; veins hardly visible, a few times forked, not reaching the margin of lobes; rachis bearing branches at middle or above, sometimes the axes forked a few times, each branch taking appearance of pinnate frond; the apical pinnae adnate at base ending in indistinct apical pinnae. *Sori* one to three in each lobe, 1—1.5 mm long; indusia covered under sporangia at maturity.

Thailand.— NORTH-EASTERN: Loei (Phu Kradueng, type).

Distribution.— Endemic.

Ecology.— Sandstone rock at about 1300 m alt., known only by the type collection, SOERENSEN et al. 2279, 7905 (C, K).

24. Asplenium longissimum Bl., En. Pl. Jav.: 178. 1828; Bedd., Handb.: 145. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 226. 1940; Holtt., Rev. Fl. Malaya 2: 427. f. 245. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 86. 1967.

Rhizome short, suberect, about 5 mm diam., densely scaly; scales gradually narrowing towards hair-pointed apex, up to 5 by 0.8 mm, entire, dark brown, clathrate with long cells. *Stipe* up to 20 cm or more long, or lower pinnae placed just above the rhizome leaving stipe of less than 3 cm, purple or darker, scaly when young. *Frond* more than 1 m long, pinnate, usually viviparous at apical portion of rachis, up to 20 cm or more wide; rachis grooved and scaly with narrow scales on upper surface; lateral pinnae usually more than 50 pairs, sessile or very short stalked, patent or slightly ascending, almost straight, truncate at acroscopic and broadly cuneate at basiscopic bases, slightly rounded and auricled at both sides, gradually narrowing towards caudately long-acuminate apex, slightly serrate at margin; midrib with two ridges above, veins once or twice forked. *Sori* long, from near the midrib, up to 1 cm long, a little curved; indusia rather firm, persistent.

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

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

Ecology.— On rather dry ground along path in light shade at about 200 m alt.

25. Asplenium pellucidum Lamk., Enc. 2: 305. 1786; Holtt., Rev. Fl. Malaya 2: 428. f. 246. 1955; Dansk Bot. Ark. 20: 28. 1961; 23: 236. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 86. 1967. — *Asplenium hirtum* Kaulf., Enum.: 169. 1824; Bedd., Handb.: 149. 1883.

Rhizome short, erect, up to 1 cm diam., densely scaly; scales gradually narrowing from base towards long-tailed apex, up to 10 by 0.8 mm, dark brown to black, bright, with very thick internal cell-wall. *Stipe* dark purple, up to 10 cm or more long, or reduced pinnae auricle-like placed just above the rhizome. *Frond* lanceolate in outline, broadest at middle, gradually narrowing towards both apex and base, up to 50 cm or more long, 10 cm wide; rachis covered with linear scales; lateral pinnae many, up to 50 pairs, the middle ones the largest, patent, sessile, gradually narrowing towards round to acute apex, broadly cuneate to truncate at roundly auricled acroscopic base, narrowly cuneate at basiscopic base, lobed to $\frac{2}{5}$ at margin, up to 5 by 2.5 mm, rounded at slightly waved apex, including 4 or 5 veinlets branched from a single lateral vein, papyraceous to thinly chartaceous; veins more or less visible. *Sori* elongate along posterior veinlets of vein groups, up to 7 mm long, more or less curved, not reaching the lobes.

Thailand.— NORTHERN: Tak (Ban Musoe); CENTRAL: Nakhon Nayok (Khao Yai, Nang Rong Falls); EASTERN: Nakhon Ratchasima (Kathok); SOUTH-EASTERN: Chanthaburi (Khao Sabap), SOUTH-WESTERN: Kanchanaburi (Klang Dong); PENINSULAR: Nakhon Si Thammarat (Thung Song), Trang (Khao Chong), Satun, Yala (Betong).

Distribution.— Old World tropics, from E. Africa (type) to New Guinea, north to Sikkim.

Ecology.— On mossy tree-trunks or on mossy or moist, muddy rocks usually near streams in evergreen forests at 100–900 m alt.

26. Asplenium paradoxum Bl., En. Pl. Jav.: 179. 1828; Bedd., Handb.: 151. f. 76. 1883; Holtt., Rev. Fl. Malaya 2: 430. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 86. 1967.

Rhizome short, ascending, 5 –7 mm diam., densely scaly throughout; scales gradually narrowing towards acuminate apex, entire, up to 7 by 1 mm, dark brown, the margin a little paler. *Stipe* stramineous or darker, purplish at basal portion, sparsely scaly, up to 20 cm long. *Frond* broadly lanceolate, pinnate, acute at apex, round at base, up to 40 by 15 cm; rachis stramineous, darker below, minutely scaly or glabrescent, gemmiferous at upper portion; pinnae about 10 pairs, ascending, stalked, lower ones with stalks of 0.5 –1 cm, falcate, gradually narrowing from base towards apex, caudately acuminate at apex, broadly cuneate and roundly auricled at acroscopic base and cuneate at basiscopic base, minutely toothed at margin, up to 10 by 3 cm, softly chartaceous to papyraceous, light green; costa grooved above with ridges, raised below, glabrous, the other veins hardly visible. *Sori* long, up to 2.5 cm long, occupying almost the whole length of veins, 1–3 for each vein group, open to posterior side.

T h a i l a n d.— NORTH-EASTERN: Loei (Phu Luang); PENINSULAR: Patthani (Ban Sai Khao).

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

E c o l o g y.— On moist muddy rocks in lower montane and evergreen forests up to 1500 m alt.

27. **Asplenium macrophyllum** Sw., Schrad. J. Bot. 1800(2): 52. 1801; Bedd., Handb.: 150. 1883; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 4. 1929; Holtt., Rev. Fl. Malaya 2: 431. f. 249. 1955; Dansk Bot. Ark. 20: 28. 1961; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958; Tagawa & K. Iwats., Southeast As. St. 5: 87. 1967.

Rhizome short, ascending, up to 1 cm diam., densely scaly; scales gradually narrowing towards long-acuminate apex, about 5 by 1 mm, dark brown to black with narrow margin only in young ones. *Stipe* up to 25 cm long, purplish, scaly or glabrescent. *Frond* oblong to narrowly oblong-subdeltoid, usually broadest just above the very base, rounded at base, acute at apex, up to 35 by 28 cm, imparipinnate; lateral pinnae 3–6 pairs, with the stalks less than 5 mm long, cuneate at basiscopic and roundly auricled at acroscopic bases, gradually narrowing towards caudately long-acuminate apex, up to 12 by 4.5 cm, distinctly toothed at margin, the basal second pair usually the largest; terminal pinnae larger, broadly rounded to subhastate at base, up to 12 by 6 cm, chartaceous; veins more or less visible, forming narrow angles with costa. *Sori* long, usually occupying the whole length of veinlets from near costa to near margin, up to 3 cm long; indusia herbaceous, open to posterior side.

T h a i l a n d.— EASTERN: Nakhon Ratchasima (Pak Thong Chai);

SOUTH-EASTERN: Chon Buri (Si Racha); PENINSULAR: Chumphon (Khao Klong), Surat Thani (Ko Tao, Khao Hua Khwai, Ban Don), Phangnga (Takua Thung), Nakhon Si Thammarat (Khao Luang, Chawang), Satun, Pattani, Yala (Khao Kalakhiri).

Distribution.— Old World tropics, E. Africa (type) to Polynesia, north to Tonkin and Taiwan.

Ecology.— On rocks, on mossy tree-trunks or terrestrial on calcareous rocky slopes in evergreen forests at low altitudes below 700 m.

28. Asplenium falcatum Lamk., Enc. 2: 306. 1786; Bedd., Handb.: 150. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 229. 1940; Sledge, Bull. Brit. Mus. (Nat. Hist). Bot. 3: 261. 1965. — *Asplenium adiantoides* (Linn.) C. Chr., Ind. Fil.: 99. 1905, non Lamk. 1786; Bonap., Not. Pterid. 14: 57. 1923; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 4. 1929; Holtt., Rev. Fl. Malaya 2: 431. f. 250. 1955.

Close to *A. macrophyllum,* Differing from it in narrower, falcate pinnae, lobed to $\frac{1}{3}$ way towards costa. Lateral pinnae stalked, up to 12 by 2 cm.

Thailand.— EASTERN: Buri Ram (Khao Luang); PENINSULAR: Chumphon (Thap Li), Nakhon Si Thammarat (Thung Song), Phangnga (Thap Put, Takua Thung)

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

Ecology.— On mossy trunks in mountain forests.

29. Asplenium caudatum Forst., Prod.: 80. 1786; Bedd., Handb.: 151. 1883; Holtt., Rev. Fl. Malaya 2: 428. f. 247. 1955; Dansk Bot. Ark. 20: 28. 1961.

Similar to *A. falcatum,* but the pinnae many, more than 20 pairs, narrower, hardly 1.5 cm broad, lobed more than $\frac{1}{3}$ way towards costa, often densely scaly on rachis and stipe.

Thailand.— NORTHERN: Chiang Mai (Doi Suthep, foot of Doi Inthanon); NORTH-EASTERN: Loei (Wang Saphung).

Distribution.— SE. Asia generally to Polynesia (type).

Ecology.— On mossy trunks or on mossy rocks in dense forests.

30. Asplenium crinicaule Hance, Ann. Sci. Nat. V. 5: 254. 1866; Bedd., Handb.:

150. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 227. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 87. 1967. — *Asplenium pellucidum* auct. non Lamk.: Christ, Bot. Tidsskr. 24: 108. 1901; C. Chr., Bot. Tidsskr. 32: 346. 1916.

Rhizome short, erect, densely scaly; scales gradually narrowing from base towards hairy pointed apex, up to 7 by 1 mm, the margin bearing irregular and sparse projections, brown to black. *Stipe* usually up to 10 (rarely up to 15) cm long, dark brownish-purple to nearly black, bearing narrow scales throughout. *Frond* narrowly lanceolate, gradually narrowing towards both ends, acuminate at apex, usually about 30 by 6 cm, fairly variable in size; rachis with very narrow hair-like scales; lateral pinnae about 25 pairs, sessile, narrowly subtriangular to elliptic, falcate or nearly patent, acute at apex, auricled at acroscopic base, narrowly cuneate at basiscopic base, the middle largest ones 2.5—5.5 by 0.7—1.5 cm, indistinctly lobed; lobes with a few teeth, each containing a single veinlet, softly chartaceous, deep green in living condition and brown when dried. *Sori* long, crescent-shaped along the posterior veinlens, opening towards posterior.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Chiang Dao, Doi Suthep), Lampang (Mae Tai), Lamphun (Doi Khun Tan); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok), Prachuap Khiri Khan (Huai Yang).

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

E c o l o g y.— On mossy tree-trunks or on mossy or muddy rocks, usually in lower montane forests at 900—1600 m alt.

31. Asplenium yoshinagae Makino, Phan. Pterid. Jap. Ic. Ill. 1: pl. 64. 1900; K. Iwats., Acta Phytotax. Geobot. 26: 172. 1975. — *Asplenium planicaule* Wall. ex Mett., Abhandl. Senckenb. Naturf. Ges. 3: 201. 1859, non Lowe 1858: C. Chr., Contr. U.S. Nat. Herb. 26: 332. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 231. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 87. 1967. — *Asplenium indicum* Sledge, Bul. Brit. Mus. (Nat. Hist.) Bot. 3: 264. 1965. Fig. 23. 1.

Rhizome short, erect, scaly; scales dark brown to nearly black, narrow, subulate, entire, up to 5 by 0.5 mm. *Stipe* usually up to 15 cm long, dark green to brownish, not polished, sparsely scaly. *Frond* narrowly lanceolate, commonly about 20 by 5 cm, sometimes up to 40 by 8 cm, acute to acuminate at apex, pinnate; rachis like the upper part of stipe, rarely gemmiferous; pinnae 12—25 pairs, stalked, dimidiate, rhomboid, acute at apex, broadly cuneate and auricled at acroscopic base, narrowly cuneate and entire at basiscopic base, margin irregularly lobed with

dentate margin, 2—4 by 0.7—1.5 cm, chartaceous, deep green, brownish in dried specimens. *Sori* elongate, many near the costa.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon); Lamphun (Doi Khun Tan), Tak (Ban Musoe); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Wang Saphung), Khon Kaen (Phu Wiang); CENTRAL: Saraburi (Hin Lap); PENINSULAR: Surat Thani (Ban Don).

D i s t r i b u t i o n.— Ceylon, N. & S. India, Burma, S. China, Indochina, Taiwan, Philippines, north to Japan (type).

E c o l o g y.— Usually epiphytic on mossy tree-trunks in dense forests at altitudes above 1300 m.

32. Asplenium perakense Matthew & Christ, J. Linn. Soc. Bot. 39: 214. 1909; Holtt., Rev. Fl. Malaya 2: 429. f. 248. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 88. 1967.

Rhizome short, suberect, bearing a tuft of fronds, densely scaly; scales gradually narrowing from base towards hair-pointed apex, entire, or with a few long projections near base, up to 10 by 1 mm at base, brown. *Stipe* polished black to dark brownish-purple, scaly throughout, 10—25 cm long. *Frond* narrowly oblong, acute at apex, a little reduced downwards, up to 40 by 16 cm; rachis like the upper part of stipe, scaly with narrow scales; pinnae 15—20 pairs, stalked, middle ones the largest, ascending, narrowly subtriangular, caudately acuminate at apex, auricled at acroscopic and cuneate at basiscopic bases, lobed nearly to costa, up to 8 by 2.5 cm; lobes oblong or quadrangular, oblique, dentate at apex, usually 5—7 mm wide; softly chartaceous to chartaceous, veins visible. *Sori* long, crescent-shaped, 1—4 for each lobe; indusia herbaceous.

T h a i l a n d.— PENINSULAR: Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Malaya (type).

E c o l o g y.— On mossy tree-trunks or on moist rocks in lower montane forests at 1000—1700 m alt.

33. Asplenium nitidum Sw., Syn. Fil.: 84, 280. 1806; Bedd., Handb.: 157. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 237. f. 27, 1. 1940.— *Asplenium glaucophyllum* v. A. v. Ros., Bull. Jard. Bot. Buit. II. 7: 6. 1912; Holtt., Rev. Fl. Malaya 2: 440. f. 258. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 55. 1968.

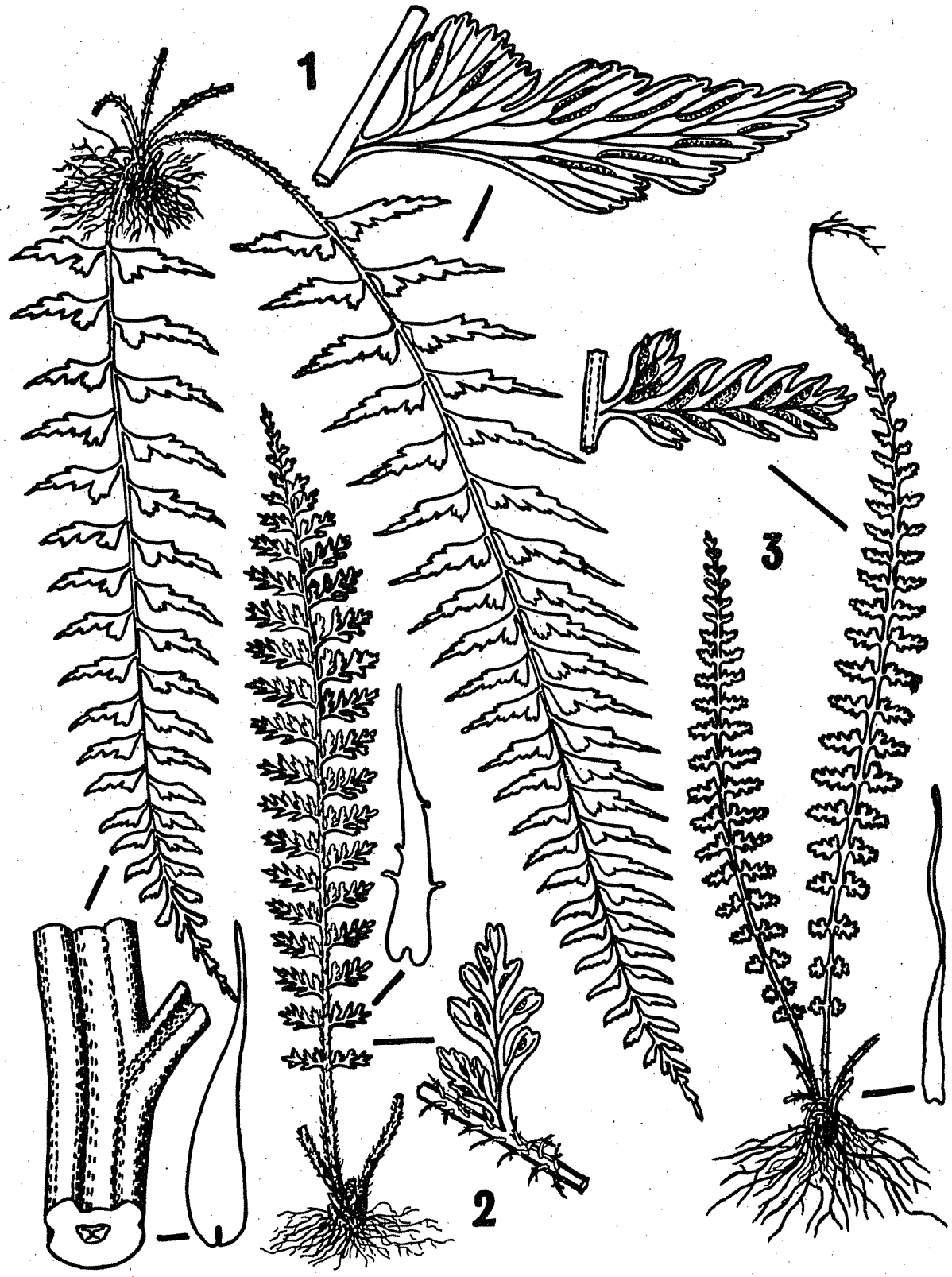

Figure 23. 1: *Asplenium yoshinagae*; habitat, x 0.5; small size pinna (top right), x 2; basal part of pinna (bottom left), x 10; scale (bottom right), x 20. 2: *Asplenium rockii*; plant, left half of frond when dry, right half when wet, natural size; scale on stipe, x 15; small size pinna (below right), x 3 scales on lamina omitted. 3: *Asplenium exiguum*; plant, natural size.; small size pinna, x 3; scale on stipe (bottom right), x 20.

Rhizome short-creeping, densely scaly; scales narrow, gradually narrowing from base to long-tailed apex, up to 1.5 cm long, 1 mm broad, entire and distinctly crisped, brown, finely clathrate. *Stipe* nearly black, glabrous, up to 40 cm long. *Frond* bipinnate, elliptic or narrower, narrowing towards acuminate apex, slightly narrow at base, about 60 by 25 cm; rachis dark, glabrous, slightly grooved on upper surface; lateral pinnae more than 10 pairs, with stalks of about 1 cm, ascending, narrowly lanceolate, narrowing towards acuminate apex, truncate at base, up to 13 by 4 cm; costa wingless, grooved, glabrous; pinnules about 8 pairs,below indistinctly lobed apical portion, shortly stalked, round to moderately acute at apex, truncate at acroscopic base, dimidiately cuneate at basiscopic base, up to 2.2 by 1.2 cm, shallowly toothed at margin, papyraceous, glabrous; veins subdichotomously 3 to 5 times forked, visible on both surfaces. *Sori* 5—7 mm long; indusia thin, pale.

T h a i l a n d.— PENINSULAR: Patthani (Bacho).

D i s t r i b u t i o n.— Ceylon, S. India (type), E. Himalaya (Nepal to Assam) and W. Malesia (Malaya, Sumatra, Borneo and Java).

E c o l o g y.— Not recorded.

N o t e.— Known only from one collection in Thailand, KERR 7227 (BK, BM, K). In its smaller size and rounded to moderately acute apex of pinnules, this specimen differs slightly from the typical form, though the other features accord very well with the Himalayan and Malesian specimens.

34. Asplenium affine Sw., Schrad. J. Bot. 1800(2): 56. 1801; Bedd., Handb.: 157. 1883; Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 3: 269. f. 2. 1965; Holtt., Rev. Fl. Malaya ed. 2. 2: 634. 1968. — *Asplenium spathulinum* J. Smith ex Hook., Sp. Fil. 3: 170. 1860, non Kunze 1848: Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 238. 1940; Holtt., Rev. Fl. Malaya 2: 439. f. 257. 1955; Dansk Bot. Ark. 20: 28. 1961.

Rhizome short-creeping, ascending, densely covered with scales at apex; scales linear, gradually narrowing towards hair-pointed apex, up to 15 by 1 mm, dark brown, clathrate, entire, more or less crisped at upper portion. *Stipe* dark green to nearly black, minutely scaly or glabrescent, about 15 cm long. *Lamina* oblong-subtriangular, narrowing towards apex, about 30 by 15 cm, bipinnate; pinnae more than 10 pairs, lowest ones the largest, stalked, oblong-subtriangular, acuminate at apex, broadly cuneate at base, up to 10 by 3.5 cm; pinnules of lower pinnae oblong-subquadrangular, rounded to moderately acute at apex, narrowly cuneate at base, shortly stalked or subsessile, lobed to $\frac{1}{4}-\frac{1}{3}$, or deeply lobed to have an acroscopic lobe, about 15 by 6 mm; lobes acute to moderately acute at apex, serrate with one-nerved teeth, chartaceous to subcoriaceous; veins distinct on both

surfaces, a few times forked. *Sori* many, up to 5 mm long; indusia pale, stiff and persistent.

Thailand.— NORTHERN: Phitsanulok (Nakhon Thai), Tak (Ban Musoe); NORTH-EASTERN: Loei (Phu Kradueng); SOUTH-EASTERN: Prachin Buri (Ban Ban Hills); PENINSULAR: Phangnga (Ko Ra, Nai Chong).

Distribution.— Madagascar, Mascarene Islands (type), Seychelles, Ceylon, S. India, Hainan, Cambodia, Malesia to New Hebrides and Fiji.

Ecology.— On mossy tree-trunks in moist dense forests at medium altitudes (400–1300 m).

35. Asplenium confusum Tard. & Ching, Not. Syst. 5: 148. pl. 4. f. 3. pl. 7. 1936; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 240. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 88. 1967. — *Asplenium laserpitiiforme* auct. non Lamk.: Christ, Bot. Tidsskr. 24: 107. 1901; C. Chr., Bot. Tidsskr. 32: 346. 1916; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8: 4. 1929.

Rhizome short, ascending, densely scaly; scales narrow, gradually narrowing towards hair-pointed apex, about 20 by 0.8 mm, entire, greyish to dark brown, crisped. *Stipe* about 20 cm long, dark stramineous to polished dark purple or nearly black, grooved above. *Lamina* elliptic to oblong-subtriangular, acuminate, 30–40 by 10–20 cm, tripinnate; rachis glabrous, grooved; lower pinnae 2–5 cm from the next ones, ascending, oblong-subtriangular, cuneate to subtruncate at base, gradually narrowing and bending up towards caudately acuminate apex, stalked, 10–15 by up to 5 cm; larger pinnules stalked, oblong-subtriangular, acute at apex, cuneate at base, pinnatifid to pinnate, up to 3 by 1.5 cm; ultimate segments (or secondary pinnules) spathulate, rounded and toothed at apex, cuneate and sessile at base, up to 10 by 5 mm, sometimes lobed to half-way, papyraceous to coriaceous; veins raised on both surfaces. *Sori* up to 7 mm long, usually nearly to midrib, close together but rarely confluent; indusia thin but firm, persistent.

Thailand.— NORTHERN: Phitsanulok (Thung Salaeng Luang), Tak (Mae Sot, Huai Krasa); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); EASTERN: Buri Ram (Khao Krap); SOUTH-EASTERN: Chon Buri (Si Racha), Prachin Buri (Ban Ban Hills), Chanthaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN: Prachuap Khiri Khan; PENINSULAR: Chumphon (Ban Krayae), Surat Thani (Ko Tao, Khlong Bakatae, Ko Samui, Ban Don), Phangnga (Pulao Tiban).

Distribution.— Indochina (type).

E c o l o g y.— On mossy tree-trunks or often on root mass of *Asplenium nidus* in dense evergreen forests at low to medium altitudes.

V e r n a c u l a r.— Kraprok hang maeo (กะปรอกหางแมว) (South-eastern).

N o t e.— We refer all the tripinnate plants of this group from Thailand to *A. confusum,* but we are not quite sure this identification. The variation among the specimens at hands ranges widely in texture (herbaceous to coriaceous), in the degree of involution of segments, in the form and size of pinnae, pinnules and segments, and in the length and position of sori.

36. Asplenium exiguum Bedd., Ferns S. Ind.: 49. t. 146. 1863; Tard. & C. Chr. in Fl. Gén. I.- C. 7(2): 234. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 112. 1968. Fig. 23.3.

Rhizome short-creeping, bearing fronds very close together or nearly in a tuft; scales narrowly lanceolate, gradually narrowing towards hair-pointed apex, up to 7 by 0.6 mm, dark brown to nearly black, clathrate, entire. *Stipe* castaneous to purplish, polished, bearing linear scales when young, up to 5 cm long, often bearing pinnae nearly to the base. *Lamina* narrowly lanceolate, attenuate towards both ends, about 10 by 1.5 cm, pinnate; lateral pinnae about 20 pairs, the middle ones the largest, stalked, oblong, patent, rounded at apex, auricled at acroscopic and cuneate at basiscopic bases, variously lobed, about 6 by 2 mm, the lower ones reflexed and the upper ones ascending; rachis paler or stramineous, glabrescent, grooved above; segments of pinnae usually oblique, narrowly subdeltoid, rounded to obtuse and toothed at apex, separated by broad sinus, thinly papyraceous, glabrous; veins hardly visible, simple to a few times forked. *Sori* one to several on each pinna, 1–2 mm long, usually confluent at maturity occupying the whole under surface of pinna; indusia pale, firm but burst at maturity.

T h a i l a n d.— NORTHERN: Chiang Mai (Doi Chiang Dao).

D i s t r i b u t i o n.— S. India (type), Himalaya to China, Tonkin, Taiwan and the Philippines.

E c o l o g y.— On moist mossy limestone cliffs in thicket at 1900–2100 m.

37. Asplenium rockii C. Chr., Contr. U.S. Nat. Herb. 26: 332. pl. 27. 1931; Tagawa & K. Iwats., Southeast As. St. 5: 88. 1967. — *Asplenium* sp.: Holtt., Dansk Bot. Ark. 23: 29. 1967. Fig. 23.2.

Rhizome short, creeping or ascending; scales narrowly subtriangular, gradually narrowing towards hair-pointed apex, about 4 by 0.5 mm, dark brown to nearly black, clathrate, entire or bearing irregular projections. *Stipe* up to 5 cm long, with dense patent scales, stramineous to darker. *Frond* bipinnate - tripinnatifid, narrowly elliptic, acute at apex, narrowing towards base, up to 20 by 4.5 cm; rachis densely scaly throughout; pinnae 20 or more pairs, elliptic-subdeltoid, acute to truncate at apex, cuneate at base, with larger basal acroscopic pinnules, subsessile, up to 2.3 by 1.2 cm; costa winged, about 0.7 mm broad, minutely scaly below, pinnules about 5 pairs, spathulate, cuneate at base, with 2–4 teeth at apex, up to 7 by 3.5 mm; ultimate lobes (or teeth of pinnules) one-nerved, about 0.5 mm broad, chartaceous to subcoriaceous, edges usually revolute, with narrow scales on axes and veins, glabrous on laminar surfaces, green to deep green. *Sori* elliptic, usually one to each segment, indusia pale, thin.

T h a i l a n d.— NORTHERN: Chiang Rai (Doi Pha Cho), Chiang Mai (Doi Chiang Dao, Doi Suthep–type, Doi Inthanon); NORTH-EASTERN: Loei (Phu Luang).

D i s t r i b u t i o n.— Burma : N'Bapa-Nawng Haeng, DICKASON F 290A (C). A specimen from S. Lushai, WAGNER 26 (BM), is also referable to this.

E c o l o g y.— On lower level of tree-trunks, usually in dense moist forests at medium to high altitudes.

INDEX

FLORA OF THAILAND VOLUME 3 PART 1 & 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

FLORA OF THAILAND

Index of families treated

(volume, part : page number)

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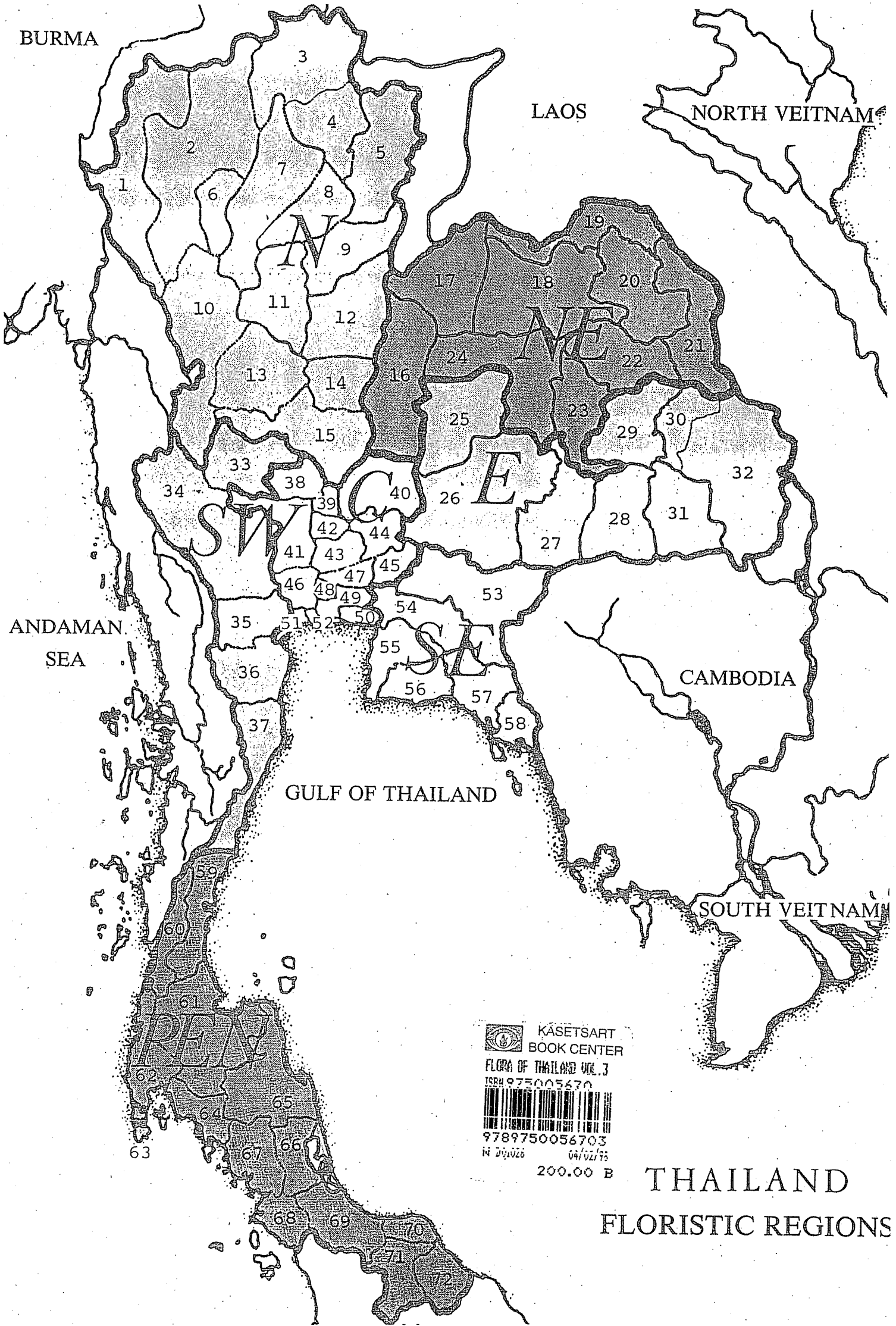

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