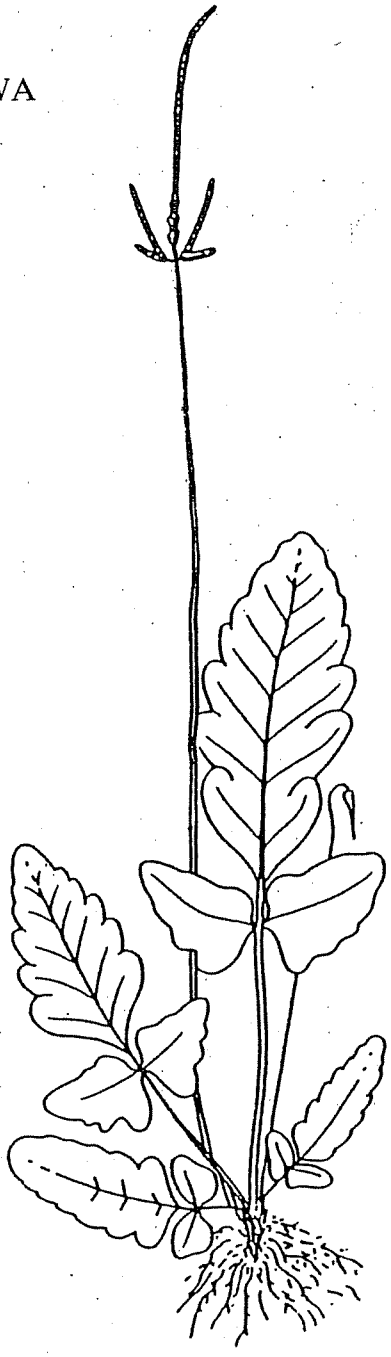
FLORA OF THAILAND

VOLUME THREE **PART THREE**

PTERIDOPHYTES

M. TAGAWA K. IWATSUKI



BLECHNACEAE
LOMARIOPSIDACEAE
DRYOPTERIDACEAE

THELYPTERIDACEAE
ATHYRIACEAE

FLORA OF THAILAND

VOLUME THREE PART THREE

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23. BLECHNACEAE

Of the seven genera currently credited to this family, the following three are known from Thailand. There are more than 200 species in this family, distributed mainly in the southern hemisphere; only five species have been collected in Thailand.

KEY TO THE GENERA

1. Indusiate; rhizome not forming trunk
 2. Pinnae entire or at most toothed; veins free except united in sori; sori continuous along costa **1. Blechnum**
 2. Pinnae deeply lobed; veins anastomosing without free included veinlets; sori interrupted, oblong, 2 rows along costule **2. Woodwardia**
1. Exindusiate; rhizome forming trunk up to 1 m in height **3. Brainea**

1. BLECHNUM

Linn., Sp. Pl.: 1077. 1753; Gen. Pl.: 560. 1754; Copel., Gen. Fil.: 155. 1947.

Rhizome stout, erect, bearing fronds in a tuft, scaly; scales narrow, entire, usually margined with pale cartilaginous edges. Lamina pinnate with apical pinna, usually not thin, glabrous; lateral pinnae usually entire, narrow, fertile ones contracted or not; costal grooves not confluent with groove of rachis; veins free, usually once or a few times forked. Sori linear, parallel and close to costa, sometimes forming costal areoles of veins (soral veins); indusia attached on the side away from costa and opening inwards.

The circumscription of this genus varies according to different authors, but all three species known in Thailand belong to the genus in the strictest sense. In the broader sense, *Blechnum* includes about 200 species throughout the world, the greater number in the southern hemisphere.

KEY TO THE SPECIES

1. Many auricles on stipe; pinna not toothed at margin nor articulated to rachis; veins forked or simple **1. B. orientale**
 2. Pinna up to 2 cm in breadth **2. B. finlaysonianum**
 2. Pinna about 4 cm in breadth
1. No auricles on stipe; pinna toothed at margin, articulate to rachis; veins usually twice forked **3. B. indicum**

1. Blechnum orientale Linn., Sp. Pl.: 1077. 1753; Bedd., Handb.: 132. f. 66. 1883; Christ, Bot. Tidsskr. 24: 107. 1901; C. Chr., Bot. Tidsskr. 32: 346. 1916; Contr. U. S. Nat. Herb. 26: 333. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 207. f. 26, 1–2. 1940; Holtt., Rev. Fl. Malaya 2: 446. f. 262. 1955; Dansk Bot. Ark. 20: 29. 1961; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 87. 1958; Tagawa & K. Iwats., Southeast As. St. 3(3): 84. 1965; 5: 88. 1967.

Rhizome thick, ascending or suberect, densely covered with scales; scales linear, gradually narrowing towards apex, 2 cm or more long, up to 2 mm broad, tailed at apex, dark brown with pale cartilaginous edges which sometimes becoming uneven. *Stipe* stout, stramineous, or sometimes purplish when young, up to 60 cm long, densely scaly at base, bearing small auricles (reduced pinnae) throughout. *Lateral pinnae* many in number, close, 2–3 cm apart from each other, ascending, linear, gradually narrowing towards long-tailed apex, round or subtruncate at sessile base, or decurrent at posterior base and adnate in the upper ones, entire, 30 by 1.2–2 cm; veins simple or forked usually near costa, distinct on both surfaces, very close, up to 0.5 mm apart; coriaceous, green, glabrous throughout. *Sori* narrow, long-continuous along costa; indusia narrow, usually broken before maturity.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung), Chiang Mai (Kong Kat, Doi Suthep, Mae Rim), Tak (Ban Musoe, Raheng); NORTH-EASTERN : Loei (Phu Ruea, Phu Luang, Phu Kradueng), Nong Khai, Udon Thani (Phon Phisai); EASTERN : Chaiyaphum (Khao Kong); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Laem Sing, Phriu Waterfall, Makham, Khao Sabap), Trat (Ko Kut, Ko Chang); PENINSULAR : Chumphon (Lang Suan, Ban Pak Chan), Ranong (Nok Nang), Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Thap Chang), Phangnga (between Thanun and Phangnga), Trang (Khao Chong), Satun, Narathiwat (Waeng, Sungai Padi), Yala (Betong, Bannang Sata).

D i s t r i b u t i o n.— Tropics of Asia, Australia and the Pacific, India to Polynesia, north to southern edge of Japan (Yakushima).

E c o l o g y.— On rather dry open slopes or in light shade at low or medium altitudes throughout Thailand.

V e r n a c u l a r.— Kut khang fan (กูดข้างฟาน) (Northern); kut doi (กูดดอย) (Central); mahasadam (มหาสะดำ) (South-eastern).

N o t e.— This is a common species in the lowlands, variable in size and texture. In shade the plants bear broader, thinner, paler pinnae which are more spaced. The edge of the pinnae is usually inrolled, which is not unusual for plants in shade.

2. Blechnum finlaysonianum Wall. ex Hook. & Grev., Ic. Fil.: t. 225. 1831; Bedd., Handb.: 132. 1883; Holtt., Rev. Fl. Malaya 2: 445. f. 261. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 55. 1968. Figure 24. 1–2.

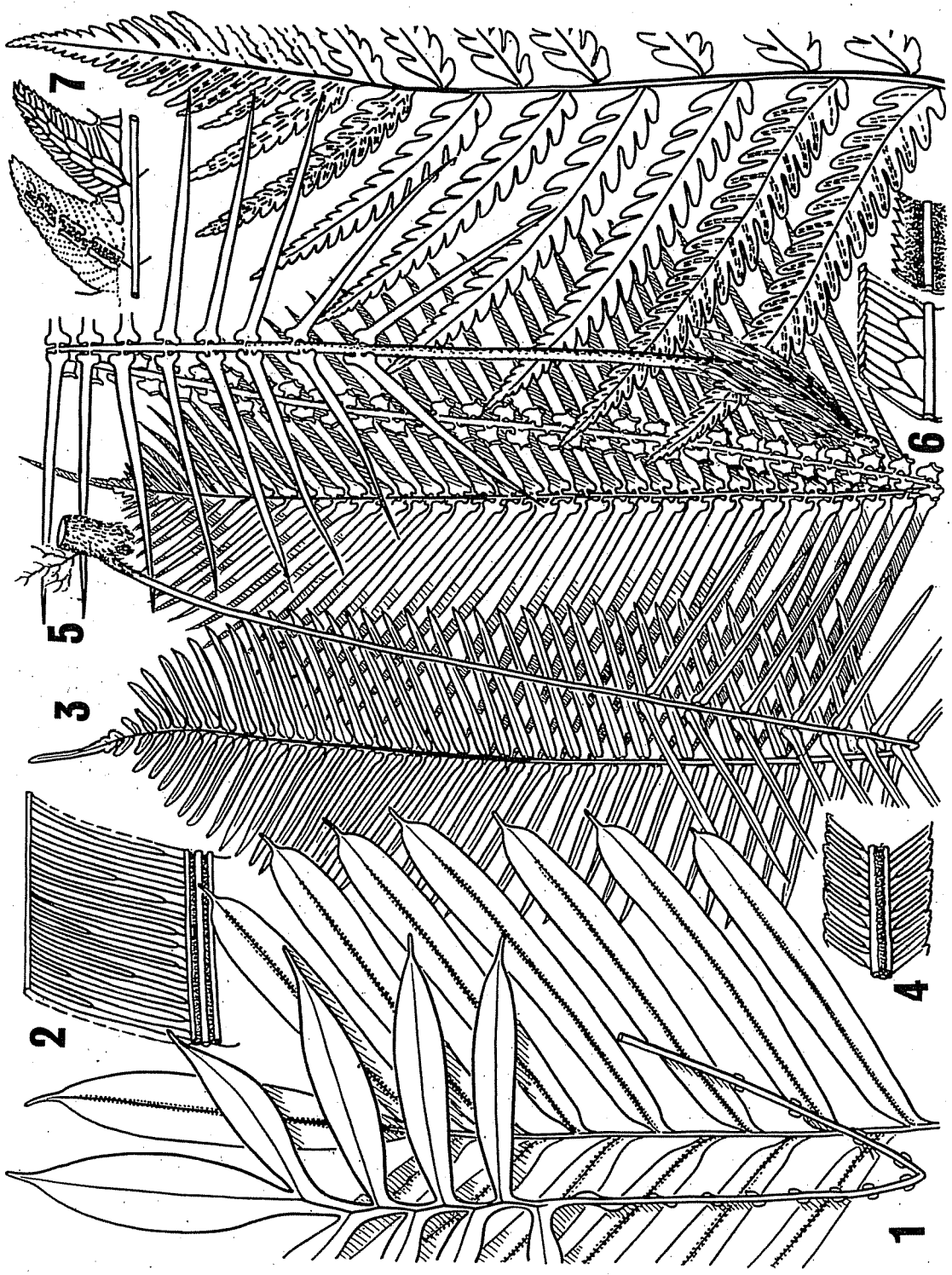


Figure 24. 1–2: *Blechnum finlaysonianum*; 1. fronds, juvenile and upper portion of adult one, x 0.25; 2. part of fertile pinna, x 1.8. 3–4: *B. indicum*; 3. part of plant, x 0.25; 4. part of fertile pinna, x 1.8. 5–6: *Brainea insignis*; 5. frond, x 0.25; 6. part of sterile and fertile pinna, x 1.8. 7: *Woodwardia cochinchinensis*; upper portion of fertile frond (x 0.25) and lobes enlarged (x 1.8).

Close to *B. orientale* but differs from it in: scales at base of stipe stiff, shining dark-brown, up to 2.3 cm by 2.5 mm; lateral pinnae narrowly cuneate at base, larger, up to about 40 by 4 cm, rather suddenly narrowed to a short acuminate apex, papyraceous.

Thailand.— PENINSULAR : Yala (Betong).

Distribution.— Malesia throughout, from Malaya (type) to New Guinea.

Ecology.— In shade along large streams at about 440 m alt.; only once collected in Thailand, E. SMITH 1917 (SING).

3. Blechnum indicum Burm. f., Fl. Ind.: 231. 1768; Holtt., Rev. Fl. Malaya 2: 466. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 18. 1971. — *Blechnum serrulatum* auct. non Bedd.: Bedd., Handb.: 132. 1883; Bonap., Not. Ptérid. 14: 58. 1923; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 208. 1940. Figure 24. 3—4.

Rhizome erect, up to a few decimetres tall, densely scaly; scales gradually narrowing towards acuminate apex, up to 5 by 0.7 mm, bright brown in central portion, brown and thin in margin. *Stipe* up to 30 cm long, stramineous, scaly at base, glabrous upwards, not bearing any auricles. *Frond* up to 50 by 18 cm, elliptic with acute apex; pinnae ascending, up to 30 pairs, subopposite, linear, truncate to cordate at sessile base, gradually narrowing towards acuminate but not pointed apex, minutely but sharply serrate at margin, up to 15 by 1.5 cm; soriferous pinnae usually narrower, about 7 mm wide; veins spreading nearly at right angles, about 1.5 mm apart near costa and usually twice forked, visible on both surfaces; subcoriaceous, glabrous throughout. *Sori* linear, along costa, usually from near rachis to less than 1 cm from apex; indusia thin but firm, often hidden under sori at maturity.

Thailand.— NORTH-EASTERN : Loei (Phu Kradueng); PENINSULAR : Surat Thani (Ban Son).

Distribution.— Mishmee, Indochina, Malesia throughout (type from Java) to Polynesia and Australia.

Ecology.— On plains in lower montain forests or near sea coast.

2. WOODWARDIA

J.E. Smith, Mem. Ac. Turin 5: 411. 1793; Copel., Gen. Fil.: 160. 1947.

Rhizome short, erect, densely scaly; scales brown, entire. Stipe not jointed

to rhizome, more or less scaly. Frond pinnate to bipinnatifid, usually widest at base; pinnae lobed; veins forming areoles without included veinlets, visible. Sori linear or oblong, in a single row along both sides of costa and midrib of lobe, interrupted; indusia firm.

About a dozen species are known, throughout the warm-temperate to tropical regions, and only one species is recorded from Thailand. This genus is defined by the discrete sori, and morphologically is hardly distinct from *Doodia* which is known in Oceania, with one species extending westwards to Ceylon.

Woodwardia cochinchinensis Ching, Bull. Fan Mem. Inst. Biol. 2: 7. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 211. 1940; Tagawa & K. Iwats., Southeast As. St. 5: 89. 1967. Figure 24. 7.

Rhizome thick, densely covered with large brown scales. *Stipe* erect, 30—50 cm long, stramineous or faintly pinkish, densely scaly at base; scales softly herbaceous, lanceolate with round base, entire at margin, brown or paler, up to 30 by 4 mm. *Lamina* oblong-lanceolate, truncate or broadly cuneate at base, acute at apex, pinnate with deeply lobed pinnae and distinct apical pinna, 60—90 by 30 cm; rachis scaly on upper surface; lateral pinnae 13—25 pairs, straight, linear-lanceolate, gradually narrowing towards acute apex, subtruncate at sessile or very shortly stalked base, deeply lobed $\frac{3}{4}$ way towards costa, up to 25 cm long, 2.5—6 cm wide; apical pinna with more than a dozen serrate segments, wider than the lateral ones, ultimate segment oblong-subdeltoid, moderately acute at apex, slightly dentate at margin, 0.8—2.5 by 0.8 cm, glabrous on both surfaces; row of costal and costular areoles distinct; papyraceous, pale-green, glabrous. *Sori* 4—10 on a segment, 2 rows along costules, 2—4 mm long, covered completely by indusia; indusia membranous, pale brown with thin white margin, toothed.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Lao, Doi Tung, Doi Pacho), Chiang Mai (Pang Bo).

D i s t r i b u t i o n.— Indochina (type). TARDIEU-BLOT & CHRISTENSEN (1940) cited China for the area of this species.

E c o l o g y.— Terrestrial on rather dry slopes in pine forests on humus-rich floor or not so dense evergreen forests at 1100—1300 m alt.

N o t e.— CHING (1931) distinguished this species from *W. japonica* by its large oblong turgid sori and the membranous brown indusia with thin broad eroso-denticulate margin, as well as by the larger size of plants. Of these characters, the structure of sori is not diagnostic in our species material but the indusia and size of plants have tendencies as noted by Ching. Malesian *W. auriculata* is another allied species.

3. BRAINEA

J. Smith, Cat. Kew Ferns : 5. 1856; Copel., Gen. Fil.: 159. 1947.

Rhizome erect, arborescent, scaly. Frond not articulated, simply pinnate, dimorphic; pinnae many, close, toothed at margin; veins close, once or twice forking, forming a series of narrow costal areoles. Sori covering the whole undersurface of narrow fertile pinnae, without indusia.

This is a monotypic genus with the habit of a tree-fern and a crown of dimorphic fronds.

Brainea insignis (Hook.) J. Smith, Cat. Kew Ferns : 5. 1856; Hook., Fil. Exot.: t. 38. 1859; Bedd., Handb.: 395. f. 230. 1883; Christ, Bot. Tidsskr. 24: 107. 1901; C. Chr., Bot. Tidsskr. 32: 346. 1916; Contr. U.S. Nat. Herb. 26: 333. pl. 28. 1931; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2): 207. f. 25, 3—4. 1940; Holtt., Rev. Fl. Malaya 2: 450. 1955; Dansk Bot. Ark. 20: 29. 1961; 23: 237. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 89. 1967.— *Bowringia insignis* Hook., J. Bot. 5: 237. t. 2. 1853. Figure 24. 5—6.

Rhizome erect, forming a trunk of more than 50 cm in height, the apex densely covered with scales; scales narrow with orbicular basal portion about 2 mm in diam., up to 30 by 0.5—0.8 mm, entire, glabrous, brown with dark brown central strand. *Stipe* 15—30 cm long, thick, stramineous, densely scaly at base. *Lamina* simply pinnate, with numerous pinnae, dimorphic; sterile lamina 40—70 by 30 cm, oblong-lanceolate with acute apex; lateral pinnae close, straight, slightly ascending, linear, gradually narrowing towards the finely acute apex, sessile, decurrent at base in uppermost ones, broadly cuneate to deeply cordate towards base, the margin sharply serrate, up to 15 by 1.2 cm; veins close; papyraceous, green to paler; fertile frond narrower; lateral pinnae up to 10 by 0.5 cm.

Thailand.— NORTHERN : Chiang Rai (Doi Pacho), Chiang Mai (Doi Chong, Doi Chiang Dao, Doi Phahom Pok, Doi Suthep, Doi Inthanon, Ban Yang, Pang Bo, Doi Hua Mot), Lamphun (Doi Khun Tan), Lampang (Doi Luang), Phrae (Mae Sai), Tak (Doi Musoe); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN : Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Song Tho).

Distribution.— Himalayas, S. China (type from Hongkong), Burma, Indochina, Malaya and N. Sumatra.

Ecology.— Terrestrial on rather dry slopes in not so dense forests or in recent clearings at medium altitude (1000—1200 m).

Vernacular.— Kut doi (กูดดอย) (Northern).

24. LOMARIOPSIDACEAE

Five out of the six genera of this family are known in Thailand, the exception being the New Guinean *Thysanosoria*.

KEY TO THE GENERA

1. Frond simple, epiphytic or on cliffs. Stipe usually jointed to rhizome **1. Elaphoglossum**
1. Frond pinnate to decompound (or rarely simple and terrestrial in *Bolbitis sinuata*): Stipe usually not jointed to rhizome
2. Terrestrial ferns; rhizome usually short, with close fronds **2. Bolbitis**
2. Scandent or epiphytic ferns; rhizome climbing the trees
3. Veins all free
4. All pinnae jointed to rachis; plant with distinct bathyphylls **3. Teratophyllum**
4. Terminal pinna not articulated; no distinct bathyphylls **4. Lomariopsis**
3. Veins anastomosing **5. Lomagramma**

1. ELAPHOGLOSSUM

Schott ex J.E. Smith, Gen. Fil.: ad t. 14. 1834; J. Smith, Hook. J. Bot. 4: 148. 1841, nom. cons.; Copel., Gen. Fil.: 119. 1947.

Rhizome creeping, bearing two rows of fronds on dorsal surface, scaly. Frond close together or remote in *E. angulatum*, simple, entire, usually coriaceous, dimorphic. Stipe swollen at base (phyllopodium), jointed to rhizome; veins simple or forked, parallel or anastomosing in some species. Sporangia covering the whole lower surface of fertile frond (acrostichoid).

A well defined genus of about 400 species known in all the warm regions, though the specific classification, both for the circumscription of species and for interrelationships, is still incomplete. Recently, HOLTTUM made extensive studies on Malesian species (in Blumea 14: 317—326. 1966 as well as in Fl. Mal. II. 1: 289—314. 1978), and SLEDGE studied the species of South India and Ceylon (in Bull. Brit. Mus. (Nat. Hist.) Bot. 4: 81—96. 1967). In Thailand eight species are known.

KEY TO THE SPECIES

1. Rhizome more than 4 mm diam., short-creeping. Fronds close together

2. Frond thick herbaceous or soft in texture, margin without distinct cartilaginous membrane, surfaces conspicuously covered with long-armed stellate hairs **1. E. stelligerum**
2. Frond coriaceous, margin with cartilaginous membrane, surfaces subglabrous or covered with usually adherent scales, without long-armed stellate hairs
3. Sterile frond more than 2 cm broad
4. Stipe of sterile frond confined to the portion below the joint **4. E. melanostictum**
4. Stipe of sterile frond continued upwards beyond the joint
5. Stipe short or lamina decurrent nearly to the base of stipe. Rhizome-scales light-brown, ovate-oblong, up to 1 cm long, more or less appressed **2. E. yoshinagae**
5. Stipe longer, or lamina short-decurrent. Rhizome-scales linear or linear-lanceolate, usually patent
6. Sterile lamina elliptic **5. E. subellipticum**
6. Sterile lamina lanceolate to oblong-lanceolate
7. Veins hardly visible. Rhizome-scales up to 7 mm long **6. E. marginatum**
7. Veins more or less distinct. Rhizome-scales up to 1.7 cm long **7. E. malayense**
3. Sterile frond less than 1 cm broad **8. E. dumrongii**
1. Rhizome slender, up to 3 mm diam., long-creeping. Fronds remote **3. E. angulatum**

1. Elaphoglossum stelligerum (Wall. ex Bak.) Moore ex Alston & Bonner, Candollea 15: 216. 1956; Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 4: 92. 1967.— *Acrostichum stelligerum* Wall. ex Bak. in Hook. & Bak., Syn. Fil. ed. 2: 521. 1874.— *Elaphoglossum yunnanense* (Bak.) C. Chr., Contr. U.S. Nat. Herb. 26: 327, 335. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 539. 1941; Holtt., Rev. Fl. Malaya 2: 455. f. 264. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 89. 1967.— *Elaphoglossum viscosum* auct. non J. Smith: Bedd., Handb.: 420. f. 250. 1883.

Rhizome short-creeping, densely scaly throughout; scales light brown, up to 7 by 0.7 mm, persistent, subentire or with irregular teeth at margin. *Sterile frond*: stipe stramineous, 5—10(—20) cm in length, densely scaly throughout; scales various, like those on rhizome, minute and hair-like, or stellate; lamina linear-lanceolate, more or less falcate, gradually narrowing towards both ends, 20—50 by 1.5—3 cm; midrib raised on both surfaces, densely covered with scales; veins simple or a few times forked, parallel, the apex ending at margin of frond, hardly visible on both surfaces or distinct on lower surface in dried specimens; papyraceous, deep green, densely covered on both surfaces with brown long-armed stellate scales, upper surface of lamina often glabrescent. *Fertile frond* lower than the sterile one; stipe like those of the sterile fronds, longer; lamina linear, acute at apex, 20—35 by 1—1.5 cm, densely covered with stellate scales on upper surface.

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

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

Ecology.— On muddy rocks or on mossy tree-trunks in dense evergreen forest at altitudes above 1000 m.

Note.— A W. Malesian species vicariant to this is *E. blumeanum* (Fée) J. Smith.

2. Elaphoglossum yoshinagae (Yatabe) Makino, Phan. Pterid. Jap. Ic. Ill. 1: pl. 51, 52. 1901; Tagawa & K. Iwats., Southeast As. St. 5: 89. 1967.— *Acrostichum yoshinagae* Yatabe, Bot. Mag. Tokyo 5: 109. t. 23. 1891.— *Elaphoglossum austrosinicum* Matthew & Christ, Not. Syst. 1: 57. 1909; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 540. 1941; Holtt., Dansk Bot. Ark. 23: 237. 1965.

Rhizome creeping, with fronds close together, densely scaly; scales light brown, membranous, appressed, ovate or somewhat irregular in outline, up to 10 by 6 mm. *Sterile frond* : stipe 7–9 cm long, narrowly winged throughout except for the basal portion, stramineous with dark base, densely scaly throughout, scales light brown, membranous, oblong-ovate with acute apex, up to 10 by 7 mm; lamina oblong-lanceolate, 20–26 by 3.5–5 cm, moderately acute at apex, gradually narrowing towards base and narrowly decurrent into the wings of stipe, subentire, narrowly cartilaginous at margin; midribs raised on upper surface, scaly; veins simple or forked, more or less distinct on both surfaces, the apex ending inside the margin; coriaceous, green in colour, the lower surface scaly. *Fertile frond* lower than the sterile ones; stipe longer, up to 12 cm long; lamina oblong, moderately acute at apex, rather suddenly narrowing at base, about 11 by 2.6 cm.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Suthep), Lampang (Doi Luang); NORTH-EASTERN : Loei (Phu Luang); SOUTH-EASTERN : Prachin Buri (Khao Khieo).

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

E c o l o g y.— On mossy tree-trunks in moist dense forests on ridges at high altitudes.

3. Elaphoglossum angulatum (Bl.) Moore, Ind. Fil.: 5. 1857; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 541. 1941; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 50. 1968; Holtt. in Fl. Mal. II. 1: 297. f. 16 b, c. 1978.— *Acrostichum angulatum* Bl., En. Pl. Jav.: 101. 1828.— *Elaphoglossum latifolium* auct. non J. Smith: Bedd., Handb.: 416. 1883. Figure 25. 1–3.

Rhizome long-creeping, bearing fronds remotely, up to 3 mm diam., dark, scaly throughout; scales light-brown, membranous, ovate-oblong or more or less irregular in shape, up to 4 by 3 mm, concolorous and entire. *Sterile frond* : stipe 10–15 cm long, stramineous with dark base, very narrowly winged on upper part, densely scaly at base, scales more sparse upwards, like those on rhizome; lamina oblong lanceolate, acute to acuminate at apex, gradually narrowing towards base, 12–20 cm long, 2–3.5 cm wide; midrib distinctly raised on both surfaces, naked or seldom scaly; veins simple or forked, parallel, more or less distinct on both surfaces, the apex ending inside the narrow cartilaginous strands at margin; coriaceous, deep-green, glabrous or very rarely minutely scaly on under surface of fronds. *Fertile frond* (not seen for Thai plants), lamina oblong, gradually narrowing upwards to acute apex, narrowly round at base.

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.— S. India, Ceylon, Tonkin, Taiwan and Malesia (type) to New Guinea.

E c o l o g y.— Only once collected at high elevation on Khao Luang.

4. Elaphoglossum melanostictum (Bl.) Moore, Ind. Fil.: 361. 1862; Holtt., Rev. Fl. Malaya 2: 455. f. 265. 1955; in Fl. Mal. II. 1: 301. f. 18. d,e. 1978; Tagawa & K. Iwats., Southeast As. St. 5: 89. 1967.— *Acrostichum melanostictum* Bl., Fl. Jav. Fil.: 26. t. 7. 1828.— *Elaphoglossum peninsulare* Holtt., Gard. Bull. S. S. 11: 270. 1947; Rev. Fl. Malaya 2: 256. f. 266. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 55. 1968.— *Elaphoglossum norrisii* auct. non (Hook.) Bedd.: Bedd., Handb.: 418. 1883.

Rhizome short-creeping, about 5 mm diam., bearing close fronds, densely scaly near apex; scales dark brown, narrow, thin, narrowing towards tapered apex, up to 7 by 1.2 mm, bearing aciculated teeth irregularly at margin. *Sterile frond* : stipe very short, confined to the portion below the joint; lamina up to 40 by 6.5 cm, widest at $\frac{1}{3}$ below apex, gradually narrowing towards base, shortly tapered towards broadly blunt-pointed apex; coriaceous, cartilaginous membrane at edge narrow, veins more or less visible on both surfaces, caducous scaly beneath, scales reduced consisting of only two rows of cells. *Fertile frond* : stipe up to 15 cm long, scaly, narrowly winged on upper portion; lamina up to 30 by 3.5 cm.

T h a i l a n d.— CENTRAL : Nakhon Nayok (Khao Yai); PENINSULAR: Yala (Ban Chana).

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 mossy tree-trunks in dense forests at low and medium altitudes.

5. Elaphoglossum subellipticum Rosenst., Hedwigia 56: 348. 1915; Tagawa & K. Iwats., Southeast As. St. 5: 89. 1967. Figure 25. 4—6.

Rhizome short, densely scaly throughout; scales brown or light brown, shining, linear, up to 10 by 1 mm, with irregular teeth or projections at margin. *Sterile frond* of two sizes : larger ones a few on a plant; stipe about 10 cm long, stramineous or darker, densely scaly at base, sparsely so on the remainder with narrow dark scales; lamina elliptic, gradually narrowing towards both ends, acute at apex, the base decurrent to very narrow wings on the upper part of stipe, about 25 by 5.5—7 cm; midrib distinctly raised on lower surface, veins forked, distinct on both surfaces, the apex ending inside the narrow cartilaginous margin; coriaceous, pure green, very sparsely scaly on lower surface; smaller sterile frond many on a plant; stipe 3—6 cm long, winged on upper part; lamina oblong, acute at apex,

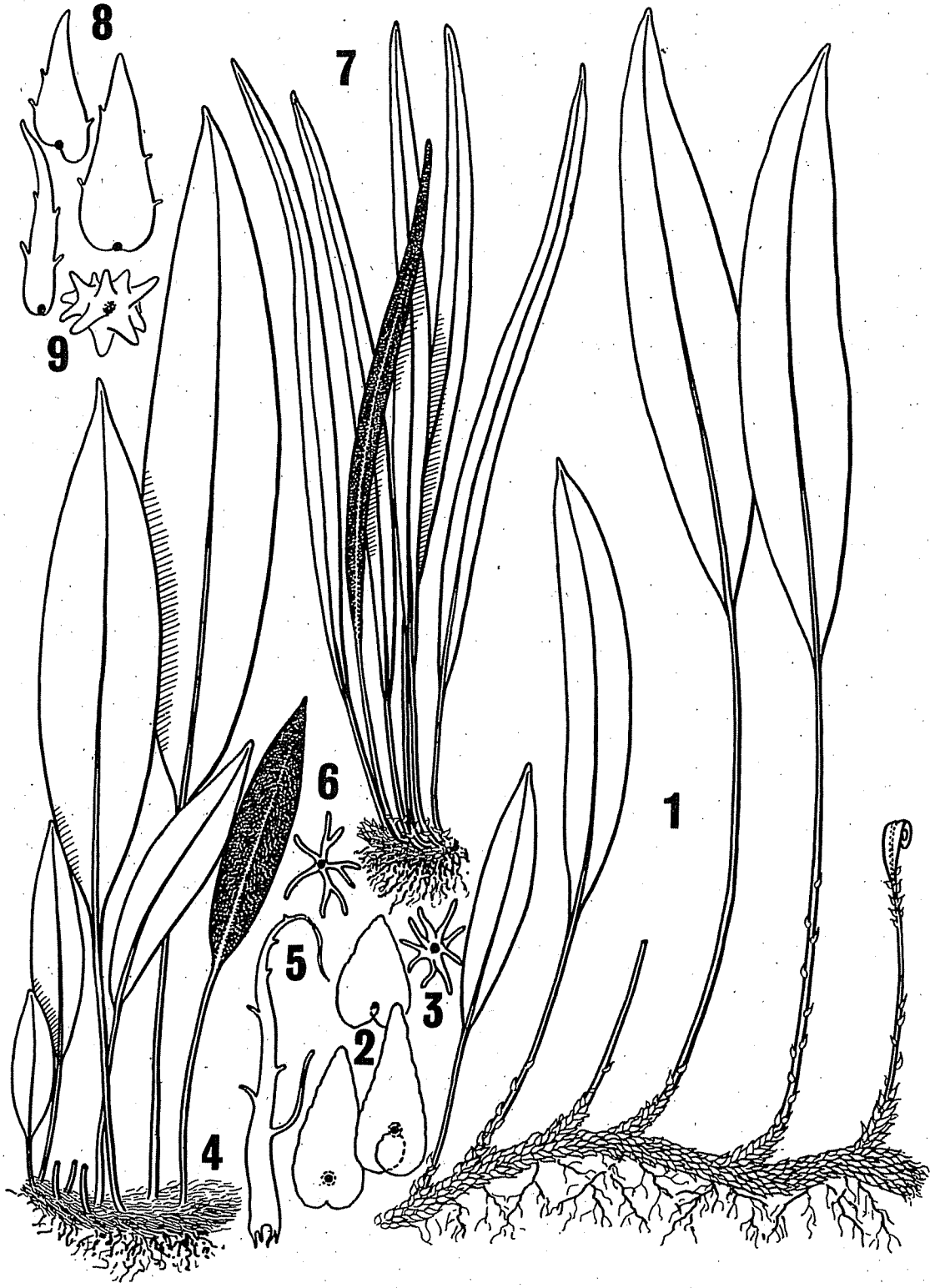


Figure 25. 1–3: *Elaphoglossum angulatum*; 1. plant, x 0.5; 2. three types of scales, normal to peltate, x 6; 3. stellate scale on leaf surface, x 30. 4–6: *E. subellipticum*; 4. plant, x 0.3; 5. scale, x 6; 6. stellate scale on leaf surface, x 15. 7–9: *E. dumrongii*; 7. plant, x 0.5; 8. scales on rhizome and stipe, x 6; 9. stellate scale on leaf surface, x 20.

round at base, 6—15 by 2.5—4 cm. *Fertile frond* : lower than the larger sterile fronds but higher than the smaller sterile ones; stipe about 10 cm long, winged at uppermost part; lamina broadest at middle, gradually narrowing towards both ends, up to 12 by 2.5 cm.

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

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

E c o l o g y.— On mossy rocks or on tree-trunks in dense evergreen forests at 1000—1400 m alt.

V e r n a c u l a r.— Kut pik kai dam (กูดปีกไก่ดำ) (North-eastern).

6. Elaphoglossum marginatum (Fée) Moore, Ind. Fil.: 8, 11. 1857 : 361. 1862; Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 4: 89. 1967.— *Acrostichum marginatum* Wall. ex Fée, Hist. Acrost.: 31. 1845.— *Elaphoglossum conforme* auct. non (Sw.) Schott; Bedd., Handb.: 416. f. 247. 1883, p.p.; Hosseus, Beih. Bot. Centr. 28(2): 363. 1911; C. Chr., Contr. U.S. Nat. Herb. 26: 335. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 541. 1941; Tagawa & K. Iwats., Southeast As. St. 5: 90. 1967.— *Elaphoglossum* sp.: Holtt., Dansk Bot. Ark. 20: 29. 1961.

Rhizome very short, bearing very close fronds; scales brown or darker, linear, up to 7 by 2 mm, with irregular projections at margin. *Sterile frond* : stipe up to 8 cm long, stramineous, narrowly winged, densely scaly at base with scales like those on rhizome, sparsely clad with narrower scales above; lamina oblong-lanceolate, up to 30 by 3.7 cm, gradually narrowing towards acute apex, the base narrowly round or attenuate, decurrent to wings of stipe, marginal cartilaginous membrane up to 1 mm wide, usually involute; midrib raised on both surfaces, sparsely scaly underneath, veins forked, parallel, hardly visible; coriaceous, green, minutely scaly on both surfaces. *Fertile frond* : stipe up to 20 cm long, thicker than sterile ones of the same plant; lamina about 25 by 2.5 cm.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Phahom Pok, Doi Suthep, Doi Inthanon), Lampang (Doi Luang), Phitsanulok (Phu Miang); NORTH-EASTERN : Loei (Phu Luang); CENTRAL : Nakhon Nayok (Khao Yai).

D i s t r i b u t i o n.— N. India (type), Yunnan, Indochina and Taiwan.

E c o l o g y.— On mossy tree-trunks in dense forests at high altitudes (1200—2200 m alt.).

7. Elaphoglossum malayense Holtt., Blumea 14: 322. 1966; in Fl. Mal. II. 1: 308. 1978.— *Elaphoglossum callifolium* auct. non (Bl.) Moore : Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 541. 1941; Holtt., Rev. Fl. Malaya 2: 459. f. 269. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 90. 1967.

Rhizome short, densely covered with scales; scales brown, membranous, oblong-lanceolate, up to 1.7 by 0.4 cm, entire or with irregular projections at margin. *Sterile frond* : stipe 8—12 cm long, stramineous with dark base, slightly winged on upper part, scales at base dense like those on rhizome becoming more sparse upwards; lamina oblong-lanceolate to linear-lanceolate, gradually narrowing towards both ends, 20—40 by 2.5—5.5 cm, entire, narrowly marginate with cartilaginous membrane; midrib raised on both surfaces, very sparsely minutely scaly or glabrescent; coriaceous, veins visible on both surfaces, green, usually brownish in dried specimens. *Fertile frond* : stipe 12—17 cm long; lamina elliptic, gradually narrowing towards both ends, 12—17 cm long, about 2.5 cm broad.

T h a i l a n d.— NORTH-EASTERN : Loei (Phu Kradueng); EASTERN : Nakhon Ratchasima (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ko Phangan), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Phangnga (Khao Phra Mi).

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

E c o l o g y.— On mossy tree-trunks or on mossy rocks in dense evergreen forests usually at 1000—1500 m alt., locally abundant.

8. Elaphoglossum dumrongii Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 112. f. 8. 1968. Figure 25. 7—9.

Rhizome creeping, about 4 mm diam., densely covered with scales; scales ovate to ovate-oblong, membranous, usually appressed, brown, 4—6 by 1.5—2.2 mm, with irregular projections at margin. *Sterile frond* : stipe stramineous to pale castaneous, winged on upper part, 3—10 cm long, scales at the base dense like those on rhizome, becoming more sparse upwards and smaller not appressed; lamina linear-lanceolate, narrowing towards acute to acuminate apex, very gradually narrowing and long attenuate at base, 7—16 by 0.5—1 cm, often involute at margin; midrib raised on both surfaces, very sparsely scaly below; veins obscure on both surfaces, the apex ending inside the very narrow and usually involute cartilaginous margin; coriaceous, pale green in living plants, brown in dried specimens, naked on upper surface, minutely scaly underneath with irregular dark brown appressed scales. *Fertile frond* : stipe 6—11 cm long; lamina similar to sterile ones both in shape and size.

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

D i s t r i b u t i o n.— Endemic.

E c o l o g y.— On moist cliffs by streams or on mossy rocks in stream-beds in dense evergreen forests at about 1100—1200 m alt.; a rheophyte.

2. BOLBITIS

Schott, Gen. Fil.: ad. t. 14. 1834; Copel., Gen. Fil.: 115. 1947; Hennipm., Leid. Bot. Ser. 2: 123. 1977.— *Egenolfia* Schott, Gen. Fil.: ad t. 16. 1834; Copel., Gen. Fil.: 116. 1947.— *Campium* Presl, Tent. Pterid.: 238. pl. X. 22—23. 1836; Copel., Phil. J. Sci. 37: 341. 1928, p.p.

Rhizome creeping, dorsiventral, bearing two rows of usually close fronds on dorsal surface and numerous roots on ventral surface, scaly; scales usually concolorous, hardly clathrate, glabrous. Frond dimorphic, usually not jointed to rhizome, simple to bipinnatifid, often viviparous near apex. Sporangia dispersed on the whole undersurface, or rarely restricted to marginal portion, of fertile pinnae or fronds (acrostichoid).

The genus was thoroughly revised by HENNIPMAN (1977), and the Thai species are enumerated here according to his classification, although the specific delimitation is kept rather narrower here in order to maintain the same species concept throughout the work. Thus twelve species and a variety have been listed up and distinguished from each other as follows.

KEY TO THE SPECIES

1. Veins anastomosing
 2. No included free veinlets in areoles
  3. Pinnae more than 15 pairs
   4. Pinnae drying light green. Sporangia dispersed on the whole undersurface of fertile pinna **1. B. angustipinna**
   4. Pinnae drying reddish. Sporangia confined to the margin of fertile pinna leaving sterile portion along costa underneath **3. B. copelandii**
  3. Pinnae not more than 6 pairs
   5. Veins clearly raised on both surfaces. Apex of frond particularly elongate, with a bud **11. B. heteroclita**
   5. Veins obscure on either surface. Apex of frond not particularly elongate, without bud **12. B. sinuata**
 2. Many included and excurrent free veinlets in areoles
  6. Pinnae drying distinctly reddish
   7. Pinnae more than 4 cm wide; areoles more than 5 rows between costa and margin of pinna **2. B. costata**
   7. Pinnae up to 4 cm wide; areoles 1—3 rows **4. B. scalpturata**
  6. Pinnae drying green
   8. Fertile pinnae oblong, having sterile along main veins **5. B. deltigera**
   8. Fertile pinnae linear to oblong-lanceolate, sporangia covering the whole undersurface **6. B. virens**

1. Veins all free
 9. Base of lateral pinnae unequal, with auricles at anterior base **7. B. appendiculata**
 9. Base of lateral pinnae nearly equal
  10. Fertile pinnae moniliform; sterile pinnae subentire or very shallowly lobed **8. B. hookeriana**
  10. Fertile pinnae narrowly oblong; sterile pinnae lobed more than halfway towards costa
   11. Stipe scaly at base only, rachis and costa very sparsely scaly. Lateral pinnae less than 20 pairs; lobes not setiferous **9. B. sinensis**
   11. Stipe, rachis, and costa underneath densely covered with oblong-ovate, dark brown, irregularly erosed, appressed scales. Lateral pinnae more than 30 pairs; veinlets ending in setae along the margin of lobes **10. B. tonkinensis**

1. Bolbitis angustipinna (Hayata) H. Ito, J. Jap. Bot. 14: 443. 1938; Hennipm., Leid. Bot. Ser. 2: 152. f. 40. a-f. 1977; in Fl. Mal. II. 1: 321. f. 26c, 27a. 1978.— *Leptochilus angustipinnus* Hayata, Ic. Pl. Formos. 5: 297. f. 119. 1915.— *Gymnopteris contaminans* auct. non Bedd.: Bedd., Handb.: 435. f. 264. 1883; Suppl.: 104. 1892.— *Bolbitis contaminans* (non Bedd.) Ching ex C. Chr., Ind. Fil. Suppl. III: 47. 1934; Tagawa & K. Iwats., Southeast As. St. 5: 91. 1967.

Rhizome up to 1 cm diam.; scales up to 6 by 1.3 mm, dark brown, entire. *Sterile frond* : stipe stramineous, densely scaly at base, rather densely above with small fugacious more or less irregularly shaped scales, about 40 cm long; lamina oblong-lanceolate, acute at apex, 60—80 by 30—40 cm; rachis scaly with membranous appressed scales usually irregular in shape; lateral pinnae up to 20 pairs, middle ones the largest, patent or slightly ascending, straight, sessile, linear-lanceolate, caudately acuminate, round at base, up to 23 by 2.3 cm, slightly lobed at margin, the lobes up to 1.5 mm long, a sharp tooth present at bottom of each sinus, terminal pinna distinct, narrow, up to 20 by 1.5 cm, lobed at base, often viviparous at middle portion; veins raised on upper surface, forming three rows of areoles between main veins, sparsely scaly beneath; softly coriaceous, green, glabrous. *Fertile frond* : lamina 35—45 by 18—27 cm; lower lateral pinnae shortly stalked, up to 130 by 6 mm, terminal pinna distinct, 70 by 5 mm, with lobed broader base.

T h a i l a n d.— NORTHERN : Lampang, Tak; NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); EASTERN : Nakhon Ratchasima (Khao Laem).

D i s t r i b u t i o n.— Himalayas to Ceylon, eastwards to Taiwan (type) and Luzon.

E c o l o g y.— On mountain slopes in dense evergreen forests at 500—1100 m alt.

2. Bolbitis costata (Presl) Ching ex C. Chr., Ind. Fil. Suppl. III.: 47. 1934; Tagawa & K. Iwats., Southeast As. St. 5: 91. 1967; Hennipm., Leid. Bot. Ser. 2: 155. f. 41. 1977.— *Campium costatum* Presl, Tent. Pterid.: 238. pl. X. 23. 1836; C. Chr., Contr. U.S. Nat. Herb. 26: 331. 1931.— *Gymnopteris costata* (Presl) Bedd., Ferns Br. Ind. Suppl. 27. 1876; Hendb.: 438. f. 266. 1883.

Rhizome thick, scaly. *Sterile frond* : stipe stramineous, about 60 cm long, densely scaly with light brown appressed membranous oblong-ovate scales; lamina oblong-lanceolate, about 65 by 28 cm; rachis minutely scaly; lateral pinnae 8 pairs, oblong-lanceolate, caudate at apex, round to cuneate at base, subentire, up to 20 by 4 cm, shortly stalked, ascending and straight or slightly falcate, little reduced towards both ends; terminal pinna longer, 23 by 3.8 cm, cuneate at base, viviparous near apex; costa sparsely scaly beneath; veins raised on lower surface, main veins 3—5 mm apart, more than one row of areoles between main veins, a few veinlets included; coriaceous, green but reddish when dried. *Fertile frond* : stipe about 60 cm long, scaly; lamina 30 by 12 cm; lateral pinnae 6 pairs, linear with round apex, shortly stalked, up to 80 by 8 mm; terminal pinna like the lateral ones, a little longer; sporangia dispersed on the whole under surface of pinnae.

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

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

E c o l o g y.— On rather dry slopes in mountain forests at 600—1000 m alt.

3. Bolbitis copelandii Ching ex C. Chr. & Tard. in Lec. Notul. Syst. 7: 101. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 434. f. 50, 1—2. 1941; Tagawa & K. Iwats., Southeast As. St. 5: 91. 1967.— *Bolbitis crispatula* (Copel.) Ching var. *copelandii* (Ching) Hennipm., Leid. Bot. Ser. 2: 159. f. 40. i, 42. 1977.

Rhizome creeping or ascending, densely scaly; scales dark brown, up to 6 by 1.2 mm, entire. *Sterile frond* : stipe stramineous, scaly at base, very minutely scaly upwards, 20—25 cm long; lamina oblong-lanceolate, gradually narrowing towards attenuate apex, up to 30—45 by 15—20 cm; pinnae up to 25 pairs, middle ones the largest, lanceolate, straight, slightly ascending, shortly stalked and jointed to rachis, gradually narrowing towards caudate-acuminate apex, subtruncate at anterior and cuneate at posterior bases, up to 10 by 1.7 cm, distinctly serrate in apical part, subentire or very slightly lobed in basal part, lower lateral pinnae shorter than the next above, apical pinna rarely distinct, small if any; rachis viviparous near the apex, costa glabrous, veins raised beneath, forming a row of costal areoles and costular ones in larger pinnae; subcoriaceous, light-green, reddish in dried condition. *Fertile frond* : lateral pinna distinctly stalked, linear with unequal base, up to 6 by 1.2 cm, shallowly lobed at margin; sporangia confined to margins and near veins, leaving broad sterile portion along costa.

T h a i l a n d.— NORTHERN : Lampang; NORTH-EASTERN : Loei (Phu Luang); EASTERN : Chaiyaphum, Nakhon Ratchasima (Pak Thong Chai), Buri Ram (Nang Rong); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Prachin Buri (Khao Chakan), Rayong (Khao Chamao).

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

E c o l o g y.— On rather dry to moist mountain slopes or on muddy rocks in dense evergreen forests at usually up to 600 m alt.

N o t e.— This is very close to *B. crispatula* of Assam and was actually reduced to a variety of that species by HENNIPMAN (1977). The Assam plants have pinnae of fertile fronds narrow, 2—5 mm wide. These fertile pinnae are covered entirely with the sporangia except for the costae and very narrow margins. In contrast to this, the fertile pinnae of Thai and Indo-Chinese plants are 4—12 mm wide, bearing the sporangia in a broad band near the margins often curving along the lobes and dispersing inwards below the sinus, and with a broad sterile portion on both sides of the costae and a narrow one at the margins of the pinnae.

4. Bolbitis scalpturata (Fée) Ching in C. Chr., Ind. Fil. Suppl. III.: 50. 1934; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 87. 1958; Hennipm., Leid. Bot. Ser. 2: 163.

f. 43. a-d. 1977; in Fl. Mal. II. 1: 321. f. 27b. 1978.— *Heteroneuron scalpturatum* Fee, Hist. Acrost.: 95. pl. 56. 1845.— *Gymnopteris costata* var. *undulata* auct. non (Hook.) Christ : Christ, Bot. Tidsskr. 24: 109. 1901.— *Leptochilus scalpturatus* var. *undulatus* auct. non (Hook.) C. Chr.: C. Chr. Bot. Tidsskr. 32: 344. 1916.

Rhizome creeping; scales up to 6 by 1.5 mm, blackish. *Sterile frond* : stipe stramineous, up to 40 cm long, scaly; lamina 20—50 by 7—25 cm, oblong in outline; rachis like the upper part of stipe, minutely scaly; lateral pinnae 5—7 pairs, widest at about the middle portion, up to 15 by 4 cm, entire or serrate at margin, reddish when dry; veins reticulate to form a row of costal areoles and one or two additional rows of areoles at each side of costa, usually with one or more free included veinlets. *Fertile frond* : stipe up to 50 cm long; lamina up to 40 by 12 cm; pinnae up to 8 by 1.5 cm, entirely covered by sporangia except on costa.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Suthep); NORTH-EASTERN : Loei (Phu Luang); SOUTH-EASTERN : Trat (Ko Chang); PENINSULAR : Surat Thani.

D i s t r i b u t i o n.— Burma, Indo-China, Malesia (type from Luzon).

E c o l o g y.— On rocks in dense forests at 200—800 m alt.

5. Bolbitis deltigera (Bedd.) C. Chr., Ind. Fil. Suppl. III.: 48. 1934; Tagawa & K. Iwats., Southeast As. St. 5: 91. 1967.— *Poecilopteris costata* var. *deltigera* Bedd., Ferns Br. Ind.: 114. pl. 114. 1865.— *Meniscium deltigerum* Wall. ex Clarke, Trans. Linn. Soc. II. Bot. 1: 572. 1880.— *Campium deltigerum* (Bedd.) Copel., Phil. J. Sci. 37: 387. f. 38. 1928.— *Bolbitis virens* var. *deltigera* (Bedd.) Hennipm., Blumea 18: 149. 1970; Leid. Bot. Ser. 2: 184. f. 47, 48. k-m. 1977. Figure 26. 6—8.

Rhizome creeping, more than 1 cm diam., densely scaly; scales oblong-subdeltoid, up to 5 by 1.2 mm, dark brown, stiff. *Sterile frond* : stipe stramineous, 30—50 cm long, scaly throughout with light brown, ferrugineous appressed scales; lamina oblong-lanceolate, 40—60 by 30—40 cm; lateral pinnae 6—9 pairs, shortly stalked, 5—8 cm apart, oblong-lanceolate, rather suddenly narrowing to cuspidate apex, round to cuneate at base, subentire or more or less waved at margin, up to 23 by 5 cm, often gemmiferous on distal portion of costa; terminal pinna like lateral ones, a little longer, viviparous near apex; costa minutely scaly beneath; veins slightly raised beneath; subcoriaceous, green even in dried condition. *Fertile frond* lower than the sterile ones : stipe 30—50 cm long; lamina 35—45 by 12—15 cm; lateral pinnae 6—8 pairs, distinctly stalked, straight, ascending, oblong, acuminate at apex, uneqully rounded to cuneate at base, 11 by 2.5 cm; terminal pinna like the lateral ones, sometimes viviparous near apex; sporangia covering the undersurface of pinnae except for narrow sterile strands along main veins.

T h a i l a n d.— NORTHERN : Lampang, Phrae (Mae Sai), Phitsanulok (Thung Salaeng Luang); CENTRAL : Nakhon Nayok (Khao Yai).

Distribution.— N. India (type).

Ecology.— On moist rocks or on humus-rich ground in dense forests, seasonally dry, at about 500 m alt.

6. Bolbitis virens (Hook. & Grev.) Schott, Gen. Fil.: ad t. 14. 1834; Holtt., Rev. Fl. Malaya 2: 468. f. 275. 1955; Tagawa & K. Iwats., Southeast As. St. 3(3): 85. 1965; 5: 91. 1967; Hennipm., Blumea 18: 149. 1970; Leid. Bot. Ser. 2: 180. f. 47—48. 1977.— *Acrostichum virens* Wall. ex Hook. & Grev., Ic. Fil. II : pl. 231. 1831.— *Campium virens* (Hook. & Grev.) Presl, Tent. Pterid.: 239. 1836; Copel., Phil. J. Sci. 37: 388. f. 39. 1928.— *Bolbitis costata* auct. non (Presl) Ching : Holtt., Dansk Bot. Ark. 20: 30. 1961.

Rhizome creeping, thick, densely scaly; scales thin but firm, dark brown, up to 8 by 1.5 mm. *Sterile frond* : stipe 30—40 cm long, densely scaly throughout, scales on upper portion light brown, ferrugineous, appressed, irregular in shape; lamina oblong-ovate to oblong, 35—60 by about 30 cm; lateral pinnae 5—7 pairs, stalked, straight, ascending or patent in lower ones, oblong to oblong-lanceolate, caudate at apex, narrowly cuneate or unequally rounded at base, up to 25 by 6 cm, toothed at margin, more or less waved; costa minutely scaly beneath, veins slightly raised on undersurface, reticulate with a few included veinlets in each areole; subcoriaceous, glabrous, green both in living and dried condition, terminal pinna like lateral ones or slightly larger, viviparous near apex. *Fertile frond* nearly as high as the sterile ones : stipe up to 55 cm long; lamina up to 40 by 20 cm; pinnae 4—6 pairs, linear, acuminate at apex, stalked, up to 20 by 2 cm; sporangia dispersed on the whole undersurface of pinnae.

KEY TO THE VARIETIES

1. Pinnae of fertile frond 80—120 by 2—7 mm, usually more than 15 times as long as wide **a.** var. **virens**

1. Pinnae of fertile frond 40—90 by 8—20 mm, 3—7 times as long as wide **b.** var. **compacta**

a. var. **virens**

Thailand.— NORTHERN : Chiang Mai (Doi Chiang Dao, Doi Suthep), Lamphun (Doi Khun Tan), Phrae (Mae Sai), Tak (Huai Krasa); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); SOUTH-WESTERN : Kanchanaburi (Khao Yai, Sai Yok); PENINSULAR : Surat Thani (Khao Hua Khwai).

Distribution.— Yunnan, Chittagong, and Burma (type).

Ecology.— On mountain slopes often near streams in dense mountain forests at 800—1200 m alt.

Vernacular.— Kut ngong (กูดง้อง) (North-eastern).

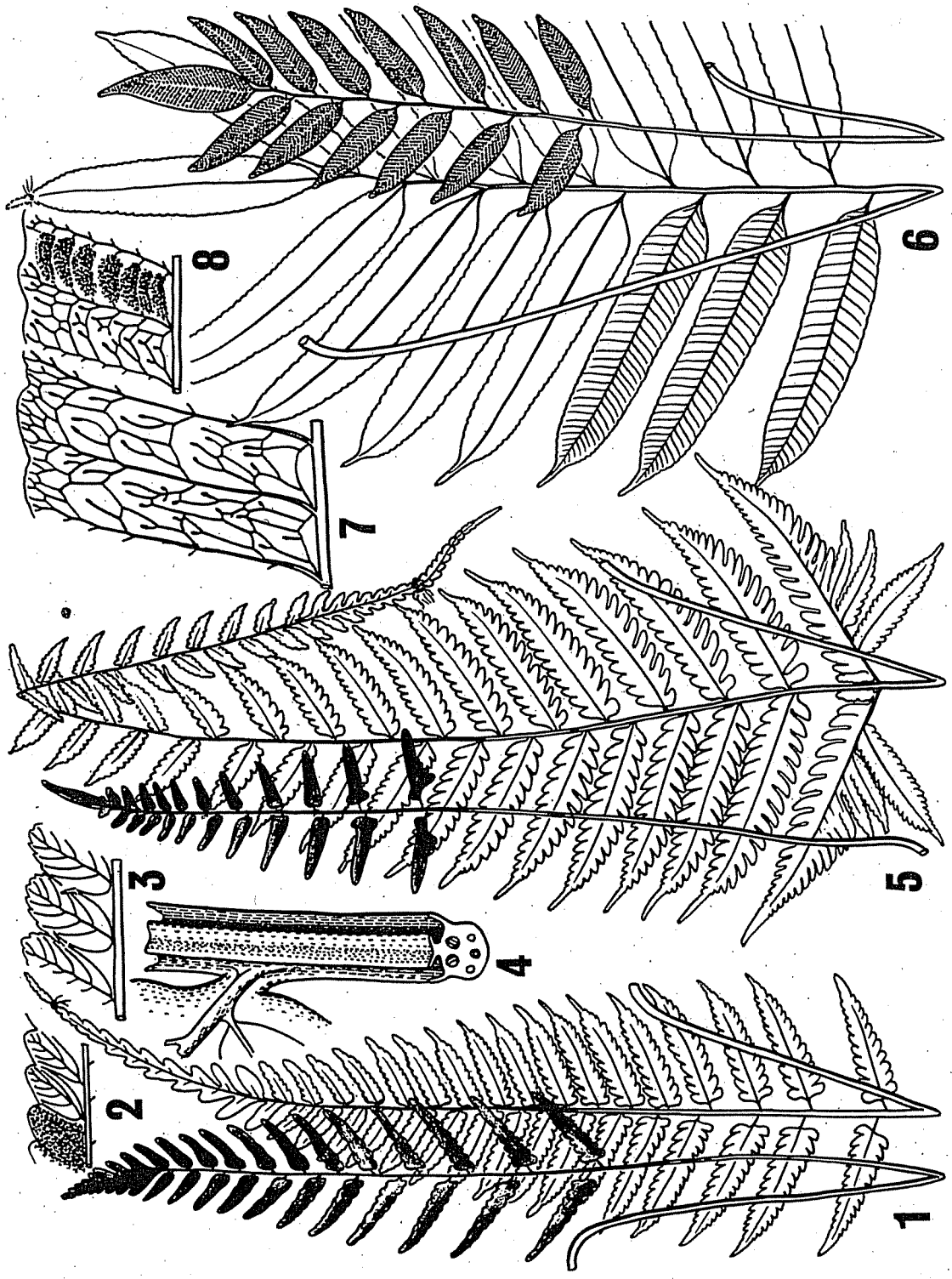


Figure 26. 1–4: *Bolbitis sinensis* var. *sinensis*; 1. fronds, sterile and fertile, x 0.25; 2. part of fertile pinna, x 1.5; 3. part of sterile pinna, x 1.5; 4. rachis and basal portion of pinna. 5: *B. sinensis* var. *costulata*; fronds, sterile and fertile, x 0.2. 6–8: *B. deltigera*; 6. fronds, sterile and fertile, x 0.17; 7. part of sterile pinna, x 1.5; 8. part of fertile pinna, x 1.5.

b. var. **compacta** Hennipm., Blumea 18: 149. 1970; Leid. Bot. Ser. 2: 184. f. 47, 48 i-j. 1977; in Fl. Mal. II. 1: 321. f. 25a-c. 1978.

Different from the type variety in : fertile pinnae broader, 4—9 by 0.8—2 cm, about 3—7 times as long as wide.

T h a i l a n d.— PENINSULAR : Phangnga (Khao Phra Mi), Trang (Khao Chong, type).

D i s t r i b u t i o n.— Malaya; also Cochinchina, vide Hennipm., l.c.

E c o l o g y.— Moist ground by streams in dense evergreen forests at low altitude less than 300 m alt.

7. Bolbitis appendiculata (Willd.) K. Iwats., Acta Phytotax. Geobot. 18: 48. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 85. 1965; 5: 90. 1967; Hennipm., Leid. Bot. Ser. 2: 185. f. 49—51. 1977; in Fl. Mal. II. 1: 322. f. 26b, 27d-f. 1978.— *Acrostichum appendiculatum* Willd., Sp. Pl. 5: 114. 1810; Hosseus, Beih. Bot. Centr. 28(2): 363. 1911.— *Polybotrya appendiculata* (Willd.) J. Smith, J. Bot. 4: 150. 1841; Bedd., Handb.: 434. f. 255. 1883; Christ, Bot. Tidsskr. 24: 109. 1901; Bonap., Not. Pterid. 14: 51. 1923.— *Egenolfia appendiculata* (Willd.) J. Smith, Ferns Br. For.: 111. 1866; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 426. 1941; Holtt., Rev. Fl. Malaya 2: 459. f. 270. 1955; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 87. 1958; Holtt., Dansk Bot. Ark. 20: 29. 1961; 23: 237. 1965.— *Polybotrya helferiana* Kunze, Farnkr. 2: 35. 1849.— *Polybotrya appendiculata* var. *helferiana* (Kunze) Christ, Bot. Tidsskr. 24: 109. 1901.— *Egenolfia helferiana* (Kunze) C. Chr., Contr. U.S. Nat. Herb. 26: 292. 1931; Holtt., Dansk Bot. Ark. 23: 237. 1965.— *Polybotrya appendiculata* var. *marginata* (Bl.) C. Chr., Bot. Tidsskr. 32: 343. 1916.— *Polybotrya marginata* Bl., En. Pl. Jav. : 100. 1828, nom. superf.— *Egenolfia appendiculata* var. *moniliformis* Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 427. 1941.— *Acrostichum* sp. Hosseus, Beih. Bot. Centr. 28(2): 363. 1911.

Rhizome creeping; scales light brown or greyish, linear, up to 4 by 0.7 mm. *Sterile frond* : stipe stramineous, sparsely scaly, 5—13 cm long; lamina lanceolate, acuminate at apex, 10—30 by 3.5—10 cm; rachis scaly beneath, winged at least on upper part, sometimes viviparous near apex; pinnae 15—25 pairs, basal ones slightly shorter than the next above, middle ones the largest, patent or ascending, stalked, oblong to longer or gradually narrowing from base to apex, rounded to acute at apex, more or less auricled at acroscopic and dimidiate at basiscopic bases, margin shallowly lobed, 1.5—5 by 0.5—1.2 cm, the apical pinna variable in shape and size, usually narrowly subtriangular; veins pinnate, all free; lobes shallow, round, with a distinct tooth at each sinus; papyraceous, deep green, dark when dried. *Fertile frond* taller : stipe up to 25 cm long; lamina linear-lanceolate, 15—25(—40) by 2—5 cm; rachis wingless, seldom viviparous; pinnae stalked or subsessile, linear or narrowly oblong or, often moniliform, patent, straight or a little falcate, 0.7—2.5(—4) cm by (2—)3—5 mm; veins simple, forked or pinnate; sporangia dispersed on the lower surface of pinna or lobes.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Suthep, Doi Inthanon), Lampang; NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang), Sakhon Nakhon (Pha Kham Hom); EASTERN : Nakhon Ratchasima (Pak Thong Chai), Chaiyaphum; SOUTH-EASTERN : Chanthaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Sai Yok, Mae Nam Noi); PENINSULAR : Chumphon (Khao Nom Sao, Ban Krayae), Phangnga (Takua Pa, Ko Talibong, Khao Phra Mi), Phuket (Thalang), Nakhon Si Thammarat (Khao Luang, Khao Khi No, Khiriwong, Chawang), Trang (Khao Chong), Songkhla, Satun.

D i s t r i b u t i o n.— S. China, India to SE. Asia generally, throughout Malesia, northwards to Taiwan and the Ryukyus (type from India Or.).

E c o l o g y.— On muddy rocks near streams or in stream-beds in dense forests or in light shade at low or medium altitudes usually below 1200 m alt.

N o t e.— A form with moniliform fertile pinnae had usually been separated specifically, although HENNIPMAN (1977) gave detailed notes on the variation of this character.

8. Bolbitis hookeriana K. Iwats., Acta Phytotax. Geobot. 18: 49. 1959.— *Polybotrya vivipara* Hamilt. ex Hook., Exot. Fl.: t. 107. 1825.— *Egenolfia vivipara* (Hamilt. ex Hook.) C. Chr., Ind. Fil. Suppl. III.: 102. 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 423. 1941.— *Bolbitis appendiculata* ssp. *vivipara* (Hamilt. ex Hook.) Hennipm., Blumea 18: 147. 1970; Leid. Bot. Ser. 2: 196. f. 50 a-h, 51. 1977.— *Polybotrya appendiculata* var. *hamiltoniana* Bedd., Handb.: 426. f. 256. 1883.— *Polybotrya nodiflora* Bory in Belang., Voy. Bot. II.: 17. 1833.— *Egenolfia nodiflora* (Bory) Fée, Hist. Acrost. 77. pl. 38. f. 2. 1845; Ching, Bull. Fan Mem. Inst. Biol. 2: 304. 1931.

Rhizome short-creeping, up to 1 cm diam.; scales gradually narrowing from base towards long-acuminate apex, up to 5 by 0.5 mm, entire or with irregular projections at margin, concolorously brown, not clathrate. *Stipe* stramineous, grooved above, scaly throughout with narrow subclathrate scales, about 10 cm long in sterile fronds, twice as long as in fertile ones. *Sterile lamina* about 35 by 10 cm; middle lateral pinnae the largest, patent or ascending, very shortly stalked, elliptic with acute apex and truncate or very broadly cuneate at base, subentire or slightly crenate at margin, up to 4.7 by 1.5 cm, the lower ones shorter, patent or deflexed, apical pinna narrowly subtriangular, elongate at apex, up to 5 cm long, gemmiferous; rachis stramineous, minutely scaly throughout, winged in upper portion; costa raised on both surfaces, pale, glabrous, veins more or less visible, all free, basiscopic branches of vein groups running to sinus ending in distinct teeth about 0.7 mm in length. *Fertile lamina* about 18 by 3.5 cm; pinnae 1—1.5 cm apart, moniliform, shortly stalked, 17 by 1.7 mm, sporangia forming 5—8 groups but usually confluent at maturity.

T h a i l a n d.— NORTHERN : Chiang Mai (Fang, Doi Suthep, Sop Aep), Mae Hong Son (Mae La Noi, Mae Sariang), Lampang, Tak (Lan Sang); CENTRAL : Uthai Thani (Huai Kha Khaeng); SOUTH-WESTERN : Kanchanaburi (Sangkhla).

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

Ecology.— On mountain slopes in dense evergreen forests at medium altitude.

9. Bolbitis sinensis (Bak.) K. Iwats., Acta Phytotax. Geobot. 18: 49. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3): 85. 1965; 5: 90. 1967; Hennipm., Leid. Bot. Ser. 2: 202. f. 53–54. 1977; in Fl. Mal. II. 1: 325. f. 27 h. 1978.— *Acrostichum sinense* Bak., Kew Bull. 1906; 14.— *Egenolfia sinensis* (Bak.) Maxon, Proc. Biol. Soc. Wash. 36: 173. 1923; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 424. f. 48, 1–2. 1941; Holtt., Dansk Bot. Ark. 20: 30. 1961.

Rhizome creeping, scales greyish-brown, narrowly subtriangular with long-acuminate apex, entire, up to 4 by 0.8 mm. *Sterile frond* : stipe 15—30 cm long, scaly at base with brown, appressed, membranous, small, broadly oblong scales; lamina narrowly subtriangular, the apex attenuately long-tailed, often viviparous at apex; rachis sparsely scaly, winged in upper part; lateral pinnae up to 5 pairs, basal pinnae the longest, stalked, middle pinnae patent, lanceolate, shortly stalked, upper ones ascending, oblong, moderately acute to rounded at apex, less lobed, adnate at base to form indistinct apical pinna; lobes oblique, rounded at apex, up to 7 mm broad, close to each other; main veins raised beneath, sparsely minutely scaly, veinlets simple or forked, all free; herbaceous to papyraceous, deep green, dark brown when dried. *Fertile frond* about the same height as or lower than the sterile one; stipe 25–40 cm long; lamina narrower, 15—25 by 5–7 cm; lower lateral pinnae oblong, gradually narrowing from base to apex, subtruncate or rounded at distinctly stalked base, rounded to moderately acute at apex, subentire or very slightly waved at margin, terminal pinna narrowly subtriangular with lobed base, about 4 cm long; veins pinnate, veinlets simple, all free, the apex ending inside the distinct cartilaginous margin; sporangia dispersed on the undersurface, naked.

KEY TO THE VARIETIES

1. Basal pinna lobed to $\frac{4}{5}$ way towards costa, up to 12 by 3.5 cm **a.** var. **sinensis**
1. Basal pinna pinnatifid, a few basal anterior pinnules large, deeply lobed to half-way towards costule **b.** var. **costulata**

a. var. **sinensis.** Figure 26. 1–4.

Lamina 25–60 by 12–25 cm; basal pinna asymmetrically oblong-subtriangular, caudately acuminate at apex, lobed to $\frac{4}{5}$ way towards costa, up to 12 by 3.5 cm.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Doi Pacho), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Chang, Pang Bo, Doi Inthanon), Lampang, Lamphun (Doi Khun Tan); NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao).

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

E c o l o g y.— Usually terrestrial on humus-rich slopes in dense mountain forests, sometimes on muddy rocks or even on base of tree-trunks, fairly common at high altitude, at 800—1800 m alt.

V e r n a c u l a r.— Kut bong (กูดบ้ง) (Northern).

N o t e.— In northern Thailand this is one of the most abundant undergrowths in dense evergreen forests. This species is distinguished from the preceding one by lower pinnae not reduced, deeply lobed pinna-margin, larger lateral pinnae equal at the base and less distinct apical pinnae.

b. var. **costulata** (Hook.) Tagawa & K. Iwats., Acta Phytotax. Geobot. 22: 102. 1967; Southeast As. St. 5: 91. 1967.— *Acrostichum appendiculatum* var. *costulatum* Hook., Sp. Fil. 5: 252. 1864.— *Polybotrya appendiculata* var. *costulata* (Hook.) Bedd., Ferns Br. Ind.: pl. 110. 1865; Handb.: 426. f. 257. 1883. Figure 26. 5.

Different from the type variety in : plants larger, sterile lamina up to 90 by 30 cm, with about 25 pairs of lateral pinnae, basal pinna asymmetrically subtriangular, pinnatifid, a few basal anterior pinnules large, up to 9 by 2.5 cm, deeply lobed to half-way towards costule, lobes more or less serrate at margin, basal pinnae of fertile fronds lobed.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Suthep), Phitsanulok (Thung Salaeng Luang).

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

E c o l o g y.— On rather dry slopes near streams in dense forests at 500—1000 m alt.

10. Bolbitis tonkinensis (C. Chr. ex Ching) K. Iwats., Acta Phytotax. Geobot. 18: 49. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 18. 1971; Hennipm., Leid. Bot. Ser. 2: 310. 1977.— *Egenolfia tonkinensis* C. Chr. ex Ching, Bull. Fan Mem. Inst. Biol. 2: 306. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 424. 1941.

Rhizome not known from Thailand; stipe and rachis densely scaly throughout; scales small, ovate-oblong, up to 3 mm long, appressed, dark brown, irregular at margin. *Sterile frond* : lamina 80 by 30 cm, narrowly elliptic with attenuate apex; lateral pinnae more than 30 pairs, sessile, oblong-lanceolate, rounded at base,

caudately acuminate with unlobed apical projections of 3.5 by 0.4 cm, lobed to $\frac{2}{3}$ way towards costa, up to 16 by 3 cm; costa raised on both surfaces, densely scaly beneath; lobes oblong-subdeltoid, oblique, rounded to moderately acute at apex, up to 13 by 6 mm, subentire with setae at margin; main veins distinct on both surfaces, veinlets simple or forked, basal posterior veinlets springing directly from costa, basal anterior veinlets running to sinus and ending in sharp narrowly triangular teeth 1.5 mm in length, the other veinlets reaching the margin of lobes and ending in setae up to 1 mm in length; softly papyraceous, glabrous, dark brown to blackish in dried specimens; rachis bearing gemmae. *Fertile frond* lower, with about twelve lateral pinnae; pinnae narrowly oblong, rounded to subtruncate at short stalked base, moderately acute at apex, entire, up to 3.5 by 6 mm, covered entirely by sporangia.

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

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

E c o l o g y.— Only once collected at 550—950 m alt., WINIT 1022 (K).

11. Bolbitis heteroclita (Presl) Ching ex C. Chr., Ind. Fil. Suppl. III.: 48. 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 434. 1941; Holtt., Rev. Fl. Malaya 2: 462. f. 271. 1954; Dansk Bot. Ark. 20: 30. 1961; 23: 237. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 85. 1965; 5: 91. 1967; Hennipm., Leid. Bot. Ser. 2: 221. f. 60. 1977; in Fl. Mal. II. 1: 325. f. 25d, 31a-g. 1978.— *Acrostichum heteroclitum* Presl, Rel. Haenk. I.: 15. pl. 2. f. 2. 1825.— *Leptochilus heteroclitus* (Presl) C. Chr., Ind. Fil.: 385. 1906; Bot. Tidsskr. 32: 343. 1916.

Rhizome long-creeping, scaly; scales nearly black with narrow brown ferrugineous margin, linear, up to 5 by 1 mm. *Sterile frond* : stipe 10—30 cm long, stramineous; lamina simple or imparipinnate with one or two pairs of lateral pinnae; lateral pinnae oblong, cuneate and shortly stalked at base, caudate at apex, 4—7 cm apart, 7—15 by 3—6 cm, almost entire or irregularly shallowly waved, terminal pinna oblong, or often very long-tailed with narrow linear tails 50—80 cm long, up to 15—20(—30) cm long excluding the tail, 5 cm broad; rachis narrowly winged, glabrescent; costa naked, sometimes viviparous; veins distinct on both surfaces, finely reticulated, without included free veinlets; herbaceous or softly papyraceous, glabrous, deep green, blackish when dry. *Fertile frond* not seen in Thailand, those of the Philippines plants : stipe nearly the same as or larger than those of sterile ones; lateral pinnae up to 4 pairs, oblong, about 5 by 2.7 cm, apical pinna a little larger than lateral ones, veins reticulate; sporangia spread over the whole undersurface of pinnae.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok), Chiang Mai (Doi Chiang Dao), Lampang, Phitsanulok (Nakhon Thai, Thung Salaeng Luang); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chon Buri (Si Racha), Chanthaburi (Nam Tok Takhamao, Pong Nam Ron), Trat (Phriu Waterfall, Huai Raeng); SOUTH-WESTERN : Kanchanaburi (Khao Yai), Prachuap Khiri Khan (Khao Luang); PENINSULAR : Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

D i s t r i b u t i o n.— N. India, Upper Burma, S. and SW. China, Taiwan, Ryukyu, Indochina, throughout Malesia (type from Luzon) to New Guinea.

E c o l o g y.— On wet ground or on muddy moist rocks usually near streams in dense forests, or rarely epiphytic on base of tree-trunks, at low or medium altitudes.

V e r n a c u l a r.— Kut pao (กูดเป๋า), kut hang nok kaling (กูดหางนกกะลิง) (Northern).

N o t e.— Characteristic of this species is the presence of apical prolonged lobes, though this species does not form colonies like *B. subcordata* of Japan. Compared with related species, *B. heteroclita* seems to prefer very moist habitats and sometimes droops from rocks in the spray of waterfalls. In the epiphytic condition no prolonged terminal pinnae are formed though they become to 30 cm in length.

12. Bolbitis sinuata (Presl) Hennipm., Blumea 18: 148. 1970; Leid. Bot. Ser. 2: 232. f. 61—62. 1977; in Fl. Mal. II. 1: 326. f. 27j. 1978.— *Polypodium sinuatum* Presl, Rel. Haenk. I: 21. 1825.— *Bolbitis diversifolia* (Bl.) Schott, Gen. Fil.: ad.t. 13. 1835; Holtt., Rev. Fl. Malaya 2: 465. f. 273. 1955; Tagawa & K. Iwats., Southeast As. St. 3(3): 85. 1965.— *Acrostichum diversifolium* Bl. En. Pl. Jav.: 103. 1828.

Rhizome creeping, ascending, scaly; scales greyish-brown, rather stiff, lanceolate, up to 4 by 1 mm. *Sterile frond* simple or tri- to quinque-foliate; stipe stramineous or darker, 3—9 cm long, sparsely scaly; simple laminae or terminal pinnae broadly oblanceolate, acuminate at apex, gradually narrowing towards base, 15—30 by 5—7.5 cm, subentire at margin; midrib scaly beneath; main veins distinct but other veins obscure on both surfaces, reticulate without included veinlets, areoles irregular, many; thickly papyraceous, glabrous. *Fertile frond* nearly the same height as sterile ones; stipe 15—25 cm long; lamina simple or impari-pinnate with 2—3 lateral pinnae and a large terminal pinna; lateral pinnae lanceolate, gradually narrowing towards both ends, sessile, up to 6 by 0.7 cm, terminal or simple pinna lanceolate, about 12 by 2 cm, veins reticulate, obscure.

T h a i l a n d.— PENINSULAR : Ranong (Khao Sai Daeng), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun, Yala (Ban Mae Wing).

D i s t r i b u t i o n.— Malaya, Sumatra, eastwards to the Philippines (type).

E c o l o g y.— On wet mossy rocks by streams in dense evergreen forests at low altitude.

3. TERATOPHYLLUM

Mett. ex Kuhn, Ann. Lugd. Bat. 4: 296. 1869; Copel., Gen. Fil.: 117. 1947.

Rhizome long, climbing trees, dorsiventral, bearing two alternate rows of fronds on dorsal surface and numerous roots on ventral surface, scaly; scales peltate, usually small, with irregular projections at margin; stipe swollen at base. Sterile frond of two kinds; young frond or bathyphyll pinnate or bipinnate, with lower pinnae articulated; adult frond or acrophyll simply pinnate, all pinnae jointed to rachis. Fertile pinnae linear, their lower surfaces covered with sporangia (acrostichoid). Spores large, bilateral, with perispore.

The species of this genus have been thoroughly revised by HOLTTUM (Gard. Bull. S. S. 5: 277–304. 1932 and 9: 355–362. 1938). He recognized twelve species, including three that COPELAND (1947) places in *Arthrobotrya* and considers generically distinct from *Teratophyllum*. The genus is Malesian, extending southeast to Polynesia and Queensland and northwest to Burma. There are two species known in Thailand.

KEY TO THE SPECIES

1. Pinnae of bathyphyll deeply incised, pinnules with few linear segments; pinnae of acrophyll sessile, 2–2.5 cm broad, sides parallel for about half the length **1. T. aculeatum**
1. Pinnae of bathyphyll at most crenate, almost equally cuneate at base; pinnae of acrophyll stalked, 2–4.5 cm broad, elliptic **2. T. ludens**

1. Teratophyllum aculeatum (Bl.) Mett. ex Kuhn, Ann. Lugd. Bat. 4: 296. 1869; Holtt., Rev. Fl. Malaya 2: 473. f. 276 a-h. 1955; in Fl. Mal. II. 1:269. f. 3, 4a-h. 1978; Tagawa & K. Iwats., Southeast As. St. 5: 92. 1967.— *Lomaria aculeata* Bl., En. Pl. Jav.: 205. 1828.— *Stenochlaena aculeata* (Bl.) Kunze, Bot. Zeit. 6: 142. 1848; C. Chr., Bot. Tidsskr. 32: 346. 1916.— *Lomariopsis sorbifolia* auct. non (Linn.) Fée : Bedd., Handb.: 423. f. 254. 1883; Christ, Bot. Tidsskr. 24: 107. 1901. Figure 27. 1–6.

Rhizome very slender, creeping or climbing. *Bathyphylls* leafy on lower portion of rachis, gradually more pinnate upwards, up to 8 by 2 cm, oblong with acute apex; pinnae up to 1.5 cm broad, entire or rarely forked. *Sterile acrophyll* up to 60 by 20 cm, oblong-lanceolate; pinnae about 15 pairs and a single terminal one, lanceolate, acuminate at apex, rounded to truncate at base, shortly stalked or sessile, up to 12 by 2.5 cm; papyraceous. *Fertile frond* pinnate; pinnae linear, more than 20 cm long, up to 2 mm broad; sporangia dispersed on lower surface of pinna except on midrib.

T h a i l a n d.— SOUTH-EASTERN : Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR : Ranong (Muang Laen), Surat Thani (Bang Bao, Ban Don, Khao Sok), Phangnga (Nai Chong), Nakhon Si Thammarat (Khao Luang), Pattani (Bacho), Narathiwat (Waeng).

D i s t r i b u t i o n.— Burma, Malaya, Sumatra to the Philippines (type from Java) and New Guinea.

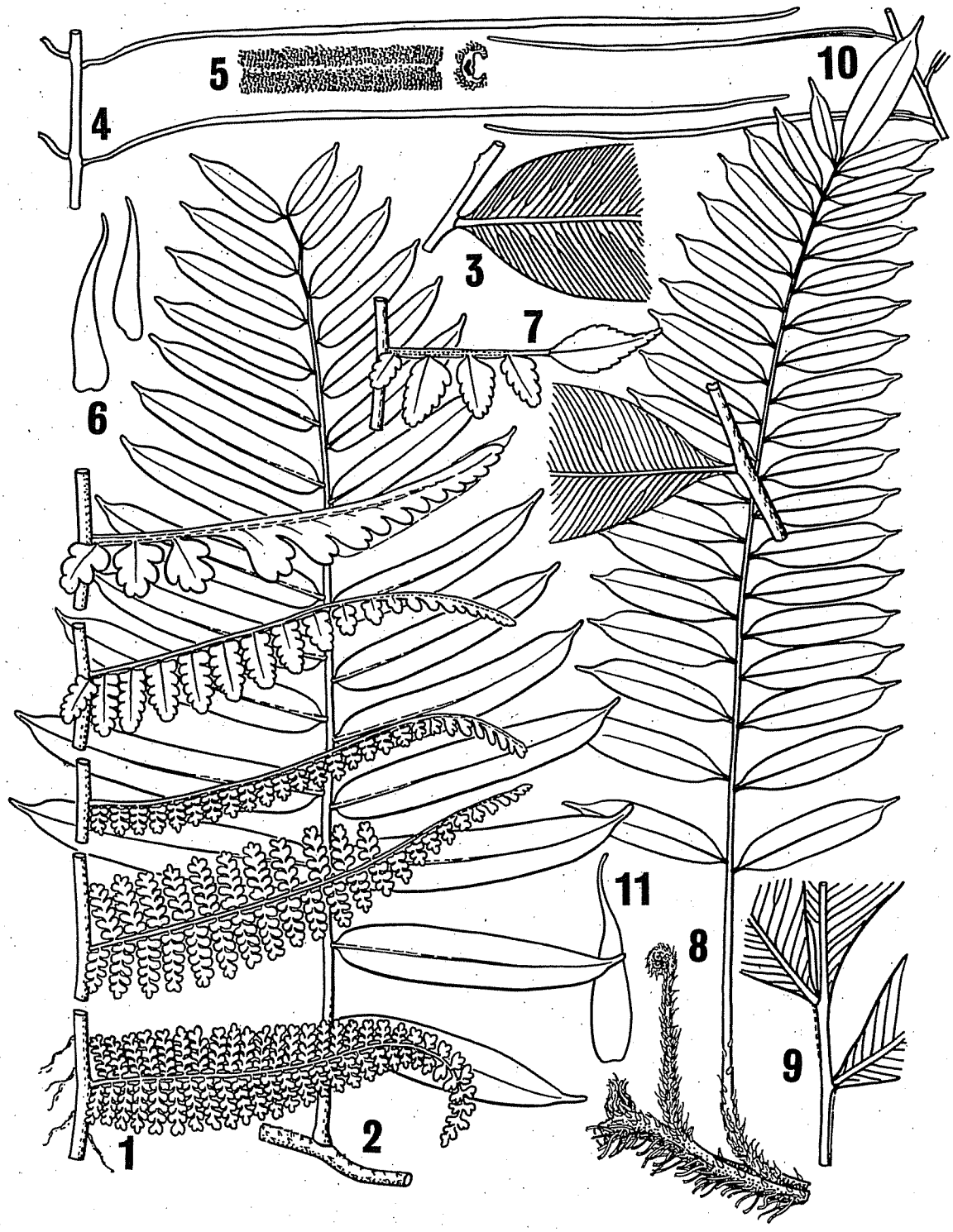


Figure 27. 1–6: *Teratophyllum aculeatum*; 1. five styles of bathyphylls, natural size except top one (x 1.5); 2. sterile acrophyll, x 0.5; 3. basal portion of sterile pinna, x 1.5; 4. fertile pinnae, x 0.5; 5. same, enlarged, x 3; 6. scales on rhizome, x 10. 7: *T. ludens*; a style of bathyphyll, x 1.5. 8–11: *Lomariopsis lineata*; 8. portion of plant, x 0.3; 9. portion of terminal pinnae, x 1.5; 10. fertile pinnae, x 0.5; 11. scale on stipe, x 4.

E c o l o g y.— On mountain slopes in dense evergreen forests at low or medium altitudes.

N o t e.— All the Thai collections are of bathyphylls and the description of acrophylls is drawn from Malayan plants.

2. Teratophyllum ludens (Fée) Holtt., Gard. Bull. S. S. 5: 298. pl. 10. f. 23—28, 31, 35, 46—47. 1932; Rev. Fl. Malaya 2: 474. f. 278. 1955; in Fl. Mal. II. 1: 275. f. 6a-e. 1978; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24: 62. 1969.— *Lomariopsis ludens* Fée, Hist. Acrost.: 70. t. 30. 1845. Figure 27.7.

Rhizome long-creeping, about 5 mm diam., sparsely prickly, scaly at apex; scales small, about 1 mm long, with irregular projections at margin. *Stipe* swollen at base, glabrescent, 5—20 cm long. *Bathyphylls* 2.5—7.5 cm long; pinnae smaller towards base, 0.5—3 cm long, ovate, cuneate at base, blunt at apex, subentire or crenate at margin at upper portion. *Acrophylls* : lamina up to 45 by 25 cm; pinnae about 10 pairs, 13—15 by 2—4.5 cm, narrowly elliptic, cuneate at base, acuminate at apex; subcoriaceous, margin not thickened, involute in dried specimens; fertile pinnae up to 20 cm by 3 mm, stalked.

T h a i l a n d.— CENTRAL : Nakhon Nayok (Khao Yai); PENINSULAR : Surat Thani (Ban Don).

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

E c o l o g y.— Climbing trees in evergreen forests along streams at low to medium altitudes.

N o t e.— There is a form which resembles the bathyphyll of *T. rotundifolium* (Bonap.) Holtt., Gard. Bull. S. S. 5: 294. pl. 7, 8, f. 36—37. 1932; Rev. Fl. Malaya 2: 474. f. 277. 1955, but we do not have sufficient information on the occurrence of this species in the extreme south of Thailand.

4. LOMARIOPSIS

Fée, Hist. Acrost.: 10, 66. 1845; Copel., Gen. Fil.: 117. 1947.

Rhizome creeping or climbing, fleshy, bearing several rows of fronds, covered densely with brown scales at apex. Frond simply pinnate; pinnae entire, jointed to rachis; veins all free. Fertile frond pinnate; pinnae narrower with lower surface covered with sporangia.

Only one species is known in Thailand among more than 25 known in the tropics throughout the world.

Lomariopsis lineata (Presl) Holtt., Novit. Bot. Inst. Prag. 1968 : 9; in Fl. Mal. II.: 262. 1978.— *Olfesia lineata* Presl, Tent. Pterid.: 235. 1836.— *Lomariopsis cochinchinensis* Fée, Hist. Acrost.: 66. t. 26. 1845; Holtt., Gard. Bull. S. S. 9: 266. 1937; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 428. f. 49, 1—2. 1941; Holtt., Rev. Fl. Malaya 2: 476. f. 279. 1955. Figure 27. 8—11.

Rhizome creeping, climbing, scaly; scales oblong-lanceolate, brown, up to 10 by 3 mm, entire. *Stipe* about 20 cm long, densely scaly at base. *Lamina* oblong-lanceolate, simply pinnate, up to 60 by 30 cm; pinnae 15—20 pairs, jointed to rachis except for the terminal one, lower ones stalked, lanceolate, up to 20 by 2—4 cm; veins distinct on both surfaces. *Fertile pinnae* linear, 8—15 cm long, up to 6 mm broad, stalked. *Sporangia* dispersed on the lower surface except on midrib.

Thailand.— CENTRAL : Prachin Buri (Khao Yai National Park); PENINSULAR : Yala (Ban Chana).

Distribution.— Burma, Indochina, Malaya, Sumatra, Java, Borneo, Philippines (type), and New Guinea.

Ecology.— Long climber on trees at low altitude, 210—350 m alt.

5. LOMAGRAMMA

J. Smith, J. Bot. 3: 402. 1841; 4: 152. 1841; Hook., Gen. Fil.: t. 98. 1842; Copel., Gen. Fil.: 118. 1947.

Rhizome slender, creeping or climbing, scaly. Bathyphyll simply pinnate; acrophyll simply pinnate to bipinnate; veins anastomosing without included veinlets; pinnae all jointed to rachis. Fertile frond simply pinnate; pinnae linear, its lower surface covered with sporangia.

Eighteen species are known in the regions from the Himalayas to Polynesia, but only one occurs in Thailand. There is a comprehensive revision by Holttum in Gard. Bull. S. S. 9: 190—221. 1937, and we have few additional materials for our Thai flora. Holttum, in Fl. Mal. II. 1: 281. 1978, records Pattani for *L. perakensis* Bedd., but we have never seen material from there.

Lomagramma grossoserrata Holtt., Gard. Bull. S. S. 9: 203. pl. 10, 11. 1937.

Rhizome long-creeping or climbing, naked but scaly at apex; scales lanceolate, brown, rather small. *Bathyphyll* : stipe 7—8 cm long, stramineous, blackish and sparsely scaly at base; lamina 35—40 cm long, up to 10 cm wide, oblong-lanceolate with acute apex; pinnae 24—25 pairs, sessile, ascending, the base unequally cuneate,

subentire, up to 10 cm long; membranous. *Acrophyll* : stipe 30 cm long; pinnae sessile, asymmetrically cuneate at base, serrate at margin, up to 18 by 1.5–2 cm; herbaceous; venation with 3 rows of areoles, without free included veinlets. *Fertile frond* pinnate; pinnae linear; sporangia covering the whole lower surface of pinna except midrib.

T h a i l a n d.— NORTHERN : Phrae (Mae Sai, type).

D i s t r i b u t i o n.— Endemic; known only by the type collection.

E c o l o g y.— Climbing at 620–880 m alt.

25. DRYOPTERIDACEAE

This large family is subdivided into two rather distinct subfamilies : Dryopteridoideae and Tectarioideae.

A. KEY TO THE SUBFAMILIES

1. Frond usually bipinnate, tripinnate, or pinnate (rarely simple in *Cyrtorium* but not in Thai species); costa grooved except in *Didymochlaena*; veins free. Frond often scaly but rarely hairy ***I. Dryopteridoideae***
1. Frond bipinnate, pinnate, or simple (or tripinnate in *Ctenitis manilensis*); costa raised on upper surface and often hairy; veins free or anastomosing. Frond usually bearing multicellular hairs (so-called *Ctenitis* hairs) ***II. Tectarioideae***

B. KEY TO THE GENERA ACCORDING TO SUBFAMILIES

I. Dryopteridoideae

1. Articulated hairs present on upper surface of veins and on axes of frond
 2. Indusia round, attached at base, shallowly cup-shaped **1. Acrophorus**
 2. Indusia globose, firm, attached all round the base of receptacles, completely covering the young sori **2. Diacalpe**

1. No articulated hairs on axes of frond
 3. Sori elongate. Pinnule articulate to rachis, subdimidiate **3. Didymochlaena**
 3. Sori round. Pinnule not articulated
  4. Indusia round, peltate
   5. Frond imparipinnate; pinnae entire or minutely toothed at margin; veins reticulate **4. Cyrtomium**
   5. Frond pinnate to bipinnate; pinnae entire to pinnate; veins free **5. Polystichum**
  4. Indusia round-reniform, attached at sinus
   6. Axes not decurrent; anadromic, or the first secondary pinnule directed towards the apex of frond **6. Arachniodes**
   6. Axes in the higher order decurrent to major ones; catadromic, or the first secondary pinnule of a medial primary pinna directed towards the base of frond **7. Dryopteris**

II. Tectarioideae

1. Veins all free; basal posterior vein of a vein-group running from costule
 2. Pinna not jointed to rachis. Indusia round-reniform
  3. No teeth in sinus between lobes of pinna or pinnule **8. Ctenitis**
  3. Prominent sinus-teeth present **13. Pteridrys**
 2. Pinna jointed to rachis. Indusia peltate **14. Cyclopeltis**
1. Veins anastomosing or free with the basal posterior vein of a vein-group running directly from costa

4. No teeth in sinus between lobes of pinna or pinnule
5. Frond not or hardly dimorphic (or dimorphic in a few species of *Heterogonium*). Sori round or rarely elongate along veins
6. Basal pinna lobed with short basal posterior lobes or pinnules **9. Heterogonium**
6. Basal pinna unlobed, or when lobed the basal basiscopic lobes or pinnules longest **10. Tectaria**
5. Frond distinctly dimorphic, trifoliate; lower surface of fertile frond covered with sporangia (acrostichoid) **11. Quercifilix**
4. Prominent sinus-teeth present **12. Pleocnemia**

1. ACROPHORUS

Presl, Tent. Pterid.: 93. 1836; Copel., Gen. Fil.: 107. 1947.

Rhizome short, ascending or erect, densely scaly; scales not peltate, castaneous, not clathrate; stipe scaly, somewhat rough by fallen scars of scales. Lamina finely dissected to quadripinnate, deltoid-ovate; pinnae opposite, at right angles to rachis; veins all free; hairs on upper surface of veins, costules, costa and rachis coarse, articulate. Sori dorsal on veinlets, with round receptacles; indusia reniform.

Two similar species are known in Southeast Asia, extending east to Fiji, one of them being native to Thailand.

Acrophorus stipellatus Moore, Gard. Chron. 1854: 135; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 296. f. 31, 3—4. 1941; Tagawa & K. Iwats., Southeast As. St. 5: 92. 1967.— *Leucostegia nodosa* (Presl) Bedd., Ferns Br. Ind. Suppl.: 4. 1876; Handb.: 54. f. 26. 1883, p.p. Figure 28. 1—2.

Rhizome thick, bearing a few fronds; scales oblong-oval, acute to acuminate at apex, cordate at base, up to 1 cm or more long, 8 mm broad, membranous, brown, concolorous. *Stipe* stramineous, rather densely scaly at base, about 80 cm long. *Lamina* oblong-subdeltoid, acute at apex, up to 100 by 80 cm, 4 to 5 times pinnately divided; lateral pinnae several pairs, opposite, the lowest the largest, asymmetrically oblong-subtriangular, up to 50 by 35 cm, basal anterior pinnules larger; pinna-rachis at right angles to rachis, i.e. almost straight with the opposite ones, slightly bending upwards in distal portion, grooved on upper surface, grooves separated from those of the joining axes by scaly edges; larger pinnule like upper pinna, oblong, rounded to moderately acute at apex, broadly cuneate to subtruncate at subsessile or shortly stalked base, 3—4 by 1.5 cm; ultimate segments oblong, unequally cuneate at sessile base, lobed almost to axes, up to 9 by 4 mm; lobes oblong or spathulate, entire; herbaceous, light green, veins all free, hairy on upper side with coarse multicellular hairs. *Sori* round, subterminal at veinlets; indusia cup-shaped, attached on basal side, at first covered the sori entirely, later becoming under sori, persistent.

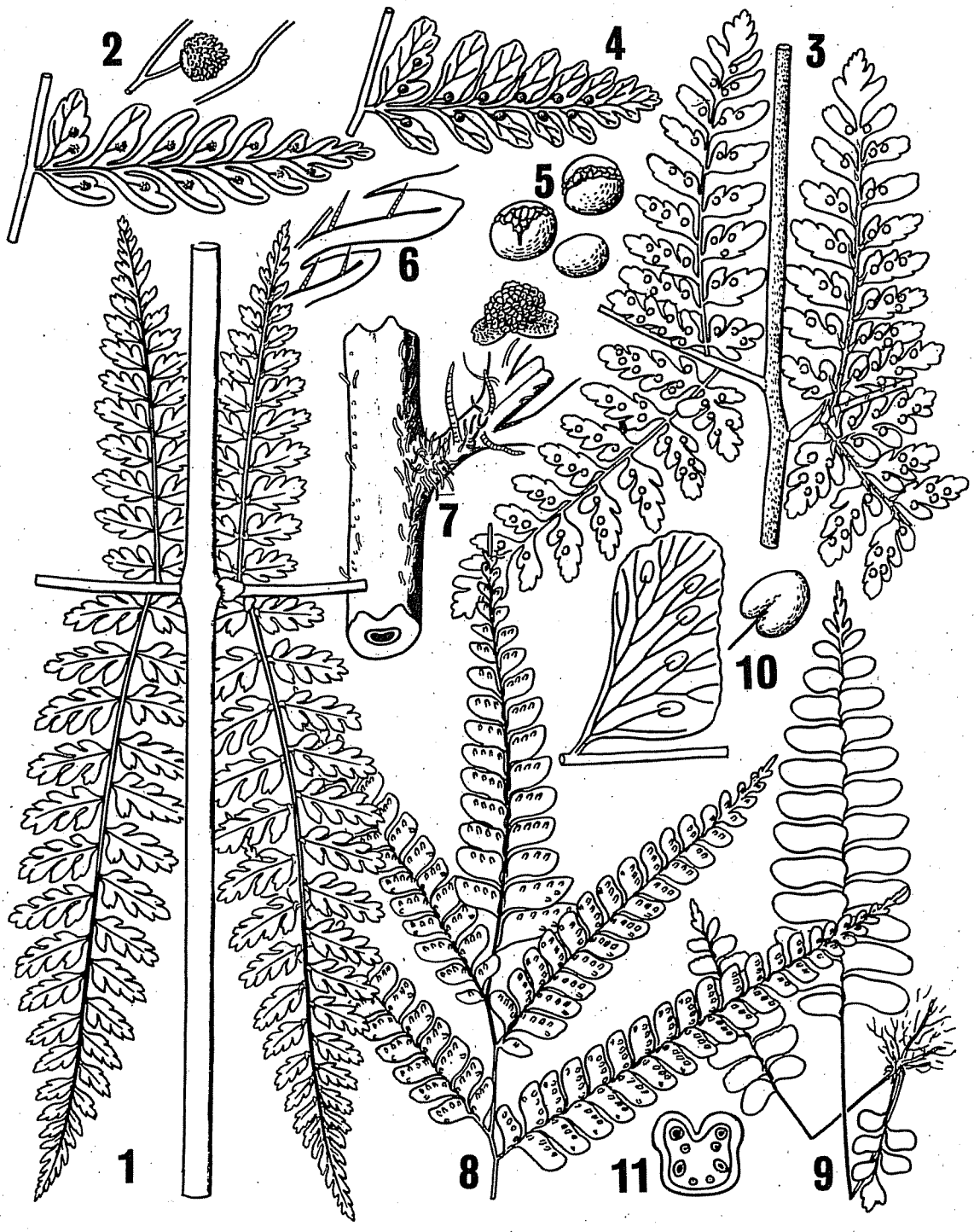


Figure 28. 1 – 2: *Acrophorus stipellatus*; 1. basal portion of large two pinnae, showing arrangement of basal pinnules, x 2; 2. smaller third order leaflet, x 3, and sorus enlarged, x 15. 3 – 7: *Diacalpe aspidioides*; 3. basal portion of large two pinnae, x 2; 4. small pinnule, x 3; 5. four sori with various stages of indusia; 6. surface of leaf, enlarged; 7. rachis and basal part of small pinna. 8 – 11: *Didymochlaena truncatula*; 8. upper portion of fertile frond, x 0.5; 9. juvenile plant, x 0.5; 10. pinnule (x 2) and young indusium (x 15); 11. cross section of rachis x 2.5.

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

D i s t r i b u t i o n.— Himalayas (type) to S. China and Taiwan, north to southern edge of Japan (Isl. Yakushima).

E c o l o g y.— On humus-rich floor of dense evergreen forests only at highest regions higher than 1800 m alt.

N o t e.— This is a handsome fern growing in deep mountain forests at the highest altitudes in this country. The patent pinnae and finely dissected fronds are comparable with those of epiphytic *Araiostegia faberiana* in the same region.

2. DIACALPE

Bl., En. Pl. Jav.: 241. 1828; Copel., Gen. Fil.: 106. 1947.

Like *Acrophorus* but differs in soral construction : indusia firm, attached all round the base of receptacle, completely covering the sori, globose, tearing irregularly at maturity.

A single species in S. and SE. Asia is known in mountainous regions in Thailand.

Diacalpe aspidioides Bl., En. Pl. Jav.: 241. 1828; Bedd., Handb.: 18. f. 7. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 292. f. 31, 1–2. 1941; Holtt., Rev. Fl. Malaya 2: 481. f. 284. 1955; Dansk Bot. Ark. 23: 237. 1965; Tagawa & K. Iwats., Southeast As. St. 5: 92. 1967. Figure 28. 3–7.

Rhizome short, ascending, covered with scales; scales linear-subtriangular, up to 10 by 2 mm, entire, glabrous, brown. *Stipe* dark stramineous to brown, deep brown on abaxial surface, polished, up to 40 cm long, scaly throughout. *Lamina* oblong-subdeltoid, about as long as stipe, tripinnate to quadripinnate; rachis minutely scaly throughout; pinnae more than ten pairs, basal ones the largest, up to 20 by 12 cm, asymmetrically subtriangular, middle ones falcate, oblong-subtriangular, caudately acute at apex, broadly cuneate at base, about 15 by 7 cm; pinnules oblong-subdeltoid, acute at apex, unequally broadly caudate at subsessile base, 2–4 by 0.8–1.2 cm, posterior side of basal pinnae more than 10 cm in length; segments oblong to spathulate, oblique, sessile, subentire or pinnate in larger ones, rounded at apex, narrowly cuneate at base, about 7 by 3 mm in those of middle pinnae; pinnae papyraceous, green to deep green, sparsely hairy on veins, hairs articulated. *Sori* dorsal on veinlets, round; indusia green and glabrous when young, about 0.7 mm diam.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Hua Mot, Doi Inthanon), Mae Hong Son (Khun Mae Lan); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng);

CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); PENINSULAR : Chumphon (Khao Nom Sao), Ranong (Khao Phota Luang Kaeo), Krabi (Phanom Bencha), Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Sri Lanka, N. India, S. China, Indochina and throughout Malesia (type from Java).

E c o l o g y.— On humus-rich floor of dense forests at medium or high altitudes.

3. DIDYMOCHLAENA

Desv., Berl. Mag. 5: 303. 1811; Copel., Gen. Fil.: 112. 1947.

Rhizome short, ascending to erect, scaly; scales broad, entire, glabrous, concolorous, those on stipe lacerate at margin. Lamina oblong, bipinnate with pinnate apex; pinnae jointed to rachis; pinnules subsessile, subdimidiate, rounded at apex, glabrescent; veins forked, all free, ending in enlarged submarginal apices. Sori terminal on veinlets, with elongate receptacles, slightly sunken; indusia elliptic, fixed to veinlets along medial line, rounded at distal end, cordate at base, firm, glabrous.

There is a single pantropical species.

Didymochlaena truncatula (Sw.) J. Smith, J. Bot. 4: 196. 1841; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 331. f. 36, 4—5. 1941; Holtt., Rev. Fl. Malaya 2: 483. f. 285. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 93. 1967; Acta Phytotax. Geobot. 23: 55. 1968.— *Aspidium truncatulum* Sw., Schrad. J. Bot. 1800(2): 36. 1801.— *Didymochlaena lunulata* auct. non (Burm.) Desv.: Bedd., Handb.: 199. f. 99. 1883. Figure 28. 8—11.

Rhizome massive, bearing a group of fronds like a small tree fern, sometimes more than 10 cm long, covered densely with scales; scales up to 20 by 5 mm, brown or sometimes black-brown in central portion, glabrous, entire. *Stipe* stramineous or dark, very densely covered with scales and downy hairs, up to 70 cm long, grooved on adaxial surface. *Lamina* oblong or narrower, up to 100 by 40 cm, bipinnate; rachis densely covered with narrower scales and downy hairs; pinnae 20 or more pairs, joined to rachis, linear-lanceolate, acuminate at apex, subtruncate at base, up to 25 by 4 cm; pinna-rachis grooved, grooves not decurrent into those on rachis; leaflets jointed to rachis, uniform in size and form throughout, nearly oblong, about 1.7 by 0.8 mm, rounded at apex, entire or very slightly serrate at margin; thick; dark green but brown in dried specimens, glabrous, bearing distinct spines at base of leaflets. *Sori* terminal on anterior branch of veins, elongate, somewhat hollowed; indusia glabrous, about 2 mm long.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Phacho), Chiang Mai (Doi Suthep, Doi Inthanon); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao, Pong

Namron); PENINSULAR : Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Phangnga (Khao Phota Luang Kaeo), Yala (Bacho, Khao Sai Khao).

Distribution.— Pantropic (type from Java).

Ecology.— On humus-rich mountain slopes in dense evergreen forests at medium or high altitudes.

Vernacular.— Kut khap (กูดขาบ) (Peninsular).

Note.— MOMOSE, Southeast As. St. 6: 135. 1968, pointed out that the prothalli of the Thai plants of this species are distinct from those of the plants cultivated in Europe. Critical studies in recent years show that there are distinct local forms in this species, and a world-wide revision is needed.

4. CYRTOMIUM

Presl, Tent. Pterid.: 86. 1836.— *Phanerophlebia* Presl, Tent. Pterid.: 84. 1836; Copel., Gen. Fil.: 110. 1947.

Rhizome short, ascending to erect, densely scaly; scales broad, entire or becoming lacerate. Lamina imparipinnate; pinnae commonly acuminate, subentire or minutely toothed at margin; coriaceous or firm; veins anastomosing to form rather large areoles with included veinlets. Sori dorsal on included free veinlets; indusia peltate, round-reniform.

About a dozen species, ranging from S. Africa to Japan and Hawaii. One has recently been found in Thailand.

Cyrtomium fortunei J.Smith, Ferns Br. For.: 286. 1866; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 378. 1941; Tagawa & K. Iwats., Acta Phytotax. Geobot. 29: 22. 1978.

Rhizome short, covered with scales; scales oblong-ovate to subtriangular, rounded at base, gradually narrowing towards tailed apex, up to 15 by 4 mm, brown, darker in central portion, minutely lacerate at margin. *Stipe* stramineous, scaly throughout, 10—15 cm long. *Lamina* imparipinnate; lateral pinnae 6—9 pairs, stalked, oblong, falcate, auricled at anterior and cuneate at posterior bases, gradually narrowing to caudate apex, minutely dentate at margin up to the very apex, 4.5—7 by 2—2.4 cm, terminal pinna commonly subtriangular, up to 3 cm broad; coriaceous, glabrous, green, paler beneath; veins anastomosing to form 4—5 rows of areoles with included veinlets. *Sori* dorsal on included veinlets, round, 2—4 rows at each side of costa; indusia round-reniform, peltate, up to 7 mm diam.

Thailand.— EASTERN : Chaiyaphum (Nam Phrom).

Distribution.— Japan (type), S. Korea, SE. China, and Indochina.

Ecology.— On sandstone in shady river border in forest at about 600 m alt.

5. POLYSTICHUM

Roth, Arch. Bot. 2(1): 106. 1799; Copel., Gen. Fil.: 108. 1947.

Rhizome short, usually ascending or erect, bearing a tuft of fronds at apex; scales usually rather broad, lacerate. Stipe densely scaly. Lamina usually oblong, narrow at base, anadromic in sequence, pinnate to bipinnate, coriaceous, with mucronate apex of ultimate lobes; veins all free, usually bearing fibroid scales. Sori commonly dorsal on veins, round; indusia round, peltate, or rarely wanting.

Polystichum is close to *Dryopteris* but differs from the latter in having peltate indusia. In frond-form and scales, some species of *Dryopteris,* such as *D. paleacea* and its relatives, are similar to *Polystichum,* but the peltate indusia and mucronate apices of ultimate lobes are good indicators for the species of *Polystichum.*

About 200 species belong to this genus of which an infrageneric classification was proposed by TAGAWA in Acta Phytotax. Geobot. 9: 119–138. 1940. Many of the species of the group of *P. aculeatum* are known to hybridize freely; the species are therefore not stable. For Thailand seven species are accepted here, although rather tentatively, since there are many Sino-Himalayan species still in need of detailed comparison.

KEY TO THE SPECIES

1. Frond pinnate; pinnae very shallowly toothed at margin **1. P. lindsaefolium**
1. Frond bipinnate to tripinnate at base
 2. Rachis gemmiferous
  3. Frond narrowly subtriangular, widest at base and attenuately very long-acuminate at apex; scales on rachis light brown **2. P. attenuatum**
  3. Frond oblong-lanceolate, widest at middle portion and acuminate at apex
   4. Scales on rachis dark brown to nearly black. Sori usually confined to the marginal portion of segments **3. P. eximium**
   4. Scales on rachis brown. Sori dispersed evenly on segments underneath **4. P. prolificans**
 2. Rachis not gemmiferous
  5. Pinnule subentire or very shallowly toothed at margin
   6. Sori marginal on medial portion of pinnules, scattered from the apical part of frond downwards **5. P. biaristatum**
   6. Sori medial or costular, scattered from the basal central portion of frond outwards **6. P. semifertile**
  5. Pinnule lobed more than $\frac{1}{3}$ way towards midrib. Sori costular, often confluent to the neighbouring ones at maturity **7. P. tenggerense**

1. Polystichum lindsaefolium Scort. ex Ridl., J. Mal. Br. Roy. As. Soc. 4: 61. 1926; Holtt., Rev. Fl. Malaya 2: 489. f. 289. 1955; Tagawa & K. Iwats., Southeast As. St. 5: 94. 1967. Figure 29. 1–2.

Rhizome short, erect, scaly at apex; scales oblong-lanceolate with long-tailed apex, light brown, fimbriate at margin, up to 7 by 1.2–3 mm. *Stipe* pale stramineous, up to 1.2 mm diam, 8–12 cm long, scaly throughout. *Lamina* pinnate, linear,

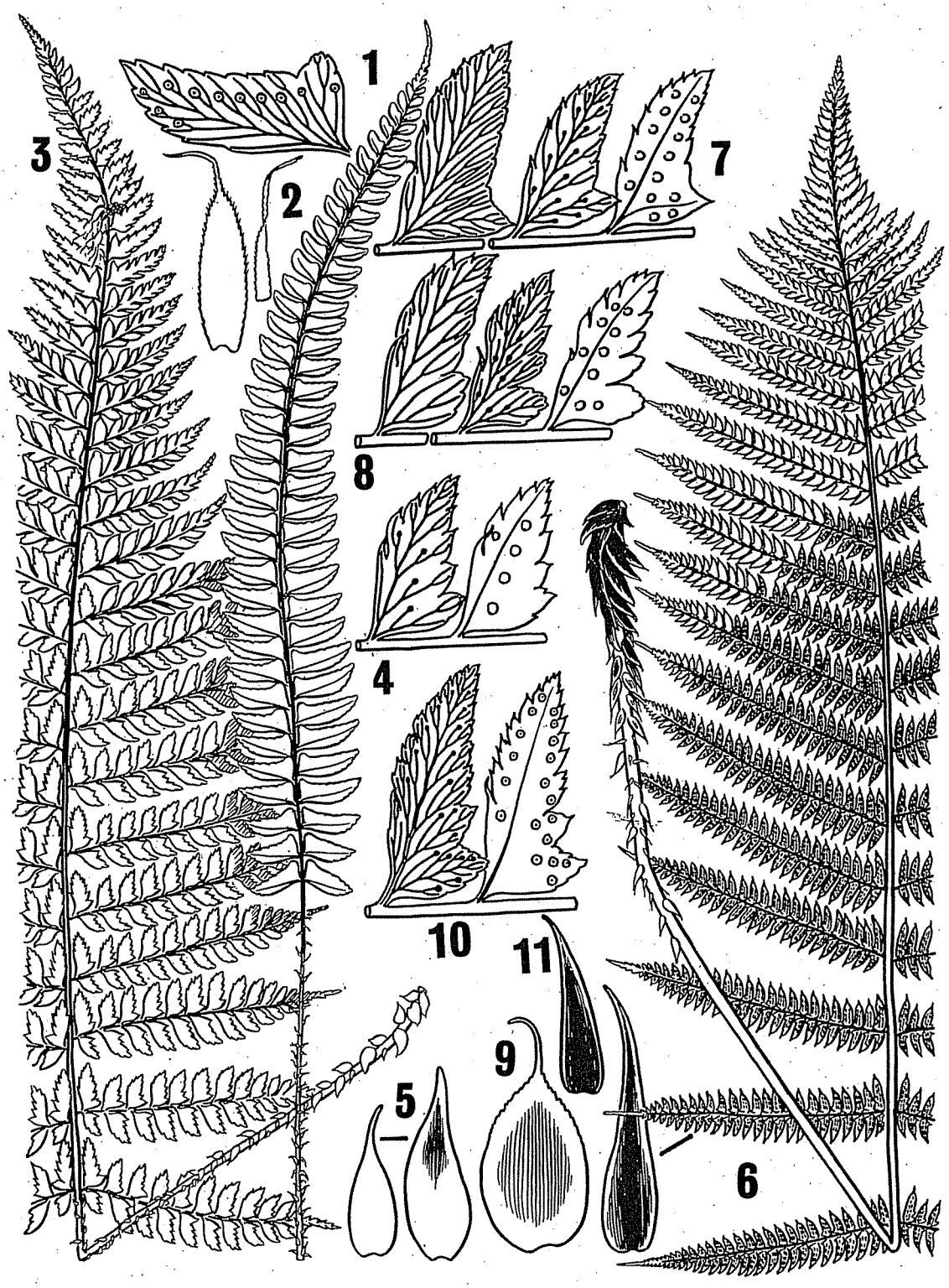


Figure 29. 1–2: *Polystichum lindsaefolium*; 1. frond (x 0.5) and fertile pinna, enlarged; 2. scales, x 4. 3–5: *P. attenuatum*; 3. frond, x 0.4; 4. fertile pinnae, x 2; 5. scales, pale and with blackish part (x 1.5). 6–7: *P. semifertile*; 6. frond (x 0.35) and scale (left, x 1.5); 7. pinnae, sterile (left) and fertile (right two), x 2. 8–9; *P. tenggerense*; 8. pinnae, sterile (left) and fertile (right), x 2; 9. scale of stipe, x 1.5. 10–11: *P. biaristatum*; 10. fertile pinnae, x 2; 11. scale on stipe, x 1.5.

25–30 by 3–3.5 cm, slightly narrowing downwards, gradually narrowing towards caudately long-acuminate apex; rachis-scales small, linear, sometimes like hairs with broad base; pinnae more than 35 pairs, sessile, almost at right angle to rachis or slightly ascending, oblong or more usually narrowing from base to apex, slightly falcate, distinctly auricled at acroscopic base, dimidiate at basiscopic base, acute at apex, margin shallowly undulate, 1.7–2 by 0.7 cm, auricles acuminate at apex, ending in awns; veins pinnate, veinlets simple or forked, very minutely scaly underneath, slightly raised on lower surface; papyraceous, green on upper surface, pale beneath. *Sori* terminal at anterior branch of veinlets, arranging in one row near the margin of pinnae; indusia rigid, about 0.8 mm diam., deciduous.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Chiang Dao); SOUTH-WESTERN : Kanchanaburi (Dong Yai).

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

E c o l o g y.— In muddy crevices or on moist surface of limestone cliffs in dense evergreen forests at 200–1800 m alt.; collected in two localities in Thailand but abundant there.

N o t e.— This is a species confined to limestone areas, and the specific identity with Malayan species should further be studied. It is also apparently close to *P. obliquum* of Sikkim-Himalayan regions. Further collection may lead to the union of there two species.

2. Polystichum attenuatum Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 113. f. 9. 1968.— *Polystichum* sp.; Tagawa & K. Iwats., Southeast As. St. 5: 94. 1967. Figure 29. 3–5.

Rhizome short, scaly at apex; scales oblong with acuminate apex, rounded at base, up to 10 by 7 mm, rigid, bicoloured with nearly black central portion and light brown margin, marginal portion caducous, often leaving concolorous black scales on older portion of rhizome. *Stipe* 15–25 cm long. *Lamina* narrowly subtriangular, commonly widest at base, 30–40 by 20 cm; rachis scaly with brown linear scales less than 0.7 mm broad, gemmiferous on upper part; lateral pinnae 30 pairs or more, oblong or slightly narrowing from base to apex, falcate, auricled at acroscopic base, dimidiate at basiscopic base, upper ones pinnatifid, a few lowest pinnae very shortly stalked, patent, slightly falcate, lanceolate, up to 10 cm long, more than 2 cm wide; basal acroscopic pinnules about 1.5 times larger than the next; pinna-rachis minutely linear scaly, narrowly winged; pinnules of lower pinnae oblong or more usually narrowing from base to acute apex, auricled at acroscopic and dimidiate at basiscopic bases, apex of lobes ending in awns; veins minutely scaly beneath, not raised on both surfaces; subcoriaceous, glabrous on laminar surface, green. *Sori* close to midrib of pinnule; indusia small, glabrous, caducous.

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

D i s t r i b u t i o n.— Endemic.

E c o l o g y.— Terrestrial on humus-rich mountain slopes in dense evergreen forests at 1200—1800 m alt.

3. Polystichum eximium (Kuhn) C. Chr., Ind. Fil. Suppl. III: 163. 1934; Tagawa & K. Iwats., Southeast As. St. 5: 94. 1967, p.p.— *Phegopteris eximia* Mett. ex Kuhn, Linnaea 36: 107. 1869.— *Polystichum setiferum* auct. non (Forsk.) Moore ex Woynar: C. Chr., Contr. U.S. Nat. Herb. 26: 330. 1931.

Rhizome short, ascending; scales oblong-subdeltoid, acuminate to tailed at apex, up to 20 by 4 mm, entire, bicoloured, central portion shining black, rigid and tough, margin brown, thinner. *Stipe* stramineous, 25—60 cm long, scaly throughout; scales at base very dense, consisting of two kinds, one like those on rhizome, the other linear, concolorous, brown, serrate at margin, scales on upper part of stipe linear, up to 1 cm long, at most 0.5 mm broad, black or dark brown. *Lamina* oblong-lanceolate, widest at middle, 35—50 by about 25 cm; rachis gemmiferous, scaly throughout; pinnae more than 15 pairs, patent or slightly ascending, lower ones lanceolate, broadly cuneate at base, acuminate at apex, more or less falcate, 10—13 by 3—3.5 cm, shortly stalked; pinna-rachis scaly underneath, grooved on upper surface; pinnules close to imbricate, oblong or narrowing from base to apex, falcate, acute at apex, slightly auricled at acroscopic and dimidiate at basiscopic bases, 15—25 by 7—10 mm; veins a little raised on lower surface; coriaceous, green, glabrous on laminar surface. *Sori* submarginal or scattered on lower surface of pinnules; indusia about 1.2 mm diam., persistent.

T h a i l a n d.— NORTHERN : Chiang Rai, Chiang Mai (Chiang Dao, Huai Mae Pan, Doi Suthep, Khun Kong Sang); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng).

D i s t r i b u t i o n.— According to the current definition of this species : tropical Asia from Sri Lanka (type) northwards to southern edge of Japan.

E c o l o g y.— On mountain slopes in dense evergreen forests at 700—1200 m alt.

N o t e.— The typification of this species is rather difficult and we are not sure at present about the correct name of the Thai plants. The Ceylon plants are not gemmiferous; we are uncertain also about the identity of the Thai plants with *P. indochinensis* Tard. & C. Chr. of Indochina, *P. fibrillosum* Ching of China and *P. gemmiferum* Tagawa of Japan.

4. Polystichum prolificans v. A. v. Ros., Bull. Jard. Bot. Buit. III. 2: 170. 1920; Holtt., Rev. Fl. Malaya 2: 490. f. 290. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 176. 1969.— *Polystichum eximium* auct. non (Mett. ex Kuhn) C. Chr.: Tagawa & K. Iwats., Southeast As. St. 5: 94. 1967, p.p.

Similar to *P. eximium,* differing in : scales on rachis and costa brown, never nigrescent, dense; lamina chartaceous to fleshy; sori evenly dispersed on the lobes underneath, not marginal in appearance.

T h a i l a n d.— PENINSULAR : Nakhon Si Thammarat (Khao Luang), Phangnga (Khao Phra Mi), Trang (Khao Chong), Yala (Khao Kala Khiri).

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

E c o l o g y.— Terrestrial on humus-rich floor of dense evergreen forests at medium altitudes.

5. Polystichum biaristatum (Bl.) Moore, Ind. Fil.: 86. 1858; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 342. 1941; Holtt., Dansk Bot. Ark. 23: 238. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 86. 1965; 5: 94. 1967.— *Aspidium biaristatum* Bl., En. Pl. Jav.: 164. 1828.— *Polystichum aculeatum* var. *biaristatum* (Bl.) Bedd., Handb.: 209. 1883.— *Aspidium aculeatum* auct. non (Linn.) Sw.: Hoss., Beih. Bot. Centr. 28(2): 363. 1911.— *Polystichum aculeatum* auct. non (Linn.) Schott : Holtt., Dansk Bot. Ark. 20: 30. 1961. Figure 29. 10–11.

Rhizome short, suberect; scales narrowly subtriangular, attenuate at apex, entire at margin, up to 25 by 4 mm, bicoloured, central portion shining black and tough, the margin brown to dark brown with ferrugineous margin. *Stipe* 30–40 cm long; scales at base of two kinds, one like those on rhizome, the other narrower, linear, up to 1 cm long, brown, toothed at margin, those on upper part linear, black with brown broader base. *Lamina* oblong-lanceolate, widest at middle, slightly narrowing towards base, acuminate at apex, 40–50 by 25–30 cm; rachis densely scaly throughout with linear black scales with brown broader base; pinnae more than 15 pairs, lower pinnae patent or slightly ascending, very shortly stalked, lanceolate, gradually acuminate at apex, broadly cuneate or subtruncate at base, up to 15 by 3 cm; basal acroscopic pinnules larger; pinnules rather close, oblong or gradually narrowing towards apex, falcate, acute and ending in sharp awns at apex, sessile, 15–20 by 5–8 mm, shallowly lobed at margin; veinlets a little raised on lower surface, minutely scaly; coriaceous, green. *Sori* arranged in one row at submarginal or medial part of pinnules; indusia pale brown, about 1 mm diam.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Talop, Doi Phacho), Chiang Mai (Doi Suthep, Doi Inthanon), Tak (Khun Kong San); NORTH-EASTERN : Loei (Phu Paek); SOUTH-EASTERN : Prachin Buri (Khao Yai), Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n.— Sri Lanka, N. India, S. China, Taiwan and Java (type).

E c o l o g y.— On humus-rich floor of dense evergreen forests at 900–1400 m alt.

6. Polystichum semifertile (Clarke) Ching, Lingnan Sci. J. 15: 398. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 341. 1941; Tagawa & K. Iwats., Southeast As. St. 5: 94. 1967.— *Aspidium aculeatum* var. *semifertile* Clarke, Trans. Linn. Soc. II. Bot. 1: 509. 1880.— *Polystichum aculeatum* var. *semifertile* (Clarke) Bedd., Handb.: 209. 1883. Figure 29. 6—7.

Rhizome massive, erect; scales oblong-subtriangular, up to 25 by 8 mm, bicoloured, central portion shining castaneous brown to nearly black, the edges light brown, ferrugineous. *Stipe* 40—60 cm long; scales at base of two kinds, one like those on rhizome, the other smaller, linear, up to 8 mm long, toothed at margin, those on upper part narrower, linear, 1 cm or more long, dark brown, toothed at margin, ferrugineous. *Lamina* oblong, acuminate at apex, truncate at base, 50—70 by 25—30 cm; rachis densely covered with downy linear scales; pinnae about 20 pairs, the lowest pinnae hardly reduced, patent, opposite, up to 15 by 2.5 cm, the middle ones patent or slightly ascending, alternate, narrowly lanceolate, broadly cuneate at base, gradually long-acuminate at apex, up to 18 by 2.5 cm in sterile and 1.5 cm in fertile ones; pinna-rachis densely scaly, grooved above; pinnules falcate, acute at apex, distinctly auricled at acroscopic and dimidiate at basiscopic bases, sessile, up to 17 by 7 mm in sterile and 12 by 5 mm in fertile ones, with shallowly crenate lobes ending in distinct awns; coriaceous, green, glabrous on laminar surface. *Sori* scattered on basal pinnae, from near rachis towards posterior portion, in one row, medial to costular, fertile pinnules smaller than sterile ones; indusia fugacious at maturity, dark in central portion, up to 1 mm.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Phahom Pok, Doi Inthanon, Doi Chang, Doi Chong), Mae Hong Son (Doi Khun Huai Pong).

D i s t r i b u t i o n.— Sw. China (Yunnan), Vietnam.

E c o l o g y.— On humus-rich floor of dense mossy evergreen forests at 1800—2300 m alt.; confined to the highest northern mountains.

7. Polystichum tenggerense Rosenst., Fedde, Rep. Sp. Nov. 8: 164. 1910; Tagawa & K. Iwats., Southeast As. St. 5 : 95. 1967. Figure 29. 8—9.

Rhizome massive, erect; scales oblong-ovate, up to 2.5 by 1.2 cm, bicoloured, central portion dark castaneous to nearly black, thin but stiff, margins brown, ferrugineous. *Stipe* about 50 cm long, brown, grooved above, densely scaly throughout, scales of two kinds, larger ones oblong-ovate, narrow ones up to 1.2 mm in breadth, ferrugineous. *Lamina* oblong-lanceolate, hardly narrowing at base, gradually narrowing towards acute apex, 65—75 by 25—30 cm; rachis densely scaly, larger scales concolorously brown, up to 10 by 5 mm, linear ones ferrugineous, in upper part like downy hairs; pinnae up to 30 or more pairs, the lowest ones subopposite, a little deflexed, middle ones patent, slightly falcate, linear-lanceolate, subtruncate and sessile, attenuate at apex, up to 12 by 2 cm; pinnules patent, up to 30 pairs, oblong, moderately acute at apex, slightly auricled at acroscopic and dimidiate at basiscopic bases, up to 12 by 5 mm, lobed to half-way;

lobes subdeltoid, acuminate at apex, about 1 mm long, up to 1.5 mm broad, apex ending in awns; veins pinnate, softly coriaceous, light green. *Sori* arranging in one row close to midrib of pinnules, confluent at maturity; indusia peltate, pale to deep brown, thin, fugaceous, glabrous.

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.— Sumatra and Java (type).

E c o l o g y.— Known only on Doi Inthanon, on humus-rich mountain slopes in dense mossy forest at about 2200 m alt.

N o t e.— This is similar to the rather variable *P. mucronifolium* Presl on the higher mountains of Java and Sumatra. Additional collections may bridge the difference between it and *P. tenggerense*.

6. ARACHNIODES

Bl., En. Pl. Jav.: 241. 1828; Ching, Acta Bot. Sin. 10 : 253. 1962.— *Rumohra* Raddi, Opusc. Sci. Bologn. 3 : 290. 1819, p.p. majore excl. typum; Ching, Sinensia 5 : 36. 1934; Copel., Gén. Fil.: 113. 1947.— *Polystichopsis* (J. Sm.) C. Chr. in Verdoorn, Man. Pterid.: 543. 1938; Holtt., J. Linn. Soc. Bot. 53 : 152. 1947.— *Byrsopteris* Mort., Amer. Fern J. 50 : 149. 1960.

Rhizome creeping, short or more commonly long, scaly; scales usually entire and glabrous, concolorous; stipe scaly or glabrescent. Lamina ovate with broad base, tripinnatifid or more compound, anadromic in sequence of frond architecture or basal posterior pinnules interior to basal anterior ones; ultimate segments rhomboid, aristate in many species; herbaceous to chartaceous; veins all free. Sori dorsal or rarely terminal on veinlets; indusia reniform, or rarely wanting.

Most recent pteridologists agree in considering *Arachniodes* close to *Dryopteris*, from which it is distinguished in the architecture of the fronds. Some species have been referred to different genera, but it is generally accepted that the species are to be placed according to the frond-architecture. There are, however, questions as to the status of some species. In definition *A. hasseltii* is included in *Arachniodes*, but it seems to have closer relationship to some species belonging to *Dryopteris*.

CHING (1962) enumerated 40 species, excluding *Leptorumohra*, most of them being in Sino-Himalayan regions. Several species are known in tropical America, ranging north to Mexico, though it may be better to exclude them from *Arachniodes*. Seven species are here recorded from Thailand.

KEY TO THE SPECIES

1. Frond tripinnatifid or more compound. Sori dorsal or terminal on veinlets
2. Sori terminal, or rarely dorsal, on veinlets; indusia rather small or wanting
3. Sori exindusiate. Lamina herbaceous; apex of lobes not aristate-mucronate **1. A. hasseltii**
3. Sori indusiate. Lamina papyraceous to chartaceous; apex of lobes aristate

4. Frond 4 – 5-pinnate. Rhizome short-creeping; scales at base of stipe more than 1.2 mm in breadth **3. A. henryi**
4. Frond tripinnate above base. Rhizome ascending or erect; scales at base of stipe very narrow **4. A. speciosa**

2. Sori dorsal on veinlets; indusia large, entirely covering the sori when young
5. Ultimate lobes not aristate; lamina dull green **2. A. cavalerii**
5. Ultimate lobes aristate to mucronate; lamina more or less shining **5. A. spectabilis**

1. Frond bipinnate above basal pinna. Sori terminal on veinlets
6. Stipe longer than lamina. Upper pinnae suddenly shortened to form caudate apical portion of lamina; costa wingless; larger pinnules deeply lobed to pinnatisect, with mucronate apex to lobes **6. A. chinensis**
6. Stipe hardly longer than lamina. Upper pinnae gradually becoming smaller; costa winged throughout; pinnules at most crenate at margin; lobes acute **7. A. assamica**

1. Arachniodes hasseltii (Bl.) Ching, Acta Bot. Sin. 10 : 258. 1962; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24 : 62. 1969.— *Polypodium hasseltii* Bl., Fl. Jav. Fil.: 195. t. 92. 1828.— *Rumohra hasseltii* (Bl.) Ching, Sinensia 5 : 61. 1934; Tard. & C.Chr. in Fl. Gén. I.-C. 7(2): 328. 1941.— *Polystichopsis hasseltii* (Bl.) Holtt., Rev. Fl. Malaya 2 : 487. f. 288. 1955.— *Nephrodium obovatum* Bak., J. Bot. 1890 : 265.— *Lastrea obovata* (Bak.) Bedd., Handb. Suppl.: 60. 1892.— *Phegopteris laserpitiifolia* Scort. ex Bedd., Handb. Suppl.: 84. 1892.

Rhizome short, suberect, scaly; scales subtriangular, gradually narrowing from base towards hair-pointed apex, about 12 by 2.3 mm, brown or darker, entire. *Stipe* about 30 cm long, stramineous or darker at scaly base, glabrescent upwards. *Lamina* oblong-subdeltoid, acuminate at apex, about 40 by 25 cm, tripinnate; rachis stramineous, grooved above, glabrescent; basal pinna largest, stalked, unequally subtriangular with larger basiscopic basal pinnules, about 12 by 6 cm; upper pinnae ascending, narrowly oblong with long-acuminate apex; costa stramineous, grooved above, very narrowly winged; larger pinnule shortly stalked, oblong to ovate, rounded at apex, cordate at base, or subdimidiate to narrowly cuneate at basiscopic base; secondary pinnule sessile, oblong, rounded at apex, round or cuneate at base, lobed with two to four lobes at each side; ultimate lobes obliquely subdeltoid, acute at apex; herbaceous, veins distinct below, glabrous. *Sori* round, terminal on veinlets, medial or closer to midribs, up to 1.2 mm diam., naked.

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.— Assam, Indochina (N. Vietnam), Hainan, Taiwan, Ryukyus, and Malesia throughout (type from Java) to New Guinea.

E c o l o g y.— In hill evergreen forest along streamlets at about 1350 m alt.; only once collected : HENNIPMAN 3597 (L, KYO).

2. Arachniodes cavalerii (Christ) Ohwi, J. Jap. Bot. 37 : 36. 1962; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24 : 63. 1969.— *Aspidium cavalerii* Christ, Bull. Acad. Géogr. Bot. 1904 : 116.— *Rumohra cavalerii* auct. non (Christ) Ching : Tard. & C.Chr. in Fl. Gén. I.-C. 7(2): 328. 1941. Figure 30. 1 –2.

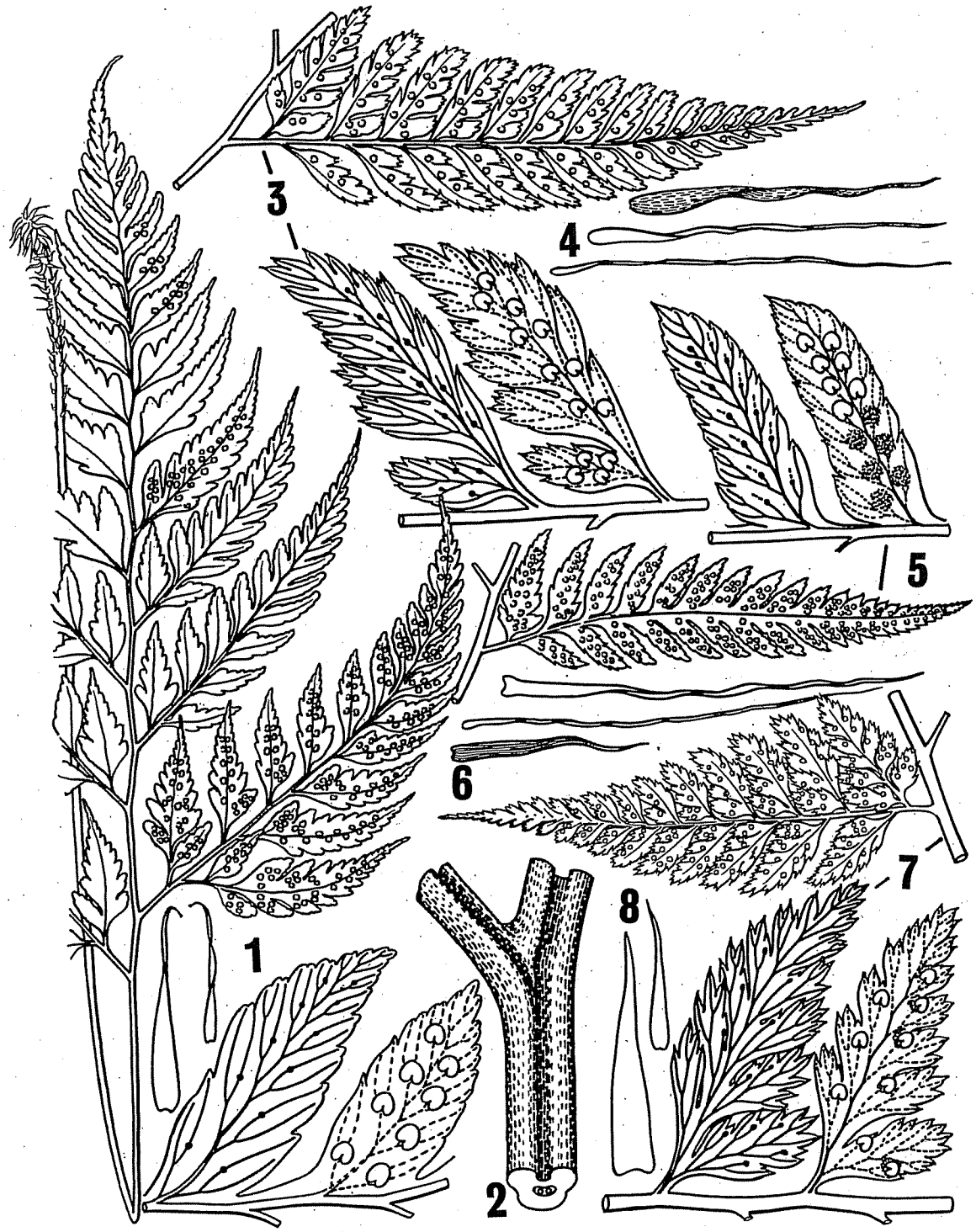


Figure 30. 1–2: *Arachniodes cavalerii*; 1. fertile frond (above, x 0.4), fertile lobes (below, x 2) and scales (x 2); 2. rachis and basal part of costa, x 8. 3–4: *A. spectabilis*; 3. small pinnule (above, natural size) and third order leaflets enlarged (below, x 2.5); 4. scales, showing variation, x 3. 5–6: *A. speciosa*; 5. small pinnule (below, natural size) and lobes enlarged (above, x 3); 6. scales, showing variation. 7–8: *A. henryi*; 7. small pinnule (above, natural size) and third order leaflets (below, x 2.5); 8. scales on stipe base, x 5.

Rhizome short, ascending, scaly; scales dark brown, small, entire. *Stipe* stramineous, up to 30 cm or more long, scaly in lower portion. *Lamina* subdeltoid, about 30 by 20 cm at base, bipinnate to tripinnatifid; rachis like the upper part of stipe, grooved above, glabrescent; basal pinna the largest, distinctly stalked with petioles of up to 2 cm in length, subtriangular with large bipinnatifid basal pinnules and acuminate apex, about 15 by 10 cm; basal basiscopic pinnule like the second basal pinna; larger pinnule of middle pinna or secondary pinnule of larger pinna parallelogram-shaped, subsessile or shortly stalked, acute at apex, cuneate at base, crenate with blunt margin, never aristate-mucronate at apex of lobes; chartaceous, with distinctive odour. *Sori* large, dorsal on veinlets, usually in one row close to each side of midrib; indusia round-reniform, up to 1.5 mm or more diam., completely covering the sori when young, falling off at maturity, irregular at margin.

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

D i s t r i b u t i o n.— S.China (type), N.Vietnam and southern edge of Japan.

E c o l o g y.— Terrestrial in evergreen forest at high altitude.

3. Arachniodes henryi (Christ) Ching, Acta Bot. Sin. 10 : 258. 1962; Tagawa & K.Iwats., Acta Phytotax. Geobot. 26 : 58. 1974.— *Polystichum henryi* Christ in Lec., Notul. Syst. 1 : 36. 1909.— *Rumohra henryi* (Christ) Ching, Sinensia 5 : 57. t. 10. 1934.— *Rumohra simulans* Ching, Sinensia 5 : 54. pl. 8. 1934; Tard. & C.Chr. in Fl. Gén. I.-C. 7(2): 326. 1941; Holtt., Dansk Bot. Ark. 20 : 31. 1961.— *Arachniodes simulans* (Ching) Ching, Acta Bot. Sin. 10 : 259. 1962; Tagawa & K.Iwats., Southeast As. St. 5 : 93. 1967. Figure 30. 7–8.

Rhizome creeping, up to 8 mm diam., scales dense, linear-subtriangular, up to 7 by 1.5 mm, brown. *Stipe* stramineous, scaly at base, very sparsely, minutely scaly upwards, up to 50 cm long. *Lamina* oblong to pentagonal, with caudate-acuminate apex, 4–5-pinnate, up to 50 by 35 cm; rachis glabrescent, grooved; pinnae about 10 pairs, the lowest the largest, with large, basal, acroscopic pinnule, middle ones oblong-subtriangular, widest at distinctly stalked base, gradually narrowing towards acuminate apex, up to 20 by 6 cm, upper pinnae rather suddenly reduced to form apical part of frond, pinnules oblong-subdeltoid, acute at apex, unequally cuneate at base, stalked, 4–10 by up to 4 cm; secondary pinnules oblong-subdeltoid, moderately acute at apex, unequally cuneate at base, pinnatisect to pinnate, segments oblong, oblique, sessile, serrate at margin, lobed in larger ones; papyraceous, green, glabrous on both surfaces or sparsely hairy on veins underneath. *Sori* round, terminal or more rarely dorsal on veinlets, medial or close to margin, raised on upper surface; indusia round-reniform, glabrous.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Hua Mot, Doi Suthep), Lampang (Mae Tia), Lamphun (Doi Khun Tan).

Distribution.— SW. China [Szechuwan, Yunnan (type), Hupeh], Upper Burma and N. Vietnam.

Ecology.— On mountain slopes usually in dense evergreen forests at 800–1400 m alt.

4. Arachniodes speciosa (D.Don) Ching, Acta Bot. Sin. 10 : 259. 1962; Tagawa & K.Iwats., Southeast As. St. 5 : 93. 1967.— *Aspidium speciosum* D.Don, Prod. Fl. Nepal.: 51. 1825.— *Rumohra speciosa* (D.Don) Ching, Sinensia 5 : 53. pl. 7. 1934; Tard. & C.Chr. in Fl. Gén. I.-C. 7(2): 325. 1941. Figure 30. 5–6.

Rhizome short, erect or ascending; scales dense, linear, up to 2 cm or more long, 1.5 mm broad at base, brown, entire, more or less crisped in linear apical portion. *Stipe* stramineous, densely scaly at base, more sparsely upwards, up to 1 m long; scales on upper part smaller and narrower, dark. *Lamina* oblong-subdeltoid, more than 80 by 50 cm, tripinnate; rachis scaly, grooved; pinnae gradually reducing in size upwards, the lowest the largest, middle pinnae falcate, oblong-subtriangular, gradually narrowing towards acuminate apex, distinctly stalked, up to 30 by 12 cm at base; pinna-rachis densely fibrillose scaly; pinnules oblong-subdeltoid, caudate-acuminate at apex, unequally cuneate at distinctly stalked base, 5–7 by 1.5–2 cm; segments oblong-lanceolate to subquadrangular, oblique or slightly falcate, acute to acuminate, crenate at margin, about 1.2 by 0.4 cm; chartaceous, deep green, fibrillose scaly, glabrous on laminar surfaces. *Sori* terminal on veinlets, closer to midrib than to margin of segments, round; indusia round-reniform, glabrous.

Thailand.— NORTHERN : Chiang Mai (Doi Suthep), Phitsanulok (Thung Salaeng Luang, Salaeng Haeng).

Distribution.— Himalaya (type) to SW. China and Vietnam.

Ecology.— On rather dry mountain slopes in mixed or in evergreen forests at medium altitudes.

5. Arachniodes spectabilis (Ching) Ching, Acta Bot. Sin. 10 : 259. 1962; Tagawa & K.Iwats., Southeast As. St. 5 : 93. 1967.— *Rumohra spectabilis* Ching, Sinensia 5 : 58. pl. 11. 1934. Figure 30. 3–4.

Rhizome short, erect; scales dense, narrow, up to 12 by 1.3 mm, brown, entire. *Stipe* stramineous, up to 60 cm long, scaly on basal part, glabrescent upwards; scales up to 20 by 1.5 mm, dark-brown, entire. *Lamina* oblong-subtriangular, gradually narrowing towards acuminate apex, tripinnate, up to 50 by 35 cm; rachis glabrous, grooved on upper surface; lateral pinnae more than 10 pairs, the lowest the largest, with large basal acroscopic pinnules, middle pinnae distinctly stalked, slightly falcate, linear-subtriangular, widest at base, gradually narrowing towards caudate-acute apex, about 20 by 5–6 cm, upper ones gradually becoming smaller; pinnules oblong-subdeltoid, acute at apex, unequally cuneate at stalked base, often dimidiate at posterior base; segments sessile, oblong, oblique, round to moderately

acute, lobed at margin, up to 10 by 5 mm; lobes serrate at margin, ending with moderate awns; harsh, glabrous green on upper surface. *Sori* dorsal on veinlets, near midrib; indusia round, entirely covered and enveloping the sori when young, breaking down irregularly, about 1.5 mm diam.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Phacho), Chiang Mai (Doi Inthanon), Mae Hong Son (Doi Khun Huai Pong), Lampang, Phitsanulok (Phu Miang); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); SOUTH-WESTERN : Kanchanaburi (Khao Ri Yai).

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

E c o l o g y.— On rather dry or humus-rich mountain slopes in mixed or in evergreen forests at 300–1500 m alt.

6. Arachniodes chinensis (Rosenst.) Ching, Acta Bot. Sin. 10 : 257. 1962; Tagawa & K.Iwats., Southeast As. St. 5 : 93. 1967.— *Polystichum amabile* (Bl.) J. Sm. var. *chinense* Rosenst., Fedde, Rep. Sp. Nov. 13 : 130. 1914.— *Rumohra chinensis* (Rosenst.) Ching, Sinensia 5 : 46. pl. 3. 1934; Tard. & C.Chr. in Fl. Gén. I.-C. 7(2): 322. 1941.— *Polystichopsis chinensis* (Rosenst.) Holtt., Rev. Fl. Malaya 2 : 486. 1955.

Rhizome short-creeping, about 6 mm diam.; scales dense, dark brown, up to 8 by 2 mm or narrower. *Stipe* stramineous, up to 55 cm long, densely scaly throughout; scales on upper portion narrow, dark to black, entire. *Lamina* oblong with acuminate apex, up to 45 by 30 cm, bipinnate; rachis densely covered with fibrillose blackish scales, grooved on upper surface; lateral pinnae 7–10 pairs, basal pinnae the largest, with large acroscopic pinnules, middle pinnae narrowly subtriangular, straight or slightly falcate, widest at shortly stalked base, gradually narrowing towards caudate-acuminate apex, up to 20 by 5–6 cm; upper pinnae suddenly shortened to form caudate apical portion of frond; pinnules lobed to pinnatisect in larger ones, shortly stalked or sessile, subparallelogram-shaped, acute at apex, more or less auricled at anterior base, subdimidiate at posterior base, 20–30 by 0.7–1.5 mm; ultimate lobes with sharp awns at acuminate apex, entire; chartaceous, glabrous, deep green; midrib of pinnule raised on lower surface, veins pinnate. *Sori* terminal on veinlets, round; indusia round-reniform, naked.

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

D i s t r i b u t i o n.— S. & SW. China (type), Indochina and Malaya.

E c o l o g y.— On mountain slopes in evergreen forests at medium or high altitudes.

7. Arachniodes assamica (Kuhn) Ohwi, J. Jap. Bot. 37 : 36. 1962; Tagawa & K.Iwats., Acta Phytotax. Geobot. 24 : 62. 1969.— *Aspidium assamicum* Kuhn, Linnaea 36 : 108. 1869.— *Rumohra assamica* (Kuhn) Ching, Sinensia 5 : 47. pl. 4–6. 1934; Tard. & C.Chr. in Fl. Gén. I.-C. 7(2): 322. 1941.— *Lastrea affinis* Bedd., Handb.: 230. 1883, p.p.

Rhizome short, creeping or suberect; scales narrowly elliptic, gradually narrowing from base towards hair-pointed apex, up to 10 by 2.5 mm, concolorous brown, entire. *Stipe* stramineous, about 25 cm long, sparsely scaly. *Frond* bipinnate, oblong, acute at apex, round at base, about 35 cm long and wide; rachis bearing linear scales, grooved above; pinnae several pairs, usually the basal ones the largest, stalked with petioles about 5 mm long, narrowly elliptic, round at base, narrowing towards long-acuminate apex, about 17 by 4 cm, upper pinnae gradually becoming smaller upwards, more ascending; pinnules rhomboid, acute, slightly auricled at subtruncate acroscopic base, narrowly cuneate at basiscopic base, crenate at margin, up to 3 by 1 cm, distal ones adnate at base, decurrent into narrow wings of scaly costa; coriaceous; veins visible on under surface, minutely scaly beneath with fimbriate scales. *Sori* terminal on veinlets, in one or two irregular rows at each side of midrib, round; indusia up to 0.7 mm diam., usually ferrugineous at maturity, glabrous.

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.— N. India (type), Burma, SW. China, N. Vietnam, and Japan.

E c o l o g y.— In lower montane forest along streamlets at high altitudes at about 2200 m; only once collected: HENNIPMAN 3457 (L, KYO).

7. DRYOPTERIS

Adans., Fam. Pl. 2 : 20, 551. 1763; Ching, Bull. Fan Mem. Inst. Biol. 8 : 363. 1938; Copel., Gen. Fil.: 121. 1947.

Rhizome short, ascending to erect, stout, scaly; scales in most cases broad and entire, non-clathrate. Stipes usually in a tuft at apex of rhizome, scaly. Lamina mostly broad at base, pinnate to decompound, basal anterior pinnules interior to basal posterior ones or catadromic in sequence of frond-architecture; usually papyraceous or firm, typically glabrous; veins all free. Sori dorsal on veinlets, round with punctate receptacles; indusia round-reniform, attached at the inner end of sinus, or rarely wanting.

Dryopteris in the current sense contains some 150 species from various parts of the world; with a high number of species in Sino-Japanese regions. Ching enumerated 93 species in his monograph of *Dryopteris* s.str. from Chinese and Sikkim-Himalayan regions in 1938.

Thirteen species are here enumerated from Thailand. At present the materials from Thailand are still inadequate, and more collections accompanied by field-notes will make more precise comparison with Sino-Himalayan species possible.

KEY TO THE SPECIES

1. Frond simply pinnate; pinnae serrate or pinnatifid at most to a quarterway towards costa
 2. Sori exindusiate. Lateral pinnae about 10 pairs **1. D. scottii**
 2. Sori indusiate. Lateral pinnae more than 20 pairs **2. D. hirtipes**
1. Frond bipinnatifid or more compound
 3. Scales on pinna-rachis beneath not bullate but plane, linear or fibrillose
  4. Frond dimorphic. Rhizome short-creeping **3. D. cochleata**
  4. Frond not dimorphic. Rhizome short, ascending or suberect
   5. Frond bipinnatifid. Indusia large, about 2 mm diam. **4. D. neochrysocoma**
   5. Frond bipinnate or more compound. Indusia if any not so large
    6. Sori indusiate
     7. Frond large, more than 60 cm in length
      8. Scales on stipe and rachis very dense, upper side of higher axes with coarse multicellular hairs **5. D. hendersonii**
      8. Scales on stipe and rachis sparse, upper side of higher axes without coarse hairs **6. D. porosa**
     7. Frond mediocre, up to 35 cm in length
      9. Rhizome-scales oblong-ovate. Stipe castaneous at least near base. Frond oblong, bipinnate-tripinnatifid. Indusia usually large, up to 1.5 mm or more in diam. **7. D. sparsa**
      9. Rhizome-scales narrowly elliptic to linear. Stipe stramineous. Frond pentagonal, quadripinnatifid. Indusia smaller, up to 1 mm diam. **8. D. gymnophylla**
    6. Sori exindusiate **9. D. polita**
 3. Scales on underside of pinna-rachis of two kinds, bullate and plane
  10. Basal pinnae not basiscopically enlarged
   11. Base of pinnules auricled in both sides, stalked
    12. Sori medial to submarginal lamina subcoriaceous **10. D. integriloba**
    12. Sori medial, lamina papyraceous **12. D. subtriangularis**
   11. Base of pinnules round or broadly cuneate, subsessile or shortly stalked **11. D. neoassamensis**
  10. Basal pinnae more or less prominently enlarged basiscopically **13. D. pseudosparsa**

1. Dryopteris scottii (Bedd.) Ching, Bull. Dept. Biol. Sun Yatsen Univ. 6 : 3. 1933; Bull. Fan Mem. Inst. Biol. 8 : 402. 1938; Tard. & C.Chr. in Fl. Gen. I.-C. 7(2): 310. 1941; Tagawa & K.Iwats., Southeast As. St. 5 : 95. 1967.— *Polypodium scottii* Bedd., Ferns Br. Ind.: t. 345. 1870.— *Phegopteris scottii* (Bedd.) Bedd., Ferns Br. Ind. Suppl.: 19. 1876; Handb. 6 : 289. f. 148. 1883.

Rhizome short, erect; scales dense, linear-subtriangular with cordate base and long-tailed apex, up to 15 by 2 mm, dark brown to nearly black, entire. *Stipe* stramineous, densely scaly at base, more sparsely upwards, up to 30 cm long. *Lamina* pinnate, oblong-lanceolate, widest at base or just above it, about 45 cm long; rachis grooved above, scaly throughout with narrow, nearly black scales about 5 by 0.2 mm; lateral pinnae usually about 10 pairs, lower pinnae lanceolate, about 12 by 2.7 cm, acuminate at apex, broadly cuneate at sessile base, lobed to $\frac{1}{5}$ way towards costa, upper ones becoming smaller, fused to each other to form indistinct apical portion of frond; costa distinct on lower surface, grooved above, glabrous or minutely scaly beneath; lobes subdeltoid, rounded at apex, with a few teeth at margin, up to 4 by 6 mm; chartaceous, green, glabrous; veins pinnate, veinlets simple. *Sori* in a few indistinct rows near costa, leaving marginal $\frac{1}{3}$ of pinna sterile, naked.

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

D i s t r i b u t i o n.— N. India (type) to Upper Burma, SW. China, N. Vietnam and Taiwan.

E c o l o g y.— On wet ground by streams in dense evergreen forests at about 1600 m alt.

2. Dryopteris hirtipes (Bl.) O. Ktze., Rev. Gen. Pl. 2 : 813. 1891; C. Chr., Contr. U.S. Nat. Herb. 26 : 330. 1931; Ching, Bull. Fan Mem. Inst. Biol. 8 : 407. 1938; Holtt., Dansk Bot. Ark. 20 : 30. 1961; Rev. Fl. Malaya 2nd ed. 2 : 635. 1968; Tagawa & K. Iwats., Southeast As. St. 5 : 95. 1967.— *Aspidium hirtipes* Bl., En. Pl. Jav.: 148. 1828.— *Lastrea hirtipes* (Bl.) Moore, Ind. Fil.: 85. 1858; Bedd., Handb.: 232. f. 120. 1883. Figure 31. 1—2.

Rhizome short, erect; oblong-lanceolate with long tail, up to 25 by 5 mm, brown to dark, membranous, entire. *Stipe* stramineous, densely scaly at base, more sparsely upwards, up to 60 cm long. *Lamina* pinnate, lanceolate, caudate-acute at apex, slightly narrowing at base, up to 85 by 45 cm; rachis grooved on upper surface, densely scaly throughout with narrow, brown to nearly black scales up to 8 mm long; pinnae more than 20 pairs, lower pinnae falcate, linear-lanceolate, caudate-attenuate, truncate or subcordate at base, subsessile or very shortly stalked, up to 20 by 2 cm, lobed to a quarter way towards costa, upper pinnae gradually becoming smaller upwards, decurrent at base; costa nearly at right angle to rachis, distinctly raised on lower surface, grooved above; lobes subdeltoid, oblique, round to acute at apex, entire, up to 5 by 6 mm; chartaceous, deep green, glabrous. *Sori* in two or three indistinct rows near costa, leaving marginal half of lamina sterile, indusiate; indusia round-reniform, small, fugacious, glabrous.

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

D i s t r i b u t i o n.— Sri Lanka, S. India, W. Malaysia, Sumatra, Java (type), Borneo and the Philippines.

E c o l o g y.— On humus-rich mountain slopes in light or deep shade at 1200—1600 m alt.

3. Dryopteris cochleata (D. Don) C. Chr., Ind. Fil.: 258. 1905; Ching, Bull. Fan Mem. Inst. Biol. 8 : 434. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 312. 1941; Holtt., Dansk Bot. Ark. 20 : 30. 1961; Tagawa & K. Iwats., Southeast As. St. 5 : 95. 1967.— *Nephrodium cochleatum* D. Don, Prodr. Fl. Nepal.: 6. 1825.— *Lastrea filix-mas* var. *cochleata* (D. Don) Bedd., Handb.: 250. f. 130. 1883. Figure 31. 3—7.

Rhizome short-creeping; scales light brown, linear, entire, about 10 by 1 mm. *Stipe* stramineous, up to 30 cm in sterile and 50 cm in fertile fronds, densely scaly at base, sparsely clad with linear scales. *Frond* bipinnate, distinctly dimorphic; sterile lamina oblong-subdeltoid, acuminate at apex, up to 45 by 30 cm; rachis glabrescent or minutely scaly, grooved above; lateral pinnae up to 10 pairs, basal pinnae the largest or slightly smaller than the next above, slightly falcate, oblong-lanceolate, caudately acuminate at apex, narrowing towards stalked base, pinnate, up to 25 by 7 cm; pinna-rachis grooved above, winged throughout; pinnules oblong, falcate, acute to moderately acute at apex, up to 4 by 1.3 cm, shallowly lobed at margin; lobes oblique, slightly toothed; herbaceous to softly papyraceous, light green, glabrous, veins bipinnate; fertile lamina oblong or narrowly subdeltoid, up to 50 by 15 cm; pinna ascending, linear, up to 10 by 1.5 cm; pinnules oblong, round at apex, truncate and shortly stalked or adnate at base, up to 10 by 5 mm; veins pinnate, veinlets simple or forked. *Sori* in one row between midrib and margin; indusia large, up to 2 mm diam., very close to each other or slightly imbricate, glabrous.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Mae Lao, Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Ban Mae Kon, Bo Luang, Doi Kiu Lom, Wang Tao, Mae Klang, Doi Inthanon), Mae Hong Son (Khun Yuam, Pang Mapha, Pa Pae), Lamphun (Doi Khun Tan), Tak (Lan Sang); NORTH-EASTERN : Loei (Phu Kradueng).

D i s t r i b u t i o n.— Himalayas (type), Burma, S. China, Philippines and E. Java.

E c o l o g y.— On clayey or rather dry slopes in not so dense forests at low to medium altitudes, fairly common in Northern, especially in the mixed forests.

4. Dryopteris neochrysocoma Ching, Lingnan Sci. J. 21 : 31. 1945; Tagawa & K. Iwats., Southeast As. St. 5 : 95. 1967. Figure 31. 8–9.

Rhizome short, ascending; scales dense, membranous, light brown, more than 1 cm long, up to 1.2 mm broad. *Stipes* few at apex of rhizome, stramineous, about 8 cm long, scaly throughout; scales not very dense, lanceolate, up to 8 by 0.8 mm, gradually becoming smaller upwards. *Lamina* bipinnatifid, oblong-lanceolate, gradually narrowing towards both ends, 20–25 by 8–12 cm at widest middle portion; pinnae about a dozen pairs, lower pinnae slightly reduced, more or less reflexed, middle ones sessile, slightly falcate, acuminate at apex, broadly cuneate to subtruncate at base, narrowly oblong, up to 4 by 1.2 cm, deeply lobed nearly to costa; lobes oblong, slightly oblique, round to obtuse at apex and slightly toothed at apical margin, about 5 by 4 mm; papyraceous, glabrous; veins pinnate, veinlets simple or forked. *Sori* in a single row very close to costa; indusia large, about 2 mm diam., perfectly covering and embracing the sori, breaking down irregularly at maturity.

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

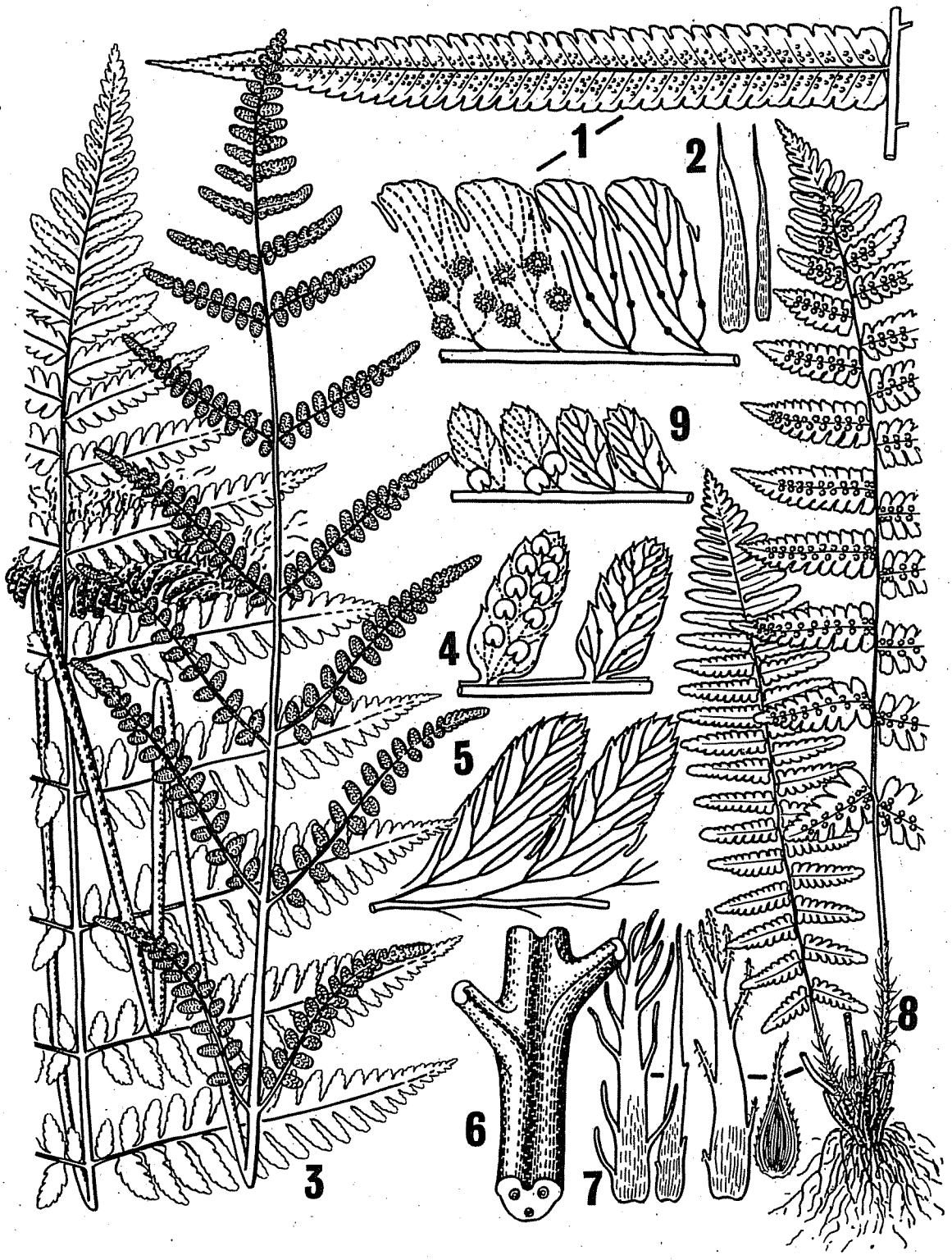


Figure 31. 1–2: *Dryopteris hirtipes*; 1. pinna (above, x 0.5) and lobes enlarged (below, x 2); 2. scales, x 2. 3–7: *D. cochleata*; 3. plant with sterile and fertile fronds, x 0.5; 4. fertile pinnae, x 3; 5. lobes of sterile pinna, x 2; 6. rachis and basal part of costae, x 5; 7. scales, x 5. 8–9: *D. neochrysocoma*; 8. plant with sterile and fertile fronds (x 0.5) and scales (x 5); 9. fertile lobes, x 2.

Distribution.— China (Kwangtung, type) and E. Himalaya.

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

5. Dryopteris hendersonii (Bedd.) C. Chr., Ind. Fil.: 270. 1905; Ching, Bull. Fan Mem. Inst. Biol. 8 : 458. 1938; Tagawa & K. Iwats., Southeast As. St. 5 : 95. 1967.— *Lastrea hendersonii* Bedd., Ferns Br. Ind. Suppl.: 17. t. 377. 1876.— *Nephrodium spectabile* Clarke, Trans. Linn. Soc. II. Bot. 1 : 526. 1880.— *Lastrea spectabilis* (Clarke) Bedd., Handb.: 257. f. 132. 1883.

Rhizome massive, erect. *Stipe* shining red-brown, muricate, about 80 cm long, grooved above, densely scaly throughout; scales linear, about 1 cm long, up to 0.8 mm wide, shining red-brown. *Lamina* oblong-subdeltoid to widely subdeltoid, moderately acute at apex, about 90 by 70 cm, tri- to quadri-pinnate; pinnae several pairs, basal pinnae the largest, asymmetrically oblong-subtriangular, acuminate at apex, 65 by 25 cm; pinna-rachis minutely scaly, grooves decurrent; pinnules of large pinna like upper pinnae, subtriangular-lanceolate, broadly cuneate at base, gradually narrowing upwards to acuminate apex, stalked at base, up to 15 by 6 cm; secondary pinnules of larger pinnule broadly cuneate at sessile base, round to moderately acute at apex, oblong-subdeltoid, falcate, up to 2.5 by 1 cm, deeply lobed nearly to costa; ultimate segments narrowly oblong, oblique, round at slightly toothed apex; papyraceous to chartaceous, deep green on upper surface, bearing coarse multicellular hairs on higher axes above. *Sori* dorsal on veinlets, costular; indusia round-reniform, covering the sori when young, seated underneath sori at maturity.

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

Distribution.— N. India (type), SW. China, Taiwan, northwards to the southern edge of Japan.

Ecology.—On moist ground by streams in dense forests at about 2500 m alt.; collected in only one place but not so rare there.

Note.— This is a beautiful gigantic fern in dense humid forest. Compared with Japanese and Taiwan plants, the Thai materials are even larger in size, but this may be the result of very good growing conditions on Doi Inthanon.

6. Dryopteris porosa Ching, Bull. Fan Mem. Inst. Biol. 8 : 460. 1938; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 114. f. 10. 1968. Figure 32. 1—2.

Rhizome short, massive. *Stipe* stramineous, up to 1 cm at base, about 50 cm long, densely scaly at base, sparsely clad with small scales or glabrescent upwards, grooved above; scales thin but firm, about 25 by 5 mm, brown, entire. *Lamina* oblong-subdeltoid, acute at apex, 60 by 50 cm, tripinnate; rachis very sparsely and minutely scaly, grooved above; pinnae about 10 pairs, patent or ascending, basal pinna the largest, oblong-subtriangular, up to 40 by 15 cm; pinna-rachis narrowly

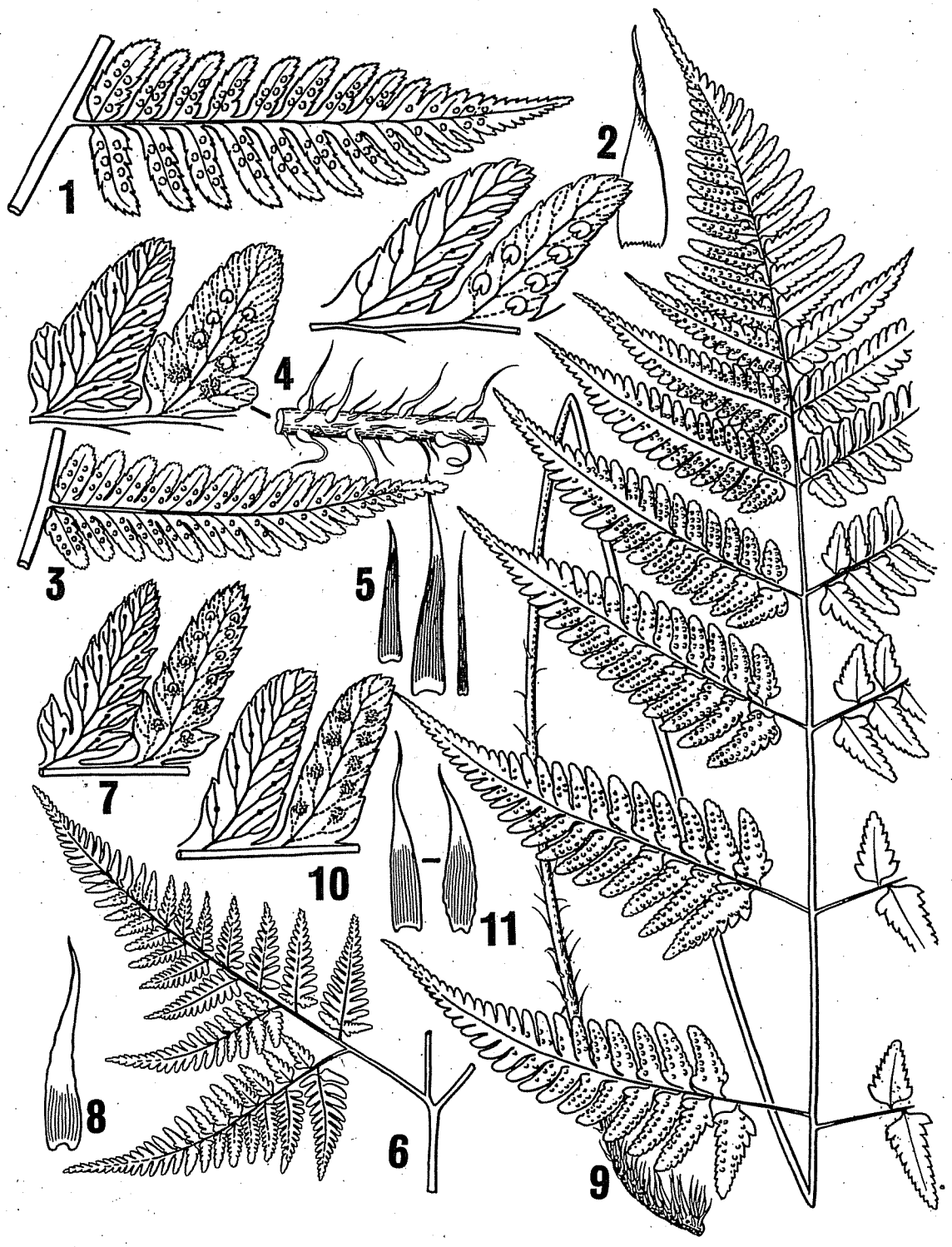


Figure 32. 1–2: *Dryopteris porosa*; 1. middle size pinnule, natural size; 2. fertile lobes enlarged (below, x 3) and large scale right, x 1.5). 3–5: *D. pseudosparsa*; 3. small pinna, natural size; 4. large pinnules left, x 2) and bullate scales on costa (right below); 5. scales on stipe base, x 4. 6–8: *D. gymnophylla*; 6. lowest pinna, x 0.5; 7. fertile lobes, x 2; 8. scale on stipe base, x 5. 9–11: *D. polita*; 9. fertile frond, x 0.5; 10. fertile lobes enlarged; 11. scales on stipe, x 4.

winged in slender portion, grooves decurrent into those of rachis; segments oblong, oblique, 15 by 5 mm, rounded and serrate, cuneate and sessile or adnate at base, lobed to halfway, lobes round-subtriangular, acuminate or acute at apex, up to 3 mm long and wide; chartaceous, light green on upper surface, midrib and veins impressed above, distinct beneath, veins ending in large globose hydathodes within the margin of lobes; paler beneath, lower midrib surface with numerous large stomata, margin cartilaginous. *Sori* dorsal on veinlets, large, costular or medial; indusia large, round-reniform, about 1.7 mm diam, persistent.

T h a i l a n d.— NORTHERN : Phitsanulok (Phu Miang).

D i s t r i b u t i o n.— China (Kweichow, type and Szechuwan).

E c o l o g y.— On humus-rich floor of dense evergreen forests at about 1600 m alt.; only once collected : TAGAWA et al. T-11593 (KYO).

N o t e.— Compared with the isotype specimen in BM, the only differences found in our Thai material are : segments are not very close to each other, the sori are scattered on the lower surface of lamina throughout, not confined to the upper pinna, and the cartilaginous membrane at margin of lobes is not very broad.

7. Dryopteris sparsa (D. Don) O. Ktze., Rev. Gen. Pl. 2 : 813. 1891; Ching, Bull. Fan Mem. Inst. Biol. 8 : 470. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 318. 1941; Holtt., Rev. Fl. Malaya 2 : 492. f. 292. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 95. 1967.— *Nephrodium sparsum* D. Don, Prod. Fl. Nepal.: 6. 1825.— *Lastrea sparsa* (Don) Moore, Ind. Fil.: 87, 104. 1858; Bedd., Handb.: 252. 1883.

Rhizome short, erect; scales membranous, light brown or the centre dark brown, oblong-ovate, about 10 by 8 mm. *Stipe* castaneous at least towards base, stramineous above, densely scaly at base, sparsely so above, up to 35 cm long. *Lamina* oblong-subdeltoid, acuminate at apex, bipinnate or tripinnate at widest base, up to 50 by 25 cm; basal pinnae the largest, asymmetrically subtriangular, acuminate at apex, up to 20 by 12 cm; middle pinnae falcate, stalked, subtriangular-lanceolate; pinnules oblong, slightly falcate, rounded or moderately acute at apex, unequally cuneate at sessile base or decurrent at base in upper ones, up to 30 by 8 mm, lobed $\frac{1}{3}$ way to midrib; basal acroscopic pinnule of lower pinnae large, about twice as large as the next one, pinnate; lobes oblong, oblique, rounded or moderately acute at apex, serrate at margin; papyraceous to chartaceous, deep green above, pale beneath; veins pinnate, veinlets simple, ending within margin of lobes. *Sori* costular or medial; indusia large, about 1.5 mm diam., glabrous.

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

D i s t r i b u t i o n.— India (type), China, Indochina, throughout Malesia to Polynesia, Taiwan and north to S. Japan.

E c o l o g y.— On mountain slopes in dense forests or in light shade at 1000–1500 m alt.

N o t e.— There is a specimen collected from Phu Miang which seems to be a variant of this rather variable species : the stipe hardly castaneous except for the very base, shorter than the frond; pinna ascending, pinna-rachis forming angles of about 45° to rachis; sori medial or a little beyond midway between midrib and margin of pinnules; veinlets ending in distinct hydathodes; apices of lobes sometimes bearing a distinct awn.

8. Dryopteris gymnophylla (Bak.) C. Chr., Ind. Fil.: 269. 1905; Ching, Bull. Fan Mem. Inst. Biol. 8 : 468. 1938; Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 58. 1974.— *Nephrodium gymnophyllum* Bak., J. Bot. 1887 : 170. Figure 32. 6–8.

Rhizome short-creeping, about 2 mm diam., densely scaly in younger portion; scales narrowly elliptic, gradually narrowing towards hair-pointed apex, up to 6 by 1.2 mm, concolorous brown, entire. *Stipe* stramineous, scaly at base, glabrescent upwards, distinctly grooved above, up to 40 cm long, much longer than lamina. *Lamina* pentagonal in outline, tripinnate-quadripinnatifid, 13–23 cm long and wide; basal pinna much the largest, unequally oblong-subtriangular, up to 13 by 9 cm, stalks 2.5 cm long; upper pinnae gradually becoming smaller upwards, oblong-subtriangular; basal posterior pinnule of lowest pinna large, about 6 by 2 cm; pinnules oblong, moderately acute at apex, rounded to broadly cuneate at base; costules winged, grooved above, bearing linear scales usually with one row of cells; secondary pinnules or pinnules of smaller pinnae oblong, rounded at apex, ultimate lobes oblique, oblong, rounded or moderately acute at apex; thinly papyraceous, orange-yellow glandular hairs on midrib and on veins, often also on laminar surface beneath. *Sori* dorsal on veinlets, usually near midrib, indusia thin, fugacious, up to 0.7 mm diam.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Suthep); NORTH-EASTERN : Loei (Phu Tong).

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

E c o l o g y.— In open evergreen forests or in mixed forests at 100–1200 m alt.

9. Dryopteris polita Rosenst. in Fedde, Rep. Sp. Nov. 13 : 218. 1914; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 317. 1941; Holtt., Rev. Fl. Malaya 2 : 492. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 96. 1967.— *Dryopteris chapensis* auct. non C. Chr.& Ching : Holtt., Dansk Bot. Ark. 20 : 30. 1961, p.p. Figure 32. 9–11.

Rhizome short, ascending or suberect, scales light brown, entire, up to 18 by 2 mm. *Stipe* stramineous, scaly at base with the scales similar to those on rhizome, more sparsely scaly upwards with smaller ones, up to 50 cm long. *Lamina* oblong with acuminate apex, bipinnate, up to 35 by 28 cm; 5 or 6 lower lateral pinnae nearly equal in size or slightly smaller upwards, with stalks of 1–2.5 cm long, narrowly subtriangular with acuminate apex, unequally broadly cuneate at base, 10–12 by 5.5 cm; upper pinnae rather suddenly shortened, very shortly stalked,

sessile or adnate at base, oblong-subdeltoid with acute apex, shallowly lobed at margin; pinnules oblong-subdeltoid, rounded at apex, round or cuneate at base or acroscopically auricled in larger ones, up to 3 by 1.2 cm, serrate at margin; papyraceous, not very thick or harsh, deep green. *Sori* dorsal on veinlets, medial or just beyond midway from midrib to margin of pinnule, in one row, exindusiate.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Chiang Dao), Tak (Doi Musoe – Mae Sot); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai National Park); PENINSULAR : Nakhon Si Thammarat (Khao Luang); Ranong (Kapoe).

D i s t r i b u t i o n.— Indochina, W. Malaysia, Sumatra, Borneo, Taiwan (type), and northwards to southern edge of Japan.

E c o l o g y.— On mountain slopes in not very dense mountain forests at 100 – 1500 m alt.

10. Dryopteris integriloba C. Chr., Bull. Dept. Biol. Sun Yatsen Univ. 6 : 5. 1933; Ching, Bull. Fan Mem. Inst. Biol. 8 : 479. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 314. f. 36, 2 – 3. 1941; Tagawa & K. Iwats., Southeast As. St. 5 : 96. 1967.— *Dryopteris subtriangularis* auct. non (Hope) C. Chr.: Holtt., Dansk Bot. Ark. 23 : 238. 1965.

Rhizome short, erect, scaly. *Stipe* dark stramineous, densely scaly; scales nearly black, linear, about 20 by 1.2 mm. *Lamina* oblong with acuminate apex, bipinnate or tripinnatifid in lower part, about 35 by 25 cm; lower 5 – 6 pairs of lateral pinnae similar to each other in size, oblong-lanceolate with caudate-acuminate apex and broadly cuneate base, 10 – 13 by 5 cm, with stalks 3 – 10 mm long; upper pinnae rather suddenly becoming smaller, sessile to adnate at base, pinnatifid to subentire; pinna-rachis densely covered with bullate scales brown with dark brown tails; pinnules patent or slightly ascending, oblong-subdeltoid, round to moderately acute at apex, cordate and shortly stalked or broadly cuneate and sessile or adnate in smaller ones, slightly auricled on both bases, pinnatisect at basal part of larger ones, up to 3 by 1 cm, lobes gradually shallower upwards; papyraceous, green. *Sori* dorsal on veinlets, medial or a little nearer margin, scattered from basal middle portion of frond; indusia round-reniform, about 0.7 mm diam., glabrous.

T h a i l a n d.— NORTHERN : Tak (Mae Sot), Phitsanulok (Salaeng Haeng); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n.— S. China (type), and N. Vietnam.

E c o l o g y.— On rather dry ground along streams in light shade at about 800 – 2000 m alt.

N o t e.— The type specimen is of an imperfect frond, though the identification is not in doubt. The stipe and rachis are nearly naked in fully matured plants, but the scars of the fallen scales show that the scales were dense there. TARDIEU & C. CHRISTENSEN (1941) give a description and figure of this species in which the stipe and rachis are without scales, which may represent old material.

11. Dryopteris neoassamensis Ching, Bull. Fan Mem. Inst. Biol. 8 : 480. 1938; Tagawa & K. Iwats., Southeast As. St. 5 : 96. 1967.

Rhizome short, erect, densely scaly at apex; scales dark brown, linear, entire, up to 10 by 1 mm. *Stipe* dark stramineous or pale brown, densely scaly at base, sparsely minutely scaly upwards, about 40 cm long. *Lamina* oblong with acuminate apex, bipinnate, 35–50 by 25–30 cm; lateral pinnae 4–6 pairs, 3–8 cm apart, subopposite, patent or ascending, very shortly stalked or subsessile, lanceolate, gradually narrowing towards caudate-acuminate apex, subtruncate or rounded at base, up to 18 by 4 cm, basal pinnules slightly shorter; upper pinnae suddenly shortened to form indistinct apical pinna, subtriangular in outline, acuminate at apex; pinna-rachis with dark brown bullate scales; pinnules subquadrangular, oblique or falcate, obtuse at apex, subtruncate at base in larger ones, decurrent into smaller ones, serrate at margin, up to 2 by 0.8 cm; midrib of pinnules underneath and sometimes veins also sparsely hairy with shining brown, short, unicellular hairs, glabrous on laminar surface. *Sori* dorsal on veinlets, medial or costular; indusia up to 1 mm diam., glabrous.

Thailand.— NORTHERN : Chiang Mai (Doi Suthep); EASTERN : Chaiyaphum (Thung Kamang); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); CENTRAL : Nakhon Nayok (Khao Yai).

Distribution.— China (Kwangtung, type).

Ecology.— On rather dry (in dry season) mountain slopes in mixed or evergreen forests at 1000–1300 m alt.

12. Dryopteris subtriangularis (Hope) C. Chr., Ind. Fil.: 296. 1905; Ching, Bull. Fan Mem. Inst. Biol. 8 : 96. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 315. f. 35, 1–2. 1941; Tagawa & K. Iwats., Southeast As. St. 5 : 96. 1967.— *Nephrodium subtriangulare* Hope, J. Bot. 28 : 327. 1890.— *Dryopteris chapensis* auct. non C. Chr. & Ching : Holtt., Dansk Bot. Ark. 20 : 30. 1961, p.p.

Rhizome short, erect, densely scaly at apex; scales linear, entire, 7–10 by 0.7 mm, nearly black. *Stipe* dark stramineous to pale brown, densely scaly at base, sparsely upwards, upper scales smaller, 20–30 cm long. *Lamina* oblong-ovate with acuminate apex, 20–30 by about 20 cm, bipinnate to tripinnatifid at base; rachis like the upper part of stipe, with linear scales, grooved above; pinnae subopposite, 4–5 pairs below an indistinct apical pinna, shortly stalked, narrowly subtriangular, caudate-acuminate at apex, subtruncate to broadly cuneate at base, up to 12 by 4 cm; pinna-rachis bullate-scaly, slightly ascending; pinnules oblong to oblong-subdelotid, rounded to obtuse at apex, broadly cuneate and auricled on both sides at base, up to 2.5 by 1 cm, lobed almost to the base in larger ones, light green in living condition, drying brown; softly papyraceous, rather thin but coarse. *Sori* dorsal on veinlets, medial; indusia about 0.7 mm diam., fugacious.

Thailand.— NORTHERN : Chiang Mai (Doi Suthep); NORTH-EASTERN : Loei (Phu Kradueng); CENTRAL : Nakhon Nayok (Khao Khieo in Khao Yai National Park).

Distribution.— India (Assam, type), S. China and N. Vietnam.

Ecology.— On rather dry sandy slopes in mountain forests at 1000–1200 m alt.

13. Dryopteris pseudosparsa Ching, Bull. Fan Mem. Inst. Biol. 8 : 489. 1938; Tagawa & K. Iwats., Southeast As. St. 5 : 96. 1967. Figure 32. 3–5.

Rhizome short, ascending or suberect; scales castaneous, thin but coarse, up to 12 by 1.5 mm. *Stipe* castaneous and densely scaly at base, stramineous and sparsely scaly upwards, about 30 cm long. *Lamina* subtriangular, acuminate at apex, tripinnatifid at base, about 30 by 20 cm; rachis bearing dense, linear, small, dark brown scales; lateral pinnae about 5 pairs, similar to each other in shape and size, narrowly subtriangular, gradually narrowing towards acuminate apex, broadly truncate at distinctly stalked base, up to 15 by 7 cm; upper pinnae rather suddenly becoming smaller, forming indistinct apical part of frond; pinna-rachis with small linear scales and brown partially bullate ones, grooved above; basal pinnules larger, narrowly subtriangular, up to 6 by 2 cm, pinnate, posterior pinnules oblong-subdeltoid, serrate or lobed at margin; segments of larger pinnules like smaller pinnules; chartaceous, deep green. *Sori* dorsal on veinlets, subcostular or medial; indusia fugacious, persistent, brown, up to 1 mm diam.

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

Distribution.— China (Yunnan, type and Kweichow).

Ecology.— On moist mountain slopes in dense mixed forests at about 1000 m alt.

8. CTENITIS

(C. Chr.) C. Chr. in Verdoorn, Man. Pterid.: 544. 1938; Ching, Bull. Fan Mem. Inst. Biol. 8 : 275. 1938; Copel., Gen. Fil.: 123. 1947.— *Dryopteris* subgen. *Ctenitis* C. Chr., Biol. Arb. Tilegn. E. Warm.: 77. 1911.

Rhizome usually short, erect, or rarely creeping with remote fronds, scaly; scales commonly large, narrow, entire, light brown. Stipe scaly and hairy, or glabrescent. Frond monomorphic, bipinnate (or tripinnate in *C. manilensis*) to pinnately decompound with basal anterior pinnules interior than basal posterior ones (i.e. catadromous); costa and costules hairy above with short, articulated, multicellular hairs (so-called *Ctenitis*-hairs); veins all free, not reaching the margin of lobes. Sori round, usually dorsal on veins, indusiate or naked; indusia, if any, round-reniform.

There are about 150 species credited to this genus from tropical regions throughout the world. From *Dryopteris*, it is distinguished by the coarse, articulated hairs on costa and costules above. In Thailand the following four species have been collected.

KEY TO THE SPECIES

1. Frond much longer than wide. Rhizome short, erect, densely scaly with large brown scales.
 2. Scales of stipe and rachis oblong-subtriangular to lanceolate, clathrate. Frond quadripinnatifid near base, about 60 cm long. Sori costular **1. C. dumrongii**
 2. Scales of stipe and rachis narrow, linear, hardly clathrate. Frond tripinnatifid near base, up to 45 cm long. Sori medial
  3. Pinnules and segments less oblique; costules forming angles of 60°—70° to costa, moderately acute at apex, subentire; plant larger; lamina 35—45 cm long **2. C. mannii**
  3. Pinnules and segments oblique; costules forming angles of 45°—60° to costa, acute at apex, more or less incised; plant smaller; lamina about 25 cm long **3. C. vilis**
1. Frond about as long as wide. Rhizome creeping, with well spaced fronds; scales sparse and smaller **4. C. manilensis**

1. Ctenitis dumrongii Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 115. f. 11. 1968. Figure 33. 1—3.

Rhizome short, erect. *Stipe* densely scaly at base, about 40 cm long, dark brown; scales at base of stipe linear, up to 25 by 1 mm, brown or paler on basal part, entire, thin, those on the upper part linear-lanceolate, up to 10 by 0.6 mm, dark brown, clathrate, gradually becoming smaller upwards. *Lamina* narrowly oblong-subtriangular, gradually narrowing towards acuminate apex, about 60 by 35 cm, quadripinnatifid in basal part; pinnae about a dozen pairs below an indistinct apical pinna, the lower pinnae 8—12 cm apart; basal pinnae the largest, stalked, asymmetrically oblong-subdeltoid, acuminate at apex, cuneate at base, up to 20 by 12 cm; posterior pinnules of the basal pinna like the upper pinnae; pinnules of middle pinna sessile, oblong, rounded or moderately acute at apex, 2.5—5 by 0.8—1.5 cm; papyraceous or thicker, green, midrib of pinnules scaly beneath, densely hairy above with articulated hairs, main veins hairy above, veinlets 3—6 pairs, simple or forked. *Sori* costular to medial, indusiate; indusia fringed in matured sori but persistent, thin, glabrous.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok, type), Chiang Mai (Kang Kat).

D i s t r i b u t i o n.— Endemic.

E c o l o g y.— On moist banks of streamlets in dense evergreen forests at medium altitudes.

N o t e.— This is close to *C. subglandulosa* (Hance) Ching found from Japan to Taiwan, but different from it in having oblong pinnules with rounded apex and oblong to quadrangular segments with obtuse apex; texture is thicker; pinnules are sessile; the sori are in general costular; and veinlets are usually simple, glandular beneath in younger fronds.

= Ctenitis subobscura (Christ) Ching

2. Ctenitis mannii (Hope) Ching, Bull. Fan Mem. Inst. Biol. 8 : 289. 1938; Holtt., Rev. Fl. Malaya 2 : 497. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 97. 1967.— *Nephrodium mannii* Hope, J. Bot. 1890 : 145.— *Lastrea intermedia* Bedd., Handb. Suppl.: 61. 1892, p.p. Figure 33. 4—5.

Rhizome short, erects; scales linear, thin, light brown, up to 20 by 1.5 mm, entire. *Stipe* 20–50 cm long, dark brown, densely scaly throughout; scales linear, up to 8 mm long, 2–3 cells broad near base, dark brown, like bristles. *Lamina* oblong-lanceolate, gradually narrowing from the broadest part at base towards acuminate apex, 35–45 by up to 20 cm, tripinnatifid at base; pinnae more than 15 pairs below bipinnatifid indistinct apical portion; basal pinnae the largest, asymmetrically oblong-subtriangular, acuminate at apex, truncate to broadly cuneate at base, stalked, about 12 by 6 cm; middle pinnae oblong-lanceolate, ascending, acuminate at apex, subtruncate or very broadly cuneate at base, pinnatifid or deeply lobed, very shortly stalked or subsessile, up to 10 by 3 cm; posterior pinnules larger, pinnatifid, up to 5 by 1.5 cm, other pinnules slightly oblique, moderately acute at apex, subentire or very slightly crenate at margin; herbaceous, deep green, rachis and costa densely scaly underneath, densely hairy above with *Ctenitis*-hairs; veins simple or forked. *Sori* medial; indusia small.

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

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

E c o l o g y.— Terrestrial on mountain slopes in dense evergreen forests at medium altitudes.

N o t e.— Thai collections match well with the plants from Malaya, but the identity with the Assam plants is still doubtful. In the Assam specimens, sori are medial to marginal; veinlets are mostly simple, the terminal of veinlets distant from the margin of pinnules.

3. Ctenitis vilis (Kunze) Ching, Bull. Fan Mem. Inst. Biol. 8 : 290. 1938; Holtt., Rev. Fl. Malaya 2 : 496. f. 293. 1955.— *Aspidium vile* Kunze, Bot. Zeit. 1846 : 474.— *Lastrea padangensis* Bedd., Handb. Suppl.: 60. 1892.

Close to *C. mannii*, different from it in : lamina smaller, up to 25 by 10 cm; pinnules, and segments as well if any, oblique (costule forming angles of 45°–60° to costa), acute at apex; basal pinna asymmetrically ovate-subdeltoid, the basal basiscopic pinnules not much larger. Rhizome-scales much smaller than those of the other species, up to 10 by 0.5 mm, brown to dark brown.

T h a i l a n d.— PENINSULAR : Satun, Narathiwat (Waeng).

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

E c o l o g y.— In earth by big streams at sea level.

N o t e.— This species is said to grow usually in stream-beds, and in such a habitat the pinnae and pinnules, or higher divisions of fronds if any, are usually placed obliquely (so-called rheophyte).

4. Ctenitis manilensis (Presl) Holtt., Nov. Bot. Inst. Bot. Univ. Carol. Prag. 1968 : 36.— *Lastrea manilensis* Presl, Epim. : 39. 1851.— *Nephrodium parishii* Hook., Sp. Fil. 4 : 131. t. 260. 1862.— *Lastrea parishii* (Hook.) Bedd., Ferns Br. Ind.: t.

= Tectaria manilensis (Presl) Holtt.

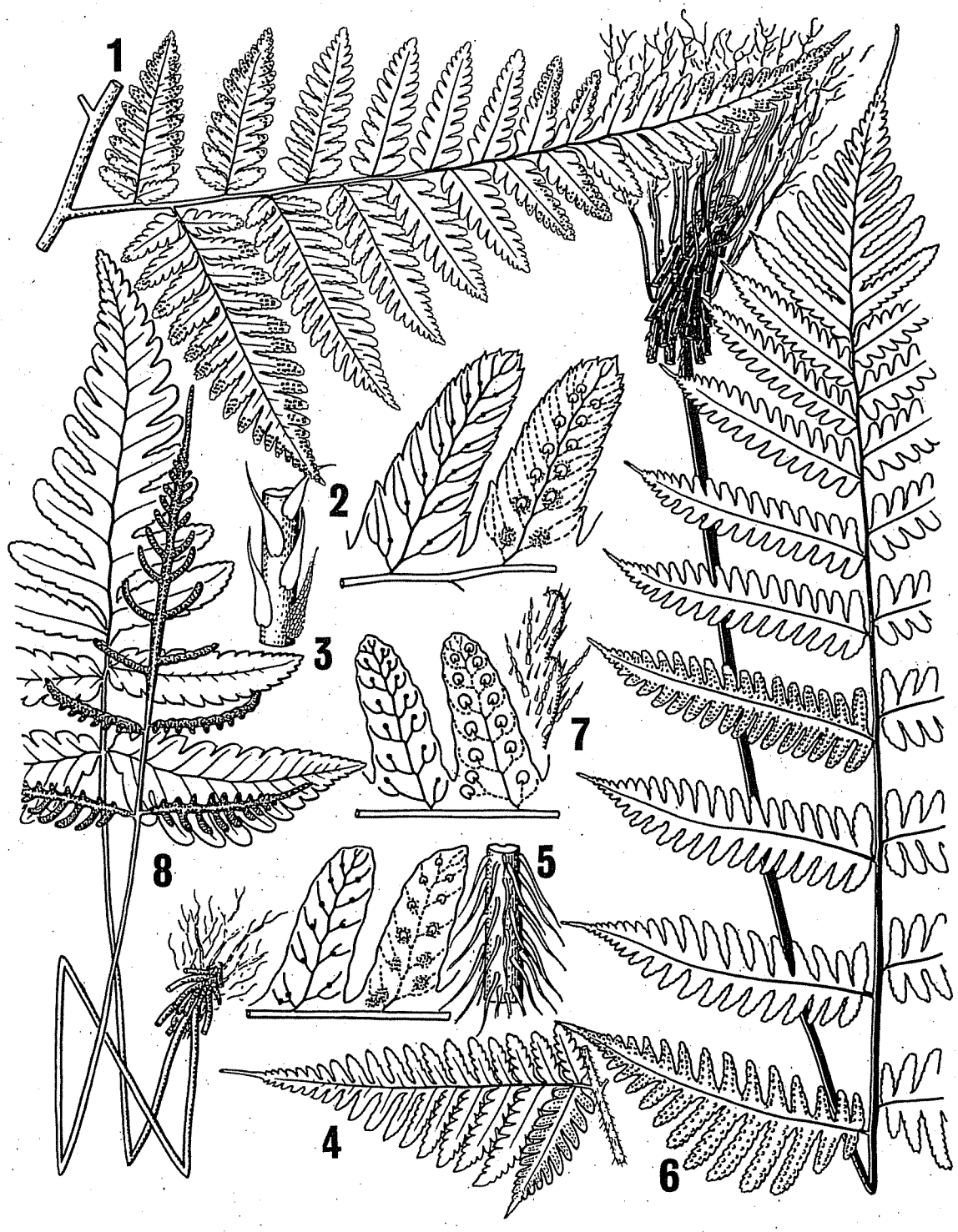


Figure 33. 1–3: *Ctenitis dumrongii*; 1. lowest pinna, x 0.5; 2. fertile lobes enlarged, x 2; 3. clathrate scales on costa, x 7. 4–5: *C. mannii*; 4. lowest pinna, x 0.5, and fertile lobes, x 2, hairs omitted; 5. scales of rachis enlarged. 6–7: *Heterogonium gurupahense*; 6. plant with fertile frond, x 0.5; 7. fertile lobes enlarged and hairs on leaf surface (x 6). 8: *H. pinnatum*; plant with sterile and fertile fronds, x 0.5.

43. 1865; Handb.: 259. f. 134. 1883.— *Lastreopsis parishii* (Hook.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 159. 1938; Holtt., Rev. Fl. Malaya 2 : 498. f. 294. 1955; Dansk Bot. Ark. 23 : 238. 1965.— *Lastrea chupengensis* Ridl., J. Str. Br. Roy. Asiat. Soc. 59 : 232. 1911.— *Lastreopsis parishii* var. *chupengensis* (Ridl.) Holtt., Rev. Fl. Malaya 2 : 498. 1955.

Rhizome creeping, fleshy, up to 4 mm diam., scaly. *Stipe* rather fleshy, pale to dark brown, glabrous, 10–20 cm long. *Lamina* tripinnate, broadly triangular, acute to acuminate at apex, up to 20 by 12–25 cm; rachis slender, winged, hairy; pinnae opposite, basal pinnae the largest, up to 15 by 7 cm, asymmetrically oblong-subdeltoid, shortly stalked, the basal basiscopic pinnules much longer; upper pinnae gradually becoming smaller, sessile, oblong-lanceolate, pinnate to bipinnatifid; basal basiscopic pinnule of basal pinna like upper lateral pinna, up to 7 by 2.5 cm; pinnules of upper pinnae oblong, oblique, rounded at apex, lobed at margin; ultimate lobes oblong, moderately acute at apex, entire; thinly herbaceous; veins free, one to each lobe, the apex not reaching the margin; densely hairy on every axis as well as on both surfaces of lamina, hairs articulate, coarse. *Sori* terminal on short acroscopic branches of veinlets; indusia small, reniform, pale-green, glabrous.

T h a i l a n d.— NORTHERN : Chiang Rai (Fang), Chiang Mai (Doi Chiang Dao, Doi Lin Luang), Lampang (Mae Ngao), Phrae (Mae Sai), Tak (Khao Phra Wo); EASTERN : Nakhon Ratchasima (Khao Sisiat); CENTRAL : Nakhon Nayok (Khao Yai, Salika Falls), Saraburi (Sam Lan); SOUTH-WESTERN : Kanchanaburi (Khriti, Huai Ban Kao, Thong Pha Phum, Bang Krasi, Sai Yok), Prachuap Khiri Khan (Khao Luang); PENINSULAR : Chumphon (Siap Yuan), Phangnga (Thap Put, Khao Nang Hong), Nakhon Si Thammarat (Thung Song), Satun.

D i s t r i b u t i o n.— Burma, W. Malaysia, SW. Celebes, and Philippines (type).

E c o l o g y.— Usually in crevices of limestone cliffs in light shade at low altitudes, collected fairly commonly throughout Thailand in rainy season.

V e r n a c u l a r.— Kut khi lap (กูดขี้หลับ) (Northern).

N o t e.— The plants from Celebes and Philippines are identical with a form named *Lastrea chupengensis*, but the variation of this species hardly allows the segregation of such a form distinguished mainly by the size.

This species is distinct from the other members of *Ctenitis* in having proportionately wider fronds and long-creeping rhizomes. These features may be related to the peculiar habitat on limestone cliffs in a monsoon area with a distinct alternation of dry and rainy seasons. The frond is green only in the rainy season, and the rhizome is fleshy, storing reserves for the dry season.

9. HETEROGONIUM

Presl, Epim.: 142. 1851; Copel., Gen. Fil.: 127. 1947; Holtt., Sarawak Mus. J. 5 : 156. 1949; Kalikasan 4 : 205. 1975.— *Ctenitopsis* Ching, Bull. Fan Mem. Inst. Biol. 8 : 304. 1938, p.p.

Rhizome short, erect, with dark castaneous scales. Stipe usually fuscous, hairy, with articulate hairs, scaly at base. Frond catadromous in plan (the basal anterior pinnules interior to the basal posterior one), monomorphic to subdimorphic, pinnate to bipinnatifid, herbaceous, hairy at margin, on axes and on upper surface; basal pinnae similar to the next above in size and form; veins free or anastomosing, basal basiscopic veins sometimes springing directly from costa. Sori dorsal on veins, round or elongate, with reniform indusia or naked.

HOLTTUM made detailed studies on the species of this genus in 1949 and in Reinwardtia 1 : 27–31. 1950 and 3 : 269–274. 1955, and finally in 1975, in Kalikasan 4 : 205–231, enumerating nineteen species mainly from Malesia. This genus is rather difficult to diagnose concisely. There are five species native to Thailand.

KEY TO THE SPECIES

1. Frond monomorphic or subdimorphic, fertile frond with distinct, indusiate sori; basal pinnae the same as or smaller than the next above; rachis not gemmiferous; veins free or anastomosing
2. Frond monomorphic, sterile frond similar to fertile one; veins all free
3. Hairs on the upper surface of lamina of two kinds **1. H. gurupahense**
3. Hairs on the upper surface of lamina of one kind **2. H. sagenioides**
2. Frond subdimorphic with narrower pinnae and segments on fertile frond; veins anastomosing **3. H. hennipmanii**

1. Frond dimorphic with subacrostichoid or acrostichoid fertile frond; basal pinnae the largest; rachis gemmiferous; veins anastomosing to form costal areoles
4. Sori round and indusiate, not really acrostichoid **4. H. alderwereltii**
4. Sporangia covering whole the undersurface of fertile frond; indusia wanting **5. H. pinnatum**

1. Heterogonium gurupahense (C. Chr.) Holtt., Reinwardtia 3 : 272. 1955; Rev. Fl. Malaya 2nd ed. 2 : 636. 1968; Tagawa & K. Iwats., Southeast As. St. 5 : 99. 1967.— *Dryopteris sagenioides* var. *gurupahense* C. Chr., Svensk Bot. Tidsskr. 16 : 95. f. 2. 1922.— *Aspidium sagenioides* auct. non Mett.: Christ, Bot. Tidsskr. 24 : 108. 1901.— *Dryopteris sagenioides* auct. non (Mett.) O. Ktze.: C. Chr., Bot. Tidsskr. 32 : 342. 1916; Contr. U.S. Nat. Herb. 26 : 330. 1931.— *Ctenitopsis sagenioides* (Mett.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 312. 1938, p.p.; Holtt., Kalikasan 4 : 211. 1975. p.p. Figure 33. 6–7.

Rhizome short, ascending or suberect; scales oblong, gradually narrowing towards tailed apex, dark brown, stiff, paler and somewhat ferrugineous at margin, hairy, up to 3 by 1 mm. *Stipe* deep purple, polished, 20–40 cm long, minutely pubescent throughout. *Lamina* bipinnatifid, oblong-lanceolate, acuminate at apex, up to 40 by 35 cm; lateral pinnae about 10 pairs, sessile, lanceolate, caudate at apex, truncate at base, deeply lobed nearly to costa; basal pinna 7–5 by up to 5 cm; middle pinnae up to 12 by 3.5 cm, upper ones gradually becoming smaller, adnate at base, forming indistinct apical portion; pinnules oblong to oblong-subdeltoid, rounded to acute at apex, entire or crenulate in larger ones, herbaceous, deep green, hairy on both surfaces, costules and veins hairy, veinlets forked; hairs on upper surface of sterile pinna dense, of two kinds, the larger ones about 1.5 mm long, 4–9 celled, more or less articulated, the shorter ones slender, 0.2–0.4 mm long, unicellular to 3-celled. *Sori* dorsal on veinlets, medial, round indusiate; indusia small, fugacious, densely hairy.

T h a i l a n d.— NORTHERN : Chiang Rai, Chiang Mai (Ban Du), Phitsanulok (Thung Salaeng Luang); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Rayong (Khao Chamao), Chanthaburi (Khao Soidao, Khao Sabap), Trat (Bo Rai, Ko Chang); PENINSULAR : Ranong (Ko Banghen), Surat Thani (Ban Don), Phangnga (Khao Katha Khwam, Khao Phra Mi), Phuket (Thalang), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Pattani (Yaring), Narathiwat (Waeng).

D i s t r i b u t i o n.— Burma (Mergui and Tenasserium), Vietnam, W. Malaysia and Celebes (type).

E c o l o g y.— On mountain slopes in dense evergreen forests at lower to middle altitudes.

N o t e.— The identification of this species is in the sense of HOLTTUM (1955). Thai material differs from the isotype in BM in having about 10 pairs of lateral pinnae, the upper surface more densely hairy, and the pinnules of the lower pinnae usually about 15 in pairs.

2. Heterogonium sagenioides (Mett.) Holtt., Sarawak Mus. J. 5 : 161. 1941; Rev. Fl. Malaya 2 : 520. f. 306. 1955, p.p.; Reinwardtia 3 : 271. 1955; Kalikasan 4 : 211. 1975, p.p.— *Aspidium sagenioides* Mett., Abh. Senckenb. Naturf. Ges. 2 : 397. 1858.— *Ctenitopsis sagenioides* (Mett.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 312. 1938, p.p.— *Ctenitopsis obscura* auct. non Fée : C. Chr. ex Tard. & C. Chr., Notul. Syst. 7 : 87. 1938, excl. basion.; in Fl. Gén. I.-C. 7(2): 349. 1941.

Similar to the preceding, but different in : plants smaller, usually bearing less than ten pairs of lateral pinnae; hairs on upper surface of lamina of one kind, multiseptate, 5–8-celled, 0.8–1.5 mm in length.

T h a i l a n d.— EASTERN : Chaiyaphum.

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

E c o l o g y.— In evergreen forests at about 200–500 m alt.

3. Heterogonium hennipmanii Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 59. f. 15. 1974; Holtt., Kalikasan 4 : 216. 1975.

Frond subdimorphic. *Sterile frond* : stipe about 35 cm long, dark brown to castaneous, scaly near base; scales oblong, gradually narrowing towards tailed apex, dark brown to nearly black, hairy, more than 1 cm by up to 2 mm. *Lamina* oblong-lanceolate, pinnate with deeply lobed pinnae, up to 35 cm wide near base; lateral pinnae sessile or very shortly stalked in basal ones, mostly straight and ascending, broadest in middle, gradually narrowing towards attenuate apex, up to 20 by 3.2 cm, ultimate segments broadly oblong, oblique, a little falcate, rounded at apex, subentire or minutely waved at margin, up to 12 by 7 mm; papyraceous, dark green; veins in segments simple or forked. *Fertile frond* : stipe up to 30 cm long; lamina oblong-lanceolate, pinnate with deeply lobed pinnae, up to 60 by 25 cm; segments oblong, oblique to subquadrangular, rounded to obtuse at apex, subentire to dentate; sori dorsal on veinlets, medial, round, indusiate; indusia round-reniform, thin, fugacious.

T h a i l a n d.— NORTHERN : Tak (Doi Musoe, type).

D i s t r i b u t i o n.— Endemic.

E c o l o g y.— Moist evergreen forests along streamlets, ca 800 m alt.

4. Heterogonium alderwereltii Holtt., Sarawak Mus. J. 5 : 163. 1949; Rev. Fl. Malaya 2 : 522. f. 305. 1955; Kalikasan 4 : 229. 1975.— *Pleocnemia stenosemioides* v. A. v. Ros., Bull. Jard. Bot. Buit. III. 2 : 164. 1920.

Rhizome short, suberect, scales lanceolate, up to 8 by 1 mm, stiff, entire, dark-brown. *Fronds* distinctly dimorphic. *Sterile frond* : stipe 10–30 cm long, densely scaly at base, pubescent throughout, deeply castaneous to purplish; lamina oblong-subdeltoid, bipinnatifid, 15–25 cm long and wide; rachis like the upper part of stipe, very densely pubescent, gemmiferous at base of the uppermost or second upper pinna; lateral pinnae about 5 below pinnatifid indistinct apical portion; basal pinnae the largest, oblong-lanceolate, caudate at apex, unequally cuneate at base, up to 12 by 4 cm, middle pinnae sessile or adnate, caudate-acuminate at apex, subtruncate to broadly cuneate at base, lobed to half way towards costa; segments oblong to oblong-lanceolate, oblique to falcate, rounded to moderately acute at apex, entire; papyraceous, deep green, glabrous; costa densely pubescent, veins pinnate, veinlets simple or rarely forked, basal veinlets forming costal areoles, other veinlets free. *Fertile frond* : stipe longer, 20–45 cm long; lamina bipinnatifid, pinnae and segments much contracted. *Sori* round or extending along veins; indusia fairly large, glabrous.

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

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

E c o l o g y.— Along paths in dense evergreen forests at low altitudes; terrestrial in non-calcareous area.

N o t e.— Abnormal sterile fronds are often found. The gemmiferous rachis is distinct in this species, though this feature is usually overlooked.

5. Heterogonium pinnatum (Copel.) Holtt., Sarawak Mus. J. 5 : 163. 1949; Rev. Fl. Malaya 2 : 524. f. 307. 1955; Kalikasan 4 : 229. 1975.— *Stenosemia pinnata* Copel., Phil. J. Sci. 1. Suppl. 2 : 146. 1906. Figure 33. 8.

Similar to *H. alderwereltii* but decidedly different from it in having acrostichoid fertile fronds wholly wanting indusia.

T h a i l a n d.— PENINSULAR : Krabi (Ao Luek), Nakhon Si Thammarat (Chawang, Khao Luang), Yala (Bannang Sata).

D i s t r i b u t i o n.— W. Malesia to the Philippines (type).

E c o l o g y.— Terrestrial near streams in jungles at low altitudes.

N o t e.— Both this and the preceding species are said to be common in Malaya on limestone, but they are recorded as terrestrial from Thailand in soil in regions not usually calcareous.

10. TECTARIA

Cav., Ann. Hist. Nat. 1 : 115. 1799; Copel., Gen. Fil.: 128. 1947.— *Ctenitopsis* Ching, Bull. Fan Mem. Inst. Biol. 8 : 304. 1938, p.p.

Rhizome usually thick, short, erect to short-creeping, scaly at apex. Stipe stramineous to ebeneous. Frond simple to amply divided, usually broad or pentagonal in outline; all axes hairy with articulated multicellular hairs; veins free to variously anastomosing with or without included veinlets. Sori terminal on included free veins, dorsal on veins or compital on connected veins, usually round, indusiate or exindusiate, or sometimes elongate; indusia if present round-reniform.

Thus diagnosed, this is a genus of more than 200 species from all tropical countries. The generic delimitation is, however, not agreed by all authors. Here we list twenty-five species of *Tectaria* from Thailand.

KEY TO THE SPECIES

1. Veins all free or anastomosing to form costal and costular areoles only
 2. Veins anastomosing only in sterile fronds, those of fertile ones all free — **1. T. fuscipes**
 2. Veins anastomosing both in fertile and sterile fronds — **2. T. devexa**
1. Veins copiously anastomosing to form areoles outside the costal and costular ones
 3. Sori usually terminal on included free veinlets, often in two rows between main veins
  4. Basal pinna pinnate or deeply lobed throughout
   5. Costal areoles distinct
    6. Frond hairy on upper surface
     7. Stipe stramineous to pale castaneous. Sori in one row at each side of main vein — **3. T. coadunata**
     7. Stipe and rachis dark purplish to nearly black, polished. Sori irregularly scattered on the whole undersurface of frond — **4. T. melanocaulis**
    6. Frond glabrous, or with a few hairs near sinus only
     8. Stipe not densely scaly except for the base; lamina up to 40 cm long. Fertile frond usually much contracted — **5. T. variolosa**
     8. Stipe hairy as well as scaly throughout; lamina up to 70 cm long. Fertile frond not or a little contracted — **6. T. griffithii**
   5. Costal areoles not distinct
    9. Rhizome creeping or ascending; basal pinna trifoliate to pinnate. Sori usually in two rows between main veins, indusiate; Northern — **7. T. phaeocaulis**
    9. Rhizome suberect; basal pinna deeply lobed to pinnatifid. Sori irregularly scattered on the lower surface of frond, indusia hardly known; Peninsular — **8. T. barberi**
  4. Basal pinna with a single basiscopic lobe, the margin at most undulate
   10. Sori large, one in each areole, in a single row at each side of main veins
    11. Stipe wingless — **9. T. crenata**
    11. Stipe with wings nearly to the base — **10. T. decurrens**
   10. Sori small, usually more than one in an areole, scattered irregularly — **11. T. angulata**
 3. Sori on anastomosing veins

12. Frond deeply lobed to pinnately or more compound
13. Frond pinnate or more compound
14. Usually more than two pairs of free lateral pinnae in fully matured plants; no gemmae on rachis
15. Apical portion of frond unlike the pinnae next below
16. Sori indusiate
17. Frond bipinnate at base; indusia large, persistent **12. T. rockii**
17. Frond pinnate, lower one or two pinnae trifurcate or trifoliate; indusia fugacious
18. Sori dorsal on veins, scattered on the lower surface of frond
19. Stipe dark, ebeneous, polished. Sori about 0.8 mm **13. T. simonsii**
19. Stipe stramineous, or pale castaneous basally. Sori about 1.2 mm **15. T. amplifolia**
18. Sori seemingly marginal, confined to the apical margin of lobes; stipe castaneous to purplish **14. T. laotica**
16. Sori exindusiate
20. Rhizome creeping. Stipe stramineous. Lamina hairy throughout, softly herbaceous **16. T. tenerifrons**
20. Rhizome short, ascending. Stipe castaneous. Lamina glabrous, papyraceous **25. T. gymnosora**
15. Apical pinnae similar to those next below
21. Rhizome short, ascending to suberect. Fronds close together
22. Base of pinna cuneate to rounded **18. T. polymorpha**
22. Base of pinna narrowly cuneate **20. T. rumicifolia**
21. Rhizome long-creeping. Frond rather remote **19. T. herpetocaulos**
14. Frond trifoliate to quinquefoliate; gemmae at junction of rachis and costa **17. T. ternifolia**
13. Frond deeply lobed, lobes connected by a wing decurrent on stipe
23. Sori indusiate
24. Stipe broadly winged almost to the base; rachis rarely proliferous; lateral lobes all connected by the wing of rachis **22. T. vasta**
24. Stipe winged only on upper half or very narrowly towards base; rachis usually gemmiferous; wing of rachis usually interrupted above the axis of lateral lobes **23. T. fauriei**
23. Sori exindusiate **24. T. maingayi**
12. Frond simple, entire **21. T. singaporeana**

1. Tectaria fuscipes (Wall. ex Bedd.) C. Chr., Contr. U.S. Nat. Herb. 26 : 290. 1931; Ching, Sinensia 2 : 14. 1931; Tagawa & K. Iwats., Southeast As. St. 5 : 97. 1967.— *Aspidium fuscipes* Wall. ex Bedd., Ferns Br. Ind. Suppl.: 15. t. 366. 1876.— *Lastrea fuscipes* (Wall. ex Bedd.) Moore ex Bedd., Handb.: 243. 1883.— *Ctenitopsis fuscipes* (Wall. ex Bedd.) C. Chr. & Tard., Notul. Syst. 7 : 87. 1938; in Fl. Gén. I.-C. 7(2): 354. 1941; Ching, Bull. Fan Mem. Inst. Biol. 8 : 313. 1938.— *Pleocnemia membranifolia* auct. non Presl : Bedd., Handb.: 225. f. 115. 1883.— *Sagenia membranifolia* auct. non (Presl) Christ : Hosseus, Beih. Bot. Centr. 28(2): 366. 1911.

Rhizome short, suberect to ascending; scales stiff, nearly black, about 10 by 1.8 mm, entire. *Fronds* dimorphic. *Sterile frond* : stipe 10–20 cm long, scaly on lower part, pubescent throughout, stramineous to darker; lamina bipinnatifid, oblong to oblong-lanceolate, acuminate at apex, broadest at base, up to 50 by 25 cm; basal pinnae asymmetrically oblong-subdeltoid, ca 15 by 10 cm, caudate-acuminate at apex, lobed to $\frac{4}{5}$ way towards costa, bearing large basal basiscopic pinnules; middle lateral pinnae lanceolate, broadest at base, up to 13 by 4 cm; upper pinnae adnate at base and decurrent to the next to form indistinct apical portion; lobes oblong-subdeltoid, oblique, round at apex, entire, 7–9 mm broad; herbaceous, deep green, hairy on upper surface; costa pubescent, a row of costal

areoles present. *Fertile frond* taller : stipe up to 35 cm long; lamina narrower, middle pinnae up to 3 cm wide, lobed to $\frac{4}{5}$ way towards costa; veins all free. *Sori* dorsal on veinlets, round, rather irregularly dispersed on lower surface of pinna, about 1 mm diam.; indusia small, persistent.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok), Chiang Mai (Doi Chiang Dao, Doi Suthep), Lampang (Mae Ngao), Phitsanulok (Thung Salaeng Luang), Tak (Ban Musoe); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng), Nakhon Sawan; SOUTH-EASTERN : Chon Buri (Ang Chang Nam), Chanthaburi (Khao Soi Dao); SOUTH-WESTERN :Kanchanaburi (Wangka).

D i s t r i b u t i o n.— Sikkim (type) to S. China, east to Taiwan.

E c o l o g y.— On rather dry slopes in humus-rich areas in dense mixed or evergreen forests at medium altitudes (500–1200 m alt.).

N o t e.— The plants referred to this species are fairly variable in size and form of frond, and they may form a collective species. The venation is variable from free to anastomosing both in the sterile and the fertile frond, though the typical form is as described above.

2. Tectaria devexa (Kunze) Copel., Phil. J. Sci. 2C : 415. 1907; Ching, Sinensia 2 : 16. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 404. 1941; Holtt., Rev. Fl. Malaya 2 : 505. f. 297. 1955; Dansk Bot. Ark. 23 : 242. 1965.— *Aspidium devexum* Kunze, Bot. Zeit. 1848 : 259.— *Polypodium membranaceum* Hook. in Blakist., Yang-tsze : 365. 1862, non D. Don 1825.— *Pleocnemia membranacea* Bedd., Ferns Br. Ind. Suppl.: 15. 1876; Handb.: 225. 1883.

Rhizome short, erect to ascending, densely scaly near apex; scales rather stiff, about 13 by 1.5 mm, dark brown, entire. *Stipe* castaneous or paler, scaly at base, densely pubescent throughout, up to 25 cm long. *Lamina* subdeltoid, tripinnatifid at base, up to 30 by 20 cm; rachis winged at upper part; lateral pinnae about 10 pairs, basal pinnae the largest, asymmetrically oblong-subdeltoid, falcate, acuminate at apex, unequally broadly cuneate at base, up to 15 by 12 cm, stalked, with larger basiscopic pinnules; middle pinnae ascending, shortly stalked, oblong-lanceolate with caudate apex and broadly cuneate base; upper pinnae sessile to adnate at base; basal pinnules of larger pinnae free, shortly stalked, oblong-subdeltoid to lanceolate, basiscopic one up to 8 by 2.5 cm, acroscopic ones 3.5 by 2 cm, deeply lobed almost to costules, smaller pinnules sessile or adnate, oblong-subtriangular; ultimate segments rounded, oblique, entire or serrate; herbaceous, green to yellow-green, pubescent on both surfaces; costa and costules castaneous or paler, densely pubescent; veins anastomosing to form the costal and costular areoles. *Sori* terminal on free veinlets, medial or submarginal, about 0.8 mm diam.; indusia small, fugacious.

T h a i l a n d.— EASTERN : Chaiyaphum (Nam Phrom, Phu Khieo); CENTRAL : Saraburi (Muak Lek); SOUTH-EASTERN :Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Sai Yok); PENINSULAR : Chumphon (Thap Li, Ko Wiang).

Distribution.— Ceylon, S. China, Indochina, Malesia (type), north to Taiwan and the Ryukyus.

Ecology.— On rocks, usually on limestone, or terrestrial in evergreen forests at low altitudes.

= T. christii Copel.

3. Tectaria coadunata (J. Smith) C. Chr., Contr. U.S. Nat. Herb. 26 : 331. 1931; Ching, Sinensia 2 : 18. pl. 1, 2. 1931; Tagawa & K. Iwats., Southeast As. St. 3(3): 86. 1965; 5 : 97. 1967.— *Sagenia coadunata* J. Smith, J. Bot. 4 : 184. 1841, based on *Aspidium coadunatum* Wall. ex Hook. & Grev., Ic. Fil.: t. 202. 1831, non Kaulf. 1824.— *Sagenia macrodonta* Fée, Gen. Fil.: 313. t. 24 A. f. l. 1852.— *Tectaria macrodonta* (Fée) C. Chr., Ind. Fil. Suppl. 3 : 181. 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 410. 1941; Holtt., Rev. Fl. Malaya 2 : 505. 1955.— *Aspidium cicutarium* auct. non Sw.; Bedd., Handb.: 220. 1883.

Rhizome short-creeping, thick; scales stiff, gradually narrowing towards long-tailed apex, up to 15 by 1 mm, entire, dark brown. *Stipe* 35–45 cm long, stramineous to pale castaneous, glabrescent above. *Lamina* deltoid, 60–100 by 60 cm, tripinnate to quadripinnatifid; basal pinnae asymmetrically oblong-subdeltoid, long-stalked, up to 55 by 40 cm; middle pinnae 5–7 pairs below deeply lobed apical pinnae, oblong to oblong-lanceolate, acute at apex; pinnules of middle pinnae stalked, oblong-subtriangular, acuminate at apex, deeply lobed to $\frac{4}{5}$ way towards costa, up to 15 by 10 cm; secondary pinnules oblong to oblong-ovate, round at apex, crenate; thin, herbaceous, light green; veins copiously anastomosing, with included free veinlets; rachis, pinna-rachis, midrib of pinnules and segments more or less densely hairy, upper surface of lamina and margin hairy; hairs articulated, coarse. *Sori* at apex of included veinlets, in one row at each side of midrib of ultimate lobes, medial, indusiate; indusia rather large, up to 1.2 mm diam., glabrous.

Thailand.— NORTHERN : Chiang Rai (Doi Pha Khao), Chiang Mai (Fang, Doi Chiang Dao, Doi Suthep, Doi Chong, Doi Inthanon), Mae Hong Son (Khun Yuam, Mae Sariang).

Distribution.— Tropical Africa, India (type), SW. China, Indochina, Taiwan and W. Malaysia.

Ecology.— On mountain slopes in dense forests at 350–1500 m alt.

4. Tectaria melanocaulis (Bl.) Copel., Phil. J. Sci. 2C : 416. 1907; Holtt., Rev. Fl. Malaya 2 nd ed. 2 : 636. 1968; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 176. 1968.— *Aspidium melanocaulon* Bl., En. Pl. Jav.: 161. 1828. Figure 34. 1.

Rhizome short, ascending, bearing close fronds, scaly at apex; scales stiff, gradually narrowing from base towards hair-pointed apex, more or less wavy in upper portion, deep purplish-brown with paler margin, up to 8 by 1 mm. *Stipe* about 50 cm long, dark purplish to nearly black, polished, densely pubescent. *Lamina*

about 50 cm long and wide, deeply bipinnatisect; lateral pinnae subopposite, 3—5 pairs, upper ones stalked or subsessile, apical portion with lobed adnate pinnae, base rather suddenly cuneate, not decurrent to form wings of rachis; lobes oblique, oblong-subtriangular, acuminate at apex, up to 7 by 2 cm, wavy at margin; herbaceous to softly papyraceous, rachis and costa dark purplish, densely pubescent above; veins raised or distinct below, copiously anastomosing. *Sori* at apex of short included free veinlets, round, small, up to 0.7 mm diam., scattered irregularly on whole undersurface; indusia small, fugaceous.

T h a i l a n d.— PENINSULAR : Yala (Bannang Sata).

D i s t r i b u t i o n.— Malesia throughout from Sumatra to New Guinea (type from Java).

E c o l o g y.— Habitat nor recorded, only once collected : E. SMITH 1842 (SING).

N o t e.— As the Thai specimen is incomplete, the above description is drawn from Malesian plants.

= T. impressa (Fée) Holtt.

5. Tectaria variolosa (Wall. ex Hook.) C. Chr., Contr. U.S. Nat. Herb. 26 : 289. 1931; Ching, Sinensia 2 : 21. pl. 3. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 412. 1941; Holtt., Rev. Fl. Malaya 2 : 506. f. 298. 1955; Dansk Bot. Ark. 20 : 31. 1961; 23 : 242. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 97. 1967.— *Aspidium variolosum* Wall. ex Hook., Sp. Fil. 4 : 51. 1862; Bedd., Handb.: 216. f. 111. 1883; Christ, Bot. Tidsskr. 24 : 108. 1901; C. Chr., Bot. Tidsskr. 32 : 419. 1916.— *Nephrodium variolosum* (Wall. ex Hook.) Hook. & Bak., Syn. Fil.: 298. 1867; Ostenfeld, Bull. Herb. Boiss. II. 5 : 721. 1905.— *Sagenia membranifolia* auct. non Christ : Hoss., Beih. Bot. Centr. 28(2): 366. 1911.

Rhizome short, creeping, ascending or erect, 3—5 mm diam.; scales linear, hairy at margin, rather stiff, bicoloured by nearly black central portion with brown ferrugineous edges or concolorous brown, up to 7 by 0.8 mm. *Stipe* pale brown to castaneous, 15—35 cm in sterile and up to 60 cm in fertile fronds, densely pubescent on adaxial surface, glabrous beneath. *Lamina* ovate-subdeltoid or pentagonal, up to 40 by 30 cm, tripinnatifid at base; lateral pinnae 2—4 pairs, the basal pinna much the largest, stalked, asymmetrically subtriangular, acute at apex, with one or two basal basiscopic pinnules; upper pinnae shortly stalked, deeply lobed or with a free sessile basal basiscopic pinnule; apical pinna subdeltoid, cuneate and a little decurrent at base, deeply lobed to pinnatifid; herbaceous, green, glabrous on laminar surface; rachis and pinna-rachis with dense articulated hairs above, glabrous beneath; veins forming copious anastomoses with included veinlets. *Sori* terminal on free included veinlets, round, usually in a single row at each side of midrib, more or less raised on upper surface; indusia up to 1 mm diam., persistent, glabrous.

T h a i l a n d.— All over the country.

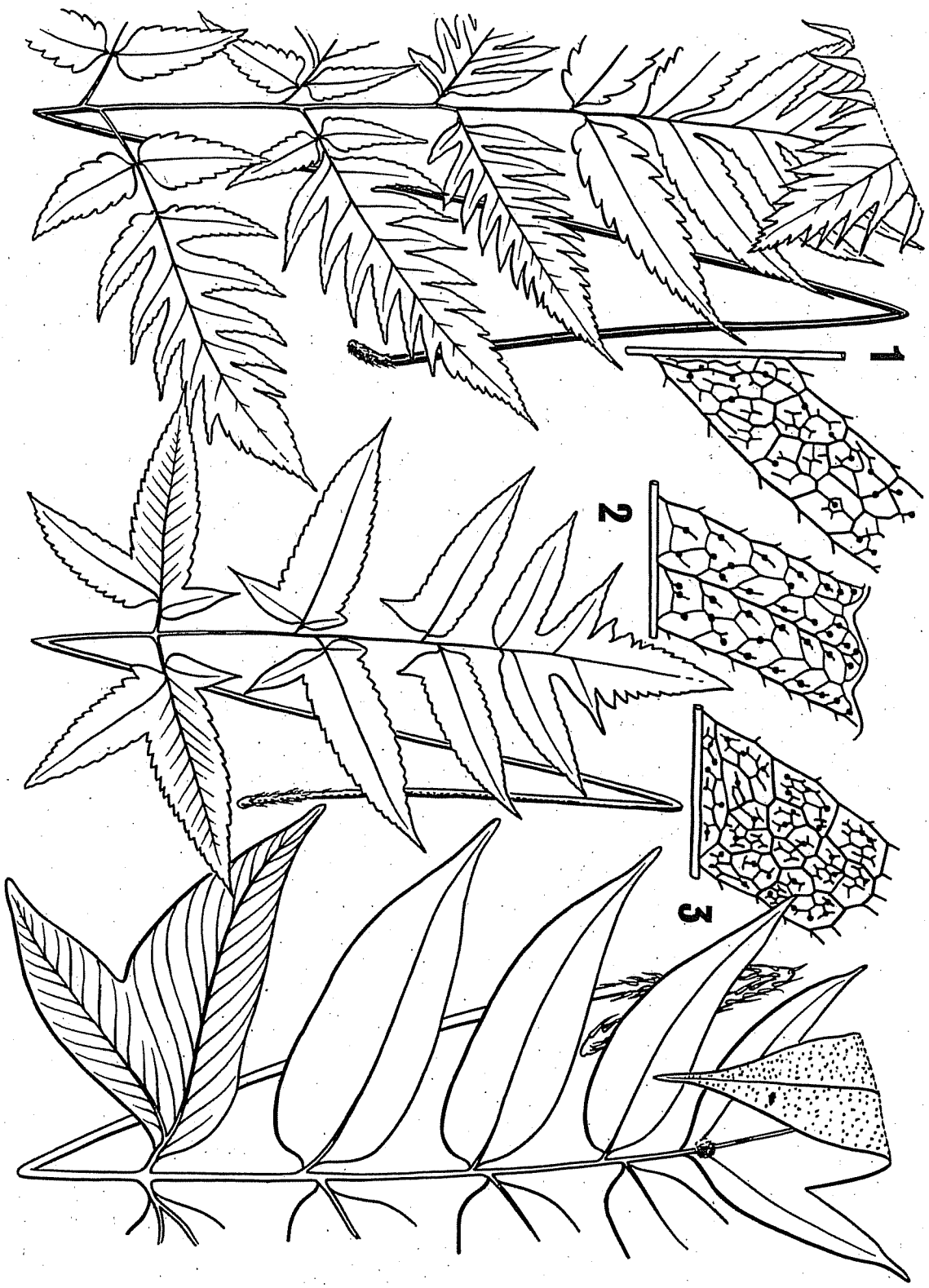


Figure 34. 1: *Tectaria melanocaulis*; frond (x 0.25) and venation (x 2). 2: *T. barberi*; frond (x 0.25) and lobes enlarged. 3: *T. angulata*; frond with gemma (x. 0.25) and venation (x 2).

Distribution.— N. India (type), SW. China, Indochina, Taiwan, W. Malaysia to Java.

Ecology.— On rather dry mountain slopes in not so dense forests at low to medium altitudes up to 900 m alt., fairly common throughout Thailand.

Vernacular.— Kut kwang (กูดกวาง), kut kieo (กูดเกี๋ยว), kut sang (กูดซาง), kut hok (กูดหก), kut hom kha (กูดฮ่มค่า) (Northern); chon pa (โชนป่า) (Peninsular).

6. Tectaria griffithii (Bak.) C. Chr., Ind. Fil. Suppl. 3 : 180. 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 411. 1941; Holtt., Dansk Bot. Ark. 23 : 240. 1965; Rev. Fl. Malaya 2 ed. 2 : 636. 1968; Tagawa & K. Iwats., Southeast As. St. 5 : 97. 1967; Acta Phytotax. Geobot. 23 : 55. 1968.— *Nephrodium griffithii* Bak., in Hook. & Bak., Syn. Fil.: 300. 1867.— *Nephrodium multicaudatum* Clarke, Trans. Linn. Soc. II. 1 : 540. t. 77. 1880.— *Tectaria multicaudata* (Clarke) Ching, Sinensia 2 : 20. 1931; Holtt., Rev. Fl. Malaya 2 : 507. f. 299. 1955.— *Aspidium multicaudatum* (Clarke) Bedd., Handb.: 222. 1883.

Rhizome short, erect, scaly; scales linear-subtriangular, up to 20 by 3 mm, entire, dark brown. *Stipe* dark brown to castaneous, up to 70 cm long, scaly throughout but scales gradually sparse upwards, hairy at least on adaxial surface. *Lamina* oblong-subdeltoid or pentagonal, up to 70 by 40 cm; lateral pinnae 1—4 pairs, basal pinna the largest, with long stalk, asymmetrically subdeltoid, acute at apex, up to 30 by 25 cm, 1 or 2 basal basiscopic pinnules much larger, free with short stalks, oblong-lanceolate, caudate-acuminate, deeply lobed, up to 20 by 6 cm, 1 or 2 basal acroscopic pinnules free; middle pinnae smaller, with 1 or 2 free pinnules; apical pinna oblong-subdeltoid, acute at apex, broadly cuneate and a little decurrent at base, deeply lobed to pinnatifid; herbaceous, dark green, glabrous on both surfaces; rachis and pinna-rachis hairy above, sparsely scaly beneath; veins anastomosing to form copious areoles. *Sori* round, terminal on short free included veinlets, indusiate, in a single row at each side of midrib, medial or a little costular, more or less immersed and raised on upper surface; indusia large, up to 2 mm diam., glabrous, persistent.

Thailand.— NORTHERN : Lampang; NORTH-EASTERN : Loei (Tha Li); SOUTH-EASTERN : Chanthaburi (Khao Sabap), Trat (Huai Raeng); SOUTH-WESTERN : Kanchanaburi (Wangka, Khao Ngi Yai, Song Tho); PENINSULAR : Phangnga (Takua Pa, Khao Nang Hong), Krabi (Khao Ao Khuan), Nakhon Si Thammarat (Khao Luang), Yala (Bannang Sata, Waterfall).

Distribution.— N. India, Burma (type), SW. China, Indochina, W. Malesia to the Philippines.

Ecology.— On rocky mountain slopes in dense evergreen forests at low altitudes below 600 m alt.

Vernacular.— Kachot raet (กะฉอดแรด) (South-eastern).

7. Tectaria phaeocaulis (Rosenst.) C. Chr., Ind. Fil. Suppl. 3 : 183. 1934; Tagawa & K. Iwats., Southeast As. St. 5 : 98. 1967.— *Aspidium phaeocaulis* Rosenst., Hedwigia 56 : 345. 1915.— *Tectaria laciniata* Ching, Bull. Fan Mem. Inst. Biol. 2 : 200. t. 15. 1931; Sinensia 2 : 24. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 414. 1941.

Rhizome short, creeping to ascending, densely scaly; scales linear-subtriangular, up to 7 by 1 mm, dark brown with very narrow paler margin, stiff. *Stipe* about 6.5 cm long, castaneous, more or less bright, glabrescent upwards. *Lamina* bipinnate at base, oblong-ovate, about 45 by 30 cm; rachis castaneous, densely pubescent on upper surface, sparsely beneath; lateral pinnae about 4 pairs, basal pinna trifoliate or with a few pairs of pinnules, terminal pinnule falcate, shallowly lobed, caudately acuminate at apex, cuneate at base, lateral pinnule broadly lanceolate, shortly stalked at cuneate base, crenate at margin, lobes ovate-subdeltoid, round to moderately acute at apex, up to 0.7 by 1 cm, middle pinnae stalked, lanceolate, shallowly lobed at margin, terminal pinna cuneate at base, lobed at basal part, caudate at apex; papyraceous, green, glabrous; costa and costules raised on both surfaces, castaneous, pubescent on both sides; main veins paler, pubescent beneath; veinlets forming irregular anastomosis with included free veinlets, pubescent beneath. *Sori* in two irregular rows between adjacent main veins, terminal on included free veinlets, round, about 1.5 mm diam.; indusia small, pubescent.

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

D i s t r i b u t i o n.— S. China, Indochina; Taiwan (type) and the Ryukyus.

E c o l o g y.— On mountain slopes in mixed forests at about 1600 m alt.

8. Tectaria barberi (Hook.) Copel., Phil. J. Sci. 2C : 414. 1907; Holtt., Rev. Fl. Malaya 2 : 508. f. 300. 1955.— *Polypodium barberi* Hook., Sp. Fil. 5 : 100. 1864.— *Dictyopteris barberi* (Hook.) Bedd., Ferns Br. Ind.: t. 322. 1869; Handb.: 298. f. 154. 1883.— *Aspidium kunstleri* Bedd., Handb. Suppl.: 44. 1892. Figure 34. 2.

Rhizome short, erect, about 1 cm diam., densely scaly; scales stiff, linear-subtriangular, up to 15 by 1.5 mm, ferrugineous at margin but subentire in age, brown. *Stipe* dark stramineous to castaneous, pubescent throughout, up to 50 cm long. *Lamina* about 40 by 30 cm, pinnate; rachis bearing short articulated hairs; lateral pinnae 4—7 pairs; basal pinna asymmetrically subtriangular, shortly stalked, lobed about $\frac{1}{3}$ way to costa at upper edge, bearing a long basal lobe 13 by 2.5 cm and some additional smaller lobes about 20 cm long; middle pinnae narrowly elliptic, shortly stalked or upper ones sessile and adnate, rounded to cuneate at base, shortly caudate-acuminate at apex, subentire to lobed about $\frac{1}{3}$ way to costa, 12—17 by 3.5 cm; apical pinna deltoid, deeply lobed, about 18 cm long and wide; firmly herbaceous, glabrous; costa and lateral main veins raised below, veins forming anastomoses with many included veinlets (venatio sagenioides), dark and distinct on both surfaces. *Sori* round or elongate, usually terminal on free veinlets but often on anastomosing veins also, irregularly scattered on the lower surface of frond; indusia not seen on Thai plants, small and caducous in Malesian plant.

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

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

E c o l o g y.— Terrestrial near streams in forests near sea level.

N o t e.— HOLTTUM in Dansk Bot. Ark. 23 : 240. 1965, identified a specimen from SOUTH-WESTERN : Kanchanaburi (Song Tho) as *Tectaria yunnanensis* (Bak.) Ching, Sinensia 2 : 24. pl. 6. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 413. 1941. The specimen is a unicate of sterile frond and we are not confident in recording this species for Flora of Thailand until we have more complete specimens.

9. Tectaria crenata Cav., Fl. Descr. Pl.: 250. 1802; Tard & C. Chr. in Fl. Gén. I.-C. 7(2): 407. 1941; Holtt., Rev. Fl. Malaya 2 : 510. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 98. 1967.— *Aspidium repandum* Willd., Sp. Pl. 5 : 216. 1810; Bedd., Handb. Suppl.: 46. 1892.— *Aspidium pachyphyllum* Kunze, Bot. Zeit. 1848 : 259; Bedd., Handb. Suppl.: 46. 1892.

Rhizome short, erect, densely covered with scales at apex; scales up to 13 by 1.5 mm, linear-subtriangular, dark brown, stiff, entire at margin. *Stipe* about 60 cm long, stramineous, densely scaly at base, glabrescent upwards. *Lamina* pinnate, broadly oblong, about 70 by 45 cm; rachis very sparsely minutely scaly, winged at upper part; lateral pinnae 8–9 pairs, basal pinnae the largest, oblong-lanceolate, each with a large basal lobe, about 25 by 4.5 cm, lobes caudate at apex, subentire or undulate, up to 16 by 3.5 cm, middle pinnae oblong-lanceolate, caudate at apex, gradually narrowing towards base, sessile and very slightly decurrent at base, irregularly crenulate at margin, about 23 by 4 cm, herbaceous, green on upper surface, paler beneath, glabrous; costa raised beneath, glabrous, main veins distinct, 7–9 mm apart, veinlets reticulate to form irregular anastomoses with included free veinlets. *Sori* terminal on included free veinlets, one for each areole, in two rows between adjacent main veins; receptacle a little elongate; indusia naked, persistent.

T h a i l a n d.— SOUTH-EASTERN : Trat (Ko Chang); PENINSULAR : Surat Thani (Khao Nong), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

D i s t r i b u t i o n.— Malesia and Polynesia extending north to N. Vietnam (type from Mariana Islands).

E c o l o g y.— On mountain slopes in dense forests at low to medium altitudes.

10. Tectaria decurrens (Presl) Copel. in Elm., Leafl. Philip. Bot. 1 : 234. 1907; Ching, Sinensia 2 : 22. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 406. 1941; Holtt., Dansk Bot. Ark. 23 : 242. 1965; Rev. Fl. Malaya ed. 2.2 : 635. 1968; Tagawa & K. Iwats., Southeast As. St. 5 : 99. 1967.— *Aspidium decurrens* Presl, Rel. Haenk. 1 : 28. 1825; Bedd., Handb.: 219. f. 113. 1883.

Rhizome short, erect, densely scaly; scales brown, stiff, with paler ferrugineous margins, up to 13 by 2 mm. *Stipe* up to 60 cm long, scaly on lower part, glabrescent above, winged nearly to the base. *Lamina* pinnate, oblong in outline, up to 50 by 30 cm; rachis winged throughout; lateral pinnae 3–6 pairs, the basal ones ascending, lanceolate, caudate at apex, subentire or crenulate, gradually narrowing towards base, each bearing a large basal acroscopic lobe, lanceolate, subentire, caudate at apex, up to 15 by 3 cm; upper pinnae lanceolate, caudate at apex, gradually narrowing towards base and decurrent to the wings of rachis, up to 25 by 3 cm in fertile and 5 cm broad in sterile ones, subentire or shallowly crenulate, apical pinna broader; papyraceous, deep green, glabrous on both surfaces; costa and main veins raised beneath, veinlets forming areoles, cross-veins not so distinct. *Sori* rather close to main veins, two rows between adjacent main veins; indusia up to 1.2 mm diam., persistent, glabrous.

Thailand.— NORTHERN : Chiang Rai, Chiang Mai (Tin Tok), Phrae (Mae Sai), Nan (Pha Sing), Phitsanulok (Thung Salaeng Luang); SOUTH-WESTERN : Kanchanaburi (Kroeng Krawia); PENINSULAR : Surat Thani (King Phanom), Krabi (Bu Phram).

Distribution.— Sikkim and SE. Asia generally (type from Philippines), east to Polynesia, north to Taiwan and the Ryukyus.

Ecology.— On mountain slopes usually in dense forests at medium altitudes.

11. Tectaria angulata (Willd.) C. Chr., Ind. Fil. Suppl. 3 : 177. 1934; Holtt., Rev. Fl. Malaya 2 : 511. f. 301. 1955; Tagawa & K. Iwats., Southeast As. St. 3(3): 86. 1965; Acta Phytotax. Geobot. 23 : 55. 1968.— *Polypodium angulatum* Willd., Sp. Pl. 5 : 185. 1810.— *Aspidium angulatum* (Willd.) J. Smith ex Mett., Ann. Lugd. Bat. 1 : 239. 1864; Bedd., Handb. Suppl.: 45. 1892. Figure 34. 3.

Rhizome short, creeping or ascending; scales linear-subtriangular, up to 20 by 1.8 mm, stiff, dark brown, entire. *Stipe* castaneous, or nearly black, more or less polished, densely scaly at lower part, glabrescent upwards, up to 50 cm long. *Lamina* pinnate, oblong-ovate to oblong, up to 50 by 40 cm; rachis pubescent on upper surface, glabrous beneath, castaneous; lateral pinnae 2–6 pairs, ascending, oblong, caudate at apex, rounded at base, entire, shortly stalked or sessile, up to 20 by 9 cm; basal pinnae bearing a single basiscopic lobe; terminal pinna larger, oblong-subdeltoid, caudately acuminate at apex, up to 23 by 12 cm; softly papyraceous, green, brown in dried condition, glabrous on both laminar surface; costa castaneous to paler, pubescent on upper surface, hirsute or glabrescent beneath, main veins raised beneath, glabrous; veins distinct on lower surface, reticulate to form fine anastomoses with main areoles and smaller ones, included free veinlets numerous, glabrous. *Sori* on included free veins, round, small, up to 1 mm diam., irregularly scattered on lower surface; indusia small, caducous.

Thailand.—NORTHERN : Lampang; PENINSULAR : Phuket (Khao Pok), Trang (Khao Chong), Satun, Yala (Bannang Sata, Betong).

Distribution.— Malesia (type from Java).

Ecology.— On rather dry ground in evergreen forests at low altitudes.

Vernacular.— Kut kaeo (กูดแก้ว), kut taem (กูดแต้ม) (Northern).

12. Tectaria rockii C. Chr., Contr. U.S. Nat. Herb. 26 : 331. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 420. 1941; Holtt., Dansk Bot. Ark. 23 : 238. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 98. 1967.— *Tectaria burmanica* Ching, Sinensia 2 : 31. pl. 12. 1931.

Rhizome short, ascending, densely scaly; scales stiff, dark brown to nearly black, entire, linear-subtriangular, up to 17 by 1.5 mm. *Stipe* up to 80 cm long, castaneous to brown, scaly near base, minutely puberulous throughout. *Lamina* broadly deltoid, about 50 cm long and wide, bipinnate at base; rachis densely puberulous; lateral pinnae 3–5 pairs, basal pinnae much the largest, up to 40 by 30 cm, asymmetrically subdeltoid, deeply lobed or pinnate near base; terminal pinna subtriangular, acuminate at apex, cuneate at base, lobed; pinna-rachis and costa densely puberulous on upper surface, hairy beneath; basiscopic pinnule of basal pinna larger, shortly stalked or sessile, crenate to lobed, up to 23 by 6 cm; lobes of other pinnae rounded to acute at apex, entire; herbaceous or thicker, deep green, paler beneath; veins sparsely hairy, raised beneath, forming irregular areoles with numerous included free veinlets. *Sori* dispersed on lower surface or sometimes confined to lobes, on reticulate veins, round, about 1.5 mm diam.; indusia more or less persistent, minutely hairy or glabrescent.

Thailand.— NORTHERN : Chiang Rai (Doi Tung), Chiang Mai (Pong Pho, Doi Suthep, Doi Chiang Dao), Tak (Doi Musoe, Tak to Mae Sot, type); NORTH-EASTERN : Loei (Phu Luang); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); SOUTH-WESTERN : Kanchanaburi (Erawan Falls, Sai Yok).

Distribution.— Burma and Indochina.

Ecology.— On mountain slopes in dense forests at 400–1200 m alt.

Vernacular.— Kachot raet (กะฉอดแรด) (South-western).

13. Tectaria simonsii (Bak.) Ching, Sinensia 2 : 32. pl. 13. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 421. 1941; Tagawa & K. Iwats., Southeast As. St. 5 : 98. 1967.— *Nephrodium simonsii* Bak., Syn. Fil.: 504. 1874.— *Aspidium simonsii* (Bak.) Bedd., Ferns Br. Ind. Suppl.: 15. t. 367. 1876; Handb.: 218. 1883.— *Aspidium longicrure* Christ, Bull. Géogr. Bot. Mans. 1909. Mém. xx : 169; Hu & Ching, Ic. Fil. 1 : t. 7. 1930. Figure 35. 1–3.

Rhizome short, ascending, scaly at apex; scales linear-subtriangular, up to 15 by 1.3 mm, dark brown to nearly black, stiff, entire. *Stipe* 40–60 cm long, dark purple to nearly black, more or less polished, minutely pubescent throughout.

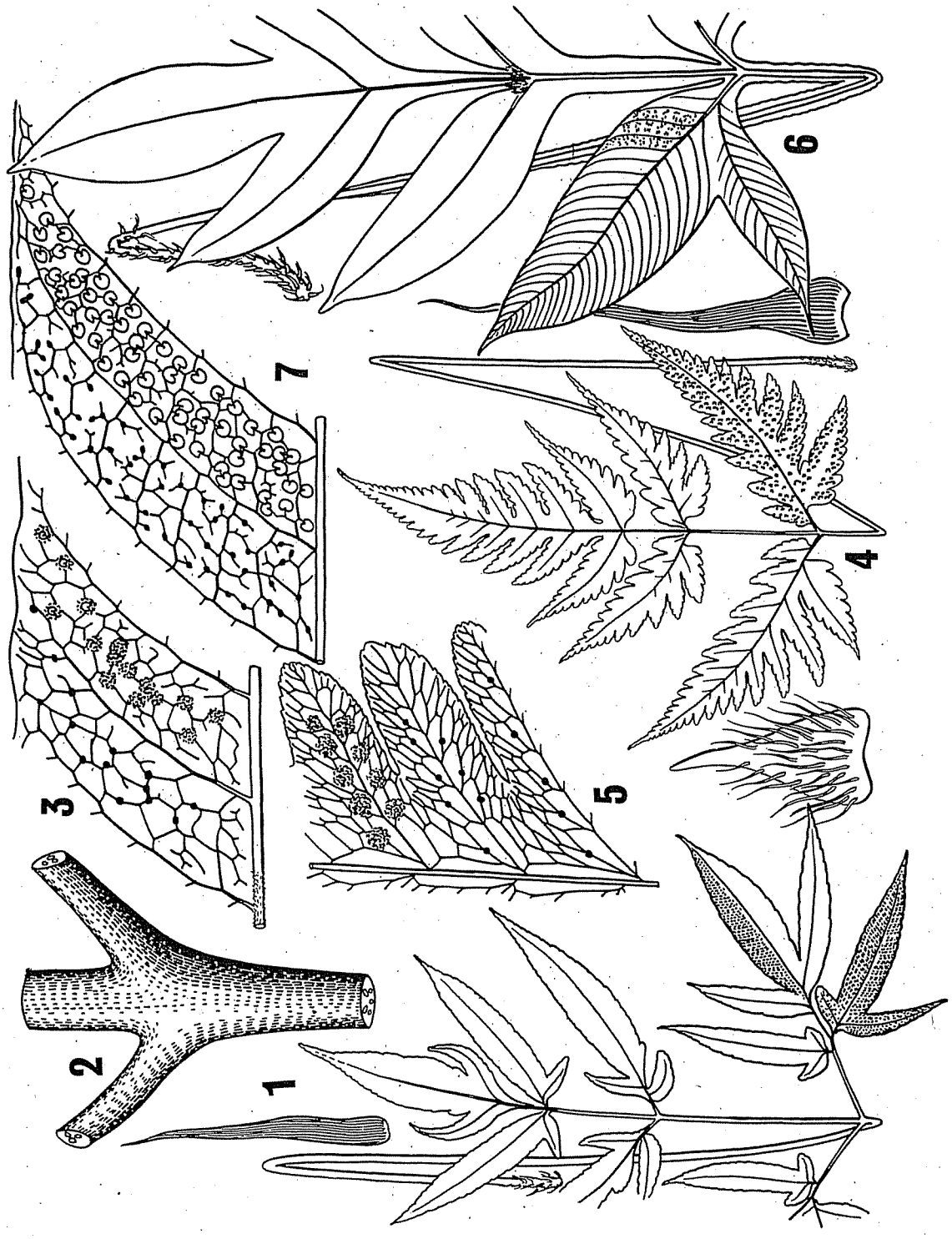


Figure 35. 1 – 3: *Tectaria simonsii*; 1. smaller frond, leaflet rather stenophyllous than typical one, (x 0.25) and scales on stipe base (x 4); 2. rachis and basal part of costae, x 5, hairs omitted; 3. part of pinna, showing venation and sori, x 2. 4 – 5: *T. tenerifrons*; 4. frond (x 0.25) and hairy scale on stipe base (x 20); 5. lobes enlarged, showing venation and sori, x 2. 6 – 7: *T. fauriei*; 6. frond with gemmae (x 0.25) and scales on stipe base (x 4); 7. part of pinna enlarged, showing venation, indusia and soral portion, x 2.

Lamina subpentagonal, bipinnate to tripinnatifid, 30—40 by 25—40 cm; lateral pinnae 2—4 pairs, basal pinnae up to 25 cm long and wide, stalked, with a few free pinnules like the upper pinnae, which are stalked or sessile, oblanceolate, caudate at apex, rounded at base, up to 23 by 5 cm, with one or two lateral lobes, subentire or irregularly crenulate, apical pinna subdeltoid-lanceolate, broadest at base, lobed in lower part; thin, deep-green; costa of lower pinnae nearly black, pubescent, of upper pinnae like main veins paler, distinctly raised beneath, other veins slightly raised on both surfaces, glabrescent, forming copious anastomoses with many included free veinlets. *Sori* at apex or at junction of veinlets, irregularly arranged in 2—5 rows between main veins, round or often elongate and united to the next one, usually up to 0.8 mm diam.; indusia small, caducous.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok, Mae Lao), Chiang Mai (Pong Pho), Lampang, Phitsanulok (Thung Salaeng Luang); SOUTH-EASTERN : Chon Buri (Ang Chang Nam); SOUTH-WESTERN : Uthai Thani (Ban Rai).

D i s t r i b u t i o n.— Sikkim, India (Assam, type) to S. China, N. Vietnam, Taiwan and the Ryukyus.

E c o l o g y.— On mountain slopes in shady places at medium altitudes.

14. Tectaria laotica Tard. & C. Chr., Notul. Syst. 7 : 94. 1938; Fl. Gén. I.-C. 7(2): 408. f. 46, 1—2. 1941; Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 60. 1974.— *Tectaria* sp.: Holtt., Dansk Bot. Ark. 20 : 31. 1961.

Similar to *T. simonsii* and *T. amplifolia* in appearance, different from both of them in : stipe and rachis deep purplish, polished; dissection of fronds similar to that of *T. subtriphylla*; sori usually confined to near the very margin of leaflets, at apex of short lobes and terminal on the main veins.

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

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

E c o l o g y.— Only twice collected in evergreen forests at the top of Phu Kradueng.

15. Tectaria amplifolia (v.A.v.Ros.) C. Chr., Ind. Fil. Suppl. 3 : 176. 1934; Holtt., Rev. Fl. Malaya 2 : 515. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 56. 1968.— *Aspidium amplifolium* v.A.v.Ros., Bull. Jard. Bot. Buitenz. II. 11 : 2. 1913.— *Aspidium subtriphyllum* auct. non Wall. ex Hook.: Bedd., Handb.: 215. f. 216. 1883.

Rhizome short, ascending, scaly. *Stipe* brown to faintly castaneous, pubescent throughout, about 40 cm long; scales linear-subtriangular, about 8 by up to 1.8 mm, concolourous, dark brown, entire or with irregular protrusions at margin. *Frond* ovate-subtriangular, about 25 cm long and wide, bipinnate at base; rachis densely pubescent, shallowly grooved above; basal pinna trifoliate with stalks 2 cm

long; basiscopic pinnules larger, oblong with long-acuminate apex, falcate, subentire, unequally cuneate at base, 11 by 2.5 cm; acroscopic pinnules smaller, rounded with acute apex and rounded subadnate base, 2.5 by 1.3 cm; terminal pinnule elliptic with caudate apex, cuneate at base, subentire to undulate at margin with a few indistinct lobes in lower part, 13 by 3 cm; terminal pinna hastate, long-acuminate at apex, broadly cuneate at base, about 15 cm long, hairy at margin; midrib stramineous, pale castaneous above, densely pubescent; veins more or less visible, copiously anastomosing to form areoles with included veinlets. *Sori* round, on reticulate veins, in two nearly regular rows between adjacent main veins, up to 1.2 mm diam.; indusia thin, pale.

T h a i l a n d.— PENINSULAR : Chumphon (Bang Son), Yala (Bannang Sata).

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

E c o l o g y.— There is no record of the habitat except "on rocks".

N o t e.— The above description is taken from Thai plants which are referable to this species but much smaller and less dissected than the plants in Malaya. We have reached no conclusion at present on the problem whether this is conspecific with *T. subtriphylla* or not.

16. Tectaria tenerifrons (Hook.) Ching, Sinensia 2 : 34. 1931; Holtt., Dansk Bot. Ark. 23 : 239. 1965.— *Polypodium tenerifrons* Hook., Sp. Fil. 4 : 104. 1862.— *Dictyopteris tenerifrons* (Hook.) Bedd., Ferns Br. Ind.: t. 4. 1865; Handb.: 298. 1883. Figure 35. 4–5.

Rhizome short-creeping, fleshy, 2–5 mm diam., scaly; scales small, up to 1.2 mm long, brown, not very stiff. *Stipe* 20–30 cm long, stramineous, rather sparsely hairy upwards. *Lamina* pentagonal, bi- or tripinnatifid at base, up to 20 cm long and wide; rachis densely pubescent throughout, slender; free lateral pinnae 1 to 3 pairs; basal pinnae the largest, asymmetrically oblong-subdeltoid, falcate, rounded at stalked base, caudate, acuminate at apex, deeply lobed, up to 12 by 7 cm; upper free pinnae like the free pinnules of basal pinnae, sessile or decurrent, falcate, acute to acuminate at apex, rounded to broadly cuneate at base, apical pinna larger, oblong-subdeltoid, deeply lobed, caudate at apex; lobes oblong-subdeltoid, round to acute at apex, entire or crenulate; soft-herbaceous, light green, minutely hairy on both surfaces; costa and costules densely and minutely hairy, veins anastomosing with few free veinlets, hairy. *Sori* round to oblong, at junction usually along costal or costular areoles, up to 2 mm diam., without indusia.

T h a i l a n d.— NORTHERN : Chiang Mai (Fang, Doi Chiang Dao), Mae Hong Son, Lampang (Huai Thak), Nakhon Sawan; SOUTH-WESTERN : Kanchanaburi (Sai Yok, Tha Po, Thung Kang Yang Hills).

D i s t r i b u t i o n.— Burma (Moulmein, type).

E c o l o g y.— On mountain slopes in light shade in limestone areas at low altitudes less than 600 m.

N o t e.— This is another species restricted to the limestone areas where the dry and rainy seasons are distinct. The fleshy tuberous rhizome is one of the characters of plants in such habitats, and fronds are seen only in the rainy season. The similarity to *Ctenitis manilensis* in this rhizome structure, as well as in the thin delicate fronds may have an ecological background not indicating any phyletic affinity between them.

17. Tectaria ternifolia (v.A.v.Ros.) C. Chr., Ind. Fil. Suppl. 3 : 185. 1934; Holtt., Rev. Fl. Malaya 2 : 516. f. 303. 1955.— *Aspidium ternifolium* v.A.v.Ros., Bull. Jard. Bot. Buit. II. 11 : 3. 1913.

Rhizome short, ascending, scaly; scales narrow, linear-subtriangular, about 5 by 0.8 mm, entire or fimbriate when young, brown or darker. *Stipe* up to 30 cm long, stramineous or pale castaneous, pubescent throughout. *Lamina* trifoliate or quinquefoliate, the fertile soriferous ones more or less contracted; lateral leaflets very shortly stalked with gemmae at junction to rachis, ovate-oblong with rounded base and caudate-acuminate apex, about 12 by 5 cm, subentire or irregularly lobed; terminal leaflets simple or trilobed, cuneate to very broadly cuneate at base, subentire to shallowly lobed, up to 14 by 6 cm; rachis and raised underside of costa with short articulated hairs; lateral main veins raised below, hairy, veins forming copious areoles (*venatio drynariae*), with simple or branched included veinlets, visible on both surfaces, glabrous; texture softly papyraceous to herbaceous, glabrous on surfaces. *Sori* round to elongate, large, up to 1.5 mm diam., dorsal on anastomosing veins, two rows between adjacent main veins, sometimes confluent at maturity; indusia not seen.

T h a i l a n d.— PENINSULAR : Trang (Khao Phap Pha), Satun.

D i s t r i b u t i o n.— W. Malaysia (Perak, type and Pahang).

E c o l o g y.— On clayey ground at peak of hills near sea-level.

N o t e.— In appearance this is comparable with *T. ternata* of Sarawak resembling it in simple to quinquefoliate fronds with gemmae at junction of rachis and costa and with copiously reticulate drynarioid venation. With nearly entire margin of leaflets, larger reniform indusia, papyraceous texture, and wide-creeping thicker rhizome, however, *T. ternata* is close to the *T. polymorpha* group.

18. Tectaria polymorpha (Wall. ex Hook.) Copel., Phil. J. Sci. 2C : 413. 1907; C. Chr., Contr. U.S. Nat. Herb. 26 : 330. 1931; Ching, Sinensia 2 : 30. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 417. 1941, p.p.; Holtt., Dansk Bot. Ark. 20 : 31. 1961; 23 : 240. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 99. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.— *Aspidium polymorphum* Wall. ex Hook., Sp. Fil. 4 : 54. 1862; Bedd., Handb.: 218. 1883.

Rhizome short, ascending to suberect; scales linear-subtriangular, about 10 by 2 mm, brown, stiff, margined with pale thinner edges about 0.3 mm broad. *Stipe* stramineous to brown, densely pubescent on adaxial surface, glabrescent

beneath, 30–80 cm long. *Lamina* imparipinnate, ovate-oblong, 30–60 by 30–50 cm; rachis densely pubescent on upper surface, glabrescent beneath; lateral pinnae oblong-lanceolate, caudate at apex, cuneate to rounded at base, shortly stalked or sessile, broadest at $\frac{1}{3}$ way from apex; usually about 20 by 5 cm, or up to 30 by 10 cm, subentire, or rarely coarsely dentate, or each basal pinna sometimes with single large basiscopic lobe, terminal pinna a little larger, broadest at $\frac{2}{3}$ way from apex, up to 20 by 6–10 cm, papyraceous, green, glabrous; costa and main veins distinctly raised beneath, shortly pubescent, veins copiously anastomosing, main areoles distinct including two rows of smaller areoles with free included veinlets, all veinlets raised beneath, glabrous. *Sori* on cross veins or sometimes on included free veins, irregularly scattered on lower surface of pinnae, round, about 1 mm diam.; indusia small, fugacious, pubescent.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Suai, Mae Kok, Doi Phacho), Chiang Mai (Doi Chong, Tha Ton, Khun Khong Sang, Doi Chiang Dao, Mae Son to Huai Sai), Tak (Ban Na, Ban Musoe), Phitsanulok (Thung Salaeng Luang), Nakhon Sawan (Pa Ma Kham Pom); NORTH-EASTERN : Loei (Phu Luang, Sam Phai, Phu Kradueng); CENTRAL : Nakhon Nayok (Khao Yai), Saraburi (Muak Lek); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao, Khao Sabap, Takha Mao Falls); SOUTH-WESTERN : Kanchanaburi (Song Tho); PENINSULAR : Chumphon (Khao Tong), Surat Thani (Ban Don), Nakhon Si Thammarat (Chawang), Trang (Khao Chong), Yala (Bannang Sata).

D i s t r i b u t i o n.— E. Himalaya (type) to S. China and Taiwan, south to Sri Lanka and W. Malaysia.

E c o l o g y.— On mountain slopes usually in dry places in dense forests at low to medium altitudes up to 1400 m alt.

V e r n a c u l a r.— Kut kaeo (กูดแก้ว), kut taem (กูดแต้ม), kut kai (กูดไก่), kut hua lek (กูดหัวเหล็ก) (Northern); kut hok (กูดหก) (Shan/Northern); seng-khia-du (เซ็งเขี่ยดู่) (Karen/Northern).

19. Tectaria herpetocaulos Holtt., Dansk Bot. Ark. 23 : 241. 1965; Rev. Fl. Malaya ed. 2.2 : 636. 1968; Tagawa & K. Iwats., Southeast As. St. 5 : 99. 1967.

Similar to the preceding except in having long-creeping rhizome with remotely placed fronds and pinnae broadly rounded at base.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Mae Suai to Huai San), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Mae Ho, Doi Suthep), Lampang, Tak (Ban Musoe); NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng); EASTERN : Nakhon Ratchasima (Khao Yai); SOUTH-WESTERN : Kanchanaburi (Tham Nam, Sangkhla, Song Tho, Thung Kang Yang); PENINSULAR : Chumphon (Bang Son), Ranong (Lam Liang), Surat Thani (Ko Tao), Krabi (Bu Phram).

D i s t r i b u t i o n.— S. India, Burma, Indochina and W. Malaysia (type).

E c o l o g y.— On mountain slopes in dense forests at 500–1100 m alt.

20. Tectaria rumicifolia (Ridl.) C. Chr., Ind. Fil. Suppl. 3 : 184. 1934; Holtt., Rev. Fl. Malaya 2 : 519. 1955; Dansk Bot. Ark. 23 : 241. 1965.— *Leptochilus rumicifolius* Ridl., J. Mal. Br. Roy. As. Soc. 4 : 116. 1926.— *Tectaria polymorpha* var. *cuneifolia* Bonap., Not. Pterid. 14 : 50. 1923; Holtt., Rev. Fl. Malaya 2 : 518. f. 304. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 56. 1968.

Different from *T. polymorpha* only in narrowly cuneate base of lateral pinnae.

T h a i l a n d.— PENINSULAR : Yala (Betong).

D i s t r i b u t i o n.— W. Malaysia (type) and E. Malaysia (Sarawak).

21. Tectaria singaporeana (Wall. ex Hook. & Grev.) Ching, Sinensia 2 : 25. 1931; Holtt., Rev. Fl. Malaya 2 : 512. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 98. 1967.— *Aspidium singaporeanum* Wall. ex Hook. & Grev., Ic. Fil.: t. 26. 1827; Bedd., Handb.: 212. f. 107. 1883; Bonap., Not. Pterid. 14 : 50. 1923.

Rhizome short, ascending to suberect, bearing a tuft of fronds at apex, scaly; scales gradually narrowing from base towards apex, brown, thin but stiff, up to 7 by 1 mm, the margin ferrugineous or hairy. *Stipe* castaneous, more or less polished, up to 45 cm in fertile and 35 cm in sterile ones, scaly at base, appressed hairy upwards. *Lamina* simple, entire, broadly lanceolate, caudate-acuminate at apex, attenuate at base, up to 40 by 10 cm, the fertile ones usually narrower; papyraceous, green to deep green, glabrescent; rachis like the upper part of stipe, glabrescent, distinctly raised beneath; main veins raised beneath, venation copiously anastomosing with main areoles and smaller areoles bearing rarely branched included free veinlets. *Sori* usually dorsal on reticulate veinlets, two rows between adjacent cross veins and 4–5 rows between main veins, round, about 1.5 mm diam.; indusia small, glabrous.

T h a i l a n d.— PENINSULAR : Surat Thani (Ban Don), Krabi (Ko Lanta), Nakhon Si Thammarat (Thung Song, Chawang, Khao Luang), Trang (Khao Chong), Satun (Khlong Ton, Bukit Tingki), Narathiwat (Waeng), Yala (Bannang Sata).

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

E c o l o g y.— On mountain slopes often near streams in dense evergreen forests at low to medium altitudes lower than 900 m alt., fairly common.

V e r n a c u l a r.— Tan loi (ตานลอย) (Peninsular).

22. Tectaria vasta (Bl.) Copel., Phil. J. Sci. 2C : 411. 1907; Ching, Sinensia 2 : 26. 1931; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 416. 1941; Holtt., Rev. Fl. Malaya 2 : 512. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 98. 1967.— *Aspidium vastum* Bl., En. Pl. Jav.: 142. 1828; Bedd., Handb.: 212. f. 108. 1883.— *Aspidium tricuspe* Bedd., Handb. Suppl.: 44. 1892.

Rhizome short, suberect, densely covered with scales at apex; scales gradually narrowing from base towards apex, dark brown, stiff, entire, up to 16 by 1.7 mm.

Stipe about 20 cm below the basal lobe, broadly winged throughout, wings up to 1 cm broad on both sides, densely scaly at base, glabrescent upwards. *Lamina* up to 35 by 20 cm, simple or pinnatifid with lateral lobes; lateral lobes oblong with caudate apex, about 12 by 4 cm; simple lamina or terminal lobe oblanceolate to oblong, acute to acuminate at apex, narrowing towards base, up to 35 by 12 cm, almost entire at margin; rachis raised beneath, pubescent; main veins raised on both surfaces, cross-veins distinct, venation reticulate to form main areoles and smaller ones with simple or branched included veinlets. *Sori* on included veinlets or on anastomosing veins, in two rows between main veins; indusia glabrous, about 1 mm diam.

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

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 mountain slopes in dense evergreen forests at 400–800 m alt.

N o t e.— Thai specimens, as described above, are comparatively smaller than those from Malesia. Typically they are up to 80 by 40 cm, bearing fronds with several pairs of lobes which are decurrent at base and connect to each other. Plants from Northern Thailand referred to *T. vasta* belong to the following species, and those from North India require reexamination.

23. Tectaria fauriei Tagawa, J. Jap. Bot. 14 : 102. 1938; Tagawa & K. Iwats., Southeast As. St. 5 : 98. 1967. Figure 35. 6–7.

Rhizome short, ascending, densely scaly; scales linear-subtriangular, dark brown, stiff, up to 18 by 2 mm, entire. *Stipe* 30–60 cm long, winged in upper half or very narrowly nearly to the base, stramineous to brown, densely scaly at base, glabrescent upwards. *Lamina* simple to pinnatisect, up to 45 by 30 cm; rachis winged throughout but often separated at just above the lateral lobes, the wings 3–10 cm at each side, bearing gemmae at base of pinna; basal pinnae oblong with caudate apex and basal basiscopic lobe, up to 20 by 7 cm, subentire, the lobes falcate, oblong-subtriangular, caudate at apex, up to 12 cm long, upper pinnae oblanceolate or braodly lanceolate, caudate at apex, entire; the terminal pinna oblong-lanceolate, entire, gradually narrowing towards both apex and base or forming trifoliate pinna decurrent into apical pinna, up to 20 by 7 cm; herbaceous, green to deep green, glabrous; costa raised and hairy on lower surface, main veins raised beneath, cross-veins distinct, veins anastomosing to form main and smaller areoles with included free veinlets. *Sori* terminal on included free veinlets or on anastomosing veins, two irregular rows between cross-veins, round or elongate; indusia small, up to 0.8 mm diam., glabrous.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Len), Chiang Mai (Tin Tok), Lampang, Phitsanulok (Thung Salaeng Luang).

Distribution.— N. India and Burma, Taiwan (type), and the Ryukyus.

Ecology.— Terrestrial usually along streams in mixed or evergreen forests at medium altitudes.

Note.— This species is very close to the preceding and seems to be a northern derivative of the latter. Any one character is not sufficient to discriminate between these two species, although we can easily distinguish the northern plants from the peninsular by the combination of characters cited in the key to the species. Our Thai plants are smaller in size and have narrower pinnae, compared with the type collection.

24. Tectaria maingayi (Bak.) C. Chr., Ind. Fil. Suppl. 3 : 182. 1934; Holtt., Rev. Fl. Malaya 2 : 513. f. 302. 1955; Dansk Bot. Ark. 20 : 31. 1961; Tagawa & K. Iwats., Southeast As. St. 3(3): 86. 1965; 5 :99. 1967; Acta Phytotax. Geobot. 23 : 55. 1968.— *Gymnogramme maingayi* Bak., Syn. Fil.: 517. 1874.

Rhizome short, erect, scaly; scales gradually narrowing from base towards apex, stiff, with ferrugineous paler edges, dark brown, bearing long coarse hairs, up to 10 by 1.7 mm. *Stipe* 15—60 cm long, dark stramineous to brown, densely scaly at base, glabrescent upwards. *Lamina* simple to imparipinnate with 1—3 pairs of free pinnae, up to 45 by 35 cm, the fertile lamina narrower; rachis like the upper part of stipe, glabrous; lateral pinnae oblong-ovate, gradually narrowing towards caudate apex, cuneate at sessile base, entire, up to 30 by 9 cm, rarely bearing basal basiscopic lobes, those of fertile ones smaller, usually up to 12 by 3.5 cm, the terminal pinna oblong, up to 30 by 12 cm; softly papyraceous, green, glabrous; costa and main veins raised beneath, cross-veins less distinct, veins anastomosing to form main areoles and smaller ones with included veinlets. *Sori* exindusiate, round or more or less elongate along reticulate veins, confluent, sometimes covering the whole undersurface of pinnae.

Thailand.— PENINSULAR : Surat Thani (Ban Don), Phangnga (Takua Pa), Phuket (Khao Phara, Khao Ao Kuang, Ko Talibong), Nakhon Si Thammarat (Khao Luang, Chawang), Trang (Khao Chong), Narathiwat (Waeng), Yala (Bannang Sata).

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

Ecology.— On mountain slopes in dense evergreen forests at low and medium altitudes.

25. Tectaria gymnosora Holtt., Dansk Bot. Ark. 23 : 308. 1966; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25 : 21. 1971.— *Hemigramma decurrens* auct. non (Hook.) Copel.: ? Tagawa & K. Iwats., Southeast As. St. 5 : 99. 1967.

Rhizome short, ascending, scaly near apex; scales brown with paler ferrugineous margin, up to 12 by 1.5 mm. *Stipe* about 50 cm long, castaneous to fuscous, scaly near base, pubescent on upper surface, very narrowly winged in upper part.

Lamina up to 45 cm long, with one or two pairs of lateral pinnae each with a large basiscopic lobe, the other lateral pinnae, if any, simple, oblanceolate, caudate at apex, subentire, more or less falcate, the basiscopic lobe of the basal pinna similar in shape to the lateral pinnae but smaller; terminal pinnae with three lobes, the central much the largest, all similar in shape to the lateral pinnae but different in size, the size of lateral pinnae about 13–18 by 2.5–4 cm, that of basiscopic lobes of basal pinnae up to 20 by 2.5 cm, that of apical lobe of terminal pinnae up to 25 by 5 cm, that of lateral lobe of terminal pinnae up to 18 by 4 cm; thinly papyraceous, glabrous; main veins in zig-zag curve, raised beneath, venation drynarioid (anastomosing with included areolae having free veinlets inside). *Sori* on anastomosing veins, exindusiate.

T h a i l a n d.— NORTHERN : Phitsanulok (Salaeng Haeng, type); CENTRAL : Nakhon Nayok (Khao Yai).

D i s t r i b u t i o n.— Endemic.

E c o l o g y.— Terrestrial near streams in evergreen forests, 700–800 m alt.

11. QUERCIFILIX

Copel., Phil. J. Sci. 37 : 408. 1928; Gen. Fil.: 132. 1947.

Like *Tectaria* but differs in : frond dimorphic, sterile frond trifoliate, apical lamina broadly and shallowly lobed, lateral lobes small and nearly circular; fertile frond trifoliate, covered with sporangia on the whole under surface; articulated hairs on frond longer, 1–1.5 mm in length, thin but straight, consisting of several cells with brown septae and thin transparent cell walls.

The generic status of *Quercifilix* is still not clear, although in practice it is discriminated from its close relative, *Tectaria,* by dimorphic fronds with acrostichoid fertile pinnae. However, dimorphism is observed among species of *Tectaria* in various degree, a continuous series of intermediate forms leading to such an extreme form as *T. maingayi.* Some authors think this genus is of hybrid origin. It is here treated as monotypic following recent accounts.

Quercifilix zeylanica (Houtt.) Copel., Phil. J. Sci. 37 : 409. 1928; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 440. f. 48. 3–4. 1941; Holtt., Rev. Fl. Malaya 2 : 528. f. 310. 1955; Dansk Bot. Ark. 20 : 31. 1961; Tagawa & K. Iwats., Southeast As. St. 5 : 100. 1967.— *Ophioglossum zeylanicum* Houtt., Nat. Hist. 14 : 43. 1783.— *Tectaria zeylanica* (Houtt.) Sledge, Kew Bull. 27 : 422. 1972.— *Acrostichum quercifolium* Retz., Obs. Bot. 6 : 39. 1791.— *Gymnopteris quercifolia* (Retz.) Bernh., Schrad., neu. J. 1(2): 20. 1806; Bedd., Handb.: 432. f. 262. 1883. Figure 36. 4–8.

Rhizome short, creeping or ascending, bearing a few sterile fronds in rosette and usually an erect fertile frond; scales up to 5 by 0.2 mm, the base dilated to 1

mm wide, membranous, dark brown, toothed at margin. *Frond* dimorphic. *Sterile frond* usually in rosette, not erect; stipe 4—8 cm long, stramineous, densely scaly at base, densely hairy throughout with long, paler or yellowish, warty hairs; lamina pinnatifid to trifoliate, up to 10 by 5 cm; lateral pinnae asymmetrically oblong-subdeltoid to nearly circular, rounded at apex, broadly cuneate to cordate at base, sessile, up to 3 by 2 cm, subentire or slightly undulate at margin, sometimes bearing auricles at basiscopic base, up to 7 mm long and wide; terminal pinnae oblong, rounded at apex cuneate to broadly so at base, lobed at margin to $\frac{1}{3}$ way towards costa, up to 7 by 4.5 cm, the lobes rounded-subdeltoid, 0.7 by 1.5 cm, entire; herbaceous, green, hairy on undersurface and at margin; veins anastomosing forming copious areoles, hairy beneath. *Fertile frond* erect; stipe up to 25 cm long, slender, very sparsely scaly or glabrescent; lamina trifoliate, lateral pinnae sometimes with short basiscopic lobes, up to 5 cm long; pinnae up to 2.5 mm broad; sporangia covering the whole under surface of pinnae except for edges.

T h a i l a n d.— NORTHERN : Lampang (Mae Long), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN : Loei (Phu Luang), Phetchabun (Nam Nao); EASTERN : Chaiyaphum (Phu Khieo); CENTRAL : Saraburi (Muak Lek); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); SOUTH-WESTERN : Prachuap Khiri Khan.

. D i s t r i b u t i o n.— Mauritius, Sri Lanka (type), S. China, Indochina, Taiwan, Borneo, and on Pulau Tioman off W. Malaysia.

E c o l o g y.— On muddy rocks in mixed or evergreen forests at altitudes lower than 500 m.

12. PLEOCNEMIA

Presl, Tent. Pterid.: 182. pl. 7. f. 12. 1836; Holtt., Reinwardtia 1 : 171. 1951; Kew Bull. 29 : 345. 1974.— *Arcypteris* Underw., Bull. Torrey Bot. Club 30 : 678. 1903; Holtt., Reinwardtia 1 : 191. 1951.— *Tectaria* Cav., Ann. Hist. Nat. 1 : 115. 1799, p.p.; Copel., Gen. Fil.: 128. 1947, p.p.

Rhizome short, massive, erect, scaly; scales very narrow, long, margins with short subpatent teeth, often twisted; lamina bipinnate-tripinnatifid, basal basiscopic pinnules of basal pinnae much enlarged; sinus-teeth present at bottom of sinus between two lobes; veins anastomosing to form costal, and sometimes also costular, areoles; hairs multicellular, short, coarse; glandular hairs on costa and veins beneath usually yellow, cylindrical; sori not terminal, on free or anastomosing veins, round, indusiate or exindusiate, paraphyses with large cylindrical yellow glandular apical cells.

This genus is united with *Tectaria* by such authors as TARDIEU-BLOT & CHRISTENSEN (1941) and COPELAND (1947), but segregated from the latter and revised by HOLTTUM (1951), who combined this with *Arcypteris* in 1974. He enumerated nineteen species in the regions from Burma and S. China through Malesia to the Pacific, including three species from Thailand.

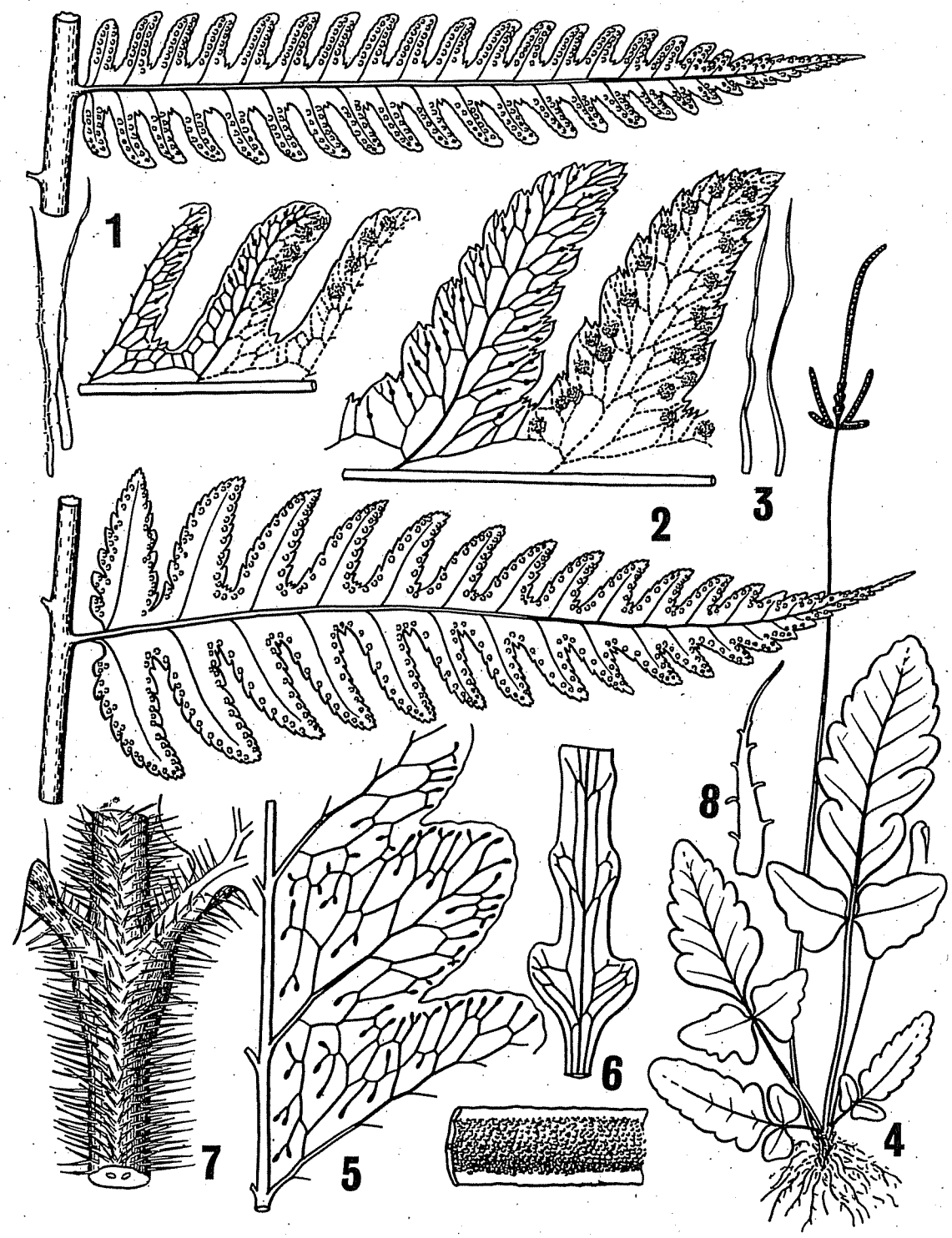


Figure 36. 1: *Pleocnemia hemiteliiformis*; large pinnule (above, x 1.25), lobes enlarged (below right, x 3) and scales (left, x 2; right, natural size). 2–3: *P. submembranacea*; 2. large pinnule (below, x 1.25) and lobes enlarged (above, x 3); 3. scales on stipe base, x 2.5. 4–8: *Quercifilix zeylanica*; 4. plant, x 0.5; 5. lobes of sterile frond, showing venation, x 2.5, hairs omitted; 6. part of fertile frond, showing venation after removing sporangia (above) and cluster of sporangia (below) hairs omitted, both x 4; 7. rachis and basal part of pinnae, x 10; 8. scale on stipe base, x 10.

KEY TO THE SPECIES

1. Frond amply bipinnate; veins anastomosing in costal and costular areoles only, or rarely with one more row of areoles
2. Base of pinnules not widened; no glands on sporangia **1. P. hemiteliiformis**
2. Base of pinnules conspicuously widened; glands present on sporangia **2. P. submembranacea**
1. Frond bipinnatifid; veins copiously anastomosing to form areoles other than costal and costular ones **3. P. irregularis**

1. Pleocnemia hemiteliiformis (Racib.) Holtt., Reinwardtia 1 : 179. f. 11. 1951; Rev. Fl. Malaya 2 : 536. f. 316. 1955; Kew Bull. 29 : 354. 1974; Tagawa & K. Iwats., Southeast As. St. 5 : 100. 1967.— *Pleocnemia leuzeana* var. *hemiteliaeformis* Racib., Fl. Buitenz. 1 : 194. 1898. Figure 36. 1.

Rhizome thick, erect, scaly; scales up to 50 by 3 mm, brown, herbaceous, toothed at margin in upper part. *Stipe* up to 50 cm long, densely scaly at base, pubescent upwards, stramineous, scales narrower. *Lamina* about 1 m long, tripinnatifid; pinnae lanceolate, about 70 by 20 cm, stalked; rachis and pinna-rachis grooved on upper surface, densely pubescent; pinnules lanceolate, caudate at abex, shortly stalked or sessile, the base hardly or slightly narrowing, about 10 by 2 cm in larger ones; lobed almost to costa or sometimes pinnate; segments oblong, rounded or moderately acute at apex, subentire or serrate at margin, 7–13 by up to 4 mm; papyraceous, deep green, brownish in dried specimens, sparsely hairy beneath; costa and midrib raised on upper surface, more or less hairy, veins anastomosing to form costal and costular areoles, or sometimes with one more row or areoles formed outside the costular ones, the other veins free, pubescent or glandular beneath. *Sori* dorsal on veins, a single row at each side of midrib, medial, naked.

T h a i l a n d.—PENINSULAR : Phangnga (Khao Kratha Khwam), Nakhon Si Thammarat (Khao Luang), Yala (Ban Chana).

D i s t r i b u t i o n.— Sumatra, W. Malaysia, Java (type) and Celebes.

E c o l o g y.— On mountain slopes in dense forests at medium altitudes.

2. Pleocnemia submembranacea (Hayata) Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 61. 1974.— *Aspidium submembranaceum* Hayata, Ic. Pl. Formos. 4 : 188. f. 126. 1914.— *Pleocnemia winitii* Holtt., Reinwardtia 1 : 181. 1951; Kew Bull. 29 : 354. 1974; Tagawa & K. Iwats., Southeast As. St. 5 : 100. 1967.— *Tectaria leuzeana* auct. non (Gaud.) Copel.: Bedd., Handb.: 228. 1883, p.p.; C. Chr., Contr. U.S. Nat. Herb. 26 : 331. 1931. Figure 36. 2–3.

Rhizome thick, short, erect, scaly near apex; scales about 20 by 1 mm, dark brown, more or less crisped, entire or irregularly toothed at margin. *Stipe* castaneous and densely scaly at base, stramineous, pubescent or glabrescent upwards. *Lamina* more than 1 m long, tripinnatifid; pinnae asymmetrically oblong-subdeltoid to oblong-lanceolate, acuminate at apex; rachis and pinna-rachis pubescent on upper surface; basal basiscopic pinnules of lower pinnae sometimes enlarged, pinnate

with deeply lobed secondary pinnules; the other pinnules subtriangular, widest at base, gradually narrowing towards caudate apex, commonly about 10 by 3.5 cm, stalked, lobed to $\frac{4}{5}$ way towards costule, the lower segments sometimes free; segments oblong-subdeltoid, moderately acute at apex, more or less serrate at margin; chartaceous, green, brownish in dried specimens; veins anastomosing forming costal and costular areoles, or with one more row of areoles outside the costular ones, sparsely hairy beneath. *Sori* dorsal on veins, in one to two rather irregular rows at each side of midrib, naked; sporangia with glands.

T h a i l a n d.—NORTHERN : Chiang Rai (Mae Kok, Mae Suai to Huai San), Chiang Mai (Ban Du and Ban Mae Khi), Lampang, Phitsanulok (Thung Salaeng Luang).

D i s t r i b u t i o n.— N. India, Burma, Indochina, China (Hainan, Hong Kong) and Taiwan (type).

E c o l o g y.— On humus-rich mountain slopes usually near streams in dense forests at medium altitudes.

V e r n a c u l a r.— Kut dam (กูดดำ) (Northern); maha sadam khao (มหาสะดำเขา) (Central).

3. Pleocnemia irregularis (Presl) Holtt., Kew Bull. 29 : 347. 1974.— *Polypodium irregulare* Presl, Rel. Haenk. 1 : 21. 1825.— *Arcypteris irregularis* (Presl) Holtt., Reinwardtia 1 : 193. f. 1–3. 1951; Rev. Fl. Malaya 2 : 538. f. 317–318. 1955; Dansk Bot. Ark. 20 : 31. 1961; Tagawa & K. Iwats., Southeast As. St. 3(3): 86. 1965; 5 : 101. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.

Rhizome thick, suberect, short, densely scaly; scales linear, up to 30 by 2 mm, dark brown, thin and more or less crisped, entire or irregularly toothed at margin. *Stipe* up to 80 cm long, dark and scaly at base, stramineous upwards. *Lamina* bipinnate at base, oblong-subdeltoid, usually more than 1 m long, 70 cm wide at base; basal pinnae the largest, asymmetrically subdeltoid with large basiscopic pinnules, middle pinnae oblong-lanceolate, acute to acuminate at apex, shortly stalked, with several free pinnules, apical portion large, pinnatifid; rachis and pinna-rachis glabrescent; pinnules sessile or more or less adnate, oblong-subdeltoid, falcate, caudate at apex, cuneate at base, waved at margin, usually about 10 by 1.7 cm; chartaceous, green to yellow green, brownish in dried specimens, glandular hairy at margin and on lower surface; veins forming copious anastomoses, a distinct broad tooth at each sinus between pinnules and between crenae of pinnules. *Sori* small, dorsal on anastomosing veins, scattered irregularly; exindusiate.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Chiang Dao), Phitsanulok (Thung Salaeng Luang); CENTRAL : Nakhon Nayok (Salika Falls, Khao Yai); SOUTH-EASTERN : Chon Buri (Ang Chang Nam), Chanthaburi (Khlung, Khao Soi Dao), Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Khao Ngi Yai); PENINSULAR : Chumphon (Khao Tong), Ranong (Thap Li, Lam Liang, Khlong Kam Phuan), Surat

Thani (Ban Don), Phuket (Tha Nun), Phangnga (Khlong Nang Yon), Nakhon Si Thammarat (Thung Song, Khao Luang, Ron Phibun), Trang (Khao Chong), Satun, Pattani, Narathiwat (Waeng), Yala (Bannang Sata).

Distribution.— Burma (Tenasserim), Cambodia, Malesia throughout (type from Philippines) to Fiji.

Ecology.— On rather dry slopes in dense forests at low or medium altitudes.

13. PTERIDRYS

(C. Chr.) C. Chr. & Ching, Bull. Fan Mem. Inst. Biol. 5 : 125. 1935; Copel., Gen. Fil.: 126. 1947.— *Lastrea* § *Pteridrys* C. Chr., Gard. Bull. S.S. 7 : 243. 1934.

Rhizome short, ascending or erect, scaly; scales narrow, concolorous brown to darker, usually entire; stipe scaly or glabrescent. Lamina oblong in outline, bipinnatifid with distinct, pinnatisect apical pinnae; lateral pinnae narrowly elliptic, basal basiscopic pinnules not distinctly larger; chartaceous, dark green or deep glass-green above and paler beneath, glabrous; rachis grooved, hairy below with septate multicellular hairs; venation campteroid, i.e. basiscopic branch of anterior basal vein meeting at sinus with that of posterior basal vein of next segment but never actually uniting, basal veins sometimes springing directly from costa; a prominent deltoid tooth at each sinus between adjacent pinnules. *Sori* round, dorsal or terminal on short acroscopic branch of veins, one row at each side of costule; indusia round-reniform.

As indicated in the name, this genus is similar to *Pteris* in venation and frond construction as well as the general habit, and to *Dryopteris* in anatomical and soral characters. The presence of prominent sinus teeth is a common feature of *Bolbitis*. Recent pteridologists consider this to be a genus of Tectarioid affinity, though the trichomes of *Pteridrys* do not accord well with the Tectarioids. Some seven species are credited to this genus, and three among them are native to Thailand.

KEY TO THE SPECIES

1. Pinnae distinctly stalked, petioles of lower pinna about 1 cm long
   2. Frond less than 1 m long; pinnae usually 5 – 12 pairs — **1. P. syrmatica**
   2. Frond usually more than 1.5 m long; pinnae usually more than 20 pairs — **2. P. cnemidaria**
1. Pinnae sessile — **3. P. australis**

1. Pteridrys syrmatica (Willd.) C. Chr. & Ching, Bull. Fan Mem. Inst. Biol. 5 : 131. pl. 11, 17. 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 302. 1941; Holtt., Rev. Fl. Malaya 2 : 530. f. 311, 312. 1955; Seidenf., Nat. Hist. Bull. Siam Soc. 19 : 87. 1958; Tagawa & K. Iwats., Southeast As. St. 3(3): 86. 1965; 5 : 100. 1967.—

Aspidium syrmaticum Willd., Sp Pl. 5 : 237. 1810.— *Lastrea syrmatica* (Willd.) Moore, Ind. Fil. : 105. 1858; Bedd., Handb.: 243. f. 124. 1883; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8 : 5. 1929.

Rhizome short, creeping or ascending; scales lanceolate, rounded or cordate at base, tailed at apex, up to 8 by 1.2 mm, dark brown, rather thick hairy at margin. *Stipe* up to 50 cm long, stramineous to pale castaneous, scaly at base, glabrescent above. *Lamina* oblong to oblong-lanceolate, pinnate with deeply lobed pinnae, 30–50 by 15–30 cm; rachis glabrescent, pale stramineous to deep brown; lateral pinnae 5–12 pairs, ascending, petioles of basal pinnae 1–1.5 cm long, lanceolate, subtruncate to broadly cuneate at base, up to 20 by 4 cm, deeply lobed to $\frac{4}{5}$ way towards costule; lobes oblong, oblique, rounded at apex, serrate at margin, up to 17 by 7 mm; papyraceous, deep green, glabrous; costules pale, glabrous, raised on both surfaces; veins pinnate, the basal basiscopic veinlets springing directly from costa, veinlets forked, acroscopic branches stopped at midway, basiscopic branches running into the projections at margin, and a branch into sinus-teeth. *Sori* apical or subapical at acroscopic branches of veinlets, thus medial, round; indusia reniform, glabrous.

T h a i l a n d.— NORTHERN : Chiang Mai (Tin Tok); SOUTH-WESTERN : Prachuap Khiri Khan (Khao Luang, Bang Saphan); PENINSULAR : Surat Thani (Ko Samui, Khao Hua Khwai, Ban Kop Kaep, Ko Tao), Phangnga, Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun (Ko Chong Lat, Ko Lanta Yai), Yala (Ban Wiang, Ban Chana).

D i s t r i b u t i o n.— Sri Lanka, Cochinchina and Malesia, east to Celebes and the Philippines.

E c o l o g y.— On humus-rich ground in dense evergreen forests at altitudes lower than 600 m.

V e r n a c u l a r.— Kut kham (กูดคำ), di ngu wa (ดีงูหว้า) (Northern); neraphusi thet (เนระพูสีเทศ) (Central).

2. Pteridrys cnemidaria (Christ) C. Chr. & Ching, Bull. Fan Mem. Inst. Biol. 5 : 136. pl. 12, 18(8–9), 20(19). 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 304. 1941; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 116. 1968.— *Dryopteris cnemidaria* Christ, Bull. Acad. Geogr. Bot. 1910 : 140. Figure 37. 1–3.

Rhizome short-creeping, thick, scaly near apex; scales brown, linear-lanceolate, up to 20 by 1.3 mm, entire. *Stipe* up to 80 cm long, stramineous, glabrescent above. *Lamina* more than 1 m long, up to 70 cm wide, pinnate with deeply lobed pinnae; rachis pale, sparsely appressed-hairy; pinnae more than 20 pairs, long-stalked at base, lanceolate, caudately acuminate, the extreme basal basiscopic pinnules lacking, up to 45 by 10 cm, deeply lobed to $\frac{9}{10}$ way towards costa; terminal pinna narrowly oblong-subtriangular, acuminate and tailed at apex, moderately rounded at base, up to 20 by 5 cm; costa raised on both surfaces, sparsely hairy or glabrescent;

larger segments lanceolate or narrowly subtriangular, caudately acuminate at apex, serrate at margin, up to 5.5 by 1 cm; papyraceous, deep green, hairy on upper surface; basal veins springing directly from costa, bifurcate or trifurcate, the anterior ones running to the sharp teeth at sinus. *Sori* round, one or two rows on each side of costule, small, up to 0.7 mm diam.; indusia pale, glabrous.

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, SW. China (type from Kweichow), Upper Burma, and S. Vietnam.

E c o l o g y.— On moist slopes in dense forests in limestone regions at low altitudes.

3. Pteridrys australis Ching, Bull. Fan Mem. Inst. Biol. 5 : 142. pl. 15, 16, 19(12–13). 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 306. 1941; Holtt., Rev. Fl. Malaya 2 : 532. f. 313. 1955; Dansk Bot. Ark. 20 : 31. 1961; Tagawa & K. Iwats., Southeast As. St. 5 : 100. 1967. Figure 37. 4–6.

Rhizome short-creeping, rather thick, scaly near apex; scales lanceolate, tailed at apex, up to 12 by 1.3 mm, dark-brown, stiff. *Stipe* stramineous or darker, scaly at base, glabrescent above, 30–50 cm long. *Lamina* oblong, hardly or a little narrowing at base, pinnate with very deeply lobed pinnae; up to 75 by 40 cm; rachis like the upper part of stipe, hairy throughout; pinnae 20 or more pairs, lanceolate, caudate at apex, broadly cuneate to subtruncate at base, sessile or very shortly stalked, deeply lobed to $\frac{3}{4}$ way towards costa, up to 25 by 4 cm; costa and costule raised on both surfaces, hairy beneath; segments oblong to oblong-lanceolate, oblique to falcate, moderately acute at apex, serrate at margin; veins once or twice forked, the basal ones springing from the base of costule; the basal acroscopic branches soriferous, stopped at various positions between costule and margin, glabrous. *Sori* round, a row in medial position at each side of costule; indusia reniform, hairy.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Chiang Dao), Lampang; SOUTH-EASTERN : Chanthaburi (Khao Soi Dao to Makham); PENINSULAR : Nakhon Si Thammarat (Khao Luang), Ranong (Khlong Kamphuan), Phangnga (Takua Pa), Yala (Ban Chana).

D i s t r i b u t i o n.— S. China (type from Kwangtung), Burma, N. Vietnam and W. Malaysia.

E c o l o g y.— On mountain slopes in dense forests at medium altitudes.

14. CYCLOPELTIS

J. Smith, Comp. Bot. Mag. 72 : 36. 1846; Copel., Gen. Fil.: 112. 1947.

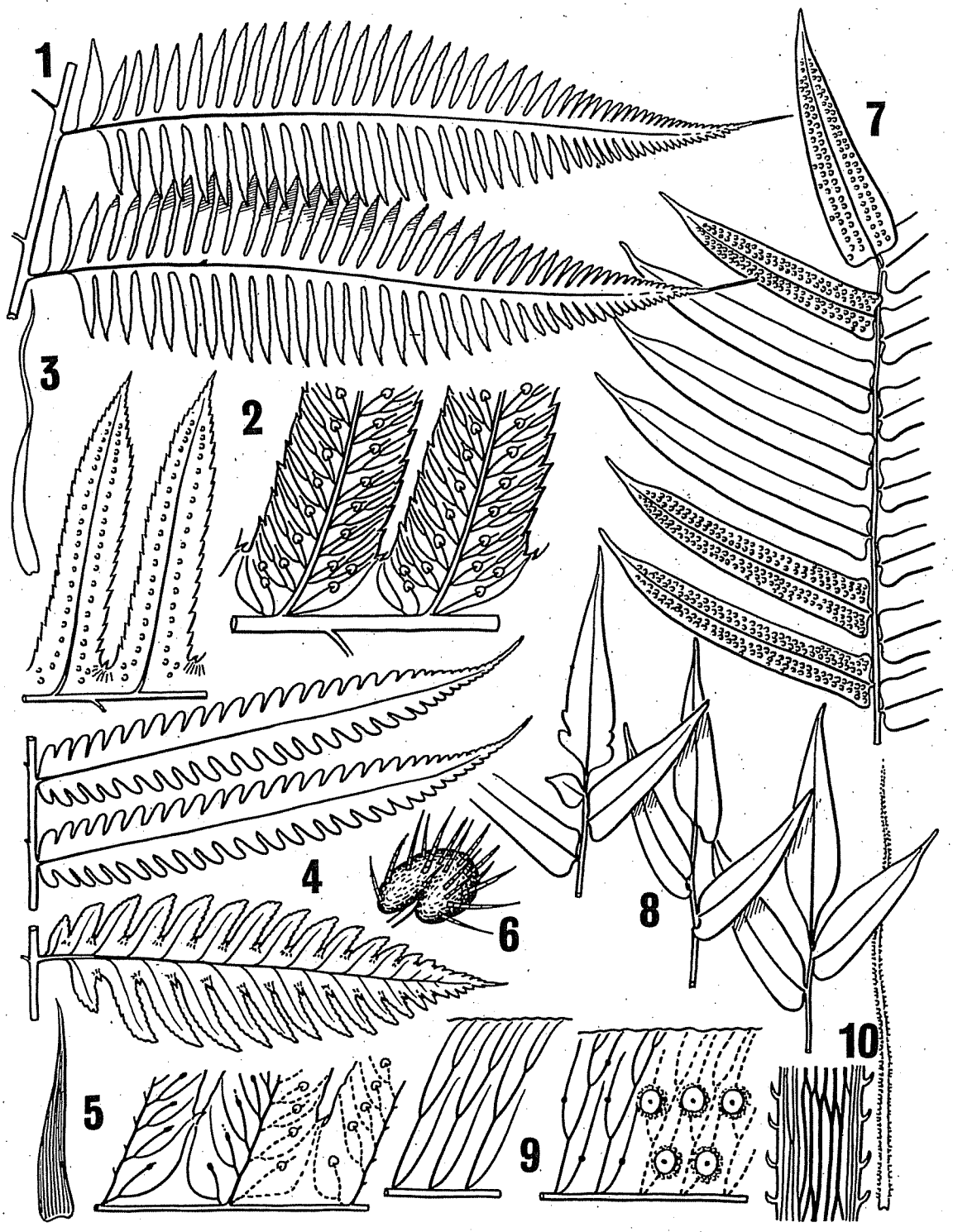


Figure 37. 1–3: *Pteridrys cnemidaria*; 1. middle sized pinnae, x 0.25; 2. lobes (left, natural size; right, x 2); 3. scales of stipe, x 4. 4–6: *P. australis*; 4. lower pinnae (above, x 0.3) and lowest one of different plant (below, x 0.5), the latter has very short stalk; 5. basal part of lobes (right, x 2) and scale of stipe base (left, x 4); 6. indusium enlarged. 7–10: *Cyclopeltis crenata*; 7. upper portion of fertile frond, x 0.5; 8. three styles of terminal pinnae, which lacks articulation contrary to the case shown at 7, ca. x 0.5; 9. venation of sterile (left) and fertile laminae (right). both x 3; 10. scale on stipe base, x 5, and a portion of it enlarged, x 50.

Rhizome short, erect, densely scaly; scales not peltate; stipe scaly throughout. Frond pinnate, pinnae many, articulate at base, subentire; thin leathery, dark green when living; veins dichotomously forked, all free. Sori dorsal on veinlets, usually in two or three nearly regular rows at each side of midrib; indusia peltate.

Among the Tectarioid group of ferns, this genus is distinct in having peltate indusia and in pinnate fronds with numerous free pinnae jointed to rachis.

There are several species distinguished in the genus, ranging in Burma to Malesia and tropical America, and one of them occurs in Thailand.

Cyclopeltis crenata (Fée) C. Chr., Ind. Fil. Suppl. 3 : 64. 1934; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 334. f. 39, 1 – 2. 1941; Holtt., Rev. Fl. Malaya 2 : 527. f. 309. 1955; Dansk Bot. Ark. 23 : 242. 1965; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 56. 1968.— *Hemicardion crenatum* Fée, Gen. Fil.: 283. t. 22. A. f. 1. 1852.— *Polystichum semicordatum* auct. non (Sw.) Moore : Bedd., Handb.: 201. f. 101. 1883. Figure 37. 7 – 10.

Rhizome short, erect, densely scaly; scales thin, linear, up to 30 by 1.3 mm, dark brown, toothed at margin. *Stipe* about 25 cm long, densely scaly at base, scales sparse and narrower upwards, stramineous. *Lamina* oblong-lanceolate, about 60 by 25 cm, gradually narrowing both towards apex and base; rachis densely clad with linear hairs, grooved above; lateral pinnae numerous, more than 30 pairs, sessile, jointed to rachis, lanceolate with caudate apex, broadly cuneate to cordate at base, the basiscopic side above rachis and the acroscopic side below rachis, middle pinnae the largest, up to 13 by 1.8 cm, subentire or serrate at margin; apical pinna larger than the uppermost lateral ones, about 2 cm wide; chartaceous, glabrous; costa raised on both surfaces, hairy beneath, veins forked near base. *Fertile pinnae* usually narrower. *Sori* dorsal on terminal veinlets, usually in two or three nearly regular rows on each side of costa; indusia entire, peltate, fugacious.

T h a i l a n d.— NORTHERN : Mae Hong Son (Mae Sariang); CENTRAL : Nakhon Nayok (Nang Rong); SOUTH-EASTERN : Chanthaburi (Thap Sai, Khao Soi Dao); SOUTH-WESTERN : Kanchanaburi (Sai Yok, Wangka), Prachuap Khiri Khan (Bang Saphan); PENINSULAR : Chumphon (Tha Ngo), Surat Thani, Satun, Yala (Kunong Ina, Bannang Sata).

D i s t r i b u t i o n.— Burma, S. China, Indochina (type) to W. Malesia.

E c o l o g y.— In evergreen forests at low altitudes.

26. THELYPTERIDACEAE

Nearly a thousand species belong to this family, mainly from tropical areas of both Old and New Worlds; however an accurate number of the species is still uncertain, even after a thorough revision of the Old World species by HOLTTUM. Several generic systems have been proposed recently. We follow here that put forward by one of the authors (IWATSUKI, 1964), but the infrageneric arrangement is in accord with the generic system of HOLTTUM (1971), in order to facilitate the comparison of Thai species with those of Malesia. Fifty one species from Thailand are here enumerated under *Thelypteris* s.lat., with an exception for *Meniscium proliferum*.

Literature.— CHING, R. C.: A reclassification of the family Thelypteridaceae from the mainland of Asia. Acta Phytotax. Sin. 8 : 289–335. 1963. IWATSUKI, K.: Taxonomy of the Thelypteroid ferns, with special reference to the species of Japan and adjacent regions III. Classification. Mem. Coll. Sci. Univ. Kyoto B. 31 : 11–40. 1964. HOLTTUM, R.E.: Studies in the family Thelypteridaceae III. A new system of genera in the Old World. Blumea 19 : 17–52. 1971.

KEY TO THE GENERA

1. Hairs unicellular or rarely multicellular, setose or hooked; rachis not gemmiferous or with a few gemmae **1. Thelypteris**
1. Hairs unicellular, simple and setose or forked to stellate; rachis bearing many buds and vigorously proliferous **2. Meniscium**

1. THELYPTERIS

Schmidel, Icon. Pl. ed. Keller : 45. t. 11, 13. 1763; K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 21. 1964.

Rhizome radial, scaly; scales concolorous, hairy. Stipe bearing scales and hairs. Lamina usually oblong to oblong-lanceolate, bipinnate, or rarely simple or pinnately compound, variously hairy according to species, softly herbaceous to chartaceous; veins pinnate, all free, or anastomosing, forming rather regularly quadrangular areoles (goniopteroid or meniscioid). Sori round or crescentic, indusiate or naked; indusia hairy; sporangia setiferous or glabrous.

More than 800 species belong to the genus in this broad definition; the geographical range is wide, but the centre of distribution is in the tropics. Fifty species are enumerated below from Thailand. Several of them are ill-defined and await biosystematic investigation.

KEY TO THE SPECIES

1. Veins all free
 2. Veinlets not reaching the very margin of lobes
  3. Frond pinnately compound, tri- to quadri-pinnate
   4. Frond 1 m long or ever larger; stipe, rachis, costa and costules scaly, scales leaving short prickles; sori exindusiate **1. T. ornata**
   4. Frond usually less than 1 m long; axes not scaly except for stipe base; sori indusiate **2. T. torresiana**
  3. Frond pinnate-bipinnatifid
   5. Pinnae lobed nearly to costa; segments serrate at margin **3. T. flaccida**
   5. Pinnae lobed to $\frac{3}{4}$ way towards costa; segments subentire or crenate **4. T. singalanensis**
 2. Veinlets all simple except in sp. 6, reaching the very margin of lobes
  6. Aerophore absent; basal veinlets running to the margin of segments; callous membrane hardly present at sinus
   7. Veinlets commonly forked; hairs rather sparse throughout plant, not glandular **6. T. confluens**
   7. Veinlets all simple; hairs dense on various parts of plant, glandular
    8. Larger lateral pinnae less than 10 cm long
     9. Rhizome erect; stipe dark brown to castaneous, pubescent **10. T. viscosa**
     9. Rhizome short-creeping; stipe stramineous to castaneous, densely long-hairy at base **11. T. hirsutipes**
    8. Plant larger in size; lateral pinnae up to 30 cm long **50. T. immersa**
  6. Aerophore present at junction of rachis and costa; basal veinlets usually running to callous membrane at sinus between adjacent segments
   10. Pinnae sessile or subsessile; basal veinlets usually springing from main veins; texture papyraceous to thinly chartaceous
    11. Basal pinnae shorter than the next above
     12. Lower pinnae suddenly reduced into auricles along stipe; costa subglabrous underneath
      13. Pinnae more than 25 cm long, 2.5 cm wide **30. T. tuberculifera**
      13. Pinnae less than 20 cm long, 1.8 cm wide **31. T. xylodes**
     12. Lower pinnae gradually shortened, the few lowest pairs being butterfly-shaped; costa hairy underneath
      14. Costa minutely pubescent underneath with hairs less than 0.5 mm long; segments patent **32. T. repens**
      14. Costa densely hairy underneath with hairs 0.8 –1 mm long; segments very oblique, at about 40° to costa **33. T. falciloba**
    11. Basal pinna as long as that next above, or a little shorter **7. T. ciliata**
   10. Pinnae long-stalked at least the lower ones; basal posterior veinlets usually springing directly from costa; texture coriaceous **8. T. crassifolia**
1. Veins anastomosing, goniopteroid or meniscioid
 15. Pinnae variously lobed, with callous membrane at sinus between lobes
  16. Aerophore absent at base of costa
   17. Stipe scaly only at the base; rachis not scaly or with small scales
    18. Sporangia glabrous
     19. Basal pair of veinlets actually anastomosing, the second basal pair running to the callous membrane
      20. Sori confined to segments, or lower 1 – 3 pairs of veinlets commonly not soriferous
       21. Rhizome long-creeping; basal veinlets actually uniting to form excurrent veinlets

22. Swamp ferns; costa with small scales underneath; texture subcoriaceous **5. T. interrupta**
22. Not swamp ferns; costa without scales underneath; texture chartaceous **48. T. terminans**
21. Rhizome erect; basal veinlets meeting at acute angle, or rarely not actually meeting below callous membrane at sinus **49. T. opulenta**
20. Sori not confined to segments, or basal veinlets usually soriferous
23. Basal 1 or 2 pairs of pinnae much reduced to form butterfly-shaped auricles **34. T. lebeufii**
23. Basal pinnae longest, or slightly shortened and deflexed
24. Rhizome long-creeping
25. Lamina glandular, with short hairs
26. Lamina subglabrous; glands dense on lamina underneath **35. T. cylindrothrix**
26. Lamina pubescent; glands confined to axes **37. T. parasitica**
25. Lamina not glandular, with dense long patent white hairs **36. T. molliuscula**
24. Rhizome erect or ascending **38. T. siamensis**
19. At least one of the second basal veinlets uniting with excurrent veinlets below callous sinus
27. Indusia round-reniform, not or hardly elongate, or wanting
28. Undersurface of lamina densely hairy
29. Rhizome short-creeping or ascending; texture herbaceous to papyraceous, with rounded or moderately acute apex
30. Pinnae usually more than 15 pairs, lobed $\frac{1}{3}$ to $\frac{2}{3}$ way towards costa **39. T. dentata**
30. Pinnae usually up to 12 pairs, lobed to $\frac{1}{3}$ way towards costa **40. T. latipinna**
29. Rhizome long-creeping; texture papyraceous to subcoriaceous, with aciculate apex to segments
31. Pinnae more than 1 cm wide, glandular beneath; costa with spreading hairs beneath **47. T. arida**
31. Pinnae less than 1 cm wide, not glandular; costa with copious appressed hairs beneath **22. T. unita**
28. Undersurface of lamina glabrous or subglabrous
32. Lower pinnae reduced
33. Rhizome erect
34. Pinnae less than 2 cm wide; scales broad, appressed **41. T. papilio**
34. Pinnae usually more than 2 cm wide; scales narrow, spreading **45. T. evoluta**
33. Rhizome creeping
35. 1.5 pairs of veinlets actually uniting **42. T. subpubescens**
35. More than 2 pairs of veinlets actually uniting
36. Pinnae less than 2 cm wide; southern species **43. T. sumatrana**
36. Pinnae generally more than 2 cm wide; northern species **44. T. subelata**
32. Lower pinnae not or little reduced
37. Indusia wanting **13. T. penangiana**
37. Indusia present
38. Plant larger, lamina up to 70 cm or more long; not glandular; sori hardly confluent **12. T. articulata**
38. Plant smaller, lamina up to 50 cm long; glandular; sori usually confluent at maturity **14. T. glandulosa**
27. Indusia elongate
39. Pinnae up to 2 cm wide, lobed to halfway towards costa; free veinlets ending at hydathodes inside margin of lobes; no multicellular hairs on axes beneath **23. T. polycarpa**
39. Pinnae 2.5-3.5 cm wide, lobed to $\frac{1}{4}$ way towards costa; free veinlets reaching the very margin of lobes; axes of lamina with long multicellular hairs beneath **25. T. larutensis**

18. Sporangia setiferous
40. Basal pinnae not or hardly reduced **27. T. hirtisora**
40. Basal pinnae gradually becoming smaller downwards **28. T. valida**
17. Stipe and rachis densely scaly throughout; rhizome erect
41. Large plant, lamina up to 2 m long, larger pinnae about 40 by 3 cm; sori costular; indusia small, glandular **9. T. ferox**
41. Smaller plant, lamina up to 1 m long; larger pinnae about 25 by 1.5 cm; sori medial; indusia hairy **46. T. crinipes**
16. Aerophore present at junction between rachis and costa
42. Basal veinlets only uniting below callous membrane **24. T. heterocarpa**
42. 1.5 or more basal veinlets actually uniting below callous sinus
43. Pinnae not verrucose beneath, glandular; usually more than 3 pairs of basal veinlets actually uniting below callous sinus **26. T. megaphylla**
43. Pinnae verrucose beneath, not glandular; 1.5 basal pairs of veinlets actually uniting below callous sinus **29. T. truncata**
15. Pinnae subentire, callous membrane absent at sinus between crenae
44. Frond dimorphic; pinnae narrow, less than 1 cm broad in sterile ones **15. T. exsculpta**
44. Frond uniform or subdimorphic; pinnae more than 2 cm broad
45. Rhizome stout, more than 5 mm diam.; frond imparipinnate
46. Frond subdimorphic; the basalmost pinna the longest; pinnae rarely up to 15 cm long **16. T. menisciicarpa**
46. Frond uniform; basal pinna not the longest; pinnae usually more than 15 cm long
47. Sporangia setiferous
48. Hairy indusia present; sporangia with 1 – 3 hairs **17. T. aspera**
48. Exindusiate; sporangia with 3 – 6 hairs **20. T. repanda**
47. Sporangia glabrous
49. Pinnae generally ten or more pairs; lamina drying green, not tinted red; sori indusiate **18. T. nudata**
49. Pinnae generally up to 9 pairs; lamina tinted red or reddish; exindusiate **19. T. lakhimpurensis**
45. Rhizome slender, about 3 mm diam.; frond trifoliate, or bearing 2 to 4 lateral pairs of pinnae **21. T. triphylla**

1. Thelypteris ornata (Wall. ex Bedd.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 346. 1936; Tagawa & K. Iwats., Southeast As. St. 5 : 64. 1967.— *Polypodium ornatum* Wall. ex Bedd., Ferns S. India : t. 171. 1864.— *Phegopteris ornata* (Wall. ex Bedd.) J. Smith, Hist. Fil. 233. 1875; Bedd., Handb.: 294. f. 152. 1883.— *Macrothelypteris ornata* (Wall. ex Bedd.) Ching, Acta Phytotax. Sin. 8 : 309. 1963; Holtt., Blumea 17 : 30. 1969. Figure 38. 4 – 7.

Rhizome short, erect or ascending; scales linear-lanceolate, concolorous, brown, about 20 by 2 mm, densely hairy both on dorsal surface and at margin. *Stipe* thick, about 100 cm long, up to 2 cm thick at base, scaly, spinose. *Frond* oblong-subtriangular, tripinnate-quadripinnatifid, commonly 100 by 80 cm or even larger; pinnae oblong-lanceolate, gradually narrowing towards acuminate apex, up to 55 by 25 cm, basal one or two pinnules often reduced in size, close to rachis; larger pinnules oblong-lanceolate with acuminate apex, up to 15 by 2.2 cm; ultimate segments narrowly oblong, rounded at apex, adnate at base, deeply lobed nearly to midrib, up to 15 by 5 mm; lobes oblong-subdeltoid, oblique, rounded at apex, entire,

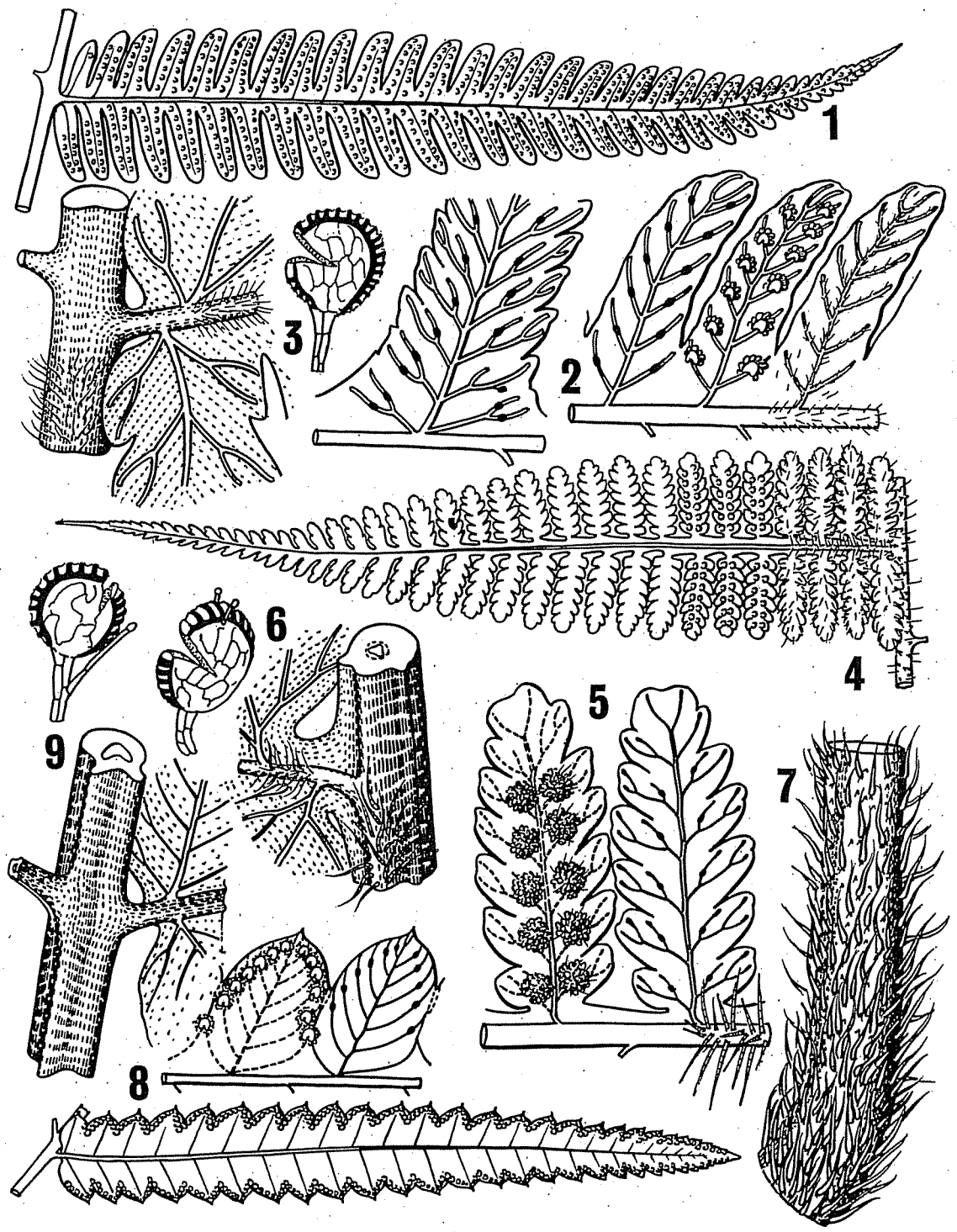


Figure 38. 1–3: *Thelypteris singalanensis*; 1. middle sized pinna, natural size; 2. larger lobes with undulate margin (right) and largest one with incised margin (left), both x 4; 3. rachis and basal part of pinnae (left, x 10) and sporangium (x 40). 4–7: *Thelypteris ornata*; 4. medium-sized pinnule, x 1.5; 5. third order leaflets, x 6; 6. pinna-rachis and basal part of costule (right below, x 10) and sporangium (left below, x 40); 7. stipe base with many pale scales and scale scars, natural size. 8–9: *Thelypteris interrupta*; 8. medium-sized pinna (bottom, x 1.5) and lobes enlarged (right above, x 5); 9. rachis and basal part of pinna, scales and hairs quite elusive, x 7.5, and sporangium (above, x 40).

about 1.5 by 1 mm, often revolute in dried specimens; papyraceous, green, hairy on under surface; rachis scaly, spinose, pinna-rachis scaly as well as hairy, costules winged throughout, densely covered with multicellular hairs; veins pinnate, veinlets simple or forked, not reaching the margin of lobes. *Sori* dorsal on veinlets, one for each lobe, exindusiate.

T h a i l a n d.— NORTHERN : Lampang (Mae Tia); NORTH-EASTERN : Phetchabun (Phu Miang); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); SOUTH-WESTERN : Kanchanaburi (Khao Yai).

D i s t r i b u t i o n.— S. & N. India (type), N. Burma and Taiwan.

E c o l o g y.— On clayey ground in open or half-shaded places at 600 – 800 m alt.

2. Thelypteris torresiana (Gaud.) Alston, Lilloa 30 : 111. 1960; K. Iwats., J. Jap. Bot. 38 : 314. 1963; Tagawa & K. Iwats., Southeast As. St. 3(3) : 78. 1965; 5 : 64. 1967.— *Polystichum torresianum* Gaud. in Freyc., Voy. Bot.: 333. 1817.— *Lastrea tenericaulis* (Wall.) Moore, Ind. Fil.: 99. 1858; Bedd., Handb.: 266. 1883.— *Thelypteris uliginosa* (Kunze) Ching, Bull. Fan Mem. Inst. Biol. 6 : 342. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 371. 1941; Holtt., Rev. Fl. Malaya 2 : 241. 1955; Dansk Bot. Ark. 23 : 232. 1965.— *Macrothelypteris torresiana* (Gaud.) Ching, Acta Phytotax. Sin. 8 : 310. 1963; Holtt., Blumea 17 : 27. 1969; in Fl. Mal. II. 1 : 348. f. 2, h-j. 1981.— *Aspidium setigerum* auct. non (Bl.) Kuhn : Christ, Bot. Tidsskr. 24 : 108. 1901; C. Chr., Bot. Tidsskr. 32 : 342. 1916.

Rhizome short, suberect; scales narrow, brown, up to 2 by 1.2 cm, hairy on dorsal surface as well as margin, the base often a few cells thick. *Stipe* up to 100 cm long, about 1 cm diam. near base, sometimes spinose in lower part. *Lamina* oblong to oblong-ovate, tripinnate, up to 90 by 75 cm; pinnae oblong, acuminate at apex, up to 40 by 20 cm; larger pinnules sessile, oblong-subdeltoid, acuminate at apex, up to 10 by 4 cm; ultimate segments oblong, oblique, rounded to moderately acute at apex, lobed to $\frac{3}{4}$ way towards midrib; lobes oblong to subdeltoid, entire, sometimes involute; rachis terete, glabrous; pinna-rachis hairy on upper surface, costules winged throughout, hairy; veins and surfaces hairy with unicellular or multicellular hairs; texture herbaceous to softly papyraceous, green but often brownish when dried. *Sori* round, usually close to midrib of ultimate segments; indusia small, often covered by mature sporangia, round-reniform, hairy.

T h a i l a n d.— NORTHERN : Chiang Rai, Chiang Mai (Doi Chiang Dao, Bo Luang, Doi Saket, Mae Klang, Pha Mon), Lampang, Lamphun (Doi Khun Tan), Tak (Ban Musoe); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Sai Yok); PENINSULAR : Chumphon, Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang), Satun, Yala (Betong).

D i s t r i b u t i o n.— Mascarene Islands, throughout tropical Asia (type from Mariana Islands), Polynesia, Hawaii, north to Japan and south to Australia; also naturalized in the New World.

E c o l o g y.— On sunny slopes along roads at edge of forests at low to medium altitudes.

3. Thelypteris flaccida (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 336. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 366. 1941; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25 : 16. 1971.— *Aspidium flaccidum* Bl., En. Pl. Jav.: 161. 1828.— *Lastrea flaccida* (Bl.) Moore, Ind. Fil.: 92. 1858; Bedd., Handb.: 244. f. 125. 1883.— *Metathelypteris flaccida* (Bl.) Ching, Acta Phytotax. Sin. 8 : 306. 1963; Holtt. in Fl. Mal. II. 1 : 351. f. 3, e-f. 1981.

Rhizome short, erect; scales narrow, thin and usually crisped, up to 5 by 0.8 mm, brown, hairy on dorsal surface and at margin. *Stipe* up to 20 cm long, stramineous to pale castaneous, scaly on basal portion, hairy throughout. *Lamina* oblong-lanceolate, pinnate-bipinnatifid, up to 40 by 15 cm; pinnae about 5 cm apart, falcate, basal one or two smaller, all sessile, middle larger ones lanceolate, acuminate at apex, up to 8 by 2 cm; costa hairy throughout, winged; pinnules patent, narrowly oblong, rounded at apex, decurrent at base towards the wings of costa, deeply lobed to $\frac{2}{3}$ way towards costule, up to 10 by 5 mm; lobes oblong to subdeltoid, moderately acute at apex, serrate; papyraceous, green; veins pinnate, veinlets usually forked, not reaching the very margin of lobes; hairs all unicellular, simple, patent or sometimes hooked on laminar surface. *Sori* dorsal on veinlets, medial; indusia caducous, small, pale brown, hairy.

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

D i s t r i b u t i o n.— Ceylon, India, SW. China (Yunnan and Kweichow), N. Vietnam, and Java (type).

E c o l o g y.— On half-shaded, humus-rich banks of new road at about 1200 m alt.; only once collected from Phu Miang, TAGAWA et al. 11698 (BKF, K, KYO).

4. Thelypteris singalanensis (Bak.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 334. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 365. 1941; Holtt., Rev. Fl. Malaya 2 : 243. f. 138. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 63. 1967.— *Nephrodium singalanense* Bak., J. Bot. 1800 : 212.— *Lastrea singalanensis* (Bak.) Bedd., Hand. Suppl.: 54. 1892.— *Metathelypteris singalanensis* (Bak.) Ching, Acta Phytotax. Sin. 8 : 306. 1963; Holtt. in Fl. Mal. II. 1 : 352. f. 3, g. 1981. Figure 38. 1–3.

Rhizome short, erect; scales very sparse, linear, up to 8 by 0.2 mm, dark brown. *Stipe* stramineous, up to 60 cm long, scaly and hairy at base when young, glabrescent upwards. *Lamina* about 60 by 35 cm, pinnate-bipinnatifid; pinnae sessile, linear-lanceolate, caudate-acuminate at apex, up to 20 by 3 cm; rachis and costa densely hairy on upper surface, glabrous below; pinnules narrowly oblong, patent to falcate, up to 15 by 4.5 mm, entire, rounded to moderately acute at apex; softly papyraceous to papyraceous, green; veins pinnate, veinlets simple, forked, or triforked, glabrous. *Sori* dorsal on veinlets, in a medial row between costules and margin of pinnules; indusia thin, glabrous.

T h a i l a n d.— NORTHERN : Phitsanulok (Thung Salaeng Luang); PENINSULAR : Nakhon Si Thammarat (Khao Luang).

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

E c o l o g y.— On mountain slopes in light shade or in evergreen forests at medium altitudes.

5. Thelypteris interrupta (Willd.) K. Iwats., J. Jap. Bot. 38 : 314. 1963, nom. tant.; Fosberg & Sachet, Smiths. Contr. Bot. 8 : 8. 1972.— *Pteris interrupta* Willd., Phytogr. 1 : 13. t. 10. 1794.— *Cyclosorus gongylodes* (Schkuhr) Link, Hort. Berol. 2 : 128. 1833; Ching, Bull. Fan Mem. Inst. Biol. 8 : 186. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 383. 1941; Holtt., Rev. Fl. Malaya 2 : 261. f. 148. 1955; Dansk Bot. Ark. 20 : 23. 1961.— *Dryopteris gongylodes* (Schkuhr) O. Ktze., Rev. Gen. Pl. 2 : 811. 1891; Seidenf., Nat. Hist. Bull. Siam Soc. 19 : 87. 1958.— *Cyclosorus interruptus* (Willd.) H. Ito, Bot. Mag. Tokyo 51 : 714. 1937, nom. tant.; Holtt. in Fl. Mal. II. 1 : 386. f. 1,r, 7,a-c. 1981.— *Aspidium goggilodus* Schkuhr, Kr. Gew. 1 : 193. t. 33 C. 1809.— *Thelypteris goggilodus* (Schkuhr) Small, Ferns SE. States : 248, 475. 1938; Tagawa & K. Iwats. Southeast As. St. 3(3) : 79. 1965; 5 : 68. 1967. Figure 38. 8–9.

Rhizome long-creeping, up to 4 mm diam., usually dark and naked; scales caducous, subdeltoid, pale brown, thin, up to 25 by 1.5 mm, glabrous. *Stipe* up to 70 cm long, stramineous with dark base, glabrous. *Lamina* oblong-lanceolate, acute at apex, basal pinnae hardly reduced, up to 60 by 20 cm; middle larger pinnae sessile, linear-lanceolate, gradually narrowing towards acute apex, rounded at base, up to 12 by 1.3 cm, lobed to $\frac{1}{4}$ way towards costa; costa hairy, bearing scales sparsely; segments oblong-subdeltoid with aciculate apex; papyraceous to thinly chartaceous, pubescent on under surface; veins pinnate, usually 1.5 pairs of basal veinlets uniting with those of the adjacent groups, hairy as well as glandular. *Sori* confined to segments, usually confluent at maturity; indusia hairy, caducous.

T h a i l a n d.— NORTHERN : Phayao, Chiang Mai (Mae Klang), Lampang (Mae Toi); CENTRAL : Krung Thep (Bangkok); SOUTH-WESTERN : Prachuap Khiri Khan (Sam Roi Yot); PENINSULAR : Surat Thani (Ban Don), Nakhon Si Thammarat (Thung Song), Phatthalung, Songkhla, Krabi (Khao Phanom), Phuket (Ko Yao Yai, Khun Talao Lake), Yala (Bannang Sata).

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

E c o l o g y.— On grassy banks along streams or in open marshy places at low altitudes.

V e r n a c u l a r.— Kut yang (กูดยาง), kut mon (กูดหม่อน) (Northern); phak kut chang (ผักกูดช้าง) (South-eastern).

6. Thelypteris confluens (Thunb.) Morton, Contr. U.S. Nat. Herb. 38 : 71. 1967; Holtt. in Fl. Mal. II. 1 : 377. f. 5, g-h. 1981.— *Pteris confluens* Thunb., Prodr. Pl. Cap.: 171. 1800.— *Nephrodium squamulosum* Hook. f., Fl. N. Z. 2 : 39. 1854.— *Thelypteris squamulosa* (Hook. f.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 5, 329. 1936; Holtt., Dansk Bot. Ark. 20 : 22. 1961. Figure 39. 1–5.

Rhizome long-creeping, with distant fronds; scales oblong with long tails, sparsely hairy at margin, 2 by 0.8 mm, pale brown. *Stipe* stramineous with dark base, about 20 cm long. *Lamina* oblong-lanceolate, acute at apex, up to 25 by 8 cm wide, pinnate; lateral pinnae lanceolate, acute at apex, shortly stalked, pinnatisect, up to 7 by 1.2 cm; segments oblong, oblique, moderately acute at apex; rachis and costa scaly underneath with broad pale brown membranous scales; veins pinnate, veinlets forked or simple, reaching the margin of lobes. *Sori* dorsal on veinlets, round, sometimes adhering to the next at maturity; indusia round-reniform, hairy at margin.

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

D i s t r i b u t i o n.— Africa (type), S. India, Burma, Laos, Sumatra, New Guinea, and New Zealand.

E c o l o g y.— In swamps in rather open places at about 1000 m alt.

N o t e.— This is similar to *T. palustris,* from which our species is distinct in hairy thin pale scales on rachis and costa underneath.

7. Thelypteris ciliata (Wall. ex Benth.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 289. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2):362. 1941; Holtt., Rev. Fl. Malaya 2 : 250. f. 142. 1955; Dansk Bot. Ark. 20 : 22. 1961; Tagawa & K. Iwats., Southeast As. St. 3(3): 78. 1965; 5 : 68. 1967.— *Aspidium ciliatum* Wall. ex Benth., Fl. Hongk.: 455. 1861.— *Lastrea calcarata* var. *ciliata* (Benth.) Bedd., Handb.: 235. f. 121. 1883.— *Trigonospora ciliata* (Benth.) Holtt., Blumea 19 : 29. 1971; Reinwardtia 8 : 507. 1974; in Fl. Mal. II. 1 : 375. f. 5, c-e. 1981. Figure 39. 6–9.

Rhizome short, erect; scales up to 3 by 1.5 mm, membranous, appressed, brown, hairy. *Stipe* stramineous to greyish, hairy throughout, about 30 cm long. *Soriferous fronds* usually taller and larger than sterile ones, oblong-lanceolate, acute at apex, 15–35 by 6–13 cm; lowest pinnae shortened, deflexed, pinnae of lower $\frac{1}{3}$ largest, patent, subsessile, linear-lanceolate, caudately acuminate at apex, broadly cuneate at base, often auricled; rachis and costa densely hirsute; segments falcate, oblique, rounded at apex, subentire, hairy at margin; chartaceous or thicker, deep green; veins pinnate, veinlets simple, basal anterior ones running to sinus, hairy. *Sori* subcostular, often confluent at maturity; indusia firm, persistent, hairy.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Phacho), Chiang Mai (Doi Phahom Pok, Ya Na, Doi Suthep, Doi Inthanon), Tak (Huai Krasa), Phitsanulok (Salaeng Haeng), Phrae (Mae Sai); NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Tong); SOUTH-EASTERN : Chanthaburi (Khao Sabap); PENINSULAR : Nakhon Si Thammarat (Khao Luang, Ban Khiri Wong), Yala (Ban Chana).

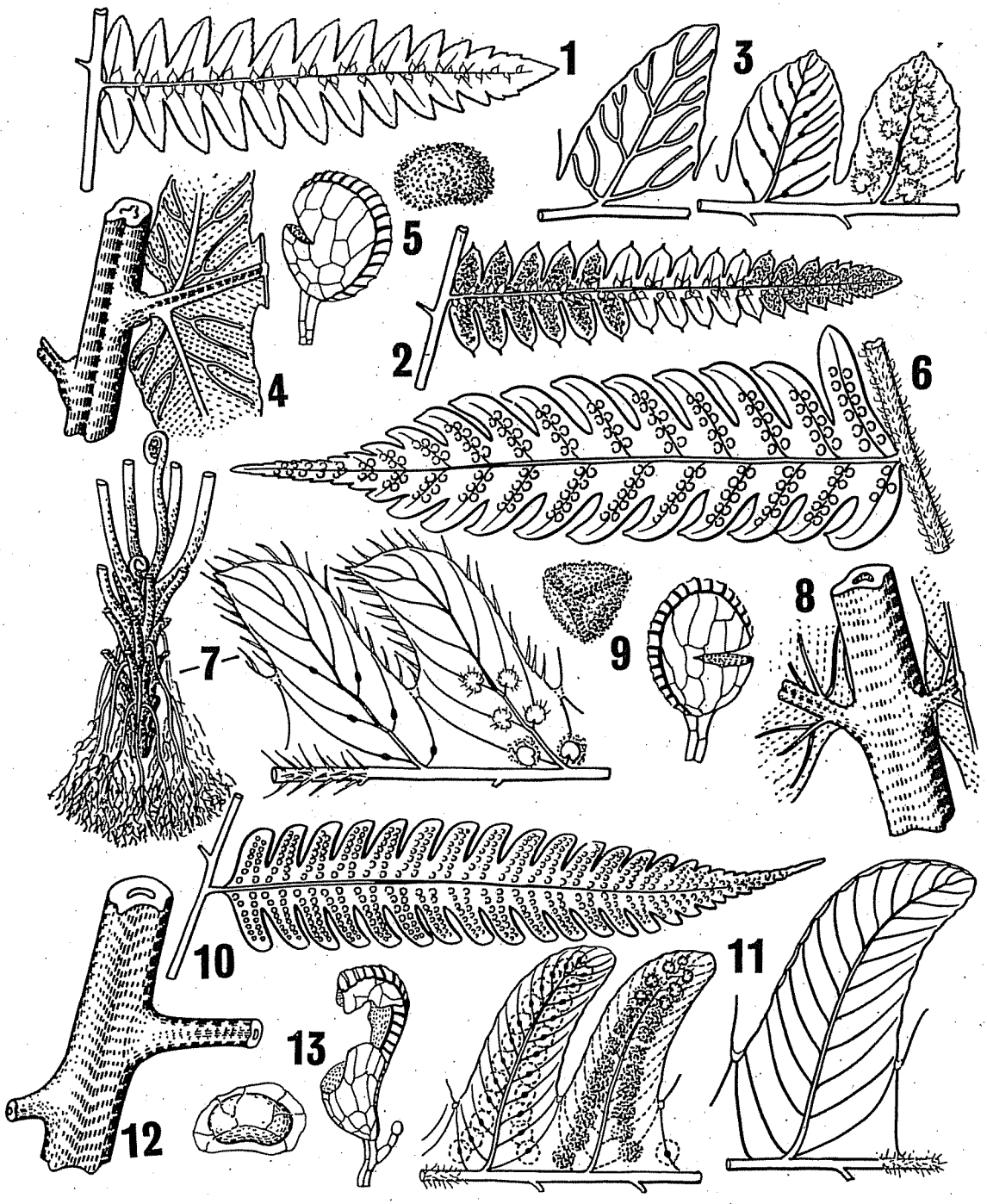


Figure 39. 1 – 5: *Thelypteris confluens*; 1. sterile medium-sized pinna, hairs omitted x 2; 2. same, fertile one, x 2; 3. lobes enlarged, sterile (left) and fertile (right), both x 6; 4. rachis and basal part of pinnae, hairs omitted x 10; 5. sporangium (x 40) and spore (x 200). 6 – 9: *Thelypteris ciliata*; 6. smaller pinna, hairs on lamina omitted, x 2; 7. lobes enlarged (right, x 5) and stock of plant (left, x 0.5); 8. rachis and basal part of pinnae, hairs omitted. x 10; 9. sporangium (x 40) and spore (x 200). 10 – 13: *Thelypteris crassifolia*; 10. larger pinna, natural size; 11. lobes, sterile (right) and fertile (left below), both x 3; 12. rachis and basal part of pinna, x 7.5, hairs omitted; 13. sporangium (x 40) and spore (x 150).

Distribution.— Nepal to W. Malesia, north to Hong Kong (type).

Ecology.— Usually on muddy stream-beds in dense forests at 500–1700 m alt.

8. Thelypteris crassifolia (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 285. 1936; Holtt., Rev. Fl. Malaya 2 : 246. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 67. 1967.— *Aspidium crassifolium* Bl., En. Pl. Jav.: 158. 1828.— *Lastrea crassifolia* (Bl.) Moore, Ind. Fil.: 89. 1858; Bedd., Handb.: 238. 1883.— *Mesophlebion crassifolium* (Bl.) Holtt., Blumea 19 : 30. 1971; 22 : 232. 1975.— *Mesophlebion motleyanum* (Hook.) Holtt. in Nayar & Kaur, Comp. Bedd. : 209. 1975; in Fl. Mal. II. 1 : 381. 1981.— *Nephrodium motleyanum* Hook., Syn. Fil. : 266. 1867. Figure 39. 10–13.

Rhizome short-creeping, up to 1 cm diam.; scales linear-lanceolate, up to 8 by 1.5 mm, brown, hairy. *Stipe* stramineous with dark base, about 50 cm in soriferous fronds, 30 cm in sterile ones. *Lamina* oblong, attenuate at apex, up to 40 by 25 cm, narrower in soriferous fronds; lowest pinnae usually deflexed, lower pinnae distinctly stalked, narrowly oblong with acuminate apex and broadly cuneate base, up to 15 by 4 cm in sterile ones, up to 2.5 cm wide in soriferous ones, lobed to $\frac{2}{3}$ way towards costa; upper pinnae sessile, smaller, ascending; segments oblong, oblique to falcate, round at apex, entire, up to 13 by 7 mm; chartaceous to coriaceous, deep green, verrucose on lower surface; veins pinnate, veinlets simple, basal posterior ones springing directly from costa, running to sinus between segments. *Sori* medial, 7 mm diam.; indusia persistent, hairy.

Thailand.— PENINSULAR : Surat Thani (Khao Lak), Nakhon Si Thammarat (Khao Luang), Narathiwat (Sungai Padi), Satun.

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

Ecology.— On humus-rich mountain slopes in dense evergreen forests at about 1400 m alt.

Note.— This is a variable species and several forms are distinguished as species among the extreme variants. A Ko Chang plant and one from Sungai Padi (FTP 4026) might better be identified as *T. chlamydophora* (C. Chr.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 287. 1936; Holtt., Rev. Fl. Malaya 2 : 246. f. 139. 1955, which is separated from *T. crassifolia* by such features as thinner texture of fronds, narrower pinnae more deeply lobed nearly to costa, and the basal posterior veinlets springing from costa near veins.

9. Thelypteris ferox (Bl.) Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 54. 1968.— *Aspidium ferox* Bl., En. Pl. Jav.: 153. 1828.— *Nephrodium ferox* (Bl.) Moore, Ind. Fil.: 91. 1858; Bedd., Handb.: 279. 1883.— *Cyclosorus ferox* (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 167. 1938; Holtt., Rev. Fl. Malaya 2 : 265. f. 151. 1955.— *Chingia ferox* (Bl.) Holtt., Blumea 19 : 31. 1971.— *Chingia pseudoferox* Holtt., Kalikasan 3 : 24. 1974.— *Thelypteris paleata* auct. non (Copel.) Holtt.: Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 53. 1968. Figure 40. 1–3.

Rhizome erect; scales narrow, about 3.5 by 2 mm, hairy, brown. *Frond* gigantic; rachis glabrous or sparsely scaly with linear hairy scales; middle lateral pinnae linear, up to 50 by 3 cm, gradually narrowing towards long-acuminate apex, narrowing a little towards truncate base, lobed to $\frac{1}{4}$ way towards costa; segments oblong-subdeltoid, moderately acute at apex, entire; papyraceous to thinly chartaceous, firm, glabrous; veins pinnate, the lowest meeting with concurrent veinlets, lower several pairs uniting at long callous membrane below sinus. *Sori* strictly costular, round, usually confluent along costules at maturity; indusia brown, thin, small but persistent, hairy, glandular at margin.

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

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

E c o l o g y.— Terrestrial in forests along streams at 160 – 500 m alt.

N o t e.— HOLTTUM (1974) distinguished *Chingia pseudoferox* from *C. ferox* by small and fragile sessile glands on surface and sporangia, distinctly flat rachis scales and thin texture of the deeply lobed pinnae. All the peninsular plants are referred to *C. pseudoferox,* though the specific distinctness of these two may better be judged after further studies.

10. Thelypteris viscosa (Bak.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 315. 1936; Holtt., Rev. Fl. Malaya 2 : 252. 1955; Tagawa & K. Iwats., Southeast As. St. 5 : 64. 1967.— *Nephrodium viscosum* Bak., Syn. Fil. : 264. 1867.— *Lastrea viscosa* (Bak.) J. Smith ex Bedd., Ferns Br. Ind. : t. 334. 1870; Handb.: 238. 1883.— *Nephrodium gymnopoda* Bak., Trans. Linn. Soc. II. Bot. 4 : 252. 1894.— *Coryphopteris viscosa* (Bak.) Holtt., Blumea 19 : 33. 1971.— *Coryphopteris gymnopoda* (Bak.) Holtt., Blumea 23 : 29. 1976; in Fl. Mal. II. 1 : 360. 1981. Figure 40. 6 – 8.

Rhizome erect, often more than 10 cm tall above ground; scales linear-lanceolate, up to 8 by 1.2 mm, brown with irregularly toothed paler margin. *Stipe* dark brown to castaneous, pubescent, scaly on lower portion, up to 20 cm long. *Lamina* narrowly oblong, acute at apex, up to 40 by 15 cm; lower pinnae deflexed, middle pinnae patent or ascending, nearly straight, sessile, lanceolate, acute at apex, truncate at base, up to 8 by 1.8 cm, deeply lobed nearly to costa; costa brown, hairy throughout; segments oblong, patent to oblique or falcate, rounded at apex, crenate at margin, up to 10 by 4 mm; papyraceous, deep green in living plants, brownish when dry; veins pinnate, veinlets simple, hairy. *Sori* medial; indusia round-reniform or horse-shoe-shaped, or sometimes elongate to form athyrioid sori, glandular.

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

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

E c o l o g y.— On clayey ridge in dense evergreen forests at about 1100 – 1750 m alt., near summit of mountains.

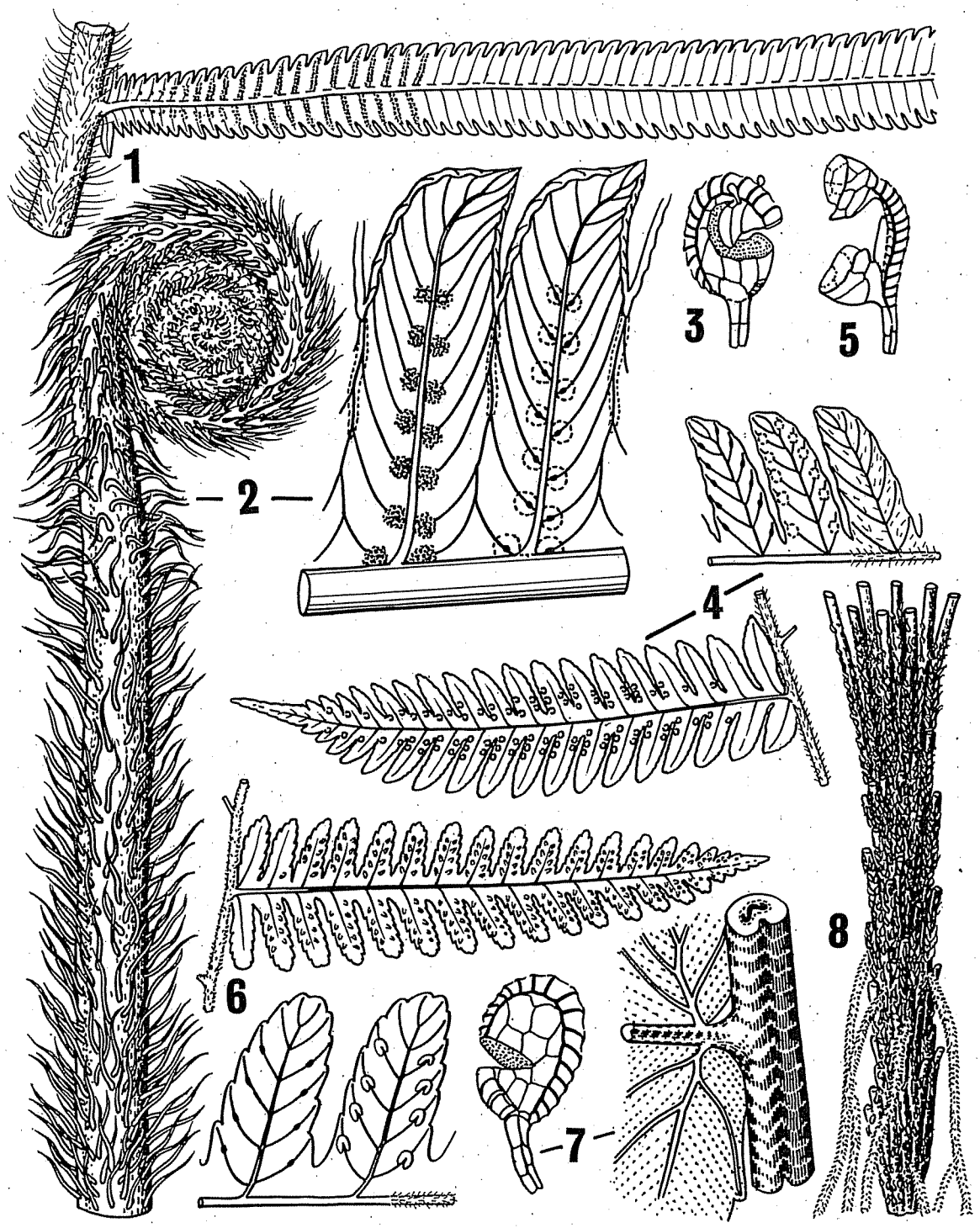


Figure 40. 1–3: *Thelypteris ferox*; 1. basal half of large pinna x 0.5; 2. lobes enlarged (right, x 4) and young fiddle head (left, x 0.5); 3. sporangium, x 40. 4–5: *Thelypteris glandulosa*; 4. medium-sized pinna (below, x 2) and lobes enlarged (above right, x 5); 5. sporangium, x 40. 6–8: *Thelypteris viscosa*; 6. medium-sized pinna (above, x 1.25) and lobes enlarged (below, x 4); 7. rachis with pinna base (right, x 8) and sporangium (x 40); 8. upper part of stock, x 0.5.

11. Thelypteris hirsutipes (Clarke) Ching, Bull. Fan Mem. Inst. Biol. 6 : 314. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 362. 1941; Tagawa & K. Iwats., Southeast As. St. 5 : 64. 1967.— *Nephrodium gracilescens* var. *hirsutipes* Clarke, Trans. Linn. Soc. II. Bot. 1 : 514. t. 67. f. 1. 1880.— *Lastrea hirsutipes* (Clarke) Bedd., Handb. Suppl.: 52. 1892.— *Coryphopteris hirsutipes* (Clarke) Holtt. in Nayar & Kaur, Comp. Bedd. Handb.: 203. 1974; Blumea 23 : 27. 1976; in Fl. Mal. II. 1 : 359. f. 4, c. 1981.

Rhizome short-creeping, with close fronds; scales sparse, small, up to 1.5 by 0.4 mm, bright brown, hairy. *Stipe* stramineous to castaneous, dark and densely hairy at base; hairs pale, patent, up to 2 mm long, multicellular. *Lamina* oblong, acute at apex, up to 40 by 15 cm; lower one or two pinnae reflexed, middle pinnae sessile, patent, acute to acuminate at apex, up to 9 by 1.8 cm, deeply lobed nearly to costa; segments oblong, rounded to obtuse at apex, softly papyraceous, green with round orange-red glands on undersurface; rachis and costa green to stramineous, hairy; veins pinnate, veinlets simple, all reaching the margin of segments, hairy as well as glandular. *Sori* medial or subcostular, large, up to 1 mm diam.; indusia round-reniform, persistent, hairy.

T h a i l a n d.— 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.— E. Himalaya (type) to SW. China and W. Malesia.

E c o l o g y.— On mountain slopes in evergreen forests at medium elevations, 1100 –1600 m alt.

12. Thelypteris articulata (Houlst. & Moore) Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 169. 1975.— *Nephrodium articulatum* Houlst. & Moore, Gard. Mag. Bot. 1851 : 293, based on *Aspidium articulatum* Lowe, Ferns Br. Exot. 6. t. 49. 1857, non Sw. 1801.— *Nephrodium glandulosum* var. *laete-strigosum* Clarke, Trans. Linn. Soc. II. Bot. 1 : 532. t. 74. f. 2. 1880.— *Dryopteris indica* v.A.v.Ros., Mal. Ferns : 224. 1909.— *Cyclosorus laete-strigosus* (Clarke) Ching, Bull. Fan Mem. Inst. Biol. 8 : 227. 1938, nom. superfl.— *Pronephrium articulatum* (Houlst. & Moore) Holtt., Blumea 20 : 116. 1972.— *Thelypteris indica* (v.A.v.Ros.) Reed, Phytologia 17 : 284. 1968; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25 : 17. 1971. Figure 41. 3; 42. 6–9.

Rhizome short, massive; scales hairy. *Stipe* about 50 cm long, hairy. *Lamina* indistinctly dimorphic; lamina oblong-lanceolate, up to 80 by 30 cm; sterile pinnae oblong-lanceolate, gradually narrowing towards long-acuminate apex, narrowly cuneate at basiscopic and subtruncate at acroscopic bases, shallowly lobed, up to 25 by 4 cm; soriferous pinnae narrower, cuneate or broadly cuneate at base, very shortly stalked or sessile, up to 20 by 2.5 cm, shallowly lobed; lobes semiorbicular, or obtuse at apex; papyraceous to softly chartaceous, glabrous, glandular; veins meniscioid with a few pairs of free veinlets near margin. *Sori* medial, round to oblong; indusia large, thin but firm, persistent, hairy.

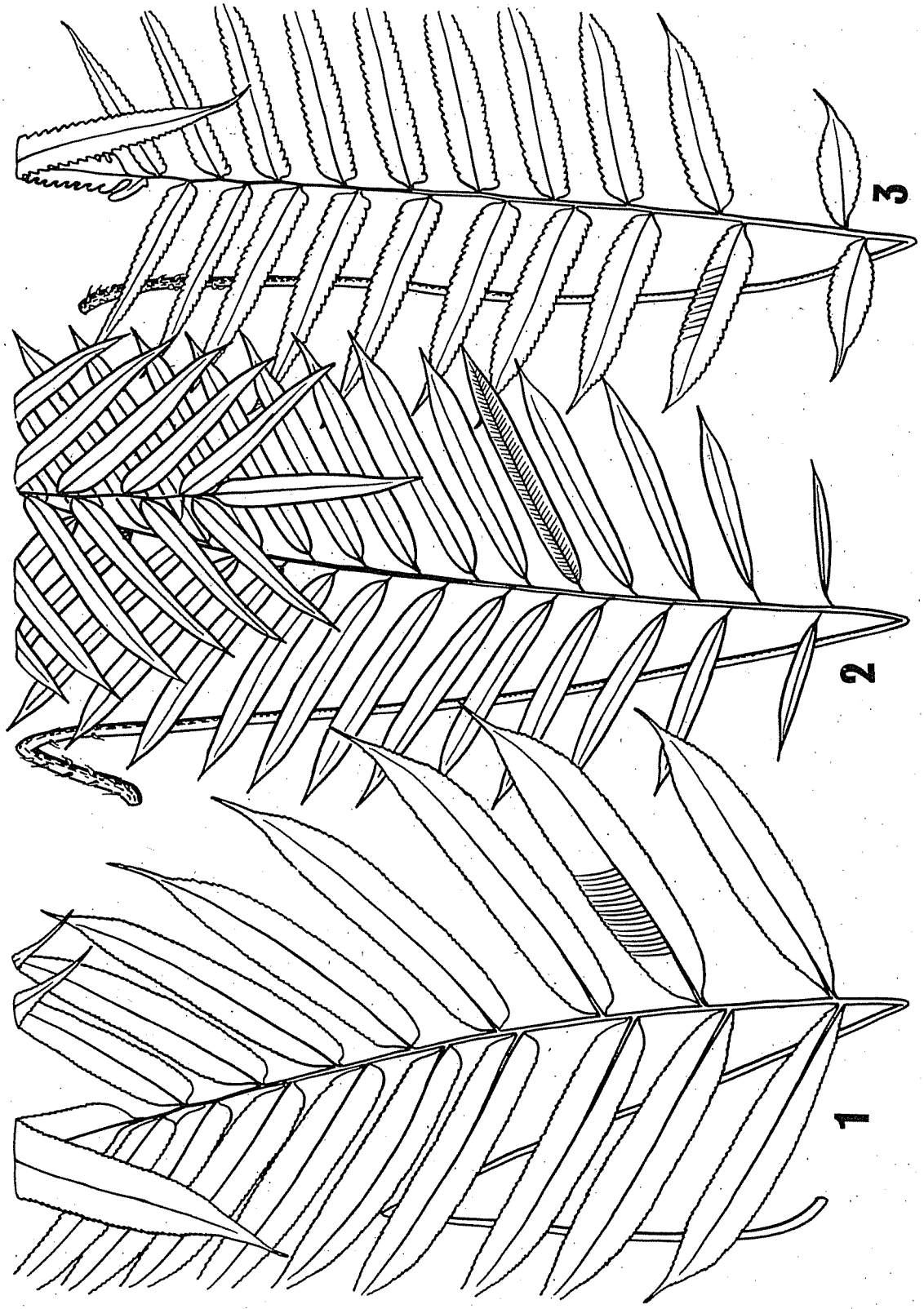


Figure 41. Fertile fronds of *Thelypteris* species; 1. *T. nudata*, 2. *T. penangiana*, 3. *T. articulata*, all x 0.25.

T h a i l a n d.— NORTHERN : Lampang, Tak (Doi Musoe); SOUTH-WESTERN : Kanchanaburi (Erawan Falls, Phomphi).

D i s t r i b u t i o n.— Ceylon, Himalaya (type), Burma, and W. China.

E c o l o g y.— Moist evergreen forests along streamlets at medium altitudes.

13. Thelypteris penangiana (Hook.) Reed, Phytologia 17 : 303. 1968; Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 170. 1975.— *Polypodium penangianum* Hook., Sp. Fil. 5 : 13. 1863.— *Nephrodium costatum* Bedd., Ferns Br. Ind. : t. 220. 1867; Handb. : 275. 1883; Suppl. : 73. 1892.— *Abacopteris penangiana* (Hook.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 255. 1938.— *Pronephrium penangianum* (Hook.) Holtt., Blumea 20 : 110. 1972. Figure 41. 2; 42. 4–5.

Rhizome creeping; scales oblong to oblong-lanceolate with acute apex, up to 7 by 2.5 mm, brown, glabrous, or with marginal hairs. *Stipe* stramineous with dark base, up to 60 cm long, sparsely scaly at base, glabrescent upwards. *Lamina* oblong-lanceolate, up to 60 by 25 cm, imparipinnate with 15–20 pairs of lateral pinnae, basal pinna more or less reduced; lateral pinnae straight, ascending, shortly petiolate, narrowly lanceolate, caudately acuminate at apex, cuneate at base, up to 15 by 2 cm, submucronate, serrate at margin; lobes indistinct in appearance but separated by prominent callous membrane at sinus often forming sinus-teeth by callous membrane, costa and costules raised beneath, veins 7–9 pairs, distinct, glabrous or very sparsely minutely hairy. *Sori* medial, exindusiate; sporangia not setose.

T h a i l a n d.— SOUTH-WESTERN : Kanchanaburi (Erawan Falls).

D i s t r i b u t i o n.— Himalaya (type), to S. and SW. China.

E c o l o g y.— Along streams in rather dry valley-forests at about 150 m alt.; once collected : MURATA et al., T-16181 (BKF, K, KYO, L, P).

N o t e.— The specific epithetis derived by the specimen of WALLICH, though it is suggested as erroneous (HOLTTUM 1972).

14. Thelypteris glandulosa (Bl.) Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 54. 1968.— *Aspidium glandulosum* Bl., En. Pl. Jav.: 144. 1828.— *Nephrodium glandulosum* (Bl.) Hook., Sp. Fil. 4 : 76. 1862; Bedd., Handb.: 273. 1883; Suppl.: 70. 1892.— *Cyclosorus glandulosus* (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 227. 1938; Holtt., Rev. Fl. Malaya 2 : 278. f. 160. 1955.— *Pronephrium glandulosum* (Bl.) Holtt., Blumea 20 : 118. 1972; in Fl. Mal. II. 1 : 522. 1981. Figure 40. 4–5.

Similar to *T. articulata* but different in : plants smaller, lamina up to 50 cm long, with closely placed lateral pinnae; lower surface of lamina glandular with round yellowish glands; lower two pairs of veinlets anastomosing; sori usually confluent at maturity.

T h a i l a n d.— PENINSULAR : Yala (Bannang Sata).

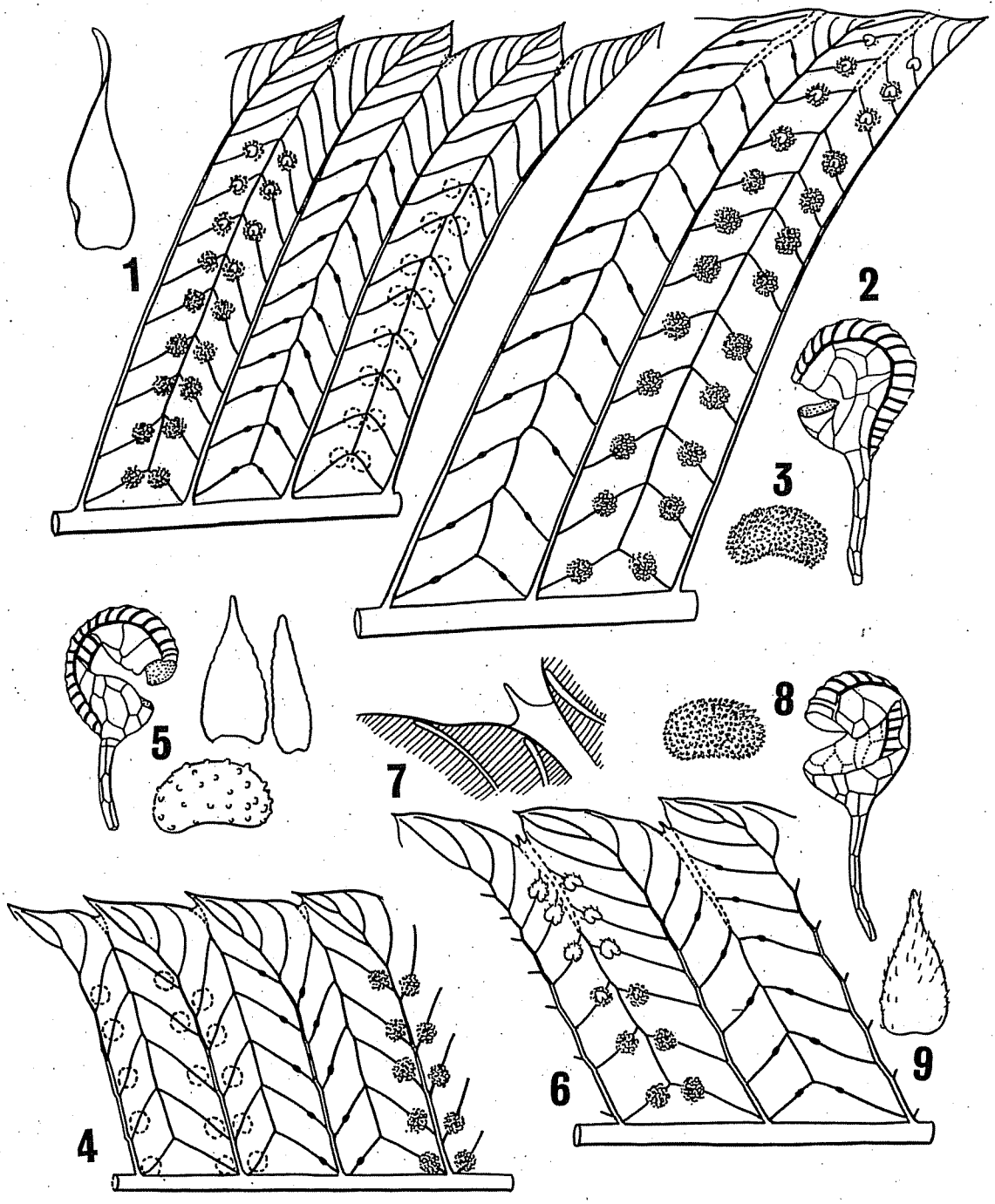


Figure 42. 1:*Thelypteris nudata* var. *nudata*; venation (x 4) and scale (x 10). 2–3: *T. nudata* var. *malayensis*; 2. venation, x 4; 3. sporangium (x 60) and spore (x 300). 4–5: *T. penangiana*; 4. venation, x 5; 5. sporangium (x 60), spore (x 300) and scale of stipe base (x 8). 6–9: *T. articulata*; 6. venation, x 5; 7. tip of callous membrane, enlarged; 8. sporangium (x 60) and spore (x 300); 9. scale of stipe base, x 8.

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

Ecology.— Terrestrial near streams at low altitudes.

15. Thelypteris exsculpta (Bak.) K. Iwats., Acta Phytotax. Geobot. 21 : 170. 1965; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 175. 1969.— *Acrostichum exsculptum* Bak., J. Bot. 26 : 326. 1888.— *Pronephrium exsculptum* (Bak.) Holtt., Blumea 20 : 117. 1972.— *Pronephrium affine* auct. non (Bl.) Presl : Holtt., Blumea 20 : 121. 1972; in Fl. Mal. II. 1 : 527. 1981.

Rhizome short, ascending; scales small, brown, hairy. *Frond* dimorphic, fertile frond taller. *Stipe* hairy throughout, up to 15 cm long in fertile and 7 cm in sterile ones. *Lamina* oblong to oblong-lanceolate, acute at apex, up to 15 by 4 cm in fertile, and 12 by 5 cm in sterile ones, without distinct terminal pinnae; sterile pinnae about 7 pairs, gradually narrowing towards acute apex, distinctly auricled at acroscopic and broadly cuneate at basiscopic bases, shortly stalked or sessile, nearly entire, up to 30 by 6 mm; chartaceous, deep green, verrucose below, venation meniscioid, areoles 2 or 3 rows; fertile pinnae narrower, up to 25 by 6 mm, with auricles at acroscopic base, shortly stalked. *Sori* round when young, indusiate, becoming confluent at maturity; indusia small, dark green, setose.

Thailand.— PENINSULAR : Yala (Betong).

Distribution.— Borneo (type).

Ecology.— On logs in streams at low altitudes.

16. Thelypteris menisciicarpa (Bl.) K. Iwats., Acta Phytotax. Geobot. 21 : 171. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3): 81. 1965.— *Aspidium menisciicarpon* Bl., En. Pl. Jav.: 142. 1828.— *Abacopteris menisciicarpa* (Bl.) Holtt., Rev. Fl. Malaya 2 : 290. f. 168. 1955; Dansk Bot. Ark. 20 : 23. 1961.— *Pronephrium menisciicarpon* (Bl.) Holtt., Blumea 20 : 111. 1972; in Fl. Mal. II. 1 : 526. 1981.

Rhizome short, with closely spaced stipes; scales membranous, brown, oblong with tailed apex, up to 5 by 1.5 mm, hairy. *Frond* subdimorphic with fertile ones taller. *Stipe* of fertile frond up to 35 cm long, of sterile ones 5 –15 cm long, hairy throughout, scaly near base, rather fleshy in living condition. *Lamina* oblong, up to 30 by 12 cm in fertile and 35 by 20 cm in sterile fronds; lateral pinnae about 5 pairs, sessile, narrowly oblong, caudate-acuminate at apex, broadly cuneate to subtruncate at base, sometimes auricled acroscopically, up to 6 by 2 cm in fertile and 10 by 2.5 cm in sterile ones, chartaceous, fleshy in living condition, verrucose below, subentire; venation meniscioid, obscure. *Sori* round, usually confluent to appear crescent-shaped at maturity; indusia brown, persistent, hairy; sporangia setose.

Thailand.— SOUTH-WESTERN : Prachuap Khiri Khan (Bang Saphan); PENINSULAR : Surat Thani (Ban Don), Trang (Khao Chong), Yala (Bannang Sata).

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

E c o l o g y.— On muddy rocks by streams in evergreen forests at low altitudes.

V e r n a c u l a r.— Kut huai (กูดห้วย) (Northern).

17. Thelypteris aspera (Presl) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 192. 1965; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25 : 17. 1971.— *Goniopteris aspera* Presl, Tent. Pterid. : 183. 1836, based on *Polypodium asperum* Presl, Rel. Haenk. 1 : 24. t. 3. f. 4. 1825, non Linn. 1753.— *Dryopteris gymnopteridifrons* Hayata, Ic. Pl. Formos. 8 : 148. f. 75, 76. 1919.— *Abacopteris presliana* (Ching) Ching, Bull. Fan Mem. Inst. Biol. 8 : 248. 1938.— *Pronephrium asperum* (Presl) Holtt., Blumea 20 : 112. 1972; in Fl. Mal. II. 1 : 512. f. 14, g-i. 1981.— *Pronephrium gymnopteridifrons* (Hayata) Holtt., Blumea 20 : 112. 1972.— *Thelypteris urophylla* auct. non (Wall. ex Hook.) K. Iwats. : Tagawa & K. Iwats., Southeast As. St. 5 : 71. 1967, p.p.

Rhizome creeping; scales oblong-subtriangular, about 7 by 1.2 mm, pale brown, hairy at margin. *Stipe* about 50 cm long, dark and scaly at base. *Lamina* oblong, about 50 by 30 cm; lateral pinnae about 4–6 pairs, lowest pair sometimes reduced, upper ones larger, sessile, narrowly oblong, caudate at apex, gradually narrowing towards narrowly cuneate base, about 20 by 4.5 cm, subentire or irregularly undulate, cartilagineous at margin; venation meniscioid; texture papyraceous, firm, pale green to green, verrucose, sparsely pubescent or glabrescent. *Sori* in two rows, medial one close to excurrent veinlets; indusia small, persistent but usually immersed among sporangia at maturity, hairy; sporangia with a few setose hairs.

T h a i l a n d.— NORTHERN : Lampang (Mae Ngao); NORTH-EASTERN :Loei (Phu Luang).

D i s t r i b u t i o n.— S. China, Taiwan, Malesia throughout (type from Luzon) to N. Queensland.

E c o l o g y.— Terrestrial on rather dry slopes in evergreen forests along streamlets at medium altitudes.

V e r n a c u l a r.— Kut tong (กูดตอง) (Northern).

N o t e.— HOLTTUM (1972) distinguished *P. gymnopteridifrons* from *T. aspera* on the basis of the long-creeping rhizome, fewer pairs of lateral pinnae and smaller wings of spore sculpture. As noted by IWATSUKI (1965), the pinnae vary in number between 4–8 in Taiwan plants, and the rhizome is short or long according to soil condition. Thai materials belong strictly to *T. gymnopteridifrons* but we treat this as conspecific with *T. aspera*.

18. Thelypteris nudata (Roxb.) Morton, Contr. U.S. Nat. Herb. 38 : 352. 1974; Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 170. 1975.— *Polypodium nudatum*

Roxb., Calc. J. Nat. Hist. 4 : 491. 1844.—*Polypodium multilineatum* Wall. ex Hook., Sp. Fil. 5 : 11. 1863.— *Nephrodium moulmeinense* Bedd., Ferns Br. Ind. Suppl. : 18. 1876; Handb. 275. f. 141. 1883.— *Nephrodium multilineatum* (Wall. ex Hook.) Bedd., Handb. Suppl. : 80. 1892.— *Dryopteris moulmeinense* (Bedd.) C. Chr., Ind. Fil. : 278. 1905; Contr. U.S. Nat. Herb. 26 : 330. 1931.— *Abacopteris multilineata* (Wall. ex Hook.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 253. 1938; Holtt., Rev. Fl. Malaya 2 : 297. 1955; Dansk Bot. Ark. 20 : 23. 1961.— *Cyclosorus multilineatus* (Wall. ex Hook.) Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 358. 1941.— *Thelypteris multilineata* (Wall. ex Hook.) Morton, Amer. Fern J. 49 : 113. 1959; K. Iwats., J. Jap. Bot. 38 : 315. 1963; Tagawa & K. Iwats., Southeast As. St. 3(3) : 80. 1965; 5 : 70. 1967, cum var. *malayensis*.— *Dryopteris urophyllum* auct. non (Mett.) C. Chr. : Bonap., Not. Pterid. 14 : 49. 1923.— *Nephrodium urophyllum* auct. non (Mett.) Keys. : E. Smith, J. Siam. Soc. Nat. Hist. Suppl. 8 : 5. 1929.— *Pronephrium nudatum* (Roxb.) Holtt., Blumea 20 : 111. 1972. Figure 41. 1, 42. 2–3.

Rhizome creeping, about 5 mm diam.; scales caducous, dark brown, hairy. *Stipe* about 50 cm long, scaly at base. *Lamina* oblong, up to 100 by 50 cm; lateral pinnae lanceolate, sessile, ascending, gradually narrowing towards long-acuminate apex, rounded to narrowly cuneate at base, subentire or crenate, up to 40 by 4 cm; terminal pinna like lateral ones, rounded to subtruncate at base; marginal lobes acute at apex, with cartilaginous margin; chartaceous, green, verrucose on lower surface; venation meniscioid. *Sori* rather close to excurrent veinlets or medial in two rows between costules; indusia setose.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok, Doi Tung, Doi Phacho), Chiang Mai (Doi Phahom Pok, Chiang Dao, Pong Pa Po, Pang Kia, Ban Mae Kon, Doi Suthep, Wang Tao, Pong Khrai, Ban Huai Khrai), Mae Hong Son (Mae La Noi, Pha Mong), Lampang, Tak (Ban Musoe), Nan (Pha Sing), Phitsanulok (Thung Salaeng Luang), Phrae (Mae Sai); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao, Pong Nam Ron), Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Wangka); PENINSULAR : Surat Thani (Ko Tao), Nakhon Si Thammarat (Khao Luang, Khiriwong), Phangnga, Yala (Bannang Sata).

D i s t r i b u t i o n.— Himalaya (type), Burma, China and N. Vietnam.

E c o l o g y.— On rather dry ground in light shade or in dense forests at medium altitudes.

V e r n a c u l a r.— Kut daeng (กูดแดง) (South-eastern).

N o t e.— Peninsular specimens are different from the typical form in lateral pinnae, which are more than 4.5 cm broad, papyraceous, and crenate at margin, the lobes with rounded apex. This form is similar to *T. aspera* in some respects, but distinct.

19. Thelypteris lakhimpurensis (Rosenst.) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 194. 1965.— *Dryopteris lakhimpurensis* Rosenst., Med. Rijksherb. 31 : 7. 1917.— *Pronephrium lakhimpurense* (Rosenst.) Holtt., Blumea 20 : 110. 1972.—

Dryopteris rubra Ching, Bull. Fan Mem. Inst. Biol. 2 : 198. t. 12. 1931.— *Abacopteris rubra* (Ching) Ching, Bull. Fan Mem. Inst. Biol. 8 : 245. 1938; Holtt., Dansk Bot. Ark. 20 : 23. 1961.— *Cyclosorus rubra* (Ching) Tard. ex Tard. & C. Chr., Notul. Syst. 7 : 76. 1938; in Fl. Gén. I.-C. 7(2) : 390. 1941.— *Thelypteris rubra* (Ching) K. Iwats., J. Jap. Bot. 38 : 315. 1963; Tagawa & K. Iwats., Southeast As. St. 3(3) : 81. 1965; 5 : 70. 1967.— *Cyclosorus moulmeinensis* auct. non (Bedd.) Copel.: Holtt., Dansk Bot. Ark. 23 : 233. 1965.

Rhizome creeping, 6–8 mm diam., blackish; scales oblong-ovate with tails, up to 5 by 1.3 mm, brown, hairy. *Stipe* up to 100 cm long, stramineous with dark scaly base. *Lamina* oblong, nearly as long as stipes, up to 50 cm wide; lateral pinnae 6–9 pairs, subsessile, ascending, narrowly oblong, cuspidate at apex, rounded to broadly cuneate at base, subentire or irregularly undulate, up to 30 by 5.5 cm, basal pinnae reduced or not; thin, papyraceous to herbaceous, green to dark green, tinted red in dried specimens, glabrous; venation meniscioid, or excurrent veins interrupted. *Sori* in two rows usually close to excurrent veinlets, round to oblong, often confluent at maturity, naked; sporangia not setose.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Lao, Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon, Ban Yang), Mae Hong Son, Tak (Doi Musoe), Phitsanulok (Thung Salaeng Luang, Phu Miang); NORTH-EASTERN: Loei (Phu Luang); SOUTH-WESTERN : Kanchanaburi (Song Tho).

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

E c o l o g y.— On humus-rich slopes usually near streams in forests at medium altitudes.

V e r n a c u l a r.— Kut sang (กูดซาง) (Northern).

N o t e.— CHING recognized var. *hirta* under his *Abacopteris rubra* for plants with dense hairs on the lower laminar surface. Indumentum is variable in this species, ranging from fronds quite glabrous underneath, hairy on costae and/or on veins, and on lower laminar surface. Density of hairs is also variable without any positive correlation with distribution or ecology. Moreover, young plants often bear hairs on lower laminar surface and become glabrescent with age.

20. Thelypteris repanda (Fée) Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 170. 1975.— *Goniopteris repanda* Fée, Gen. Fil. : 251. 1852.— *Pronephrium repandum* (Fée) Holtt., Blumea 20 : 108. 1972; in Fl. Mal. II. 1 : 533. f. 1 n, 16 i-j. 1981.— *Phegopteris urophylla* Mett., Pheg. Aspid. : 26. 1858, excl. syn. and var.— *Polypodium urophyllum* Wall. ex Hook., Sp. Fil. 5 : 9. 1863.— *Nephrodium urophyllum* (Mett.) Keys., Pol. Cyath. Hb. Bung.: 49. 1873; Bedd., Handb.: 274. f. 140. 1883; Suppl.: 72. 1892.— *Cyclosorus urophyllus* (Mett.) Tard. ex Tard. & C. Chr., Not. Syst. 7 : 77. 1938; in Fl. Gén. I.-C. 7(2) : 391. 1941.— *Abacopteris urophylla* (Mett.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 251. 1938; Holtt., Rev. Fl. Malaya 2 : 296. f. 172. 1955; Dansk Bot. Ark. 20 : 24. 1961.— *Thelypteris urophylla* (Mett.) K. Iwats. in Tagawa & K. Iwats., Southeast As. St. 3(3) : 81. 1965; 5 : 71. 1967; Acta Phytotax. Geobot. 23 : 54. 1968.

Rhizome creeping, about 1 cm diam.; scales narrow, up to 15 by 1.2 mm, dark brown to blackish, hairy at margin as well as on dorsal surface. *Stipe* up to 80 cm long, brownish with dark scaly base. *Lamina* oblong to obovate, 40 – 70 by about 50 cm; lateral pinnae about 5 pairs, basal pinnae sometimes reduced, lower ones shortly stalked, oblong-lanceolate, cuspidate at apex, cuneate at base, up to 30 by 5.5 cm, irregularly undulate at margin; terminal pinna longer, broader; papyraceous, firm, yellowish-green to green, verrucose; venation meniscioid. *Sori* in two medial to subcostular rows, exindusiate; sporangia with several setose hairs.

T h a i l a n d.— SOUTH-WESTERN : Kanchanaburi (Wangka); PENINSULAR : Chumphon (Khao Tong), Surat Thani (Ban Don), Phuket, Nakhon Si Thammarat (Khao Luang, Thung Song), Trang (Khao Chong), Satun, Yala (Bannang Sata, Bo Hin).

D i s t r i b u t i o n.— Burma (Moulmein), N. Vietnam, Malaya (type), Sumatra, Borneo (var. *nitida*), W. Java, Celebes (var. *nitida*) and Philippines (var. *nitida*).

E c o l o g y.— On humus-rich mountain slopes in dense evergreen forests at low to medium altitudes.

21. Thelypteris triphylla (Sw.) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 190. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 70. 1967.— *Meniscium triphyllum* Sw., Schrad. J. Bot. 1800 (2) : 16. 1801; Bedd., Handb.: 397. f. 231. 1883; Christ, Bot. Tidsskr. 24 : 109. 1901.— *Dryopteris triphylla* (Sw.) C. Chr., Ind. Fil.: 298. 1905; Bot. Tidsskr. 32 : 343. 1916; Seidenf., Nat. Hist. Bull. Siam Soc. 19 : 87. 1958.— *Cyclosorus triphyllus* (Sw.) Tard. ex Tard. & C. Chr., Notul. Syst. 7 : 77. 1938; in Fl. Gén. I.-C. 7(2) : 386. 1941.— *Abacopteris triphylla* (Sw.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 241. 1938; Holtt., Rev. Fl. Malaya 2 : 287. f. 166. 1955.— *Pronephrium triphyllum* (Sw.) Holtt., Blumea 20 : 122. 1972; in Fl. Mal. II. 1 : 534. f. 16 k-1. 1981.

Rhizome long-creeping, about 3 mm diam.; scales narrow, up to 5 by 0.6 mm, brown, hairy. *Stipe* remote, about 50 cm long, stramineous with dark scaly base, hairy. *Lamina* trilobed; terminal pinna larger, oblong-lanceolate, caudate-acuminate at apex, rounded to cuneate at base, up to 25 by 5 cm, subentire or irregularly undulate; lateral pinnae in one opposite pair, more or less falcate, caudate at apex, cuneate to round at base, 4 – 15 by 1.2 – 2.5 cm; venation meniscioid, hairy; texture herbaceous to thinly papyraceous, deep green, often tinted red in dried specimens. *Sori* elongate along united veinlets, crescent-shaped, naked; sporangia setiferous.

T h a i l a n d.— NORTHERN : Chiang Rai, Phitsanulok (Nakhon Thai); NORTH-EASTERN : Loei (Phu Kradueng), Nong Khai; CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chon Buri (Si Racha), Chanthaburi (Khao Sabap), Trat (Ko Chang, Huai Raeng); PENINSULAR : Ranong (Kapoe, Muang Laen), Phangnga (Tha Nun), Narathiwat (Waeng).

D i s t r i b u t i o n.— Tropics of Asia to Australia, north to southern edge of Japan (Type is without locality in S-PA).

E c o l o g y.— Rather rare on dry banks of river in shade at low altitudes.

var. **parishii** (Bedd.) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 191. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 70. 1967.— *Meniscium parishii* Bedd., Ferns Br. Ind.: t. 184. 1866.— *Meniscium triphyllum* var. *parishii* (Bedd.) Bedd., Handb.: 399. 1883; Suppl.: 102. 1892.— *Cyclosorus parishii* (Bedd.) Tard. ex Tard. & C. Chr., Notul. Syst. 7 : 76. 1938; in Fl. Gén. I.-C. 7(2) : 387. 1941.— *Abacopteris triphylla* var. *parishii* (Bedd.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 242. 1938; Holtt., Rev. Fl. Malaya 2 : 287. 1955.— *Pronephrium parishii* (Bedd.) Holtt., Blumea 20 : 123. 1972; in Fl. Mal. II. 1 : 535. 1981.

Different from the type variety in having more than two pairs of lateral pinnae.

T h a i l a n d.— NORTH-EASTERN : Loei (Huai Ya); CENTRAL : Nakhon Nayok (Khao Yai).

D i s t r i b u t i o n.— India, Burma (type), Indochina, Malaya, Taiwan and the Ryukyus.

E c o l o g y.— On rather dry river-banks in light shade at medium altitudes.

N o t e.— The specimen from Huai Ya has lobed terminal pinnae which are similar to those of *T. insularis* of the Ryukyus and to *T. thwaitesii* of Ceylon.

22. Thelypteris unita (Linn.) Morton, Amer. Fern J. 49 : 113. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25 : 16. 1971.— *Polypodium unitum* Linn., Syst. Nat. ed. 10. 2 : 1362. 1759.— *Nephrodium unitum* (Linn.) R. Br., Prod.: 148. 1810; Bedd., Handb.: 268. 1883.— *Cyclosorus unitus* (Linn.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 192. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 396. 1941; Holtt., Rev. Fl. Malaya 2 : 260. f. 1955.— *Sphaerostephanos unitus* (Linn.) Holtt., J. S. Afr. Bot. 40 : 165. 1974; Kalikasan 4 : 63. 1975; in Fl. Mal. II. 1 : 477. 1981.

Rhizome long-creeping, about 3 mm diam.; scales brown to paler, membranous, up to 5 by 1.5 mm. *Stipe* 20–50 cm long, scaly and hairy near base, bearing extremely reduced pinnae on upper portion. *Lamina* oblong-lanceolate, gradually narrowing downwards, acute at apex; rhachis densely hairy throughout; lower pinnae reduced to auricles, middle pinnae sessile, patent, linear-lanceolate gradually narrowing towards long-acuminate apex, up to 10 by 1 cm, lobed $\frac{1}{5}$ - $\frac{1}{4}$ way towards costa; segments subdeltoid, acute to aciculate at apex, entire, coriaceous, pubescent on lower surface, costa underneath densely hairy with short and appressed hairs; veins pinnate, not glandular. *Sori* medial; indusia hairy, persistent.

T h a i l a n d.— PENINSULAR : Chumphon, Satun.

D i s t r i b u t i o n.— Sri Lanka, S. India, N. Vietnam, Malaya, Philippines, New Guinea, Micronesia to Polynesia (type without locality).

E c o l o g y.— Edge of streams near sea-level.

23. Thelypteris polycarpa (Bl.) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 32. 1964; Tagawa & K. Iwats., Southeast As. St. 3(3): 78. 1965; 5 : 69. 1967; Acta Phytotax. Geobot. 23 : 54. 1968.— *Aspidium polycarpum* Bl., En. Pl. Jav.: 156. 1828.— *Nephrodium polycarpum* (Bl.) Keys., Pol. Cyath. Hb. Bung.: 7. 1873; Bedd., Handb. Suppl.: 74. 1892.— *Cyclosorus polycarpus* (Bl.) Holtt., Rev. Fl. Malaya 2 : 283. f. 164. 1955.— *Mesochlaena polycarpa* (Bl.) Bedd., Ferns Br. Ind. Suppl.: 13. 1876; Handb.: 199. f. 100. 1883.— *Sphaerostephanos polycarpus* (Bl.) Copel., Univ. Calif. Publ. Bot. 16 : 60. 1929; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 400. f. 33. 3–4. 1941; Holtt., Blumea 19 : 40. 1971; Kalikasan 4 : 56. 1975; in Fl. Mal. II. 1 : 448. f. 12 a-c. 1981.

Rhizome massive, erect; scales narrow, up to 20 by 1.2 mm, hairy at margin as well as on dorsal surface, concolorous brown. *Stipe* about 100 cm long, 2 cm diam., hairy, bearing reduced pinnae nearly to base. *Lamina* about 100 by 50 cm, oblong-lanceolate; lower pinnae suddenly reduced to butterfly-like projections and to mere auricles, middle pinnae nearly straight, ascending or patent, linear, up to 30 by 2 cm, lobed to a half-way towards costa; segments oblong, oblique, rounded at apex, entire; chartaceous, green; rachis and costa pubescent; veins pinnate, veinlets more than 15 pairs, simple, lower 2.5 pairs usually uniting below sinus, hirsute on both surfaces, ending in hydathodes just inside the margin. *Sori* medial, elongate along veinlets, up to 1.5 by 0.2 mm, confluent at maturity; indusia oblong, dark, hairy.

T h a i l a n d.— SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ban Don), Phangnga (Khao Nang Hong), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong, Khao Khao), Satun, Narathiwat (Waeng), Yala (Betong, Ban Chana).

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

E c o l o g y.— On rather dry ground by paths in open places at low altitudes.

24. Thelypteris heterocarpa (Bl.) Morton, Amer. Fern J. 49 : 113. 1959.— *Aspidium heterocarpum* Bl., En. Pl. Jav.: 155. 1828.— *Cyclosorus heterocarpus* (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 180. 1938; Tard. & C. Chr. in Fl. Gen. I.-C. 7(2) : 385. 1941; Holtt., Rev. Fl. Malaya 2 : 269. f. 155. 1955.— *Sphaerostephanos heterocarpus* (Bl.) Holtt. in Nayar & Kaur, Comp. Bedd. Handb.: 209. 1974; Kalikasan 4 : 67. 1975; in Fl. Mal. II. 1 : 457. f. 1 g. 1981.— *Nephrodium glaucostipes* Bedd., Handb. Suppl. : 80. 1892.

Rhizome erect; scales narrow, up to 8 by 1.2 mm, hirsute, dark brown. *Stipe* about 50 cm long, bearing reduced pinnae nearly to base, hirsute. *Lamina* oblong-lanceolate, acute at apex, lower pinnae suddenly reduced in size to mere auricles, middle pinnae larger, nearly straight, ascending, linear-lanceolate, caudate-acuminate at apex, cuneate at sessile base, up to 15 by 1.8 cm, lobed to half-way towards costa; segments oblong, oblique, rounded to obtuse at apex; thinly papyraceous, green to yellowish-green, pubescent on upper surface, glandular below; rachis and costa hairy

throughout; veins pinnate, veinlets simple, 1.5 basal pairs uniting below sinus. *Sori* medial; indusia persistent, brown at maturity, hairy.

T h a i l a n d.— SOUTH-EASTERN : Chanthaburi (Khao Sabap); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Thung Song), Satun, Narathiwat (Bacho Falls), Yala (Ban Wing, Bannang Sata).

D i s t r i b u t i o n.— S. China, Vietnam, Malesia throughout (type from Java) to Polynesia.

E c o l o g y.— Terrestrial in evergreen forests at low altitudes.

25. Thelypteris larutensis (Bedd.) Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 53. 1968.— *Nephrodium larutense* Bedd., Handb. Suppl. : 73. 1892.— *Sphaerostephanos larutensis* (Bedd.) C. Chr., Ind. Fil. Suppl. 3 : 172. 1934; Holtt., in Fl. Mal. II. 1 : 489. f. 12 d-e. 1981.— *Cyclosorus larutense* (Bedd.) Ching, Bull. Fan Mem. Inst. Biol. 10 : 245. 1941; Holtt., Rev. Fl. Malaya 2 : 284. f. 165. 1955.

Rhizome short; scales narrow, hairy. *Stipe* hairy throughout, scaly near base, bearing reduced pinnae. *Lamina* oblong-lanceolate, with a distinct terminal pinna; middle lateral pinnae narrowly lanceolate, gradually narrowing towards long-acuminate apex, subtruncate to broadly cuneate at sessile base, up to 25 by 3.5 cm, lobed to $\frac{1}{4}$ way towards costa; segments oblique, round to obtuse at apex, papyraceous, pubescent on both surfaces; rachis and costa hairy, hairs setose, multicellular; veins pinnate, veinlets 10—12 pairs, several basal pairs uniting to form a long excurrent vein, hairy, glandular on under surface. *Sori* medial, oblong, hardly confluent at maturity; indusia oblong, persistent, up to 1.7 by 0.7 mm, bearing round, red, sessile glands and setose hairs.

T h a i l a n d.—PENINSULAR : Yala (Muang Wing).

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

E c o l o g y.— In shade at low altitudes.

26. Thelypteris megaphylla (Mett.) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 34. 1964; Tagawa & K. Iwats., Southeast As St. 3(3) : 80. 1965; 5 : 70. 1967; Acta Phytotax. Geobot. 23 : 54. 1968.— *Aspidium megaphyllum* Mett., Ann. Mus. Lugd. Bat. 1 : 233. 1864.— *Cyclosorus megaphyllus* (Mett.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 225. 1938; Holtt., Rev. Fl. Malaya 2 : 268. f. 154. 1955.— *Cyclosorus euphlebius* auct. non Ching; Holtt., Dansk Bot. Ark. 23 : 232. 1965.— *Sphaerostephanos penniger* (Hook.) Holtt. in Nayar & Kaur, Comp. Bedd.: 209. 1974; in Fl. Mal. II. 1 : 461. f. 1 a-h. 1981. Figure 43. 3—4.

Rhizome short, massive; scales linear-lanceolate with long tails, about 15 by 2 mm, dark brown, hairy at margin as well as on dorsal surface. *Stipe* stramineous, hairy throughout, bearing small reduced pinnae on upper portion, about 50 cm long.

Lamina up to 100 by 50 cm; rachis densely setose hairy; lower pinnae suddenly reduced to form butterfly-shaped auricles, middle pinnae larger, ascending, linear-lanceolate, widest at middle portion, rather suddenly narrowing towards acute apex, narrowing towards base, cuneate to subtruncate at basiscopic and truncate to auricled at acroscopic bases, sessile, up to 30 by 3.2 cm, lobed to $\frac{1}{4}$ way towards costa; segments oblong-subdeltoid, oblique, round to moderately acute at apex, entire; papyraceous to chartaceous, green, covered with round yellow glands on both surfaces; veins pinnate, veinlets simple, several lower pairs anastomosing, pubescent. *Sori* medial; indusia round reniform to horse-shoe-shaped, sometimes confluent, pubescent.

T h a i l a n d.— SOUTH-WESTERN : Kanchanaburi (Sai Yok, Wangka); PENINSULAR : Nakhon Si Thammarat (Khiriwong, Khao Luang), Trang (Khao Chong), Yala (Bannang Sata).

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

E c o l o g y.— On moist slopes in dense evergreen forests at low altitudes.

27. Thelypteris hirtisora (C. Chr.) K. Iwats., J. Jap. Bot. 38 : 314. 1963; Tagawa & K. Iwats., Southeast As. St. 5 : 66. 1967.— *Dryopteris hirtisora* C. Chr., Contr. U.S. Nat. Herb. 26 : 277, 330. 1931.— *Cyclosorus hirtisorus* (C. Chr.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 221. 1938.— *Cyclosorus validus* auct. non (Christ) Tard.: Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 398. 1941, p.p.— *Cyclosorus acuminatus* auct. non (Houtt.) Nakai ex H. Ito : Holtt., Dansk Bot. Ark. 20 : 22. 1961. Figure 43. 1–2.

Rhizome long-creeping, about 6 mm diam.; scales up to 10 by 1.5 mm, brown, hairy. *Stipe* 20–50 cm long, scaly at base, hirsute throughout. *Lamina* oblong or subrectangular with a long terminal pinna, up to 80 by 45 cm; lower pinnae hardly reduced, or lower one or two pairs slightly reduced and deflexed, larger pinnae patent to slightly ascending, about 12 pairs, nearly straight, shortly stalked, linear, gradually narrowing to long-acuminate apex, round to broadly cuneate at base, up to 25 by 2.5 cm, lobed more than $\frac{1}{3}$ way towards costa; segments subdeltoid, oblique, acute at apex; softly papyraceous, hirsute on surface, more than 2 pairs of lower veinlets truly anastomosing below callous-sinus. *Sori* medial, round; indusia rather small, hairy, persistent but usually under sporangia in matured sori; sporangia setose.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Doi Phacho, Chiang Kham), Chiang Mai (Doi Suthep, Doi Chang, Doi Hua Mot, Mae Klang, Ban Yang), Tak (Ban Musoe); NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); SOUTH-WESTERN : Kanchanaburi (Khao Ngua).

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

E c o l o g y.— On rather dry slopes in mixed or evergreen forests at medium altitudes at 600–1300 m alt.

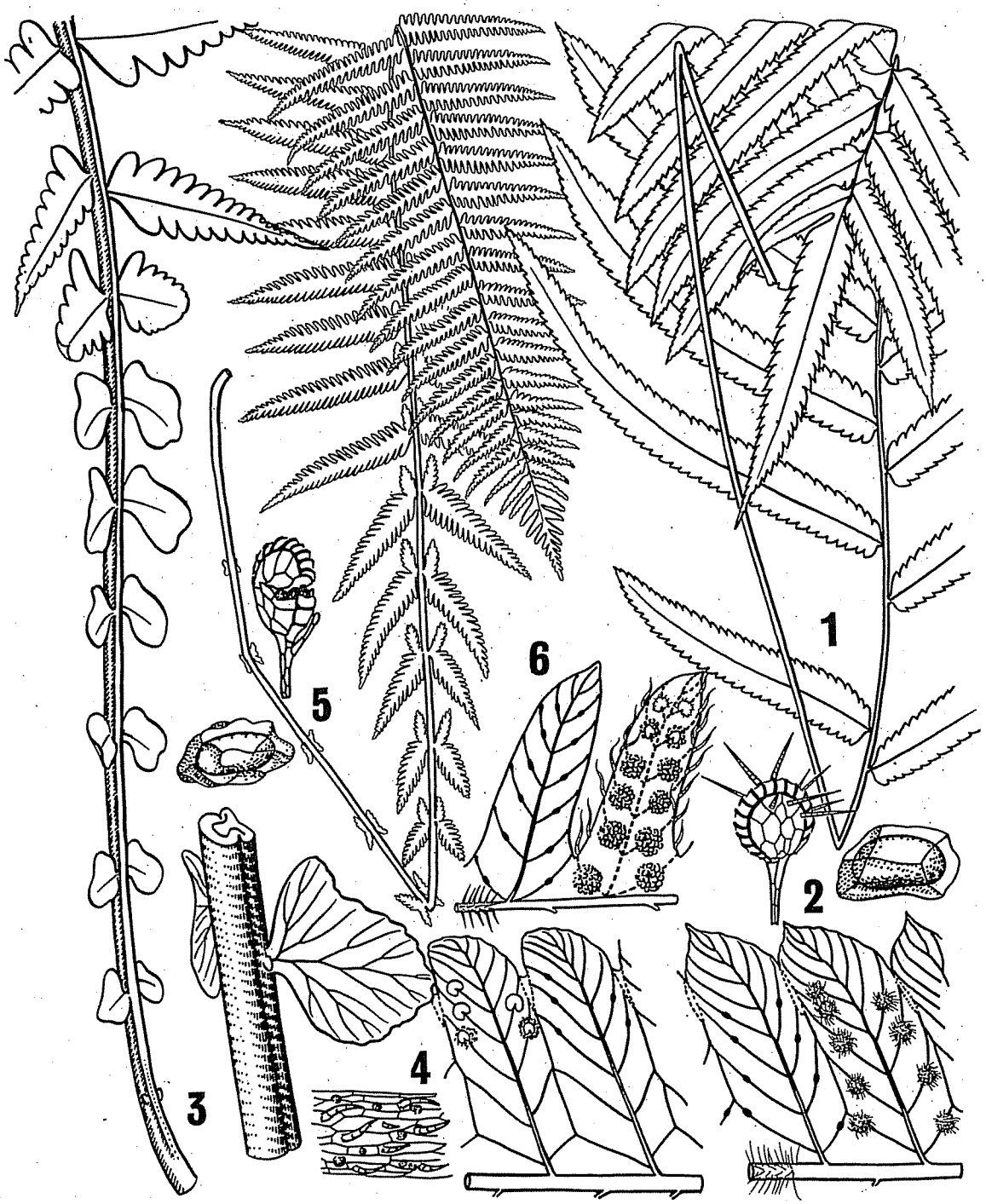


Figure 43. 1–2: *Thelypteris hirtisora*; 1. frond, x 0.5; 2. lobes enlarged (below, x 3), sporangium (x 40) and spore (x 200). 3–4: *T. megaphylla*; 3. basal part of frond (left, x 0.5) and portion seeing from the back (x 1.25); 4. lobes of fertile pinna (right, x 4), short hairs and glands on costa (left below, x 20). 5–6: *Thelypteris repens*; 5. frond (x 0.5), sporangium (x 40) and spore (x 200); 6. lobes, x 5.

28. Thelypteris valida (Christ) Tagawa & K. Iwats., Acta Phytotax. Geobot. 22 : 101. 1967; Southeast As. St. 5 : 67. 1967.— *Dryopteris valida* Christ, J. Bot. 21 : 230, 261. 1908.— *Cyclosorus validus* (Christ) Tard. ex C. Chr. & Tard., Notul. Syst. 7 : 78. 1938; in Fl. Gén. I.-C. 7(2) : 398. 1941, p.p.; Ching, Bull. Fan Mem. Inst. Biol. 8 : 221. 1938.

Similar to the preceding species but different in : lateral pinnae more numerous, narrower, lower pinnae gradually narrowing downwards to mere auricles.

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.— N. Vietnam (type).

E c o l o g y.— On dry mountain slopes in mixed forests at medium altitudes.

29. Thelypteris truncata (Poir.) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 33. 1964; Tagawa & K. Iwats., Southeast As. St. 3(3) : 80. 1965; 5 : 69. 1967; Acta Phytotax. Geobot. 23 : 54. 1968.— *Polypodium truncatum* Poir. in Lamk., Enc. 5 : 534. 1804.— *Nephrodium truncatum* (Poir.) Presl, Tent. Pterid.: 81. 1836; Bedd.,Handb.: 280. f. 143. 1883.— *Cyclosorus truncatus* (Poir.) Tard. ex Tard. & C. Chr., Notul. Syst. 7 : 78. 1938; Ching, Bull. Fan Mem. Inst. Biol. 8 : 216. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 394. 1941; Holtt., Rev. Fl. Malaya 2 : 266. f. 152. 1955; Dansk Bot. Ark. 20 : 23. 1961.— *Pneumatopteris truncata* (Poir.) Holtt., Blumea 21 : 314. 1973; in Fl. Mal. II. 1 : 429. f. 11 d-f. 1981.

Rhizome short, erect; scales brown, thin, up to 1.5 by 4 mm, consisting of large cells, hairy. *Stipe* usually more than 50 cm long, pale, dark and scaly at base, pubescent, bearing reduced pinnae in upper part. *Lamina* oblong-lanceolate, up to 100 cm or more long, 50 cm wide; lower pinnae suddenly reduced to mere auricles, middle pinnae larger, straight, ascending, up to 20 by 2.5 cm, lobed to $\frac{1}{3}$ way towards costa, gradually narrowing towards long-acuminate apex, broadly cuneate at sessile base, nearly parallel at margin; segments obtuse at apex, minutely dentate; papyraceous, green, verrucose on lower surface, glabrous; veins pinnate, a few pairs of basal veinlets anastomosing, free ones ending in teeth at margin of segments. *Sori* medial; indusia pale, glabrous, persistent.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok, Doi Tung, Mae Lao, Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Mae Klang), Mae Hong Son (Mae La Noi), Lamphun (Doi Khun Tan), Tak (Ban Musoe), Phrae (Mae Sai, Huai Hok), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); PENINSULAR: Krabi (Phanom Bencha), Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Yala (Khao Kala Khiri).

D i s t r i b u t i o n.— Sri Lanka, S. India, Himalaya to S. China, Burma, Indochina, Ryukyu Is., Taiwan, W. Malesia to Philippines. Sometimes all the local species are considered to be conspecific with this, and the area is then widely extended. Type was said to come from Brasil, but it is considered to be a specimen from Asia.

E c o l o g y.— On wet ground usually along streams in light or deep shade at low to medium altitudes up to 1500 m alt.

V e r n a c u l a r.— Kut kan daeng (กูดก้านแดง) (Northern).

N o t e.— There are several specimens from N. Thailand with phenetic characters similar to those of var. *loyalii* Holtt., Blumea 21 : 314. 1973, although there is no cytological evidence that these plants are diploid.

30. Thelypteris tuberculifera (C. Chr.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 295. 1936; Tagawa & K. Iwats., Southeast As. St. 3(3) : 78. 1965; 5 : 67. 1967.— *Dryopteris tuberculifera* C. Chr., Contr. U.S. Nat. Herb. 26 : 275. 1931.

Similar to *T. xylodes*, differing in larger size of plants : stipe up to 70 cm or more long; lamina more than 100 by 50 cm; larger pinnae about 30 by 2.5 cm.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Phacho), Chiang Mai (Doi Suthep, Pha Mon, Doi Chong).

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

E c o l o g y.— On wet sandy ground along streams in light shade at medium altitudes.

N o t e.— In essential taxonomic features this is similar to *T. xylodes* which itself varies greatly in size. *T. tuberculifera* might, therefore, be better treated as an extremely large form of that species.

31. Thelypteris xylodes (Kunze) Ching, Bull. Fan Mem. Inst. Biol. 6 : 296. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 357. 1941; Tagawa & K. Iwats., Southeast As. St. 5 : 67. 1967.— *Aspidium xylodes* Kunze, Linnaea 24 : 283. 1851.— *Lastrea ochthodes* var. *xylodes* (Kunze) Bedd., Handb. : 240. 1883.— *Pseudocyclosorus xylodes* (Kunze) Ching, Acta Phytotax. Sin. 8 : 324. 1963; Holtt., in Fl. Mal. II. 1 : 413. f. 10 d-e. 1981.

Rhizome short, ascending to suberect; scales small, caducous, up to 3 by 0.8 mm, brown, hairy. *Stipe* up to 80 cm long, variable in size, bearing auricles of reduced pinnae nearly to the base. *Lamina* oblong-lanceolate, acute to acuminate at apex, 15—70 by 5—40 cm, variable in size; lower pinnae suddenly reduced to auricles, lowest normal pinna often reduced and deflexed, middle pinnae linear-lanceolate, gradually narrowing towards long-acuminate apex, broadly cuneate at sessile base, deeply lobed to $\frac{3}{4}$ way to costa; segments narrowly oblong, oblique, acute at apex, entire or crenate; chartaceous, deep green; veins pinnate, veinlets simple, basal ones running to callous-membrane in sinus between segments. *Sori* round, medial to costular; indusia persistent, glabrous.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Doi Phacho), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon, Ban Yang, Sop Aep), Tak, Phitsanulok (Phu Miang).

D i s t r i b u t i o n.— Sri Lanka, S. India (type), Himalaya, S. & SW. China and Vietnam.

E c o l o g y.— On wet sandy ground or stream-beds in light shade at medium altitudes.

32. Thelypteris repens (Hope) Ching, Bull. Fan Mem. Inst. Biol. 6 : 304. 1936; Tagawa & K. Iwats., Southeast As. St. 5 : 67. 1967.— *Nephrodium repens* Hope, J. Bomb. Nat. Hist. Soc. 12 : 535. t. 8. 1899. Figure 43. 5—6.

Rhizome short-creeping, about 3 mm diam.; scales about 4 mm long, pale brown, membranous, appressed, hairy. *Stipe* stramineous, with reduced pinnae, or auricled, nearly to base. *Lamina* oblong-lanceolate, acute at apex, narrowing towards base, up to 1 m tall but commonly about 50 by 10 cm; middle pinnae sessile, patent, linear-lanceolate, acute at apex, truncate and more or less auricled at base, deeply lobed, basal pinnae rather remote, reduced; segments oblong, oblique, round to moderately acute at apex, entire and somewhat involute at margin; softly chartaceous, green; costa and rachis hairy; veins pinnate, veinlets simple, hairy. *Sori* medial, round; indusia persistent, hairy.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Phacho), Chiang Mai (Doi Phahom Pok, Ban Yang); EASTERN : Chaiyaphum (Thung Kamang).

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

E c o l o g y.— On wet sandy ground by streams or in paddy fields at medium altitudes.

33. Thelypteris falciloba (Hook.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 298. 1936; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 358. 1941; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 49. 1968.— *Lastrea falciloba* Hook., J. Bot. 9 : 337. 1857.— *Lastrea calcarata* var. *falciloba* (Hook.) Clarke, Trans. Linn. Soc. II. Bot. 1 : 516. 1880; Bedd., Handb. : 237. 1883.

Rhizome short, erect; scales up to 4 by 2 mm, pale brown, thin and appressed, hairy at margin. *Stipe* up to 25 cm long, with reduced pinnae nearly to base. *Lamina* oblong-lanceolate, acute at apex, up to 30 by 13 cm; lower pinnae reduced to mere auricles, middle pinnae linear-lanceolate, gradually narrowing towards long-acuminate apex, cuneate at sessile base, up to 12 by 1.2 cm, deeply lobed nearly towards costa; segments falcate, oblique, forming angle of 35°—45° between costa and costule, acute at apex, entire and often involute; softly chartaceous, green, pubescent on under surface; veins pinnate, veinlets simple, hairy, basal anterior ones running to callous-membrane in sinus between segments. *Sori* round, medial; indusia persistent, glandular.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Lao), Chiang Mai (Huai Na).

Distribution.— Assam, Upper Burma, SW. & S. China (type from Hong Kong), and Vietnam. All the Japanese plants that have been referred to this species are *T. esquirolii* var. *glabrata*.

Ecology.— Terrestrial near streams in shade at medium altitudes.

34. Thelypteris lebeufii (Bak.) Panigrahi, Notes Roy. Bot. Gard. Edinb. 33 : 498. 1975.— *Polypodium lebeufii* Bak., Ann. Bot. 5 : 461. 1891.— *Christella lebeufii* (Bak.) Holtt. in Nayar & Kaur, Comp. Bedd. Handb. : 206. 1974; Kew Bull. 31 : 332. 1976.— *Nephrodium biauritum* Bedd., Handb. Suppl. : 68. 1892.— *Cyclosorus biauritus* (Bedd.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 197. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 385. 1941; Holtt., Dansk Bot. Ark. 23 : 232. 1965.— *Thelypteris biaurita* (Bedd.) Reed, Phytologia 17 : 263. 1968. Figure 44. 1–3.

Rhizome long-creeping, about 2 mm diam.; scales up to 2 by 0.3 mm, brown. *Stipe* 12–17 cm long, stramineous, dark at base, densely hairy on adaxial surface. *Lamina* narrowly elliptic, acute at apex, a little narrowing downwards, about 40 by 10 cm, pinnate; rachis densely hairy above, glabrescent below, hairs setose, transparent, unicellular or with occasional septa(e), up to 0.7 mm long; pinnae 10–15 pairs, middle ones larger, narrowly lanceolate, acuminate at apex, broadly cuneate to subtruncate at sessile base, up to 5 by 1.2 cm, basal acroscopic segments often larger, deeply lobed to more than half-way towards costa, lower pinnae about 4.5 cm apart, a little smaller downwards, distinctly auricled at both bases (i.e. the basal lobes more than twice as large as the next above), the terminal pinna up to 6 by 2 cm, narrowly subtriangular with attenuate apex, basal veinlets joined with the opposite ones, excurrent veins running towards the callous-membrane, second basal veinlets usually running to the margin of lobes above base of sinus; costa, veins and veinlets setose hairy on both surfaces. *Sori* round, medial, with naked sporangia; indusia small, fugaceous, densely setiferous.

Thailand.— SOUTH-WESTERN : Kanchanaburi (Sai Yok, Si Sawat).

Distribution.— Assam and Cambodia (type).

Ecology.— On clayey soil along river at low altitudes.

35. Thelypteris cylindrothrix (Rosenst.) K. Iwats. in Hara, Fl. E. Himal. : 482. 1966; Tagawa & K. Iwats., Southeast As. St. 5 : 64. 1967.— *Dryopteris cylindrothrix* Rosenst., Rep. Sp. Nov. 12 : 346. 1913.— *Cyclosorus cylindrothrix* (Rosenst.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 199. 1938; Holtt., Dansk Bot. Ark. 20 : 22. 1961.— *Cyclosorus parasiticus* var. *cylindrothrix* (Rosenst.) Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 382. 1941.— *Christella cylindrothrix* (Rosenst.) Holtt. in Nayar & Kaur, Comp. Bedd. Handb. : 208. 1974; Kew Bull. 31 : 308. 1976.— *Dryopteris procurrens* auct. non (Mett.) O. Ktze. : C. Chr., Contr. U.S. Nat. Herb. 26 : 330. 1931.

Rhizome creeping, about 5 mm diam.; scales narrow, up to 7 by 1 mm, brown, hairy. *Stipe* about 50 cm long, hairy throughout, scaly and dark at base. *Lamina*

oblong-lanceolate, acute at apex, up to 40 by 25 cm; basal 1 or 2 pairs of pinnae deflexed, not shortened, middle pinnae patent or ascending, more or less falcate, caudate-acuminate at apex, truncate at sessile base, deeply lobed nearly to costa, up to 12 by 2 cm; rachis and costa rather densely hairy throughout; segments oblong, oblique, moderately acute to rounded at apex, entire, up to 7 by 3 mm; venation pinnate, veinlets simple, about 12 pairs, the lowest pairs uniting to form excurrent veinlets towards callous-sinus, hairy as well as glandular; texture thinly papyraceous, pale green, densely hairy with setose unicellular hairs, glandular on lower surface; glands orange to red, round to clavate, sessile, rather dense. *Sori* medial; indusia small, persistent, shortly hairy.

T h a i l a n d.—NORTHERN : Chiang Rai (Chiang Kham, Wiang Papao), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Ya Na, Doi Suthep, Bo Luang, Ban Yang), Lamphun (Doi Khun Tan), Tak; NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng).

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

E c o l o g y.— On rather dry ground in deciduous or mixed forests at medium elevation, 500 – 1000 m alt., locally abundant.

36. Thelypteris molliuscula (Kuhn) K. Iwats. in Hara, Fl. E. Himal. : 484. 1966; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25 : 16. 1971.— *Aspidium molliusculum* Kuhn, Bot. Zeit. 26 : 41. 1868.— *Nephrodium molliusculum* (Kuhn) Bedd., Handb. Suppl. : 68. 1892.— *Cyclosorus molliusculus* (Kuhn) Ching, Bull. Fan Mem. Inst. Biol. 8 : 197. 1938.— *Christella appendiculata* (Presl) Holtt., Kew Bull. 31 : 311. 1976. Figure 44. 4 – 6.

Similar to *T. cylindrothrix,* different in : base of pinna auricled at least at acroscopic side; pinnae broader; under side of veins and laminar surface densely hairy with long, patent, pale hairs, not glandular; indusia densely long-hairy.

T h a i l a n d.—NORTH-EASTERN : Phetchabun (Phu Miang); SOUTH-EASTERN: Prachin Buri (Khao Yai).

D i s t r i b u t i o n.— Himalaya (type) to N. Burma.

E c o l o g y.— On mountain slopes in evergreen forests at 1200 – 1300 m alt.

37. Thelypteris parasitica (Linn.) Fosberg, Occ. Pap. B.P. Bishop Mus. 23 : 30. 1962; K. Iwats., J. Jap. Bot. 38 : 315. 1963; Tagawa & K. Iwats., Southeast As. St. 3(3) : 79. 1965; 5 : 65. 1967.— *Polypodium parasiticum* Linn., Sp. Pl. 2 : 1090. 1753.— *Aspidium parasiticum* (Linn.) Christ, Bot. Tidsskr. 24 : 109. 1901.— *Dryopteris parasitica* (Linn.) O. Ktze., Rev. Gen. Pl. 2 : 811. 1891; C. Chr., Bot. Tidsskr. 32 : 343. 1916.— *Cyclosorus parasiticus* (Linn.) Farw., Amer. Midl. Nat. 12 : 259. 1929; Ching, Bull. Fan Mem. Inst. Biol. 8 : 201. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 381. 1941; Holtt., Rev. Fl. Malaya 2 : 281. f.162. 1955; Dansk Bot. Ark. 23 :

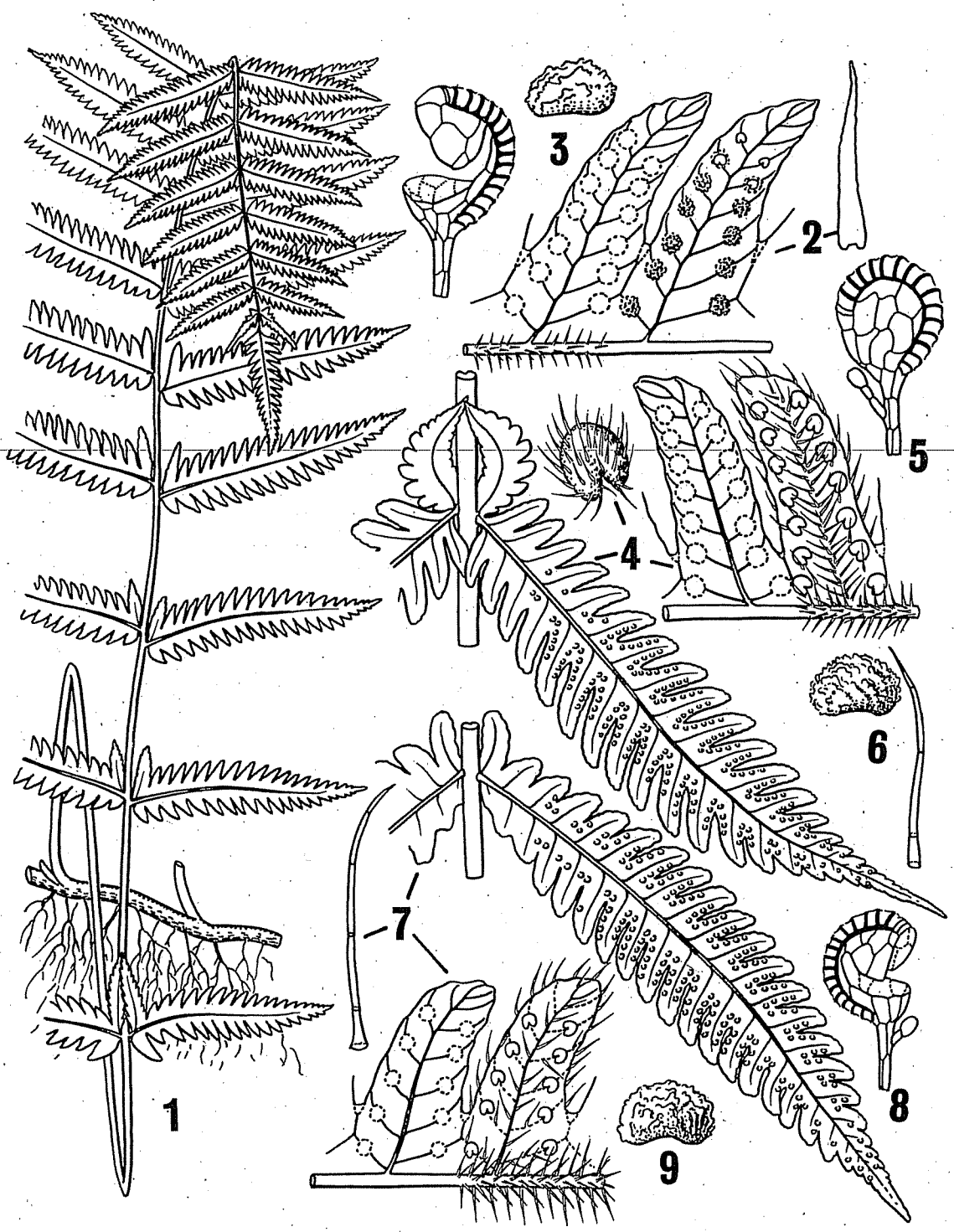


Figure 44. 1–3: *Thelypteris lebeufii*, drawn from isotype specimen; 1. plant, x 0.5; 2. lobes (x 5) and scale on stipe (x 13); 3. sporangium (x 80) and spore (x 200). 4–6: *T. molliuscula*; 4. second lowest pinna, hairs omitted (left, x 1.5), lobes (right, x 5) and indusium enlarged (above); 5. sporangium, x 80; 6. spore (x 300) and hair (x 40). 7–9: *T. siamensis*, drawn from holotype specimen; 7. second lowest pinna, hairs omitted (above, x 1.5), lobes (below, x 4) and hair (left, x 40); 8. sporangium, x 80; 9. spore, x 300.

233. 1965.— *Christella parasitica* (Linn.) Lév., Fl. Kouy-Tchéou : 475. 1915; Holtt., Kew Bull. 31 : 309. 1976; in Fl. Mal. II. 1 : 559. f. 20 f. 1981.— *Nephrodium amboinense* auct. non Pr. : Hosseus, Beih. Bot. Centr. 28(2) : 365. 1911.

Rhizome creeping, about 8 mm diam.; scales narrow, up to 12 by 1 mm, dark brown, hairy. *Stipe* about 50 cm long, scaly at base, hairy throughout. *Lamina* oblong-lanceolate, acute at apex, about 50 by 25 cm; basal pinnae deflexed, lower pinnae patent or ascending, linear-lanceolate, sessile at acroscopic base, about 12 by 1.8 cm, lobed more than half-way towards costa; segments oblong, oblique, rounded at apex, entire; thinly papyraceous, yellow-green to green, hairy on under surface; basal pairs of veins anastomosing, the other veinlets running to margin of lobes, glandular; glands sessile, rod-shaped, orange to red; *Sori* supramedial, usually not on lobes, i.e. on one or two basal veinlets; indusia persistent, hairy.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Mae Kok), Chiang Mai (Mae Hok, Doi Chiang Dao, Wang Tao, Doi Saket, Doi Suthep, Mae Klang, Pha Mon), Lampang (Mae Ngao), Tak (Mae Sot), Phitsanulok (Thung Salaeng Luang); EASTERN : Chaiyaphum (Nam Phrom); NORTH-EASTERN : Loei (Phu Kradueng); SOUTH-EASTERN : Chon Buri (Si Racha), Trat (Ko Chang); PENINSULAR : Surat Thani (Ban Don, Ban Huai Tha), Nakhon Si Thammarat (Khiriwong), Phangnga, Trang, Satun.

D i s t r i b u t i o n.— Tropics and subtropics in Asia (type from S. China), north to S. Japan and south to New Zealand.

E c o l o g y.— On rather dry slopes along path in open places or in evergreen forests at low to medium altitudes.

38. Thelypteris siamensis Tagawa & K. Iwats., Acta Phytotax. Geobot. 22 : 101. f. 5. 1967; Southeast As. St. 5 : 65. 1967.— *Christella siamensis* (Tagawa & K. Iwats.) Holtt., Kew Bull. 31 : 332. 1976. Figure 44. 7–9.

Rhizome erect; scales linear-lanceolate with long tails, ca 10 by 1.2 mm, sparsely hairy at margin. *Stipe* densely scaly at base, hirsute throughout, up to 50 cm long. *Lamina* oblong-lanceolate, acute at apex, up to 40 by 20 cm; a few lower pinnae slightly reduced, deflexed, auricled at acroscopic base, middle larger ones falcate, sessile, linear-lanceolate, long-acuminate at apex, broadly cuneate to truncate at base, up to 10 by 1.8 cm, lobed to $\frac{2}{3}$ way to costa; segments oblong, oblique, rounded to moderately acute at apex, entire; papyraceous, hairy on surface; basal veinlets uniting to form goniopteroid venation. *Sori* medial to supramedial; indusia round-reniform, persistent, densely hirsute.

T h a i l a n d.— NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang, type).

D i s t r i b u t i o n.— Endemic.

E c o l o g y.— On humus-rich mountain slopes in evergreen forests at 1200–1400 m alt.

39. Thelypteris dentata (Forssk.) St. John, Amer. Fern J. 26 : 44. 1966; Tagawa & K. Iwats., Southeast As. St. 3(3) : 79. 1965; 5 : 65. 1967.— *Polypodium dentatum* Forssk., Fl. Aegypt.-Arab. : 185. 1775.— *Cyclosorus dentatus* (Forssk.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 206. 1938; Holtt., Dansk Bot. Ark. 20 : 22. 1961; 23 : 233. 1965.— *Christella dentata* (Forssk.) Brownsey & Jermy, Brit. Fern Gaz. 10 : 338. 1973; Holtt., Kew Bull. 31 : 314. 1976; in Fl. Mal. II. 1 : 557. f. 1 p, 20 a. 1981.— *Cyclosorus subpubescens* auct. non (Bl.) Ching; Holtt., Rev. Fl. Malaya 2 : 273. f. 157. 1955.

Rhizome short, erect, ascending, or shortly creeping, with a tuft of fronds; scales narrow, about 8 by 1.5 mm, pale brown, hairy. *Stipe* about 30 cm long, bearing reduced pinnae on upper portion, scaly at base, hairy throughout. *Lamina* narrowly oblong, acute at apex, gradually narrowing downwards, up to 75 by 25 cm; lateral pinnae about 20 pairs, patent to ascending, sessile, linear-lanceolate, more or less auricled at base, gradually narrowing towards long-acuminate apex, up to 14 by 2 cm, lobed $\frac{1}{3}$ to $\frac{2}{3}$ way to costa; lower pinnae gradually becoming smaller downwards but rarely reduced to mere auricles; segments oblong-subdeltoid, oblique, rounded at apex, entire; herbaceous to softly papyraceous, yellow-green to green, densely pubescent on both surfaces; basal veinlets and basal second anterior ones uniting below callous-membrane. *Sori* medial, round; indusia large, densely hairy.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok, Ban Nong Lu), Chiang Mai (Doi Suthep, Mae Klang), Mae Hong Son (Khun Yuam), Lamphun (Doi Khun Tan), Lampang (Mae Ang), Phrae (Mae Sai), Tak (Ban Musoe, Mae Sot), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang, Dan Sai), Khon Kaen (Pha Nok Khao); CENTRAL : Nakhon Nayok (Khao Yai), Saraburi (Muak Lek), Krung Thep (Bangkok, Khlong San); SOUTH-EASTERN : Prachin Buri (Krabin, Bu Phram), Chanthaburi (Khao Soi Dao, Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN : Kanchanaburi (Bang Krasi, Wangka, Phomphi, Thung Kang Yang); PENINSULAR : Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Thung Song), Phangnga, Trang, Satun.

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

E c o l o g y.— Usually on rather dry ground in light shade or in forests at low or medium altitudes.

40. Thelypteris latipinna (Hook.) K. Iwats., Acta Phytotax. Geobot. 23 : 166. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 66. 1967.— *Nephrodium latipinna* Hook., Syn. Fil. : 292. 1867.— *Dryopteris latipinna* (Hook.) O. Ktze., Rev. Gen. Pl. 2 : 813. 1891; C. Chr., Bot. Tidsskr. 32 : 342. 1916.— *Cyclosorus latipinna* (Hook.) Tard., Notul. Syst. 7 : 73. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 397. 1941; Holtt., Rev. Fl. Malaya 2 : 276. f. 159. 1955.— *Aspidium pennigerum* auct. non Bl.: Christ, Bot. Tidsskr. 24 : 109. 1901.— *Christella subpubescens* (Bl.) Holtt., Kew Bull. 31 : 323. 1976, p.p.

Similar to *T. dentata,* different from it in : frond smaller, up to 50 cm long including stipe; rhizome erect or ascending; lateral pinnae up to 12 pairs, less

deeply lobed; basal 1.5–2.5 pairs anastomosing to form goniopteroid venation; lower surface subglabrous to pubescent; indusia subglabrous to hirsute.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok), Chiang Mai (Doi Phahom Pok, Doi Saket), Lampang (Tham Pha Thai); NORTH-EASTERN : Nong Khai (Phon Phisai); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Prachin Buri (Krabin, Bu Phram), Chon Buri (Si Racha), Chanthaburi (Phriu Waterfalls), Trat (Ko Chang); PENINSULAR : Chumphon, Surat Thani (Ban Don), Phangnga (Takua Pa), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun.

D i s t r i b u t i o n.— Tropical Asia (type from Hong Kong), the exact area not known.

E c o l o g y.— On rather dry ground along rivers in light shade at low or medium altitudes.

N o t e.— This is apparently a form of the *T. dentata* complex distinguished by its smaller size. *T. dentata* is already soriferous in young stages and is often difficult to distinguish from *T. latipinna.*

41. Thelypteris papilio (Hope) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 175. 1965; Tagawa & K. Iwats., Southeast As. St. 3(3) : 79. 1965.— *Nephrodium papilio* Hope, J. Bomb. Nat. Hist. Soc. 12 : 625. t. 12. 1899.— *Cyclosorus papilio* (Hope) Ching, Bull. Fan Mem. Inst. Biol. 8 : 214. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 382. 1941; Holtt., Rev. Fl. Malaya ed. 2.2 : 633. 1968.— *Christella papilio* (Hope) Holtt. in Nayar & Kaur, Comp. Bedd. Handb. : 208. 1974; Kew Bull. 31 : 321. 1976; in Fl. Mal. II. 1 : 556. f. 20 d-e. 1981.

Similar to *T. dentata,* different from it in : rhizome erect; scales broad, membranous, usually appressed; lower reduced pinnae butterfly-shaped, usually opposite in pairs; indusia rather sparsely hirsute.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Inthanon, Doi Suthep); SOUTH-WESTERN : Kanchanaburi (Khao Ngi Yai).

D i s t r i b u t i o n.— Sri Lanka, Himalaya (type), Taiwan, and Malaya.

E c o l o g y.— On moist ground by streamlets at edge of evergreen forests at medium altitudes.

42. Thelypteris subpubescens (Bl.) K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 173. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 65. 1967.— *Aspidium subpubescens* Bl., En. Pl. Jav. : 149. 1828.— *Cyclosorus subpubescens* (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 211. 1938; Holtt., Rev. Fl. Malaya 2 : 273. f. 157. 1955.— *Cyclosorus parasiticus* var. *subpubescens* (Bl.) Tard. & C. Chr., Notul. Syst. 7 : 78. 1938; in Fl. Gén. I.-C. 7(2) : 382. 1941; Seidenf., Nat. Hist. Bull. Siam Soc. 19: 86. 1958.— *Christella subpubescens* (Bl.) Holtt., Kew Bull. 31 : 323. 1976; in Fl. Mal. II. 1 : 558. f. 20 g. 1981.

Similar to *T. dentata,* different from it in : rhizome long-creeping with remote stipes; lower pinnae reduced to mere auricles; stipe usually subquadrangular in cross section; lower surface of frond subglabrous or rather sparsely hairy; indusia glabrous or sparsely hirsute.

T h a i l a n d.— SOUTH-EASTERN : Chanthaburi (Khao Soi Dao).

D i s t r i b u t i o n.— Tropical Asia (type from Java) to Australia (Queensland), north to S. Japan.

E c o l o g y.— On rather dry mountain-slopes in forests at medium altitudes.

N o t e.— HOLTTUM (1976) included both *T. latipinna* and *T. sumatrana* in this species.

43. Thelypteris sumatrana (v.A.v.Ros.) K. Iwats., Acta Phytotax. Geobot. 22 : 101. 1976; Tagawa & K. Iwats., Southeast As. St. 5 : 66. 1967.— *Dryopteris sumatrana* v.A.v.Ros., Handb. : 227. 1908.— *Cyclosorus sumatranus* (v.A.v.Ros.) Ching, Bull. Fan Mem. Inst. Biol. 10 : 249. 1941; Holtt., Rev. Fl. Malaya 2 : 275. f. 158. 1955; Dansk Bot. Ark. 23 : 233. 1965.— *Christella subpubescens* (Bl.) Holtt., Kew Bull. 31 : 323. 1976, p.p.

Rhizome short, creeping, up to 1 cm diam., bearing close stipes; scales dark brown, up to 5 by 0.8 mm, hairy. *Stipe* about 30 cm long, hairy throughout, bearing reduced pinnae on upper part. *Lamina* oblong-lanceolate, acute at apex, up to 70 by 35 cm; lower lateral pinnae reduced, lower ones remote, butterfly-shaped or mere auricles, middle larger pinnae shortly stalked or subsessile, ascending, linear-lanceolate, gradually narrowing towards long-acuminate apex, broadly cuneate to subtruncate at base, up to 20 by 2.3 cm, shallowly lobed about $\frac{1}{4}$ way to costa; segments oblique, round at apex, papyraceous, glabrous or pubescent on lower surface; venation goniopteroid, basal 2 to 3 pairs anastomosing. *Sori* medial; indusia rather large, persistent, glabrous or sparsely hairy.

T h a i l a n d.— CENTRAL : Saraburi (Muak Lek); SOUTH-WESTERN : Kanchanaburi (Thung Kang Yang), Prachin Buri (Ban Bueng Hills); PENINSULAR : Surat Thani (Ban Don), Chumphon (Khao Tong), Nakhon Si Thammarat (Khao Luang), Satun.

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

E c o l o g y.— On humus-rich mountain slopes in dense evergreen forests.

44. Thelypteris subelata (Bak.) K. Iwats., J. Jap. Bot. 38 : 315. 1963; Tagawa & K. Iwats., Southeast As. St. 3(3) : 80. 1965; 5 : 66. 1967.— *Nephrodium subelatum* Bak., Kew Bull. 1906 : 11.— *Cyclosorus subelatus* (Bak.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 224. 1938.— *Christella subelata* (Bak.) Holtt., Kew Bull. 31 : 331. 1976.— *Thelypteris subpubescens* auct. non (Bl.) K. Iwats. : Tagawa & K. Iwats., Southeast As. St. 5 : 65. 1967, p.p.

Rhizome creeping, about 6 mm diam.; scales narrow, up to 5 by 1 mm, dark brown hirsute. *Stipe* about 50 cm long, hairy throughout, bearing reduced lower pinnae on upper portion. *Lamina* oblong, acuminate at apex with long terminal pinna, up to 80 by 45 cm; lower lateral pinnae shortened to mere auricles, middle pinnae shortly stalked or subsessile, linear-lanceolate, gradually narrowing towards acuminate apex, round to broadly cuneate at base, about 25 by 3.5 cm, lobed more than $\frac{1}{3}$ way to costa; segments oblong to subrectangular, oblique, rounded at apex; papyraceous, dark to greyish-green, pale below, subglabrous to sparsely pubescent, often verrucose; 2 or 3 pairs of lower veinlets truly anastomosing below callous-sinus. *Sori* medial; indusia round, persistent, shortly hairy or densely long-hairy.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung, Mae Sai, Mae Kok, Doi Phacho, Ban Doi Hang), Chiang Mai (Doi Phahom Pok, Fang, Doi Chiang Dao, Kang Kat, Doi Suthep, Ban Yang), Mae Hong Son (Ban Mae Pong), Lamphun (Doi Khun Tan), Lampang, Tak (Doi Musoe, Mae Sot), Phrae (Mae Sai), Phitsanulok (Phu Miang); NORTH-EASTERN : Nong Khai, Loei (Phu Kradueng); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao, Ta Khamao Falls); SOUTH-WESTERN : Kanchanaburi (Sai Yok).

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

E c o l o g y.— On mountain slopes in open places to somewhat deep shade at medium altitudes.

N o t e.— This fern is common in northern Thailand and rather variable in size and form of fronds and in pubescence. Chanthaburi plants are distinct in having densely long-hairy indusia.

45. Thelypteris evoluta (Clarke) Tagawa & K. Iwats., Acta Phytotax. Geobot. 22 : 101. 1967; Southeast As. St. 5 : 66. 1967.— *Nephrodium amboinense* var. *evolutum* Clarke, J. Linn. Soc. 24 : 417. 1888.— *Cyclosorus evolutus* (Clarke) Ching,Bull. Fan Mem. Inst. Biol. 8 : 219. 1938.— *Christella evoluta* (Clarke) Holtt. in Nayar & Kaur, Comp. Bedd. Handb. : 208. 1974; Kew Bull. 31 : 330. 1976.

Similar to the preceding species but different in glabrous verrucose undersurface of fronds and short erect rhizome.

T h a i l a n d.— NORTHERN : Tak; NORTH-EASTERN : Loei (Phu Luang, Phu Kradueng).

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

E c o l o g y.— On humus-rich slopes in evergreen forests at medium altitudes.

46. Thelypteris crinipes (Hook.) K. Iwats., J. Jap. Bot. 38 : 315. 1963; Tagawa & K. Iwats., Southeast As. St. 3(3) : 80. 1965; 5 : 68. 1967.— *Nephrodium crinipes* Hook., Sp. Fil. 4 : 71. 1862; Bedd., Handb. : 279. 1883.— *Cyclosorus crinipes* (Hook.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 179. 1938.— *Christella crinipes* (Hook.) Holtt. in Nayar & Kaur, Comp. Bedd. Handb. : 208. 1974; Kew Bull. 31 : 326. 1976.

Rhizome short, erect or ascending; scales linear-lanceolate with long-tailed apex, up to 20 by 1.2 mm, brown, glabrous. *Stipe* 20–60 cm long, with reduced pinnae on upper part, densely scaly throughout. *Lamina* oblong-lanceolate with acute apex, up to 100 by 40 cm; rachis scaly throughout; several lower pinnae distinctly reduced and immersed among scales, lower normal pinnae straight, ascending, linear, gradually narrowing towards long-acuminate apex, up to 25 by 1.5 cm, lobed halfway to costa; segments oblong, oblique, acute at apex; chartaceous, green to deep green, pubescent on undersurface; costa pubescent; veins pinnate, basal pairs of veinlets uniting with those of the adjacent group to form connivent veinlets, the others running to the margin of segments, hairy. *Sori* medial or nearer to margin, round; indusia round-reniform, densely hairy.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Tung), Chiang Mai (Doi Phahom Pok, Chiang Dao, Tin Tok, Ban Mae Ho, Doi Suthep, Mae Klang, Bo Luang, Ban Yang), Mae Hong Son (Ban Mae Pang), Lamphun (Doi Khun Tan), Lampang (Mae Tia), Tak (Huai Krasa, Doi Musoe, Lan Sang); SOUTH-WESTERN : Uthai Thani (Ban Rai).

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

E c o l o g y.— On sandy ground along streams in deciduous or evergreen forests at low to medium altitudes.

47. Thelypteris arida (D.Don) Morton, Amer. Fern J. 49 : 113. 1959; K. Iwats., J. Jap. Bot. 38 : 314. 1963; Tagawa & K. Iwats., Southeast As. St. 5 : 68. 1967.— *Aspidium aridum* D. Don, Prod. Fl. Nepal.: 4. 1825.— *Nephrodium aridum* (Don) J. Smith in Hook., J. Bot. 4 : 188. 1841; Bedd., Handb. : 272. f. 139. 1883.— *Cyclosorus aridus* (Don) Ching, Bull. Fan Mem. Inst. Biol. 8 : 194. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 395. 1941; Holtt., Rev. Fl. Malaya 2 : 259. f. 146. 1955; Dansk Bot. Ark. 20 : 22. 1961.— *Christella arida* (Don) Holtt. in Nayar & Kaur, Comp. Bedd. Handb. : 206. 1974; Kew Bull. 31 : 320. 1976; in Fl. Mal. II. 1 : 555. f.1 i. 1981.

Rhizome long-creeping, about 3 mm diam.; scales pale brown, membranous, caducous, up to 5 by 1.5 mm. *Stipe* about 50 cm long, scaly as well as hairy near base, bearing reduced pinnae on upper part. *Lamina* oblong-lanceolate, gradually narrowing downwards, acute at apex; rachis densely hairy throughout; lower pinnae gradually narrowing downwards to mere auricles, middle pinnae larger, sessile, patent, linear-lanceolate, gradually narrowing towards long-acuminate apex, more or less auricled at base, up to 12 by 1.3 cm, lobed $\frac{1}{3}$ way to costa; segments oblong-subdeltoid, acute to aciculate at apex, entire; chartaceous to coriaceous, pubescent on lower surface; veins pinnate, about 3 lower pairs uniting with those of the opposite groups, hairy as well as yellow-glandular. *Sori* medial; indusia small, thin, hairy, usually immersed among sporangia at maturity.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok, Doi Tung), Chiang Mai (Fang, Pang Bo, Ban Mae Kong, Kang Kat, Doi Suthep, Mae Klang, Ban Yang), Tak; PENINSULAR : Satun, Yala (Bannang Sata).

D i s t r i b u t i o n.— Himalaya (type) to W. Malesia, north to N. Vietnam, Hong Kong and Taiwan.

E c o l o g y.— On clayey ground or in grassy fields in some open places at medium altitudes.

48. Thelypteris terminans (Hook.) Tagawa & K. Iwats., Acta Phytotax. Geobot. 26 : 169. 1975.— *Nephrodium terminans* Hook., Sp. Fil. 4 : 73. 1862.— *Amphineuron terminans* (Hook.) Holtt., Amer. Fern J. 63 : 82. 1973; Blumea 23 : 207. 1977; in Fl. Mal. II. 1 : 545. f. 19 a. 1981.— *Nephrodium pteroides* auct. non (Retz.) J. Smith: Bedd., Hand. : 269. 1883; Ostenfeld, Bull. Herb. Boiss. II. 5 : 721. 1905; Hosseus, Beih. Bot. Centr. 28(2) : 365. 1911; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8 : 5. 1929.— *Dryopteris pteroides* auct. non (Retz.) O. Ktze. : C. Chr., Contr. U.S. Nat. Herb. 26 : 184. 1931.— *Cyclosorus interruptus* auct. non (Willd.) H. Ito : Ching, Bull. Fan Mem. Inst. Biol. 8 : 184. 1938; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 397. 1941; Holtt., Rev. Fl. Malaya 2 : 262. f. 149. 1955; Dansk Bot. Ark. 20 : 23. 1961.— *Thelypteris interrupta* auct. non (Willd.) K. Iwats. : Tagawa & K. Iwats., Southeast As. St. 3(3) : 79. 1965; 5 : 68. 1967.— *Cyclosorus extensus* auct. non (Bl.) Ching : Holtt., Dansk Bot. Ark. 20 : 23. 1961.

Rhizome long-creeping, about 1 cm diam.; scales narrow, brown, up to 10 by 0.8 mm, hairy. *Stipe* 40 – 60 cm long, stramineous with dark scaly base, pubescent. *Lamina* oblong-lanceolate, acute at apex, 50 – 80 by about 40 cm; lateral pinnae more than 30 pairs, basal pinnae not or little reduced, patent to ascending, lower ones linear, straight, gradually narrowing towards long-acuminate apex, cuneate and shortly stalked at base, up to 25 by 1.2 – 2 cm, lobed to half-way to costa; segments oblong, oblique, round to moderately acute at apex, entire; papyraceous, green; veins pinnate, veinlets simple, hairy, basal 1 – 1.5 pairs uniting with those of the next group below sinus. *Sori* confined to upper part of segments, often hollowed; indusia persistent, hairy.

T h a i l a n d.— Common all over the country.

D i s t r i b u t i o n.— Tropics of Asia (type from Burma) to Australia (Queensland).

E c o l o g y.— Common on rather dry mountain slopes in forests at low or medium altitudes up to 1200 m alt.

49. Thelypteris opulenta (Kaulf.) Fosb. in Fosb. & Sachet, Smiths. Contr. Bot. 8 : 3. 1972.— *Aspidium opulentum* Kaulf., Enum. : 238. 1824.— *Amphineuron opulentum* (Kaulf.) Holtt., Blumea 19 : 45. 1971; 23 : 212. 1977; in Fl. Mal. II. 1 : 548. f. 19 b-c. 1981.—*Aspidium extensum* Bl., En. Pl. Jav.: 156. 1828; Christ, Bot. Tidsskr. 24: 109. 1901.— *Nephrodium extensum* (Bl.) Moore, Ind. Fil. : 91. 1858; Bedd., Handb.: 269. 1883; E. Smith, J. Siam Soc. Nat. Hist. Suppl. 8 : 5. 1829.— *Dryopteris extensa* (Bl.) O. Ktze., Rev. Gén. Pl. 2 : 812. 1891; C. Chr., Bot. Tidsskr. 32 : 343. 1916.—

Cyclosorus extensus (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 8 : 182. 1938; Holtt., Rev. Fl. Malaya 2 : 264. f. 150. 1955; Dansk Bot. Ark. 23 : 232. 1965.— *Thelypteris extensa* (Bl.) Morton, Amer. Fern J. 49 : 113. 1959; Tagawa & K. Iwats., Southeast As. St. 3(3) : 80. 1965; 5 : 69. 1967; Acta Phytotax. Geobot. 23 : 53. 1968.

Similar to the preceding species, differing in : rhizome short, ascending to erect; lateral pinnae fewer in number, broader, thinner in texture, more deeply lobed, $\frac{2}{3}$ to $\frac{3}{4}$ towards costa; only one pair of basal veinlets or less uniting below the sinus forming more acute curve, often all veinlets free; sori not strictly confined to segments.

T h a i l a n d.— NORTHERN : Lampang (Mae Toi), Tak (Lan Sang); NORTH-EASTERN: Nong Khai; CENTRAL : Saraburi (Muak Lek); SOUTH-EASTERN: Chon Buri (Si Racha), Rayong (Khao Chamao), Chanthaburi (Khao Soi Dao), Trat (Ko Chang); SOUTH-WESTERN: Uthai Thani (Khao Pradu), Kanchanaburi (Erawan Nat. Park, Sai Yok, Thung Kang Yang); PENINSULAR: Surat Thani (Ko Tao, Ban Don), Chumphon, Phangnga (Thap Put), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun, Narathiwat (Bacho Falls),Yala (Bannang Sata), Pattani (Ban Sai Khao).

D i s t r i b u t i o n.— Sri Lanka to Malesia, Micronesia (type from Guam) and Polynesia.

E c o l o g y.— On rather dry mountain slopes in light shade usually at low altitudes.

50. Thelypteris immersa (Bl.) Ching, Bull. Fan Mem. Inst. Biol. 6 : 306. 1936; Holtt., Rev. Fl. Malaya 2 : 243. 1955; Dansk Bot. Ark. 20 : 22. 1961; Tagawa & K. Iwats., Southeast As. St. 5 : 64. 1967.— *Aspidium immersum* Bl., En. Pl. Jav. : 156. 1828.— *Lastrea immersa* (Bl.) Moore, Ind. Fil. : 89. 1857; Bedd., Handb. : 234. 1883.— *Amphineuron immersum* (Bl.) Holtt. in Nayar & Kaur, Comp. Bedd. Handb. : 203. 1974; Blumea 23 : 211. 1977; in Fl. Mal. II. 1 : 547. f. 19 e. 1981. Figure 45.

Rhizome short, erect, thick; scales linear, brown, up to 20 by 1.5 mm, hairy on dorsal surface as well as at margin. *Stipe* stramineous to pale castaneous, about 70 cm long, scaly near base, pubescent. *Lamina* oblong-lanceolate, pinnate, about 100 by 50 cm; lateral pinnae more than 30 pairs, lower ones opposite, basal pair much reduced, lower ones linear-lanceolate, acuminate at apex, narrowing towards sessile base, about 30 by 3 cm, deeply lobed to costa leaving about 1 mm below the sinus; lobes patent or a little falcate, narrowly oblong, moderately acute at apex, entire, about 15 by 3 mm; thin, papyraceous, pale green; veins pinnate, veinlets simple, more than 15 pairs, covered densely with yellow glands; costa; costules and veins hairy, hairs pale, setose, 1 mm or longer. *Sori* medial; indusia up to 0.7 mm diam., glabrous, persistent.

T h a i l a n d.— NORTHERN : Lampang; EASTERN : Chaiyaphum (Nam Phrom); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); SOUTH-WESTERN : Prachuap Khiri Khan (Sam Roi Yot), Kanchanaburi (Si Sawat); PENINSULAR : Nakhon Si Thammarat (Khao Luang), Phangnga (Yan Yao), Trang (Khao Chong), Satun, Yala (Bannang Sata).

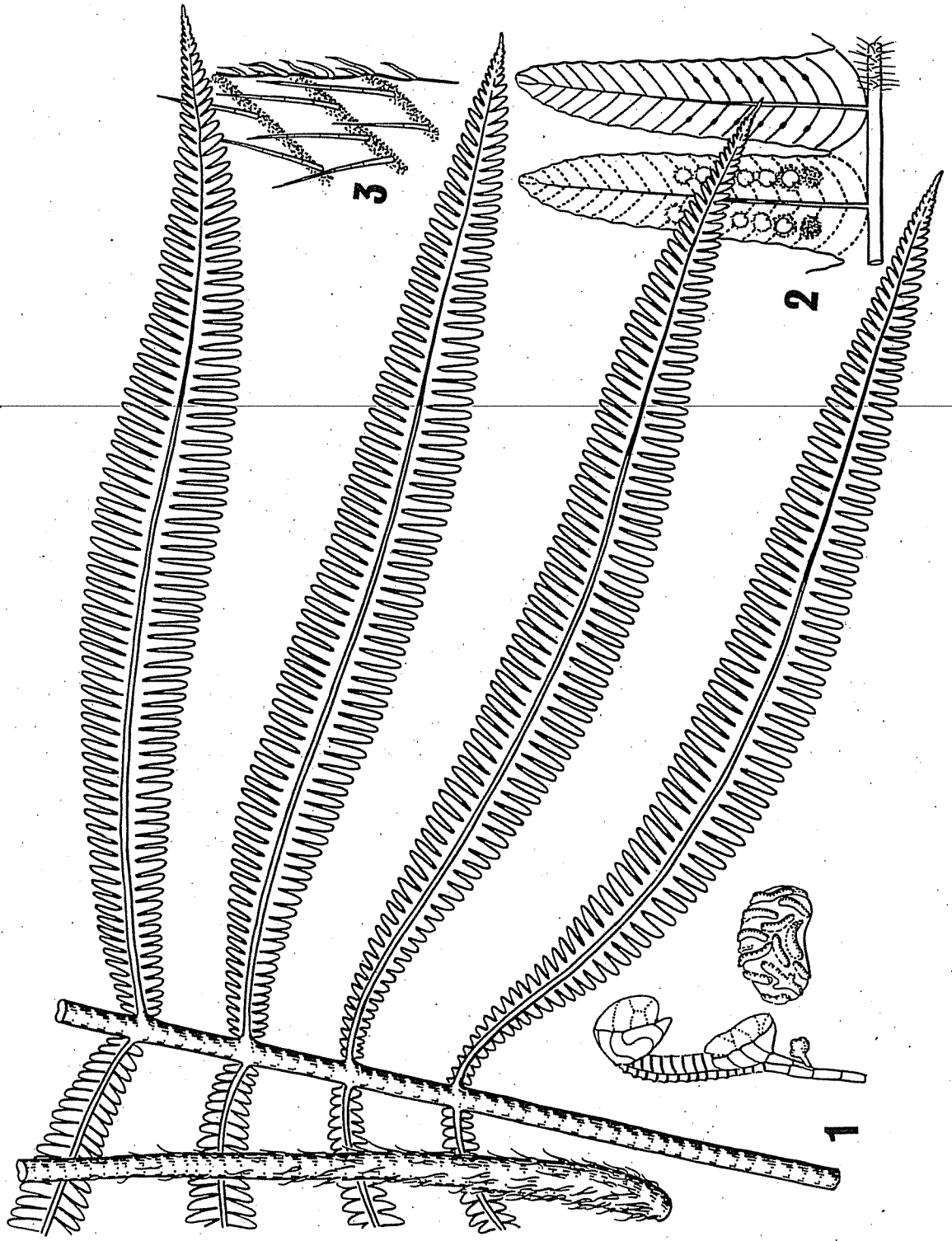


Figure 45. *Thelypteris immersa*; 1. basal pinnae and stipe (x 0.5), sporangium (x 50) and spore (x 400); 2. lobes enlarged; 3. long hairs and powder on the veinlet beneath, x 15.

Distribution.— Malesia (type from Java), north to Hainan.

Ecology.— On rather dry banks of paths in light shade to dense evergreen forests at low.or medium altitudes.

2. MENISCIUM

Schreber in Linn., Gen. Pl. ed. 8. 2 : 757. 1791; K. Iwats., Mem. Coll. Sci. Univ. Kyoto B. 31 : 37. 1964.— *Ampelopteris* Kunze, Bot. Zeit. 6 : 114. 1848; Copel., Gen. Fil. : 143. 1947; Holtt., Blumea 19 : 25. 1971.

Rhizome creeping, dictyostelic, scaly. Stipe hirsute; rachis often proliferous; veins free or all anastomosing to form rather regularly quadrangular areoles by main veins, united veinlets and conjugated veinlets (goniopteroid or meniscioid venation); hairs on plants unicellular, simple, branched or stellate. Sori round or oblong, indusiate or naked; spores bilateral with perispore.

About 80 species belong to this genus and are classified in four sections, three of which are confined to the New World. Monotypic *Ampelopteris* is the only representative in the Old World and occurs in Thailand.

Meniscium proliferum (Retz.) Sw., Syn. Fil. : 19, 206. 1806; K. Iwats., J. Jap. Bot. 38 : 315. 1963.— *Hemionitis prolifera* Retz., Obs. 6 : 38. 1791.— *Goniopteris prolifera* (Retz.) Fée, Cr. vasc. Br. 1 : 105. 1869; Bedd., Handb. : 296. f. 153. 1883.— *Cyclosorus proliferus* (Retz.) Tard. ex Tard. & C. Chr., Notul. Syst. 7 : 76. 1938; in Fl. Gén. I.-C. 7(2) : 389. 1941.— *Ampelopteris prolifera* (Retz.) Copel., Gen. Fil.: 144. 1947; Holtt., Rev. Fl. Malaya 2 : 299. 1955; Dansk Bot. Ark. 23 : 233. 1965; in Fl. Mal. II. 1 : 387. f. 7 d-f. 1981.

Rhizome creeping, about 4 mm diam.; scales ovate-subtriangular, brown, hairy. *Stipe* up to 50 cm long, less than 5 cm long in young but fully soriferous frond, hairy, scaly at base. *Lamina* oblong-lanceolate; rachis proliferous, bearing a tuft of fronds and rooting at several places, with simple or bifurcate hairs; lateral pinnae about 12 pairs, shortly stalked, linear-lanceolate, moderately acute to acute at apex, truncate at base, very shallowly incised, 4–8 by 1–1.5 cm; lobes rectangular, oblique, truncate at apex; herbaceous, dark olive-green when dry; veins pinnate, veinlets about 10 pairs, 5–7 pairs, uniting to form a goniopteroid venation. *Sori* oblong or elongate along united veinlets, naked; sporangia glabrous.

Thailand.— NORTHERN : Chiang Rai (Huai Sai, Mae Lao), Chiang Mai (Kang Kat); EASTERN : Chaiyaphum (Tat Ton), Udon Thani (Ban Nong Deru Tong); CENTRAL : Saraburi (Maenam Sak); SOUTH-WESTERN : Kanchanaburi (Sai Yok, Khuchae).

Distribution.— Tropics and subtropics throughout the Old World (type from S. India).

Ecology.— On moist banks near streams usually in open places or in light shade at low to medium altitudes.

FLORA OF THAILAND 3, 3 : 436 – 466.

27. ATHYRIACEAE

The generic classification of this family is not a natural one and is now under discussion. In the following enumeration seven genera are tentatively listed from Thailand, pending further investigations.

Literature.— Ching, R.-C.: On some confused genera of the family Athyriaceae. Acta Phytotax. Sin. 9 : 41—84. 1964; Kato, M. : Classification of *Athyrium* and allied genera of Japan. Bot. Mag. Tokyo 90 : 23—40. 1977.

KEY TO THE GENERA

1. Veins all free
 2. Sori round to oblong, not elongate along veins, indusiate
  3. Rhizome dorsiventral in structure. Stipe on distinct phyllopode (enlarged base of stipe which remains on rhizome after leaf-shedding) **1. Hypodematium**
  3. Rhizome radial in structure. Stipe not on a phyllopode
   4. Multiseptate hairs present at least on higher axes underneath. Indusia horse-shoe-shaped to hooked, subentire or toothed at margin **2. Deparia**
   4. Multiseptate hairs absent from axes. Indusia round-reniform, lacerate at margin **4. Kuniwatsukia**
 2. Sori elongate, indusiate or naked
  5. Fleshy horn-shaped outgrowths present at junction of rachis with its branches. Sori naked **3. Cornopteris**
  5. No horn-shaped outgrowths on rachis. Sori indusiate (or naked in *Athyrium dissitifolium*)
   6. Indusia rarely on both sides of veins, horse-shoe-shaped or hooked, or sori naked **6. Athyrium**
   6. Indusia usually on both sides of veins
    7. Grooves of rachis not open at the junction of branches; multiseptate hairs present on higher axes underneath **2. Deparia**
    7. Grooves of rachis deep, open to admit the grooves of a branch of higher order, the decurrent basiscopic edge of the latter being raised; multiseptate hairs absent or present in some species **7. Diplazium**

1. Veins reticulate
 8. Sori round; indusia round-reniform, lacerate at margin **5. Anisocampium**
 8. Sori elongate along veins; indusia narrow, usually on both sides of veins, entire to toothed **7. Diplazium**

1. HYPODEMATIUM

Kunze, Flora 16 : 690. 1833; Ching, Sunyatsenia 3 : 3. 1935; K. Iwats., Acta Phytotax. Geobot. 21 : 50. 1964.

Rhizome creeping, dorsiventral in structure, with a broad ventral strand and a slender dorsal one, bearing two dorsal rows of stipes, densely scaly; scales basally attached, entire, glabrous. Stipe on a phyllopode or an enlarged base which is covered with scales and remains on rhizome after leaf-shedding, seemingly jointed but without distinct abscission. Frond pentagonous in outline, tripinnatifid to quadripinnate, setose- and/or glandular-hairy; grooves of rachis open to admit those of costa; veins all free. Sori dorsal on veins, round to slightly elongate; indusia round-reniform or horse-shoe shaped, setose- and/or glandular-hairy; basic chromosome number n = 40 or 41.

The systematic position of this genus is variously interpreted, though we consider it as an Athyrioid genus (K. IWATSUKI, 1964). Four species are enumerated from all the warmer parts of the Old World, and two of them are native to Thailand.

KEY TO THE SPECIES

1. Glandular hairs absent; rhizome-scales more than 2 cm long **1. H. crenatum**
1. Both setose- and glandular-hairs present, though the latter being sparse; rhizome-scales less than 1.5 cm long **2. H. glanduloso-pilosum**

1. Hypodematium crenatum (Forssk.) Kuhn, Deck. Reis. Bot. 3 : 37. 1879; Ching, Sunyatsenia 3 : 9. f. 1. 1935; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 374. f. 32, 3—4. 1941; Holtt., Rev. Fl. Malaya 2 : 501. f. 295. 1955; Dansk Bot. Ark. 23 : 238. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 106. 1967.— *Polypodium crenatum* Forssk., Fl. Aegypt. Arab.: 185. 1775.— *Lastrea crenata* (Forssk.) Bedd., Ferns Br. Ind. Suppl.: 18. 1876; Handb.: 258. 1883.

Rhizome short-creeping, bearing close fronds, densely scaly; scales oblong-lanceolate, about 25 by 2.5 mm, concolorous, brown, entire. *Stipe* up to 50 cm long, green to stramineous, densely setose-hairy. *Frond* oblong-subdeltoid, widest at base, up to 55 by 45 cm, quadripinnatifid at basal pinnae; rachis deeply grooved, the grooves open at junction of costa; pinnae subtriangular, the upper ones gradually becoming smaller; ultimate segments oblong, adnate at base, moderately acute to subtruncate at apex, lobed with oblong, oblique lobes; softly papyraceous; veins pinnate, reaching the margin of lobes, all free; hairs dense on every part of frond, setose, about 5 mm long. *Sori* dorsal on veinlets, rather close to costules; indusia round-reniform or horse-shoe-shaped, about 1 mm broad, white to slightly greyish, densely setose-hairy.

T h a i l a n d.—NORTHERN : Chiang Rai (Doi Tham Yup), Chiang Mai (Doi Chiang Dao), Lampang (Mae Ngao); SOUTH-WESTERN : Kanchanaburi (Tha Po).

D i s t r i b u t i o n.— Throughout the warmer parts of the Old World : S. & E. Africa, Cape Verde Islands, Mauritius, Arabia (type), N. India, N. Vietnam, S. & Central China, Taiwan, Philippines, Malaya, Pacific Islands and as far north as Japan (subsp. *fauriei*).

E c o l o g y.— In crevices of rather moist limestone cliffs in mixed forests at medium to high altitudes.

2. Hypodematium glanduloso-pilosum (Tagawa) Ohwi, Bull. Nat. Sci. Mus. Tokyo 3 : 98. 1956.— *Hypodematium fauriei* f. *glanduloso-pilosum* Tagawa, J. Jap. Bot. 27 : 321. 1952.— *Lastreopsis parishii* auct. non (Hook.) Ching : Tagawa & K. Iwats., Southeast As. St. 5 : 97. 1967. Figure 46. 1—6.

Different from the preceding species in : rhizome-scales smaller, 1—1.5 cm long; frond smaller, stipe up to 20 cm long, frond up to 25 by 20 cm; ultimate segments oblique, acute to moderately acute at apex; hairs of two kinds, setose-hairs about 0.3 mm long, glandular hairs sparse.

T h a i l a n d.— NORTH-EASTERN : Loei (Phu Kradueng); SOUTH-WESTERN : Prachuap Khiri Khan (Sam Roi Yot).

D i s t r i b u t i o n.— Japan (type) and China (Shantung, Anhwei and Honan).

E c o l o g y.— On rocks in shade in deciduous or mixed forests at about 400 m alt.

N o t e.— Geographically it is interesting to find this species in Thailand, for it is a warm temperate species in Central China and Japan. Phu Kradueng plants are peculiar in having few glandular hairs, though our Thai plants are just the same at Japanese and Chinese plants except for this feature.

2. DEPARIA

Hook. & Grev., Ic. Fil. : t. 154. 1829; M. Kato, Bot. Mag. Tokyo 90 : 35. 1977.— *Lunathyrium* Koidz., Acta Phytotax. Geobot. 1 : 30. 1932.— *Dryoathyrium* Ching, Bull. Fan Mem. Inst. Biol. 11 : 79. 1941.— *Parathyrium* Holtt., Kew Bull. 1958 : 448.— *Athyriopsis* Ching, Acta Phytotax. Sin. 9 : 63. 1964.— *Athyrium* Roth, Röm. Mag. 2(1) : 109. 1799, p.p.; Copel., Gen. Fil. : 147. 1947, p.p.

Rhizome creeping, short or suberect, radial in structure, scaly; scales concolorous, brown, entire, glabrous. Stipe more or less broadened near base, mucilaginous when young, hairy. Frond pinnately compound, the lowest pinnae usually the largest; rachis grooved, grooves not open at the junction of branches or of leaflets; veins pinnate, all free; rachis, costa, costules hairy underneath, hairs coarse, multicellular, septae dark brown, distinct. Sori round to oblong, dorsal on veins, indusiate.

About 20 species are known in the warmer parts of the Old World: E. Africa including the adjacent islands, Ceylon, Himalaya, SW. China, Japan, W. Malesia to Luzon, and Hawaii; one species in N. America. Two of them are native to Thailand.

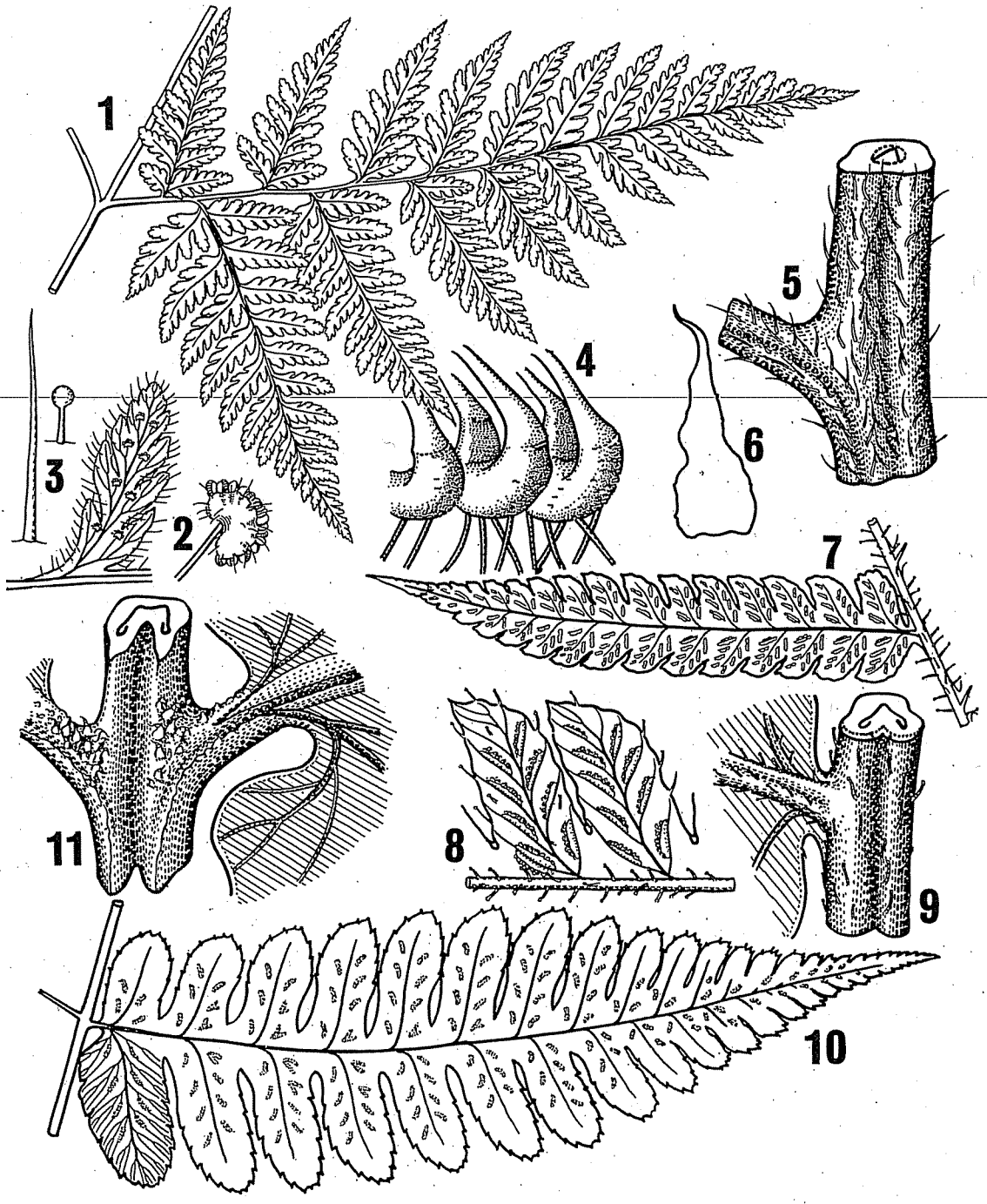


Figure 46. 1–6: *Hypodematium glanduloso-pilosum*; 1. lowest pinna excluding hairs, natural size; 2. ultimate segment (x 3.0) and sorus enlarged; 3. two kinds of hairs, acicular (left) and glandular (right), x ca. 150; phyllopodes, scales being removed, x 3.0; 5. rachis and basal part of pinna, x ca. 20; 6. a scale on stipe base, x 5.0. 7–9: *Deparia japonica*; 7. medium-size pinna, x 1.5; 8. ultimate segments, x 4.0; 9. rachis and basal part of pinna, x ca. 15.0. 10–11: *Cornopteris opaca*; 10. medium-size pinna, natural size; 11. rachis and basal part of pinna, x 10.0.

KEY TO THE SPECIES

1. Rhizome thick, ascending. Frond tripinnate. Sori round to oblong **1. D. boryana**
1. Rhizome slender, long-creeping. Frond pinnate with lobed pinnae. Sori elongate along veins **2. D. japonica**

= Deparia subfluviatilis (Hayata) M. Kato

1. Deparia boryana (Willd.) M. Kato, Bot. Mag. Tokyo 90 : 36. 1977.— *Aspidium boryanum* Willd., Sp. Pl. 5 : 285. 1810.— *Lastrea boryana* (Willd.) Moore, Ind. Fil. : 86. 1858; Bedd., Handb. : 266. 1883.— *Phegopteris kingii* Bedd., Handb. Suppl. : 84. 1892.— *Dryopteris boryana* (Willd.) C. Chr., Ind. Fil. : 255. 1905; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 318. 1941.— *Athyrium boryanum* (Willd.) Tagawa, Acta Phytotax. Geobot. 4 : 144. 1935; Holtt., Rev. Fl. Malaya 2 : 567. 1955.— *Dryoathyrium boryanum* (Willd.) Ching, Bull. Fan Mem. Inst. Biol. 11 : 81. 1941; Tagawa & K. Iwats., Southeast As. St. 5 : 101. 1967.— *Parathyrium boryanum* (Willd.) Holtt., Kew Bull. 1958 : 449.

Rhizome thick, ascending to suberect, sometimes subarborescent, up to 25 cm high, covered with intricate roots, bearing fronds in a tuft at apex, scaly; scales narrowly lanceolate, gradually narrowing towards long-tailed apex, concolorous brown, entire, up to 13 by 1.5 mm. *Stipe* stramineous, up to 40 cm long, hairy as well as scaly. *Frond* tripinnate, up to 120 cm long and wide; pinnae up to 10 pairs, the largest ones stalked, oblong-lanceolate, up to 60 by 20 cm; pinnules of larger pinnae subsessile, narrowly triangular, widest at truncate to subcordate base, long-acuminate at apex, up to 10 by 3.5 cm; ultimate segments adnate at base forming broad wings of costules, oblong, round at apex, up to 15 by 7 mm, lobed to $\frac{1}{3}$ way, with oblique entire lobes, papyraceous; stipe, costa, costule and veins beset with coarse articulated hairs of 0.5 –1 mm long; veins pinnate, all free. *Sori* round, costular; indusia small, fugaceous.

T h a i l a n d.— NORTHERN : Chiang Rai (Doi Phacho), Tak (Doi Pae Poe, Doi Musoe).

D i s t r i b u t i o n.—Réunion (type), Sri Lanka, India, S. China, Taiwan, Malaya, Philippines, Borneo, and Java.

E c o l o g y.— Wet sandy stream-beds in deep shade at about 1000 –1400 m alt.

= Deparia petersenii (Kunze) M. Kato

2. Deparia japonica (Thunb.) M. Kato, Bot. Mag. Tokyo 90 : 37. 1977.— *Asplenium japonicum* Thunb., Fl. Jap. : 334. 1784.— *Diplazium japonicum* (Thunb.) Bedd., Ferns Br. Ind. Suppl. : 12. 1876; Handb.: 180. 1883; Tard. & C. Chr. in Fl. Gén I.-C. 7(2) : 256. 1940.— *Athyrium japonicum* (Thunb.) Copel., Phil. J. Sci. Bot. 3 : 290. 1908; Holtt., Rev. Fl. Malaya 2 : 551. 1955; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24 : 181. 1970.— *Lunathyrium japonicum* (Thunb.) Kurata, J. Geobot. (Kanazawa) 9 : 99. 1961; Holtt., Rev. Fl. Malaya 2nd ed. 2 : 637. 1968. Figure 46. 7–9.

Rhizome creeping, slender, 2–3 mm diam., scaly; scales gradually narrowing from base towards acute apex, concolorously brown, thin, entire at margin. *Stipe* up to 25 cm long, stramineous to darker, hairy above. *Lamina* pinnate with deeply lobed pinnae, oblong to oblong-subtriangular, acuminate at apex, broadest or rarely a little reduced at base, up to 25 by 15 cm; rachis sparsely hairy, grooved above; lateral pinnae up to 10 or more pairs, subsessile, lanceolate, caudate-acuminate at apex, subtruncate to cordate at base, deeply lobed more than half-way to costa, up to 12 by 1.2–3 cm, widest at middle or basal $\frac{1}{3}$; lobes oblong to subquadrangular, oblique, round to obtuse at apex, serrate at margin, 5–15 by 3.5–7.5 mm; herbaceous, green to deep green, paler beneath; veins pinnate, 4–7 pairs in each lobe, veinlets simple or forked, reaching the very margin of lobes, bearing sparse multiseptate hairs. *Sori* along veinlets, about 2 mm long, rather costular; indusia crescentic, attached at posterior end.

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.— Tropical Asia north to Korea and Japan (type).

E c o l o g y.— On muddy rocks near streams at 600–800 m alt.

N o t e.— The identification of the Thai material of the *D. japonica* complex is still doubtful. The tropical Asiatic form of *D. japonica* is often separated and identified as *D. petersenii* (Kunze) M. Kato. All the Southeast Asiatic forms of the *D. japonica* group should be revised before finally deciding the specific identification of the Thai materials.

3. CORNOPTERIS

Nakai, Bot. Mag. Tokyo 44 : 7. 1930; M. Kato, Acta Phytotax. Geobot. 30 : 102. 1979.— *Athyrium* Roth, Röm. Mag. 2(1) : 105. 1799, p.p.; Copel., Gen. Fil.: 147. 1947, p.p.

Rhizome short-creeping to ascending, scaly; scales narrow, concolorous, membranous, entire. Lamina bipinnate to tripinnate, softly herbaceous, usually becoming blackish when dry; rachis grooved above, with grooves decurrent to those on costa, occupying small horn-shaped outgrowths at junction; veins pinnate, all free. Sori oblong to elongate along veinlets, dorsal on veinlets, naked.

About a dozen species are known in the regions from Himalaya eastwards to Japan, and one of them has been collected in Thailand.

Cornopteris opaca (D. Don) Tagawa, Acta Phytotax. Geobot. 8 : 92. 1939; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 176. 1969; M. Kato, Acta Phytotax. Geobot. 30 : 108. 1979.— *Hemionitis opaca* D. Don, Prod. Fl. Nepal. : 13. 1825.— *Diplazium opacum* (D. Don) Christ, Bull. Géogr. Bot. Mans. 1906 : 242. Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 261. 1940. Figure 46. 10–11.

Rhizome (unknown in Thai plants) thick, ascending to suberect, bearing a few fronds near apex; scales narrow, up to 8 by 2 mm, entire, brown, membranous. *Stipe* up to 30 cm or more long, stramineous to brown, more or less broadened at scaly base. *Frond* bipinnate to tripinnatifid, oblong with acute apex and round base, about 50 by 25 cm; pinnae subopposite, ascending, subsessile or shortly stalked in larger ones; rachis grooved, the grooves decurrent to those of pinnae; pinnules of the larger pinnae narrowly oblong-subdeltoid, acute to acuminate at apex, truncate or broadly cuneate at sessile base, about 8 by 2.4 cm, lobed nearly to costule with subquadrangular lobes with obtuse apex and subentire or crenate margin of about 1 by 0.5 cm, pinnules of the upper pinnae like the lobes of larger pinnules; herbaceous to thin-papyraceous, usually blackish when dry; veins pinnate with simple or rarely forked veinlets reaching the very margin of lobes. *Sori* oblong, costular, naked.

T h a i l a n d.— NORTHERN : Lampang.

D i s t r i b u t i o n.— N. India, Nepal (type) to SW. Japan, south to Vietnam; also in Java.

E c o l o g y.— Terrestrial on mountain slopes at about 1000 m alt.

4. KUNIWATSUKIA

Pichi-Ser., Webbia 28 : 455. 1973.— *Microchlaena* Ching, Bull. Fan Mem. Inst. Biol. 8 : 322. 1938, non Wight et Arn., 1834 : K. Iwats., Acta Phytotax. Geobot. 24 : 188. 1970.— *Athyrium* Roth, Röm. Mag. 2(1) : 105. 1799, p.p.; M. Kato, Bot. Mag. Tokyo 90 : 25. 1977, p.p.

Rhizome short, creeping to ascending, radial in structure bearing fronds in a tuft near apex, scaly; scales narrow, concolorous, brown, entire, glabrous. Stipe thickened near base with constriction just above the rhizome. Frond imparipinnate with shallowly serrate linear pinnae; veins pinnate, all free, the basal posterior veinlets springing directly from costa. Sori dorsal on veins, round; indusia round-reniform, lacerate at margin.

A monotypic genus, sometimes included in *Athyrium*.

Kuniwatsukia cuspidata (Bedd.) Pichi-Serm., Webbia 28 : 455. 1973.— *Lastrea cuspidata* Bedd., Ferns Br. Ind. corr. ad pl. 118. 1870; Handb. : 232. f. 119. 1883, based on *Aspidium cuspidatum* Mett., Abhandl. Senckenb. Naturf. Ges. 2 : 376. 1858, non Desv., 1827.— *Aspidium yunnanense* Christ, Bull. Herb. Boiss. 6 : 965. 1898.— *Microchlaena cuspidata* (Bedd.) Ching, Acta Phytotax. Sin. 9 : 99. 1964; Tagawa & K. Iwats., Acta Phytotax. Geobot. 22 : 103. 1967; Southeast As. St. 5 : 101. 1967; K. Iwats., Acta Phytotax. Geobot. 24 : 188. 1970.— *Microchlaena yunnanensis* (Christ) Ching, Bull. Fan Mem. Inst. Biol. 8 : 325. 1938; Tagawa & K. Iwats., Southeast As. St. 3(3) : 87. 1965. Figure 47. 1—4.

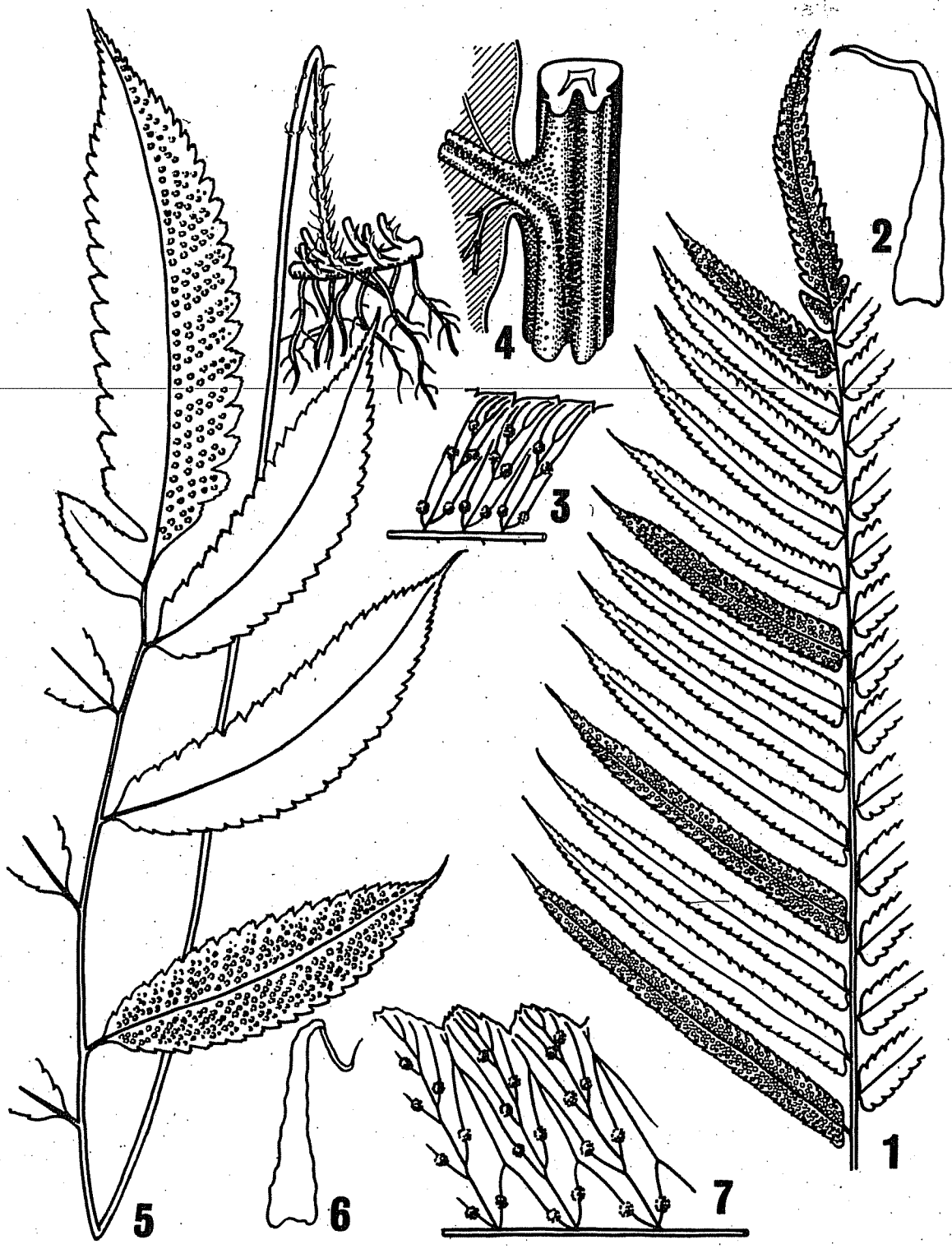


Figure 47. 1–4: *Kuniwatsukia cuspidata*; 1. upper portion of fertile frond, x 0.5; 2. a scale on stipe bace, x 5.0; 3. venation and sori, x 2.5; 4. rachis and basal part of pinna, x 6.0. 5–7: *Anisocampium cumingianum*; 5. plant, x 0.75; 6. a scale on rhizome, x 10.0; 7. venation and sori, x 3.0.

Rhizome short, creeping to ascending; scales linear-lanceolate, gradually narrowing towards the tailed apex, up to 12 by 1.2 mm, entire. *Stipe* purplish when young, stramineous to pale brown, up to 60 cm long, broadened near scaly base. *Frond* imparipinnate, oblong in outline, about 60 by 35 cm; pinnae linear, acuminate at apex, truncate to auricled at acroscopic and cuneate at basiscopic bases, shallowly lobed at margin, up to 20 by 1.3 – 1.7 cm, the soriferous pinnae usually narrower; lobes triangular, with sharp teeth at apex; papyraceous, green, paler beneath; rachis and costa glabrous or with linear scales; veins pinnate, the veinlets simple, all except the basal pairs reaching the margin of lobes. *Sori* dorsal on veinlets, costular, with small round-reniform indusia lacerate at margin.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Suai, Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon), Lamphun (Doi Khun Tan).

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

E c o l o g y.— On rather dry mountain slopes in mixed or evergreen forests at 800 – 1600 m alt.

5. ANISOCAMPIUM

Presl, Epim.: 52. 1849; Copel., Gen. Fil.: 151. 1947.— *Athyrium* Roth, Röm. Mag. 2(1) : 105. 1799, p.p.; M. Kato, Bot. Mag. Tokyo 90 : 25. 1977, p.p.

Rhizome short-creeping, rather deep in earth, bearing rather close fronds, scaly; scales thin, concolorous, brown, entire, glabrous. Frond imparipinnate with oblong-lanceolate lobes; pinnae a few in number; herbaceous; rachis hairy, grooved, grooves decurrent to those of costa; veins anastomosing to form rather regularly arranged areoles (seemingly goniopteroid venation). Sori dorsal, round, a single row at each side of, and close to main veins; indusia small, round-reniform, lacerate.

The delimitation of this genus is in accordance with current practice, but recently a species with free venation, *Athyrium sheareri,* has been included. It is therefore difficult to distinguish this genus from *Athyrium.*

Anisocampium cumingianum Presl, Epim.: 59. 1849; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 281. f. 29, 2 – 3. 1940; Holtt., Dansk Bot. Ark. 23 : 243. 1965; Tagawa & K. Iwats., Southeast As. St. 5 : 101. 1967. Figure 47. 5 – 7.

Rhizome creeping, about 5 mm diam., more or less fleshy, scaly throughout; scales linear-subtriangular, about 3 by 1 mm. *Stipe* stramineous with brownish base up to 35 cm long, scaly on lower portion, hairy. *Frond* imparipinnate, up to 35 by 25 cm; lateral pinnae 2 – 6 pairs, shortly stalked or sessile, oblong, cuspidate at apex, rounded to narrowly cuneate at base, up to 13 by 3 cm in soriferous pinnae and about 4.5 cm broad in non-soriferous ones, lobed about $\frac{1}{5}$ way to costa; lobes oblique, rounded to obtuse at apex with sharp teeth; herbaceous, light green,

glabrous or minutely hairy; terminal pinna oblong, acuminate at apex, cuneate, round or cordate at base, lobed at margin sometimes deeply in lower portion; veins pinnate, the veinlets uniting to the opposite ones of the next group, the excurrent veinlets continuous. *Sori* dorsal, medial, round, irregularly scattered; indusia small, thin, pale, round-reniform, lacerate.

Thailand.— NORTHERN : Chiang Rai (Doi Tung), Chiang Mai (Kang Kat, Doi Chiang Dao, Doi Suthep, Doi Makena, Sop Aep), Mae Hong Son (Mae La Noi, Khun Yuam), Lamphun (Doi Khun Tan), Lampang (Huai Thak, Mae Mo), Tak (Wang Chao, Lan Sang, Doi Musoe, Khao Phra Wo), Phitsanulok (Thung Salaeng Luang), Phrae (Mae Ban); CENTRAL : Saraburi (Sam Lan); SOUTH-EASTERN : Prachin Buri (Ban Ban Hills); SOUTH-WESTERN : Kanchanaburi (Thung Kang Yang).

Distribution.—Himalaya, S. India, Sri Lanka, Laos, and Philippines (type).

Ecology.— On sandy or muddy slopes in mixed forests at low to medium elevations up to 1100 m alt., usually confined to places completely exposed in the dry season.

Note.— The fleshy rhizome is similar to that of *Ctenitis manilensis* and *Tectaria tenuifrons* both of which are known in the mixed forests of the monsoon area. This seems to be an adaptive feature for survival when completely exposed in the dry season.

6. ATHYRIUM

Roth, Röm. Mag. 2(1) : 105. 1799; Tent. Fl. Germ. 3 : 58. 1800; Copel., Gen. Fil. 147. 1947, p.p. [Type species : *A. filix-femina* (Linn.) Roth]

Rhizome creeping, ascending or erect, scaly; scales concolorous or discolorous, with thin cell-walls, glabrous. Lamina simply pinnate to pinnately compound; rachis grooved, groove decurrent to that on costa, hairy or glabrous; veins pinnate, all free; hairs coarse, multicellular if any. Sori dorsal on veinlets, elongate (or shorter to round in *A. dissitifolium*); indusia unequally round-reniform, horse-shoe-shaped, hooked, or crescentic, very rarely wanting.

About 200 species are known from various parts of the world but not many in the tropical regions. The generic circumscription varies according to the concept of the author : some unite this with *Diplazium* (COPELAND, HOLTTUM, etc.)recognizing a large genus of about 600 species, which the splitters distinguish a number of genera around *Athyrium* s. str. (CHING, PICHI-SERMOLLI, KURATA, KATO, etc.).

The specific classification is still obscure for the Asiatic members of *Athyrium*. We enumerate here four species from Thailand, though the identifications will have to be revised after comparison with material from neighbouring areas. There are some additional specimens which cannot be identified at the moment with any of the described species, though they are not sufficient for final decisions.

KEY TO THE SPECIES

1. Sori naked, oblong to round — **1. A. dissitifolium**
1. Sori indusiate
2. Lamina bipinnate or more compound
3. Frond oblong-subdeltoid; no spine at junction between costa and veins and between veins and veinlets — **2. A. mackinnonii**
3. Frond narrowly oblong; a spine present at each junction between costa and vein and between vein and veinlet — **3. A. setiferum**
2. Lamina simply pinnate to bipinnatifid — **4. A. anisopterum**

1. Athyrium dissitifolium (Bak.) C. Chr., Contr. U.S. Nat. Herb. 26 : 296, 332. pl. 18. 1931; Tagawa & K. Iwats., Southeast As. St. 3(3) : 87. 1965; 5 : 101. 1967.— *Polypodium dissitifolium* Bak., Kew Bull. 1895 : 54. Figure 48. 1.

Rhizome short-creeping, bearing close fronds; scales narrow, up to 10 by 1 mm, pale brown, entire. *Stipe* up to 30 cm long, stramineous, dark brown at broadened base, scaly in lower part. *Frond* narrow, widest at base, acuminate to attenuate at apex, up to 30 by 12 cm in soriferous and 15 cm wide in sterile fronds, bipinnatifid; pinnae more than 15 pairs, lower pinnae shortly stalked, linear-lanceolate, falcate, truncate at base, acuminate at apex, up to 6 by 1.5 cm in soriferous and up to 8 by 2.2 cm in sterile ones, deeply lobed nearly to costa, upper pinnae becoming smaller upwards; ultimate segments patent to oblique, oblong to subdeltoid, rounded to moderately acute at apex, toothed at margin; papyraceous to subcoriaceous, light green; veins pinnate, veinlets simple or forked, ending in sharp teeth at margin. *Sori* oblong or sometimes round, naked, sometimes uniting with the next ones at maturity.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Talop, Mae Suai, Doi Phacho, Phu Langka), Chiang Mai (Ban Mae Kong, Mae Ho, Pong Pho, Doi Chiang Dao, Doi Suthep, Doi Hua Mot, Sop Aep, Doi Kiu Lom, Doi Inthanon), Mae Hong Son (Bo Luang), Lamphun (Doi Khun Tan).

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

E c o l o g y.— On rather dry ground or on mountain slopes in mixed or evergreen forests at 600 – 1500 m alt.

N o t e.— This species is distinct in *Athyrium* by its oblong exindusiate sori, though the systematic position is doubtless in this genus as indicated by two leaf-traces, broadened base of stipe, grooved rachis and costa with grooves decurrent to each other, and other features.

2. Athyrium mackinnonii (Hope) C. Chr., Ind. Fil. : 143. 1905; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 277. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 102. 1967.— *Asplenium mackinnonii* Hope, J. Bot. 1896 : 124. Figure 48. 2.

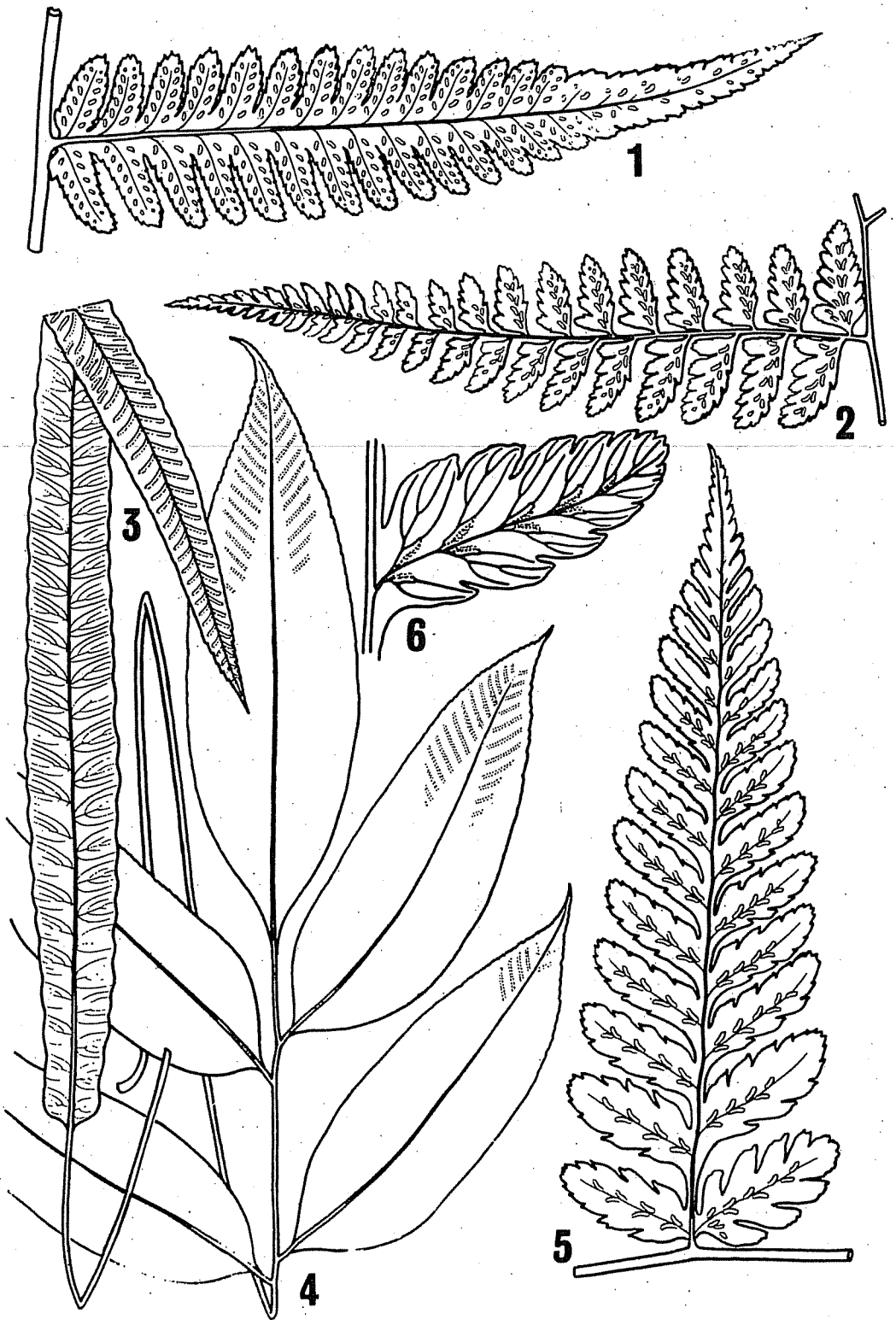


Figure 48. 1: *Athyrium dissitifolium*, medium-size pinna, x 2.0. 2: *A. mackinnonii*, medium-size pinna, natural size. 3: *Diplazium subserratum*, a frond, x 0.5. 4: *D. donianum*, a frond, x 0.5. 5–6: *D. muricatum*; 5. medium-size pinnule, x 2.0; 6. large segment enlarged, x 4.0.

Rhizome erect, with a few fronds at apex, scaly; scales narrow with long-tailed apex, up to 6 by 0.8 mm, dark brown, entire. *Stipe* up to 20 cm long, stramineous, dark brown and scaly at base. *Frond* broadly oblong, acute at apex, up to 30 by 20 cm, bipinnate-tripinnatifid; pinnae about 10 pairs, lower pinnae stalked, ascending, oblong-lanceolate, up to 11 by 5 cm, the upper pinnae becoming smaller upwards; pinnules subsessile or shortly stalked, oblong, oblique, moderately acute to rounded at apex, truncate to auricled at anterior and cuneate at posterior bases, about 2.5 by 1 cm; ultimate segments oblong, rounded at apex, distinctly toothed; papyraceous to subcoriaceous; veins pinnate, veinlets simple or rarely forked, ending in teeth at margin of segments. *Sori* oblong, usually close to costules; indusia opening anteriorly, oblong, crenate at margin.

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

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

E c o l o g y.— On rather dry mountain slopes in dense evergreen forests at 1100–1300 m alt.

3. Athyrium setiferum C. Chr., Ind. Fil. : 146. 1905, based on *Asplenium tenerum* (Wall. n. n. sub *Allantodia*) Hope, J. Bomb. Nat. Hist. Soc. 12 : 529. t. 4. 1899, non Roxb. 1816, nec Fée 1852.

Rhizome short, erect, bearing a few fronds at apex, scaly; scales narrow, with tailed apex, up to 8 by 1 mm, brown, entire. *Stipe* up to 35 cm long, stramineous, dark and scaly at broadened base. *Frond* narrowly oblong, acuminate at apex, up to 30 by 15 cm, bipinnate-tripinnatifid; lower pinnae 3–5 cm apart, patent or slightly deflexed, narrowly oblong, acuminate at apex, auricled at acroscopic base, the upper pinnae smaller, ascending; pinnules oblong, oblique, round at apex, auricled or broadly cuneate at anterior and narrowly cuneate at posterior bases, subsessile or shortly stalked, about 1 by 0.5 cm, deeply lobed; lobes oblong, oblique, rounded to obtuse at apex, toothed; papyraceous, light green; veins pinnate, veinlets ending in teeth; a unicellular hair present at each junction between costa and costule and between veins and veinlets. *Sori* round to oblong, costular; indusia thin, all one-sided, crenate at margin.

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.— Himalaya (type) to Yunnan.

E c o l o g y.— On humus-rich mountain slopes near streams in dense mossy forests at 2000–2500 m alt.

4. Athyrium anisopterum Christ, Bull. Herb. Boiss. 6 : 962. 1898; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 116. f. 12. 1968.— *Athyrium macrocarpum* auct. non (Bl.) Bedd. : Holtt., Rev. Fl. Malaya 2 : 550. f. 323. 1955.

Rhizome short, ascending, scaly; scales narrow and subulate, up to 8 by 1 mm, entire, tailed at apex, more or less bicoloured. *Stipe* up to 12 cm long, stramineous, dark and scaly at base. *Frond* narrowly oblong, acuminate to attenuate at apex, up to 20 by 6 cm, pinnate-bipinnatifid; pinnae stalked, patent or deflexed in lower ones, oblong to oblong-subdeltoid, rounded to acute at apex, auricled at acroscopic and cuneate to dimidiate at basiscopic bases, up to 35 by 1.2 mm, lobed nearly towards costa; lobes rounded, toothed; papyraceous, minutely scaly on rachis and costa. *Sori* medial, round, rather large; indusia round to oblong, opening outwards, more than 1 mm wide, crenate to lacerate at margin.

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.— Sri Lanka, S. India, Himalaya, Burma, SW. China (Yunnan, type, and Kwangtung), Taiwan, Indochina, Malaya, Borneo, and Luzon.

E c o l o g y.— On humus-rich floor of dense evergreen forests above 1800 m alt.

N o t e.— This species resembles. *A. macrocarpon* in various features and was actually reduced to the latter by C. CHRISTENSEN (1931) and HOLTTUM (1955). It was treated as distinct by SLEDGE (1962), who distinguished *A. anisopterum* from *A. macrocarpon* by much smaller, narrowly oblong, simply pinnate to subbipinnate fronds of 4 – 6 cm in breadth, and by auriculate pinnae. In addition the cytological evidence (MANTON & SLEDGE, 1954) is that *A. anisopterum* is tetraploid and *A. macrocarpon* is hexaploid in Sri Lanka plants.

7. DIPLAZIUM

Sw., Schrad. J. Bot. 1800(2) : 61. 1801.— *Callipteris* Bory in Belanger, Voy. 1 : 282. 1804; Copel., Gen. Fil. : 152. 1947.— *Athyrium* Roth, Röm. Mag. 2(1) : 105. 1799, p.p.; Copel., Gen. Fil. : 147. 1947, p.p.

Rhizome creeping to erect, scaly; rhizome-scales entire or toothed; rachis grooved, the grooves distinct, open. Frond simple to pinnately compound; veins pinnate, or reticulate to form rather regular quadrangular areoles at each side of veinlets (seemingly goniopteroid venation); usually glabrous or minutely scaly on axes. Sori elongate along veins; indusia crescentic, often adjacent to the next ones, opening in opposite direction.

About 400 species are known chiefly in the tropical regions, and twenty-nine species are enumerated here from Thailand. We have some additional records of *Diplazium* from Thailand as : *D. montanum* v.A.v.Ros. in Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 56. 1968; *D. incomptum* Tagawa in Tagawa & K. Iwats., Southeast As. St. 5 : 104. 1967. These records are based on insufficient materials, and they are not listed here as actually occurring in Thailand. The specific classification of *Diplazium* is problematic as yet, and we have some unidentified materials not referable to any of the known species.

KEY TO THE SPECIES

1. Frond simple, entire or crenate
 2. Veins all free. Frond lanceolate, attenuate to cuneate at base
  3. Rhizome short, suberect; scales toothed — **3. D. subserratum**
  3. Rhizome creeping; scales entire — **4. D. subsinuatum**
 2. Veins anastomosing. Frond oblong to oblong-subdeltoid with cordate base — **5. D. cordifolium**
1. Frond pinnate or pinnately compound
 4. Frond pinnate
  5. Lateral pinnae often more than 4 cm broad, subentire to crenate
   6. Terminal pinna not distinct
    7. Scales toothed. Free lateral pinnae more than 5 pairs
     8. Veins copiously anastomosing — **1. D. accedens**
     8. Veins free, or rarely irregularly reticulate — **10. D. megaphyllum**
    7. Scales entire. Free lateral pinnae 1–3 pairs — **2. D. heterophlebium**
   6. Frond imparipinnate with a terminal pinna like lateral one
    9. Rhizome-scales entire
     10. Veins copiously anastomosing — **5. D. cordifolium**
     10. Veins free or rarely anastomosing
      11. Lateral pinnae 5–9 pairs; veins occasionally anastomosing; gemmae present at junction between rachis and costa — **6. D. xiphophyllum**
      11. Lateral pinnae 3–5 pairs; veins free or very rarely anastomosing; gemmae absent — **7. D. riparium**
    9. Rhizome-scales toothed
     12. Rhizome short, erect to ascending; gemmae often present at junction between rachis and costa — **8. D. bantamense**
     12. Rhizome creeping; gemmae absent — **9. D. donianum**
  5. Lateral pinnae usually less than 3.5 cm broad, crenate to lobed
   13. Rhizome-scales entire
    14. Scales black-margined. Sori impressed — **11. D. sorzogonense**
    14. Scales not distinctly black-margined. Sori superficial
     15. Frond up to 15 cm wide; rachis and costa densely hirsute — **12. D. tomentosum**
     15. Frond wider; rachis and costa glabrous
      16. Pinnae subentire or shallowly lobed
       17. Veinlets 4–6 in each vein group. Pinnae lobed, shortly stalked — **13. D. prescottianum**
       17. Veinlets usually 3–4 in each vein group. Pinnae subentire, distinctly stalked — **14. D. subintegrum**
      16. Pinnae lobed more than half-way to costa — **15. D. malaccense**
   13. Rhizome-scales toothed
    18. Rhizome short, erect
     19. Lateral pinnae gradually becoming smaller upwards forming no distinct terminal portion
      20. Scales irregularly toothed. Pinnae up to 2.3 cm wide, thicker, distinctly auricled at base — **16. D. crenatoserratum**
      20. Scales strongly toothed. Pinnae up to 3.5 cm wide, thinner, not or moderately auricled at base — **17. D. silvaticum**
     19. Lateral pinnae suddenly becoming smaller above 6 or 7 larger ones forming distinct terminal portion of fronds — **18. D. siamense**
    18. Rhizome long-creeping — **19. D. mettenianum**
 4. Frond bipinnate or more compound
  21. Veins all free
   22. Pinnules sessile, most or all adnate at base
    23. Pinnules about 1 cm broad, crenate; pinnae with long stalks — **20. D. petri**
    23. Pinnules about 1.4 cm broad, subentire; pinnae with rather short stalks — **25. D. petelotii**
   22. Pinnules more or less stalked at least in larger ones
    24. Sori oblong, less than 2.5 mm long

25. Scales not black-margined. Stipe not spinose. Lobes serrate or subentire
  26. Sori close to midrib **21. D. muricatum**
  26. Sori medial to marginal
    27. Pinnules subcordate at base. Rhizome creeping **22. D. conterminum**
    27. Pinnules cuneate to subtruncate at base. Rhizome erect **23. D. taiwanense**
25. Scales black-margined. Stipes spinose in lower part. Lobes sharply toothed **28. D. polypodioides**

24. Sori elongate, more than 3 mm long
  28. Scales entire **24. D. leptophyllum**
  28. Scales toothed
    29. Lobes oblong with rounded apex; pinnules long-stalked; veinlets simple or forked **26. D. dilatatum**
    29. Lobes subquadrangular with obtuse apex; pinnules shortly stalked; veinlets all simple **27. D. simplicivenium**

21. Veins anastomosing **29. D. esculentum**

1. Diplazium accedens Bl., En. Pl. Jav. : 192. 1828; Holtt., Gard. Bull. S.S. 11 : 81. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 56. 1968.— *Athyrium accedens* (Bl.) Milde, Bot. Zeit. 1870 : 353; Holtt., Rev. Fl. Malaya 2 : 558. f. 329. 1955.

Rhizome massive, erect; scales linear, about 15 by 1 mm, brown with blackish-brown thickened marginal strand bearing sharp teeth. *Stipe* about 50 cm long, up to 1.5 cm diam. near scaly base, the scars of fallen-off scales sometimes spinose, stramineous. *Frond* pinnate, 5–15 pairs of lateral pinnae free, stalked in lower ones, sessile to decurrent in upper ones, basal pinnae the largest, oblong with acuminate apex, rather suddenly broadly cuneate to subtruncate at base, about 30 by 8 cm, undulate at margin; uppermost part of frond deltoid, deeply lobed in lower portion, up to 15 by 10 cm; papyraceous, glabrous or minutely scaly, scabrous underneath; rachis grooved on upper surface, gemmiferous; costa raised below, grooved with distinct ridges on upper surface; veins pinnate, veinlets uniting with those of the opposite group, forming continuously united veinlets (seemingly goniopteroid venation), the areoles like that of *D. heterophlebium* in outer part. *Sori* along veinlets, often forming areoles following the venation; indusia opening outwards.

T h a i l a n d.— PENINSULAR : Ranong (Phato), Yala (Bannang Sata).

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

E c o l o g y.— On moist ground by streams in evergreen jungle at low altitude.

2. Diplazium heterophlebium (Mett. ex Bak.) Diels in Nat. Pflanzenfam. 1(4) : 228. 1899; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 268. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24 : 63. 1969.— *Asplenium heterophlebium* Mett. ex Bak. in Hook. & Bak., Syn. Fil. : 243. 1867.— *Anisogonium heterophlebium* (Mett. ex Bak.) Bedd., Ferns Br. Ind. : t. 329. 1869; Handb. : 191. f. 93. 1883.— *Athyrium heterophlebium* (Mett. ex Bak.) Copel., Phil. J. Sci. 38 : 142. 1929; Holtt., Rev. Fl. Malaya 2 : 549. 1955.

Rhizome short, ascending, bearing fleshy green roots; scales ovate with tailed apex, up to 7 by 2 mm, pale brown, membranous, entire. *Stipe* about 20 cm long, stramineous to darker, narrowly scaly. *Frond* oblong, pinnate or pinnatifid above, up to 30 by 20 cm; lower 1 –3 lateral pinnae free, sessile, oblong, caudate at apex, subtruncate to cordate at base, up to 10 by 3.5 cm, subentire or undulate at margin; upper part of frond lobed less deeply upwards, the lower lobes like the free pinnae; herbaceous, minutely hairy on surfaces; rachis minutely scaly as well as hairy, dark; veins pinnately branching, forming areoles without included veinlets (venation of the type of *Diplaziopsis*). *Sori* elongate along veinlets, sometimes on both sides of veinlets; indusia completely covering the sori, not so thin, brown at maturity.

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) to Yunnan, south to N. Vietnam and Malaya, north to southern edge of Japan (Isl. Yakushima).

E c o l o g y.— Along streams in moist hill evergreen forest at about 1750 m alt., once collected: HENNIPMAN 3432 (L, KYO).

N o t e.— CHING described a new genus *Dictyodroma* based on this species (Acta Phytotax. Sin. 9 : 57. 1964), and enumerated 5 closely related species. He distinguished *D. formosanum* from *D. heterophlebium* by entire lobes and obscure venation. COPELAND noted that *D. formosanum* is less hairy on rachis. These features, however, are insufficient to discriminate the two species.

3. Diplazium subserratum Bl., En. Pl. Jav. : 174. 1828; Bedd., Handb. : 174. 1883.— *Athyrium subserratum* (Bl.) Milde, Bot. Zeit. 1870 : 354; Holtt., Rev. Fl. Malaya 2 : 546. f. 321. 1955. Figure 48. 3.

Rhizome short, suberect, bearing a tuft of fronds at apex, scaly; scales oblong-subtriangular with acuminate apex, about 1 by 0.3 mm, concolorous, dark brown, toothed at margin. *Stipe* dark brown to nearly black towards base, 10—17 cm long, slightly grooved above. *Lamina* simple, narrowly lanceolate, 20—45 by up to 3.8 cm at middle, gradually narrowing towards both ends, acuminate at apex, attenuate but not decurrent at base, subentire in lower part, dentate at upper edges; herbaceous to softly papyraceous, dark when dried; midrib grooved above, distinctly raised on both surfaces. *Sori* one to four for a vein group, up to more than 1 cm long; indusia stiff, brown when dry.

T h a i l a n d.— PENINSULAR : Satun (Khao Khieo range).

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

E c o l o g y.— On moist mountain slopes by streams in evergreen jungle at about 700 m alt.

N o t e.— This resembles *D. subsinuatum* in appearance, but is distinct from the latter by suberect rhizome with fronds in a tuft, small darker scales with toothed margin, thinner texture of frond usually dark when dried, with serrate margin on upper portion of frond, and more oblique shorter sori.

4. Diplazium subsinuatum (Wall. ex Hook. & Grev.) Tagawa, Col. Ill. Jap. Pterid. : 135. 203. f. 298. 1959; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24 : 63. 1969.— *Asplenium subsinuatum* Wall. ex Hook. & Grev., Ic. Fil. 1 : t. 27. 1827.— *Diplazium lanceum* (Thunb.) Presl, Tent. Pterid. : 113. 1836, non Bory, 1833 : Bedd., Handb. : 174. f. 84. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 248. 1940.

Rhizome long-creeping, 1—1.5 mm diam., scaly throughout; scales narrowly subtriangular with long tails, 2.5—3 by up to 0.8 mm, concolorous, brown to darker, entire. *Stipe* up to 12 cm long, stramineous to darker, scaly at base, glabrous upwards. *Lamina* simple, narrowly lanceolate, attenuate towards both apex and base, subentire to crenate at margin, up to 20 by 1.8 cm; coriaceous, glabrous; midrib raised beneath, slightly grooved on upper surface, glabrous; veins 2—5 in each group, forming angles of 70°—80° to midrib, reaching to margin. *Sori* elongate along veins, on acroscopic or on both sides of veinlets, usually elongate from near midrib to near the margin; indusia not so thin, pale green or brown when dry.

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

D i s t r i b u t i o n.—Sri Lanka, India (type) to China, Indochina, Taiwan to Japan, south to Luzon and Borneo.

E c o l o g y.— On sandstone boulders along streams in evergreen forests at about 1175 m alt.

5. Diplazium cordifolium Bl., En. Pl. Jav.:190. 1828; Tagawa & K. Iwats., Southeast As. St. 5 : 102. 1967.— *Diplazium integrifolium* Bl., En. Pl. Jav. : 190. 1828.— *Anisogonium cordifolium* (Bl.) Bedd., Ferns Br. Ind. : t. 331. 1870; Handb. 191. f. 92. 1883.— *Athyrium cordifolium* (Bl.) Copel., Phil. J. Sci. Bot. 3 : 300. 1908; Holtt., Rev. Fl. Malaya 2 : 548. f. 322. 1955.

Rhizome short, erect, or ascending, scaly in younger part, about 5 mm diam.; scales narrow, up to 8 by 1 mm, concolorous, brown, entire. *Stipe* 30—60 cm long, stramineous or brownish in lower part, scaly or glabrescent upwards, grooved on adaxial surface. *Lamina* simple or imparipinnate; simple frond narrowly oblong-subdeltoid, cordate at broadest base, narrowing upwards towards acuminate apex, subentire to undulate at margin, about 30 by 13 cm; coriaceous, more or less fleshy; midrib distinctly raised beneath, glabrous; veins branching a few times, irregularly anastomosing in the marginal part; gemmae usually present at junction between stipe and midrib, viviparous; imparipinnate frond with a few pairs of lateral pinnae becoming smaller upwards, lateral pinnae sessile, bearing gemmae at junction between rachis and costa; veins forming angles of 45°—55° to costa. *Sori* elongate along veinlets, up to 4 cm or more long, on both sides of each veinlet or on acroscopic side; indusia thin but persistent.

T h a i l a n d.— PENINSULAR : Surat Thani (Lang Suan), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Narathiwat (Waeng), Yala (Ban Chana).

D i s t r i b u t i o n.— Malesia throughout (type from Java) eastwards to the Solomon Islands.

E c o l o g y.— On moist sandy mountain slopes in dense gloomy forests at low or medium altitudes, locally fairly abundant.

N o t e.— We could distinguish the form with simple frond from the form with imparipinnate frond in the field : the latter has been named *D. integrifolium* Bl.

6. Diplazium xiphophyllum (Bak.) C. Chr., Ind. Fil. : 241. 1905; Holtt., Gard. Bull. S.S. 11 : 106. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 102. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.— *Athyrium xiphophyllum* Bak., J. Bot. 1879 : 40; Holtt., Rev. Fl. Malaya 2 : 553. 1955.

Similar to imparipinnate form of *D. cordifolium* differing in : frond larger, with 5–9 pairs of lateral pinnàe; lateral pinnae narrowly cuneate at base, sessile or very shortly stalked, the margin crenate in posterior portion, the apex caudate; veins sparse, occasionally anastomosing but never copiously; gemmae on rachis rare.

T h a i l a n d.— PENINSULAR : Nakhon Si Thammarat (Khao Luang), Narathiwat (Ban Waeng), Yala (Ban Chana).

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

E c o l o g y.— On moist mountain slopes in dense evergreen forests at medium altitudes.

7. Diplazium riparium Holtt., Gard. Bull. S.S. 11 : 97. f. 5. 1940.— *Athyrium riparium* (Holtt.) Holtt., Rev. Fl. Malaya 2 : 554. f. 326. 1955.

Rhizome short, ascending to suberect; scales narrowing towards long-tailed apex, up to 15 by 1.3 mm, dark brown to nearly black, margined with caducous brownish membrane, entire. *Stipe* stramineous, scaly at base, 40–70 cm long. *Lamina* imparipinnate with less than four pairs of lateral pinnae, about 35 cm long and wide; rachis grooved on upper surface, minutely hairy, without buds; lateral pinnae oblong, subentire or serrate at margin, broadest at middle or upper $\frac{1}{3}$ portion, rounded at apex, gradually narrowing towards narrowly cuneate, sessile or adnate base, 12–25 by up to 5.5 cm; chartaceous, deep green above, paler below, glabrous; costa grooved above, raised below; veins widely placed on costa with angles of more than 60°, 2–3 times branched, free, visible on both surfaces. *Sori* along veins, from basal veinlets to minor branches, often on every veinlet, about 2 cm long; indusia thin but firm, pale brown when dried, attached by posterior side.

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

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

E c o l o g y.— On muddy rocks or on earth by streams in dense forests at low altitudes.

8. Diplazium bantamense Bl., En. Pl. Jav. : 191. 1828; Tagawa & K. Iwats., Southeast As. St. 5 : 103. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.— *Athyrium bantamense* (Bl.) Milde, Bot. Zeit. 1870 : 353; Holtt., Rev. Fl. Malaya 2 : 558. f. 330. 1955.

Rhizome short, erect or ascending, bearing a few fronds at apex; scales narrow, 13 by 1.2 mm, concolorous, dark brown, minutely toothed at margin. *Stipe* up to 65 cm long, brownish, darker in lower portion, grooved on adaxial surface. *Frond* imparipinnate, oblong in outline, 40–60 by about 20 cm; rachis grooved on upper surface, minutely hairy, often gemmiferous at junction with costa; lateral pinnae 4 or 5 pairs, upper ones smaller, ascending, shortly stalked, oblong, caudate at apex, round at base, subentire or serrate at posterior portion, up to 20 by 5.5 cm; chartaceous, surface glabrescent; costa raised below, grooved with minute hairs on upper surface; veins several times forked, all free. *Sori* elongate along veins, longest on basal acroscopic veinlets, usually on both sides of veins; indusia thin, brown.

T h a i l a n d.— PENINSULAR : Surat Thani (Khao Khieo range), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Yala (Ban Chana, Ban Malao, Bannang Sata).

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 mountain slopes near streams in dense evergreen forests at medium altitudes.

9. Diplazium donianum (Mett.) Tard., Aspl. Tonkin : 58. t. 5. 1932; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 249. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 102. 1967; Holtt., Rev. Fl. Malaya 2nd ed. 2 : 637. 1968.— *Asplenium donianum* Mett., Fil. Lechl.: 177. 1859.— *Athyrium bantamense* auct. non (Bl.) Milde : Bedd., Handb. : 177. f. 86. 1883; Christ, Bot. Tidsskr. 24 : 108. 1901; Holtt., Dansk Bot. Ark. 20 : 32. 1961. Figure 48. 4.

Similar to *D. bantamense,* different in : rhizome creeping, 3–4 mm diam., blackish, scaly on younger part; lateral pinnae 1–4 pairs, stalks distinct, more than 5 mm long, cuneate at base; coriaceous or fleshy; rachis never gemmiferous; sori usually elongate along the whole length of veinlets.

T h a i l a n d.— NORTHERN : Chiang Mai (Doi Suthep), Tak (Doi Musoe), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN : Loei (Phu Kradueng); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Trat (Ko Chang); PENINSULAR : Nakhon Si Thammarat (Khao Luang, Ron Phibun, Khiriwong).

D i s t r i b u t i o n.— N. India (type) to S. China and Taiwan, north to S. Japan, south to Indochina.

E c o l o g y.— On mountain slopes in light shade or in dense evergreen forests at low elevations lower than 800 m alt.

N o t e.— The Doi Suthep plant has 4–5 pairs of very narrow lateral pinnae, 2–3 cm in breadth and rounded at base.

10. Diplazium megaphyllum (Bak.) Christ, Bull. Herb. Boiss. 6 : 961. 1898; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 251. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 24 : 63. 1969.— *Asplenium megaphyllum* Bak., J. Bot. 1890 : 264.

Similar to *D. accedens* in general habit, trichomes, and pinnation, but differs in : lateral pinnae rounded to subtruncate or rarely subcordate at base; rachis not gemmiferous; veins free or very rarely irregularly anastomosing, all except the basal pairs of veinlets running to the margin of lobes.

T h a i l a n d.— NORTHERN : Tak (Doi Musoe).

D i s t r i b u t i o n.— E. Burma, SW. China (Kwangsi, Kweichow, Yunnan), Taiwan, Vietnam (Tonkin, type) and Annam.

E c o l o g y.— Along streamlets in moist evergreen forests at about 800 m alt.

11. Diplazium sorzogonense (Presl) Presl, Tent. Pterid. : 114. 1836; Bedd., Handb. : 181. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 254. f.28, 3–4. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 56. 1968.— *Asplenium sorzogonense* Presl, Rel. Haenk. 1 : 45. 1825.— *Athyrium sorzogonense* (Presl) Milde, Bot. Zeit. 1870 : 354; Holtt., Rev. Fl. Malaya 2 : 552. f. 325. 1955.

Rhizome erect, about 20 cm tall; scales subtriangular, 0.8–1.3 by up to 1.2 mm, concolorous, brown, black-margined. *Stipe* about 40 cm long, dark stramineous, often nearly black near base, scaly throughout. *Lamina* pinnate, oblong-lanceolate with acute apex, 60–90 by up to 40 cm; rachis shallowly grooved above; pinnae about 20 pairs, basal one or two pairs more or less reflexed, upper ones adnate at base or decurrent to form indistinct apical portion, middle pinnae shortly stalked, patent to ascending, narrowly lanceolate, acuminate at apex, subtruncate to cordate at base, deeply lobed to $\frac{4}{5}$ way to costa, up to 18 by 4 cm at middle; costa grooved with distinct ridges and indistinct spines minutely scaly below, hairy or glabrescent; lobes narrowly oblong, oblique, obtuse to rounded at apex, dentate at margin, 10–17 by 5–6.5 mm; papyraceous to chartaceous, deep green, paler beneath; veins pinnate, dark and distinct below, veinlets 8–10 pairs, mostly simple. *Sori* elongate along veinlets, somewhat marginal, often not extending to main veins with 1–2 mm of naked veinlets, but nearly to the margin of lobes; indusia crescentic, attached by posterior side, pale but brown when dry.

T h a i l a n d.— PENINSULAR : Chumphon (Khao Tong), Nakhon Si Thammarat (Khao Luang), Phangnga (Khao Katha Khwam), Yala (Ban Malao, Khao Kalakhiri).

D i s t r i b u t i o n.— Vietnam to Malesia throughout (type from Philippines).

E c o l o g y.— On rather dry mountain slopes in dense evergreen forests at medium elevations at 600–1400 m alt.

12. Diplazium tomentosum Bl., En. Pl. Jav. : 192. 1828; Bedd., Handb. : 179. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 257. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 103. 1967.— *Athyrium tomentosum* (Bl.) Milde, Bot. Zeit. 1870 : 354; Holtt., Rev. Fl. Malaya 2 : 551. f. 324. 1955.

Rhizome short, erect or ascending, bearing wiry roots; scales narrow, up to 4 by 0.6 mm, concolorous, dark brown, subentire or irregularly waved at margin. *Stipe* stramineous with dark castaneous lower portion, up to 35 cm long on soriferous fronds and 15 cm on sterile ones. *Frond* pinnate-bipinnatifid, oblong-subdeltoid, attenuate at apex, with deflexed basal pinnae, up to 30 by 12 cm; rachis densely covered with short coarse multicellular hairs with brown septa; lowest pinnae deflexed, lanceolate, shortly stalked, auricled at acroscopic base, up to 7 by 2 cm; lower and middle pinnae shortly stalked, patent, acute to acuminate at apex, auricled at acroscopic and rounded to cuneate at basiscopic bases, lobed $\frac{1}{5}$ -$\frac{2}{3}$ way to costa, upper pinnae sessile to adnate at base; lobes oblique, oblong, moderately acute at apex, toothed, up to 10 by 4 mm; chartaceous, deep green, dark when dry, veins pinnate, veinlets simple or forked. *Sori* on practically all veinlets of tall soriferous frond, usually only on basal acroscopic veinlets; indusia firm, persistent.

T h a i l a n d.— SOUTH-EASTERN : Chanthaburi (Khao Sabap), Trat (Bo Rai); PENINSULAR : Surat Thani (Khao Nom Sao), Krabi (Phanom Bencha), Nakhon Si Thammarat (Khao Luang), Trang (Khao Sung), Narathiwat (Waeng).

D i s t r i b u t i o n.— Burma (Tenessarim), Malaya, Vietnam, Sumatra, Java (type), Borneo, and Mindanao.

E c o l o g y.— On mountain slopes in dense evergreen forests at altitudes below 800 m alt.

13. Diplazium prescottianum (Wall. ex Hook.) Moore, Ind. Fil.: 156, 334. 1859; Holtt., Gard. Bull. S.S. 11 : 94. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 103. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.— *Asplenium prescottianum* Wall. ex Hook., Sp. Fil. 3 : 251. 1860.— *Diplazium sylvaticum* var. *prescottianum* (Wall. ex Hook.) Bedd., Handb. : 178. 1883.— *Athyrium prescottianum* (Wall. ex Hook.) Holtt., Rev. Fl. Malaya 2 : 557. 1955.

Rhizome short, erect, bearing thick black roots; scales dark brown, about 15 by 1 mm, entire. *Stipe* about 80 cm long, stramineous with dark brownish base, glabrous. *Frond* oblong, about 50 by 20 cm, pinnate; lateral pinnae stalked, ascending, falcate, caudate-attenuate at apex, rounded to moderately auricled at acroscopic and cuneate at basiscopic bases, up to 15 by 1.7 cm, shallowly crenate, terminal pinna not distinct with deeply lobed base, the lower ones like the upper lateral pinnae; thin chartaceous, dark green with paler lower surface, glabrous; costa raised below, veins twice or thrice forked, all free, glabrous. *Sori* elongate along basal anterior veinlets or rarely along basal posterior ones; indusia thin but firm, persistent.

T h a i l a n d.— SOUTH-EASTERN : Trat (Ko Chang); PENINSULAR : Nakhon Si Thammarat (Khao Luang), Yala (Ban Chana, Ban Malao).

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

E c o l o g y.— On humus-rich mountain slopes in dense evergreen forests at medium altitudes.

14. Diplazium subintegrum Holtt., Gard. Bull. S.S. 9 : 125. 1937; Tagawa & K. Iwats., Southeast As. St. 5 : 103. 1967.— *Athyrium subintegrum* (Holtt.) Holtt., Rev. Fl. Malaya 2 : 557. f. 328. 1955.

Rhizome short, erect, bearing fronds in a tuft; scales dark brown, about 8 by 1.5 mm, entire. *Stipe* up to 50 cm long, stramineous, dark near base. *Frond* oblong, about the same length as stipe, $\frac{2}{3}$ as broad as long, imparipinnate; lateral pinnae about 10 pairs, lower ones stalked, narrowly lanceolate, caudate-attenuate at apex, rounded at base, very shallowly crenate with toothed margin, up to 20 by 2.5 cm; terminal pinna up to 20 by 3 cm at broadest lobed basal portion or rarely larger, cuneate at base; softly chartaceous, glabrous; costa raised below, glabrous; veins pinnate, all free. *Sori* usually on basal anterior veinlets, often also on basal posterior ones, usually diplazioid; indusia pale brown, thin but firm, persistent.

T h a i l a n d.— NORTHERN : Phitsanulok (Salaeng Haeng); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Trat (Ko Chang).

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

E c o l o g y.— On rather dry ground near rivers in light shade at medium altitudes.

15. Diplazium malaccense Presl, Epim. : 86. 1849; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 258. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 104. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.— *Athyrium malaccense* (Presl) Holtt., Rev. Fl. Malaya 2 : 552. 1955.

Rhizome short, erect, bearing wiry roots; scales narrow, up to 12 by 1.5 mm, concolorous, dark brown with blackish margin. *Stipe* stramineous with brown scaly base, about 25 cm long, grooved on adaxial surface. *Frond* about 50 by 25 cm, pinnate, oblong with acuminate apex; pinnae patent or ascending, shortly stalked, cuneate at base, attenuate at apex, up to 14 by 2.3 cm, lobed to $\frac{2}{3}$ way to costa; rachis and costa minutely scaly or glabrous; lobes oblong to ovoid, rounded to obtuse at apex, entire, up to 7 mm broad; papyraceous or firmer, green; veins pinnate, veinlets simple. *Sori* on all veinlets, diplazioid on basal acroscopic veinlets; indusia drying brown, persistent.

T h a i l a n d.— PENINSULAR : Surat Thani (Ban Don), Trang (Khao Chong), Yala (Ban Mae Prik).

Distribution.— Indochina to Malesia (type from Malacca).

Ecology.— On mountain slopes in dense evergreen forests at medium altitudes.

16. Diplazium crenatoserratum (Bl.) Moore, Ind. Fil. : 121. 1859; Tagawa & K. Iwats., Southeast As. St. 5 : 104. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.— *Asplenium crenatoserratum* Bl., En. Pl. Jav. : 177. 1828.— *Athyrium crenatoserratum* (Bl.) Milde, Bot. Zeit. 1870 : 353; Holtt., Rev. Fl. Malaya 2 : 561. f. 332. 1955.

Rhizome short, erect; scales narrow, up to 8 by 1.3 mm, concolorous, dark brown, irregularly toothed at margin. *Stipe* up to 50 cm long, stramineous with dark scaly base, glabrous. *Frond* narrowly oblong-subtriangular, attenuate towards apex, widest at base, usually longer than stipe, up to 25 cm wide, pinnate without distinct terminal pinna; rachis grooved above, minutely hairy, usually viviparous at apical portion; lateral pinnae about 20 pairs, lower ones stalked, narrowly oblong, acuminate at apex, distinctly auricled at acroscopic and auricled or cuneate at basiscopic bases, up to 13 by 2.3 cm, lobed to $\frac{1}{3}$ way to costa or nearly entire; softly chartaceous; veins pinnate with simple veinlets, glabrous. *Sori* practically on all veinlets, diplazioid usually only on basal anterior ones; indusia thin but firm, persistent.

Thailand.— PENINSULAR : Surat Thani (Ban Don, Klong Ton), Nakhon Si Thammarat (Khao Luang, Khao Huai Pampun, Chawang), Satun, Yala (Klong Bla Hot, Ban Mae Prik, Betong).

Distribution.— Malesia (type from Java).

Ecology.— On moist mountain slopes in dense evergreen forests at low to medium elevations lower than 1000 m alt.

17. Diplazium silvaticum (Bory) Sw., Syn. Fil. : 92. 1806; Bedd., Handb. : 177. 1883; Christ, Bot. Tidsskr. 24 : 108. 1901; C. Chr., Bot. Tidsskr. 32 : 346. 1916; Holtt., Gard. Bull. S.S. 11 : 99. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3) : 87. 1965; ibid. 5: 104. 1967; Acta Phytotax. Geobot. 23 : 56. 1968.— *Callipteris silvaticum* Bory in Belanger, Voy. Bot. 1 : 282. 1804.— *Athyrium pinnatum* (Blanco) Copel., Phil. J. Sci. Bot. 3 : 297. 1908; Holtt., Rev. Fl. Malaya 2 : 560. f. 331. 1955; Dansk Bot. Ark. 20 : 32. 1965.

Similar to *D. crenatoserratum* but differs in : rhizome-scales distinctly toothed; pinnae wider, up to 4.5 cm wide, thinner, less auricled at base.

Thailand.— NORTHERN : Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN : Loei (Phu Kradueng); SOUTH-EASTERN :Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR : Chumphon (Khao Tong), Krabi (Phanom Bencha), Surat Thani (Klong Ton, Ban Don), Phangnga, Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun, Yala (Betong).

Distribution.— Mauritius (type), India, Burma, Malaya, Borneo, Java, and Philippines.

Ecology.— On mountain slopes usually in moist places in dense evergreen forests at low to medium elevations below 1200 m alt.

18. Diplazium siamense C. Chr., Contr. U.S. Nat. Herb. 26 : 332. pl. 26. 1931; Tagawa & K. Iwats., Southeast As. St. 5 : 104. 1967; Acta Phytotax. Geobot. 23 : 116. 1968.— *Diplazium latilobum* Holtt., Dansk Bot. Ark. 23 : 308. 1966.

Rhizome erect; scales concolorous, brown, about 15 by 0.8 mm, irregularly minutely toothed. *Stipe* about 50 cm long, stramineous with dark scaly basal portion. *Frond* oblong with acute apex, up to 70 by 30 cm, pinnate; lateral pinnae about 7 pairs below indistinct terminal portion of frond, with distinct stalks more than 1 cm long, gradually narrowing towards long acuminate apex, rounded to cuneate at base, up to 20 cm long, 3.5 cm wide in middle, lobed half-way to costa; terminal portion of frond lobed near base, gradually narrowing towards attenuate apex, up to 20 cm long; rachis and costa often minutely scaly, veins pinnate with 6–9 pairs of simple veinlets, the basal anterior ones ending below the sinus between lobes; lobes oblong, oblique, rounded to obtuse at apex, serrate; thinly chartaceous, green to deep green, paler below. *Sori* along veinlets, those on basal anterior veinlets not exceptionally elongate, rarely diplazioid; indusia thin but firm, persistent.

Thailand.— NORTHERN : Chiang Rai (Doi Pacho), Chiang Mai (Doi Suthep, type), Phitsanulok (Phu Rom Rot), Phrae (Mae Sai); NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang).

Distribution.— Endemic to northern Thailand.

Ecology.— On humus-rich mountain slopes in mixed or evergreen forests at 850–1500 m alt.

Note.— *Diplazium latilobum* is not really distinct from *D. siamense* specifically. The terminal portion of the frond seems to be terminal pinna, for the lateral pinnae suddenly reduce in size above 6 or 7 larger ones. In this pattern of pinnation, it is similar to *D. subintegrum,* though the lobation of the pinnae is like that of *D. mettenianum* and of *D. silvaticum.*

19. Diplazium mettenianum (Miq.) C. Chr., Ind. Fil. : 236. 1906; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 253. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 103. 1967.— *Asplenium mettenianum* Miq., Ann. Lugd. Bat. 3 : 174. 1867.

Rhizome creeping, about 4 mm diam.; scales dark brown to black, narrow, up to 6 by 1 mm, toothed at margin. *Stipe* up to 50 cm long, green to stramineous with dark basal portion, glabrous. *Frond* pinnate, oblong with acute apex, about 40 by 25 cm; lower pinnae distinctly stalked, up to 14 by 2.3 cm, attenuately acuminate at apex, round to auricled at acroscopic and round to cuneate at basiscopic

bases, lobed to $\frac{1}{3}$ way to costa; lobes oblique, rounded to obtuse at apex, subentire to serrate, upper pinnae rather suddenly becoming smaller, adnate and gradually decurrent at base; thinly chartaceous, deep green when living, brown when dry, paler beneath; veins pinnate, veinlets all simple. *Sori* on all veinlets, not so long except on basal acroscopic ones, sometimes diplazioid; indusia firm, persistent.

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

D i s t r i b u t i o n.— N. Vietnam, China, Taiwan to Japan (type).

E c o l o g y.— On humus-rich slopes in dense forests at about 1100 m alt.

N o t e.— This is a species of the group of *D. silvaticum,* but distinct in its long-creeping rhizome. This is typically a Sino-Japanese species, and Phu Kradueng seems to be a southernmost locality of this species.

20. Diplazium petri Tard., Aspl. Tonkin : 67. pl. 9, 1—2. 1932; Tard. & C. Chr. in Fl. Gén. I-C. 7(2) : 260. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 104. 1967.

Rhizome short-creeping; scales dark brown, up to 20 by 1.2 mm, toothed. *Stipe* about 40 cm long, green to stramineous with dark basal portion. *Frond* subtriangular, about 45 cm long and wide, bipinnatifid to bipinnate; pinnae stalked, basal pinnae the largest, oblong with acuminate apex, more than 20 cm long, 10 cm wide, with stalks of about 3 cm long, upper pinnae gradually becoming smaller upwards; pinnules narrowing towards acuminate apex, falcate, cordate to decurrent at base, lobed to $\frac{1}{3}$ way towards costules, the posterior pinnules usually decurrent to the next ones; chartaceous, deep green; veins pinnate with 2—4 pairs of simple veinlets. *Sori* usually on basal veinlets, crescentic or diplazioid.

T h a i l a n d.— SOUTH-EASTERN : Chanthaburi (Khao Soi Dao, Pong Nam Ron); PENINSULAR : Nakhon Si Thammarat (Khao Luang).

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

E c o l o g y.— On rather dry mountain slopes in dense evergreen forests at 1000—1400 m alt., rather rare.

N o t e.— This is a species close to *D. mettenianum,* and intermediate forms were found in Ryukyu and Taiwan, though the Thai materials are distinct in bipinnate fronds and less variable both in size and pinnation.

21. Diplazium muricatum (Mett.) v.A.v.Ros., Mal. Ferns : 829. 1909; Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 2 : 312. 1962; Tagawa & K. Iwats., Southeast As. St. 5 : 104. 1967.— *Asplenium muricatum* Mett., Ann. Lugd. Bat. 2 : 239. 1866. Figure 48. 5—6.

Rhizome short, creeping, about 1 cm diam., scaly only on apical part; scales dark brown, up to 18 by 2 mm, entire. *Stipe* about 50 cm long, stramineous with

dark scaly base. *Frond* subdeltoid, 60–80 by 50–70 cm, tripinnate to quadripinnatifid; lower pinnae stalked, gradually narrowing towards acute apex, up to 35 by 25 cm; pinnules shortly stalked, oblong with acuminate apex and subtruncate base, pinnate to pinnatisect; ultimate lobes oblong, oblique, round at apex, serrate; veins pinnate with 5–8 pairs of forked veinlets. *Sori* oblong, usually close to midrib, allantoid, rarely placed back to back, less than 2.5 mm long; indusia thin, fragile.

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.— Sri Lanka, India, Burma, also in Java.

E c o l o g y.— On moist mountain slopes in dense forests at high altitudes.

22. Diplazium conterminum Christ, J. Bot. 1905 : 67; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 258. 1940; Tagawa & K. Iwats., Southeast As. St. 5 : 105. 1967.

Rhizome creeping; scales dark brown, up to 15 by 1 mm, toothed. *Stipe* about 50 cm long. *Frond* subdeltoid, about 50 by 50 cm, bipinnate; lower pinnae with stalks up to 5 cm long, gradually narrowing towards acute apex, up to 30 by 13 cm; larger pinnules oblong-subdeltoid, acute at apex, cordate at base, shortly stalked, lobed halfway to costule, up to 8.5 by 1.8 cm; lobes orbicular, serrate, up to 7 mm broad; softly papyraceous, dark green, paler beneath; veins pinnate with 5–8 pairs of simple veinlets. *Sori* oblong, usually along posterior half of veinlets, thus submarginal, up to 2 mm long; indusia thin but firm, persistent.

T h a i l a n d.— NORTHERN : Phitsanulok (Phu Miang); PENINSULAR : Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Vietnam (type), S. China, Ryukyu, and SW. Japan.

E c o l o g y.— On mountain slopes in dense forests at 900–1500 m alt.

23. Diplazium taiwanense Tagawa, Acta Phytotax. Geobot. 5 : 259. 1936; Tagawa & K. Iwats., Southeast As. St. 5 : 105. 1967.

Rhizome erect; scales dark brown, up to 15 by 1.2 mm, toothed. *Stipe* about 50 cm long, scaly below. *Frond* subdeltoid, about 60 by 55 cm, bipinnate; lower pinnae oblong with acuminate apex, up to 30 by 15 cm; larger pinnules distinctly stalked, subtriangular, broadly cuneate at base, gradually narrowing towards acute apex, lobed $\frac{1}{3}$ way to costule, up to 8 by 1.8 cm; lobes subquadrangular, moderately rounded to obtuse at apex, indistinctly serrate; softly papyraceous; dark green, paler beneath; veins pinnate, veinlets all simple. *Sori* oblong, usually along middle or posterior portion of veinlets, medial or submariginal.

T h a i l a n d.— CENTRAL : Nakhon Nayok (Khao Yai).

D i s t r i b u t i o n.— N. Vietnam and Taiwan (type) to SW. Japan.

E c o l o g y.— On moist ground along rivers in light shade at about 800 m alt.

N o t e.— Comparing with the typical form of this species, Thai material differs in less deeply lobed pinnules with shorter stalks. This identification is tentatively based on a single collection (IWATSUKI et al. 7385), which consists only of three fronds on a single stock.

24. Diplazium leptophyllum Christ in C. Chr., Ind. Fil. Suppl. : 103. 1913, based on *Asplenium leptophyllum* Bak., Kew Bull. 1906 : 10, non Sw. 1791; Tagawa & K. Iwats., Southeast As. St. 5 : 105. 1967.

Rhizome short-creeping; scales nearly black, up to 13 by 1.5 mm, entire. *Stipe* about 50 cm long. *Frond* subdeltoid, about 60 cm long and wide, tripinnatifid; lower pinnae oblong with acute apex and long petiole, up to 30 by 18 cm; larger pinnules stalked, oblong-subdeltoid with acuminate apex and round to subcordate base, up to 10 by 3 cm; ultimate segments adnate at base, oblong to subquadrangular, rounded at apex, serrate at margin; herbaceous, light green, paler below; veins pinnate, veinlets usually forked. *Sori* elongate along veinlets, about 6 mm long, those along basal veinlets diplazioid.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Lao), Chiang Mai (Doi Chiang Dao, Doi Suthep), Lamphun (Doi Khun Tan).

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

E c o l o g y.— On moist ground or on mountain slopes in dense mixed or evergreen forests at 850 – 1600 m alt.

25. Diplazium petelotii Tard., Aspl. Tonkin : 66. pl. 8, 3 – 5. 1932; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 259. 1940; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23 : 116. 1968.

Rhizome-scales narrow, 13 by 1 mm, concolorous, brown, densely toothed with black setae. *Stipe* about 50 cm long, stramineous to brownish. *Frond* broadly oblong, about 60 by 45 cm, widest at lower $\frac{1}{3}$ bipinnate; lower second or third pinnae largest, shortly stalked, narrowly oblong, gradually narrowing towards acuminate apex, falcate, up to 25 by 9 cm; the basal pinnae smaller with smaller basal pinnules, upper pinnae gradually becoming smaller upwards; larger pinnules sessile or adnate at base, oblong with acuminate apex and broadly cuneate to subtruncate base, falcate, serrate at margin, up to 5 by 1.5 cm; papyraceous, green; costules hardly raised below, veins pinnate with simple veinlets. *Sori* elongate, about 8 mm long, often diplazioid.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok), Phitsanulok (Phu Rom Rot).

Distribution.— N. Vietnam (type).

Ecology.— On mountain slopes in dense evergreen forests at medium to high altitudes.

26. Diplazium dilatatum Bl., En. Pl. Jav. : 194. 1828; Holtt., Gard. Bull. S.S. 11 : 85. 1940; Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 2 : 303. 1962; Tagawa & K. Iwats., Southeast As. St. 3(3) : 87. 1965; 5 : 106. 1967.— *Asplenium maximum* D. Don, Prod. Fl. Nepal. 8 : 1825.— *Athyrium dilatatum* (Bl.) Milde, Bot. Zeit. 1870 : 353; Holtt., Rev. Fl. Malaya 2 : 574. f. 341. 1955.— *Asplenium bellum* Clarke, Trans. Linn. Soc. II. Bot. 1 : 496. t. 63. f. 2. 1880.— *Diplazium maximum* (D. Don) C. Chr., Ind. Fil. : 235. 1905; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 263. 1940.— *Asplenium umbrosum* var. *bellum* (Clarke) Hosseus, Beih. Bot. Centr. 28(2) : 364. 1911.

Rhizome massive, erect; scales about 20 by 2 mm, more commonly narrower, dark brown, black-margined, distinctly toothed. *Stipe* usually 50 cm or more high, densely scaly near base. *Frond* about 100 by 70 cm or variable in size, bipinnate to tripinnatifid; pinnae narrowly oblong, acuminate at apex, basal pinnules usually a little reduced, up to 50 by 25 cm; larger pinnule oblong-subtriangular, gradually narrowing towards attenuate apex, basal lobes a little reduced, cordate at stalked base, lobed halfway to costa, up to 13 by 2.5 cm; lobes subdeltoid to semiorbicular, round to moderately acute at apex, subentire or serrate, up to 7 mm in breadth; veins pinnate with 5–9 pairs of simple or forked veinlets. *Sori* along veinlets about 5 mm long.

Thailand.— NORTHERN : Chiang Rai (Doi Pacho, Mae Kok), Chiang Mai (Doi Chiang Dao, Doi Khun Huai Pong, Doi Suthep, Kang Kat, Doi Inthanon), Phitsanulok (Thung Salaeng Luang, Phu Rom Rot), Tak (Ban Musoe); NORTH-EASTERN : Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); EASTERN : Chaiyaphum (Thung Kamang), Nakhon Ratchasima (Khao Laem); CENTRAL : Nakhon Nayok (Khao Yai); SOUTH-EASTERN : Chanthaburi (Khao Soi Dao); PENINSULAR : Surat Thani (Khao Khieo range), Trang (Khao Chong).

Distribution.— India, Burma, S. China, Taiwan, Ryukyu, S. Japan, Indochina, Malesia throughout (type from Java) to N. Australia.

Ecology.— On moist or humus-rich mountain slopes in dense gloomy forests at 400–1500 m alt., rather common.

27. Diplazium simplicivenium Holtt., Gard. Bull. S.S. 11 : 100. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3) : 88. 1965; 5 : 106. 1967.— *Athyrium simplicivenium* (Holtt.) Holtt., Rev. Fl. Malaya 2 : 573. f. 340. 1954; Dansk Bot. Ark. 20 : 32. 1961.

Rhizome massive, erect, bearing a tuft of gigantic fronds; scales about 20 by 2 mm, brown, black-margined, toothed. *Stipe* up to 1 m long, about 2 cm diam.

near base. *Frond* about 1.4 by 1 m, bipinnate; lower pinnae about 60 by 25 cm, narrowly oblong with acute apex; larger pinnules shortly stalked or subsessile, narrowly oblong-subtriangular, gradually narrowing towards a long acuminate apex, broadly cuneate to subtruncate or subcordate at base, usually shallowly lobed, up to 12 by 2.5 cm; lobes subquadrangular, obtuse at apex, subentire, 5–8 mm in breadth; softly papyraceous, green; veins pinnate with 4–6 pairs of simple veinlets; veinlets hardly reaching the margin of lobes, basal anterior ones stopping far below the sinus. *Sori* about 8 mm long.

Thailand.— SOUTH-WESTERN : Kanchanaburi (Khao Ngi Yai), Uthai Thani (Ban Rai); PENINSULAR : Surat Thani (Klong Ton), Nakhon Si Thammarat (Khao Luang), Phangnga (Khao Pok), Trang (Khao Chong), Satun, Yala (Muang Wing).

Distribution.— Malaya (type) and probably also in Borneo.

Ecology.— On moist mountain slopes in dense evergreen forests at medium elevations at 400–1500 m alt.

Note.— According to the definition by Holttum, the difference between this and the preceding species is found in the venation, though the veinlets are often simple in all the lobes even in *D. dilatatum*. The example drawn by HOLTTUM (1955, f. 341) is a form rather particular for the plants in southern Thailand. We can enumerate the features of *D. simplicivenium* distinct from *D. dilatatum* as follows : pinnules shortly stalked or subsessile, broadly cuneate to subtruncate or subcordate at base, lobed only $\frac{1}{4}$ way to costule; lobes subquadrangular, obtuse or truncate at apex; veinlets simple, 4–6 pairs, usually stopping far below the sinus; sori elongate, occupying about $\frac{3}{4}$ of the veinlets. In spite of these discriminating features, it is still rather doubtful whether these two are distinct or not.

28. Diplazium polypodioides Bl., En. Pl. Jav. : 194. 1828; Bedd., Handb. : 184. f. 89. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2): 266. 1940; Holtt., Gard. Bull. S.S. 11 : 93. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3) : 88. 1965; 5 : 105. 1967.— *Diplazium asperum* Bl., En. Pl. Jav. : 195. 1828; Bedd., Handb. : 184. f. 88. 1883; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 265. 1940.— *Athyrium asperum* (Bl.) Milde, Bot. Zeit. 1870 : 353; Holtt., Rev. Fl. Malaya 2 : 571. f. 320. 1955.

Rhizome massive, erect; scales narrow, about 30 by 1.8 mm, medium brown, black-margined, toothed. *Stipe* stout, about 1.5 cm diam. near base, up to 1 m long, densely scaly near base, surface prickly due to scars of fallen scales. *Frond* usually more than 1 m long, 70 cm wide, bipinnate-tripinnatifid; lower pinnae about 50 by 20 cm, acute at apex; larger pinnules oblong with acuminate apex and subtruncate base, sessile or shortly stalked, up to 10 by 2 cm, lobed nearly to costule; lobes oblong to subquadrangular, oblique, rounded to obtuse at apex, sharply serrate, about 4 mm broad, up to 1 cm long; papyraceous, deep green, paler below; veins pinnate, veinlets 5–9 pairs, mostly forked. *Sori* usually close to costules, less than 2 mm long; indusia thin.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Lao), Chiang Mai (Doi Suthep, Mae Klang, Doi Inthanon), Phrae (Mae Sai), Tak, Phitsanulok (Phu Miang); SOUTH-EASTERN : Chanthaburi (Khao Soidao); PENINSULAR : Surat Thani (Ban Don), Ranong (Phato), Nakhon Si Thammarat (Khao Luang).

D i s t r i b u t i o n.— Sri Lanka, S. India, Himalaya, Indochina, Malesia throughout (type from Java), north to Taiwan.

E c o l o g y.— On humus-rich mountain slopes with high moisture at various elevations throughout the country, usually at edge of forests or in clearings, not in deep shade.

29. Diplazium esculentum (Retz.) Sw., Schrad. J. Bot. 1801(2) : 312. 1803; Tard. & C. Chr. in Fl. Gén. I.-C. 7(2) : 269. 1940; Tagawa & K. Iwats., Southeast As. St. 3(3) : 88. 1965; 5 : 106. 1967; Holtt., Dansk Bot. Ark. 23 : 242. 1965.— *Hemionitis esculenta* Retz., Obs. Bot. : 38. 1791.— *Anisogonium esculentum* (Retz.) Presl, Tent. Pterid. : 116. 1836; Bedd., Handb. : 192. f. 94. 1883.— *Athyrium esculentum* (Retz.) Copel., Phil. J. Sci. Bot. 3 : 295. 1908; Holtt., Rev. Fl. Malaya 2 : 562 f. 333. 1955.

Rhizome erect, sometimes more than 1 m in height; scales up to 10 by 1.2 mm, dark brown, black-margined, toothed. *Stipe* about 70 cm long. *Frond* variable in size, often more than 1 m long, bipinnate; lower 1 or 2 pinnae often reduced, larger pinnae up to 40 by 25 cm, rather suddenly narrowing towards acute apex; larger pinnules subsessile or shortly stalked, subcordate or auricled at base, narrowing towards acuminate apex, up to 13 by 2.5 cm, lobed to $\frac{1}{4}$ way to costule; lobes rounded at apex, serrate, papyraceous; veins pinnate, veinlets up to 10 pairs, uniting with the opposite ones forming excurrent veinlets (seemingly goniopteroid venation). *Sori* on nearly the whole length of veinlets, often uniting with opposite ones.

T h a i l a n d.— NORTHERN : Chiang Rai (Mae Kok), Chiang Mai (Fang, Ban Mae Kon, Mae Klang, Kang Kat, Sop Aep), Mae Hong Son (Mae La Noi, Mae Su Rin), Lampang, Tak; EASTERN : Chaiyaphum (Nam Phrom); CENTRAL : Nakhon Nayok (Khao Yai), Saraburi (Muak Lek), Krung Thep (Bangkok); SOUTH-EASTERN : Chon Buri (Si Racha); SOUTH-WESTERN : Kanchanaburi (Kroeng Kawia, Phomphi, Sai Yok); PENINSULAR : Surat Thani (Khao Pok, Ban Don), Satun, Narathiwat (Waeng).

D i s t r i b u t i o n.— Tropics of Asia, north to Central China and S. Japan, east to S. Pacific Islands.

E c o l o g y.— Usually on moist, level ground in paddy fields or along rivers in open places or at least in light shade at low or medium elevations less than 800 m alt.

U s e s.— Young fronds locally consumed as vegetable.

V e r n a c u l a r.— Hatsadam (หัสดำ) (Peninsular); kut kin (กูดกิน) (Northern).

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