

LINDSAEA-GROUP (K. U. Kramer, Utrecht)

Small to medium-sized, rarely large, terrestrial or epiphytic ferns. *Rhizome* creeping, terrestrial and radially symmetric or nearly so, solenostelic or more often with a special type of protostele with internal phloem but without internal endodermis and medulla; or epiphytic and with a similar but strongly dorsiventral protostele with the internal phloem close to the dorsal side of the xylem, or in some small species the xylem strand open and U-shaped. *Petioles* with a single U- or V-shaped vascular bundle. *Indument* of the rhizome of scales, these non-peltate, non-clathrate (in Mal. *spp.*), glabrous, entire, or with weakly developed teeth of two protruding cell-ends; terminal cell of scale glandular. Juvenile leaves with similar but narrower, caducous scales. In some species some or even all scales are entirely uniseriate but not true hairs. Laminal parts with scattered microscopical two-celled hairs, hardly ever with macroscopically visible hairs. Axes of leaves adaxially with a single groove bordered by ridges, both mostly continuous with those on axes of different order. *Lamina* once pinnate to decom-pound (rarely simple in a single Old World *sp.*), anadromous. Ultimate divisions various, often dimidiate. Veins free, or reticulate without free included veinlets, not reaching the margin. *Sori* terminal on one to many veins, often on a commissure \pm parallel to the margin, submarginal, indusiate; indusium attached at its base, the sides free or adnate, the free edge next to the leaf-margin and often \pm equaling it. Sporangia \pm long-stalked, with a triseriate stalk; bow of annulus interrupted; stomium well differentiated or not. Spores trilete or less often mono-lete, without perisporium, smooth or with little sculpture. Paraphyses mostly, perhaps always, present, filiform, 2- to many-celled, often early disappearing. Gametophyte known in very few species, cordate.

Distribution. Pantropic, extending considerably beyond the tropics in Japan, Australia, South Africa, and eastern South America; comparatively weakly represented in continental Africa. Six genera: *Odontosoria* (10 American *spp.*, 2 African *spp.*), *Ormoloma* (2 *spp.*, neotropical), *Tapeinidium* (17 *spp.*, SE. Asia to Samoa), *Sphenomeris* (11 *spp.*, pantropic-subtropic), *Xyopteris* (monotypic, Malesian), and *Lindsaea* (c. 150 *spp.*, pantropic-subtropic).

The group is much more diversified in the Old than in the New World, but species here regarded as primitive occur in both hemispheres, and the origin and early history of the group cannot be traced; there are no fossils that can be positively attributed to one of its genera.

Ecology. Most Lindsaeoid ferns are forest plants, but some of them occur often or mostly by and in beds of watercourses. A number of species grow on rocks in locally moist situations, e.g. by the coast (*Lindsaea orbiculata*, *Sphenomeris biflora*). A few prefer open, exposed situations, on banks, in natural and artificial grassland, and may then become somewhat weedy (*Lindsaea ensifolia*). None of the species goes beyond an altitude of c. 3000 m; in subtropical regions the altitudinal limit is, of course, much lower. Above c. 1500 m some species that are otherwise strictly terrestrial are sometimes found on moss-covered tree trunks *etc.* and are then often described on labels as epiphytes which they are not in the true sense of the word.

Morphology & anatomy. For an account of the morphology and anatomy of the group see PÉREZ ARBELÁEZ (Bot. Abh. Goebel 14, 1928), WAGNER (Un. Cal. Publ. Bot. 26, 1, 1952), and KRAMER (Act. Bot. Neerl. 6, 1957, 97-134; *ibid.* 15, 1967, 562-584; Blumea 15, 1968, 557-561). To this may be added the following notes on the *sporangium*. The annulus has a bow of c. 8-23 thickened cells. In *Lindsaea* very many species have 10, 11, or 12 bow cells, 11 being a particularly common number. Some species have, however, consistently larger numbers, especially in the sections *Isoloma*, *Osmolindsaea*, and *Tropidolindsaea*, where numbers between 14 and 20 are common. Here the sporangial head is also somewhat larger. This holds for *Tapeinidium*, *Xyopteris*, and *Sphenomeris*, too, where the annulus has 15-23, usually between 16 and 18 indurated cells.

In most species the stomium is morphologically not or scarcely differentiated from the non-indurated part of the annulus. Two to four well-marked lip cells occur, however, in the sections *Isoloma*, *Tropidolindsaea*, and nearly all species of *sect. Schizoloma*. The character appears to fluctuate, with many transitional cases, in *Tapeinidium* and *Sphenomeris*.

The bow of the annulus reaches up to or slightly beyond the insertion of the stalk in *Tapeinidium* and

most species of *Lindsaea*; in the latter genus the taxonomic value of the character is slight. In *Sphenomeris* it is also variable but apparently well-marked and constant for each species (KRAMER, 1957, *l.c.* 106).

Cytotaxonomy. Relatively very few chromosome numbers of Lindsaeoid ferns are known at present. Moreover, several of them are only approximately known, and in some cases the identity of the plants is uncertain, as can be concluded from the names under which they have been reported.

In *sect. Schizoloma* there are counts of $n = 88$ for *Lindsaea ensifolia ssp. ensifolia* (MANTON & SLEDGE) and for *L. 'tenera'* (prob. *L. orbiculata var. commixta*) (MANTON), *c.* 88 for *L. viridis* (BROWNLIE), 44 or 45 for *L. ensifolia ssp. coriacea* (MANTON ex HOLTUM; see KRAMER, 1968), *c.* 42 for *L. trichomanoides* (as '*cuneata*') (BROWNLIE), *c.* 40 for *L. prolongata* (BROWNLIE), and *c.* 47 for *L. vieillardii* (BROWNLIE) and *L. chienii* (KURITA). It seems likely that most, if not all, of these numbers are 44 or twice as many. This was also found in other sections; in *sect. Odontoloma* there is a count of $n = c. 44$ for *L. repens var. sessilis* (WALKER, *in litt.*) and 44 or 45 for *L. pulchella var. blanda* (WALKER, *in litt.*), in *sect. Lindsaea* $n = 88$ in *L. portoricensis* (neotropical) (WALKER) and *c.* 84 in *L. arcuata* (neotropical) (MICKEL, WAGNER & LIM CHEN). Other numbers may or may not be related, e.g. *L. 'nitida'* (= *integra?*) (MANTON in KRAMER) and *L. 'scandens var. terrestris'* (= *L. doryphora*) (MANTON in KRAMER), both *c.* 47. The number $n = 47$ has, however, been found unequivocally in certain species, e.g. *L. 'macraeana'* (= *L. repens var.*) (WAGNER), *L. 'concinna'* (Australia; *L. brachypoda?*) (MANTON in KRAMER) and *L. parallelogramma* (MANTON in KRAMER). The numbers *c.* 50 and *c.* 100 reported for *L. decomposita* (= *L. obtusa?*) (MANTON in HOLTUM), from the same section as *L. parallelogramma*, may have been 47 and 94, respectively. *L. 'pectinata'* (prob. *L. oblanceolata*) was also found to have *c.* 50 chromosomes (MANTON in HOLTUM), but this species is closely related to *L. repens* (*c.* 44, see above). In *L. odorata*, placed in *sect. Osmolindsaea*, divergent in its monoete spores but not otherwise very distinct, a polyploid series was found, ranging from $n = 150$ (MEHRA & KHANNA) or 150–152 (WALKER, *in litt.*), to *c.* 220 (WALKER, *in litt.*); the report of 82 (MANTON in KRAMER) from Ceylon may be due to misidentification of the plant. A basic number of 50 or 51 for this species seems possible. *L. linearis*, a member of the distinct *sect. Paralindsaea*, was found to have $n = 34$ (BROWNLIE).

The picture is equally confusing in the related but much smaller genus *Sphenomeris*. In *S. chinensis*, by far the most widespread species, there are reports of $n = 94$ (MEHRA & KHANNA; KURITA & NISHIDA), *c.* 100 (BIR; MANTON & SLEDGE), and 145, 146, 147 (MANTON & SLEDGE). Its close relative *S. biflora* was counted as $n = 48$ (KURITA & NISHIDA). *S. retusa* had $n = 88$ and *c.* 88 (WALKER, *in litt.*); another specimen, apparently of hybrid origin, with abortive spores, had 162–164 chromosomes, with univalents (WALKER, *in litt.*). Two counts of $n = 38$ and 39, respectively, for the New World *S. clavata* (WALKER; WAGNER) are again divergent. It has been suggested that *Sphenomeris* is not a natural genus (WAGNER, *Am. Fern J.* 53, 1963, 4), but morphological data do not seem to support this.

Two species of *Odontosoria* from Jamaica have been counted as *c.* 96 (WALKER). No counts for *Tapeinidium* or *Xyopteris* have been found in the literature.

It seems that the numbers 44 and 47 are widespread in the group, and that some counts of approximately one of these numbers are equal to them or have been derived from them. It is also certain that one or more divergent basic numbers occur besides. Differences in basic number are, however, not necessarily connected with considerable morphological ones. It may be hoped that a clearer picture emerges when more data are available and that then some more light may be shed on the affinities in the group.

Principal sources of data: BIR, *Curr. Sci.* 31 (1926) 248; BROWNLIE, *Trans. R. Soc. New Zeal.* 85 (1958) 213; *ibid.* *Bot.* 1 (1961) 1; *Pac. Sci.* 19 (1965) 4; KURITA & NISHIDA, *J. Jap. Bot.* 38 (1963) 4; MANTON in HOLTUM, *Rev. Fl. Mal.* 2 (1954) 623; MANTON in KRAMER, *Act. Bot. Neerl.* 6 (1957) 108; MANTON & SLEDGE, *Phil. Trans. R. Soc. Lond. B* 238 (1954) 127; MEHRA & KHANNA, *J. Genet.* 56 (1959) 296; MICKEL, WAGNER & LIM CHEN, *Caryologia* 19 (1966) 95; WALKER, *Trans. R. Soc. Edinb.* 66 (1966) 169.

Taxonomy. In the older literature the *Lindsaea*-group is usually associated with, or included in, the Davallioid ferns, even as late as 1928 by PÉREZ ARBELÁEZ (*l.c.*), although he noted the great differences in scale and rhizome structure, spore morphology, etc., between the two groups. More recent authors have tended to emphasize the differences between them and have placed the Lindsaeoids in a separate family (CHING, *Sunyatsenia* 5, 1940, 216), associated them with the very broadly defined *Pteris*-group (COPELAND, *Gen. Fil.* 1947), or placed them in *Dennstaedtiaceae*. In the present Flora, the question of formal delimitation of families has been left open (HOLTUM, *Fl. Mal.* II, 1, 1959, I–II); therefore no formal status is here proposed for the *Lindsaea* group of genera. I would, however, express the opinion that, though the group is a very natural one, its separation as a distinct family does not seem warranted, in view of its many similarities to *Dennstaedtia* and allied genera.

As expounded in the revision of the American Lindsaeoids (KRAMER, 1957, *l.c.*), and in the chapter on the classification of the Malesian representatives (KRAMER, *Blumea* 15, 1968, 557 *seq.*), the leaf pattern, greatly and excessively used in the past, is by itself insufficient as a basis for generic classification. Such genera as have been based entirely on characters of leaf architecture and venation: *Schizoloma*, *Iso-loma*, *Synaphlebium*, are here merged with *Lindsaea*. Comments on the circumscription of *Sphenomeris* and *Tapeinidium* can be found in the above-cited papers (KRAMER, 1957, 1968, *l.c.*; *Act. Bot. Neerl.* 15, 1967, 562).

KEY TO THE GENERA

- 1. Sori on 1-8 vein-ends; indusium laterally entirely or largely adnate to the lamina; ultimate divisions never dimidiate; veins free.
- 2. Ultimate free divisions not of a linear- or cuneate-divaricate type, subentire to pinnatifid; sori on the lateral margin of the divisions or in their lobes; pluricellular filiform paraphyses usually (always?) present; spores monolete 2. *Tapeinidium*
- 2. Ultimate free or nearly free divisions of a linear- or cuneate-divaricate type, with the sorus (sori) on their apical margin; paraphyses 2- or 3-celled, not usually found; spores monolete or trilete 1. *Sphenomeris*
- 1. Sori on many vein-ends, or, if on 8 or fewer, the sides of the indusium free, or the pinnules dimidiate, or the veins anastomosing, or these characters combined.
- 3. Ultimate free divisions lanceolate, equal-sided or the base anteriorly auricled; veins free; spores monolete. 3. *Xyopteris*
- 3. Ultimate free divisions not lanceolate and equal-sided, or, if so, the spores trilete; veins free or anastomosing 4. *Lindsaea*

1. SPHENOMERIS

MAXON, J. Wash. Ac. Sc. 3 (1913) 144, *nom. cons.*; COPELAND, Gen. Fil. (1947) 54; Philip. J. Sc. 78 (1949) 24; HOLTUM, Rev. Fl. Mal. 2 (1954) 340; KRAMER, Act. Bot. Neerl. 6 (1957) 152; COPELAND, Fern Fl. Philip. 1 (1958) 115.—*Davallia* J. E. SMITH, Mém. Ac. Turin 5 (1793) 414; HOOKER, Sp. Fil. 1 (1845) 151; and of many other authors; all in part.—*Stenoloma* FÉE, Gen. Fil. (1852) 330, *p.p. min.*; CHING, Fl. Reip. Pop. Sin. 2 (1959) 275, in part; and of other authors.—*Odontosoria* FÉE, Gen. Fil. (1852) 325; J. SMITH, Hist. Fil. (1875) 263; DIELS in E. & P. Nat. Pfl. Fam. I, 4 (1902) 215; v.A.v.R. Handb. (1908) 258; Suppl. (1917) 202; and of many other authors; all in part.

Terrestrial ferns with a short- to moderately long-creeping *rhizome*, if stout with a solenostele with a sclerotic medullary strand, if more slender mostly with a lindsaeoid protostele. *Rhizome scales* elongate-triangular to acicular, in the smaller species some scales wholly uniseriate and therefore the scales grading into hairs. *Petioles* abaxially terete, adaxially upward sulcate. *Lamina* much dissected, decompound, strongly anadromic, without a conform terminal pinna, the ultimate divisions confluent near the pinna-apices, not free and conform (except in the New Caledonian *S. alutacea*). Veins free, simple or forked in the ultimate divisions. *Sori* uni- to paucinerval, on the apical margin of the segments; indusium attached at the base and the sides. Paraphyses 2- or 3-celled, observed in one species (*S. chinensis*), presumably present in all and fugacious. Spores monolete or trilete. Gametophyte undescribed.

Type species: *Sphenomeris clavata* (L.) MAXON (tropical America).

Distr. In the tropics and in the northern subtropical regions of both hemispheres 11 spp., 6 of them with very small areas.

Note. *Sphenomeris* MAXON was conserved against *Stenoloma* FÉE, a name of somewhat controversial application. In the Code of Nomenclature *Stenoloma dumosum* FÉE was at first designated as type species, but afterwards, on MORTON's suggestion (Taxon 8, 1959, 29), this was changed to *Stenoloma clavatum* (L.) FÉE, as this was said to agree much better with the original description of the genus. However, FÉE explicitly mentioned as an essential character of *Stenoloma*, setting it apart from *Odontosoria*, the only basally attached but laterally free indusium. This is not found in any true species of *Sphenomeris*, and certainly not in *Sphenomeris clavata*. The issue should be reconsidered.

KEY TO THE SPECIES

- 1. Rhizome 5-20 mm ø, solenostelic, with an internal sclerotic strand; rhizome scales to 7 mm long, the larger ones to c. 20-seriate at the base; spores trilete; sori of larger segments on (2-)5-8 vein-ends, occupying their whole apical margin (fig. 5) 1. *S. retusa*
- 1. Rhizome 2-4 mm ø, with a lindsaeoid protostele; scales to 4 mm long, to 4-seriate at the base (wider in *S. biflora*); spores monolete; sori of larger segments on 1-2(-4) vein-ends, not occupying their whole apical margin.

2. Scales up to 3-seriate at the base; sori strictly uninerval; ultimate divisions $\frac{1}{2}$ - $\frac{3}{4}$ mm wide, or the fertile gradually widened to the sorus and there 1 mm wide; texture coriaceous . . . 4. *S. veitchii*
2. Scales to 5-6-seriate at the gradually widened base; sori uni- or binerval; larger free ultimate divisions c. 2 mm wide; lamina subcoriaceous or coriaceous, usually bipinnate + pinnatifid or tripinnate + crenate . . . 2. *S. biflora*
2. Scales 1-3-seriate (or to 4-seriate at the suddenly broadened base); sori 1-3(-4)-nerval; larger free ultimate divisions 1 mm or more wide, or, if narrower, spatulately widened at the sorus; lamina herbaceous to subcoriaceous, in full-grown plants bipinnate + bipinnatifid, tripinnate + pinnatifid, or more dissected . . . 3. *S. chinensis*

1. *Sphenomeris retusa* (CAV.) MAXON, J. Wash. Ac. Sc. 3 (1913) 144; COPELAND, Philip. J. Sc. 78 (1949) 24; Fern Fl. Philip. 1 (1958) 116.—*Davallia retusa* CAV. Descr. (1802) 278.—*Stenoloma retusum* (CAV.) FÉE, Gen. Fil. (1852) 330.—*Lindsaea retusa* (CAV.) METT. Fil. Lips. (1856) 105.—*Odontosoria retusa* (CAV.) J. SMITH, Bot. Voy. Herald (1857) 430.—*Schizoloma retusum* (CAV.) KUHN, Chaetopt. (1882) 346. — Type: NÉE *s.n.*, Mt Isarrog, Luzon (MA, *n.v.*; phot. U).
Lindsaea cuneifolia PRESL, Rel. Haenk. 1 (1825) 60.—? *Saccoloma cuneifolium* PRESL, Tent. Pterid. (1836) 126. — *Acrophorus cuneifolius* (PRESL) MOORE, Ind. Fil. (1857) 41. — Type: HAENKE *s.n.*, Luzon (*n.v.*).

? *Adiantum falcatum* BLANCO, Fl. Filip. (1837) 833. — Type: BLANCO *s.n.*, 'Mandalogon' (*n.v.*; perhaps this species acc. to C. CHR. Ind. Fil. Suppl. 1, 1913, corr. 89).

Davallia decipiens CESATI, Rendic. R. Accad. Sci. Fis. Mat. Napoli 16 (1877) 29.—*Odontosoria decipiens* (CESATI) CHRIST, Nova Guinea 8 (1909) 158.—Type: BECCARI *s.n.*, Mt Arfak at Putat, W. New Guinea (FI, 2 sh.).

Odontosoria lindsayae v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 21 (1908) 4.—Type: not cited; 3 sh. so annotated in BO; on the ground of the date chosen as lectotype: VERSTEG 1467, s.w. W. New Guinea, prob. back of Sabang (BO; dupl. in B, K, L, U). — Fig. 5.

Rhizome probably short-creeping (only short pieces seen), enveloped in a dense mass of roots, stout, in full-grown plants $\frac{1}{2}$ -2 cm \varnothing , with an internal sclerotic strand; scales dark reddish brown, elongate-triangular, to 7 mm long, to c. 20-seriate at base, a short apical portion uniseriate. *Petioles* stramineous or darker with age, the base often slightly verrucose from scale-bases, 2-15 mm \varnothing at base, 20-70 cm long (on labels said to attain 1.6 m), c. $\frac{2}{3}$ -1 times as long as the lamina; all axes abaxially rounded, marginate near the ultimate divisions. *Lamina* oblong-triangular, to 3 m long, mostly brown or olivaceous when dry, chartaceous to coriaceous, subtripinnate to tripinnate + pinnatifid, or less often quadripinnate. *Major pinnae* 5-12 to a side, alternate or the lower ones subopposite, obliquely ascending, the lower ones with a stalk of 1-2 cm, the upper ones gradually subsessile, elongate-triangular, to 30 by 12 cm, caudate-acuminate, equal-sided but the larger pinnae basiscopically in their basal part often slightly narrower. Lower pinnae their width apart or more, the upper ones usually somewhat overlapping. *Larger secondary pinnae* narrowly

triangular, shortly petiolulate, acuminate, c. 5-10 cm long, $2\frac{1}{2}$ -6 cm wide, pinnate + pinnatifid or less often bipinnate, basiscopically narrower, with often 3 or 4 free pinnules to a side, the larger ones pinnatifid or less often pinnate, the upper ones cuneate, confluent; upper primary and distal secondary pinnae rhombic, submidiate, basiscopically more narrowly cuneate. Apices of primary and secondary, sometimes also of tertiary pinnae narrow, serrate, \pm caudiform. *Ultimate pinnules*, except if transitional between pinnate and non-pinnate ones, subrhombic and with a few very shallow incisions, or cuneate and entire, often 7-15 mm long and 5-10 mm wide, $1\frac{1}{2}$ -2 times as long as wide (upper, smaller ones relatively narrower), evenly cuneate from the base, widest at the truncate or just below the triangular apex, with straight or slightly convex, sometimes subrevolute lateral edges. The quadripinnate form with narrower pinnules, c. 5-6 by 2 mm, $2\frac{1}{2}$ -3 times as long as wide. Sterile pinnules (hardly found in full-grown plants) crenate-cleft. Veins adaxially impressed, abaxially prominulous, usually twice forked; close, c. $\frac{1}{4}$ mm apart. *Sori* continuous across the whole apical margin of cuneate, interrupted in subrhombic pinnules and then continuous across the separate straight portions of their apical margin, on 5-8 vein-ends and to 5 mm long, in smaller segments or lobes shorter, in the quadripinnate form often bi- to quadrinerval. Indusium pale to brown, entire, the slightly narrowed sides adnate, rather thin, 0.4-0.6 mm wide, almost reaching the margin, bulging but scarcely reflexed at maturity. Spores medium brown, trilete, almost smooth, c. 38-40 μ .

Distr. Malesia: Celebes, Philippines (almost throughout), Moluccas (Morotai, Halmahera, Tidore, Ambon, Ceram), New Guinea, Admiralty Is., Bismarck Arch.; Solomon Is.,?New Hebrides.

Ecol. On banks, in open places, often among rocks by rivers, less often in forests, from sea level to c. 2000 m.

Note. A quadripinnate form with narrower pinnules and shorter sori, as described above, has been collected several times in New Guinea and also in Manus. It is not sharply distinct from the broader, less dissected form. Its status is uncertain; one specimen had an irregular meiosis (WALKER, pers. comm.) and proved to have abortive spores; it is almost certainly a hybrid (with *S. chinensis*?), but this is scarcely the case with all.

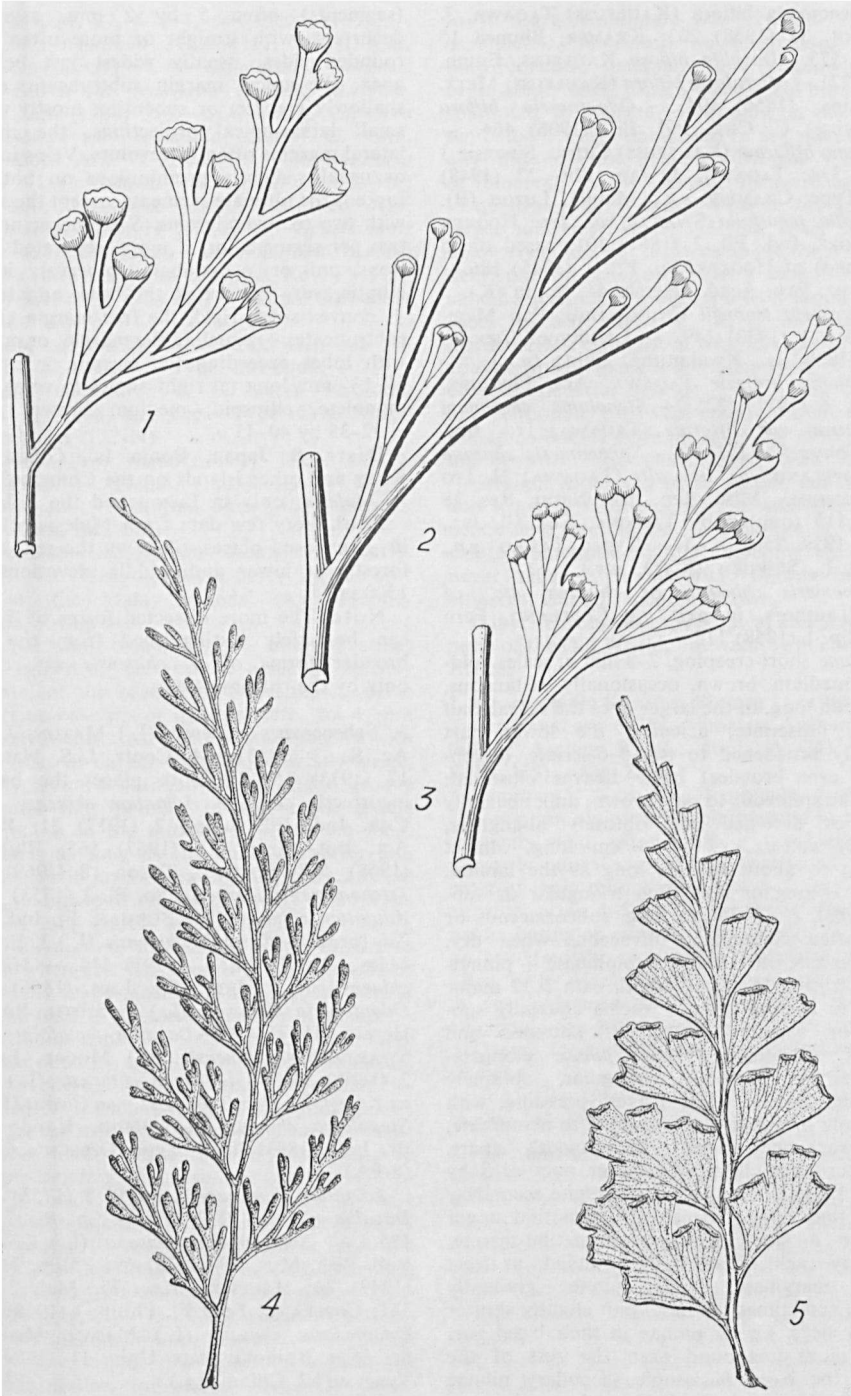


Fig. 1-3. *Sphenomeris chinensis* (L.) MAXON.—Fig. 1. var. *divaricata* (CHRIST) KRAMER. Pinnule, $\times 4$ (RANT 21).—Fig. 2. var. *rheophila* KRAMER. Pinnule, $\times 4$ (SURBECK 315).—Fig. 3. var. *chinensis*. Pinnule, $\times 4$ (BARTLETT & DE LA RUE 77).—Fig. 4. *S. veitchii* (BAKER) C. CHR. Pinna, $\times 1\frac{1}{4}$ (CLEMENS 50992).—Fig. 5. *S. retusa* (CAV.) MAXON. Pinnule, $\times 1\frac{1}{4}$ (KOORDERS 17033).

2. *Sphenomeris biflora* (KAULFUSS) TAGAWA, J. Jap. Bot. 33 (1958) 203; KRAMER, Blumea 15 (1968) 573.—*Davallia biflora* KAULFUSS, Enum. (1824) 221.—*Microlepia biflora* (KAULFUSS) METT. Fil. Lips. (1856) 104.—*Odontosoria biflora* (KAULFUSS) C. CHR. Ind. Fil. (1906) 464.—*Stenoloma biflorum* (KAULFUSS) CHING, Sinensia 3 (1933) 338; TAGAWA, J. Jap. Bot. 22 (1948) 160.—Type: CHAMISSO *s.n.*, Manila, Luzon (B).

Davallia tenuifolia SWARTZ var. *lata* HOOKER ex MOORE, Ind. Fil. 2 (1861) 301, based on β (unnamed) of HOOKER, Sp. Fil. 1 (1845) 186.—Lectotype: Exp. Acad. Petersb. 44, Bonin (K).

Odontosoria tsoongii CHING, Bull. Fan Mem. Inst. Biol. 1 (1930) 149.—Lectotype: TSOONG 1423, Hailin Is., Kwangtung, China (*n.v.*).

Stenoloma littorale TAGAWA, Act. Phytotax. Geobot. 6 (1937) 225.—*Stenoloma chusanum* (L.) CHING var. *littorale* (TAGAWA) ITO, Bot. Mag. Tokyo 52 (1938) 6.—*Sphenomeris chusana* (L.) COPELAND var. *littoralis* (TAGAWA) H. ITO ex MIZUSHIMA, Misc. Rep. Inst. Natur. Res. 38 (1955) 115 (quoted by TAGAWA, Col. III. Jap. Perid. 1959, 256, *n.v.*)—Type: TASIRO *s.n.*, Oshima I., Shikoku (KYO, *n.v.*).

Sphenomeris chinensis or *chusana*, etc., of various authors, in part, e.g. COPELAND, Fern Fl. Philip. 1 (1958) 115.

Rhizome short-creeping, 2–3 mm \varnothing ; scales golden to medium brown, occasionally castaneous, to 3½ mm long, in the larger ones the apical half or less uniseriate, acicular, the lower part gradually broadened to the 5–6-seriate (exceptionally even broader) base. Leaves clustered; *petioles* stramineous to pale brown, dull, abaxially terete, or flattened and obtusely bi-angular, adaxially sulcate, *c.* 10–25 cm long, almost equalling to about half as long as the lamina. *Lamina* oblong or less often triangular or subpentagonal, *c.* 15–35 cm long, subcoriaceous or more often coriaceous, olivaceous when dry, the upper side often blackish, bipinnate + pinnatifid or tripinnate + pinnatifid, with 7–12 major pinnae to a side; primary rachis abaxially subterete or usually upward \pm flattened and gradually marginate. *Primary pinnae* elongate-triangular or narrowly triangular, obliquely ascending, or in small leaves spreading, with a petiolule of a few mm, subacute to acuminate, the lower ones about their width apart, the upper ones closer, the larger ones *c.* 5 by 1½ to 13 by 5 cm, with 3–6 pinnate secondary pinnae, and some subtire to pinnatifid upper ones, to a side, the apex pinnatifid-serrate; secondary rachises abaxially rounded, at least upward marginate. Upper pinnae gradually reduced, sometimes the basal pair slightly shorter than the next. Lower pinnae in their basal part usually more compound than the rest of the lamina, the basal basicopic secondary pinnae sometimes larger than all the others. Axes of higher order often \pm flexuous. Smaller *pinnules* rhombic, pinnatifid + pinnatisect or forked, the smallest entire, obtriangular-cuneate. Largest free or nearly free non-dissected pinnules

(segments) often 5 by 2 mm, asymmetric, decurrent, with straight or more often upward rounded sides, usually widest just below the apex, the apical margin subtruncate, erose to shallowly crenate, or subtire, mostly with two small latero-apical projections, the thickened lateral margins often \pm revolute. Veins immersed or usually slightly prominulous on both sides, forked, the ultimate segments, except the smallest, with two to several veins. *Sori* one or not rarely two per segment, or, if more, separated by incisions, uni- or occasionally binerval; indusium elliptic, very convex at the base, adnate at the \pm convex sides, rigid, the free margin rounded, subtruncate, \pm equaling the margin, or not rarely with lobes exceeding the margin, 1 mm wide, ½–1¼ mm long (at right angles to vein). Spores monolete, ellipsoid, medium brown, smooth, *c.* 32–35 by 40–45 μ .

Distr. S. Japan, Bonin Is., Guam, Hong Kong and other islands on the Chinese S. coast; in *Malesia*: only in Luzon and the Batanes Is.

Ecol. Very few data from *Malesia*; elsewhere in \pm exposed places, often by the sea, never in forests; at lower and middle elevations, to *c.* 1300 m.

Note. The more dissected forms of *S. biflora* can be safely distinguished from the larger, broader forms of *S. chinensis* var. *chinensis* only by the rhizome scales.

3. *Sphenomeris chinensis* (L.) MAXON, J. Wash. Ac. Sc. 3 (1913) 144; Contr. U.S. Nat. Herb. 17 (1913) 159 (in both places the basionym incorrectly cited as *Adiantum chinense* L.); C. CHR. Ind. Fil. Suppl. 2 (1917) 31; KRAMER, Act. Bot. Neerl. 15 (1967) 565; Blumea 15 (1968) 572; FOSBERG, Taxon 18 (1969) 596.—*Trichomanes chinense* L. Sp. Pl. 2 (1753) 1099.—*Adiantum chinense* (L.) BURMAN, Fl. Ind. (1768) 236 (prob.).—*Davallia chinensis* (L.) J. E. SMITH, Mém. Ac. Turin 5 (1793) 414.—*Microlepia chinensis* (L.) METT. Fil. Lips. (1856) 104.—*Odontosoria chinensis* (L.) J. SMITH, Bot. Voy. Herald (1857) 430.—*Davallia tenuifolia* (LAMK) SWARTZ var. *chinensis* (L.) MOORE, Ind. Fil. 2 (1861) 302.—*Lindsaea chinensis* (L.) METT. ex KUHN, Fil. Afr. (1868) 67, non CHING (1929).—*Stenoloma chinense* (L.) BEDD. Handb. Ferns Br. Ind. (1883) 70.—Type: OSBECK *s.n.*, China (S-PA).

Adiantum chusanum L. Sp. Pl. 2 (1753) 1095.—*Davallia chusana* (L.) WILLD. Sp. Pl. 5 (1810) 475.—*Sphenomeris chusana* (L.) COPELAND, Bull. Bish. Mus. 59 (1929) 69; Philip. J. Sc. 78 (1949) 24; HOLTUM, Rev. Fl. Mal. 2 (1954) 341; COPELAND, Fern Fl. Philip. 1 (1958) 115.—*Odontosoria chusana* (L.) MASAM. Mem. Fac. Sci. Agr. Taihoku Imp. Univ. 11 (1934) 67.—Type: coll.?, China (*n.v.*).

Adiantum tenuifolium LAMK, Encycl. 1 (1783) 44.—*Davallia tenuifolia* (LAMK) SWARTZ in Schrader, J. Bot. 1800^o (1801) 88.—*Stenoloma tenuifolium* (LAMK) FÉB, Gen. Fil. (1852) 330.—*Microlepia tenuifolia* (LAMK) METT. Fil. Lips.

(1856) 104, pl. 27, f. 1-4, non PRESL (1851).—*Odontosoria tenuifolia* (LAMK) J. SMITH, Cat. Cult. Ferns (1857) 67. — *Odontosoria chinensis* (L.) J. SMITH var. *tenuifolia* (LA)MK MATSUM. Ind. Pl. Jap. (1904) 330.—*Sphenomeris chinensis* (L.) MAXON var. *tenuifolia* (LAMK) C. CHR. Dansk Bot. Ark. 7 (1932) 78. — *Odontosoria chusana* (L.) MASAM. var. *tenuifolia* (LAMK) (err. 'MAK.') MASAM. Mem. Fac. Sci. Agr. Taihoku Imp. Univ. 11 (1934) 67.—*Sphenomeris chusana* (L.) COPELAND var. *tenuifolia* (LAMK) HOLTUM (incorr. ascr. to C. CHR.), Rev. Fl. Mal. 2 (1954) 341, as to type only. — Type: SONNERAT s.n., 'Inde' (P).

Davallia didyma HEDWIG, Fil. Gen. & Sp. (1803) pl. 22, ex icon.—Type: not cited.

Davallia microcarpa J. E. SMITH in Rees, Cyclop. 11 (1808) sine pag.—Type: CHR. SMITH s.n., Amboina (LINN).

Hymenophyllum ramosissimum HAM. ex D. DON, Prod. Fl. Nepal. (1825) 12. — Type: HAMILTON s.n., Nilkantha, Nepal (n.v.; identity teste C. CHR. Ind. Fil.).

Trichomanes malayanum ROXB. ex GRIFF. Calc. J. Nat. Hist. 4 (1844) 519.—Type: coll.? 'native of the Malay Islands' (n.v.; identity uncertain).—Fig. 1-3.

Rhizome short-creeping, 2-4 mm \varnothing ; scales reddish brown to castaneous, acicular, entirely uniseriate, or the base often biseriate, less often the extreme base tri- or quadriseriate, to 4 mm long. Leaves clustered; *petioles* stramineous with darker base, or darker with age, abaxially terete, adaxially upward gradually sulcate, the groove broad and flat; *petioles* of full-grown plants 1½-3 mm \varnothing in the middle, c. 12-60 cm long, ⅔-1 times as long as the lamina, shorter and more slender in juvenile but fertile plants. *Lamina* oblong, elongate-ovate, or narrowly triangular, 15-85 cm long (rarely smaller in fertile plants), usually olivaceous, medium or dark brown to blackish when dry, herbaceous to chartaceous or occasionally subcoriaceous, if fertile at the base at least bipinnate + pinnatifid, usually bipinnate + bipinnatifid or tripinnate + pinnatifid, or in large specimens up to quadripinnate + pinnatifid. Primary rachis and axes of higher order stramineous, abaxially terete, upward gradually marginate. Larger leaves with c. 6-10 major *primary pinnae* to a side; *pinnae* rather strongly spreading to strongly ascending, elongate-triangular or -rhombic, with a stalk of a few mm to 3 cm, the base usually inequilateral, the anterior side broader as the pinna is strongly anadromic and the anterior side has longer and/or less ascending pinnules, the apex acuminate; larger *pinnae* (5-10-20 cm long, (1½-3)-10 cm wide, 2-4½ times as long as wide, the lower ones usually subopposite and several cm apart, the upper ones gradually alternate, smaller, and closer. *Secondary pinnae* triangular or rhombic, acute or acuminate, ascending, shortly petiolulate, alternate, often c. 6-8 major ones to a side, often twice as long as wide, size and dissection depending upon size and dissection of the lamina and their place

in it. Largest *ultimate free divisions* rhombic, asymmetric, pinnatisect on both sides, smaller ones cuneate, unequally and shallowly bifid, or, if deeply bifid, usually once again bifid, linear-spathulate to cuneate (depending on the variety; see below). Veins immersed, in dry material usually little or not evident. *Ultimate lobes* uni- or binerval, or in broader forms occasionally to quadrinerval, ½-2 mm wide at the apex, the larger undivided ones 2-3 mm long, the ones below them incised, the ones above them reduced, denticuliform, confluent into a pinnatifid, often caudate-acuminate pinna-(pinnula-)apex. Sterile lobes apically subacute, or, if broader, often denticulate. Fertile lobes with straight or slightly convex apical margin, broader ones not rarely erose-denticulate. *Sori* on 1 or 2, less often on 3, exceptionally on 4 vein-ends, not quite reaching the apico-lateral extremities of the lobes; indusium brownish and chartaceous when dry, with \pm straight to convex base, adnate, convex sides, and straight, slightly convex, or sometimes erose-denticulate free margin, \pm equaling or, if denticulate, sometimes slightly exceeding the margin, never reflexed at maturity. Spores monoletic, ellipsoid, smooth, medium brown.

Distr. Throughout the tropical and subtropical parts of the Old World, but wanting in continental Africa.

1. var. *reophila* KRAMER, Blumea 15 (1968) 573.—Type: BARTLETT 6718a, Sumatra, Asahan, waterfall of Asahan R. (L; dupl. in GH, MICH, S-PA, US).—Fig. 2.

Lamina 15-20 cm long, tripinnate + pinnatifid or less often bipinnate + bipinnatifid at the base; segments rigid, often with \pm revolute margin, narrowly cuneate, gradually broadened to base, most of them monosorous and 4-5 times as long as wide, often 4-5 by 1 mm. Outer edge of segments entire or sinuate. *Sori* on one, less often on two (mostly connivent) vein-ends; indusium often ½ by ½ mm, with convex base. Spores as in var. *chinensis*, c. 44-48 μ long, but more elongate, bean-shaped, \pm twice as long as broad.

Distr. *Malesia*: Pahang and Central Sumatra (9 coll.).

Ecol. By torrents and waterfalls, on riverbanks, 100-500 m.

2. var. *divaricata* (CHRIST) KRAMER, Blumea 15 (1968) 572.—*Odontosoria chinensis* (L.) J. SMITH var. *divaricata* CHRIST, Journ. de Bot. sér. 2, II (1909) 23.—*Sphenomeris chusana* (L.) COPELAND var. *divaricata* (CHRIST) TARDIEU-BLOT, Fl. Madag. Com. 5e fam. I (1958) 29.—Type: CHEVALIER 14309, São Tomé (P).

Sphenomeris chusana (L.) COPELAND var. *tenuifolia* of HOLTUM, Rev. Fl. Mal. 2 (1954) 341, and of other authors; not *Adiantum tenuifolium* LAMK.—Fig. 1.

Lamina usually over 20 cm long, at the base often tripinnate + bipinnatifid; segments cuneate, suddenly spatulate-broadened at the sorus, slightly narrowed at the rounded apex, the apical margin not rarely erose, the sides often corn-

iculate; at the base often $\frac{1}{2}$ mm wide, slightly broadened to the apex, $1-1\frac{1}{4}$ mm wide at the sorus, of varying length; sori not rarely two together in a segment, mostly uninerval, if binerval mostly on two connivent vein-ends; indusium even in binerval sori with distinctly convex base. Spores mostly $55-60 \mu$ long.

Distr. São Tomé; sporadically from Sikkim and S. China to *Malesia*: throughout Malesia, common in Sumatra, Java, and New Guinea, rare in Borneo (Sarawak only) and local in the Philippines (Luzon, Mindanao).

Ecol. As the next variety, but mostly above 700 m.

Note. See the note at the end of the species.

3. *var. chinensis*.—In so far as known most or all of the synonyms enumerated under the species apply to this variety.—Fig. 3.

Lamina of variable length, at the base often tripinnate + pinnatifid; segments cuneate, gradually broadened from the base, rarely with one sorus only, except the upper, reduced ones, usually with several sori and shallow incisions between them (not entire and with one sorus across the apical margin, as in *S. retusa*), often \pm twice as long as wide, the apical margin not or scarcely erose; sori not rarely uninerval, most often bi- or tri-, rarely to quadrinerval, to 2 mm long, most often $\frac{3}{4}-1\frac{1}{2}$ mm long. Spores mostly $42-48 \mu$ long.

Distr. As the species.

Ecol. Terrestrial and on rocks, in thickets and open forests, in exposed or lightly shaded places, often by hollow roads, on slopes, escarpments, by streams, etc., 100–2400 m, apparently most common from c. 800–1500 m, often said to be locally numerous.

Notes. The three varieties of *S. chinensis*, notably the last two, are not quite sharply distinct; this is one reason for treating them as varieties. Intermediates between *var. chinensis* and *var. divaricata* occur not rarely, but are much less numerous than typical specimens. The two varieties overlap throughout Malesia, only in New Guinea the former is quite rare and the latter relatively frequent. On the continent *var. divaricata* becomes increasingly rare to the North and West; it is absent from Japan and nearly so from China. In the Pacific it has not been found so far. However, on many islands a form occurs with narrower, mostly monosoral segments and prevaillingly uninerval sori. It lacks the spatulate segments of *var. divaricata* and is therefore regarded as an aberrant form of *var. chinensis*. Similar specimens occur here and there in Malesia, too, notably in Celebes. Their taxonomic status

cannot be elucidated with the help of dried material only. A form with exceptionally broad segments occurs in Sumatra. It has been confused with *S. retusa* and *S. biflora*, but must be assigned to *S. chinensis* because of its monoete spores and its narrow rhizome scales, and some other characters, too.

4. *Sphenomeris veitchii* (BAKER) C. CHR. Gard. Bull. S. S. 7 (1934) 234.—*Davallia veitchii* BAKER, J. Bot. 17 (1879) 39.—*Stenoloma veitchii* (BAKER) C. CHR. Ind. Fil. Suppl. 3 (1934) 174.—Type: BURBIDGE 49 or *s.n.*, Mt Kinabalu, Sabah (K, 2 sh.; dupl. in BM).—Fig. 4.

Rhizome rather long-creeping, c. 4 mm \varnothing ; scales dark castaneous, acicular, the upper half uniseriate, the base bi- to triseriate, to $2\frac{1}{2}$ mm long. Leaves $\frac{1}{2}-1$ cm apart; *petioles* slender, $1\frac{1}{2}-2$ mm \varnothing , fuscous or upward stramineous, abaxially terete, adaxially broadly and shallowly grooved, 30–40 cm long. *Lamina* narrowly oblong, c. 30 by 5 to 70 by 15 cm, bipinnate + bipinnatifid or tripinnate + bipinnatifid, with c. 10–20 primary pinnae to a side; primary rachis like the petiole, upward paler and sometimes very obtusely bi-angular. *Basal pinnae* remote, to 12 cm apart, the upper ones gradually closer, subcontiguous, all ascending, elongate-triangular, acuminate, with a stalk of up to 1 cm, pronouncedly anadromic, the larger ones c. 10–12 by 4–5 cm, the upper ones gradually smaller; major *secondary pinnae* c. 6–8 to a side in larger pinnae, rhombic, acute. Axes of secondary and higher order stramineous, adaxially narrowly and deeply sulcate, abaxially rounded or narrowed-rounded, upward gradually somewhat flexuous and marginate, therefore in the lamina the pinnate grading into the pinnatifid condition. *Ultimate segments* rigid, coriaceous, olivaceous when dry, basally often with adaxially raised, thick edges, linear, often 4–5 by 0.5–0.7 mm, the fertile ones gradually to 1 mm wide at the sorus, subobtusely to erose-truncate, the sterile ones acute, the larger ones forked. Veins strictly single and undivided in the lobes, immersed, scarcely visible. *Sori* uninerval; indusium rigid, yellowish, subelliptic, with adnate sides, not reaching the lateral margins of its segment, c. $\frac{1}{2}-\frac{3}{4}$ mm wide, $\frac{1}{2}$ mm long (at right angles to its vein), \pm equaling the often laterally shortly bicorniculate outer margin of the segment, subtent to shallowly erose. Spores monoete, subellipsoid, light brown, smooth, c. 45 by 38 μ .

Distr. *Malesia*: confined to Mt Kinabalu, Sabah, Borneo (3 coll.).

Ecol. In mountain forests, 2000–2500 m.

2. TAPEINIDIUM

(PRESL) C. CHR. Ind. Fil. (1906) 631; COPELAND, Gen. Fil. (1947) 53; HOLTUM, Rev. Fl. Mal. 2 (1954) 338; KRAMER, Blumea 15 (1968) 545.—*Microlepia sect. Tapeinidium* PRESL, Epimel. Bot. (1851) 968.—*Protolindsaya* COPELAND, Philip. J. Sc. 5 (1910) Bot. 283.—*Wibelia auct. non BERNHARDI*; FÉE, Gen. Fil. (1852)

331; DIELS, in E. & P. Nat. Pfl. Fam. I, 4 (1902) 216.—*Davallia* or *Microlepia auctt. plur.*, p.p.

Small to medium-sized terrestrial ferns with very short to moderately long-creeping *rhizome* with at least in the larger species a true solenostele with external and internal endodermis and a medullary strand of sclerenchyma. Scales long and narrow, glabrous, non-clathrate. *Lamina* up to the last divisions pinnately compound, at least once pinnate; ultimate divisions not dichotomously divaricate. Veins free. *Sori* terminal on the veins, uni- or less often binerval (rarely trinerval), mostly close to the margin. Indusium rigid, attached at the base and at least the greater part of the sides. Pluricellular uniseriate filiform paraphyses present (probably in all *spp.*). Spores monolete. Gametophyte unknown.

Type species: *Tapeinidium pinnatum* (CAV.) C. CHR.

Distr. 17 *spp.*, from S. India, the Malay Peninsula, and the Ryu Kyu Is. to Melanesia and Samoa; absent from Australia, probably also from New Caledonia.

Ecol. In forests, mostly at lower and middle altitudes, to c. 2500 m.

KEY TO THE SPECIES

1. Lamina simply pinnate and with a conform terminal pinna (fig. 14).
2. Sori submarginal, most often binerval; petiole and rachis abaxially sharply bi-angular; scales to 5 mm long 15. *T. longipinnulum*
2. Sori intramarginal, almost always uninerval; rachis abaxially sharply bi-angular or sulcate, basally dark and pale-margined; scales to 2½ mm long 14. *T. acuminatum*
1. Lamina more strongly dissected, or, if simply pinnate, the upper pinnae reduced and confluent into a pinnatifid leaf-apex, or at least the terminal division strongly lobed at its base.
3. Lamina simply pinnate, or, if more dissected, the primary rachis abaxially sharply carinate; at least a considerable upper portion of the petiole abaxially bi-angular.
4. Petiole, at least in the upper part, and rachis dark, pale-angled; lamina pinnate + pinnatifid or bipinnate.
5. Larger pinnae of full-grown plants 20–25 mm wide at the widest point; texture subcoriaceous; margin often reflexed in dry leaves; lobes of larger pinnae sinuate, the sori not on lobes 8. *T. gracile*
5. Larger pinnae of full-grown plants 10–12 mm wide at the widest point; texture herbaceous; margin not reflexed; lobes of larger pinnatifid or basally subpinnate pinnae lobed, each sorus on a lobe: smaller forms of. 1. *T. denhamii*
4. Petiole pale, or, if occasionally darker, the rachis not also dark and pale-angled; or lamina simply pinnate.
6. Lamina to 12 cm long; petiole slender, less than 1 mm ø 10. *T. oligophlebium*
6. Lamina larger; petiole stouter.
7. Petiole abaxially obtusely bi-angular, dark and dull, ± pale-angled; rachis abaxially mostly narrowed-rounded; sori submarginal, on saw-teeth; lamina simply pinnate 13. *T. prionoides*
7. Petiole abaxially sharply bi-angular at least near the apex, nearly always pale; rachis abaxially carinate or bi-angular; sori intramarginal; lamina variously dissected.
8. Lamina pinnate + pinnatifid or more incised* 11. *T. luzonicum*
8. Lamina simply pinnate or in large leaves the basal pinnae with very few basal lobes* 12. *T. pinnatum*
3. Lamina at least pinnate + pinnatifid; primary rachis abaxially terete or bi-angular, or, if obtusely carinate, the petiole abaxially not (or only at the apex) sharply bi-angular.
9. Primary rachis atropurpureous; secondary rachises (except sometimes the basal ones) abruptly pale; pinnae pinnatifid, with crenate segments, only the basal pinnae occasionally with some pinnatifid basispicopic pinnules; most sori with their greatest extension at right angles to their vein. 9. *T. calomelanos*
9. Primary rachis at least at the base dark; secondary rachises pale; pinnae pinnate + pinnatifid or subbipinnate; sori with their greatest extension in the prolongation of the vein 5. *T. stenocarpum*
9. Primary rachis pale, or, if dark, the secondary rachises not abruptly pale; lamina often more incised.
10. All axes, except the primary, green-margined to base or almost so, i.e., lamina only once fully pinnate, then pinnatifid; secondary axes abaxially rounded. 2. *T. buniifolium*
10. Lamina mostly fully bipinnate; secondary rachises, if marginate, abaxially carinate.
11. Secondary rachises abaxially black, with two pale lateral or one pale median ridge; lamina bipinnate or almost so, with superficially crenato-lobate pinnules; pinnae not enlarged at the base 7. *T. atratum*

* For intermediates see 12a. *T. biserratum* (BLUME) v.A.V.R.

11. Secondary rachises abaxially various, but not black with pale ridges; lamina often bipinnate + pinnatifid.
12. Primary rachis and indusia black; ultimate lobes abaxially with very broad and prominent veins occupying $\frac{1}{4}$ – $\frac{1}{2}$ of their width (fig. 9) 6. *T. obtusatum*
12. Primary rachis and indusia pale to dark brown; ultimate lobes with immersed, if slightly prominent, relatively much narrower veins.
13. Indusia about twice as broad as long*, 0.3 mm long; margin bordering the apical sorus of the segment usually denticulate; texture herbaceous 1. *T. denhamii*
13. Indusia longer, or, if only $\frac{1}{3}$ mm long, \pm isodiametric or longer than broad*; margin bordering the apical sorus entire, or no apical sorus; texture firmer.
14. Larger segments pinnatifid, each lobe with a sorus overtopped by part of the lobe (fig. 6). 3. *T. amboynense*
14. Larger segments (except for the basal pinnae) crenate, each lobe with a terminal or sub-terminal sorus.
15. Secondary rachises abaxially terete in a considerable basal portion; basispicic pinnules of basal pinnae usually enlarged and more dissected than the others (fig. 10) 4. *T. novoguineense*
15. At least the larger secondary rachises abaxially carinate; basispicic pinnules of basal pinnae rarely enlarged and more dissected (fig. 11) 11. *T. luzonicum*

1. *Tapeinidium denhamii* (HOOKER) C. CHR. Ind. Fil. (1906) 631; KRAMER, Act. Bot. Neerl. 15 (1967) 583. — *Davallia denhami* HOOKER, Second Cent. Ferns (1861) pl. 47.— *Microlepia denhami* (HOOKER) MOORE, Ind. Fil. 2 (1861) 292. — *Lindsaea denhami* (HOOKER) METT. ex KUHN, Verh. Zool. Bot. Ges. 19 (1869) 573.— *Wibelia denhami* (HOOKER) KUHN, Chaetopt. (1882) 346. — Type: MILNE 116, Viti Levu, Fiji (K).

T. tenuis COPELAND, Philip. J. Sc. 60 (1936) 110, pl. 17. — Type: BRASS 3025, San Cristóval, Solomon Is. (MICH, dupl. in BISH, GH, L).

T. tenue auct. non (BRACKENR.) COPELAND, Bull. Bish. Mus. 59 (1929) 69; KRAMER, Blumea 15 (1968) 548; not *Microlepia tenuis* BRACKENR. U.S. Expl. Exp. (1854) 236.—Fig. 7.

Rhizome short-creeping, 1–2 mm σ ; scales reddish brown, acicular, to 1½ mm long, up to 4-seriate at base, the greater part uni- or biseriata. Leaves clustered to moderately close; *petioles* stramineous to reddish or less often dark brown, abaxially obtusely or upward sharply bi-angular and then mostly pale-angled, 5–30 cm long, less than half to about as long as the lamina. *Lamina* oblong to triangular or subpentagonal, 10–35 cm long, 5–20 cm wide, in small specimens pinnate + pinnatifid or mostly bipinnate, in larger ones tripinnate + pinnatifid at base; primary rachis like the upper part of the petiole or abaxially subterete. *Primary pinnae* c. 12–20 to a side, laxly ascending, sessile or the basal short-petiolulate, if small and once pinnate, linear and up to c. 6 by 1½ cm, if larger and more compound, to 15 by 10 cm; secondary rachises stramineous, abaxially rounded or narrowed-rounded, or almost keeled. *Secondary pinnae* of at least twice pinnate leaves c. up to 20 to a side, pinnate or pinnate + pinnatifid, the basal ones of the basal primary pinnae often prolonged and then the leaf approximately pentagonal; ultimate pinnules 1–5 cm long, $\frac{1}{3}$ –1 cm wide,

lanceolate to linear, acuminate, pinnatifid to bipinnatifid. *Ultimate segments* herbaceous, dark green or olivaceous when dry, oblique, ovate or oblong to lanceolate, decurrent and connected, obtuse or subacute, dentate to pinnatifid, size and shape depending greatly on the degree of dissection of and the place in the lamina, larger and broader in less dissected pinnules, somewhat asymmetric, without thickened margin, with evident, flexuous costa giving off single (or forked in larger lateral lobes), evident veins. Upper pinnae, secondary pinnae, and pinnules gradually reduced, confluent into pinnatifid, acute or mostly acuminate apices of lamina, pinnae, etc. *Sori* single or rarely paired on the teeth of the lobes, in most cases also on the apical one, uninerval. the soriferous vein distinctly broadened below the indusium, the margin opposite the indusium occasionally denticulate; indusium brownish, delicate, suborbicular to elongate in prolongation of its vein, 0.3–0.7 mm long, 0.4–0.8 mm wide, not quite reaching the margin and with rounded edge or with a small protracted lobe that often slightly exceeds the margin, sometimes ruptured at maturity, attached at the base and sides. Spores brownish, subellipsoidal, smooth, c. 36 by 28 μ .

Distr. Admiralty Is. (Manus), Bismarck Arch. (New Ireland, New Hannover), Solomon Is., New Hebrides, Fiji.

Ecol. Terrestrial in forests, 100–900 m, often said to be locally common.

Note. Quite variable in the degree of dissection, but the shape and especially the place of the sori is very characteristic, no other species regularly having sori on the terminal lobes.

2. *Tapeinidium buniifolium* KRAMER, Blumea 15 (1968) 549.—*T. moluccanum auct. non* (BLUME) C. CHR.; WAGNER & GREYER, Un. Cal. Publ. Bot. 23 (1948) 36.—Type: GREYER & WAGNER 4188, Tjajiak Mts, Mt Dremsl region, Manus,

* For the sake of consistency with the terminology employed in *Lindsaea* the length of an indusium is measured at right angles to its vein, the width in prolongation of its vein.

Admiralty Is. (MICH; dupl. in BISH, US).

Rhizome only known from very short pieces, c. $3\frac{1}{2}$ mm ϕ ; scales reddish brown, to c. 1 mm (or more?) long, to \pm 4-seriate at base, with long, acicular, uni- or pauciseriate apex. *Petioles* stout, rather lustrous, medium brown, crushed but apparently abaxially upward obtusely bi-angular, c. 60 cm long. *Lamina* probably 30 cm or more long (no complete leaf seen), pinnate + quadripinnatifid or subbipinnate + tripinnatifid at the base, probably deltoid; primary pinnae at least 4 to a side, the lower ones remote. Primary rachis stramineous to medium brown, abaxially apparently bi-angular. Largest *primary pinnae* oblong, with a petiolule of a few mm, c. 18 by 5 cm, with c. 12–15 major secondary pinnae to a side, these somewhat ascending; axes of higher than the first order abaxially stramineous, rounded, narrowly green-margined to base, only the basal ones unmarginated at the extreme base. Larger *secondary pinnae* c. 8–12 by 3–6 cm, elongate-triangular, with c. 10–15 segments to a side, these chartaceous, obliquely ascending, not close, lanceolate to linear, the largest $1\frac{1}{2}$ –3 cm by 4–5 mm, deeply pinnatifid at base, at the acute apex like the smaller segments dentato-lobate. *Ultimate lobes* lanceolate-ligulate, the larger ones up to 4 by $1\frac{3}{4}$ mm, subacute, often somewhat falcately ascending, asymmetric, with a bulge on the anterior margin where the sorus is situated, smaller lobes triangular, with subterminal sorus. Apical lobes of segments not soriferous. Veins abaxially evident at base but higher up evanescent, simple, forked in larger lobes. *Sori* uninerval; indusium brownish, pouch-shaped, narrowed at base, often with irregular free edge, 0.3–0.5 mm long and broad. Spores brownish, subellipsoidal, smooth, c. 35 by 26 μ .

Distr. Only known from the type collection.

Ecol. In mountainside woods, c. 700 m.

3. *Tapeinidium amboynense* (HOOKER) C. CHR. Ind. Fil. (1906) 631; KRAMER, Blumea 15 (1968) 549. — *Davallia amboynensis* HOOKER, Sp. Fil. 1 (1845) 178, pl. 56 C. — *Lindsaea amboynensis* (HOOKER) METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279. — *Wibelia amboynensis* (HOOKER) KUHN, Chaetopt. (1882) 346. — Type: CHR. SMITH *s.n.*, Ambon (K).

Davallia stenoloba BAKER in Becc. Malesia 3 (1886) 35. — *T. moluccanum* (BLUME) C. CHR. var. *stenolobum* (BAKER) C. CHR. Ind. Fil. Suppl. 3 (1934) 176. — *T. stenolobum* (BAKER) WAGNER & GREYER, Un. Cal. Publ. Bot. 23 (1948) 36. — Type: BECCARI *s.n.*, Mt Salhutu, Ambon (FI; fragm. in K).

T. amplum COPELAND, Occ. Pap. Bish. Mus. 15 (1939) 82, f. 3. — Type: TAKAMATSU 1572, Garasumao, Palau Is. (MICH; dupl. in BISH, K, US).

T. moluccanum C. CHR. Ind. Fil. Suppl. 3

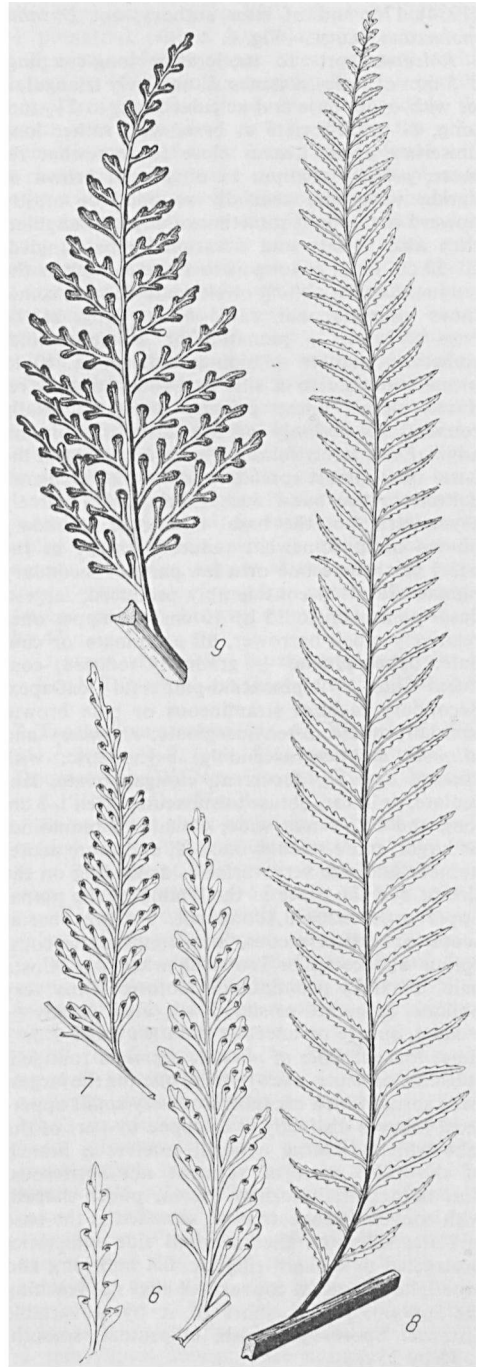


Fig. 6. *Tapeinidium amboynense* (HOOK.) C. CHR. Two pinnules from different parts of the lamina, $\times 1\frac{1}{4}$ (DE VRIESE 358). — Fig. 7. *T. denhamii* (HOOK.) C. CHR. Pinnule, $\times 1\frac{1}{4}$ (BRASS 3335). — Fig. 8. *T. atratum* KRAMER. Pinna, $\times \frac{3}{4}$ (H. J. LAM 1556). — Fig. 9. *T. obtusatum* v.A.v.R. Pinna, $\times \frac{3}{4}$ (H. J. LAM 1857).

(1934) 176, and of later authors; not *Davallia moluccana* BLUME.—Fig. 6.

Rhizome short- to moderately long-creeping, 3–5 mm \varnothing ; scales castaneous, narrowly triangular, or with ovate base and acicular apex, to 2½ mm long, 8- to 10-seriate at base, with rather long uniseriate apex. Leaves close to somewhat remote; *petioles* medium to olivaceous brown or darker with age, abaxially rounded or mostly upward obtusely or sometimes sharply bi-angular, then also sulcate and occasionally pale-angled, 25–50 cm long, as long as to twice as long as the lamina. *Lamina* oblong or elongate-deltoid, sometimes subpentagonal, c. 25–40 cm long, at the base bipinnate + pinnatifid or + bipinnatifid, sometimes pinnate + bipinnatifid, with c. 10–15 primary pinnae to a side and some strongly reduced upper ones; primary rachis abaxially rounded to obtusely or less often sharply bi-angular, not rarely sulcate. *Pinnae* ascending or the basal ones almost spreading, oblong or elongate-deltoid or the basal ones subrhombic, scarcely asymmetric but the basal basicopic secondary pinnae often somewhat reduced, except in the basal pair where one or a few pairs of secondary pinnae are often considerably produced; largest, basal pinnae up to 15 by 10 cm, the upper ones relatively much narrower, all acuminate or caudate; upper pinnae \pm gradually reduced, confluent into a bipinnatifid-pinnatifid leaf-apex. Secondary rachises stramineous or pale brown, abaxially terete, often marginate; *secondary* and *ultimate divisions* ascending, asymmetric, with cuneate base, \pm decurrent, elongate-ovate, lanceolate, or linear, obtuse to subacute, often 1–3 cm long and 1½–5 mm wide, crenate to pinnatifid, or larger, more strongly incised, and more acute; number and size very variable, depending on the size of and the place in the lamina of the pinna; upper ones reduced, confluent. Texture chartaceous or subcoriaceous, sometimes coriaceous; colour olivaceous or brownish when dry. Costa pale, abaxially prominulous, obtuse. Veins very oblique, immersed or slightly elevated, mostly \pm evident, simple or once, or in larger lobes 2 or 3 times forked; *lobes of ultimate segments* rounded, subacute or acute, each bearing one (or the largest two) sorus, which except in the very small uppermost lobes is distinctly overtopped by part of the lobe which, if large enough, receives a branch of the vein; apex of segment not soriferous. *Sori* uninerval; indusium brown, pouch-shaped, with convex or cuneate base, attached at the base and the sides, on the marginal side sometimes protracted as a slight ridge, c. 0.4 mm long and broad, its somewhat convex free edge not reaching the margin, falling short of it by a variable distance. Spores yellowish, ellipsoidal, smooth, c. 35 by 25 μ .

Distr. *Malesia*: Celebes, Moluccas (Talaud, Morotai, Halmahera, Ternate, Ceram, Ambon), Kei Is., Waigeo, Biak, W. New Guinea, Palau Is.; doubtfully Borneo.

Ecol. Terrestrial in forests, from sea level to 800 m.

4. *Tapeinidium novoguineense* KRAMER, *Blumea* 15 (1968) 550. — Type: SCHLECHTER 14319, Torricelli Mts, Terr. of New Guinea (B; dupl. in BM, BO, K, P).—Fig. 10.

Rhizome moderately long- to rather short-creeping, 2–4 mm \varnothing ; scales medium brown, elongate-triangular, to 3 mm long, to c. 12-seriate at base, the uniseriate apex relatively short. Leaves rather close; *petioles* stout, the base often verruculose from scale bases or persistently scaly, dull, stramineous with darker base or darker throughout, abaxially terete, c. 25–75 cm long, slightly shorter than to twice as long as the lamina. *Lamina* bipinnate, or bipinnate + pinnatifid, at the base often tripinnate, elongate-triangular or subpentagonal-triangular, less often oblong, c. 20–55 cm long; primary rachis stramineous to pale brown, abaxially rounded or narrowed-rounded, keeled only near the apex. *Pinnae* 15–35 to a side (not counting the confluent upper ones), laxly ascending, lanceolate, or the basal ones broader at the base, often acroscopically wider at the base, shortly acuminate; *larger pinnate pinnae* 12–16 cm long, 3–5 cm wide, with c. 20–30 pinnules to a side, the basal pinnae usually with a strongly protracted basal basicopic secondary pinna (smaller but similar ones may be present next to and opposite it, and on the second pair of pinnae) similar in shape to a middle primary pinna. Secondary (and, if any, tertiary) rachises stramineous, abaxially rounded in the lower, carinate in the upper part. *Ultimate free pinnules* c. 20–30 to a side, ascending, closely and regularly spaced but not contiguous, subcoriaceous or coriaceous, mostly olivaceous or brownish when dry, lanceolate, mostly obtuse or subacute and with narrowed, cuneate-decurrent base, the larger ones usually 3–4 cm long and 3–4 mm wide, crenate to pinnatifid to the middle (or beyond in the basal pinnae), with abaxially prominulous, pale costa. Veins simple in the lobes (crenations) or forked in the larger ones, somewhat prominulous. Lobes oblong, or \pm triangular if small, obtuse. *Upper pinnae* rather suddenly reduced, pinnatifid, then crenate, gradually simpler, confluent into a pinnatifid leaf-apex; upper pinnules (segments) also reduced and confluent. *Sori* single in the lobes, or paired or a few together in exceptionally large ones, uninerval, their vein often conspicuously broadened at the end; indusium brownish, pouch-shaped to almost triangular, entire, 0.4–0.7 mm long, 0.3–0.5 mm wide, not reaching the margin by its width or less, about equally remote from both the lateral and the apical edges of its lobe. Spores brownish, ellipsoidal, smooth, c. 35 by 24 μ , exceptionally larger.

Distr. *Malesia*: Japen I., New Guinea (all Div.); Solomon Is.

Ecol. In forests and thickets, 200–2100 m, often said to be locally common.

5. *Tapeinidium stenocarpum* v.A.v.R. Nova Guinea 14 (1924) 52; KRAMER, *Blumea* 15 (1968) 550.—Type: H. J. LAM 1442, mountain ridge near

Idenburg R., W. New Guinea (BO; dupl. in K, L, SING, U; fragm. in US).

Rhizome not very short-creeping, 2–2½ mm ø; scales fuscous, elongate-triangular, to c. 3 mm long, to c. 10-seriate at base, with well-developed uniseriate apex. Leaves not close; *petioles* atropurpureous to blackish, dull, abaxially terete in the lower part, upward obtusely to subacutely bi-angular and somewhat pale-angled, c. 15–20 cm long, half as long as to as long as the lamina. *Lamina* oblong to elongate-rhombic, bipinnate + deeply pinnatipartite at the base (almost tripinnate), c. 20–35 cm long; primary rachis abaxially obtusely bi-angular at the base, ± distinctly pale-angled and often mottled, upward pale, narrowed-rounded, subcarinate near the apex. *Primary pinnae* c. 15–25 to a side, ascending, often somewhat overlapping, the basal ones c. 10–15 by 3½–4 cm, the upper ones gradually, then abruptly more strongly reduced, confluent into an acuminate pinnatifid leaf-apex. Secondary rachises abaxially pale, terete at the base, upward narrowed-rounded to subcarinate. *Pinnules* to 15–20 to a side, ascending, acute to acuminate, not contiguous, the basal basicopic ones sometimes subpinnate + pinnatilobate; average pinnules deeply pinnatisect, with c. 10–12 ascending linear lobes to a side, these up to 3 by ⅔ mm, obtuse, connected by narrow, upward broader wings, the upper ones denticuliform, broadly connected and forming a lobed pinnule-apex; upper pinnules of pinnae, and pinnules of upper pinnae, less incised, lobed to entire. Pinnule costules abaxially prominent, pale, obtuse; lobes often with revolute margin, chartaceous, brown when dry, the vein immersed but evident, simple or slightly branched in the largest ones. *Sori* single in the ultimate lobes, absent from the terminal ones, uninerval, terminal in small lobes, on an ascropic lateral bulge in larger ones; indusium narrowly pouch-shaped, 0.2–0.4 mm long, 0.3–0.7 mm wide, dark, entire, not reaching the margin by ½–1 times its width. Spores brownish, ellipsoidal, smooth, c. 35 by 25 μ (very few seen).

Distr. *Malesia*: W. New Guinea (2 coll.).

Ecol. Terrestrial in mossy forests, c. 1400–1800 m.

6. *Tapeinidium obtusatum* v.A.v.R. Nova Guinea 14 (1924) 52; KRAMER, Blumea 15 (1968) 550.—Type: H. J. LAM 1857, mountain ridge near Doormantop, W. New Guinea (BO; dupl. in L, SING, U).—Fig. 9.

Rhizome moderately long-creeping, 3–4 mm ø; scales light castaneous, narrowly triangular, to 5 mm long, to c. 10-seriate at base, there often with laterally protruding cell-walls, with a relatively short uniseriate apex. Leaves not close; *petioles* black, dull, somewhat verruculose at base, abaxially terete or very obtusely and indistinctly bi-angular near the apex, c. 25 cm long, usually longer than the lamina. *Lamina* oblong or elongate-triangular, c. 15–25 cm long, described as lustrous on both sides when fresh, rigidly coriaceous, brown to blackish when dry, at the

base tripinnate + pinnatifid, elsewhere bipinnate + pinnatifid, with c. 10 major pinnae to a side and some reduced upper ones; primary rachis brown to black, dull, abaxially like the petiole, near the apex subcarinate. *Pinnae* ascending, the basal ones triangular, c. 8 by 5 cm, the other ones oblong, c. 5–6 by 2 cm; basal pinnae with a basicopic bipinnate + pinnatifid pinnule, otherwise the pinnae once pinnate, with the larger pinnules pinnatifid or pinnatilobate. Secondary axes dark or, especially the upper ones, pale, abaxially narrowed-rounded to subcarinate. *Larger secondary pinnae* with 5–8 segments on a flexuous costa, the segments alternate, linear-subspathulate, oblique, not close, decurrent, joined by narrow wings, the margin subrevolute, often 2–4 by 1 mm, with a broad, abaxially much elevated, obtuse, stramineous costule that occupies about ⅓ of its width and is often conspicuously broadened under the sorus. Apex of lobes obtuse, in the larger ones slightly oblique. *Sori* single (rarely paired) and apical in the lobes, uninerval; indusium dark, rigid, in larger lobes somewhat oblique on the vein, with ± straight base and convex free edge, adnate at the sides, ½–1 mm long, ½ mm wide, not quite reaching the margin. Spores medium brown, ellipsoidal, smooth, 60 by 45 μ.

Distr. Only known by the type collection.

Ecol. Terrestrial in mossy forest, c. 2500 m.

7. *Tapeinidium atratum* KRAMER, Blumea 15 (1968) 551.—Type: H. J. LAM 1556, mountain ridge near Doormantop, W. New Guinea (BO, 2 sh.; dupl. in L, SING, U).—Fig. 8.

Rhizome not short-creeping, c. 2 mm ø; scales reddish brown, narrowly triangular, to 2 mm long, to c. 8-seriate at base, with a long uni-biseriate apex. *Petioles* stout, 4–5 mm ø at base, almost black, sublustrous, basally verruculose, abaxially sharply bi-angular above, downward gradually rounded, not pale-margined, to 60 cm long, about as long as the lamina. *Lamina* oblong, bipinnate, with c. 15–20 remote but ascending and often ± touching pinnae to a side; primary rachis blackish, abaxially sharply bi-angular, upward pale-margined and ± sulcate. *Pinnae* narrowly deltoid, shortly acuminate, c. 20 by 2½–3 cm, basicopically slightly narrowed at the base, pinnate, upward pinnatifid; secondary rachises dark, abaxially with one median or two lateral pale ridges. Upper pinnae gradually reduced, confluent into a pinnatifid leaf-apex. *Pinnules* up to c. 35 to a side, rigidly coriaceous, brown when dry, about twice their width apart, somewhat ascending, very narrowly lanceolate, the largest c. 17 by 4 mm, pinnatilobate, with c. 9 lobes to a side, these broadly rounded, to 1 by 1 mm; apex obtuse; base cuneate, decurrent. Costa pale, abaxially prominent, obtuse, flexuous towards the apex; veins hidden, simple or once forked. Upper pinnules reduced, confluent. *Sori* 1, less often 2 or 3 per lobe, near the anterior margin, just inside the apex, uninerval; indusium blackish, pouch-shaped, 0.3–0.5 mm long, 0.3–0.4 mm wide,

attached at the sides, not reaching the margin by little less than its width. Spores brownish, ellipsoidal, smooth, *c.* 35 by 25 μ .

Distr. Only known by the type collection.

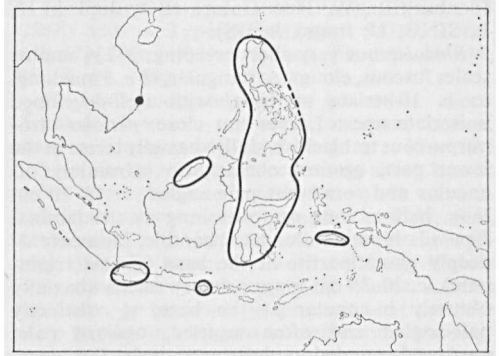
Ecol. Collected at 1420 m.

8. *Tapeinidium gracile* (BLUME) v.A.v.R. Handb. (1908) 315; KRAMER, Blumea 15 (1968) 551.—*Davallia gracilis* BLUME, En. Pl. Jav. (1828) 233.—*Microlepidia gracilis* (BLUME) J. SMITH, Lond. J. Bot. 1 (1842) 427.—*Wibelia gracilis* (BLUME) CHRIST, Ann. Jard. Bot. Btzg II, 5 (1905) 134.—Type: BLUME 1731 or *s.n.*, Java (L).

? *Dicksonia linearis* CAV. Descr. (1802) 274.—Type: NÉE *s.n.*, Philippines (MA, *n.v.*).

Rhizome rather short- to rather long-creeping, *c.* 2 mm ϕ ; scales reddish brown, narrowly triangular, to 2½ mm long, to *c.* 6-seriate at base, with a long uniseriate apex. Leaves close to *c.* 1 cm apart; *petioles* slender, ⅔–1 mm ϕ at apex, reddish brown to atropurpureous, at least upward pale-margined, abaxially sharply bi-angular, the base usually subterete, *c.* 10–35 cm long. *Lamina* oblong, *c.* 12–30 cm long, *c.* 2–3 times as long as wide, to 1½ times as long as the petiole, rarely shorter, pinnate + pinnatifid, less often at the base pinnate + pinnatifid; rachis abaxially at the base dark and pale-angled, the two abaxial angles of the petiole merging into one near the basal pinnae to form a sharp keel on the rachis, the upper part quite pale. *Larger pinnae* *c.* 10–15 to a side, somewhat ascending, about their width apart, lanceolate to linear, the largest *c.* 8–15 cm long, (½–)1¼–3 cm wide, subsessile, acuminate; lowest pinnae the longest, the upper ones gradually and strongly reduced, confluent into a pinnatifid leaf-apex. Texture chartaceous or subcoriaceous or sometimes coriaceous, colour medium green or brownish when dry. *Lower pinnae* pinnatifid to the middle (rarely less) to deeply pinnatifid to a narrow costal wing, the lobes asymmetrically triangular and serrate or crenate if short, linear, obtuse, subentire to crenate if larger, ascending, occasionally somewhat falcate, often 12–15 major ones to a side in the larger pinnae, to 2½ by 3 mm; *basal basicopic segments* of most pinnae reduced, those opposite them often somewhat prolongate. Costae of pinnae pale, abaxially acute, of segments pale, flat, both abaxially prominulous. *Upper segments* strongly reduced, most pinnae with a long pinnatifid-crenate apex. Veins hidden, ascending, simple or rarely once forked. *Sori* uninerval, on the lateral and not rarely also on the terminal veinlets of the segments, separated by crenations; indusium pouch-shaped, \pm semi-elliptic, with straight or slightly lobed edge, ⅓–½ mm long and broad, mostly falling short of the apex of its lobule by its width or more, the margin sometimes revolute and touching it when dry. Spores pale brownish, subellipsoidal to bean-shaped, smooth, 34–36 by 24–28 μ .

Distr. E. Annam; in *Malesia*: W. Java, Bali, Sarawak, Brunei, Celebes, Ceram, Philippines.



Map 1. Distribution of *Tapeinidium gracile* (BL.) v.A.v.R.

The only species with a notably disjunct area. Map 1.

Ecol. Terrestrial and epilithic, in forests, 500–1300 m.

9. *Tapeinidium calomelanos* KRAMER, Blumea 15 (1968) 551.—Type: KORTHALS *s.n.*, G. Sakumbang, SE. Borneo (L, 2 sh.).

Rhizome short- to somewhat more long-creeping, 2–3 mm ϕ ; scales castaneous, elongate-triangular, to *c.* 2 mm long, to *c.* 6-seriate at base, long-acuminate. Leaves close to 1 cm apart; *petioles* very dark purplish brown, dull or shining, 1–2 mm ϕ at apex, abaxially terete, 10–35 cm long, mostly shorter than the lamina. *Lamina* elongate-triangular to oblong or subpentagonal, 10–35 cm long, pinnate + deeply pinnatifid, or at the base bipinnate (+ pinnatifid), subcoriaceous or coriaceous, olivaceous-brown when dry. Primary rachis atropurpureous or dark castaneous, abaxially terete. *Pinnae* ascending, *c.* 12–20 major ones to a side, lanceolate, the lower ones usually triangular, subsessile, often somewhat overlapping, acuminate, the larger ones deeply pinnatifid or occasionally pinnate at the base and then sometimes the largest basicopic pinnules pinnatifid, to *c.* 15 by 2½ cm; *major pinnules* (segments) to 18 to a side, lanceolate, ascending, 30 by 2½ cm to 8 by 7 mm, or larger if incised, otherwise serrate or crenate, unequally cuneate at the base, obtuse or subacute, rapidly decreasing in size to the pinna-apex; secondary (and, if any, tertiary) rachises abruptly pale (except sometimes those of the lowest pinnae), abaxially terete. *Upper pinnae* crenate, confluent into a pinnatifid leaf-apex. Veins immersed, hidden, or slightly elevated, simple, or forked in the larger lobes. *Sori* uninerval, slightly immersed, single in the lobes of the ultimate segments, the margin opposite the indusium sometimes notched; indusium dark, 0.3–0.6 mm long, 0.3 mm wide, mostly longer than wide, not reaching the margin by its width or more. Spores brownish, ellipsoidal, smooth, *c.* 35 by 26 μ .

Distr. *Malesia*: Sumatra (?), Borneo, Celebes, Philippines (Luzon).

Ecol. One record from moist shady forest, c. 140 m.

10. *Tapeinidium oligophlebium* (BAKER) C. CHR. Ind. Fil. (1906) 631; KRAMER, *Blumea* 15 (1968) 552. — *Davallia oligophlebia* BAKER, J. Bot. 26 (1888) 323. — *Wibelia oligophlebia* (BAKER) CHRIST, Ann. Jard. Bot. Btzg II, 5 (1905) 134. — Type: HOSE 220, Laupi, Sarawak (K).

Protolindsaya brooksii COPELAND, Philip. J. Sc. 5 (1910) Bot. 283. — *T. brooksii* (COPELAND) C. CHR. Ind. Fil. Suppl. 3 (1934) 176. — Type: BROOKS 47, G. Bengkaim, Sarawak (SAR, holotype?; dupl. in BM).

Rhizome short-creeping, $\frac{2}{3}$ –2 mm ϕ ; scales light brown, lanceolate to elongate-triangular, to $1\frac{1}{2}$ mm long, to c. 6-seriate at base, the uniseriate apex comparatively short. Leaves close; *petioles* slender, stramineous with darker base or brown throughout, abaxially bi-angular, 2–10 cm long. *Lamina* narrowly lanceolate to triangular, about as long as to 5 times as long as wide, $2\frac{1}{2}$ –12 cm long, with c. 6–20 pinnae to a side; rachis abaxially bi-angular at the base, the angles fusing, mostly between the two basal pairs of pinnae, to form one keel. *Pinnae* slightly ascending or the basal ones spreading, ovate and crenate to linear and then usually pinnatifid to pinnatifid, or the basal ones fully pinnate, with crenate pinnules; size and shape of pinnules strongly dependent on the degree of dissection of and the place in the lamina; larger pinnules often c. 2 mm wide, mostly obtuse. Upper pinnae and pinnules gradually reduced, confluent. Texture herbaceous to subcoriaceous, colour usually brownish or olivaceous when dry. *Secondary rachises* (costae) abaxially carinate, costae of smaller divisions usually rounded and obsolete above the base. Veins immersed, abaxially \pm evident. *Sori* uninerval, single or a few together on the lateral lobes of the larger segments, in larger lobes sometimes overtopped by a sterile part of the lobe, otherwise subterminal; indusium $\frac{1}{4}$ mm broad, $\frac{1}{4}$ – $\frac{1}{2}$ mm long, brownish, subentire, pouch-shaped, not reaching the margin by its width or more, sometimes ruptured at maturity. Spores brownish, ellipsoidal, smooth, c. 35 by 25 μ .

Distr. *Malesia*: Borneo (Sarawak, Kalimantan).

Ecol. Terrestrial, in forests and on shaded cliffs, c. 700–1000 m.

Note. The specific distinctness of this taxon is doubtful. It may be a reduced variety or form of another species, e.g. *T. luzonicum*.

11. *Tapeinidium luzonicum* (HOOKER) KRAMER, *Blumea* 15 (1968) 552. — *Davallia luzonica* HOOKER, Sp. Fil. 1 (1845) 174, pl. 60 B. f. 2, 3, 5. — *Wibelia bipinnata* FÉE, Gen. Fil. (1852) 331, nom. superfl. — Type: CUMING 139, p.p., Luzon (dupl. in B, GH, L).

Lindsaea pinnata (CAV.) METT. ex KUHN var.

bipinnata METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279. — Type: ZOLLINGER 1305, Java (dupl. in HBG, L).

Davallia philippinensis HARRINGTON, J. Linn. Soc. Lond. 16 (1877) 27. — *Microlepia philippinensis* (HARRINGTON) COPELAND, Polypod. Philip. (1905) 56. — *T. philippinense* (HARRINGTON) C. CHR. Ind. Fil. Suppl. 3 (1934) 176. — Type: STEERE s.n., Mt Mahayhay, Luzon (K).

Davallia hosei BAKER, J. Bot. 26 (1888) 323. — Type: HOSE 219, Lambur, Sarawak (K).

T. sumatranum v.A.V.R. Bull. Jard. Bot. Btzg III, 2 (1920) 174. — Type: BROOKS 332/S, Bencoolen, Sumatra (BM; fragm. in BO).

T. biserratum auct. non (BLUME) v.A.V.R.; HOLTUM, Rev. Fl. Mal. 2 (1954) 339, f. 197; and of other authors. — Fig. 11.

Rhizome usually short-creeping, to 4 mm ϕ ; scales golden brown, narrowly triangular, long-acuminate, to 4 mm long. *Petioles* about as long as to twice as long as the lamina, abaxially terete at the base, in the upper half or less often only near the apex obtusely to acutely bi-angular, flat or usually sulcate. *Lamina* oblong, narrowly oblong, triangular, or occasionally subpentagonal, at least once pinnate + pinnatifid. Primary rachis stramineous or pale brown, abaxially sharply carinate. Secondary rachises (costae) abaxially elevated, sharply carinate, pale. Upper pinnae and pinnules (segments) gradually reduced, confluent. *Sori* uninerval. Spores pale brown, ellipsoidal, smooth, c. 40 by 28 μ .

KEY TO THE VARIETIES

1. Petiole less than 1 mm ϕ at base of lamina; lamina subtripinnate at the base
 1. var. *leptophyllum*
1. Petiole over 1 mm ϕ at base of lamina; lamina pinnate + deeply pinnatifid or bipinnate
 2. var. *luzonicum*
1. Petiole sometimes less than 1 mm ϕ at base of lamina; lamina pinnate, the pinnae not incised beyond $\frac{2}{3}$ of their width
 3. var. *thelypteridoides*

1. var. *leptophyllum* KRAMER, *Blumea* 15 (1968) 553. — Type: ELMER 14103, Mt Urdaneta, Mindanao (L; dupl. in BM, BO, HBG, MICH).

Rhizome scales to 7-seriate at base. *Petioles* close, slender, at the most 1 mm ϕ at the base of the lamina, often medium brown. *Lamina* almost tripinnate, i.e. the tertiary divisions there almost free; ultimate free or nearly free divisions linear, obtuse, 1–2 mm wide, mostly not over 1 cm long; texture chartaceous, colour olivaceous or brownish when dry. Veins \pm evident, mostly simple in the lobes, these usually regularly rounded; indusium c. 0.3 mm long and broad. Otherwise like var. *luzonicum*.

Distr. *Malesia*: Philippines (Luzon, Negros, Mindanao, Panay, Leyte).

Ecol. No data.

Note. In appearance not unlike *Pityrogramma*

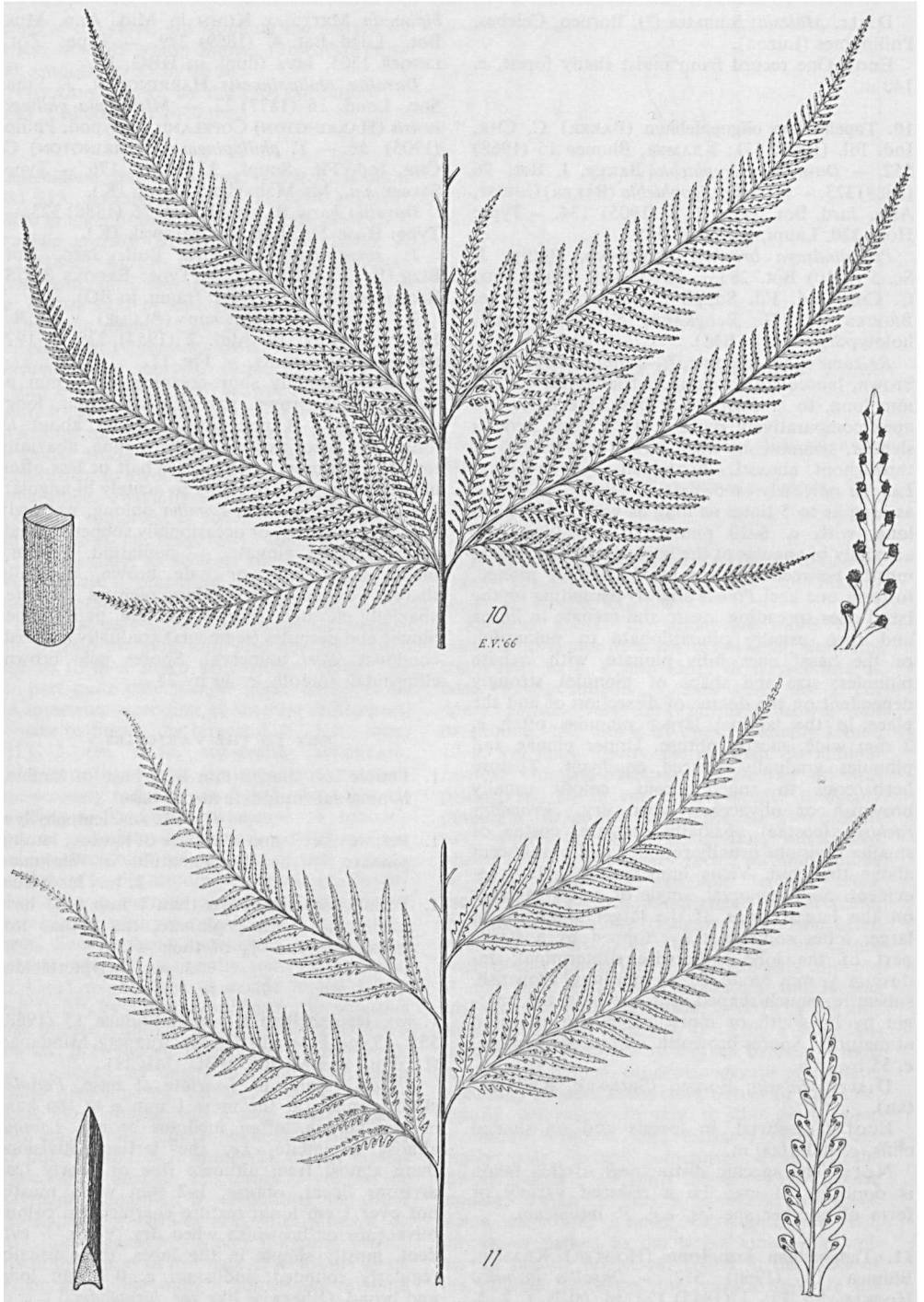


Fig. 10. *Tapeinidium novoguineense* KRAMER. Basal part of lamina, $\times \frac{2}{5}$, pinnule, $\times 2$, portion of rachis, $\times 3\frac{1}{4}$ (v. ROYEN & SLEUMER 6394).—Fig. 11. *T. luzonicum* (HOOK.) KRAMER var. *luzonicum*. Basal part of lamina, $\times \frac{2}{5}$, pinnule, $\times 2$, portion of rachis, $\times 3\frac{1}{4}$ (SAN 24071).

calomelanos (L.) LINK; also resembling *T. denhamii*, from which it differs, *i.a.*, by the rounded, not dentate, soriferous lobes, the structure of the axes, and the firmer texture.

2. *var. luzonicum*.—Fig. 11.

Rhizome often not short-creeping, the *petioles* up to a few cm apart, stramineous to pale sordid brown, concolorous, *c.* 20–65 cm long, 1½–2 mm ø at the base of the lamina. *Lamina* 18–50 cm long, 8–30 cm wide, up to 4 times as long as wide, but mostly shorter, coriaceous, less often chartaceous, dark brownish or olivaceous when dry, pinnate + deeply pinnatifid, or at the base bipinnate + pinnatifid. *Major pinnae* *c.* 6–12 to a side, spreading or ascending, 10–20 cm long, their shape and width very variable, depending on the degree of dissection, linear and 1–2 cm wide if pinnatifid, triangular and to 12 cm wide if pinnate + pinnatisect, acuminate, with long serrato-crenate apex. *Basal basiscopic divisions* of pinnae mostly somewhat reduced, those opposite them not distinctly enlarged, if more dissected than pinnate + pinnatifid, only rarely with one basiscopic or a pair of basal enlarged, more incised secondary pinnae (as in *T. novoguineense*). *Ultimate free* (or almost free) *divisions* ascending, variable in size and shape, often 1½–2½ cm long, 1–4 mm wide, mostly obtuse or subacute, or the longest acute or shortly acuminate, shallowly crenate to pinnatifid, margin often ± revolute when dry; small segments with only the anterior margin crenate. Veins immersed, not evident, simple, or in the largest segments with a few branches. *Sori* often slightly immersed; indusium dark, rather rigid, pouch-shaped, ½–½ mm wide, ½–¾ mm long, the free edge entire, convex, not reaching the margin by about its width, sometimes the exterior lateral margin protracted as a ridge on the leaf-tissue.

Distr. Thailand, in *Malesia*: Malay Peninsula, Natuna and Lingga Is., Banka, Sumatra, W. Java, Borneo, Celebes, Philippines (Luzon, Mindanao, Polillo).

Ecol. Terrestrial in moist forests, mostly 600–1500 m, occasionally to 2200 and down to 100 m. Often said to be locally common, but rare in Java.

Note. See under 12a. *T. biserratum*.

var. thelypteridoides KRAMER, *Blumea* 15 (1968) 553.—Type: BROOKE 8190, Mt Santubong, Sarawak (L; dupl. in SING, US).

Rhizome short-creeping, with relatively narrow cales; *petioles* clustered, 10–27 cm long, not rarely less than 1 mm ø at base of lamina. *Lamina* to *c.* 40 by 20 cm, chartaceous, rather pale green when dry, pinnate + pinnatifid; *pinnae* to 15 cm long and 12 mm wide, very regularly pinnatifid, the lowest to ¾, the upper ones gradually less, serrate, then subentire; segments oblong-ligulate, ascending, the largest *c.* 12 by 3 mm, obtuse, shallowly crenate-serrate; pinnae basally on the posterior margin shortly narrowed. Veins evident. *Sori* often more distinctly intramarginal.

Otherwise like less compound forms of *var. luzonicum*.

Distr. *Malesia*: Borneo (Sarawak, Sabah) (4 coll.).

Ecol. On rocks in forest, 400–1300 m.

12. *Tapeinidium pinnatum* (CAV.) C. CHR. Ind. Fil. (1906) 631; HOLTUM, Rev. Fl. Mal. 2 (1954) 339, f. 196; COPELAND, Fern Fl. Philip. 1 (1958) 114; KRAMER, *Blumea* 15 (1968) 553.—*Davallia pinnata* CAV. Descr. (1802) 277, non METT. ex KUHN (1869).—*Saccoloma pinnatum* (CAV.) PRESL, Tent. Pterid. (1836) 126.—*Microlepia pinnata* (CAV.) J. SMITH, Hook. J. Bot. 3 (1841) 416.—*Wibelia pinnata* (CAV.) BERNHARDI ex FÉE, Gen. Fil. (1852) 331, pl. 27 bis B.—*Lindsaea pinnata* (CAV.) METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279.—Type: NÉE *s.n.*, Philippines (also incorr. cited 'Chile') (MA, *n.v.*; phot. seen).

Davallia flagellifera HOOKER & GREVILLE, Ic. Fil. (1831) pl. 183.—Type: WALLICH *s.n.*, Pulu Penang (*n.v.*).

Davallia serrata ROXB. ex GRIFF. Calc. J. Nat. Hist. 4 (1844) 514, non WILLD. (1810).—Type: ROXBURGH *s.n.*, Pulu Penang (*n.v.*).

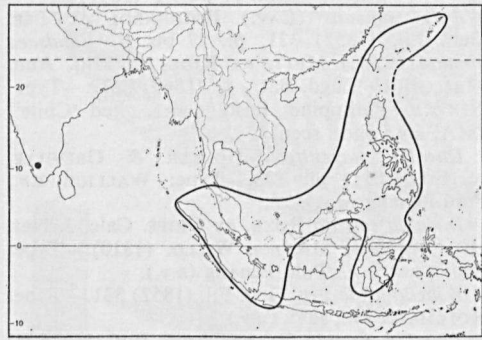
Wibelia javae FÉE, Gen. Fil. (1852) 331.—Type: KOLLMANN *s.n.*, Java (*n.v.*).

Davallia firmula BAKER, Ann. Bot. 8 (1894) 123.—*Microlepia firmula* (BAKER) C. CHR. Ind. Fil. (1906) 426.—*Tapeinidium firmulum* (BAKER) C. CHR. Ind. Fil. Suppl. 3 (1934) 176.—Type: HANCOCK 72, Barisan Range, Sumatra (K).

Rhizome short- to rather short-creeping, 2–3 mm ø; scales castaneous, with an oval basal and a long acicular uni-biseriate apical part, to *c.* 10-seriate at base, to 4 mm long. *Leaves* clustered to 1 cm apart; *petioles* stramineous to medium brown, mostly darker at base, or rarely quite dark, in adult plants 1–2 mm ø at base of lamina, abaxially at least in the upper half obtusely or more often acutely bi-angular, *c.* 10–35 cm long, ½–¾ the length of the lamina. *Lamina* oblong, acuminate, simply pinnate, *c.* 15–75 cm long, with *c.* 12–30 major pinnae to a side; rachis stramineous to pale brown, abaxially sharply carinate, the keel starting at the base through coalescence of the two angles on the petiole. *Pinnae* coriaceous, mostly olivaceous-brown when dry, ascending, sessile, narrowly lanceolate to linear, shortly and somewhat unequally cuneate at the base, subacute to acuminate, the basal ones remote, slightly or not reduced, the upper ones gradually closer but usually at least their width apart, gradually, then just below the pinnatifid leaf-apex suddenly more strongly reduced, the terminal lobe often caudate. *Major pinnae* 7–22 cm long, 0.3–0.8 cm wide, shallowly serrate or more often crenate or bicrenate when fertile, serrate or biserrate when sterile, with strongly ascending teeth; costa percurrent, abaxially elevated, stramineous, acute. Veins immersed, mostly hidden, once or twice forked, oblique. *Sori* uninerval (rarely on two adjacent vein-ends), on the acroscopic vein-branch and then

single, or on both branches, and then paired in the lobes, scarcely or not embossed. Indusium dark, subentire, pouch-shaped, ovate to transversely elongate-semi-elliptic, 0.3–1 mm long, 0.3–0.5 mm wide, falling short of the margin by its width or more. Spores medium brown, subellipsoidal to bean-shaped, smooth, *c.* 35 by 25 μ .

Distr. S. India, Thailand, Ryu Kyu Is., Taiwan; in *Malesia*: Malaya, Singapore, Riouw and Lingga Is., Banka, Sumatra, W. Java, Borneo, Celebes, Philippines. Reports from elsewhere due to confusion with *T. longipinnulum* and *T. melanesicum*. Map 2.



Map. 2 Distribution of *Tapeinidium pinnatum* (CAV.) C. CHR.

Ecol. In moist forests, often by or on rocks in streams, 50–2700 m, mostly between 500 and 1000 m. Apparently a facultative rheophyte.

Notes. Juvenile plants have relatively broader, serrate pinnae, but apart from their size they are similar to adult ones.

In Luzon there is a form with dark, often pale-margined petiole and abaxially narrowed-rounded rather than carinate rachis; the pinnae are smaller and narrower than in the typical form which is much more common on the island. A fairly uniform series of this form, JACOBS 7852 (L), would seem to indicate that it is more than an accidental, phenotypic form; but it is neither very strongly nor very sharply distinct from typical *T. pinnatum* and therefore left unnamed.

12a. *Tapeinidium biserratum* (BLUME) v.A.v.R. Handb. Suppl. (1917) 509; KRAMER, *Blumea* 15 (1968) 554; not of HOLTUM, *Rev. Fl. Mal.* 2 (1954) 339.—*Davallia biserrata* BLUME, *En. Pl. Jav.* (1828) 232.—*Microlepia biserrata* (BLUME) PRESL, *Epimel. Bot.* (1851) 97.—Type: BLUME *s.n.*, Java (L.).

The type of this 'species' is intermediate between *T. luzonicum* and *T. pinnatum*; there are 25–30 other intermediates. Their status is not clear; see KRAMER, *l.c.* They occur throughout the common range of the two species.

13. *Tapeinidium prionoides* KRAMER, *Blumea* 15 (1968) 554.—Type: BÜNNEMEIJER 1910, G. Siang, Banka (L; dupl. in BO).—Fig. 13.

Rhizome rather short-creeping, *c.* 3–4 mm ϕ ;

scales fuscous, elongate-triangular, long-acuminate, to 3 mm long, to *c.* 8-seriate at base, the uniseriate apex rather short. Leaves close; *petioles* dark stramineous to castaneous, dull, abaxially (mostly obtusely) bi-angular, upward usually pale-edged, *c.* 10–45 cm long, $\frac{2}{3}$ –1½ times the length of the lamina. *Lamina* simply pinnate, oblong, with *c.* 10–18 free pinnae to a side and a pinnatifid, basally hastate leaf-apex; rachis stramineous to dark, abaxially narrowed-rounded or sometimes carinate, at the base often shortly bi-angular. *Pinnae* coriaceous, dark olivaceous above when dry, ascending, linear, subacute to acuminate, *c.* 10–20 cm long, 4–6 mm wide, unequally cuneate at the base, the margin serrate; teeth ascending, $\frac{1}{2}$ –1 mm long, acute when sterile, \pm obtuse if soriferous, the basal acroscopic tooth often larger and slightly auricle-like. Costa stout, percurrent, mostly pale, abaxially strongly elevated, rounded to subacute; veins abaxially \pm prominulous, close, very oblique, once forked, the anterior branches running to the marginal teeth, or when fertile often both branches bearing a sorus on their connivent ends. *Upper pinnae* rather suddenly reduced. *Sori* placed in the teeth, uni- or occasionally binerval; indusium darkish, entire, $\frac{1}{2}$ –1 mm long, $\frac{1}{2}$ mm wide, almost reaching the margin. Spores light brown, ellipsoidal, smooth, *c.* 36 by 28 μ .

Distr. *Malesia*: Anambas, Riouw, and Lingga Is., Banka.

Ecol. In forests, sometimes on rocks in streams, 200–300 m.

14. *Tapeinidium acuminatum* KRAMER, *Blumea* 15 (1968) 554.—Type: ESCRITOR 21173, Palanan Bay, Luzon (L; dupl. in BO, BRI, GH, MICH, SING, US).—Fig. 14.

Rhizome rather short-creeping, 2–3 mm ϕ ; scales castaneous, lanceolate, long-acuminate, to 2½ mm long, to *c.* 10-seriate at base. Leaves close; *petioles* dark castaneous or atropurpureous, abaxially at least upward sharply bi-angular and pale-angled, *c.* 25 cm long, about as long as the lamina. *Lamina* oblong, simply pinnate, with 8–12 pinnae to a side and a conform terminal one; rachis like the upper part of the petiole or paler. *Pinnae* coriaceous, brown when dry, ascending, very narrowly lanceolate, acuminate, 10–15 cm long, 6–7 mm wide, unequally cuneate at the base, the margin shallowly and evenly crenate or sometimes biconnate. *Upper pinnae* somewhat reduced; terminal pinna conform, smaller than the larger lateral ones. Costa prominent on the abaxial side, pale, flattish; veins immersed, not evident, close, very oblique, once forked, sometimes the posterior branch forked again. *Sori* uninerval, laminal or partly extending onto the largest lobes; indusium brown, subentire, $\frac{1}{4}$ mm wide, $\frac{1}{2}$ –¾ mm long, with convex free edge and \pm convex base, $\frac{1}{4}$ mm or farther from the margin. Sporangia strongly protruding at maturity. Spores abortive.

Distr. Beside the type two doubtful collections from Sabah.

Ecol. No data.

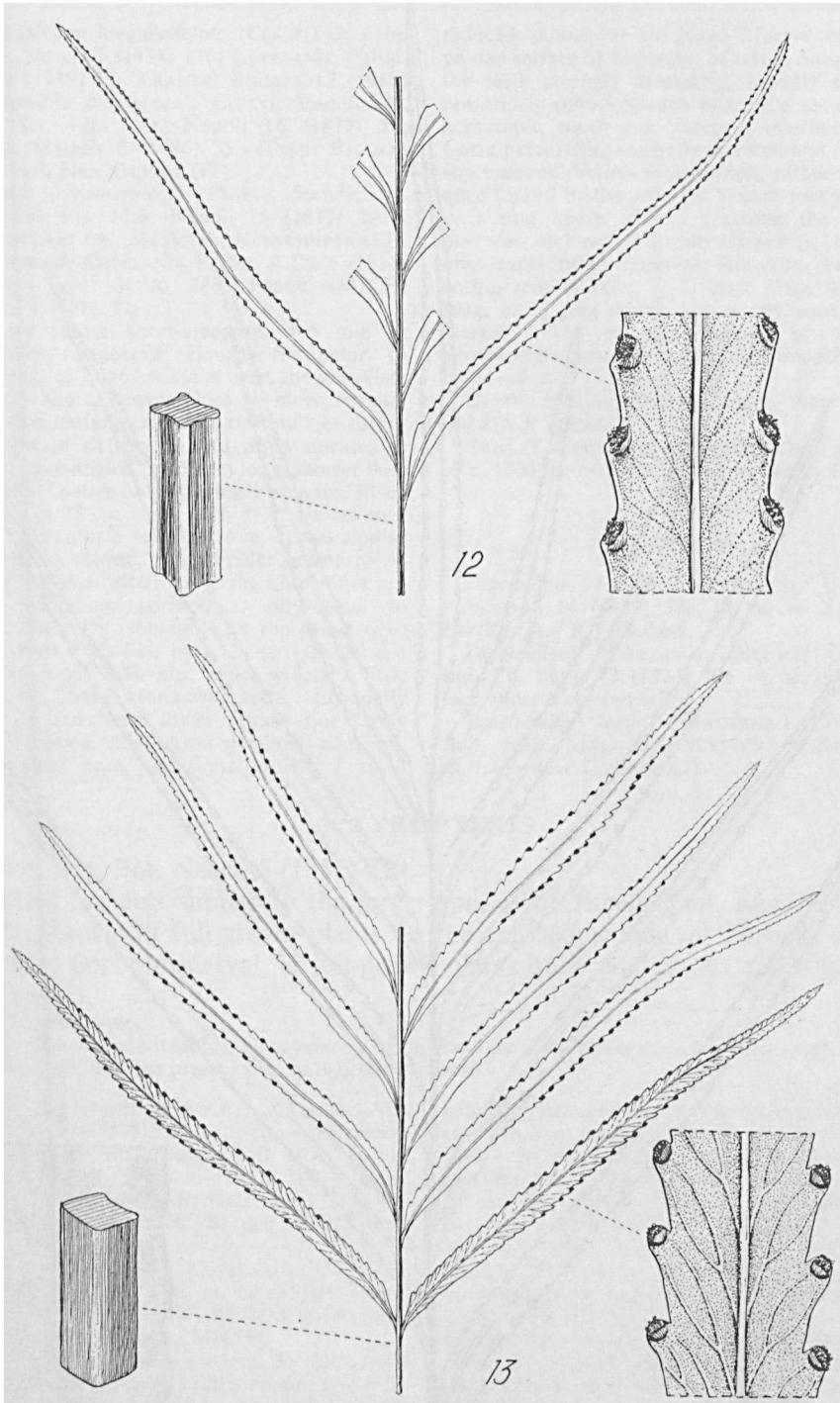


Fig. 12. *Tapeinidium longipinnulum* (CESATI) C. CHR. Basal part of lamina, $\times \frac{1}{2}$, portion of pinna, $\times 3$, portion of rachis, $\times 5$ (BAMLER ROS. 115).—Fig. 13. *T. prionoides* KRAMER. Basal part of lamina, $\times \frac{1}{2}$, portion of pinna, $\times 3$, portion of rachis, $\times 5$ (BÜNNEMEIJER 1910).

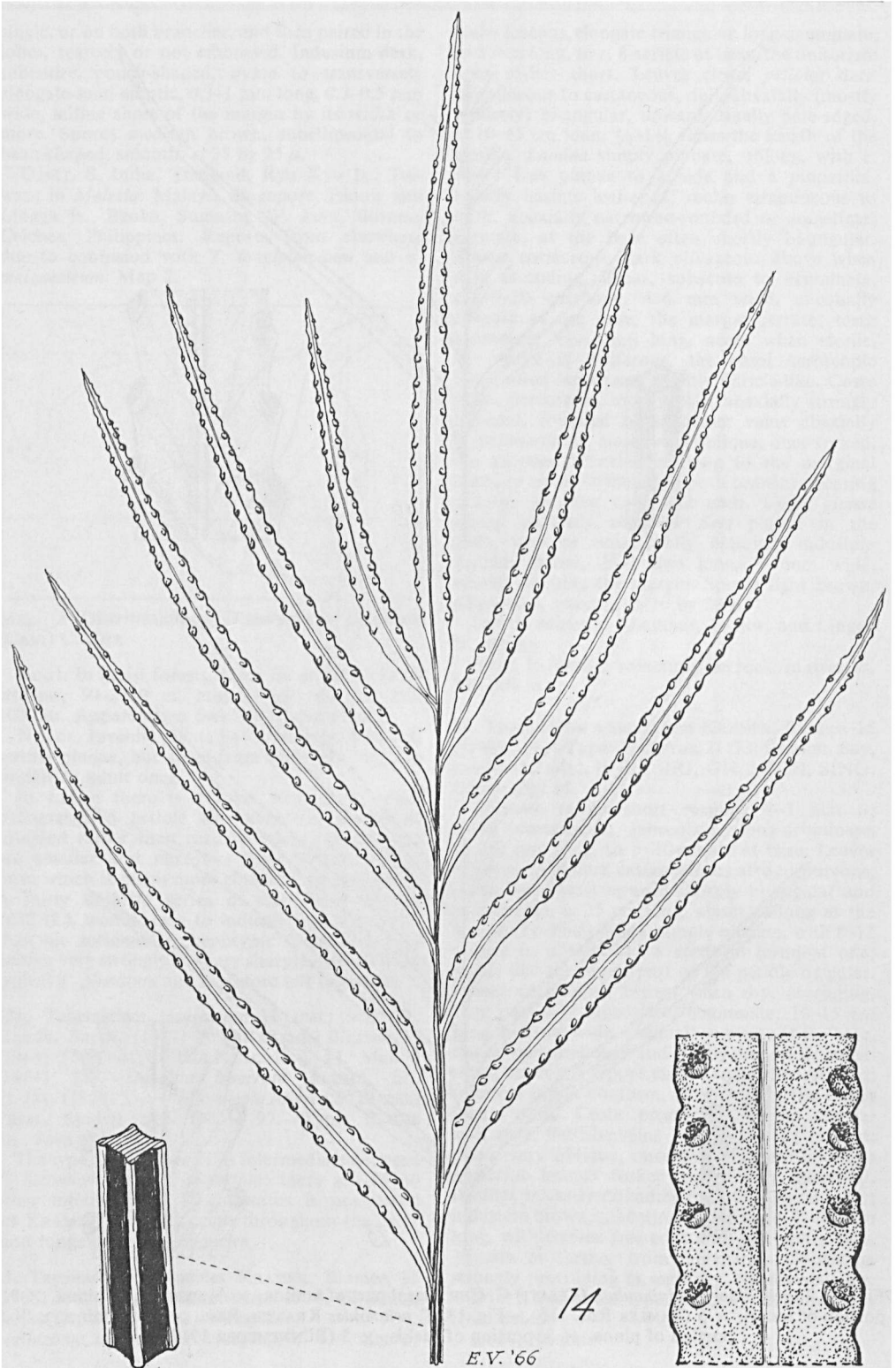


Fig. 14. *Tapeinidium acuminatum* KRAMER. Upper part of lamina, $\times \frac{1}{2}$, portion of pinna, $\times 3$, portion of rachis, $\times 5$ (ESCRITOR 21173).

15. *Tapeinidium longipinnulum* (CESATI) C. CHR. Ind. Fil. Suppl. 3 (1934) 176; COPELAND, Philip. J. Sc. 78 (1949) 23; KRAMER, Blumea 15 (1968) 555.—*Davallia longipinnula* CESATI, Rendic. R. Accad. Sci. Fis. Mat. Napoli 16 (1877) 26; BECCARI, Malesia 3 (1886) 35.—Type: BECCARI *s.n.*, Ramoi, New Guinea (FI).

Davallia intramarginalis CESATI, Rendic. R. Accad. Sci. Fis. Mat. Napoli 16 (1877) 29.—Type: BECCARI *s.n.*, Mt Arfak, New Guinea (FI).

T. marginale COPELAND, Philip. J. Sc. 6 (1911) Bot. 82.—Type: KING 283, Papua (MICH; dupl. in P).—Fig. 12.

Rhizome rather short-creeping, 4–6 mm \varnothing ; scales dark castaneous, elongate-triangular, to 5 mm long, to *c.* 16-seriate at base, the uniseriate apex very short. Leaves close to more remote; *petioles* dark castaneous to blackish, dull, quadrangular, upward sharply so and often sulcate, \pm distinctly pale-angled, 10–50 cm long, shorter than the lamina. *Lamina* oblong, simply pinnate, 30–65 cm long, 15–25 cm wide, with 8–20 pinnae to a side and a conform terminal one; rachis similar to the petiole, sulcate, upward paler and narrowly marginate. *Pinnae* alternate or the lower ones opposite, ascending, coriaceous, olivaceous to fuscous when dry, sessile or the lower ones with a short stalk-like base, linear, the largest 10–25 cm long, 7–10 mm wide, widest a little above the base, long-acuminate, unequally cuneate at the base; lower pinnae not rarely slightly reduced, the terminal pinna conform, with unequal base, occasionally with 1 or 2

reduced pinnae at its base. *Margin* of sterile pinnae serrate or biserrate, of fertile ones serrate, the teeth strongly ascending, broadly truncate, posteriorly rounded, each bearing a sorus; basal acroscopic tooth not rarely somewhat larger. Costa percurrent, abaxially elevated and rounded, stramineous. Veins often hidden, rather oblique, once forked or the anterior branch forked again, *c.* 1 mm apart, almost reaching the margin. *Sori* uni- or binerval (rarely trinerval), the upper ones most often binerval; indusium brownish, entire, semi-elliptic, $\frac{1}{2}$ –2, most often $\frac{2}{3}$ –1 mm long, *c.* $\frac{1}{3}$ mm wide, very nearly equaling the margin, often strongly bulging at maturity. Spores brownish yellow, oblong, smooth, 30–35 by 24–26 μ .

Distr. *Malesia*: Ceram, Japen, New Guinea (all Div.), Rossell I.

Ecol. Terrestrial in rain-forest, from sea level to *c.* 1500 m; often described as locally frequent.

Excluded

Tapeinidium bartlettii COPELAND, Un. Cal. Publ. Bot. 14 (1929) 376, pl. 60 = *Xyopteris stortii* (v.A.v.R.) KRAMER.

Tapeinidium moluccanum (BLUME) C. CHR. Ind. Fil. Suppl. 3 (1934) 176 = *Saccoloma sp.* (see under *T. amboynense*).

Tapeinidium tenue (BRACKENR.) COPELAND, Bull. Bish. Mus. 59 (1929) 69 = *Saccoloma sp.* (see under *T. denhamii*).

3. XYOPTERIS

KRAMER, Act. Bot. Neerl. 6 (1957) 599.

In most respects similar to the larger species of *Tapeinidium*. *Lamina* simply pinnate. *Pinnae* of full-grown plants on the acroscopic side of the base sharply auriculate. *Sori* plurinerval, in full-grown plants quite continuous and occupying all vein-ends.

Distr. Monotypic.

Note. This is undoubtedly a close relative of *Tapeinidium*. That genus is, however, so homogeneous in its short sori that the present species is better excluded.

1. *Xyopteris stortii* (v.A.v.R.) KRAMER, Act. Bot. Neerl. 6 (1957) 599, with fig.—*Schizoloma stortii* v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 36; Handb. Suppl. 1 (1917) 214.—Type: AMDJAH (v. GENDEREN STORT's coll.) 711, Mt Djempanga, Kalimantan, Borneo (BO; dupl. in K, L; fragm. in BM).

Tapeinidium bartlettii COPELAND, Un. Cal. Publ. Bot. 14 (1929) 376, pl. 60.—Type: BARTLETT 6731a, near waterfall Si Saliang, Asahan, Sumatra (dupl. in GH, L, MICH).

Rhizome rather short-creeping, in full-grown plants to 1 $\frac{1}{4}$ cm \varnothing ; scales golden-brown, elongate-triangular, acuminate, to 5 by 1 $\frac{1}{2}$ mm, to *c.* 18-seriate at base. *Petioles* close, to a few mm apart, to 40 cm long, to 1 $\frac{1}{2}$ cm \varnothing at base, more slender upward, stramineous to fawn-coloured, abaxially terete, or in young plants somewhat angular,

adaxially flattened to sulcate. *Lamina* 70 to 150 cm long, but already fertile in young plants and then *c.* 30 cm long, oblong, with up to 18 pinnae to a side; rachis like the petiole, adaxially narrowly sulcate. *Pinnae* ascending, alternate, very narrowly lanceolate, 15–30 cm long, 1 $\frac{1}{2}$ –3 cm wide, the upper ones shortened, 4–10 cm long; texture chartaceous to subcoriaceous, colour olivaceous when dry; base of (especially larger) pinnae stalk-like, to 1 cm long. *Margin* obliquely and distantly serrate in young plants, entire with only a few teeth near the apex in full-grown ones. *Lamina of pinnae* unequal at the base, the basicopic side narrower, the acroscopic side with a large acute auricle to 7 cm long, this wanting in juvenile plants. Costa median, percurrent, pale, prominent on both sides, adaxially sulcate; veins immersed, evident, very oblique, less so

outward, mostly 2 or 3 times forked, free; auricles of pinnae with a costule. *Upper pinnae* in large leaves 4–10 cm long; terminal pinna free, to c. 15 cm long, unequally and deeply trilobate, with long-acuminate lobes, the central shank much longer than the lateral ones. *Sori* plurinerval but interrupted in young, continuous in adult plants, absent only from the extreme base and apex of the pinnae and the apex of the auricle; indusium brown, entire or wavy, $\frac{1}{4}$ – $\frac{1}{3}$ mm wide, not reaching the margin by about its own width, \pm reflexed at maturity. Multicellular filiform

paraphyses present among the sporangia. Spores medium brown, monolete, bean-shaped, smooth, c. 50–60 by 30–35 μ .

Distr. *Malesia*: Sumatra (3 coll.), Borneo (Kalimantan) (type coll.).

Ecol. In ravines by streams, c. 300–500 m; presumably a rheophyte.

Note. An excellent series of specimens from Sumatra (SURBECK 49, L, U), including young as well as full-grown plants, shows that *Tapetidium bartlettii* COPELAND is the juvenile form of *X. stortii*.

4. LINDSAEA

DRYANDER in J. E. Smith, *Mém. Ac. Turin* 5 (1793) 401; *Trans. Linn. Soc.* 3 (1797) 39; HOOKER, *Sp. Fil.* 1 (1846) 203; J. SMITH, *Hist. Fil.* (1875) 267; DIELS in E. & P. *Nat. Pfl. Fam. I*, 4 (1902) 219; v.A.v.R. *Handb.* (1908) 260; *Suppl.* (1917) 202; HOLTUM, *Gard. Bull. S. S.* 5 (1930) 58; TAGAWA, *Act. Phytotax. Geobot.* 6 (1937) 24; COPELAND, *Gen. Fil.* (1947) 52; *Philip. J. Sc.* 78 (1949) 15; HOLTUM, *Rev. Fl. Mal.* 2 (1954) 321; KRAMER, *Act. Bot. Neerl.* 6 (1957) 97; CHING, *Fl. Reip. Pop. Sin.* 2 (1959) 257; KRAMER, *Blumea* 15 (1968) 557.—*Davallia* J. E. SMITH *sensu* HOOKER, *Sp. Fil.* 1 (1845) 151, *p.p.*—*Schizoloma* GAUD. *Ann. Sc. Nat.* 3 (1824) 507, *p.p.*; J. SMITH, *Hist. Fil.* (1875) 270, *p.p.*; DIELS in E. & P. *Nat. Pfl. Fam. I*, 4 (1902) 218, *p.p.*; v.A.v.R. *Handb.* (1908) 275; *Suppl.* (1917) 214; HOLTUM, *Rev. Fl. Mal.* 2 (1954) 342; CHING, *Fl. Reip. Pop. Sin.* 2 (1959) 272.—*Isoloma* J. SMITH, *Hook. J. Bot.* 3 (1841) 414; *Hist. Fil.* (1875) 227; COPELAND, *Gen. Fil.* (1947) 55; *Philip. J. Sc.* 78 (1949) 24; HOLTUM, *Rev. Fl. Mal.* 2 (1954) 336; COPELAND, *Fern Fl. Philip.* 1 (1958) 100.—*Odontoloma* J. SMITH, *Hook. J. Bot.* 3 (1841) 415, *nom. subnud.*; in Hooker & Bauer, *Gen. Fil.* (1842) pl. 114 B; FÉE, *Gen. Fil.* (1852) 329; J. SMITH, *Hist. Fil.* (1875) 269.—*Synaphlebium* J. SMITH in Hooker & Bauer, *Gen. Fil.* (1842) pl. 101; *Hist. Fil.* (1875) 268.—*Lindsaenium* (or *Lindsaynium*) FÉE, *Mém. Soc. Mus. Hist. Nat. Strasb.* 4 (1850) 201; *Gen. Fil.* (1852) 333.

The name is often misspelled '*Lindsaya*'.

Small to medium-sized, terrestrial, epilithic, scandent, or epiphytic ferns with a Lindsaeoid protostele, the xylem with an internal phloem strand, or in some small epiphytes open. Scales variable in shape, mostly entire. *Lamina* rarely simple, mostly once or twice pinnate, sometimes more dissected, to decompose, anadromous; ultimate divisions various, most often dimidiate, sometimes partly or entirely equal-sided, rarely cuneate and dichotomously divaricate. Veins free, connivent, or anastomosing without free included veinlets. *Sori* terminal on the veins, bi- to plurinerval, less often uninerval, mostly very close to the margin. Indusium short, roundish, ovate, or hippocrepiform and then free at the sides, or more elongate, and laterally free or adnate, rarely fugacious. Bicellular filiform paraphyses present in some, probably in all species. Spores trilete or (very rarely in the Old World species) monolete.

Type species: *Lindsaea trapeziformis* DRYANDER (neotropical).

Distr. About 150 *spp.*, $\frac{2}{3}$ in the Old World, but few in continental Africa; extending north to Japan, south to Tasmania, east to the Marquesas.

Descriptive terms. In accordance with the terminology used earlier in the *Lindsaea* group (KRAMER, 1957) the term 'pinnule' is always used for an ultimate free division, regardless of the degree of dissection

of the lamina which bears it, except in some species of *sect. Schizoloma*, in which there are transitions from simple entire primary pinnae to pinnate ones. If the division is not entirely free it is called a segment. The length of a sorus is always measured at right angles to the vein(s) bearing it, its width parallel to (in prolongation of) the vein(s).

SUBDIVISION OF THE GENUS

The subgenera of *Lindsaea*, as proposed in the past, proved as a whole unsatisfactory. Too much value was attached to such characters as the shape of the pinnules and their venation and the length of the sori. Some of the subgenera defined on such characters were even raised to generic rank. It seems that these features are useful, together with several others, for distinguishing species, or sections at the most. It can be demonstrated, for instance, that anastomosing veins have independently arisen in four groups of species, here treated as sections *Synaphlebium*, *Schizoloma*, *Lindsaenium*, and *Penna-arborea*, respectively. A feature of much more fundamental importance seems to be the morphology and anatomy of the rhizome. This led to the distinction of two clear-cut groups, treated as subgenera (KRAMER, *Blumea* 15, 1968, 557 *seq.*). Apparently natural, but not necessarily entirely sharply defined groups of species are treated as sections under these two subgenera. The number of characters available at present for defining these groups is relatively small in the *Lindsaea* group, these rather primitive ferns being of simpler structure than most other leptosporangiate ferns. As in some species, notably in *sect. Schizoloma* and *sect. Synaphlebium*, not all specimens show the sectional characters very clearly, the key to the species has not primarily been constructed on the basis of the sections, although in many instances most or all species of a section will be found together.

SYNOPSIS OF MALESIAN SUBGENERA AND SECTIONS

1. Rhizome essentially terrestrial, short- to moderately long-creeping, the stele radially symmetric or nearly so. SUBG. LINDSAEA.
 2. Lamina bi-(tri-)pinnate, with the upper pinnae gradually reduced, a conform terminal pinna wanting; or simply pinnate (rarely simple), with equal-sided pinnules and anastomosing veins (one species with combinations of both possibilities). *Spp.* 1-8 1. *Sect. Schizoloma*
 2. Lamina bipinnate, with a conform terminal pinna; or simply pinnate, with free veins, or, if the veins are anastomosing, with dimidiate pinnules.
 3. Lamina simply pinnate, with \pm equal-sided pinnules; rachis \pm sclerotic.
 4. An articulation at the base of each pinnule. *Spp.* 36-41 8. *Sect. Isoloma*
 4. No articulations at the pinnule-bases. *Sp.* 35 7. *Sect. Psammolindsaea*
 3. Lamina bipinnate, or, if simply pinnate, with dimidiate pinnules; rachis various.
 5. Lamina simply pinnate, the rachis strongly sclerotic, abaxially sharply carinate. *Sp.* 34.
 6. *Sect. Tropidolindsaea*
 5. Lamina bipinnate, or, if simply pinnate, the rachis not simultaneously sclerotic and abaxially carinate.
 6. Veins anastomosing, sometimes only irregularly. *Spp.* 15-30 3. *Sect. Synaphlebium*
 6. Veins free.
 7. Spores monoletic; lamina simply pinnate, with abaxially rounded rachis and (except in small forms) interrupted sori. *Sp.* 33 5. *Sect. Osmolindsaea*
 7. Spores triletic; if lamina simply pinnate and rachis abaxially rounded, the sori continuous.
 8. Lamina simply pinnate, basally distinctly reduced and/or with more widely spaced pinnules; petiole and rachis abaxially bi-angular; pinnules not more than twice as long as broad, or, if longer, deeply incised. *Spp.* 42-43 9. *Sect. Stenolindsaea*
 8. Lamina bipinnate, or, if simply pinnate, basally not reduced nor with remote pinnules and the axes abaxially terete.
 9. Sori continuous; pinnules entire. *Spp.* 31-32 4. *Sect. Lindsaea*
 9. Sori interrupted, pinnules \pm incised. *Spp.* 9-14. 2. *Sect. Temnolindsaea*
 1. Rhizome epiphytic, long-creeping, the stele strongly dorsiventral. SUBG. ODONTOLOMA.
 10. Rhizome wiry, not over 1 1/4 mm thick, with an open xylem strand, deciduously scaly, more persistently so only near the petiole bases, lustrous when naked. Leaves simply pinnate. Veins free or anastomosing. *Spp.* 60-62 13. *Sect. Penna-arborea*
 10. Rhizome 1-2 mm or more thick (except in a few small species), with a closed xylem strand, more persistently scaly, not lustrous when naked. Leaves simply pinnate, free-veined, or bipinnate, free- or reticulate-veined.
 11. Lamina simply pinnate, the rachis on the adaxial side not grooved to the base (exc. often in *L. capillacea*). *Spp.* 44-51 10. *Sect. Odontoloma*
 11. Lamina bipinnate, in some species occasionally also simply pinnate leaves present, these with the rachis on the adaxial side grooved to the base.
 12. Pinnules entire, with uninterrupted sori. *Sp.* 52. 11. *Sect. Pseudolancea*
 12. Pinnules incised, with interrupted sori, or with only one short sorus near the apex, otherwise sterile. *Spp.* 53-59 12. *Sect. Lindsaenium*

KEY TO THE SPECIES

1. Lamina pinnate + deeply pinnatifid, bipinnate, or more compound, without conform terminal pinna, the upper (primary) pinnae gradually reduced (fig. 20, 21) Group A
1. Lamina simple, simply pinnate, or, if bipinnate or subtripinnate, with a conform terminal pinna sharply set off from the upper lateral pinnae.
2. Ultimate free divisions not, or only a very short basal portion, dimidiate.
3. Veins anastomosing, sometimes irregularly so Group A
3. Veins quite free.
4. Leaf-apex and pinna-apices or the entire pinnae triangular or rhombic-triangular, acuminate 5. *L. javanensis*
4. Leaf- and pinna-apices otherwise.
5. Pinnules articulate with the rachis Group E
5. Pinnules continuous with the rachis (*sect. Psammolindsaea*) 35. *L. walkerae*
2. Ultimate pinnules dimidiate.
6. Rhizome long-creeping, epiphytic or scandent, with remote leaves; stele dorsiventrally symmetric Group G
6. Rhizome short-creeping, terrestrial, or exceptionally longer and sometimes epiphytic (in case of doubt both choices will lead to the correct species), with radially or nearly radially symmetric stele.
7. Veins free.
8. Sori continuous in fully fertile pinnules.
9. Petiole pale, abaxially terete; or, if upward obtusely bi-angular, the upper pinnules little reduced, the terminal segment (pinnule) large, hastate, and the larger pinnules 2 cm or more long and over twice as long as wide Group D
9. Petiole pale or dark, abaxially bi-angular; upper pinnules much reduced, the terminal segment small, not hastate; or the larger pinnules smaller and not over 1½ times as long as wide.
10. Larger, basal pinnules asymmetrically suborbicular, only the basal half dimidiate (fig. 15); simply pinnate sterile leaves with sharply dentate pinnules often present 3. *L. orbiculata*
10. Pinnules entirely dimidiate, not suborbicular; sterile leaves not usually present, their pinnules not sharply dentate Group C
8. Sori interrupted in fully fertile pinnules.
11. Simply pinnate; rachis abaxially rounded or narrowed-rounded; spores monolete (*sect. Osmolindsaea*) 33. *L. odorata*
11. Simply pinnate; rachis abaxially keeled; spores trilete (*sect. Tropidolindsaea*) 34. *L. adiantoides*
11. Simply pinnate, with abaxially bi-angular rachis; or bi-(subtri-)pinnate; spores trilete.
12. Simply pinnate; pinnules up to 2½ times as long as wide; lamina basally mostly at least somewhat reduced Group F
12. Simply pinnate; at least some pinnules over 2½ times as long as wide; lamina truncate at the base Group C*
12. Bipinnate Group B*
7. Veins anastomosing Group C

Group A (*sect. Schizoloma*)

1. Veins free.
2. Pinnae in the basal part with segments only on the acroscopic side, in the apical part on both sides (fig. 19); lamina pinnate + deeply pinnatifid. 1. *L. hemiacroscopica*
2. Pinnae equal-sided, or basiscopically more compound than acroscopically; simply pinnate with entire pinnules, bipinnate, or more compound.
3. Terminal segment of lateral pinnae narrow, acute, small in comparison to the pinnules next to it (fig. 21); indusium not or scarcely erose, falling short of the margin by less than half its width 2. *L. bouillodii*
3. Terminal segment of lateral pinnae broad, rhombic, obtuse, or sometimes acuminate-caudate, large in comparison to the pinnules next to it; or lamina simply pinnate; indusium falling short of the margin by more than half its width (except often in *L. javanensis*).
4. Terminal segment of lateral pinnae (if any) as large as or often much larger than the basal pinnules of that pinna, rhombic to caudate-rhombic; no simply pinnate leaves with sharply dentate pinnules present beside the fertile ones; texture herbaceous to chartaceous; petiole dark, abaxially at least upward obtusely or usually acutely bi-angular 5. *L. javanensis*
4. Terminal segment of lateral pinnae about as large as the larger basal pinnules of that pinna, flabellate, suborbiculate (fig. 16); texture subcoriaceous to coriaceous; petiole dark, abaxially mostly rounded; sterile leaves with crenate pinnules often present. 4. *L. gomphophylla*

* In case of doubt both ways will lead to the correct species.

- 4. Terminal segment of lateral pinnae (if any) smaller than the larger basal pinnules of that pinna, rhombic, obtuse; texture herbaceous to chartaceous; petiole pale to dark, abaxially at least upward sharply bi-angular; unipinnate sterile leaves with sharply dentate pinnules often present 3. *L. orbiculata*
- 1. Veins anastomosing, sometimes irregularly so and then some pinnules quite free-veined.
- 5. Larger secondary pinnules dimidiate, trapezoidal; pinnae without a large lanceolate undivided apical portion 6. *L. media*
- 5. Free secondary pinnules (if present) flabellate, not dimidiate; pinnae entire or with a large lanceolate undivided apical portion.
- 6. Veins even in larger pinnae (pinnules) irregularly anastomosing; upper (primary) free pinnules relatively wide, c. 1-3 times as long as wide 7. *L. heterophylla*
- 6. Veins regularly anastomosing, except in small secondary pinnules (if present); upper (primary) pinnules mostly relatively narrower 8. *L. ensifolia*

Group B (sect. *Temnolindsaea*)

- 1. Petiole and rachises abaxially keeled 14. *L. tenuifolia*
- 1. Petiole and rachises abaxially bi-angular, rarely only obscurely so.
- 2. Basal (primary) pinnae strongly reduced (fig. 25) 9. *L. kingii*
- 2. Basal pinnae hardly or not reduced.
- 3. Pinnules incised beyond 3/4 of their width, with capillary segments 0.2-0.4 mm wide, wider at the sorus, the wing connecting them as wide (fig. 28); sori uninerval 13. *L. polyctena*
- 3. Pinnules at the base incised beyond the middle, the segments not capillary, 0.3-0.8(-1) mm wide, connected by a wing of 1/2-1 mm; sori very predominantly uninerval 12. *L. tetragona*
- 3. Pinnules at the base not incised to the middle, the segments 0.8 mm wide or more; sori usually on more than one vein (except in *L. tetragona*).
- 4. Outer incisions of the pinnules reaching to the middle; lobes longer than broad.
- 5. Sori uni- or binerval; largest pinnules 10-12 mm long 12. *L. tetragona*
- 5. Sori bi- or trinerval; largest pinnules 7-8 mm long. 10. *L. multisora*
- 4. No incisions reaching beyond 1/4 of the width of the pinnules; lobes broader than long.
- 6. Veins 1 mm apart 11. *L. natunae*
- 6. Veins 1/2 mm or less apart see Group C

Group C (sect. *Synaphlebium*)

- 1. Veins of larger fertile pinnules irregularly anastomosing, sometimes almost or even quite free (see also 3. *L. orbiculata*).
- 2. Sori continuous; pinnules narrowed from base to apex, 5-15 mm long, 2-2 1/2 mm wide; veins adaxially impressed, abaxially prominulous; larger pinnules rarely entirely free-veined; sterile pinnules sinuate-dentate; petioles rarely pale, usually brown, abaxially obtusely to acutely bi-angular 27. *L. crispa*
- 2. Sori continuous or interrupted, the incisions of the pinnules not reaching 1 mm deep in fully fertile pinnules; pinnules very little narrowed close to the apex, 10-12 mm long, 3-4 mm wide, often 3 1/2-4 times as long as wide; veins immersed; pinnules often quite free-veined; petiole pale, abaxially flat or convex, bi-angular, the angles evanescent downward; sterile pinnules broadly crenate-sinuate 16. *L. napaea*
- 2. Sori interrupted; pinnules scarcely narrowed to the apex, 10-20 mm long, 4-6 mm wide, their incisions to 1 mm deep; veins immersed; pinnules often without any anastomoses; petiole pale, abaxially angular to the base, at least near the apex sulcate; sterile pinnules bicrenate. 15. *L. malayensis*
- 1. Veins of larger fertile pinnules regularly anastomosing, at least in the basal half of the pinnules.
- 3. Sori of larger, fully fertile pinnules continuous.
- 4. Upper pinnules little reduced, ± half as long as the larger ones; terminal segment comparatively large, lanceolate, free or nearly so (fig. 32b).
- 5. Pinnules twice as long as wide; petiole usually reddish brown 25. *L. integra*
- 5. Pinnules 2 1/2-3 times as long as wide; petiole stramineous 23. *L. cultrata*
- 4. Upper pinnules strongly reduced, some denticuliform ones connected with the narrow pinna-apex.
- 6. Pinnules not over twice as long as wide.
- 7. Larger pinules 5-7 mm long, 3-4 mm wide; pinnae strongly ascending; outer veins, in small pinnules sometimes all or nearly all veins free; never 2 series of areoles 20. *L. ramosii*
- 7. Larger pinnules 9-15 mm long, 4-7 mm wide; pinnae laxly ascending; veins regularly anastomosing; not rarely two series of areoles between lower and upper margin 26. *L. azurea*
- 6. Pinnules 2 1/2 to over 3 times as long as wide.
- 8. Larger pinnules 16-20 mm long 24. *L. papuana*
- 8. Larger pinnules to 12 mm long 16. *L. napaea*
- 3. Sori of larger pinnules interrupted by incisions of the margin.

9. Terminal pinnule free, cuneate or cuneate-flabellate (fig. 34); rhizome not very short-creeping.
10. Sori bi- to trinerval; pinnules translucent; terminal pinnule narrowly cuneate or with 2 narrowly cuneate divisions 30. *L. modesta*
10. Sori quadri- to plurinerval; pinnules opaque; terminal pinnule flabellate 29. *L. obscura*
9. Terminal segment narrow, connected with some denticuliform upper pinnules, or, if \pm free, triangular, acute.
11. Pinnules 2-3½ cm long, 3-3½ times as long as wide; simply pinnate 17. *L. subalpina*
11. Pinnules under 2 cm long, not over 3 times as long as wide; lamina usually bipinnate.
12. Pinnules opaque, hardly narrowed to the obliquely truncate apex; outer margin distinct, with an incision; pinnae rather suddenly narrowed below the \pm caudate, pinnatifid apex (fig. 29); pinnule-bearing rachises abaxially brown, sulcate and pale-margined. 22. *L. paralelogramma*
12. Pinnules with subacute to rounded apex, and/or distinctly narrowed to apex; or, if truncate, the outer margin not incised; pinnules often translucent; pinnae more gradually narrowed; pinnule-bearing rachises various.
13. Pinnules twice as long as broad, to 5 mm long. 28. *L. hewittii*
13. Pinnules more elongate, or, if not, at least 7 mm long.
14. Pinnae (if any) strongly ascending; pinnules 7-10 by 3½-5 mm, 1½-2½ times as long as wide; indusium not reaching the margin by more than half its width 19. *L. longifolia*
14. Pinnae (if any) not strongly ascending; pinnules larger, or, if 10 mm or less long, over 2½ times as long as wide, or the indusium closer to the margin.
15. At least the inner incisions reaching to ⅓ or ½ of the width of the pinnules; pinnules translucent; all lobes and receptacles distinctly convex; indusium reaching the margin or very nearly so. 21. *L. lobata*
15. Pinnules more shallowly incised, or, if the inner incisions reach ⅓, the pinnules not translucent, or the inner or all lobes and receptacles straight.
16. Pinnules usually with the upper margin convex, the lower concave, *i.e.*, slightly falcately decurved; a distinct outer margin present, joining the upper at an angle of less than 90°, its sorus mostly continuous with the outermost one of the upper margin; at least the inner incisions reaching considerably beyond the receptacle 23. *L. cultrata*
16. Pinnules usually as above; a distinct outer margin wanting, rounded into the upper; most or all incisions reaching considerably beyond the receptacle 18. *L. obtusa*
16. Pinnules usually with both margins straight or faintly convex; no distinct outer margin developed, rounded into the upper; incisions reaching to the level of the receptacle or shallower 16. *L. napaea*

Group D (*sect. Lindsaea*)

1. Pinnules to 11 mm long, to 5 mm wide 31. *L. borneensis*
1. Pinnules to 20(-35) mm long, to 6(-13) mm wide 32. *L. doryphora*

Group E (*sect. Isoloma*)

1. Pinnules 5 times or more as long as broad, 3-4 mm wide (apart from basal auricles), with contiguous bases 41. *L. divergens*
1. Pinnules relatively much shorter, or, if up to 5 times as long as wide, 8 mm wide (apart from basal auricles) and at least in the basal half of the lamina not contiguous.
2. Pinnules suborbicular, not more than 1 mm longer than broad, coriaceous, not auricled; rachis black, lustrous 40. *L. jamesonioides*
2. Pinnules ovate to lanceolate, the difference between length and width greater; at least some pinnules distinctly auricled; rachis brown to black, lustrous or not.
3. Rachis blackish, lustrous, abaxially keeled to the base; upper pinnules little or not reduced, terminal division free 37. *L. ovata*
3. Rachis not blackish and lustrous, or, if so, not keeled to the base; upper pinnules reduced, some confluent with the terminal segment.
4. Rachis dull, medium to dark reddish brown, rarely darker or lustrous; pinnules obtuse or rarely subacute, the larger ones 7-18 mm long, up to 2½ times as long as wide 36. *L. gueriniana*
4. Rachis lustrous, reddish to dark brown; pinnules obtuse, the larger ones 5-8 mm long, less than 1½ times as long as wide 39. *L. philippinensis*
4. Rachis dull, dark brown; pinnules acute or rarely subacute, the larger ones 18-30 mm long, to 4 times as long as wide 38. *L. pellaeiformis*

Group F (*sect. Stenolindsaea*)

1. Pinnules entire, or, if incised, the inner incisions of larger pinnules not going beyond the middle 42. *L. lucida*
1. Pinnules incised far beyond the middle 43. *L. bakeri*

Group G (subg. *Odontoloma*)

1. Rhizome wiry, not over 1¼ mm ø, deciduously scaly, eventually naked, dark brown to blackish, polished, with open xylem strand; lamina simply pinnate but the pinnules sometimes incised (*sect. Penna-arborea*).
2. Veins anastomosing; larger pinnules 1½–3 cm long; few or no upper pinnules strongly reduced.
3. Terminal segment narrow, lanceolate or caudate (fig. 38) 61. *L. wernerii*
3. Terminal pinnule broad, obtuse, cuneate or flabellate. Group C
2. Veins free, or, if anastomosing, the largest pinnules less than 1½ cm long; upper pinnules gradually and strongly reduced.
4. Pinnules deeply pinnatifid, the segments connected by wings ¼–½ mm wide (fig. 23) 62. *L. roemeriana*
4. Pinnules shallowly incised, or, if more deeply incised, the lobes much more broadly connected. 60. *L. pulchella*
1. Rhizome not wiry, 1½–2 mm ø, or, if thinner, not polished when naked, with closed, strongly dorsiventral xylem strand.
5. Lamina always simply pinnate (species where this character fluctuates can be keyed out both ways).
6. Lamina truncate at the base, with a well-developed petiole and few or no reduced basal pinnules; pinnules incised considerably beyond the receptacle.
7. Veins anastomosing Group C
7. Veins free.
8. Pinnules very regularly incised (fig. 50); sori distinctly intramarginal, mostly uni-, some binerval. 47. *L. apoensis*
8. Pinnules irregularly incised; sori uni- to quadrinerval, very close to the margin, the sporangia often spreading beyond it at full maturity 46. *L. repens*
6. Lamina gradually and strongly narrowed at the base, the petiole often very short or virtually absent; pinnules subentire to variously incised.
9. Pinnules incised far beyond the middle; sori uni- or binerval.
10. Pinnule-lobes truncate, their outer margin erose to corniculate (fig. 46, 47).
11. Rhizome ½ mm ø; ultimate pinnule-lobes 0.4–0.8 mm wide near the apex, there laterally with two horn-like projections 0.3–0.4 mm long (fig. 46); sori uninerval. 51. *L. capillacea*
11. Rhizome ¾–2 mm ø; ultimate pinnule-lobes ½–2 mm wide near the apex, there laterally without, or with rudimentary horn-like projections (fig. 47); sori not rarely binerval 50. *L. fissa*
10. Pinnule-lobes rounded or narrowed to subacute, not truncate.
12. Pinnule-lobes 0.3–1 mm wide, nearly all of them once or twice bifid, joined by wings of less than ½ mm width (fig. 48). 49. *L. carvifolia**
12. Pinnule-lobes 1 mm or more wide, joined by wings of 1 mm or more (fig. 49) 44. *L. glandulifera*
9. Pinnules subentire to incised to the middle; sori uni- to plurinerval.
13. Sori continuous (shortly interrupted in very shallowly incised, incompletely fertile pinnules); rhizome scales chocolate brown 45. *L. oblanceolata*
13. Sori interrupted (beware of old, abundantly fertile pinnules where the sori may be confluent); scales golden brown (darker in some varieties of *L. repens* with more deeply incised pinnules).
14. At least some of the fertile lobes denticulate or erose; sterile lobes acute, tooth-like (fig. 42). 48. *L. merrillii*
14. Fertile lobes not denticulate, erose, or tooth-like, but truncate, rounded, or narrowed-rounded.
15. Larger pinnules 10–12 mm long; pinnules incised to ⅓ or ½, the lobes evenly narrowed from base to apex (fig. 49) 44. *L. glandulifera*
15. Larger pinnules 15 mm or more long, with truncate or apically rounded lobes, or, if shorter, much less deeply incised, or the lobes ± parallel-sided. 46. *L. repens***
5. Lamina of all, most, or at least some leaves bipinnate.
16. Sori continuous 52. *L. parasitica*
16. Sori interrupted.
17. Secondary rachises abaxially rounded 54. *L. monocarpa*
17. Secondary rachises abaxially carinate 55. *L. sarawakensis*
17. Secondary rachises abaxially bi-angular (and/or sulcate) at least in the upper half.
18. Pinnules coriaceous; veins sometimes anastomosing 53. *L. rigida*
18. Pinnules herbaceous or chartaceous.
19. Pinnules shallowly incised, at the most to the receptacle or slightly beyond, never to the middle.

* Simply pinnate forms of *L. rosenstockii* and *L. versteegii* will also run to this heading. The former has only the basal pinnule-lobes bifid, the latter has more divergent lobes (see fig. 39 and 40).

** Simply pinnate forms of *L. microstegia* will also run here; their basal pinnules are inserted on the edge of the adaxial face of the rachis, not below it, as in *L. repens*.

20. Adaxial groove of the primary rachis broad, occupying half of its width or more; most pinnules fertile only near the apex; veins sometimes anastomosing; indusium not reaching the margin by less than its width; bipinnate 53. *L. rigida**
20. Adaxial groove of the primary rachis narrow, occupying much less than half its width; most pinnules entirely fertile; veins free; indusium not reaching the margin by less than its width; bipinnate 56. *L. regularis*
20. Adaxial groove of the primary rachis narrow, occupying much less than half its width; most pinnules entirely fertile; veins free; indusium not reaching the margin by $1\frac{1}{2}$ -3 times its width; not rarely simply pinnate leaves present alongside the bipinnate ones 57. *L. microstegia*
19. Pinnules incised considerably beyond the middle.
21. Segments capillary, c. $\frac{1}{5}$ - $\frac{1}{4}$ mm wide, all forked. 59. *L. versteegii*
21. Segments not capillary $\frac{2}{3}$ -2 mm wide, the outer ones often not forked 58. *L. rosenstockii*

Subgenus *Lindsaea*

1. Section *Schizoloma*

(GAUD.) KRAMER, Act. Bot. Neerl. 15 (1967) 571.—*Schizoloma* GAUD. Ann. Sc. Nat. 3 (1824) 507.

Type species: *Schizoloma billardieri* GAUD. (= *Lindsaea ensifolia* SWARTZ).

Distr. Pantropic, extending far into the temperate zone in Japan, Australia, and New Zealand. Many species concentrated in Madagascar.

Taxon. The short-creeping rhizome and the lamina lacking a conform terminal pinna characterize nearly all species. *L. orbiculata* (LAMK) METT. ex KUHN is sometimes only simply pinnate, and *L. ensifolia* SWARTZ ssp. *ensifolia* is simply pinnate with a conform non-dimidiolate terminal pinna, but otherwise the section is quite clear-cut. It seems to be the most primitive in the genus, with the possible exception of the New Caledonian sect. *Davalliastrum*. Several other subdivisions of the genus comprise one or a few species that show definite affinity with sect. *Schizoloma*; among the most interesting are some Madagascan species with the rhizome of subg. *Odontoloma* but a *Schizoloma*-like leaf architecture.

1. *Lindsaea hemiacroscopica* KRAMER, Blumea 15 (1968) 563.—Type: HALLIER 3244, Mt Amai Ambit, Borneo, Kalimantan (BO).—Fig. 19.

Rhizome short-creeping, c. 0.6 mm ϕ ; scales reddish brown, c. $\frac{1}{3}$ cm long, narrowly lanceolate, biseriate at base, the apical uniseriate part consisting of 1-3 cells. Leaves close; *petioles* 2-4 cm long, somewhat shorter than the lamina, adaxially pale, channelled, abaxially dark brown, sharply bi-angular with narrowly paler edges and flat faces, subterete at base. *Lamina* herbaceous, olivaceous when dry, ovate with truncate base, to 5-6 cm long, 3-4 $\frac{1}{2}$ cm wide, pinnate + deeply pinnatifid, without conform terminal pinna. *Major pinnae* c. 10 to a side, spreading or slightly ascending, less than their width apart, the larger ones 20 by 7 mm, acuminate, inequilateral, deeply pinnatifid. Segments cuneate to ligular, 2 or in larger pinnae 3 on the acroscopic side, 3-4 by 2 mm, with only a very narrow wing on the opposite, basicopic side; upper segments of acroscopic and all (or all but one) of basicopic side narrowly cuneate, all narrowed at base and connected by wings of leaf-tissue; uppermost pinnae and segments reduced, confluent. Apex of segments rounded-truncate, entire or sinuate; sterile segments often subacute. Largest segments often bilobed. Costae evident, stramineous; veins immersed, evident, single or in larger lobes paired, one sometimes forked. *Sori* uni-

to trinerval; indusium greyish, $\frac{1}{2}$ -1 $\frac{1}{2}$ mm long, 0.4 mm wide, suborbicular to oblong, free at the narrowed sides, subentire, not reaching the margin by a little less than its width, not reflexed at maturity. Spores medium brown, trilete, smooth, c. 22 μ .

Distr. Only known from type collection. No ecological data.

2. *Lindsaea bouillodii* CHRIST, Not. Syst. 1 (1909) 59.—Type: BOUILLOD 48, Cam-chay Mts, Cambodia (P).

L. orbiculata (LAMK) METT. ex KUHN var. *odontosorioides* COPELAND, Philip. J. Sc. 6 (1911) Bot. 138.—Type: BROOKS 19, Tringos, Sarawak (MICH).

L. orbiculata (LAMK) METT. ex KUHN var. *sumatrana* ROSENSTOCK in Fedde, Rep. 13 (1914) 214.—Type: WINKLER 55 (Ros.-exs. 117), Batak Lands, Sumatra (S-PA; dupl. in BM, L, P).

L. cambodgensis auct. non CHRIST; KRAMER, Blumea 15 (1968) 563.

L. tenera auct. non DRYAND. (or *Schizoloma tenerum*) of other authors, e.g., HOLTUM, Gard. Bull. S. S. 5 (1930) 64; Rev. Fl. Mal. 2 (1954) 348, f. 201.—Fig. 21.

Rhizome moderately to very short-creeping, $1\frac{1}{2}$ -2 mm ϕ ; scales ferruginous, very narrowly triangular, to 2 $\frac{1}{2}$ mm long, to 5-seriate at base, with long uniseriate apex. Leaves close to cluster-

* Epiphytic specimens with unusually long rhizomes of species of sect. *Synaphlebium* (Group C) will run to this heading; they have regularly anastomosing veins.

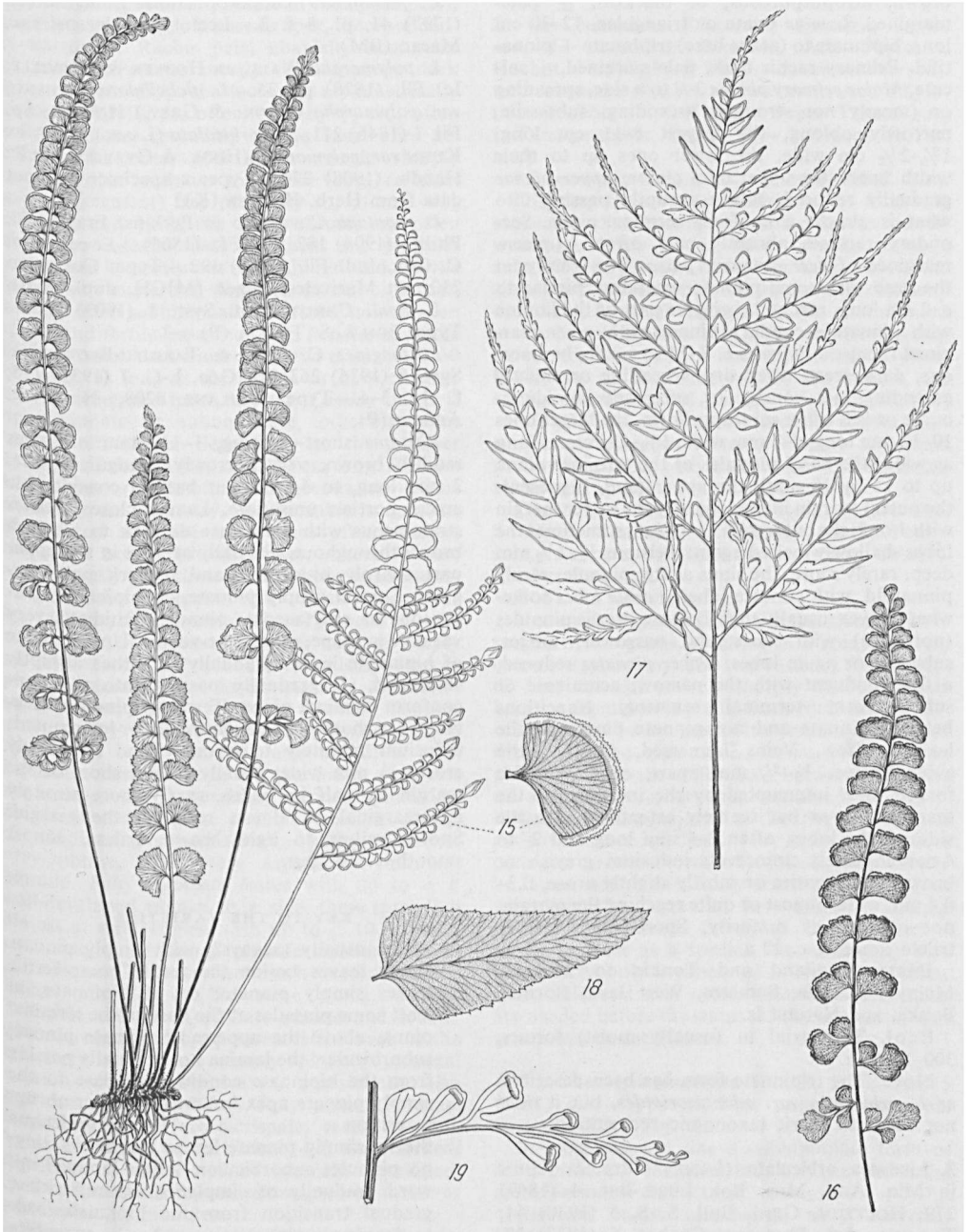


Fig. 15. *Lindsaea orbiculata* (LAMK) METT. ex KUHN var. *orbiculata*. Plant, $\times \frac{1}{3}$, pinnule, $\times 1\frac{1}{4}$ (TANAKA & SHIMADA 13522).—Fig. 16. *L. gomphophylla* BAKER. Lamina, $\times \frac{1}{3}$ (HOSE? s.n., SAR).—Fig. 17–18. *L. heterophylla* DRYAND.: fig. 17. Lamina, $\times \frac{1}{3}$ (BAKHUIZEN VAN DEN BRINK 7153): fig. 18. Sterile pinnule, nat. size (PETERSEN s.n., L).—Fig. 19. *L. hemiacroscopica* KRAMER. Basal pinna, $\times 2$ (HALLIER 3244).

ed; *petioles* 8–40 cm long, to 1½ times as long as the lamina, sharply quadrangular, dark reddish brown, atropurpureous, or blackish, ± pale-margined. *Lamina* ovate or triangular, 12–30 cm long, bipinnate to (at the base) tripinnate + pinnatifid. Primary rachis dark, pale-margined, ± sulcate. *Major primary pinnae* 3–8 to a side, spreading or (mostly not strongly) ascending, subsessile, narrowly oblong, the largest 8–11 cm long, 1¾–2½ cm wide, the lower ones up to their width apart, the upper ones closer; *upper pinnae* gradually reduced, rather abruptly passing into what is almost a conform terminal pinna. Secondary rachises abruptly pale, often ± green-margined. *Lower primary pinnae* not rarely at the base with some pinnate secondary pinnae to c. 2 cm long, rarely the greater part of the lamina with pinnate secondary pinnae with green-margined rachises. *Pinnules* c. 7–12 to a side, herbaceous, dark green when dry, spreading or slightly ascending, not contiguous, subsessile, dimidiate-ovate or less often subtrapeziform, the larger ones 10–13 mm long, 5–7 mm wide, 1½–2 times as long as wide (the basal pinnules of the terminal pinna up to 15 by 10 mm), the upper (and, if present, the outer) margin incised, mostly the upper margin with 1 or 2, the outer with 1 incision, sometimes the lobes shallowly incised again; incisions ½–1½ mm deep, rarely more, the sinus acute; pinnules rarely pinnatifid, with cuneate lobes. *Fertile lobes* somewhat convex, usually slightly erose; sterile pinnules (not rare) with more and narrower, longer, subacute or acute lobes. *Upper pinnules* reduced, a few confluent with the narrow, acuminate or subcaudiform terminal segment; transitions between pinnate and non-pinnate pinnae in the leaf-apex few. Veins immersed, mostly little evident, free, ½–⅔ mm apart, once or twice forked. *Sori* interrupted by the incisions of the margin, convex but scarcely extending onto the sides of the lobes, often 2–4 mm long and 2- to 4-nerval, rarely uninerval; indusium greyish or brownish, subentire or mostly slightly erose, 0.3–0.4 mm wide, almost or quite reaching the margin, not reflexed at maturity. Spores pale brown, trilete, smooth, c. 22 μ.

Distr. Thailand and Tonkin to *Malesia*: Malay Peninsula, Sumatra, West Java, Borneo, Banka, and Natuna Is.

Ecol. Terrestrial in (usually moist) forests, 300–1400 m.

Note. The tripinnate form has been described as *L. orbiculata* var. *odontosorioides*, but it does not seem to merit taxonomic recognition.

3. *Lindsaea orbiculata* (LAMK) METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279; HOLTUM, Gard. Bull. S. S. 5 (1930) 64; TAGAWA, Act. Phytotax. Geobot. 6 (1937) 33, f. 3 D-G; COPELAND, Fern Fl. Philip. 1 (1958) 112, p.p. — *Adiantum orbiculatum* LAMK, Encycl. 1 (1783) 41. — *Schizoloma orbiculatum* (LAMK) KUHN, Chaetopt. (1882) 346; HOLTUM, Rev. Fl. Mal. 2 (1954) 344, f. 199. — *Schizolegnia orbiculata* (LAMK) ALSTON, Bol. Soc. Brot. II,

30 (1956) 24. — Type: SONNERAT *s.n.*, near Malacca (P).

L. flabellulata DRYAND. Trans. Linn. Soc. 3 (1797) 41, pl. 8 f. 2. — Lectotype: NELSON *s.n.*, Macao (BM).

L. polymorpha WALL. ex HOOKER & GREVILLE, Ic. Fil. (1828) pl. 75. — *L. flabellulata* DRYAND. var. *polymorpha* (HOOK. & GREV.) HOOKER, Sp. Fil. 1 (1846) 211. — *L. orbiculata* (LAMK) METT. ex KUHN var. *polymorpha* (HOOK. & GREV.) v.A.v.R. Handb. (1908) 270. — Type: a specimen without data from Herb. HOOKER (K).

L. montana COPELAND in Perkins, Fragm. Fl. Philip. (1904) 182, non FÉE (1866). — *L. copelandi* C. CHR. Ind. Fil. (1906) 392. — Type: COPELAND 230, Mt Mariveles, Luzon (MICH; dupl. in B).

L. bonii CHRIST, Not. Syst. 1 (1909) 187. — Type: BON 8, S. Tonkin (P).

L. longipes C. CHR. & TARDIEU-BLOT, Not. Syst. 5 (1936) 263; Fl. Gén. I-C. 7 (1939) 125, f. 15 3–4. — Type: POILANE 8208, Nhatrang, Annam (P).

Rhizome short-creeping, 1–1½ mm ø; scales reddish brown, very narrowly triangular, to c. 2 mm long, to 4-seriate at base, a considerable apical portion uniseriate. Leaves close; *petioles* stramineous with dark base or dark to blackish brown throughout, abaxially at least in the upper part sharply bi-angular and if dark pale-margined. *Lamina* simply pinnate or bipinnate, herbaceous or chartaceous; pinnules dimidiate, very variable in shape, erose, free-veined. Upper pinnae of bipinnate leaves gradually to rather abruptly shortened, ± gradually passing into the non-conform terminal pinna. Terminal pinnules (segments) ± rhombic. *Sori* continuous or interrupted; indusium minutely to strongly and irregularly erose, ½ mm wide, usually falling short of the margin by half its width, rarely more strongly intramarginal or almost reaching the margin. Spores yellow to light brown, trilete, almost smooth, c. 25–30 μ.

KEY TO THE VARIETIES

1. Plants usually (always?) with simply pinnate sterile leaves beside the fertile ones; fertile leaves simply pinnate; or, if bipinnate, at least some pinnules at the base of the terminal pinna, above the uppermost pinnate pinnae, suborbicular; the lamina not gradually passing from the bipinnate condition at base to the simply pinnate apex but with a rather abrupt transition 1. var. *orbiculata*

1. Sterile simply pinnate leaves mostly wanting; no pinnules suborbicular; larger laminas upward gradually of simpler structure, with a gradual transition from the bipinnate base to the simply pinnate apex 2. var. *commixta*

1. var. *orbiculata*. — Fig. 15.

Sterile, simply pinnate leaves mostly, perhaps in nature always, present, together with fertile ones. *Petioles* of sterile leaves slender, stramineous to reddish brown or rarely darker, 2–8 cm long,

mostly about half as long as the lamina; *lamina* linear, c. 5–10 cm long, with 6–12 pinnules to a side (larger ones mostly fertile in the upper part), slightly narrowed from base to apex, there suddenly narrowed. Rachis pale, abaxially bi-angular or sulcate. *Pinnules* mostly olivaceous or dark green when dry, chartaceous, asymmetrically ovate or $\frac{1}{4}$ -elliptic, often $\frac{2}{3}$ –1 by $\frac{1}{2}$ cm, often subcontiguous, spreading or the basal ones de-curved, the outer and upper margin sharply dentate, the teeth up to 1 mm long; *terminal pinnule* (segment) free or nearly so, often 1–1½ cm long and $\frac{1}{2}$ – $\frac{3}{4}$ cm wide, obtuse, less often acute, cuneate-flabellate, toothed, the pinnules just below it mostly not strongly reduced. *Fertile leaves* more numerous, simply pinnate or bipinnate, or very often subbipinnate; intermediates between sterile and fertile leaves not rare. *Petioles* of fertile leaves stouter than those of sterile ones, c. 10–30 cm long, as long as the lamina or in very large leaves sometimes much shorter. *Lamina* linear if once pinnate or subbipinnate, otherwise very variable in shape, depending on the number and size of the pinnae, c. 12–50 cm long. *Pinnules* herbaceous or more often chartaceous, olivaceous or dark green when dry, very variable in number, shape, and size, the lower ones often remote, the upper ones gradually closer, subcontiguous; the *rachis* basally sometimes dark, otherwise stramineous, abaxially bi-angular, upward sulcate; secondary rachises, if any, similar. *Fertile pinnules* like the sterile ones or at least the lower ones of simply pinnate leaves, simply pinnate leaf-apices, or larger pinnate pinnae, very asymmetrically flabellate-suborbicular, with broadly rounded upper/outer and \pm concave, descending lower margin, then often 1–1½ cm long and broad; in subbipinnate laminas some of the lower (but not necessarily the lowermost) pinnae pinnatifid or pinnate, with some cuneate-flabellate or $\frac{1}{4}$ -elliptic pinnules on both sides and a large, rhombic, very obtuse, often very asymmetric terminal pinnule. *Fully bipinnate leaves* with up to c. 8 well-developed pinnae to a side, these spreading almost at right angles, with up to c. 10 pinnules to a side, the terminal pinnule smaller than in subbipinnate leaves but not much smaller than the lateral pinnules of the same pinna, obtuse. Transitions between pinnate pinnae and lobed pinnules nearly always present at the base of the relatively very long simply pinnate terminal portion of bipinnate leaves, occasionally also between and even below fully pinnate pinnae. Edge of pinnules erose-crispate, rarely dentate. Veins immersed, evident, close, 1–3 times forked, flabellate, a costa not or scarcely developed. *Sori* continuous except as interrupted by incisions of transitional pinnules.

Distr. SE. China, S. Japan, to *Malesia*: Malay Peninsula, Singapore, Sumatra, Banka, Java, Bawean, Sarawak, Sulu Archipelago, Philippines (Luzon); incorrectly reported from Madagascar.

Ecol. In thickets and open forests, on banks and rock faces, often in locally dry situations

in ravines or by rivers or near the coast, to 500 (rarely to 1000) m.

2. *var. commixta* (TAGAWA) KRAMER, *comb. nov.*—*L. commixta* TAGAWA, Act. Phytotax. Geobot. 6 (1937) 37, f. 3 H-J.—*L. tenera* DRYAND. *var. commixta* (TAGAWA) IWATSUKI, Act. Phytotax. Geobot. 19 (1961) 6.—Type: TASIRO *s.n.*, I. Tane-ga-shima, Osumi Prov., Kyushu (KYO, *n.v.*).

? *L. montana* COPELAND.—*L. copelandi* C. CHR. Differing from *var. orbiculata* in the following characters: Sterile simply pinnate leaves mostly wanting. *Fertile leaves* never simply pinnate; suborbicular pinnules none, even at the base of the simply pinnate leaf-apex, *i.e.*, all pinnules distinctly dimidiate; terminal segments larger and/or more acute. Larger laminas fully bipinnate, more evenly narrowed from base to apex, the terminal pinna hardly set off from the rest of the lamina, the simply pinnate apical portion relatively shorter; *sterile pinnules* more deeply incised; lowest non-subpinnate pinnules of terminal part of lamina shallowly incised, with interrupted sori. Rhizome scales and spores as in *var. orbiculata*.

Distr. SE. China, India, Ceylon, Indo-China, S. Japan, Thailand, to *Malesia*: Malay Peninsula, Sumatra, Philippines (Luzon), Celebes, Sumba, Sarawak.

Ecol. As *var. orbiculata*.

Notes. *L. orbiculata* is one of the most variable species of the genus, resulting in a comparatively extensive synonymy. The two varieties distinguished here are not entirely sharply distinct, partly because depauperate plants from rock fissures *etc.* often cannot be assigned with certainty to one of them, *e.g.* the type of *L. montana* COPELAND, partly because the differences between them are of a gradual rather than fundamental order. Nevertheless the majority of the specimens can be assigned to one of them. *Var. commixta* is more common to the North of *Malesia*, particularly in Japan, where it is fairly sharply distinct from *var. orbiculata* but is not entirely sharply distinguishable from *L. chienii* CHING which I prefer to treat as a species but which may also prove to be only a variety of *L. orbiculata*. Many more field and also cytotoxic observations are needed before the status of the species of this group can be ascertained.

4. *Lindsaea gomphophylla* BAKER, Ann. Bot. 5 (1891) 204.—Type: H. Low *s.n.*, Borneo, prob. Sarawak (K).—Fig. 16.

In most respects like a subbipinnate form of *L. orbiculata*, characterized by the following combination of characters:

Rhizome scales castaneous, very narrowly triangular, to 3 mm long, to 6-seriate at base, a considerable apical part uni- and biseriate. *Lamina* subcoriaceous to coriaceous; at least some leaves of each plant subbipinnate, with a few paucijugate pinnae at base, rarely the basal pinnae more fully pinnate; terminal pinnules of lateral pinnae large, flabellate-suborbicular.

Petiole and *rachis* dark, abaxially terete or the *rachis* obtusely bi-angular; secondary *rachises* abruptly pale. *Sterile margin* less acutely dentate. Spores *c.* 30 μ .

Distr. *Malesia*: Borneo (Sarawak, Brunei), Sumatra (5 or 6 coll. in all).

Ecol. One record 300–400 m.

Note. This may be another variety of *L. orbiculata*.

5. *Lindsaea javanensis* BLUME, En. Pl. Jav. (1828) 219.—*Schizoloma javanense* (BLUME) HOLTUM, Rev. Fl. Mal. 2 (1954) 349, f. 202.—*Schizolegnia javanensis* (BLUME) ALSTON, Bol. Soc. Brot. II, 30 (1956) 24.—Type: BLUME *s.n.*, Java (L).

L. flabellulata DRYAND. var. *gigantea* HOOKER, Sp. Fil. 1 (1846) 211, pl. 63 c.—*L. orbiculata* (LAMK) METT. ex KUHN var. *gigantea* (HOOKER) METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279.—*L. tenera* DRYAND. var. *gigantea* (HOOKER) HOLTUM, Gard. Bull. S. S. 5 (1930) 65.—*L. gigantea* (HOOKER) C. CHR. Bot. Jahrb. 66 (1933) 53.—Lectotype: GRIFFITH *s.n.*, Khasya and Assam (K).

Rhizome short-creeping, 1–2 mm σ ; scales medium brown, lanceolate, long-acuminate, to 1½ mm long, to 4-seriate at base, with a long uniseriate apex. Leaves clustered; *petioles* 10–30 cm long, especially in large leaves much longer than the lamina, dark reddish brown to atropurpureous, \pm lustrous, abaxially terete at base, upward gradually obtusely, at apex mostly acutely bi-angular, the angles and especially the borders of the adaxial groove often pale. *Lamina* herbaceous to chartaceous, dark green or olivaceous when dry, very variable, triangular or oblong or in small leaves sometimes transversely triangular, 7–20 cm long, 6–15 cm wide, 1¼ to (in large leaves) 1¾ times as long as wide, simply pinnate to amply bipinnate, in the first case with up to as little as 2 pairs of lateral pinnules and a distinct but not conform terminal one, in the second case with up to 5 (pinnate) pinnae to a side and several simple ones above, which are gradually reduced to and confluent (or not) with the terminal pinnule (segment). *Primary rachis* dark, adaxially with a narrow, pale-edged groove, abaxially flattened, pale-angled. *Primary pinnae* their width apart to contiguous, spreading or in plurijugate bipinnate leaves ascending. *Pinnules* of simply pinnate or subbipinnate leaves rhombic, very often with long-acuminate to caudate apex, with very unequal base, basiscopically much more cut away, to *c.* 8 by 2 cm; apex of lamina similar but \pm symmetric at base; apices of fully pinnate pinnae similar but smaller, progressively smaller and less pointed as there are more secondary pinnules; larger transitional pinnules between pinnate pinnae and the lamina apex often rhombic-caudate, smaller ones subtrapeziform or subflabellate, very obtuse; pinnules of fully pinnate pinnae up to 8 to a side, mostly not contiguous, subtrapeziform, rounded-rhombic or subflabellate. *Secondary rachises* abaxially flattened or slightly sulcate, abruptly pale at their insertion on the

dark primary *rachis*, usually distinctly green-margined. Fertile *pinnule-margin* subentire or minutely erose, in larger leaf segments here and there incised by shallow crenations; *sterile margin*, especially near the segment bases, sharply serrate or dentate, with deeper incisions. Lobes of pointed pinnules often slightly concave. Veins immersed but \pm evident, free, mostly twice forked, *c.* 1 mm apart; larger pointed pinnules and terminal divisions with a percurrent costa. *Sori* continuous in small pinnules, progressively more interrupted in larger ones, bi- to plurinerval. Indusium pale, subentire to erose, 0.3–0.4 mm wide, almost reaching the margin to falling short of it by more than its width, little reflexed at maturity. Spores light brown, trilete, smooth, *c.* 25 μ .

Distr. Assam, SE. China, and S. Japan to *Malesia*: Malay Peninsula, Sumatra, West Java, Borneo, Celebes (?), Philippines (Sibuyan, Mindoro). Apparently nowhere common. Incorrectly reported from Madagascar.

Ecol. Terrestrial in forests, 80–1400 m, mostly above 800 m.

Notes. The only collection from Celebes, KJELLBERG 3527a (BO, S-Pa) is not well developed and also resembles *L. orbiculata* var. *commixta*.

The specimens from the continent North of the Malay Peninsula have more intramarginal indusia and are in several respects close to *L. chienii* CHING; there is probably some introgression between the two species.

6. *Lindsaea media* R.Br. Prod. Fl. Nov. Holl. (1810) 156.—*Schizoloma medium* (R.Br.) KUHN, Chaetopt. (1882) 346.—*Schizoloma ensifolium* (SWARTZ) J. SMITH var. *medium* (R.Br.) DOMIN, Bibl. Bot. 20 (1915) 78.—Type: R. BROWN *s.n.*, N. coast of Australia (K; several other authentic, possibly isotype coll. in K, P, U).

L. subtripinnata COPELAND, J. Arn. Arb. 24 (1943) 441.—Type: BRASS 8491, Tarara, W. Div., Papua (MICH; dupl. in BO, GH, L).—Fig. 20.

Rhizome rather long-creeping, 1–1½ mm σ , rather thinly and decidedly scaly; scales yellow, ovate-triangular, to *c.* 1 mm long, to 6-seriate at base, a short apical portion uniseriate. Leaves to ½ cm apart; *petioles* stramineous to fawn-coloured, 10–40 cm long, mostly longer than the lamina, abaxially terete below, upward gradually obtusely or acutely bi-angular and flattened. *Lamina* herbaceous or chartaceous, 10–30 cm long, 4–17 cm wide, 2–3 times as long as wide, triangular or oblong, bipinnate or bipinnate + pinnatilobate or bipinnate + pinnatifid, rarely tripinnate at base; leaf apex gradually of simpler structure. *Primary rachis* abaxially flattened, bi-angular. *Pinnae* spreading or slightly ascending, the major ones *c.* 4–10 to a side, most or all subopposite, the largest, basal ones 2½–10 cm long and 12–18 mm wide, not narrowed at the base, rather evenly narrowed in the upper half or throughout; secondary *rachises* abaxially flattened, bi-angular, green-margined to the base or almost so. *Basal pinnules* on both sides of lower pinnae of large leaves usually pinnatilobate to

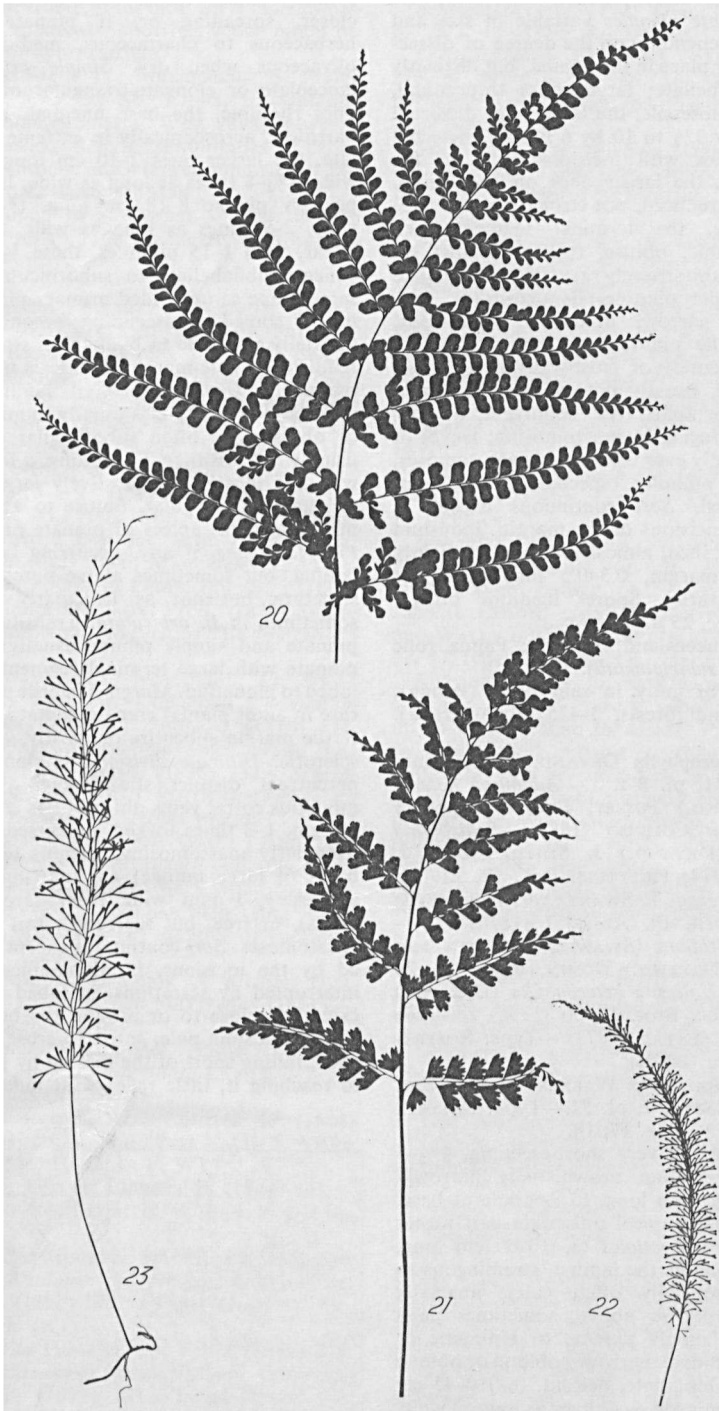


Fig. 20. *Lindsaea media* R.Br. Lamina, $\times \frac{2}{5}$ (BRASS 8491).—Fig. 21. *L. bouillodii* CHRIST. Lamina, $\times \frac{2}{5}$ (CUMING 399).—Fig. 22. *L. bakeri* (C. CHR.) C. CHR. var. *bakeri*. Lamina, $\times \frac{2}{5}$ (BRASS 13651).—Fig. 23. *L. roemeriana* ROSENSTOCK. Leaf, $\times \frac{2}{5}$ (v. RÖMER 1137).

pinnatifid, rarely fully pinnate, then with few pinnules. *Ultimate pinnules* variable in size and shape, largely depending on the degree of dissection of and their place in the lamina, but distinctly dimidiate-subflabellate; larger ones trapezoidal, subquadratic, subsessile, the larger, not dissected ones up to 5 by 3½ to 10 by 6 mm, if dissected the smaller ones with incisions only on the acroscopic side, the larger ones on both sides. *Upper pinnules* reduced, not strongly so in paucijugate pinnae, the terminal segment then obliquely rhombic, obtuse, free or almost so, to 5 mm long, more strongly reduced in plurijugate pinnae, the upper pinnules denticuliform, confluent into a narrow, pinnatifid pinna-apex. Margin of sterile pinnules sharply dentate, of fertile ones obscurely or mostly distinctly erose. Veins immersed, usually not evident, 1–3 times forked, c. ½ mm apart, free, connivent, or sporadically and irregularly anastomosing; leaves of adult plants hardly ever without any anastomoses, but often many pinnules, especially smaller ones, quite free-veined. *Sori* continuous except as interrupted by incisions of the margin; indusium pale, erose to gashed, almost reaching to slightly exceeding the margin, 0.3–0.5 mm wide, not reflexed at maturity. Spores medium brown, trilete, smooth, c. 25 μ.

Distr. N. Queensland; *Malesia*: Papua (one coll., type of *L. subtripinnata*).

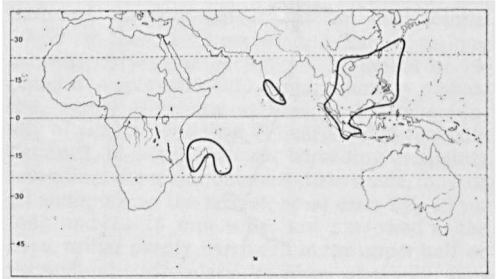
Ecol. Bank of gully in rain forest (Papua); grassy places and forests, 0–425 m (Australia).

7. *Lindsaea heterophylla* DRYAND. Trans. Linn. Soc. 3 (1797) 41, pl. 8 f. 1.—*Adiantum heterophyllum* (DRYAND.) POIRET, Encycl. Suppl. 1 (1810) 139, non COLENSO (1888).—*Schizoloma heterophyllum* (DRYAND.) J. SMITH, Hook. J. Bot. 3 (1841) 414; HOLTUM, Rev. Fl. Mal. 2 (1954) 345.—*L. ensifolia* SWARTZ var. *heterophylla* (DRYAND.) BENTH. Fl. Austr. 7 (1878) 722.—*Schizoloma ensifolium* (SWARTZ) J. SMITH var. *heterophyllum* (DRYAND.) DOMIN, Bibl. Bot. 20 (1915) 77.—*Schizolegnia heterophylla* (DRYAND.) ALSTON, Bol. Soc. Brot. II, 30 (1956) 24.—non *L. heterophylla* PRENTICE (1873).—Type: ROBERTSON *s.n.*, Malacca (BM).

L. variabilis HOOKER & WALKER ARNOTT, Bot. Beech. Voy. (1838) 257, pl. 52.—Type: MILLETT *s.n.*, Macao (*n.v.*).—Fig. 17, 18.

Rhizome rather to very short-creeping, 1½–3 mm ø; scales medium brown, very narrowly triangular, to 2½ mm long, to 7-seriate at base, long-acuminate, the apical uniseriate part rather long. Leaves close; *petioles* (3–)10–50 cm long, ½–2 times as long as the lamina, stramineous to dark brown, adaxially often paler, abaxially bi-angular, sharply so above, sometimes pale-angled. *Lamina* simply pinnate to bipinnate or rarely to subtripinnate, narrowly oblong or oblong or, especially if bipinnate, deltoid, (6–)10–45 cm long, (3–)6–20 cm wide, 2–6 times as long as wide, with 4–25 primary divisions to a side. Primary rachis mostly stramineous, abaxially sharply bi-angular or broadly and shallowly sulcate.

Primary pinnae rather remote, the upper ones closer, spreading or, if pinnate, ascending, herbaceous to chartaceous, medium green or olivaceous when dry. *Simple primary pinnae* lanceolate or elongate-triangular or the smaller ones rhombic, the base unequal, basiscopically narrower, acroscopically in extreme cases cordulate, the larger ones 2–10 cm long, ¾–1½ cm wide, 1½–8 times as long as wide; larger pinnate primary pinnae 8–18 cm long, (¾–)1½–6 cm wide, 2–9 times as long as wide, triangular to linear, with 1–15 pinnules, these ½–5 cm long, cuneate-subflabellate to suborbicular or of the same shape as undivided primary pinnae, spreading or somewhat ascending; secondary rachises abaxially subterete to bi-angular, stramineous, or reddish and pale-margined, at least upward green-margined. *Upper pinnae* of lamina gradually reduced, the upper ones usually rhombic, subacute or obtuse, less often suborbicular or flabellate, usually not less than ½ cm long, a few connected with the mostly comparatively large, lanceolate or elongate-triangular, obtuse to acuminate terminal segment; apices of pinnate pinnae similar. *Pinnate pinnae*, if any, occurring basally in the lamina, but sometimes above pinnae of simpler structure, but not as irregularly arranged as sometimes in *L. orbiculata*. Transitions between pinnate and simple pinnae usually paucijugate-pinnate with large terminal segment rather than lobed to pinnatifid. *Margin* of sterile pinnules (very rare in adult plants) crenate-dentate to subentire; fertile margin subentire or mostly ± erose, little sclerotic. *Ultimate divisions*, if elongate, with a percurrent, distinct, stramineous, abaxially prominent costa; veins oblique, less so towards the margin, 1–3 times forked, immersed but evident, irregularly anastomosing, forming (except in the bases of large pinnae) an interrupted series of areoles ½–1 mm wide (very rarely a second series), or free, but scarcely a leaf without any anastomoses. *Sori* continuous except as interrupted by the incisions, in pinna-apices sometimes interrupted by serrations, in lobed pinnae often extending close to or around the bottom of the sinus. Indusium pale, entire to erose, 0.3–0.5 mm wide, falling short of the margin by half its width to reaching it, little reflexed at maturity. Spores



Map 3. Distribution of *Lindsaea heterophylla* DRYAND.

pale yellowish, trilete, smooth, c. 30 μ (sometimes irregular and apparently abortive, which might be connected with hybrid origin).

Distr. Mascarene Is., Madagascar; S. India, Ceylon, Ryu Kyu Is., SE. China, to *Malesia*: Malay Peninsula, Sumatra, West Java, Bawean, Borneo (Sarawak, Sabah), Philippines (Luzon, Mindanao), Ambon; much less common than the closely related *L. ensifolia*. Map 3.

Ecol. In open to somewhat shaded, mostly moist places, up to 1100 m, mostly at lower altitude.

8. *Lindsaea ensifolia* SWARTZ in Schrader, J. Bot. 1800^a (1801) 77; COPELAND, Fern Fl. Philip. 1 (1958) 113; KRAMER, Blumea 15 (1968) 564.—*Adiantum ensifolium* (SWARTZ) POIRET, Encycl. Suppl. 1 (1810) 139.—*Schizoloma ensifolium* (SWARTZ) J. SMITH, Hook. J. Bot. 3 (1841) 414; BACKER & POSTHUMUS, Varenfl. Java (1939) 110, f. 20; TARDIEU-BLOT & C. CHR. Fl. Gén. I.-C. 7 (1939) 129, f. 15 1-2; HOLTUM, Rev. Fl. Mal. 2 (1954) 346, f. 200.—*Schizolegna ensifolia* (SWARTZ) ALSTON, Bol. Soc. Brot. II, 30 (1956) 24.—Type: coll. unknown, Mauritius (S-PA).

Pteris stricta POIRET in Lamk, Encycl. 5 (1804) 713.—*L. pteroides* DESVAUX, Prod. (1827) 312.—Type: COMMERSON *s.n.*, Mauritius ('Ile de France') (P).

L. lanceolata LABILL. Nov. Holl. Pl. Sp. 2 (1806) 98, pl. 248 f. 1.—*Adiantum lanceolatum* (LABILL.) POIRET, Encycl. Suppl. 1 (1810) 134, non FÉE (1852).—*Schizoloma lanceolatum* (LABILL.) PRESL, Tent. Pterid. (1836) 132.—*Schizoloma ensifolium* (SWARTZ) J. SMITH var. *lanceolata* (LABILL.) R. BONAPARTE, Notes Ptérid. 13 (1921) 259.—*Schizoloma billardieri* GAUD. Ann. Sc. Nat. 3 (1824) 508, nom. *superfl.*—*L. billardieri* (GAUD.) CARRUTHERS ex SEEMANN, Fl. Vit. (1873) 337.—Type: LABILLARDIÈRE *s.n.*, Cape Van Diemen, Australia (P; identity of specimen uncertain).

L. erecta MIRBEL in Lamk & Mirbel, Hist. Nat. Vég. 5 (1803) 126, non METTENIUS (1861).—Type: coll.?, Réunion (*n.v.*).

Pteris angulata PRESL, Rel. Haenk. 1 (1825) 54, nom. *illeg.*, incl. *L. lanceolata* LABILL.—Type: coll.?, Marianas (*n.v.*).

L. membranacea KUNZE, Linnaea 18 (1844) 121.—Type: GUEINZIUS *s.n.*, Port Natal, S. Africa (B; dupl. in BM, HBG, L, P, W).

L. sublobata KUNZE, Linnaea 18 (1844) 121.—Type: CUMING 369, Malacca (B; dupl. in GH, L, SING, W).

L. griffithiana HOOKER, Sp. Fil. 1 (1846) 219, pl. 68B.—*Schizoloma griffithianum* (HOOKER) FÉE, Gen. Fil. (1852) 108.—Type: GRIFFITH *s.n.*, Mergui, Burma (K).

L. pentaphylla HOOKER, Sp. Fil. 1 (1846) 219, pl. 67A.—*Schizoloma pentaphyllum* (HOOKER) FÉE, Gen. Fil. (1852) 108.—Type: BYNOE *s.n.*, Australia ('New Holland') (K).

L. oligoptera KUNZE, Bot. Zeit. (1846) 445.—Type: ZOLLINGER 1513 ('& 1515'), Java (B; dupl. in HBG, L, Z).

Schizoloma javae FÉE, Gen. Fil. (1852) 109, pl. 29 f. 1.—Type: ZOLLINGER 1504, Java (*n.v.*).

L. schizoloma ETtingsh. Farnkr. 3 (1865) 213, pl. 145 f. 4, pl. 146 f. 6.—Type: not cited; perhaps a new name for *Pteris stricta* POIRET (*vide supra*).

Schizoloma heterophyllum (DRYAND.) J. SMITH var. *speluncae* COPELAND, Philip. J. Sc. 5 (1910) Bot. 284.—Type: FOXWORTHY 578, Sandakan (MICH).

Schizoloma ensifolium (SWARTZ) J. SMITH var. *attenuatum* DOMIN, Bibl. Bot. 20 (1915) 77, with *f. typicum* DOMIN, type: C. B. CLARKE *s.n.*, several coll. from India; *f. pteroides* DOMIN, types: GRIFFITH 173, Mergui, Burma, and WALLICH *s.n.*, Singapore; *f. praelongum* DOMIN, types: KUNSTLER 1881, Singapore, and coll.?, Mauritius (*n.v.*).

Schizoloma ensifolium (SWARTZ) J. SMITH var. *borneense* DOMIN, l.c.—Type: coll.?, Borneo (*n.v.*).

Schizoloma ensifolium (SWARTZ) J. SMITH var. *clarkeanum* DOMIN, l.c. 76.—Type: CLARKE *s.n.*, N. India (*n.v.*).

Schizoloma ensifolium (SWARTZ) J. SMITH var. *longipinnum* DOMIN, l.c. 76, with *f. typicum* DOMIN, type: GOMEZ *s.n.*, Javoy, India; *f. sub-simplex* DOMIN, types: GRIFFITH *s.n.*, Malacca, and WALLICH 92, Ceylon; *f. griffithianum* DOMIN, l.c. 77, type: GRIFFITH *s.n.*, Mergui, Burma (*n.v.*).

Rhizome short- to mostly not very short-creeping. *Lamina* mostly simply pinnate, with up to c. 15 pinnae to a side. *Pinnae* lanceolate to linear, with almost symmetric base, non-dimidiolate, with percurrent costa; veins immersed, \pm evident, very oblique near the costa, less so outward, regularly anastomosing even in narrow pinnae, with 1 or 2, rarely 3-5 rows of areoles between costa and margin. *Sori* continuous; indusium linear, pale brownish, 0.3-0.5 mm wide, almost reaching the margin. Spores trilete, smooth.

KEY TO THE SUBSPECIES

1. Upper pinnae gradually and strongly narrowed, gradually confluent into or at least some small ones connected with the terminal segment; sometimes bipinnate. . . 1. *ssp. agatii*
1. Upper pinnae little reduced; lamina with a free, conform terminal pinna.
2. Rachis abaxially sharply bi-angular; sterile margin serrate, or rarely subentire 2. *ssp. ensifolia*
2. Rachis abaxially not sharply bi-angular; sterile margin entire 3. *ssp. coriacea*

1. *ssp. agatii* (BRACKENR.) KRAMER, Act. Bot. Neerl. 15 (1967) 579.—*Schizoloma agatii* BRACKENR. U.S. Expl. Exp. (1854) 216, pl. 30 f. 1.—Type: U.S. Expl. Exp. *s.n.*, Fiji (dupl. in K).

Schizoloma ensifolium (SWARTZ) J. SMITH var. *intercedens* DOMIN, Bibl. Bot. 20 (1915) 80, pl. 14 f. 8, pl. 15 f. 3.—Type: DOMIN *s.n.*, Yarraba, N. Queensland (*n.v.*).

Rhizome not very shortly creeping, 1½ mm thick; scales as in the next subspecies. Leaves

$\frac{1}{2}$ –1 cm apart. *Petioles* stramineous to reddish brown, quadrangular, often sulcate. *Lamina* often lanceolate, with c. 8–15 pinnae to a side, sometimes subbipinnate or fully bipinnate. *Pinnae* often rather strongly ascending, the major ones c. 5–10 cm by 4–7 mm, 10–15 times as long as wide, the lower ones sometimes subauriculate at base, chartaceous or firmly herbaceous, acute or subacute, not rarely some lower (but not necessarily the lowermost) pinnatifid or pinnate, their segments usually rhombic or obovate, rarely prolongate-rhombic to lanceolate, up to c. 12 to a side, decurrent and often wing-connected, the basal ones often broader. Apices of pinnatifid or pinnate pinnae with a long undivided segment. *Upper primary pinnae* gradually and strongly reduced, the uppermost ones less than $\frac{1}{3}$ the size of the lower ones, terminal segment confluent with some reduced upper pinnae or lobed at the base. Veins in smaller secondary pinnules irregularly anastomosing; often only one row of areoles present. *Sterile margin* serrate. *Sori* continuous except as interrupted by incisions of the pinnae, in small pinnules of bipinnate leaves occupying only their outer margin. *Indusium* often with an irregular edge, occasionally slightly exceeding the margin. Spores light brown, c. 26 μ .

Distr. *Malesia*: Ambon, Timor and New Guinea; 2 doubtful collections from Sabah. North and eastward to Micronesia, Queensland, New Caledonia, the Tonga Is., and Samoa.

Ecol. Terrestrial, very euryoecious, but not in swamps; to 1200 m.

Notes. In regions where this and the following subspecies occur together intermediates are not very rare.

L. ensifolia ssp. agatii has often been confused with *L. heterophylla*, e.g. by DOMIN, l.c. Bipinnate forms may closely resemble that species but may be told apart by relatively wider pinnules, notably the upper ones, and more regularly anastomosing veins. *Ssp. ensifolia* and *ssp. agatii* overlap geographically and are connected by intermediates whereas *L. heterophylla* overlaps only with *ssp. ensifolia* from which it is sharply distinct.

2. *ssp. ensifolia*.

Rhizome sometimes short-creeping, (1–)1 $\frac{1}{2}$ –2 (–2 $\frac{1}{2}$) mm ϕ ; scales light reddish brown, narrowly triangular, to 2 mm long, to 5-seriate at the base, about the apical $\frac{1}{3}$ uniseriate. Leaves to 2 cm apart. *Petioles* c. 10–35 cm long, $\frac{1}{2}$ –1 times as long as, rarely longer than the lamina, stramineous to reddish brown, rarely darker, abaxially at least upward bi-angular and sometimes also sulcate, if dark not or hardly pale-margined. *Lamina* very variable, c. 15–45 cm long, mostly once pinnate, rarely simple, very rarely subbipinnate; if simple lanceolate, c. 10 by 1 $\frac{1}{2}$ –3 cm, or linear, c. 10 cm by 3–10 mm. Pinnate lamina with the rachis like the upper part of the petiole, abaxially sharply bi-angular and mostly also sulcate. *Lateral pinnae* one odd one to 12 to a side, most often in 2–8 pairs, not contiguous,

spreading to strongly ascending, the larger ones usually subpetiolulate, lanceolate to linear, \pm evenly narrowed from base to apex, subacute to acuminate, 10–22 cm long, 4–25 mm wide, 4 to over 25 times as long as wide (the great variability at least in part due to the presence of juvenile yet fertile plants), the base broadly to narrowly cuneate, the basicopic side usually slightly longer and narrower. Texture herbaceous to chartaceous, rarely thicker; colour dark green or olivaceous when dry. *Sterile leaves* (not common) with fewer, relatively broader pinnae; sterile margin (in fertile pinnae often present at the apex) serrate, less often subentire. *Upper pinnae* little reduced, in large leaves c. $\frac{1}{3}$ the size of the lower ones; terminal pinna conform, with asymmetric base, of the size of the larger lateral ones, free or slightly connected with 1 or 2 lobe-like upper pinnae. Costa stramineous, not carinate. Areoles of veins $\frac{1}{3}$ –1 $\frac{1}{2}$ (–2) mm wide. *Indusium* entire, 0.4–0.5 mm wide, strongly reflexed and concealed at maturity. Spores light yellow, c. 25–28 μ .

Distr. Uncommon near the coasts of W. and E. Africa; Madagascar and Mascarenes, Seychelles; S. and E. India, Ceylon, Ryu Kyu Is., SE. China to *Malesia*: throughout, including some of the Lesser Sunda Is., but rare and local in the Philippines, Celebes, and most of New Guinea; Micronesia, tropical Australia, to the Solomon Is. and New Caledonia, Hawaii.

Ecol. Terrestrial or epilithic, in swampy to moderately dry places, exposed or in light shade, from sea-level up to 1000 (rarely up to 1750) m; common in most parts of its Asiatic area.

Note. Various authors, notably DOMIN, l.c., tried to classify the confusing array of forms in this subspecies. These are, however, connected by all kinds of intermediates and defy description. The lamina of simple forms probably represents the terminal pinna.

3. *ssp. coriacea* (v.A.v.R.) KRAMER, *Blumea* 15 (1968) 564.—*Schizoloma coriaceum* v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 18 (1908) 10.—Type: HALLIER 1934, between S. and G. Kenepai, Kalimantan, Borneo (BO).

Rhizome 2–3 mm ϕ , mostly not short-creeping; scales to 2 $\frac{1}{4}$ mm long, to 8-seriate at the base, with a short uniseriate apex. *Petioles* atropurpureous, shining, abaxially terete or upwards obtusely carinate. *Lamina* rarely simple, mostly once pinnate, with 1–5 pinnae to a side and a conform terminal one. Rachis like the petiole, abaxially terete or obtusely carinate, rarely obtusely bi-angular. *Pinnae* lanceolate, acute or acuminate, chartaceous or subcoriaceous, 10–25 cm long, 1–2 $\frac{1}{2}$ cm wide, 6–15 times as long as wide, widest above the scarcely unequal base, not rarely sterile, then entire; terminal pinna the largest. Costa stout, stramineous to dark brown. Areoles in 2 or 3 rows, often to 2 mm wide. *Indusium* entire, usually not over 0.3 mm wide. Spores yellowish brown, trilete, smooth, c. 20 μ .

Distr. *Malesia*: Johore, Singapore, Riouw

Is., Sumatra, Borneo (Sarawak, Kalimantan); a single collection doubtfully from Java.

Ecol. In swamp forests, on acid soil.

Note. It is feasible that the criterium of the rachis structure used here for distinguishing *ssp.*

coriacea from the exceedingly variable *ssp. ensifolia* is not entirely reliable. There are a few collections that match *ssp. coriacea* in other characters but have abaxially \pm pronouncedly bi-angular axes.

2. Section Temnolindsaea

KRAMER, Act. Bot. Neerl. 6 (1957) 176.

Type species: *Lindsaea klotzschiana* MORITZ.

Distr. Neotropical, and 7 *spp.* in Malesia and New Caledonia.

Taxon. The short-creeping rhizome, bipinnate lamina with conform terminal pinna, dimidiate free-veined pinnules, interrupted sori, and trilete spores are characters of all species. Otherwise the paleotropical species do not have very much in common with the neotropical ones, and it may well be that they are more closely related to *sect. Synaphlebium*.

9. *Lindsaea kingii* COPELAND, Philip. J. Sc. 6 (1911) Bot. 83; *ibid.* 78 (1949) 19.—Type: KING 241, Papua (MICH; fragm. in BM).—Fig. 25.

Rhizome short-creeping, 2½–3 mm ϕ ; scales fawn-coloured, narrowly triangular, to c. 3 mm long, to 18-seriate at base, with a very short apical uniseriate portion. Leaves clustered; *petioles* quadrangular with channelled sides, stramineous to olivaceous brown, their lateral faces with a series of median elongate pale pustules, 10–25 cm long, ½–½ as long as the lamina. *Lamina* to c. 70 cm long, with 5–11 major lateral pinnae to a side, a similar terminal one, and 1–5 strongly reduced basal ones. Primary rachis like the petiole, sometimes also with pustules, the adaxial groove with thick pale ridges. *Pinnae* alternate, ascending, subsessile, linear, the major ones 10–20 by 1½–2 cm, broadest at base or in the basal third, evenly narrowed to the subacute to shortly acuminate apex. Secondary rachises abaxially brownish in the lower, pale in the upper part or throughout, abaxially bi-angular except for a short basal portion. *Pinnules* 25–35 to a side, alternate, subcontiguous to half their width apart, subsessile, herbaceous, medium or dark green when dry, slightly ascending, subtrapezoidal to semi-ovate, the upper edge convex and without an outer edge, or the upper edge straight and with a distinct outer edge; larger pinnules 9–10 by 4–5 mm. Upper/outer margin with about 4 incisions to 2 mm deep, with very narrow sinus; sterile pinnules with alternating deeper and shallower incisions; margin otherwise entire. Upper pinnules strongly reduced, denticuliform. *Reduced basal pinnae* with a few almost or quite sterile pinnules. Veins immersed, evident, once or twice forked, free. *Sori* interrupted by the incisions of the margin, usually binerval (uni- to quadrinerval); receptacle laterally exceeding the soral veins. Indusium pale, entire or nearly so, with straight or slightly convex base, often c. 1 mm long, 0.3 mm wide, narrowed at the ends, not reaching the edge by about its own width, little reflexed at maturity. Spores pale brown, smooth, trilete, c. 30 μ .

Distr. *Malesia*: Moluccas (Morotai, Ceram), New Guinea (all Div.), Schouten I., Waigeu, d'Entrecasteaux Is., Admiralty Is. (Manus),

Solomon Is.

Ecol. In forests, terrestrial and on logs, 30–1000 m.

Note. The reduced basal pinnae of bipinnate leaves are unique in the genus.

10. *Lindsaea multisora* v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 21.—Type: RACHMAT (exp. VAN VUUREN) 669, Mt Lambolo, Celebes (BO; dupl. in L).

L. kjellbergii C. CHR. Bot. Jahrb. 66 (1933) 53.—Type: KJELLBERG 3615, Malili, Celebes (S-PA; dupl. in BM, BO).—Fig. 27.

Rhizome short-creeping, c. 2 mm ϕ ; scales reddish brown, narrowly triangular, to 2 mm long, to c. 8-seriate at the sometimes rather suddenly broadened base, the apical ½ or ¼ uniseriate. Leaves close; *petioles* stramineous, sharply quadrangular and shallowly sulcate, 10–30 cm long, about as long as the lamina. *Lamina* oblong, 15–30 cm long, bipinnate (in juvenile yet partly fertile plants simply pinnate), with 1–4 pinnae to a side and a conform terminal one. Primary rachis similar to the petiole. *Pinnae* 10–15 cm long, 9–16 mm wide, obliquely ascending, subopposite, sessile, widest in the lower half, gradually and strongly acuminate. Secondary rachises abaxially sharply bi-angular almost to the base, shallowly sulcate. *Pinnules* c. 25–40 to a side, close, subcontiguous, subsessile, \pm ascending, especially the upper ones, herbaceous, dark green or olivaceous when dry, approximately semi-ovate in outline, the larger ones 7–8 by 2½–3 mm, without a distinct outer margin, the lower margin usually convex, the upper margin with mostly 3 major incisions reaching down to the middle or a little less, the basal lobes often, the other ones occasionally again incised; lobes, especially the outer ones, often oblique, mostly ¾–1 mm wide, approximately parallel-sided, truncate or faintly convex and slightly erose if fertile, narrowed-rounded if sterile, the wing joining the lobes c. 1 mm wide. *Upper pinnules* gradually and strongly reduced, confluent into the narrow pinna-apex. Veins immersed, evident, 2 or 3 in the larger lobes, single in the smaller ones. *Sori* usually bi- or trinerval (uni- to quadrinerval); indusium thin, pale, entire, 0.3–0.4 mm wide, not quite reaching

the margin, \pm reflexed at maturity. Spores pale yellowish, trilete, smooth, *c.* 22 μ .

Distr. *Malesia*: Celebes (2 coll.).

Ecol. Terrestrial in rain-forest, 100 m.

11. *Lindsaea natunae* BAKER, Kew Bull. (1896) 40.—Type: HOSE 315, Natuna Is. (K; dupl.? in E, SAR).

L. canaliculatifera v.A.V.R. Bull. Jard. Bot. Btzg III, 5 (1922) 211.—Lectotype: BÜNNE-MEIJER 5835, Riouw (BO; dupl. in K, L, P, SING, U; fragm. in US).—Fig. 26.

Rhizome rather short-creeping, 2 mm ϕ ; scales reddish brown, narrowly triangular, acuminate, to 2½ mm long, to *c.* 10-seriate at base, the apical uniseriate part relatively short. Leaves rather close; *petioles* 8–35 cm long, about equaling the lamina, stramineous to fawn-coloured, quadrangular, with paler edges, \pm sulcate. *Lamina* bipinnate (rarely subtripinnate), with 3–5 pinnae to a side and a conform terminal one. Primary rachis similar to the petiole, abaxially narrowly channelled. *Pinnae* obliquely ascending, not close, sessile, 10–15 cm long, 1½–2½ cm wide, narrowed in the upper ⅓, the upper ones little shortened; basal pinnae rarely with 1 or 2 basal pinnate secondary pinnae. Secondary rachises abaxially bi-angular. *Pinnules* *c.* 20–30 to a side, mostly not contiguous, herbaceous, dark green when dry, semi-ovate to subtrapeziform, sessile, 9 by 3 to 12 by 4½ mm, 2½–3 times as long as wide, the lower margin \pm straight, the upper straight or slightly convex, a distinct outer margin not or scarcely developed. *Upper pinnules* gradually and strongly reduced, several denticuliform ones connected with the narrow terminal segment. Upper margin of pinnules mostly with 3 oblique incisions which scarcely reach farther than ¼ but get slightly deeper towards the apex of the pinnule; outer margin without or with one incision. *Larger pinnule lobes* with a straight or sinuate outer margin, laterally somewhat convex; sinus acute. Veins immersed, evident, mostly once forked. *Sori* one per lobe, mostly binerval, laterally exceeding the vein-ends; indusium entire, ¼–⅓ mm wide, almost or quite reaching the margin, scarcely reflexed at maturity. Spores pale brown, trilete, smooth, *c.* 28 μ .

Distr. *Malesia*: Natuna Is. (3 coll.), Riouw (2 coll.).

Ecol. Terrestrial in forests, 500–1000 m.

12. *Lindsaea tetragona* KRAMER, Blumea 15 (1968) 564.—*L. tenuifolia* auct. non BLUME, with syn., of other authors, in part.—Type: BINNENDIJK 160, Ambon (U).

Rhizome short-creeping, 1½–2 mm ϕ ; scales reddish or yellowish brown, narrowly triangular, to 1¾ mm long, to *c.* 4-seriate, the uniseriate apex short. Leaves close; *petioles* stramineous or mottled with age, quadrangular and sulcate, 10–30 cm long, about as long as the lamina. *Lamina* *c.* 10–40 cm long, oblong, bipinnate, with 3–9 pinnae to a side and a conform terminal one; primary rachis like the petiole. *Pinnae*

sessile, obliquely ascending, not close, 8–15 cm long, 17–25 mm wide, gradually to rather suddenly narrowed at apex. Secondary rachises stramineous, abaxially bi-angular, with a flat channel. *Pinnules* *c.* 20–45 to a side, herbaceous, mostly pale green when dry, close but usually not contiguous, somewhat ascending; lower margin often concave. Upper/outer margin deeply incised, at least the outer incisions reaching the middle of the pinnule, very oblique. Lobes linear, parallel-sided, the larger ones often forked. Sterile lobes narrowed-rounded at apex, fertile ones often slightly broadened at the sorus, truncate or slightly convex. *Upper pinnules* gradually and strongly reduced, confluent with the pinnatifid, narrow pinnule apex. Veins immersed, evident. *Sori* uni- or binerval. Spores very pale brown, trilete, smooth, *c.* 22 μ .

1. var. *tetragona*.

Lobes of pinnules ⅓–¾ (rarely to 1) mm wide; pinnules incised to ⅔ or ¾ (in sterile ones less), semi-ovate to asymmetrically triangular; veins rarely two per lobe; sori rarely binerval; indusium pale, entire or sinuate, ¼–½ (to almost 1) mm long, ¼ mm wide, not reaching the margin by ¼–½ mm, strongly reflexed and concealed at full maturity.

Distr. *Malesia*: Celebes, Philippines (Mindanao), Moluccas (Talaud, Ceram, Ambon), Louisiades; Solomon Is., Fiji, Samoa, Tahiti.

Ecol. Terrestrial in forests, often by water-courses, to *c.* 600 m.

2. var. *brassiana* KRAMER, Blumea 15 (1968) 565.—Type: BRASS 27919, Sudest I., Louisiades (L; dupl. in GH).

Pinnules incised to ⅓ or ¼, only at the apex to ½, semi-ovate to subrhomboid; lobes ¾–1 mm wide, with \pm erose outer edge, often binerval; apices of pinnules often protracted into a caudiform, lobed segment; indusium erose, often not reaching the edge of the pinnule by more than its width.

Distr. Louisiades (2 coll.).

Ecol. In rain-forest, 300 m.

13. *Lindsaea polycytena* KRAMER, Blumea 15 (1968) 565.—*Davallia blumeana* of HOOKER, Sp. Fil. 1 (1845) pl. 54 A.—Type: CUMING 309, Philippines, Leyte (US; dupl. in B, BM, HBG, K, L, MICH, P, W)—Fig. 28.

Rhizome short-creeping, *c.* 2 mm ϕ ; scales light reddish brown, elongate to very narrowly triangular, to *c.* 2 mm long, up to 8-seriate at base, the uniseriate apex short. Leaves close; *petioles* stramineous, quadrangular, at least adaxially sulcate, 10–25 cm long, mostly somewhat shorter than the lamina. *Lamina* bipinnate (rarely subtripinnate), oblong, 10–30 cm long, with 3–11 pinnae to a side and a conform terminal one; primary rachis like the petiole. *Pinnae* ascending, sessile, 8–12 cm long, 1½–2 cm wide, the upper ones hardly or not shortened. Secondary rachises abaxially sharply bi-angular, the angles sometimes

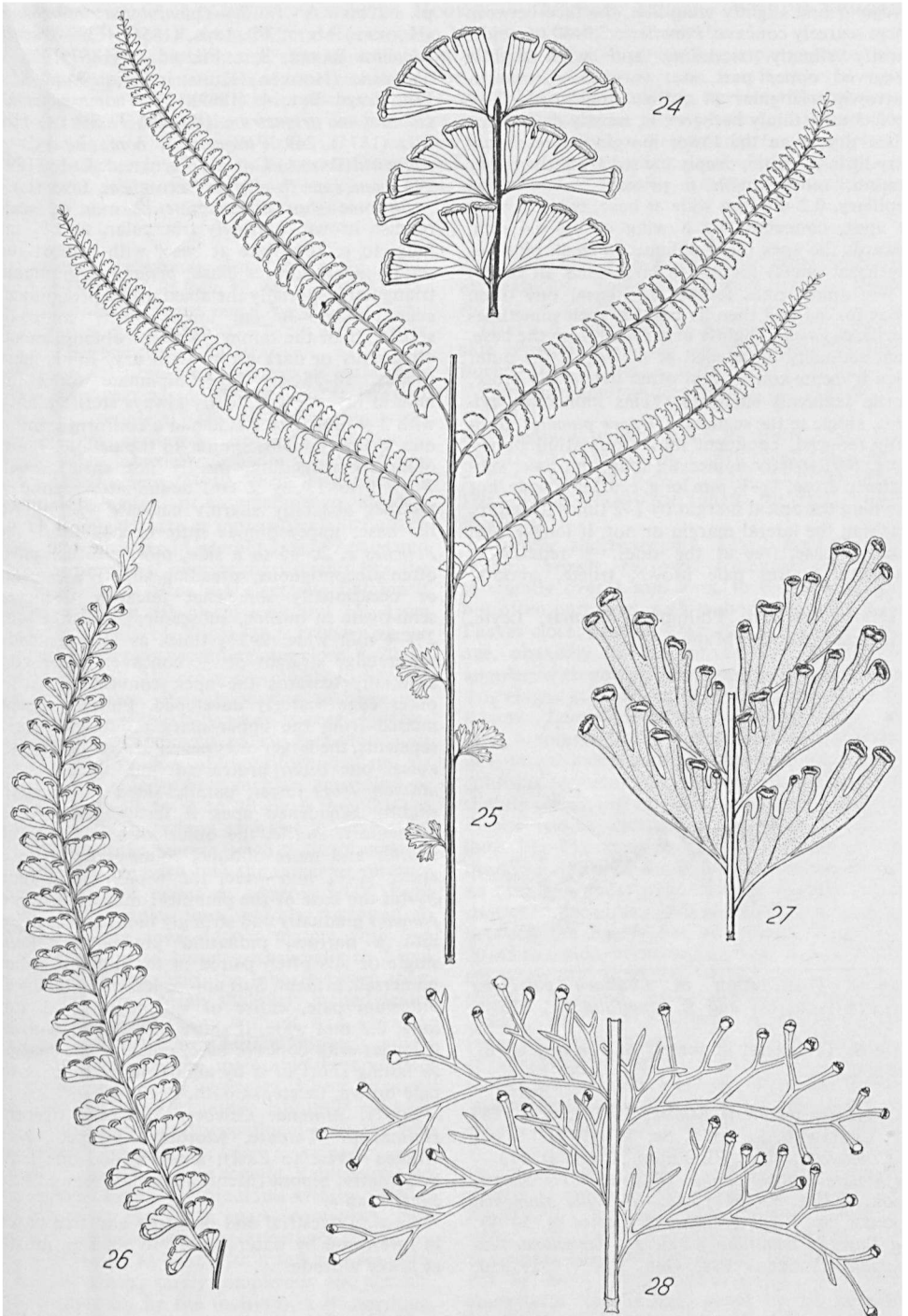
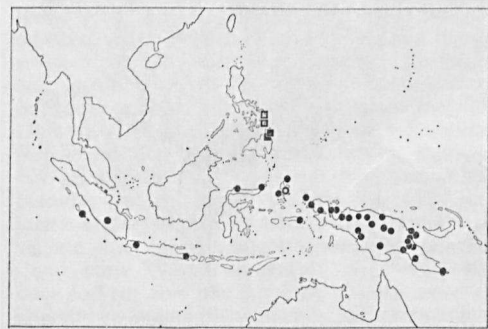


Fig. 24. *Lindsaea adiantoides* J. SMITH. Lower part of lamina, $\times 1\frac{1}{2}$ (EDAÑO 40514).—Fig. 25. *L. kingi* COPEL. Basal part of lamina, $\times \frac{1}{2}$ (BRASS 25622).—Fig. 26. *L. natunae* BAKER. Pinna, nat. size (BÜNNE-MEIJER 5840).—Fig. 27. *L. multisora* v.A.v.R. Part of a pinna, $\times 3\frac{1}{2}$ (KJELLBERG 3515).—Fig. 28. *L. polycytena* KRAMER. Part of a pinna, $\times 6$ (CUMING 309).

irregular and slightly wing-like, the face between them scarcely concave. *Pinnules* c. 20–40 to a side, mostly slightly ascending and with slightly decurved upper part, not very close, curved-narrowly triangular in outline, the largest 7–12 by 2–3 mm, thinly herbaceous, mostly dark green when dry, even the lower margin at base only very little sclerotic, deeply incised from the upper margin, mostly with 6 primary lobes, these capillary, 0.2–0.4 mm wide at base, twice as wide at apex, connected by a wing of 0.2–0.4 mm, towards the apex more oblique, in small pinnules the basal one(s) forked, in large ones all except a few apical ones forked, the basal one often twice forked and then its basal branch sometimes sterile. *Segments* slightly broadened from the base, then suddenly broadened at the sorus, the outer edge truncate-convex and often irregularly erose; sterile segments subacute. Veins immersed, evident, single in the segments. *Upper pinnules* gradually reduced, confluent into a pinnatifid pinna-apex. *Sori* strictly uninerval; indusium pale, subentire to erose, $\frac{1}{4}$ – $\frac{1}{2}$ mm long, c. 0.2 mm wide, not reaching the apical margin by 1–2 times its width, reaching the lateral margin or not, if longer with concave base, free at the sides, \pm reflexed at maturity. Spores pale brown, trilete, smooth. c. 20 μ .

Distr. *Malesia*: Philippines (Samar, Leyte, Mindanao; 8 coll.). Map 4.



Map 4. Distribution of *Lindsaea polycetena* KRAMER (squares) and *L. tenuifolia* BL. (dots).

Ecol. Terrestrial in forest; one record 60 m, one 800 m.

14. *Lindsaea tenuifolia* BLUME, En. Pl. Jav. (1828) 219; COPELAND, Philip. J. Sc. 78 (1949) 17; not of COPELAND, Fern Fl. Philip. 1 (1958) 110.—*Odontoloma tenuifolium* (BLUME) J. SMITH, Hook. J. Bot. 3 (1841) 415.—*Davallia blumeana* HOOKER, Sp. Fil. 1 (1845) 177 (not of pl. 54 A); non *Davallia tenuifolia* SWARTZ.—*Stenoloma blumeanum* (HOOKER) FÉE, Gen. Fil. (1852) 330,

pl. 27bis A f. 2.—*Odontoloma blumeanum* (HOOKER) METT. Fil. Lips. (1856) 104.—*Davallia triquetra* BAKER, Syn. Fil. ed. 1 (1867) 93.—*L. blumeana* (HOOKER) KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 277, *nom. superfl.*—*Odontoloma triquetrum* (BAKER) J. SMITH, Hist. Fil. (1875) 269 ('*triquetra*'), *nom. superfl.*—*L. triquetra* (BAKER) CHRIST, Farnkr. d. Erde (1897) 294, *nom. superfl.*—Type: BLUME s.n., Java (L).

Rhizome short-creeping, c. 2 mm ϕ ; scales reddish brown, narrowly triangular, to $2\frac{1}{2}$ mm long, to c. 10-seriate at base, with a short uniseriate apex. Leaves close; *petioles* stramineous, triangular, especially the abaxial keel pronounced, acute, (5–)15–30 cm long, mostly somewhat shorter than the lamina. *Lamina* oblong, mostly olivaceous or dark green when dry, thinly herbaceous, 10–35 cm long, bipinnate (once pinnate in juvenile but nearly always sterile plants), with 3–9 pinnae to a side and a conform terminal one. Primary rachis similar to the petiole. *Pinnae* obliquely ascending, mostly not close, sessile, 7 by 1 to 15 by 2 cm, acuminate; secondary rachises abaxially sharply carinate virtually to the base; upper pinnae little or not shortened. *Pinnules* c. 20–45 to a side, mostly rather close, often subcontiguous, spreading, slightly ascending, or occasionally somewhat falcately decurved, semi-ovate in outline, subsessile, 5–14 mm long, $2\frac{1}{2}$ –4 mm wide, 2–3 $\frac{1}{2}$ times as long as wide; lower edge straight or \pm concave, upper edge especially towards the apex convex, a distinct outer edge scarcely developed. *Pinnules* deeply incised from the upper margin into 4–6 major segments, the larger ones nearly always forked, the apical one often protracted and pinnatilobate; *ultimate lobes* linear, parallel-sided to near the slightly broadened apex if fertile, rounded or subacute if sterile, the outer ones progressively shorter and more oblique, rounded or erose at apex, $\frac{1}{4}$ – $\frac{3}{4}$ mm wide, the wing joining them $\frac{1}{2}$ –(at the base of the pinnule) 1 mm wide. *Upper pinnules* gradually and strongly reduced, confluent into a narrow, pinnatifid pinna-apex. *Veins* single or less often paired in the ultimate lobes, immersed, evident. *Sori* uni- or less often binerval; indusium pale, entire or subentire, 0.4–1 mm long, 0.2 mm wide, if short with flat or convex, if longer with concave base, reaching the margin to falling short of it by almost its width. Spores pale brown, trilete, smooth, c. 20 μ .

Distr. *Malesia*: Celebes, Moluccas (Ceram, Halmahera, Ternate, Morotai), Waigeu, New Guinea (West to East); a few collections from S. Sumatra, Sipora (Mentawai Is.), West and East Java. Map 4.

Ecol. Terrestrial and on rocks and tree bases, in forest and by watercourses, to 1000 m, mostly at lower altitude.

3. Section *Synaphlebium*

(J. SMITH) DIELS in E. & P. Nat. Pfl. Fam. I, 4 (1902) 221.—*Synaphlebium* J. SMITH, Hook. J. Bot. 3 (1841) 415, *nom. nud.*; in Hooker & Bauer, Gen. Fil. (1842) pl. 101.

Type species: *Synaphlebium recurvatum* HOOKER = *Lindsaea cultrata* (WILLD.) SWARTZ.

Distr. Paleotropical, from India to Taiwan, the Marquesas, and NE. Australia.

Taxon. Lamina bipinnate or subtripinnate, with conform terminal pinna, or simply pinnate; pinnules dimidiate, reticulate-veined; spores trilete. The rhizome is short-creeping, but it may be more long-creeping in exceptionally epiphytic specimens from moist montane habitats. Species with anastomosing veins from other sections have in the past been incorrectly assigned to this section. A few species: *L. crispa* BAKER, *L. malayensis* HOLTUM, *L. napaea* v.A.v.R., usually have irregularly, *i.e.* incompletely anastomosing veins, and the boundary of the section is not entirely sharp. It is particularly close to *sect. Temnolindsaea*. The delimitation of the species meets with unusual difficulties, and the present treatment should by no means be regarded as final.

15. *Lindsaea malayensis* HOLTUM, Gard. Bull. S. S. 5 (1930) 69, f. 8; Rev. Fl. Mal. 2 (1954) 335, f. 194.—*L. subalpina* auct. non v.A.v.R.; HOLTUM, Gard. Bull. S. S. 5 (1930) 71.—Type: Md. HANIFF 4032, G. Kerbau, Perak (SING).

Rhizome short-creeping, 1–2 mm ϕ ; scales medium brown, very narrowly triangular, to $1\frac{3}{4}$ mm long, to c. 5-seriate at base, with a long uniseriate apex. Leaves clustered; *petioles* stramineous, quadrangular, abaxially broadly and shallowly sulcate or flat below, (6–)10–30 cm long, about as long as the lamina, or in small leaves shorter. *Lamina* simply pinnate or more often paucijugate-bipinnate, with one odd lateral pinna to 2 pairs and a conform terminal one; primary rachis like the petiole, abaxially often more sulcate. Lamina if simply pinnate c. 10–20 cm long and $3\frac{1}{4}$ –4 cm wide, if bipinnate 18–30 cm long. *Primary pinnae* (if any) not strongly ascending, not close, 8–20 cm long, 2–4, often $2\frac{1}{2}$ cm wide, mostly rather abruptly acuminate. Pinnule-bearing rachises like the primary, or abaxially more sulcate. *Pinnules* herbaceous to chartaceous, pale to dark olivaceous when dry, rounded-subtrapeziform-ligulate or less often rounded-subrectangular, spreading or \pm ascending, 12 by 4 to 20 by 6 mm, $2\frac{1}{2}$ to almost $3\frac{1}{2}$ times as long as wide; lower margin \pm straight, upper margin often outward convex, outer margin rounded into the upper or meeting both lower and upper at approximately right angles, the pinnules then scarcely narrowed to the subtruncate apex. Upper margin with 3–5 narrow incisions to 1 mm, occasionally to 2 mm ($\frac{1}{3}$ of the width) deep, the lobes between them flattish, the largest rarely shallowly incised again; outer margin with 1 or without any incision; fertile margin often in addition minutely erose; sterile margin with the major incisions equally developed, the lobes crenate. *Upper pinnules* gradually or mostly rather abruptly reduced, some denticuliform ones confluent with the pinatifid terminal segment; *lower pinnules* of simply pinnate leaves often more remote. Veins immersed or adaxially slightly prominulous, evident, once or twice forked, $\frac{1}{2}$ –1 mm apart. connivent. here and there anastomosing, or sometimes quite free, but most leaves at least with a few anastomoses, the row of areoles rarely complete in one pinnule. *Sori* interrupted by the incisions, 1–4 mm long, the one on the outer margin usually continuous with the outermost one of the upper; indusium greenish or brownish, subentire, 0.2–0.3 mm wide, not reaching the margin by an equal or

larger distance, reflexed and often quite concealed at maturity. Spores very pale brown, trilete, smooth, c. 22–25 μ .

Distr. S. Thailand, in *Malesia*: Malay Peninsula (Pahang, Perak). Incorrectly reported from Borneo (Act. Phytotax. Geobot. 22, 1966, 90).

Ecol. In mountain forests, c. 1200–2000 m.

16. *Lindsaea napaea* v.A.v.R. Bull. Jard. Bot. Btzg II, 20 (1915) 19, pl. 3; HOLTUM, Gard. Bull. S. S. 5 (1930) 66; Rev. Fl. Mal. 2 (1954) 330, f. 189.—Type: TEIJSMANN 16616, Mt Dai, Lingga Is. (BO).

Rhizome short-creeping, $1\frac{1}{2}$ –2 mm ϕ ; scales reddish brown, narrowly triangular or linear, to slightly over 1 mm long, to 6-seriate at base but often narrower, with a short uniseriate apex. Leaves close; *petioles* stramineous or darker with age, abaxially flat or convex and laterally bi-angular, with obtuse, downward gradually evanescent ridges, c. 10–30 cm long, about as long as the lamina. *Lamina* broadly ovate, c. 10–25 cm long, bipinnate (rarely simply pinnate and fertile, or subtripinnate), with 1–4 pinnae to a side and a conform terminal one; primary rachis abaxially slightly concave or upward channelled, bi-angular. *Pinnae* sessile, ascending, not close, 10–22 cm long, $1\frac{3}{4}$ – $2\frac{1}{2}$ cm wide, gradually narrowed from the lower third or the middle but more strongly so near the apex; upper pinnae slightly or not shortened. Secondary rachises abaxially bi-angular, between the angles flat or convex. *Pinnules* c. 20–45 to a side, herbaceous, olivaceous or brownish when dry, spreading or a little ascending or slightly decurved, often subcontiguous, evenly spaced, 10–12 by 3–4 mm, ligular or trapeziform, truncate-rounded or narrowed-rounded at apex; upper margin very faintly sinuate or more often with 3 or 4 oblique incisions, the inner very shallow, the outer a little deeper but not reaching to $\frac{1}{3}$ of the width; outer margin mostly not incised; sterile pinnules crenate-sinuate on the upper and outer margin. *Upper pinnules* strongly reduced, some denticuliform ones confluent with the caudate pinna-apex. Veins immersed, not evident, mostly twice forked, $\frac{1}{2}$ – $\frac{2}{3}$ mm apart, very oblique, free or less often connivent or more freely anastomosing. *Sori* rarely continuous, mostly interrupted by the incisions, the sorus on the outer margin mostly continuous with the outermost one of the upper margin. *Sori* of completely fertile pinnules straight or the outer ones slightly convex, mostly on 2–6

veins. Indusium entire, $\frac{1}{6}$ – $\frac{1}{5}$ mm wide, not reaching the margin by less than its width, reflexed and \pm concealed at maturity. Spores pale brown, trilete, smooth, *c.* 17–19 μ .

Distr. S. Peninsular Thailand, in *Malesia*: Malay Peninsula (Perak, Pahang, Penang, Selangor, Kelantan, Negri Sembilan, Kedah, Malacca), Lingga Is., W. Sumatra, Siberut.

Ecol. Terrestrial and epilithic, in mountain forests, *c.* 1000–1300 m, apparently of local occurrence.

Note. The three collections from Sumatra and Siberut have more regularly anastomosing veins than the others, but are otherwise not aberrant.

17. *Lindsaea subalpina* v.A.v.R. Bull. Jard. Bot. Btzg II, 23 (1916) 15; not of HOLTUM, Gard. Bull. S. S. 5 (1930) 71.—Type: AJOEB 388, Rimbo Pengadang, Bencoolen, Sumatra (BO); dupl. in L).—Fig. 33.

Rhizome short-creeping, *c.* 2 mm ϕ ; scales (few seen) reddish brown, narrowly triangular, $\frac{2}{3}$ mm long, to 4-seriate at base, with a very short uniseriate apex. Leaves close; *petioles* stramineous to pale reddish brown, stout, quadrangular with shallowly sulcate sides, *c.* 15–30 cm long, about as long as the lamina. *Lamina* simply pinnate, linear, *c.* 15–40 cm long, $4\frac{1}{2}$ – $5\frac{1}{2}$ cm wide; rachis similar to the petiole. *Pinnules* *c.* 12–30 to a side, spreading or slightly ascending, firmly herbaceous, mostly dark green when dry, usually not contiguous, elongate-parallelogram-shaped to ligular, 2 by 0.6 to $3\frac{1}{2}$ by 1 cm, 3– $3\frac{1}{2}$ times as long as wide, subsessile, little narrowed to the apex, this rounded or occasionally caudate-protruded; upper margin with 5–7 major incisions, these rather oblique, reaching $\frac{1}{4}$ – $\frac{1}{3}$ down, narrow, the largest lobes sometimes more shallowly incised again; lobes slightly convex, often erose. Sterile pinnules not seen. Relatively few *upper pinnules* reduced, mostly one of *c.* $\frac{3}{4}$ cm adnate to the narrow, lanceolate, lobed terminal segment. Veins immersed but evident, especially above, very oblique, regularly anastomosing, often with 2 series of areoles between the two margins, almost 1 mm apart at the vein-bases. *Sori* single in the lobes, usually on 4–8 veins, the one on the outer margin often continuous with the outermost of the upper; indusium pale, erose, $\frac{1}{4}$ – $\frac{1}{3}$ mm wide, not reaching the margin by about the same distance or less, reflexed and \pm concealed at maturity. Spores pale brown, trilete, smooth, *c.* 19–22 μ .

Distr. *Malesia*: Sumatra (Bencoolen, 5 coll., West Java (1 coll.)).

Ecol. Terrestrial in forest, 600–1000 m.

18. *Lindsaea obtusa* J. SMITH in Hooker, Sp. Fil. 1 (1846) 224.—Type: CUMING 394, Malacca (K; dupl. in B, E, GH, P, W).

? *L. tripartita* BLUME, En. Pl. Jav. (1828) 219.—Type: BLUME *s.n.*, Java (L).

? *L. ambigens* CESATI, Rendic. R. Accad. Sci. Fis. Mat. Napoli 16 (1877) 25, *nom. subnud.*—Type: BECCARI *s.n.*, Andai, Papua (*n.v.*).

L. schultzei BRAUSE, Bot. Jahrb. 49 (1912) 29.—

Type: SCHULTZE 3049, Sepik R., Terr. of New Guinea (B).

L. decomposita WILLD. *f. minor* v.A.v.R. Bull. Jard. Bot. Btzg II, 7 (1912) 21.—Type: KING 48 'p.p.', Papua (BO).

L. ceramica v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 32.—Type: KORNASSI 707, Ceram (BO).

? *L. sinuato-crenata* v.A.v.R. Nova Guinea 14 (1924) 30; COPELAND, Philip. J. Sc. 78 (1949) 20.—Type: H. J. LAM 1888, mountain ridge near Doormantop, W. New Guinea (L).

L. decomposita WILLD. *f. longipinnula* v.A.v.R. Nova Guinea 14 (1924) 30.—Type: H. J. LAM 1163, near Prauwenbivak, Mamberamo R., W. New Guinea (BO; dupl. in L).

L. furcata COPELAND, Un. Cal. Publ. Bot. 18 (1942) 218; Philip. J. Sc. 78 (1949) 21, pl. 4.—Type: BRASS 13229, Bernhard Camp, Idenburg R., W. New Guinea (MICH; dupl. in GH, L).

L. decomposita *auct. non* WILLD.; COPELAND, Philip. J. Sc. 78 (1949) 20.

L. davallioides *auct. non* BLUME; HOLTUM, Gard. Bull. S. S. 5 (1930) 69, f. 7; Rev. Fl. Mal. 2 (1954) 332, f. 190.—Fig. 31.

Rhizome short-creeping, 1– $2\frac{1}{2}$ mm, usually $1\frac{1}{2}$ mm ϕ ; scales medium brown, narrowly triangular, to $1\frac{1}{2}$ mm long, to 4-seriate at base, with a rather short uniseriate apex. Leaves close (less so in epiphytic plants); *petioles* stramineous or in mature specimens mostly medium to dark brown or blackish, sometimes pale-margined or mottled, \pm sharply quadrangular and mostly somewhat sulcate, *c.* 10–30 cm long, $\frac{1}{2}$ as long as to equaling the lamina. *Lamina* simply pinnate or in full-grown plants mostly bipinnate, with 1 or 2, less often with 3 pairs of pinnae (very rarely the basal pinnae forked) and a conform terminal one; primary rachis like the petiole. *Pinnae* mostly subopposite, obliquely ascending, 10–20 cm long, $1\frac{1}{2}$ –3 cm wide (simply pinnate laminae may be wider), widest in the lower half, gradually and strongly narrowed to the usually long-acuminate apex; secondary rachises abaxially bi-angular, mostly distinctly sulcate, usually pale. *Pinnules* herbaceous to chartaceous, mostly rather dark when dry, *c.* 20–35 to a side, mostly distinctly ascending, close but hardly contiguous, the basal ones of simply pinnate leaves often more remote, ligulate to subtrapeziform, the larger ones 10–16 mm long and 5–7 mm wide, nearly always slightly over twice as long as wide, narrowed from the base to the broadly rounded or subtruncate apex, less often of almost equal width from base to apex, the upper margin straight at the base, outward convex. *Upper pinnules* gradually and strongly reduced, mostly some denticuliform ones present below the crenate-pinnatifidate pinna-apex. Upper and outer margins of pinnules incised, mostly with 3–5 narrow, oblique incisions usually less than 1 mm (but in extreme cases to 2 mm) deep; margin otherwise minutely but distinctly crispate and/or erose. Lobes of fertile pinnules, especially the inner ones, flat, truncate, not convex. Veins immersed and often obscure, mostly twice

forked, regularly anastomosing, forming one or sometimes towards the apex of the pinnule two series of areoles; larger areoles to 1 mm wide. *Sori* interrupted by the incisions, variable in size, the innermost one often quadrinerval, the outer ones bi- or trinerval, but often on more or fewer vein-ends. Indusium subentire or, if broader, often erose, very variable in width, 0.2–0.7 mm wide, not reaching the margin by $\frac{1}{2}$ –1 times its width, bulging but hardly reflexed at maturity. Spores pale yellowish, trilete, smooth, c. 24 μ .

Distr. Taiwan; throughout *Malesia* (but absent from the Lesser Sunda Is. except Bali), east to the Solomon Is. and the Bismarck Archipelago; Micronesia, Queensland.

Ecol. In primary forest, often on banks, on rocks, by or on tree bases, from sea-level up to 2000 m, mostly below 1500 m.

Notes. As defined here this is one of the most common and widespread species of SE. Asia. It is exceedingly variable, and the extremes look quite distinct. In E. *Malesia* and W. *Melanesia* a form occurs with indusia 0.2–0.35 mm wide, less than half their width removed from the edge, pinnule lobes not rarely concave and then sometimes laterally subcorniculate, thinner texture, and truncate, subrectangular pinnules; it may represent a distinct infraspecific taxon. It occurs, however, together with the more widespread form, with large numbers of intermediates, and classification on the basis of herbarium material alone seems at present impossible.

The type of *L. tripartita* BLUME is largely sterile, and it is impossible to ascertain which species it really represents. The type of *L. sinuato-crenata* V.A.v.R. is a diseased or for another reason malformed leaf; it probably belongs to the present species. The type of *L. schultzei* BRAUSE is a specimen with extremely narrow pinnules (4 by 18 mm); it may represent a distinct taxon.

19. *Lindsaea longifolia* COPELAND, Philip. J. Sc. 38 (1929) 145, pl. 3; Fern Fl. Philip. 1 (1958) 109.—Type: REILLO B. Sc. 16227, Basilan, Philippines (MICH; dupl. in B, P).—Fig. 30.

Rhizome short-creeping, 2 mm \varnothing ; scales rather dark brown, narrowly triangular, to $\frac{1}{4}$ mm long, to 8-seriate at base, with a short uniseriate apex. Leaves crowded; *petioles* c. 10–40 cm long. $\frac{1}{2}$ –2 times as long as the lamina, stramineous or reddish brown or darker with age, at least in the upper part obtusely to sharply bi-angular, often also sulcate. *Lamina* bipinnate (rarely simply pinnate and fertile, or subtripinnate), 12–35 cm long, with 1–5 pinnae to a side and a conform but often longer terminal one; primary rachis abaxially bi-angular, sulcate. *Pinnae* strongly ascending, $2\frac{1}{2}$ cm distant, linear, 10–25 by 0.7–2 cm, long-acuminate; secondary rachises abaxially bi-angular to shallowly sulcate. *Pinnules* c. 30–40 to a side, herbaceous, mostly dark green when dry, close, subcontiguous to overlapping, ascending or the lower ones spreading, 7–10 by $3\frac{1}{2}$ –5 mm (rarely smaller, 5 by $2\frac{1}{2}$ mm), $1\frac{1}{2}$ – $2\frac{1}{2}$ times as long as wide, subovate to dimidiate-

subglulate, very obtuse, little narrowed to the rounded apex; upper/outer margin with 1–3 incisions, these in large pinnules $\frac{1}{2}$ – $\frac{1}{3}$ mm deep, in small ones sometimes deeper; margin otherwise entire; sterile margin shallowly crenate. *Upper pinnules* \pm entire, gradually and very strongly reduced, several denticuliform ones confluent with the small, narrow pinna-apex. Veins immersed, not evident, mostly twice forked, forming a (sometimes incomplete) series of areoles $\frac{1}{2}$ – $\frac{2}{3}$ mm wide. *Sori* interrupted by the incisions, mostly tri- or quadrinerval, longer in upper, entire pinnules. Indusium pale, subentire, 0.3 mm wide, not reaching the margin by 0.2 mm, little reflexed at maturity. Spores pale yellowish, trilete, smooth, c. 25 μ .

Distr. *Malesia*: Philippines (Luzon, Mindanao, Polillo, Samar, Leyte, Catanduanes, Panay, Biliran, Basilan).

Ecol. Terrestrial, in mountain forests (always?).

20. *Lindsaea ramosii* COPELAND, Philip. J. Sc. 38 (1929) 144, pl. 2; Fern Fl. Philip. 1 (1958) 110.—Type: RAMOS B. Sc. 7652, Cagayan Prov., Luzon (MICH).

Very similar to *L. longifolia*; pinnules small, 7 by 4 to 5 by 3 mm, more rounded, not incised.

Distr. *Malesia*: Philippines (Luzon, 4 coll.).

Note. Very doubtfully distinct from *L. longifolia*.

21. *Lindsaea lobata* POIRET in Lamk, Encycl. Suppl. 3 (1813) 448.—*Adiantum lobatum* (POIRET) POIRET ex STEUDEL, Nomenkl. 2 (1824) 275, *nom. invalid. in syn.*; non PRESL (1825), *nec* KUNZE ex KUHN (1881).—*Davallia lobata* (POIRET) DESVAUX, Prod. (1827) 315.—*Schizoloma lobatum* (POIRET) BEDD. Ferns S. Ind. & Br. Ind. Suppl. (1876) 6, *quoad typum*.—Type: COMMERSON *s.n.*, Java (P).

L. davallioides BLUME, En. Pl. Jav. (1828) 218; HOOKER, Sp. Fil. 1 (1846) 224, pl. 68 A; DIELS in E. & P. Nat. Pfl. Fam. I, 4 (1902) 221, f. 119 G; BACKER & POSTHUMUS, Varenfl. Java (1939) 115, f. 22; not of HOLTUM, Rev. Fl. Mal. 2 (1954) 332.—*Synphlebium davallioides* (BLUME) J. SMITH, Lond. J. Bot. 1 (1842) 424.—*Davallia kunzeana* HOOKER, Sp. Fil. 1 (1845) 177.—*Schizoloma davallioides* (BLUME) MOORE, Ind. Fil. (1857) 35.—*L. decomposita* WILLD. var. *davallioides* (BLUME) DOMIN, Bibl. Bot. 20 (1915) 84.—Type: BLUME *s.n.*, Java (L; dupl. in P).

L. lobata POIRET var. *incisa* METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 277.—Lectotype: ZOLLINGER 1087, Java (L; dupl. in B, HBG) (the other coll. cited, ZOLLINGER II 381, is *L. obtusa*).

Rhizome short-creeping, $1\frac{1}{2}$ –2 mm \varnothing ; scales dark reddish brown, narrowly triangular, to 2 mm long, to c. 10-seriate at base, with a short uniseriate apex. Leaves clustered; *petioles* stramineous to pale brown, quadrangular, occasionally with paler angles, abaxially flat to shallowly sulcate, at the base often dark-verruculose, 8–45 cm long, equaling to over twice as long as the

lamina. *Lamina* bipinnate (very rarely once pinnate and fertile), with 1–4, most often 2 or 3 pinnae to a side and a conform terminal one; primary rachis like the petiole, often more distinctly pale-margined, abaxially usually sulcate. *Pinnae* ascending, sessile, linear, their width apart to contiguous, 10–20 cm long, 1.7–2.5 cm wide, widest in the lower third or the middle, gradually and strongly tapering to the often long-acuminate apex; terminal pinna often the longest and widest; secondary rachises abaxially broadly and \pm shallowly sulcate, sometimes pale-margined. *Pinnules* *c.* to a side, half their width apart to contiguous, spreading or mostly ascending, herbaceous, medium to dark or blackish green when dry, translucent, $\frac{1}{4}$ -elliptic, narrowed and obtuse to subacute, 7–15 mm long, $2\frac{1}{2}$ –5 (often 4) mm wide, $2\frac{1}{2}$ –3 times as long as wide, almost evenly narrowed throughout, the upper margin outward increasingly convex, with 3 or 4 major incisions, the inner ones reaching to $\frac{1}{4}$ or $\frac{1}{3}$, or rarely to $\frac{1}{2}$, the outer ones to $\frac{1}{2}$ or slightly beyond, with acute sinus; at least the broader lobes with convex outer margin, the lateral margins almost parallel, the major ones often shallowly incised again, otherwise entire, a distinct outer margin not developed. *Upper pinnules* strongly reduced, some denticuliform ones confluent with the narrow, \pm caudiform terminal segment. Veins immersed, evident, mostly twice forked, regularly anastomosing, with one series of areoles, one under each incision, *c.* $\frac{3}{4}$ mm wide, the lobes containing 2–5 vein-ends. *Sori* joining all vein-ends of a lobe; receptacle at least in larger lobes distinctly convex; indusium pale, entire, 0.3–0.4 mm wide, reaching the margin or very nearly so, \pm reflexed at maturity; sporangia often spreading beyond the pinnule margin. Spores rather pale brown, trilete, smooth or almost so, *c.* 21–23 μ .

Distr. Malesia: Sumatra, West and Central Java, Lesser Sunda Is. (Bali, Sumba, Flores), Borneo, Celebes, Philippines (rare and local), New Guinea (rare), Admiralty Is.; a few doubtful collections from the Malay Peninsula; Caroline Is. Distinct varieties in Hainan and Indo-China. Records from elsewhere are due to confusion with related species.

Ecol. Terrestrial or on tree bases in primary forest, 50–1800, mostly 600–1500 m.

Note. In West Java, where this species is common, it is very homogeneous. Specimens from elsewhere, where it is much rarer, are often somewhat aberrant. There may be some hybridization with related species.

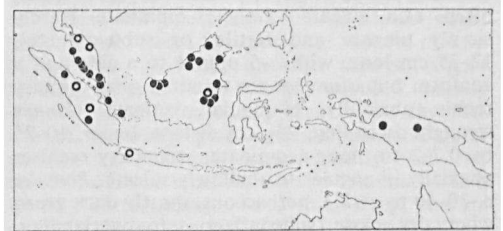
22. *Lindsaea parallelogramma* v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 212; HOLTUM, Gard. Bull. S. S. 5 (1930) 70, f. 9; Rev. Fl. Mal. 2 (1954) 335, f. 193.—Type: BÜNNEMEIJER 7359, Mt Tjikalu, P. Singkep, Lingga Is. (BO; dupl. in L).

L. davallioides BLUME *f. parallelogrammoides* v.A.v.R. Nova Guinea 14 (1929) 31.—Type: H. J. LAM 859, near Prauwenbivak, W. New

Guinea (BO; dupl. in L).—Fig. 29.

Rhizome short-creeping, $1\frac{1}{2}$ –2 mm ϕ ; scales fawn-coloured, narrowly triangular, to 2 mm long, up to *c.* 10-seriate at base, with a rather short uniseriate apex. Leaves close; *petioles* characteristically olivaceous-brown, dull, sharply quadrangular, adaxially channelled and pale-margined, *c.* 15–30 cm long, $1\frac{1}{2}$ –2 times as long as the lamina. *Lamina* bipinnate, broadly oblong, sometimes wider than long (rarely simply pinnate and fertile, then linear), *c.* 10–20 cm long, with 1–4 pairs of lateral pinnae and a conform terminal one; primary rachis similar to the petiole, abaxially channelled. *Pinnae* patent or ascending, often contiguous, sessile, *c.* 8–18 cm long, 2–3 $\frac{1}{2}$ cm wide, the upper ones little or not shortened; secondary rachises similar to the primary, abaxially sulcate and pale-edged. *Pinnules* *c.* 15–30 to a side, mostly somewhat ascending, scarcely to slightly contiguous, herbaceous, mostly drying dark brownish green, not translucent, parallelogram-shaped, the larger 9–14 mm long, 3–5 mm wide, $2\frac{1}{2}$ to nearly 3 times as long as wide (except when the apex is caudiform), very little or not narrowed to the obliquely truncate apex. Upper and outer margin obliquely incised, the upper usually with 4, the outer with 1 incision, those of the upper margin reaching $\frac{1}{4}$ – $\frac{1}{3}$ ($-\frac{1}{2}$), the apical ones often $\frac{1}{2}$ ($-\frac{2}{3}$); lobes parallel-sided, convex, entire or minutely erose, the basal, broadest often with a shallow incision; sinus narrow, acute. Some pinnules occasionally caudate-protracted at the apex. *Upper pinnules* rather suddenly strongly reduced, several denticuliform ones confluent with the caudate, linear pinna-apex. Veins immersed or slightly raised, mostly evident, regularly anastomosing, forming a series of areoles $\frac{1}{2}$ mm wide below the level of the incisions, rarely the larger lobes with another series. *Sori* one per lobe, up to *c.* 2 mm long, bi- to quadri-, mostly trinerval; indusium $\frac{1}{6}$ – $\frac{1}{4}$ mm wide, entire, not reaching the margin by less than its width to about twice its width, reflexed at maturity. Spores very pale brown, trilete, smooth, *c.* 17–20 μ .

Distr. Malesia: Peninsular Thailand, Malay Peninsula, Singapore, Lingga Is., Banka, Sumatra, Java (very rare, no recent collections), Borneo (apparently quite common), New Guinea (a few collections from W. New Guinea and the Territory of New Guinea). Map 5.



Map 5. Distribution of *Lindsaea parallelogramma* v.A.v.R. Several localities, mainly in Borneo, could not be located.

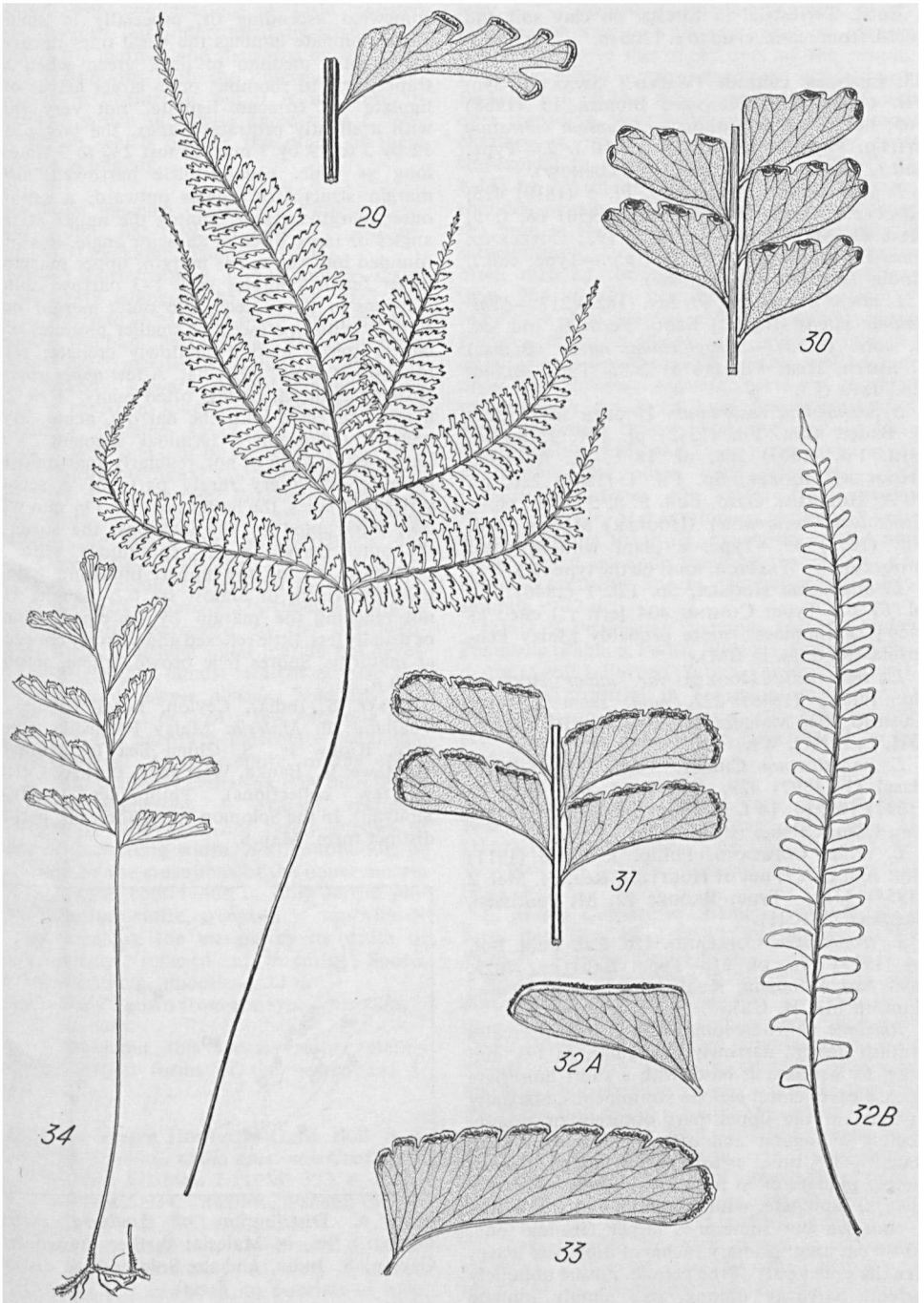


Fig. 29. *Lindsaea parallelogramma* v.A.v.R. Leaf, $\times \frac{1}{2}$, pinnule, $\times 2\frac{1}{2}$ (BROOKE 9482).—Fig. 30. *L. longifolia* COPEL. Part of a pinna, $\times 2\frac{1}{2}$ (WENZEL 585).—Fig. 31. *L. obtusa* J. SMITH in HOOKER. Part of a pinna, $\times 2$ (BAKHUIZEN VAN DEN BRINK 6630).—Fig. 32. *L. integra* HOLT. A. Pinnule, $\times 2$; B. Leaf, $\times \frac{1}{2}$ (WRAY 3674).—Fig. 33. *L. subalpina* v.A.v.R. Pinnule, $\times 1\frac{1}{2}$ (BAKHUIZEN VAN DEN BRINK 3360).—Fig. 34. *L. modesta* KRAMER. Leaf, nat. size (AET & IDJAN 297).

Ecol. Terrestrial in forests, on clay soil and rocks, from sea-level up to c. 1200 m.

23. *Lindsaea cultrata* (WILLD.) SWARTZ, Syn-Fil. (1806) 119; KRAMER, Blumea 15 (1968) 565; not of other authors.—*Adiantum cultratum* WILLD. Phytogr. (1794) 14, pl. 10 f. 2.—Type: coll.?, 'Malabar' (B, herb. WILLDENOW).

L. decomposita WILLD. Sp. Pl. 5 (1810) 425; HOLTUM, Gard. Bull. S. S. 5 (1930) 66, f. 5; Rev. Fl. Mal. 2 (1954) 333, f. 192; COPELAND, Fern Fl. Philip. 1 (1958) 111, p.p.—Type: coll.?, 'India' (B, herb. WILLDENOW).

L. nitens BLUME, En. Pl. Jav. (1828) 217.—*Schizoloma nitens* (BLUME) BEDD. Ferns S. Ind. ed. 2, corr. (1873).—*Synphlebium nitens* (BLUME) J. SMITH, Hist. Fil. (1875) 268.—Type: BLUME s.n., Java (L).

Synphlebium recurvatum HOOKER in Hooker & Bauer, Gen. Fil. (1842) pl. 101; J. SMITH, Hist. Fil. (1875) 268, pl. 18 c.—*L. recurvata* (HOOKER) HOOKER, Sp. Fil. 1 (1846) 220, pl. 70 A; HOLTUM, Gard. Bull. S. S. 5 (1930) 66.—*Schizoloma recurvatum* (HOOKER) MOORE, Ind. Fil. (1857) 35.—Type: a plant without data, prob. coll. by WALLICH, must be the type (K).

L. intermedia HOOKER, Sp. Fil. 1 (1846) 222, pl. 67 B.—Type: CUMING 404 [err. (?) cited as '464'] 'Philippines', more probably Malay Peninsula (K; dupl. in BM).

L. intermedia HOOKER var. *minor* HOOKER, Sp. Fil. 1 (1846) 222, nom. *subnud.*—Type: CUMING 392, Malacca (K; dupl. in B, BM, E, GH, L, SING, W).

L. sarasinorum CHRIST, Verh. Naturf. Ges. Basel 11 (1897) 429; Ann. Jard. Bot. Btzg 15 (1897) 101, pl. 14 f. 13 (poor).—Type: SARASIN s.n., Ussu, Celebes (P).

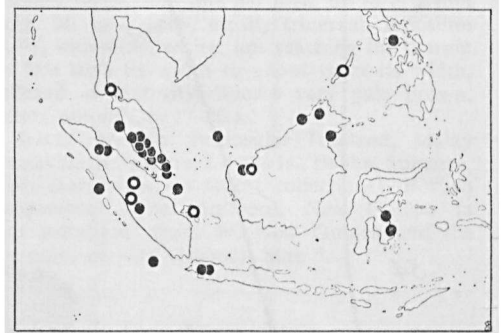
L. nitida COPELAND, Philip. J. Sc. 6 (1911) Bot. 138, pl. 21; not of HOLTUM, Rev. Fl. Mal. 2 (1954) 333. —Type: BROOKS 12, Mt Penrissen, Sarawak (MICH).

L. trapezoidea COPELAND, Un. Cal. Publ. Bot. 14 (1929) 376, pl. 61.—Type: BARTLETT 7029, near Aek Kanopan, Kuala, Sumatra (UC, n.v.; dupl. in MICH, US).

Rhizome short-creeping, 1½–2 mm ø; scales reddish brown, narrowly triangular, to 1½ mm long, to 8-seriate at base, with a short uniseriate apex. Leaves close; *petioles* stramineous, abaxially at least in the upper part obtusely or usually acutely bi-angular and often sulcate, 10–40 cm long, ½–1½ times as long as the lamina. *Lamina* simply pinnate or in full-grown plants (probably always) bipinnate, with 1–2 pinnae to a side and a conform but sometimes larger terminal one, 10–30 cm long; primary rachis of bipinnate leaves like the upper part of the petiole. *Pinnae* obliquely patent, narrowly oblong, like simply pinnate laminas, 10–20 cm long, 2–4 cm wide, acute or shortly, rarely more long-acuminate; pinnule-bearing rachises abaxially sharply bi-angular or shallowly sulcate, the edges sometimes slightly wing-like. *Pinnules* c. 12–30 to a side, less than their width apart to contiguous, spreading to

somewhat ascending or, especially in smaller, simply pinnate laminas the basal ones decurved, herbaceous, medium to dark green when dry, trapeziform to rhombic, or in larger leaves often ligulate or truncate-ligulate, not very rarely with a slightly protracted apex, the larger ones 12 by 3 to 19 by 7 mm, almost 2½ to 3 times as long as wide, usually little narrowed; upper margin straight or convex outward, a separate outer margin present, joining the upper at right angles or more often at an acute angle, less often rounded into the upper margin; upper margin of larger fertile pinnules with 1–3 narrow oblique incisions to 1 mm deep, the outer margin occasionally with one incision; smaller pinnules often entire; sterile margin shallowly crenate; fertile margin not erose; lobes flat. A few *upper pinnules* strongly reduced, or less often many, 1 or 2 or a few connected with the narrow, acute, asymmetrically lanceolate terminal segment. Veins immersed, evident or not, regularly anastomosing, forming one (very rarely parts of a second) series of areoles, the larger ones ¾–1¼ mm wide. *Sori* interrupted by the incisions, the sorus on the outer margin mostly continuous with the outermost one of the upper. Indusium pale or greenish, entire or almost so, 0.2–0.3 mm wide, not reaching the margin by an equal distance or usually less, little reflexed and scarcely concealed at maturity. Spores pale brown, trilete, smooth, c. 20 µ.

Distr. S. India?, Ceylon, Botel Tobago, S. Thailand; in *Malesia*: Malay Peninsula, Singapore, Riouw Is., S. China Sea Is., Sumatra, Mentawai Is., Banka, West Java, Borneo, Celebes (a few collections), Philippines (Palawan, Sibuyan). In the Solomon Is. an aberrant, perhaps distinct form. Map 6.



Map 6. Distribution of *Lindsaea cultrata* (WILLD.) Sw. in Malesia; further known from Ceylon, S. India, and the Solomons (a distinct form).

Ecol. Terrestrial in forests, up to c. 1300 m; often locally frequent.

Note. The name *L. decomposita*, under which this species was known for a long time, has been greatly misused for various species of *sect. Syna-*

phlebium. The combination of little reduced upper pinnules, sori interrupted by shallow incisions of the margin, and the sorus on the outer margin continuous with the outermost one on the upper, is distinctive, but it is not rare to find plants which otherwise agree with *L. cultrata* but in which one or the other of these characters is missing.

24. *Lindsaea papuana* COPELAND, Philip. J. Sc. 7 (1912) Bot. 68; *ibid.* 78 (1949) 21.—Type: KING 358, Lakekamu, Papua (MICH).

Rhizome short-creeping, c. $1\frac{1}{4}$ mm σ ; scales very narrowly triangular to acicular, to 3 mm long, to 7-seriate at base but often the apical half uniseriate, the basal half biseriate almost to base. Leaves close; *petioles* stramineous. abaxially below obtusely, upward acutely bi-angular and sulcate, c. 12–30 cm long, $1-1\frac{1}{2}$ times as long as the lamina. *Lamina* 15–22 cm long, simply pinnate or with one pair of pinnae to 15 cm long and a conform terminal one; rachises like the upper part of the petiole. *Pinnules* c. 20–30 a side, dark olivaceous when dry, herbaceous, spreading, the upper ones subcontiguous, the lower ones their width apart; larger pinnules asymmetrically elongate-triangular to subglugate, 18 by 6 to 30 by 9 mm, $3-3\frac{1}{2}$ times as long as wide, not much narrowed to the narrowed-rounded apex, a distinct outer margin not developed; both margins almost straight at base and convex outward. *Upper pinnules* gradually and strongly reduced, 1 or 2 of a few mm long connected with the narrowly lanceolate acuminate terminal segment. *Margins* entire, or the upper remotely and shallowly crenate; sterile margin not seen. Veins immersed, \pm evident, regularly anastomosing, with 1 or not rarely 2 rows of areoles of fluctuating width. *Sori* continuous, or interrupted by the crenations of the upper margin (probably quite continuous in fully fertile pinnules). Indusium entire, greenish, $\frac{1}{4}$ mm wide or less, not reaching the margin by its width or more, scarcely reflexed at maturity. Spores light brown, trilete, smooth, c. 23 μ .

Distr. Only known from the type collection.

Ecol. No data.

Note. In habit this species rather closely resembles certain forms of the neotropical *L. arcuata* KUNZE.

25. *Lindsaea integra* HOLTUM, Gard. Bull. S. S. 5 (1930) 67, f. 6.—*L. nitida* auct. non COPELAND; HOLTUM, Rev. Fl. Mal. 2 (1954) 333, f. 191.—Type: HOLTUM 20934, Tahan R., Pahang (SING; dupl. in BM, BO, K, US).—Fig. 32.

Rhizome short-creeping, $1\frac{1}{2}$ –2 mm σ ; scales medium brown, narrowly to very narrowly triangular, to $1\frac{1}{4}$ mm long, to 6-seriate at base, with a long uniseriate apex. Leaves clustered; *petioles* sharply quadrangular almost throughout, reddish, abaxially in the upper part mostly pale and somewhat wing-angled, rarely stramineous, 2–20 cm long, much shorter than to about equaling the lamina. *Lamina* linear, 8–22 cm

long, $1-2\frac{1}{2}$ cm wide (wider if bipinnate), simply pinnate, or rarely with one pair of pinnae; rachis similar to the upper part of the petiole, abaxially nearly always distinctly wing-angled. *Pinnules* c. 6–30 to a side, ascending or the lower ones spreading, their width apart to contiguous, chartaceous, mostly olivaceous when dry, sub-trapezoidal to semi-ovate, the larger ones 7–12 (–15) by $3\frac{1}{2}$ –6 (–7) mm, twice as long as wide, rounded or subtruncate at apex, narrowed from the base to the rounded apex, or, especially if subtruncate, little narrowed, the outer margin often meeting the upper at an angle of less than 90° . *Lower pinnules* sometimes slightly remote; a few (more in larger leaves) *upper pinnules* rather suddenly but not strongly reduced, rarely less than half as long as the larger ones, the terminal segment narrowly rhombic to lanceolate, c. $\frac{1}{2}$ –1 cm long, free or almost so. Veins immersed, little evident, not very regularly anastomosing, with one (very rarely two) series of areoles, the outer veins often (in small pinnules sometimes all veins) free; areoles $\frac{1}{2}$ – $\frac{3}{4}$ mm wide. *Sori* continuous, uniting all vein-ends; indusium subentire, brownish, 0.3–0.4 mm wide, almost or quite reaching the margin, reflexed at maturity. Spores pale yellowish, trilete smooth, c. 22 μ .

Distr. S. Peninsular Thailand; *Malesia*: Malay Peninsula (Pahang, Perak, Malacca, Selangor), Sumatra (1 coll.), Borneo (Sabah, Sarawak, Brunei).

Ecol. Terrestrial in forest, often (always?) by streams on rocks; from c. 100–1200 m; few ecological data. Reported to be a rheophyte by ASHTON, Sarawak.

26. *Lindsaea azurea* CHRIST, Verh. Naturf. Ges. Basel 11 (1897) 429; Ann. Jard. Bot. Btzig 15 (1897) 101, pl. 14 f. 12; COPELAND, Philip. J. Sc. 78 (1949) 21.—Type: SARASIN *s.n.*, Ussu, Celebes (P).

L. azurea CHRIST var. *mambae* v.A.v.R. Bull. Jard. Bot. Btzig II, 7 (1912) 21.—Type: KING 48 'p.p.', Mamba, Papua (BO).

Rhizome short-creeping, 2–3 mm σ ; scales reddish brown, narrowly triangular, to 2 mm long, to c. 8-seriate at base, with a short uniseriate apex. Leaves close; *petioles* stramineous to pale brown, or darker with age, abaxially subterete, upwards obtusely or less often acutely bi-angular, 20–35 cm long, about equaling the lamina. *Lamina* oblong, c. 15–35 cm long, with 2–4 pinnae to a side and a conform terminal one (rarely simply pinnate but fertile); primary rachis similar to the upper part of the petiole, rarely shallowly sulcate. *Pinnae* obliquely ascending, sessile, 12–25 cm long, $1\frac{1}{2}$ – $2\frac{1}{2}$ cm wide, widest in the lower third or in the middle, gradually and strongly tapering at the tip. Secondary rachises abaxially terete at the base, upward gradually bi-angular, or bi-angular almost to the base, usually little sulcate. *Pinnules* c. 25–40 to a side, spreading or little ascending, mostly subcontiguous, rounded-trapeziform, the larger ones 9–15 by 4–7 mm, about twice as long as wide; apex rounded, but

the outer margin distinct, especially from the lower, forming an angle of about 90° with the slightly convex upper margin. Margins entire, or shallowly crenate if sterile; texture firmly herbaceous, dark green and ± glossy above when dry, sometimes described as bluish in the living state. *Upper pinnules* strongly reduced, several denticuliform ones connected with the small, narrow terminal segment. Veins immersed, evident, not very oblique, regularly anastomosing, with one, occasionally part of a second series of areoles; larger areoles ½–1 mm wide. *Sori* in completely fertile pinnules continuous on upper and outer margin; indusium entire, 1/8–¼ mm wide, not reaching the margin by an equal or slightly larger distance, reflexed at maturity. Spores medium brown, trilete, smooth, c. 22 μ.

Distr. *Malesia*: New Guinea; a few collections from Celebes and Borneo.

Ecol. Terrestrial in rain-forests, 80–1500 m.

Note. In habit this species is rather like the South American *L. guianensis* (AUBL.) DRYAND. *ssp. lanceastrum* KRAMER.

27. *Lindsaea crispa* BAKER, J. Bot. n.s. 8 (1879) 39; HOOKER, Ic. Pl. 17 (1886) pl. 1627; C. CHR. & HOLTUM, Gard. Bull. S. S. 7 (1934) 238.—Type: BURBRIDGE *s.n.*, Sabah (K).

L. impressa CHRIST, Ann. Jard. Bot. Btzg II, 5 (1905) 132.—Type: HALLIER 3137, Amai Ambit, Kalimantan, Borneo (L; fragm. in BO, P).

L. kinabaluensis HOLTUM, Gard. Bull. S. S. 7 (1934) 237.—Type: CLEMENS 25433, Tenompok to Lumulumu, Mt Kinabalu, Sabah (SING; dupl. in BM).

Rhizome short-creeping, 1–1½ mm ø; scales medium brown, elongate-triangular, to c. 1¼ mm long, to c. 10-seriate at base, with a short uniseriate apex. Leaves clustered; *petioles* medium to dark brown (rarely pale), in large leaves longer than the lamina and abaxially mostly obtusely bi-angular, in small leaves shorter than the lamina and abaxially sharply bi-angular, pale-edged or not, 6–45 cm long. *Lamina* simply pinnate or bipinnate (very rarely subtripinnate), if bipinnate with up to 3 pinnae to a side and a conform terminal one, c. 15–20 cm long, if once pinnate, c. 8–15 by 1½–2 cm. Primary rachis (if any) like the petiole. *Pinnae* 10 by 1½ to 18 by 3 cm; pinnule-bearing rachises stramineous to dark brown, abaxially sharply bi-angular, pale-edged or not, ± sulcate. *Pinnules* c. 25–30 to a side, spreading, ascending, or falcately decurved, their width apart to slightly overlapping, ¼-elliptic to falciform, 5 by 2 to 15 by 5 mm, 2½–3 times as long as wide, dark green to blackish when dry, chartaceous; apex of pinnules narrowed-rounded to very obtuse, a distinct outer margin not developed. *Upper pinnules* gradually and strongly reduced, several denticuliform ones confluent into a narrow pinnatifid leaf- or pinna-apex. Veins slightly impressed on the adaxial and prominent on the abaxial side, once or twice forked, anastomosing to form an incomplete series of areoles ½–1 mm wide, the outer veins

often free, in small (rarely in larger ones) pinnules the veins may be quite free. Sterile margin sinuate-dentate, fertile margin mostly crispate. *Sori* continuous in fully fertile pinnules; indusium delicate, pale, subentire, sometimes crispate, 0.3–0.5 mm wide, not reaching the margin by ½–1 times its width, reflexed and often concealed at maturity. the fertile margin sometimes revolute over part of the sorus. Spores pale brown, trilete, smooth, 20–22 μ.

Distr. *Malesia*: Borneo (Kalimantan, Sarawak, more frequent on Mt Kinabalu, Sabah).

Ecol. Terrestrial in forests, c. 1000–1600 m.

Note. The series of plants assigned to this species is rather variable. If it were not for the limited geographical distribution they might be taken for depauperate specimens of one or several other species.

28. *Lindsaea hewittii* COPELAND, Philip. J. Sc. 3 (1909) Bot. 346, pl. 5.—Type: HEWITT 36, Mt Poi, Sarawak (MICH; dupl. in BM, P, SAR).

Rhizome short-creeping, 1–2 mm ø; scales castaneous, narrowly triangular, to c. 1 mm long, to c. 7-seriate at the base, with a short uniseriate apex. Leaves close; *petioles* rather dark brown, faintly pale-margined, the greater part acutely, the base obtusely quadrangular, abaxially ± sulcate, c. 22–30 cm long, twice as long as the lamina. *Lamina* approximately rhombic in outline, 12–15 cm long, bipinnate, with 2 or 3 ascending pinnae to a side and a conform terminal one; rachis like the petiole, pale to medium brown. *Pinnae* linear, 9–12 cm long, 1–1¼ cm wide, widest above the base, long-acuminate, with c. 25–35 pinnules to a side; secondary rachises reddish brown, abaxially sharply bi-angular, stramineous-margined, hardly sulcate. *Pinnules* slightly ascending, not contiguous, chartaceous, olivaceous when dry, ligulate or more often ¼-elliptic, the larger ones 5 by 2½ mm, twice as long as broad; upper margin with 1 or 2 oblique incisions ½ mm deep or less; lobes with a slightly convex or the inner ones with a straight outer margin. *Upper pinnules* gradually and very strongly reduced, several minute, denticuliform ones confluent with the linear, very narrow pinna-apex. Veins immersed, ± evident, very close, regularly anastomosing, forming one series of areoles c. ⅓ mm wide. *Sori* interrupted by the incisions on the outer, sometimes also on the inner lobes (the material probably incompletely fertile), 2- to 8-nerval; indusium brownish, subentire, 0.3–0.4 mm wide, not reaching the margin by an approximately equal distance, scarcely reflexed at maturity. Spores yellowish brown, trilete, smooth, c. 20 μ.

Distr. Beside the type known from two other collections from the same area.

Ecol. No data.

Note. This is perhaps only an extreme form of the very variable *L. obtusa*.

29. *Lindsaea obscura* BRAUSE, Bot. Jahrb. 56 (1920) 132; COPELAND, Philip. J. Sc. 78 (1949)

20.—Type: LEDERMANN 8969, Etappenberg, Sepik R. region, Terr. of New Guinea (B).

Rhizome rather short-creeping, 1 mm ϕ ; scales not seen. Leaves close; *petioles* quadrangular, sulcate, blackish, narrowly pale-margined, c. 5 cm long, almost as long as the lamina. *Lamina* simply pinnate, c. 5–7½ cm long; rachis similar to the petiole. *Pinnules* c. 4–8 to a side, almost contiguous at their bases, spreading, subtrapeziform to ¼-elliptic-subligulate, 1–2 cm long, 5–8 mm wide, 2–2½ times as long as wide, dark green when dry, herbaceous; upper margin outward increasingly convex, a distinct outer margin hardly or not developed. Margin of smaller pinnules entire, in larger ones the upper/outer margin with 1–3 oblique rather broad incisions to 1 mm deep. *Upper pinnules* very little reduced; terminal pinnule free, large, flabellate with cuneate base, almost symmetric, with convex upper margin, incised like the lateral ones, c. 1 cm long and 1½ cm wide. Veins immersed, not evident, mostly twice forked, regularly anastomosing, with one or towards the apex of the pinnules two series of areoles 1–1¼ mm wide. *Sori* interrupted by the incisions of the margin, if any, also on the outer margin of the terminal pinnule, 4- to plurinerval; indusium greenish, subentire, ¼ mm wide, falling short of the margin by ½–1 times its width. Spores very pale brown, trilete, smooth, c. 20 μ .

Distr. Beside the type only known from another collection from the same area (LEDERMANN 9163a, B).

Ecol. Epiphytic in mountain forest, 850 m.

30. *Lindsaea modesta* KRAMER, Blumea 15 (1968)

565.—Type: AET & IDJAN 297, Waimiami near Serui, Japen I. (BO).—Fig. 34.

Rhizome rather long-creeping, wiry, 0.4 mm ϕ , fuscous, dull; scales rather persistent, dark brown, scarcely 1 mm long, acicular, biseriate in the lower, uniseriate in the upper half. *Petioles* ½–¾ cm apart, to 7 cm long, a little longer than the lamina, stramineous and quadrangular almost to the base, slender, ¼–½ mm ϕ at the apex. *Lamina* c. 4–6 cm long, 3 cm wide, oblong, simply pinnate, with 4–5 pinnules to a side; rachis like the petiole. *Pinnules* thinly herbaceous, olivaceous when dry, translucent, somewhat ascending, their width or a little less apart, obliquely triangular, the base rather strongly cuneate, somewhat stalk-like, the apex subacute, the largest 15 by 4–5 mm, almost evenly narrowed from base to apex; upper margin with mostly 3 very oblique major incisions to 1 mm deep, the lobes with slightly to strongly and irregularly erose outer edge. *Upper pinnules* little reduced. Terminal pinnule free, flabellate-cuneate, 1–2 cm long, usually once deeply and once or twice shallowly bifid. Veins immersed, evident, very oblique, once or twice forked, forming one series of areoles, the outer veins not rarely free. *Sori* mostly bi- or trinerval, in the larger lobes often interrupted by the gashes in the margin, basally straight or with slightly concave ends; indusium 0.3–0.4 mm wide, subentire or usually erose, not reaching the margin by less than its width to reaching it, \pm reflexed at maturity. Spores pale brownish, trilete, smooth, c. 20 μ .

Distr. Only known from the type collection.

Ecol. No data on the label, but probably epiphytic, as the rhizomes are rather long and interwoven with mosses and *Hymenophyllaceae*.

4. Section *Lindsaea*

Type species: *Lindsaea trapeziformis* DRYAND. [= *L. lancea* (L.) BEDD.].

Distr. Tropical America, SE. Asia.

Taxon. The two paleotropical species share with the neotropical ones a short-creeping rhizome, a bipinnate lamina with conform terminal pinna, or a simply pinnate lamina, dimidiate pinnules, free veins, and continuous sori. The spores are trilete in most neotropical and both paleotropical species. Otherwise the resemblance is not close, in spite of much habitual similarity between *L. borneensis* HOOKER and *L. guianensis* (AUBL.) DRYAND., and between *L. doryphora* KRAMER and *L. lancea* (L.) BEDD. It is not at all certain that the paleotropical species are of the same derivation as the neotropical ones.

31. *Lindsaea borneensis* HOOKER ex BAKER, Syn. Fil. ed. 1 (1867) 107; HOLTUM, Gard. Bull. S. S. 5 (1930) 65; Rev. Fl. Mal. 2 (1954) 331.—Lectotype: LOBB 175, Labuan I., Borneo (K).

Rhizome short- to long-creeping, 2–4 mm ϕ ; scales castaneous, narrowly triangular, to 2½ mm long, to c. 8-seriate at base, with acicular, uniseriate apex. Leaves close; *petioles* stramineous, abaxially terete, to 60 cm long, to 2 times as long as the lamina. *Lamina* oblong, to c. 40 by 25 cm, bipinnate, with up to 12 pinnae to a side and a conform terminal one; primary rachis like the petiole. *Pinnae* mostly subopposite, about their width apart, linear, long-acuminate, spreading

or ascending, 8–25 cm long, 1¼–2 cm wide, the upper ones little or not shortened, the terminal often the longest; secondary rachises abaxially terete at base, upward gradually bi-angular, sulcate only in the upper part. *Pinnules* to c. 50 to a side, dark green when dry, firmly herbaceous, spreading, mostly slightly overlapping, ¼-elliptic or shortly ligulate, 7 to 11 mm long, 3½–5 mm wide; margin crenate if sterile, otherwise entire. *Upper pinnules* gradually and strongly reduced, denticuliform below the pinnatifid, sometimes caudate pinna-apex. Veins immersed or more often slightly prominulous, mostly twice forked, close, free. *Sori* in fully fertile pinnules occupying all vein-ends but often only on the inner ones, con-

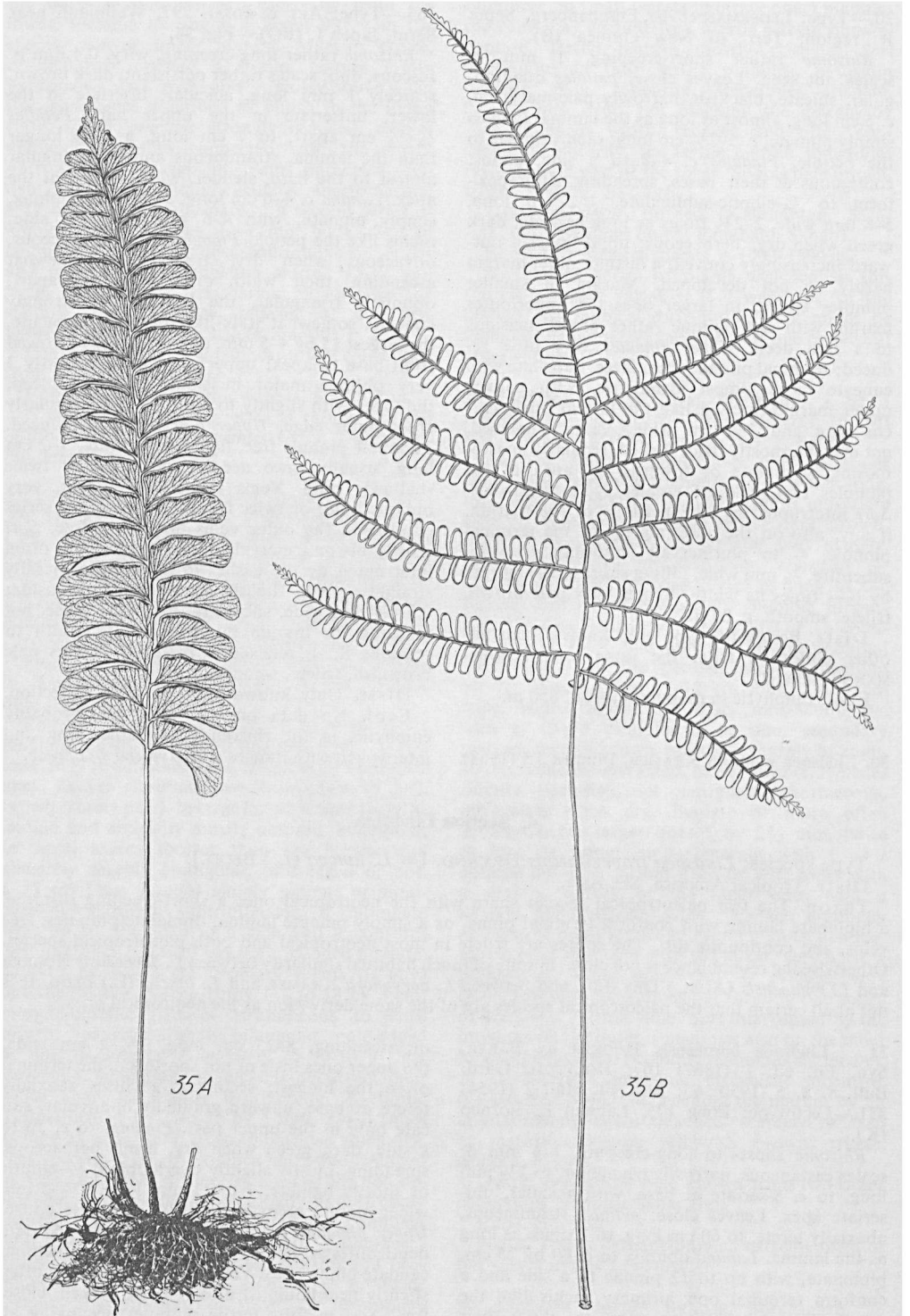


Fig. 35. *Lindsaea doryphora* KRAMER. A. Simply pinnate lamina, $\times \frac{2}{6}$ (KORTHALS 298); B. Bipinnate lamina, $\times \frac{1}{4}$ (KORTHALS 296).

tinuous; indusium brownish, entire, *c.* $\frac{1}{5}$ – $\frac{1}{4}$ mm wide, falling short of the margin by its own width or less, reflexed and concealed at maturity. Spores pale brown, trilete, smooth, *c.* 22 μ .

Distr. *Malesia*: Malay Peninsula (Selangor, Johore, Perak), Singapore (according to HOLTUM perhaps extinct), Sumatra (few coll.), Borneo (apparently frequent throughout).

Ecol. In forests, on shaded rocks, mostly on poor, moist soil, to *c.* 700 m.

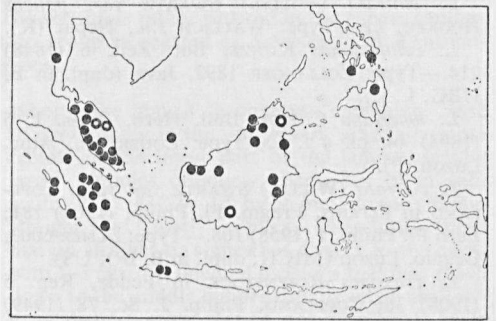
Note. In appearance rather like the neotropical *L. guianensis* (AUBL.) DRYAND. *ssp. guianensis*, and perhaps related to it.

32. *Lindsaea doryphora* KRAMER, *Blumea* 15 (1968) 566.—*L. scandens* HOOKER *var. terrestris* HOLTUM, *Rev. Fl. Mal.* 2 (1954) 327, *nom. invalid.* (not typified).—*L. lancea* or *L. trapeziformis* *auctt. quoad specimina asiatica*.—Type: ALSTON 13358, Permantang, S. of Kwala Kwajan, Kalimantan, Borneo (U; dupl. in BM).—Fig. 35.

Rhizome rather short-creeping, 1½–2 mm ϕ ; scales medium brown, very narrowly triangular, to 1½ mm long, to *c.* 12-seriate at base, with a short uniseriate apex. Leaves close; *petioles* stramineous. *abaxially* rounded or rarely upward obtusely biangular, to 70 cm long, 1–2 times as long as the lamina. *Lamina* 15–35 cm long, bipinnate or (only when not yet full-grown?) simply pinnate, with 1–6 pinnae to a side and a conform terminal one; primary rachis similar to the petiole. *Pinnae* (and simply pinnate lamina) to 25 cm long, 2½–5(–7) cm wide, ascending, half their width apart to contiguous, widest below or in the middle or sometimes scarcely narrowed close to the apex; secondary rachises similar to the primary. *Pinnules* usually 20–25 to a side, subcontiguous, chartaceous, dark green when dry, described by many collectors as having a metallic sheen, somewhat variable in shape, if large ligular, spreading or slightly decurved, not rarely with concave or lower margin, 2½–3 times as long as wide; if smaller similar or rounded-trapeziform, 2–2½ times as long as wide; largest pinnules seen 35 by 13 mm, but more often about 15–20 by 6–8 mm. Upper margin outward increasingly convex, a distinct outer margin hardly developed. Sterile margin shallowly crenate towards the apex of the pinnule. *Upper pinnules* in simply pinnate and paucijugate-bipinnate leaves mostly little reduced, few or none denticuliform and confluent with the comparatively large, obliquely hastate, obtuse to acuminate terminal pinnule; in larger, more amply bipinnate leaves not rarely the upper pinnules more strongly reduced, several confluent with the small, basally lobed, lanceolate terminal

segment. Veins immersed, evident, rather close, free, mostly twice forked. *Sori* occupying all vein-ends of a pinnule or not rarely only the inner ones, continuous; indusium pale to dark, entire, $\frac{1}{4}$ – $\frac{1}{5}$ mm wide, falling short of the margin by 1–2 times its width, \pm reflexed at maturity. Spores pale brownish, trilete, smooth, *c.* 17 μ .

Distr. Tenasserim, S. Thailand, in *Malesia*: Malay Peninsula, Singapore, Sumatra, Sipora, Natuna Is., Lingga Is., West Java (rare), Borneo, Philippines (Negros, Leyte, Mindanao). Map 7.



Map 7. Distribution of *Lindsaea doryphora* KRAMER.

Ecol. Terrestrial in moist to swampy forests, from sea-level to 1300 m, apparently frequent in large parts of its area.

Note. This species was described by HOLTUM as a variety of *L. scandens* (= *L. parasitica*); in the present treatment the two species are placed in different subgenera. Yet the similarity between them is striking, and detached leaves, without the rhizome, are sometimes difficult to determine as the one or the other. The following additional characters may help in determining such incomplete specimens:

L. doryphora: lamina of simply pinnate leaves hardly or not narrowed at base; sterile pinnule-margin crenate, especially near the apex; groove of rachis (adaxial) narrow, quite concave; indusium falling short of the margin by its width or more; colour of dry pinnules dark green or olivaceous.

L. parasitica: lamina of simply pinnate leaves gradually narrowed to base; sterile pinnule-margin entire or faintly sinuate; groove of rachis (adaxial) broad, flat- or convex-bottomed; indusium falling short of the margin by its width or less; colour of dry pinnules often blackish.

5. Section Osmolindsaea

KRAMER, *Blumea* 15 (1968) 560.

Type species: *Lindsaea odorata* ROXB. [*L. cultrata* *auct. non* (WILLD.) SWARTZ].

Distr. Rhodesia, Madagascar; N. India and China to Japan, *Malesia* and the Solomon Is.

Taxon. Well-marked by a short-creeping rhizome, simply pinnate lamina with abaxially rounded axes and reduced upper pinnules, dimidiate free-veined pinnules with (except in reduced forms) broken

sori, and monoete spores; the last character is not found in any other Malesian section. A group of rather obscure affinity, perhaps related to the next.

33. *Lindsaea odorata* ROXB. Calc. J. Nat. Hist. 4 (1844) 511; KRAMER, Blumea 15 (1968) 567.—Type: a plant from the Garrow Hills, India; no specimen extant; pl. 2578 of Icones Roxburghianae to be regarded as type (K).

L. apiculata KUNZE, Farrnkr. 1 (1846) 206, pl. 4 A.—Type: SONDER 16, Java (*n.v.*).

L. cultrata (WILLD.) SWARTZ var. *attenuata* HOOKER, Sp. Fil. 1 (1846) 204.—Lectotype: GRIFFITH *s.n.*, Khasia, Assam (K).

L. cultrata (WILLD.) SWARTZ var. *pallens* HOOKER, *l.c.*—Type: WALLICH *s.n.*, Nepal (K).

L. calomelanos KUNZE, Bot. Zeit. 6 (1848) 214.—Type: ZOLLINGER 1892, Java (dupl. in B, HBG, L, Z).

L. loheriana CHRIST, Bull. Herb. Boiss. I, 6 (1898) 44, pl. 4 f. 6.—Type: LOHER *s.n.*, Atoc, Luzon (P).

L. cultrata (WILLD.) SWARTZ var. *varia* COPELAND in Perkins, Fragm. Fl. Philip. (1905) 181; Fern Fl. Philip. 1 (1958) 108.—Type: ELMER 6003, Baguio, Luzon (MICH; dupl. in B, BO, US).

L. crassipes ROSENSTOCK in Fedde, Rep. 5 (1908) 36; COPELAND, Philip. J. Sc. 78 (1949) 19.—Type: WERNER 74, Upper Mojo R., Terr. of New Guinea (B; dupl. in L, US).

L. bullata v.A.v.R. Bull. Jard. Bot. Btzig II, 16 (1914) 20.—Type: DOCTERS VAN LEEUWEN 1104; Mt Telemojo, Java (BO; dupl. in L.)

L. plumula RIDL. J. Mal. Br. R. As. Soc. 4 (1926) 22; HOLTUM, Gard. Bull. S. S. 5 (1930) 62, f. 1-2.—*L. cultrata* (WILLD.) SWARTZ var. *plumula* (RIDL.) HOLTUM, Rev. Fl. Mal. 2 (1954) 329.—Type: RIDLEY 15997, G. Tahan, Pahang (SING; dupl. in BM, K).

L. cultrata (WILLD.) SWARTZ var. *parvula* HOLTUM, Gard. Bull. S. S. 5 (1930) 61, f. 3.—Type: Md. NUR 7297, Sibolangit, Sumatra (SING; dupl. in K).

L. cultrata auct. non (WILLD.) SWARTZ of all later authors, e.g. TAGAWA, Act. Phytotax. Geobot. 6 (1937) 26, f. 1 A-C; BACKER & POSTHUMUS, Varenfl. Java (1939) 118, f. 23; HOLTUM, Rev. Fl. Mal. 2 (1954) 328, f. 188; COPELAND, Fern Fl. Philip. 1 (1958) 107.

Rhizome short-creeping, dark, 1½–2½ mm ø, occasionally more slender and long-creeping in epilithic specimens; scales reddish brown, very narrow, to 2½ mm long, to 4-seriate at base, ¼–½ uniseriate. Leaves close (or occasionally more remote); *petioles* (3–)6–25 cm long, ⅛–⅓, rarely as long as the lamina, stramineous with darker base or more often pale reddish brown to atropurpureous throughout, hardly lustrous, abaxially rounded or upward narrowed-rounded, the adaxial groove often pale-edged. *Lamina* narrowly oblong or narrowly lanceolate, 8–30 cm long, 2–4½ cm wide, simply pinnate, with 15–30 (rarely fewer) pinnules to a side, these subpetiolulate, alternate except the basal ones, spreading or slightly ascending, less than their width apart to contiguous, in the lower ⅓ or ½ more remote,

the basal ones usually remote and slightly or occasionally more strongly reduced and sometimes decurved. Rachis abaxially rounded or narrowed-rounded, stramineous or dark at base (rarely throughout), the pinnule-bases abruptly pale. *Larger pinnules* 8–21 mm long, 3–8 mm wide, 2½, rarely 3 times as long as wide, ¼-elliptic or rarely asymmetrically oblong, subacute, less often acute or obtuse, the truncate base sometimes overlying the rachis, firmly herbaceous to subcoriaceous, occasionally coriaceous, mostly light green or olivaceous when dry; lower margin convex, upper margin straight or outward faintly convex; rarely both margins evenly convex; a distinct outer margin never developed. *Upper margin* with 1–6 but little oblique, narrow incisions, ½–1, rarely to 2 mm deep, reaching beyond the receptacle, with acute sinus, the lobes with flat or faintly convex or not rarely slightly concave edge, sometimes with small, pointed, horn-like extremities. Lobes of sterile pinnules crenate. *Upper pinnules* gradually reduced, with few or no incisions, some denticuliform ones confluent with the small, narrow leaf-apex. Veins immersed, evident or hidden, free, simple to twice forked, ½–1 mm apart. *Sori* interrupted by the incisions except in reduced pinnules, (1–)2–6 per pinnule, on 2 to 6 vein-ends, 1–6 mm long; receptacle straight or in short sori often convex. Indusium pale, entire to slightly erose, ½ mm wide (narrower in small forms), not quite reaching the margin to equaling it, with narrow, adnate ends, not reflexed but bulging at maturity. Spores medium brown, monoete, smooth, c. 55 by 38 μ.

Distr. Rhodesia, Mascarenes?, Madagascar, S. India, Ceylon, E. Himalaya, South and Central China, Japan, to *Malesia*: Malay Peninsula (Pahang, Perak), Sumatra, Java, Borneo, Philippines (Luzon, Mindanao, Negros, Panay, Mindoro), Talaud, Flores, New Guinea; Solomon Is. So far not collected in Celebes or the S. Moluccas.

Ecol. In open or slightly shaded places, often on escarpments and earth banks, apparently never in very dry places, from sea-level up to over 2000 m. Apparently common in most parts of its area, but rare east of Borneo and Java.

Notes. Freshly dried leaves have a distinct coumarin-like odour which may persist for several months in the herbarium.

In spite of its large area and rather diverse habitats *L. odorata* is only moderately variable. Only in extreme habitats aberrant forms occur, e.g. in exposed places in the mountains where the plants are dwarfed, with rigid pinnules and very dark axes ('*L. crassipes*'), or on moss-covered tree trunks and rocks where they are small but not rigid ('*L. loheriana*'. '*L. bullata*', '*L. plumula*', etc.).

Some small plants from the Philippines, e.g. CUMING 65, MANGUBAT B. Sc. 1354, MERRILL 5930, approach a small form that occurs in China

and Japan and is recently treated as a species, *L. japonica* (BAKER) DIELS, but is probably not more than a variety. They have, however, inter-

rupted sori, and are more probably extreme forms of *L. odorata* proper.

6. Section *Tropidolindsaea*

KRAMER, Act. Bot. Neerl. 6 (1957) 267.

Type species: *Lindsaea seemannii* J. SMITH.

Distr. Very discontinuous; the neotropical species for which the section was described occur in Costa Rica, Panama, W. Colombia, and Hispaniola; the sole paleotropical species occurs in the eastern Philippines.

Taxon. The combination of short-creeping rhizome, once-pinnate lamina that tapers basally as well as apically, and sclerotic, abaxially narrowed-rounded or carinate rachis, is sufficient for characterization. The pinnules are dimidiate and free-veined. The section is rather isolated in the genus; similarities with *sect. Osmolindsaea*, and with the Madagascan group segregated as *Sambirania* by TARDIEU-BLOT, may be due to true relationship or to convergence.

34. *Lindsaea adiantoides* J. SMITH in Hooker, Sp. Fil. 1 (1846) 204, pl. 61 C; COPELAND, Fern Fl. Philip. 1 (1958) 108; KRAMER, Blumea 15 (1968) 560; *non* (BLUME) KUHN (1869).—*L. humilis* KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 278.—Type: CUMING 176, S. Camarines, Luzon (K; dupl. in B, BM, E, GH, P, W).

L. tropidorachis v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 211; COPELAND, Fern Fl. Philip. 1 (1958) 108.—Type: RAMOS & EDAÑO B. Sc. 33778, Camarines, Luzon (BO; dupl. in B, BM, P, US).

L. trimarginata C. CHR. Dansk Bot. Ark. 9 (1937) 68.—Type: RAMOS & EDAÑO B. Sc. 33778, Camarines, Luzon (B; dupl. in BM, BO, P, US).—Fig. 24.

Rhizome very short-creeping or ascending, c. 1½ mm ø, with densely scaly apex; scales reddish brown, to almost 2 mm long, narrowly triangular, up to 5-seriate at base, biseriate below the glandular top-cell. Leaves very close; *petioles* blackish brown to atropurpureous, hardly shining, sharply triangular to base, with somewhat paler edges, the lateral faces much wider than the adaxial ones, 3–10 cm long, much shorter than the lamina. *Lamina* simply pinnate, linear, c. 15–50 by 2–3 cm, widest mostly somewhat above the middle, with c. 25–40 pinnules to a side; rachis similar to the petiole, dark throughout, the edges often irregular and more pronouncedly pale. *Pinnules* firmly herbaceous, mostly olivaceous when dry,

subopposite almost throughout, spreading, close to overlapping in the upper part, gradually more remote in the lower part of the lamina, sessile; larger pinnules obliquely triangular, often subacute, 9 by 4½ to 15 by 9 mm; lower margin straight or slightly convex, ascending, upper margin straight or somewhat convex to the apex, with 1–3 narrow, unequal incisions that may reach down to the middle but are usually much shallower; a distinct outer margin not developed; bases of pinnules abruptly non-sclerotic, suggesting an articulation. *Lower pinnules* gradually very remote, reduced, auriculiform, incised; *upper pinnules* gradually and strongly reduced, little or not incised, 1 or 2 confluent with the lobed, non-caudate terminal segment. Veins slightly impressed above and prominent beneath, giving the pinnules a striate appearance, free, once or twice forked, ¼–¾ mm apart. *Sori* one per lobe, on 4–10 vein-ends; receptacle straight, with convex ends; indusium pale, herbaceous, erose, adnate at the sides, 0.6–0.9 mm wide, mostly not quite reaching the margin, scarcely reflexed at maturity. Spores yellowish, trilete, almost smooth, c. 38–41 µ.

Distr. *Malesia*: Philippines (Luzon, Samar, Dinagat, 9 coll.).

Ecol. Very few data; once reported from an open bank.

Note. This species is taxonomically isolated in Asia; its closest relatives are in tropical America.

7. Section *Psammolindsaea*

KRAMER, Blumea 15 (1968) 560.

Type and sole species the following, which has been included in *Schizoloma* and in *Isoloma*, but is not closely related to either.

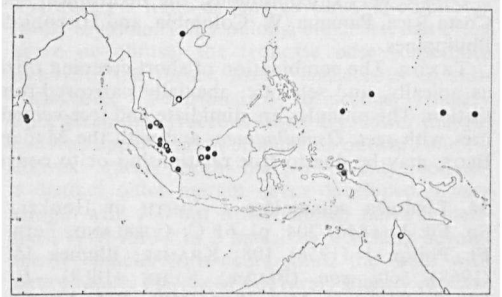
35. *Lindsaea walkerae* HOOKER, Sp. Fil. 1 (1846) 209, pl. 69 A.—*Isoloma walkerae* (HOOKER) FRESL, Epimel. Bot. (1851) 101.—*Schizoloma walkerae* (HOOKER) KUHN, Chaetopt. (1882) 346; DIELS in E. & P. Nat. Pfl. Fam. I, 4 (1902) 218; HOLTUM, Rev. Fl. Mal. 2 (1954) 344.—*Schizolegnia walkerae* (HOOKER) ALSTON, Bol. Soc. Brot. II, 30 (1956) 25.—Type: Mrs WALKER, Ceylon (K; dupl. in B).

Rhizome rather short- to long-creeping, 1½–2 mm ø; scales reddish brown to castaneous, almost linear, to 2 mm, to 4-seriate at base, there usually with laterally projecting cell partitions, the apex uniseriate, paler. Leaves rather close to 4 cm apart; *petioles* dark castaneous to black, lustrous, abaxially rounded, adaxially flattened or broadly sulcate, c. 10–45 cm long, much shorter to longer than the lamina. *Lamina* narrowly

oblong, 15–70 cm long, 1½–20 cm wide, simply pinnate, with 3–17 pinnules to a side and a free terminal one; rachis like the upper part of the petiole. *Pinnules* chartaceous to rigidly coriaceous, mostly olivaceous or dark brown when dry, paler beneath, sessile, obliquely to very strongly ascending, a few cm apart, opposite or subopposite throughout, linear, 2½–15 cm long, 4–8 mm wide, 6–20 times as long as wide; lower pinnules often more remote and sometimes slightly shortened; upper pinnules little or not reduced. Base of pinnules slightly unequally cuneate, the basiscopic side narrower, the dark colour of the rachis ending rather abruptly in the stalk-like base, but without an articulation; margin entire, somewhat revolute; upper half of pinnule narrowed, obtuse, if acuminate the tip still obtuse. *Terminal pinnule* conform, symmetric, occasionally joined to an upper lateral one or lobed at base, usually soriferous. Costa distinct, abaxially elevated, almost percurrent. Veins elevated on both sides, very oblique, less so towards their apices, 2–3 times forked, close, ¼–½ mm apart, free. *Sori* continuous, extending around the apices of the pinnules, the vein-ends below the receptacle thickened; indusium rigid, yellow or brown, entire, 0.4 mm wide, almost reaching the

margin, somewhat reflexed at maturity. Spores dark brown, trilete, smooth, 25–30 μ.

Distr. Ceylon, Indo-China, in *Malesia*: Malay Peninsula (Pahang, Trengganu, Johore, Malacca, Kedah), Singapore, Lingga Is., Banka, Borneo (Sarawak, Brunei, Kalimantan), W. New Guinea, Queensland; Carolines (Palau, Yap, Truk, Ponape). Rare in relation to its large area. Map 8.



Map 8. Distribution of *Lindsaea walkerae* Hook.

Ecol. In moist, open places, often on poor, acid soil, in swamps and by streams, at low elevation, but in Malaya also at 1000–1200 m.

8. Section *Isoloma*

(J. SMITH) KRAMER, *Blumea* 15 (1968) 560.—*Isoloma* J. SMITH, *Hook. J. Bot.* 3 (1841) 414; *Hist. Fil.* (1875) 227.

Type species: *Lindsaea divergens* HOOKER & GREVILLE.

Distr. Throughout Malesia to western Polynesia. All species occur in the Flora Malesiana area.

Taxon. One of the groups treated most persistently as a distinct genus, mainly on account of the non-dimidiolate, basally articulate pinnules. Other characters are the short-creeping rhizome, sclerotic axes, continuous sori, free veins, and trilete spores. The species of this section were in the past often placed in the genus *Schizoloma*, together with the species lacking dimidiolate pinnules of *sect. Schizoloma* as treated here; but the resemblance is only a negative one.

36. *Lindsaea gueriniana* (GAUD.) DESVAUX, *Prod.* (1827) 312.—*Schizoloma guerinianum* GAUD. *Ann. Sc. Nat.* 3 (1824) 508; Freyc. *Voy. Bot.* (1829) 380, pl. 18.—*Isoloma guerinianum* (GAUD.) FÉE, *Gen. Fil.* (1852) 108; TARDIEU-BLOT, *Not. Syst.* 14 (1952) 332, *comb. superfl.*; COPELAND, *Fern Fl. Philip.* 1 (1958) 118.—*Guerinia articulata* J. SMITH, *Hist. Fil.* (1875) 272.—Type: GAUDICHAUD *s.n.*, Rawak, Papua Is. ('Moluccas') (P; dupl. in B, K, L).

L. indurata BAKER, *J. Bot.* 26 (1888) 324.—*Schizoloma induratum* (BAKER) C. CHR. *Ind. Fil.* (1906) 618.—*Isoloma induratum* (BAKER) TARDIEU-BLOT, *Not. Syst.* 14 (1952) 332; TAGAWA, *Act. Phytotax. Geobot.* 16 (1956) 174, *comb. superfl.*—Type: HOSE 221, Niah, Sarawak (K; dupl. in BM).

Schizoloma fuliginum COPELAND, *Philip. J. Sc.* 1 (1906) Suppl. IV, 252, pl. 1 A.—*Isoloma fuliginum* (COPELAND) COPELAND, *Philip. J. Sc.* 78 (1949) 24.—Type: BOLSTER 276, Surigao, Mindanao (MICH; dupl. in P, US).

Nephrolepis schizolomae v.A.v.R. *Bull. Jard. Bot. Btzg II*, 7 (1912) 22.—*Schizoloma schizolo-*

mae (v.A.v.R.) v.A.v.R. *Handb. Suppl.* (1917) 214.—*Isoloma schizolomae* (v.A.v.R.) TAGAWA, *Act. Phytotax. Geobot.* 16 (1956) 174.—Type: GJELLERUP 1000, Mt Cycloop, W. New Guinea (BO).—Fig. 36.

Rhizome short- to moderately long-creeping, 1½–2½ mm ø; scales reddish to dark brown, lustrous, acicular, to 1½ mm long, uni- or biseriolate or sometimes triseriolate at the base. Leaves close or not; *petioles* reddish brown to fuscous, rarely blackish, rather dull, abaxially terete, adaxially upwards (sometimes pale) bimarginate, 5–25 cm long, much shorter than to about equaling the lamina. *Lamina* linear, 10–30 cm long, 1½–3½ cm wide, with up to c. 30 pinnules to a side; rachis medium to dark reddish brown, rarely blackish, dull, abaxially terete at the base, upwards gradually carinate, occasionally the keel extending to the base or present only near the apex, sometimes pale, adaxial side ± distinctly pale-margined. *Pinnules* chartaceous to coriaceous, usually drying brown, spreading or slightly upcurved, ½–1 times their width apart or less often contiguous, the lower ones remote, not reduced, the upper ones gradually reduced,

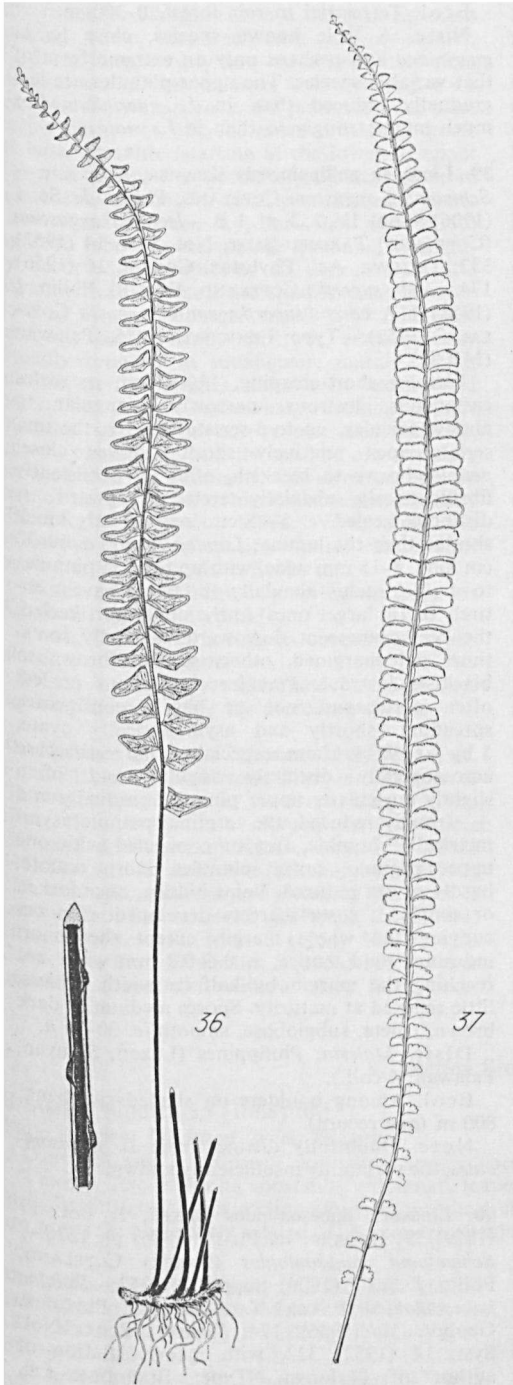


Fig. 36. *Lindsaea gueriniana* (GAUD.) DESV. Leaf, $\times \frac{2}{5}$, and portion of the rachis, $\times 4$ (ZIPPÉLIUS s.n., L).—Fig. 37. *L. lucida* BL. ssp. *orevipex* (COPEL.) KRAMER. Lamina, $\times \frac{2}{5}$ (BRASS 28253).

the smallest c. 1 or 2 mm long, connected with the small lanceolate terminal segment. Larger pinnules 7–18 mm long, $3\frac{1}{2}$ –8 mm wide (excluding basal auricles), asymmetrically ovate, 2– $2\frac{1}{2}$ times as long as wide, obtuse to broadly rounded or rarely subacute, the acroscopic side of the base mostly with a small but distinct auricle often touching the rachis; articulation at the bases of the pinnules distinct. Veins immersed, obscure, once or twice forked, free; costa evident, not percurrent. Margin entire in fertile, crenate in sterile pinnules. *Sori* continuous, or absent from the pinnule-apices, always absent from the base of the lower margin; indusium rigid, subentire, $\frac{1}{3}$ – $\frac{1}{2}$ mm wide, almost or quite reaching the margin, scarcely reflexed at maturity. Spores medium brown, trilete, almost smooth, c. 25–30 μ .

Distr. *Malesia*: Borneo (Sarawak), Celebes, Philippines (Sibuyan, Mindanao), Moluccas (Talaud, Halmahera), New Guinea (Japen, Waigeu, and other small islands; W. New Guinea, Papua); Solomon Is., Tahiti. Many collections are from small islands.

Ecol. In forests and open, drier places, terrestrial, sometimes on decaying wood; from sea-level up to 750 m.

Note. Some specimens, e.g. the type of *L. indurata* and TEYSMANN 11822 from Celebes, are atypical in having short, rounded pinnules. *L. gueriniana* is the most variable species of *sect. Isoloma*.

37. *Lindsaea ovata* J. SMITH in Hooker, Sp. Fil. 1 (1846) 204, pl. 64 A.—*Isoloma ovatum* (J. SMITH) PRESL, Epimel. Bot. (1851) 101; HOLTUM, Rev. Fl. Mal. 2 (1954) 338; COPELAND, Fern Fl. Philip. 1 (1958) 117.—*Schizoloma ovatum* (J. SMITH) COPELAND, Philip. J. Sc. 1 (1906) Suppl. IV, 252 ('*ovata*').—Type: CUMING 175, S. Camarines, Luzon (K; dupl. in B, BM, E, W).

Schizoloma divergens (HOOKER & GREVILLE) KUHN var. *auriculata* v.A.v.R. Handb. (1908) 278.—*Schizoloma auriculatum* (v.A.v.R.) v.A.v.R. Bull. Jard. Bot. Btzig III, 5 (1922) 224.—*Isoloma auriculatum* (v.A.v.R.) TAGAWA, Act. Phytotax. Geobot. 16 (1956) 174.—Type: coll. not cited, 'Malaya' (specimens in herb. BO so annotated by v.A.v.R. are this species, but none is from Malaya).

L. vrieseana ROSENSTOCK, Meded. Rijksherb. 31 (1917) 4, *nom. subnud.*—Type: DE VRIESE 52, Borneo, *sine loc.* (L).

Rhizome short-creeping, 2 mm ϕ ; scales dark castaneous, to $1\frac{1}{4}$ mm long, almost acicular, up to 3-seriate at base, the apex long, uniseriate. Leaves clustered; *petioles* dark brown or black, lustrous, adaxially flattened and with two pale lateral ridges, abaxially usually keeled in the upper part, 6–18 cm long, $\frac{1}{4}$ as long as to equaling the lamina. *Lamina* very narrowly oblong, 8–20 cm long, (1)– $2\frac{1}{2}$ –4 cm wide, scarcely or not narrowed at the base, very shortly narrowed at the apex, with up to c. 30 pinnules to a side; rachis abaxially keeled or rarely basally subterete, the keel at least upward pale, otherwise the rachis like the

petiole. *Pinnules* chartaceous, mostly drying green, spreading or the basal ones deflexed, asymmetrically ovate to lanceolate, (5-)10-20 mm long, (3-)5-7 mm wide, 2-3½ times as long as wide, broadly rounded to subacute; the base at the upper side sharply rectangular to shortly auriculate. Lower pinnules not, a few upper ones slightly, or no upper pinnules reduced, the terminal pinnule free, rhombic to asymmetrically triangular. Articulation at pinnule-bases distinct. Fertile pinnules entire, sterile ones crenate-sinuate or rarely lobed. Veins immersed but abaxially mostly evident, mostly twice forked; costa weak, diagonal, not percurrent. *Sori* unbroken, occupying the upper and outer or also part of the lower margin; indusium yellowish to green, entire, 0.3-0.4 mm wide, equaling the margin, ± reflexed at maturity. Spores rather pale brown, trilete, verruculose, *c.* 22 μ.

Distr. *Malesia*: Malay Peninsula (Johore), Singapore, Anambas Is., Lingga Is., Banka, Borneo, Philippines (Luzon, Mindanao, no recent coll.). Apparently common only in Sarawak.

Ecol. Terrestrial and on rocks, often on poor soil and in moist places, from sea-level up to *c.* 1000 m.

38. *Lindsaea pellaeiformis* CHRIST, Verh. Naturf. Ges. Basel 11 (1897) 430.—*Schizoloma pellaeiforme* (CHRIST) C. CHR. Ind. Fil. (1906) 619.—*Isoloma pellaeiforme* (CHRIST) TARDIEU-BLOT, Not. Syst. 14 (1952) 332; TAGAWA, Act. Phytotax. Geobot. 16 (1956) 174, *comb. superfl.*—Type: SARASIN *s.n.*, SE. Celebes (P).

Rhizome short-creeping, 2 mm ø; scales medium brown, to 2½ mm long, acicular, the lower part biseriate, the upper half uniseriate. Leaves close; *petioles* dark castaneous to blackish, little lustrous to dull, abaxially terete, to *c.* 20 cm long. *Lamina* linear, to *c.* 30 cm long, to 5½ cm wide, widest a little above the base, with up to *c.* 35 pinnules to a side; rachis dark brown, dull, adaxially scarcely pale-margined, abaxially terete, the upper half ± pronouncedly carinate, the keel pale. *Pinnules* chartaceous to coriaceous, brown when dry, not contiguous, the basal ones remote, spreading or slightly falcately ascending, asymmetrically lanceolate, actue or rarely subacute, the larger ones 18-30 by 8 mm, 1½ to almost 4 times as long as wide (disregarding the auricle); base unequal, the basiscopic side narrower, the acroscopic side with a short (to 2 mm) subacute auricle. Margin entire, or notched in sterile pinnules, somewhat revolute. Basal pinnules slightly or not reduced; upper pinnules more strongly and gradually reduced, one or two small ones connected with the narrow, asymmetrically lanceolate terminal segment. Veins hidden, once or twice forked, oblique; costa almost percurrent. *Sori* continuous; indusium brown, rigid, entire, ½ mm wide, reaching the margin or nearly so, little reflexed at maturity. Spores medium brown, smooth, trilete, *c.* 27 μ.

Distr. *Malesia*: Celebes (3 coll.; beside the type KJELLBERG 2059 and 3561, both BO and S-PA).

Ecol. Terrestrial in rain-forest, 0-300 m.

Note. A little known species, close to *L. gueriniana* and perhaps only an extreme form of that variable species. The upper pinnules are less gradually reduced than in *L. gueriniana* but much more strongly so than in *L. ovata*.

39. *Lindsaea philippinensis* KRAMER, *nom. nov.*—*Schizoloma angustum* COPELAND, Philip. J. Sc. 1 (1906) Suppl. IV, 252, pl. 1 B.—*Isoloma angustum* (COPELAND) TARDIEU-BLOT, Not. Syst. 14 (1952) 332; TAGAWA, Act. Phytotax. Geobot. 16 (1956) 174, *comb. superfl.*; COPELAND, Fern Fl. Philip. 1 (1958) 117, *comb. superfl.*; non *L. angusta* COPELAND (1952).—Type: FOXWORTHY 875, Palawan (MICH).

Rhizome short-creeping, 1½-2 mm ø; scales castaneous, lustrous, narrowly triangular to almost acicular, up to 5-seriate at base, the uniseriate apex relatively short. Leaves close; *petioles* brown to blackish, often ± persistently fibrillose-scaly, abaxially terete or upward ± distinctly keeled, *c.* 3-15 cm long, mostly much shorter than the lamina. *Lamina* linear, *c.* 10-30 cm long, 8-15 mm wide, with up to *c.* 35 pinnules to a side; rachis abaxially (in small leaves) entirely or (in larger ones) in the upper part keeled, the keel evanescent downward, adaxially sometimes pale-margined, otherwise dark brown to blackish, lustrous. *Pinnules* chartaceous or less often coriaceous, not or hardly contiguous, spreading, shortly and asymmetrically ovate, 5 by 4 to 8 by 6 mm, especially if large the base acroscopically distinctly angular and often slightly auriculate; upper pinnules gradually and ± strongly reduced, the terminal pinnule asymmetrically rhombic, free or connected with one upper pinnule; lower pinnules more remote, hardly or not reduced. Veins hidden, once forked or simple, a costa scarcely developed. *Sori* occupying the whole margin except the inner; indusium rigid, entire, *c.* 0.6-0.8 mm wide, not reaching the margin by half its width or less, little reflexed at maturity. Spores medium to dark brown, trilete, subglobose, smooth, *c.* 30-35 μ.

Distr. *Malesia*: Philippines (Luzon, Sibuyan, Palawan; 4 coll.).

Ecol. Among boulders on shaded riverbank, 800 m (one record).

Note. Doubtfully distinct from *L. jamesonioides*, the variability insufficiently known.

40. *Lindsaea jamesonioides* BAKER, J. Bot. 17 (1879) 39; HOOKER, Ic. Pl. 17 (1886) pl. 1626.—*Schizoloma jamesonioides* (BAKER) COPELAND, Philip. J. Sc. 1 (1906) Suppl. IV, 252.—*Isoloma jamesonioides* (BAKER) TAGAWA, Act. Phytotax. Geobot. 16 (1956) 174; TARDIEU-BLOT, Not. Syst. 14 (1952) 332, with incorr. citation of author of basionym.—Type: BURBIDGE *s.n.*, Mt Kinabalu, Sabah (K; dupl. in BM).

Rhizome short-creeping, 1½-2 mm ø; scales castaneous, narrowly triangular, to 3 mm long, up to 8-seriate at the base, with a short uniseriate apex. Leaves clustered; *petioles* black, dull, abaxi-

ally rounded, adaxially with a flat groove, often bearing some scattered dark narrow scales, 2–15 cm long, mostly considerably shorter than the lamina. *Lamina* linear, c. 6–25 cm long, 8–18 mm wide, with up to c. 50 pinnules to a side; rachis dark, not pale-margined, abaxially terete at base, upwards (starting at the lower to upper $\frac{1}{3}$) with a keel that becomes progressively more acute above. *Pinnules* thickly coriaceous, sometimes wrinkled when dry, dark, half their width apart to (above) overlapping, spreading or slightly decurved, suborbicular to very shortly and asymmetrically ovate, the smaller ones 4 by 4 to 5 by 6 mm, the larger ones 8 by 7 mm; base unequal, basicopically narrower, acropically broadly rounded to subangular; margin entire, also in sterile pinnules, thinner in texture and paler, not rarely somewhat revolute. Lower pinnules slightly or not remote and reduced, upper pinnules gradually and more strongly reduced but not confluent, the terminal pinnule free or nearly so, suborbicular or asymmetrically rhombic, occasionally lobed. Veins and *sori* as in the preceding species. Spores rather dark brown, trilete, smooth, c. 31–34 μ .

Distr. *Malesia*: Borneo (only known from Mt Kinabalu, Sabah; 11 coll.).

Ecol. On moist rocks, in forest and open places, c. 1500–3000 m.

Note. Young leaves described as bright red. See also the note after the preceding species.

41. *Lindsaea divergens* HOOKER & GREVILLE, Ic. Fil. (1831) pl. 226.—*Vittaria divergens* (HOOKER & GREVILLE) ROXBURGH ex GRIFFITH, Calc. J. Nat. Hist. 4 (1844) 510.—*Schizoloma divergens* (HOOKER & GREVILLE) KUHN, Chaetopt. (1882) 346; DIELS in E. & P. Nat. Pfl. Fam. I, 4 (1902) 219, *comb. superfl.*—*Isoloma divergens* (HOOKER & GREVILLE) J. SMITH, Hook. J. Bot. 3 (1841) 414; HOLTUM, Rev. Fl. Mal. 2 (1954) 337, f. 195; COPELAND, Fern Fl. Philip. 1 (1958) 117.—Type: probably a specimen without data from herb.

HOOKER, said to be a WALLICH coll. from ROXBURGH's herbarium (K).

Rhizome short-creeping, 1½–2 mm ϕ ; scales very dark brown, to c. 1 mm long, almost acicular, to 4-seriate at base, many scales largely or entirely uniseriate. Leaves clustered; *petioles* black, lustrous, abaxially terete, adaxially flattened and with 2 sharp, occasionally paler lateral ridges but hardly sulcate, to c. 15 cm long, mostly about $\frac{1}{3}$ as long as the lamina. *Lamina* narrowly oblong, 15–50 cm long, 3½–6 cm wide, narrowed at both ends but more gradually at the base, widest about the middle; rachis like the petiole, abaxially keeled only near the apex. *Pinnules* spreading or the upper ones ascending, the basal ones deflexed, contiguous with their broadened bases, elongate-ligulate, chartaceous to subcoriaceous, dark green or brown when dry, the lower side markedly paler, often somewhat glaucous; larger pinnules 1¾–3 cm long, 3–4 mm wide (not counting the broadened base), little narrowed to the obtuse apex; acropical side of base with an obtuse or subacute auricle that does not touch the rachis; basicopic side less broadened. Lowermost, reflexed pinnules mostly several mm long, scarcely auriculiform; uppermost pinnules more strongly reduced, a few confluent with the lobate-hastate, lanceolate terminal segment, or a free, scarcely lobed, lanceolate pinnule present. Margin entire, often revolute when dry, then the pinnules seemingly acute. Veins immersed, obscure, lax, very oblique, mostly once or twice forked. *Sori* continuous, absent from the basal auricle and sometimes, from the apex; indusium 0.2–0.3 mm wide, pale, entire, not reaching the margin by less than its width. Spores medium brown, trilete, smooth, c. 17–19 μ .

Distr. S. Thailand; *Malesia*: Malay Peninsula, Singapore, Riouw Is., Lingga Is., Sumatra, Banka, Borneo, Philippines (Palawan).

Ecol. Terrestrial in forest, from sea-level up to c. 800 m.

9. Section *Stenolindsaea*

KRAMER, *Blumea* 15 (1968) 561.

Type species: *Lindsaea lucida* BLUME.

Distr. A small section of only three species, occurring from China and Southern Japan to Fiji.

Taxon. Except for its constantly unipinnate leaves and basally tapering lamina (not always distinct in *L. lucida* BLUME) this section agrees in technical characters with *sect. Temnolindsaea*, but the groups are probably not closely related. The axes are abaxially bi-angular.

42. *Lindsaea lucida* BLUME, En. Pl. Jav. (1828) 216; HOLTUM, Rev. Fl. Mal. 2 (1954) 328, f. 187; KRAMER, *Blumea* 15 (1968) 567.—Type: BLUME *s.n.*, Java (L).

L. gracilis BLUME, En. Pl. Jav. (1828) 217, *non* KLOTZSCH (1844); not or only in part of later authors.—Type: BLUME *s.n.*, Java (L).

L. concinna J. SMITH, Hook. J. Bot. 3 (1841) 415, *nom. subnud.*; HOOKER, Sp. Fil. 1 (1846) 205, pl. 61 B.—*L. cultrata* (WILLD.) SWARTZ *var.*

concinna (J. SMITH) DOMIN, Bibl. Bot. 20 (1915) 82.—Type: CUMING 198, Luzon (K); dupl. in B, E, GH, HBG, L, P, SING, US, W).

L. securifolia PRESL ex GOLDMANN, Nova Acta Ac. Caes. Leop.-Car. Suppl. 1 ad 16 (1843) 464; KUNZE, *Farrnkr.* 1 (1846) 204, pl. 85 f. 1; COPELAND, Fern Fl. Philip. 1 (1958) 108.—*L. cultrata* (WILLD.) SWARTZ *var. securifolia* (PRESL) BAKER in Beccari, *Malesia* 3 (1886) 36.—Type: MEYEN *s.n.*, Manila, Luzon (dupl. in B, HBG).

L. colobodes KUNZE, Bot. Zeit. (1846) 446.—Type: ZOLLINGER 1507, Java (dupl. in B, HBG, W, Z).

L. lobbiana HOOKER, Sp. Fil. 1 (1846) 205, pl. 62 C; HOLTUM, Gard. Bull. S. S. 5 (1930) 61.—*L. cultrata* (WILLD.) SWARTZ var. *lobbiana* (HOOKER) BECCARI, Malesia 3 (1886) 36.—Type: LOBB s.n., Java (K).

L. crenulata FÉE, Gen. Fil. (1852) 105, pl. 28 f. 2.—Type: GRIFFITH s.n., 'Malacca?' (n.v.).

L. gracilis BLUME var. *major* METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 276.—Lectotype: HASSKARL s.n., Java (L).

L. gracillima COPELAND in Perkins, Fragm. Fl. Philip. (1905) 181.—Type: MERRILL 287, Caraballo Sur, Luzon (dupl. in B, BO, US).

L. propria v.A.V.R. Bull. Jard. Bot. Btzig II, 16 (1914) 20.—Type: BACKER 6084, Mt Handjawang near Bogor, Java (BO).

Rhizome short- or very short-creeping, c. 1 mm ϕ ; scales rather dark brown, to 1 mm long, acicular, to 6-seriate at the base, the greater part uni- or biseriate. Leaves very close; *petioles* stramineous to reddish brown, quadrangular, adaxially hardly sulcate. *Lamina* linear, c. 10–40 cm long, c. 10–25 times as long as wide, simply pinnate; rachis like the petiole. *Pinnules* spreading or slightly ascending or decurved, the upper ones subcontiguous to slightly overlapping, the lower ones gradually more widely spaced; larger pinnules $1\frac{1}{2}$ – $2\frac{1}{2}$ times as long as wide, firmly herbaceous, medium to dark green or olivaceous when dry. Upper pinnules reduced; larger pinnules mostly incised. Veins immersed, evident, once or twice forked or the outer ones simple, free; a costa scarcely developed. *Indusium* pale, entire; spores trilete.

KEY TO THE SUBSPECIES

1. Petiole 3–15 cm long, $\frac{1}{5}$ – $\frac{1}{2}$ of the length of the lamina; indusium 0.3–0.4 mm wide, at least in the inner sori almost or quite reaching the margin. 1. *ssp. lucida*
1. Petiole 1–2(–4) cm long, $\frac{1}{15}$ – $\frac{1}{30}$ of the length of the lamina; indusium 0.2 mm wide, more strongly intramarginal. 2. *ssp. brevipes*

1. *ssp. lucida*.

Petioles c. 3–15 cm long, $\frac{1}{5}$ – $\frac{1}{2}$ as long as the lamina. *Lamina* 1–3 cm wide, with c. 25–60 pinnules to a side. *Larger pinnules* 5 by 3 to 15 by 6 mm, almost 2– $2\frac{1}{2}$ times as long as wide, rather variable in shape, $\frac{1}{4}$ -elliptic or subtriangular if small, ligulate to subtrapeziform or elongate- $\frac{1}{4}$ -elliptic if larger, the apex subacute to broadly rounded, the lower margin \pm straight, the upper margin especially in small pinnules evenly convex and no separate outer margin developed, or outward increasingly convex, the outer margin \pm distinct. *Upper pinnules* gradually and suddenly rather strongly reduced, some denticuliform ones connected with the narrow, small, lobed, usually obtuse and often fertile leaf-apex. *Lower pinnules* not reduced or more often slightly to strongly

and gradually reduced, then often somewhat decurved, in extreme cases only 2 mm long but usually larger, the petiole below them well developed. *Sterile pinnules* crenate; *fertile pinnules* if very small entire or with 1 or 2 incisions on the outer/upper margin to $\frac{1}{2}$ mm deep, in larger forms rarely entire, mostly at least with one incision of $\frac{1}{2}$ –1 mm between upper and outer margin, most commonly the upper margin with 1–3 incisions of c. 1 mm (but up to 2 mm), the outer entire. *Sori* continuous except as interrupted by the incisions, on 2–7(–10) vein-ends, the outermost usually longer; upper, smaller pinnules entire, fertile; lower, reduced ones, if any, partly or entirely sterile. Receptacle straight, or concave in the outer sorus. *Indusium* 0.3–0.4 mm wide, little narrowed at the edges, almost or quite reaching the margin, or more strongly intramarginal in the outer sori, reflexed or not at maturity. Spores yellowish brown, smooth, c. 25–28 μ .

Distr. Central Himalaya, S. China, and Ryu Kyu Is. to *Malesia*: throughout *Malesia* (except Lesser Sunda Is.) but rare in New Guinea; Palau Is.

Ecol. Terrestrial or on rocks, rarely epiphytic, in primary forests, from 400–1600 m, sporadically to sea-level.

2. *ssp. brevipes* (COPELAND) KRAMER, *Blumea* 15 (1968) 567.—*L. brevipes* COPELAND, Philip. J. Sc. 6 (1911) Bot. 83; *ibid.* 78 (1949) 19.—Type: KING 237, Papua (MICH; dupl. in BO).—Fig. 37.

Petioles 1–2(–4) cm long, $\frac{1}{15}$ – $\frac{1}{30}$ of the length of the lamina. *Lamina* $1\frac{1}{4}$ –2 cm wide, widest above the middle, very gradually long-tapering at the base, rather shortly acuminate at the apex, with 25–80 pinnules to a side. *Larger pinnules* 6–9 mm long, 3–4 mm wide, mostly $\frac{1}{4}$ -elliptic, occasionally subligulate, mostly with straight lower and outward increasingly convex upper margin and \pm distinctly angular at the junction of outer and upper margins. Incisions various, occasionally none, usually 1–3 per pinnule, $\frac{1}{2}$ –1, sometimes to 2 mm deep and then reaching to or the outer ones beyond the middle. *Upper pinnules* as in *ssp. lucida*. *Lower pinnules* from above the middle of the lamina downward gradually and strongly reduced, many lower ones auriculiform, 1–2 mm long, sterile, crenate to cleft. *Indusium* 0.2 mm wide, not reaching the margin, usually reflexed and \pm concealed at maturity. Spores c. 20 μ , otherwise as in *ssp. lucida*.

Distr. *Malesia*: S. Moluccas (Ceram, Ambon), New Guinea (Waigeu, W. New Guinea, Terr. of New Guinea, Papua); Admiralty Is. (Los Negros), Solomon Is.

Ecol. Terrestrial and on rocks and tree-bases, in forests, from sea-level up to c. 1000 m.

Note. This is a somewhat variable species. The extremes certainly look different, e.g., the form described from (and particularly common in) the Philippines as *L. concinna* with short pinnules and basally rather strongly tapering

lamina; but they all grade into each other. *Ssp. brevipes* alone seems reasonably distinct, although there are a few intermediates, notably in New Guinea.

43. *Lindsaea bakeri* (C. CHR.) C. CHR. Ind. Fil. Suppl. 3 (1934) 121; COPELAND, Philip. J. Sc. 78 (1949) 17.—*Davallia lanceolata* BAKER, Kew Bull. (1899) 119; non *Asplenium lanceolatum* HUDSON (1762), nec *L. lanceolata* LABILLARDIÈRE (1806).—*Asplenium bakeri* C. CHR. Ind. Fil. (1906) 102.—Type: GIULIANETTI & ENGLISH s.n., Vanape valley, Papua (K).

L. trichophylla COPELAND, Philip. J. Sc. 6 (1911) Bot. 83.—Type: KING 262, Papua (MICH; dupl. in BRI, ?P).

L. schlechteri BRAUSE, Bot. Jahrb. 49 (1912) 28, f. 1 J; COPELAND, Philip. J. Sc. 78 (1949) 17.—Type: SCHLECHTER 19395, Pema, Terr. of New Guinea (B).

L. ledermannii BRAUSE, Bot. Jahrb. 56 (1920) 130.—Lectotype: LEDERMANN 10017, Lordberg, Sepik R. region, Terr. of New Guinea (B; dupl. in S-PA).—Fig. 22.

Rhizome short-creeping, $\frac{1}{2}$ – $\frac{2}{3}$ mm \varnothing ; scales not seen. Leaves clustered; *petioles* abaxially obtusely to sharply bi-angular, 1–10 cm long, shorter than to about equaling the lamina. *Lamina* linear, once pinnate + deeply uni- to tripinnatifid, narrowed on both sides or truncate at the base, with c. 20–50 pinnules to a side; rachis abaxially sharply bi-angular, hardly sulcate. *Pinnules* subcontiguous to slightly overlapping, the basal ones farther apart, spreading, slightly ascending, or somewhat falcately decurved, thinly herbaceous, medium to dark green when dry, 5 by 2½ mm to 3 by 1½ cm, semi-ovate to suboblong in outline, 2–2½ times as long as wide, very deeply incised from the upper margin, with 3–9 primary segments (in one plant at the apex also incised from the lower edge), these rarely all simple, mostly at least the basal ones once or twice forked, or in very large pinnules acropically-dimidiately or subequally pinnatifid, then some of the secondary segments again bifid; ultimate lobes \pm divergent, linear, often with revolute margin, gradually but slightly broadened upward, then suddenly broadened at the sorus, the wing connecting them about as wide as the segments. Veins immersed, single or

very rarely paired in the lobes. *Upper pinnules* gradually reduced, confluent into a pinnatifid leaf-apex; basal pinnules \pm reduced. *Sori* uni- or binerval; indusium pale or greenish, delicate, subentire, laterally free, $\frac{1}{4}$ mm wide, not reaching the margin by its width or a little less, not strongly reflexed at maturity but the sporangia often spreading beyond the margin. Spores pale brown, trilete, smooth, c. 20 μ .

KEY TO THE VARIETIES

1. Axes stramineous to medium brown; ultimate lobes 0.3–0.5 mm wide, at the sorus $\frac{1}{2}$ –1 mm wide; sori hardly ever binerval 1. *var. bakeri*
1. Axes medium to dark brown; ultimate lobes 0.6–1 mm wide, 0.8–1.2 mm wide at the sorus; sori not rarely binerval. 2. *var. pycnophylla*

1. *var. bakeri*.—Fig. 22.

Petioles stramineous to medium brown, then not rarely pale-angled. *Lamina* 4–30 cm long, 1–6 cm wide; rachis stramineous or basally pale brown. *Ultimate lobes* of the pinnules divergent, linear-capillary, 0.3–0.5 mm wide, at the sorus 0.5–1 mm wide, their apices erose, rounded or subtruncate, not rarely laterally bicorniculate, rounded-subacute when sterile. Veins evident. *Sori* very rarely binerval, 0.3–0.8 mm long; base of indusium \pm straight.

Distr. *Malesia*: Moluccas (Morotai), New Guinea (all Div.).

Ecol. Terrestrial, on banks and mounds, and on tree-bases, in forests, from c. 80–1000 m.

2. *var. pycnophylla* KRAMER, Blumea 15 (1968) 567.—Type: BRASS 6838, Fly R. region, Papua (GH).

Petioles and rachises medium to dark brown, pale-margined. *Lamina* to 12 by 3 cm, little narrowed at base. *Pinnule lobes* not capillary, 0.6–1 mm wide, at the sorus 0.8–1.2 mm wide, little divergent, apically hardly or not erose. Veins concealed. *Sori* not rarely binerval, to 1 mm long. Base of indusium not rarely strongly concave.

Distr. *Malesia*: Papua (2 coll.; beside the type also BRASS 6902, BM, GH, from the same area).

Ecol. 80–100 m.

Subgenus *Odontoloma*

(HOOKER) KRAMER, Blumea 15 (1968) 561.—*Davallia subg. Odontoloma* HOOKER, Sp. Fil. 1 (1845) 174.—*Odontoloma* J. SMITH, Hook. J. Bot. 3 (1841) 415, *nom. subnud.*; in Hooker & Bauer, Gen. Fil. (1842) pl. 114 B; non H.B.K. (1820) (*Compositae*).

Type species: *Dicksonia repens* BORY = *Lindsaea repens* (BORY) THWAITES.

10. Section *Odontoloma*

Type species: As the subgenus.

Distr. Mascarene Islands, Ceylon, NE. India, Ryu Kyu Is. to Hawaii, and NE. Australia.

Taxon. A group of closely related species with closed xylem strand, \pm persistently scaly rhizome, and

unipinnate leaves. The differences between most taxa are slight, and the present species and varieties are not quite satisfactory.

44. *Lindsaea glandulifera* v.A.v.R. Bull. Jard. Bot. Btżg II, 1 (1911) 9.—Type: KOORDERS 15415, Besuki, Java (BO; dupl. in K, L).

L. repens (BORY) THWAITES var. *laciniata* METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 277.—Lectotype: ZOLLINGER II 3712, Mt Idjen, Java (L; dupl. in B, BM, P, W).—Fig. 49.

Rhizome long-scandent, brown, 1–2 mm ø, dorsally ± persistently scaly; scales honey-coloured to pale golden-brown, narrowly triangular, to c. 25-seriate at base, to 4 by 1 mm, the uniseriate apex of up to 10 cells. Leaves 1–3 cm apart, issuing under an acute angle; *petiole* almost wanting to c. 2 cm long, stramineous, darker and verruculose at base, sharply quadrangular almost to the base, laterally and sometimes also adaxially broadly and shallowly sulcate. *Lamina* linear, 20–35 cm long, 1½–2½ cm wide, simply pinnate, with c. 40–60 pinnules to a side; rachis stramineous, abaxially flat, sharply bi-angular, adaxially broadly sulcate, laterally ± sulcate. *Pinnules* regularly spaced except at the base, not contiguous, spreading or mostly somewhat ascending, at least the basal ones inserted below the level of the adaxial-lateral ridges, asymmetrically elongate-triangular, herbaceous, bright green to olivaceous when dry, the largest 10–12 by 4–5 mm, ± evenly narrowed from base to apex, cuneate at base, narrowed-rounded at apex; lower margin mostly somewhat convex; upper margin outward convex, incised, with mostly 3 major, oblique incisions reaching down to ⅓ or ½ or occasionally to ¾, the lobes not parallel-sided but narrowed, rounded at apex, the largest lobes shallowly incised again. Pinnules of juvenile plants and sterile ones not more incised. *Lower pinnules* gradually remote and reduced, largely sterile; *upper pinnules* gradually and strongly reduced, confluent into a pinnatifid leaf-apex. Veins immersed, evident, simple or once forked. *Sori* one per lobe, on the ends of 1 or 2 connivent veins; indusium transversely elongate to hippocrepiform, with ± concave base, free at the narrowed sides, ⅓–1 mm long, c. ⅓ mm wide, not reaching the margin by its width or a little less, reflexed and concealed at maturity. Spores pale brown, trilete, nearly smooth, c. 22 μ.

Distr. Ceylon; in *Malesia*: East Java, Lesser Sunda Islands (Lombok, Sumbawa). Map 10.

Ecol. Epiphytic in mountain forests, c. 1000 m. Apparently rare.

45. *Lindsaea oblanceolata* v.A.v.R. Bull. Jard. Bot. Btżg II, 23 (1916) 15.—Type: AJOEB 100, Rimbo Pengadang, Bencoolen, Sumatra (BO; dupl. in L).

L. subsemilunularis v.A.v.R. Bull. Jard. Bot. Btżg II, 28 (1918) 31.—Type: HALLIER 591, Mt Damus, Borneo (BO).

? *L. lunulata* v.A.v.R. Bull. Jard. Bot. Btżg II, 11 (1913) 15.—Type: RAAF 634, Batu Islands (BO).

L. pectinata auct. non BLUME; HOLTUM, Gard. Bull. S. S. 5 (1930) 62; Rev. Fl. Mal. 2 (1954) 324.

Rhizome long-scandent, dark castaneous, 1–2 mm ø; scales when mature dark brown, narrowly triangular or lanceolate, to 2½ by ¾ mm, up to c. 15-seriate at the base, the uniseriate apex very short. Leaves remote, 1–5 cm apart, not rarely issuing almost at right angles; *petioles* abaxially bi-angular, mostly brown and pale-angled but sometimes quite stramineous except at the base, 2–10 cm long (exceptionally longer), much shorter than the lamina, at the most half as long. *Lamina* linear, 15–50 cm long (rarely shorter but fertile), 2–4½ cm wide, 5–15 times as long as wide, in juvenile plants usually broadest just below the apex, in full-grown ones narrowed to both ends, simply pinnate, with c. 20–60 pinnules to a side; rachis pale brown, stramineous-margined, or stramineous throughout, at the base sharply quadrangular with flat or slightly convex faces, the pinnules in the basal part inserted below the adaxial face, upward sulcate. *Pinnules* herbaceous or chartaceous, dark green or blackish when dry, sometimes described as glossy, less than their width apart to slightly overlapping, spreading, the lower ones not rarely deflexed and the upper ones somewhat ascending, dimidiate-ligulate or trapezoidal, broadly rounded or narrowed-rounded at the apex; larger pinnules 10 by 5 to 22 by 9 mm, 2–2½ times as long as wide, entire; sterile or incompletely fertile pinnules crenate. *Lower pinnules* gradually reduced but few or none so strongly as to be auriculiform; *upper pinnules* not reduced in juvenile plants, increasingly so in older ones, in the largest leaves several very small ones connected with the small lanceolate terminal segment; small leaves with a large, free, very obtuse, transversely elongate, asymmetrically lance-shaped or flabellate or broadly lanceolate terminal pinnule, with all intermediates between the two extremes possible. Veins immersed, ± evident, once or twice forked, free, ¾–1¼ mm apart. *Sori* continuous, occupying all vein-ends, interrupted only in incompletely fertile pinnules; indusium 0.3–0.5 mm wide, pale, subentire, not reaching the margin by ½–1 times its width. Spores yellowish brown, trilete, almost smooth, c. 20 μ.

Distr. Annam, Peninsular Thailand; in *Malesia*: Malay Peninsula, Sumatra, West Java, Borneo, Philippines (Luzon, Leyte, Mindanao), Moluccas (Ceram, Ambon). Not yet found on Celebes.

Ecol. On tree trunks, or occasionally terrestrial, 800–1800 m, rarely lower. Apparently uncommon in most parts of its area.

Notes. Incompletely fertile leaves without rhizome cannot always be distinguished from *L. repens*. Juvenile plants lack the deeply incised pinnules of that species.

The type of *L. lunulata* v.A.v.R. is a juvenile,

nearly quite sterile plant of uncertain identity.

46. *Lindsaea repens* (BORY) THWAITES, En. Pl. Zeyl. (1864) 388; BEDD. Ferns S. Ind. (1864?) pl. 209; CHRIST, Geogr. d. Farne (1910) f. 46, 47; HOLTUM, Gard. Bull. S. S. 5 (1930) 63, f. 4.—*Dicksonia repens* BORY, Voy. 2 (1804) 323.—*Davallia repens* (BORY) DESVAUX, Prod. (1827) 314, non KUHN (1867).—*Odontoloma repens* (BORY) PRESL, Epimel. Bot. (1851) 97.—*Acrophorus repens* (BORY) MOORE, Ind. Fil. (1857) 91.—*Davallia boryana* PRESL, Rel. Haenk. (1825) 66, as to type only.—*Saccoloma boryanum* (PRESL) PRESL, Tent. Pterid. (1836) 126.—*Odontoloma boryanum* (PRESL) J. SMITH, Hook. J. Bot. 3 (1841) 415 ('boryana').—*L. boryana* (PRESL) BRAUSE, Bot. Jahrb. 56 (1920) 129.—Type: BORY s.n., Bourbon (= Réunion) (P; dupl. in B, BM).—*L. bantamensis* BLUME, En. Pl. Jav. (1828) 218.—Type: BLUME s.n., Bantam, Java (L).
- L. hymenophylloides* BLUME, l.c.; not or in part only of later authors.—*Acrophorus hymenophylloides* (BLUME) MOORE, Ind. Fil. (1857) 2.—*Davallia hymenophylloides* (BLUME) BAKER, Syn. Fil. ed. 1 (1867) 93.—*Odontoloma hymenophylloides* (BLUME) J. SMITH, Hist. Fil. (1875) 269.—Type: BLUME s.n., Java (L).
- L. pectinata* BLUME, En. Pl. Jav. (1828) 217; not of HOLTUM, Rev. Fl. Mal. 2 (1954) 324, nor of COPELAND, Fern Fl. Philip. 1 (1958) 104.—Type: BLUME s.n., Java (L).
- Davallia hemiptera* BORY, Bél. Voy. Bot. 2 (1833) 73, pl. 7 f. 2.—*Saccoloma hemipterum* (BORY) PRESL, Tent. Pterid. (1836) 126.—*Odontoloma hemipterum* (BORY) PRESL, Epimel. Bot. (1851) 98.—*Acrophorus hemipterus* (BORY) MOORE, Ind. Fil. (1861) 295.—*L. repens* (BORY) THWAITES var. *hemiptera* (BORY) v.A.v.R. Handb. (1908) 261; not *L. hemiptera* KRAMER (1957).—Type: BÉLANGER s.n., Java (P).
- L. oblongifolia* REINW. ex HOOKER, Sp. Fil. 1 (1846) 206, at least in part.—Type: CUMING 186, S. Camarines, Luzon (K; dupl. in B, GH, L, SING, US, W).
- Davallia delicatula* CHRIST, Verh. Naturf. Ges. Basel 11 (1895) 224, pl. 3, 1-3.—*L. delicatula* CHRIST, l.c., nom. illeg.—Type: SARASIN 987, Borau, Celebes (P).
- L. sessilis* COPELAND, Philip. J. Sc. 6 (1911) Bot. 82; *ibid.* 78 (1949) 16.—Type: KING 244, Papua (MICH).
- L. repens* (BORY) THWAITES var. *intermedia* CHRIST, Ann. Cons. Jard. Bot. Genève 15/16 (1912) 197.—Type: HOCHREUTINER 782, Mt Salak, Java (n.v.).
- L. foersteri* ROSENSTOCK in Fedde, Rep. 12 (1913) 527; COPELAND, Philip. J. Sc. 78 (1949) 17.—Type: KEYSER 193, Mt Sattelberg, Terr. of New Guinea (B; dupl. in MICH).
- L. pectinata* (BORY) THWAITES f. *dimorpha* ROSENSTOCK in Fedde, Rep. 13 (1914) 213.—Type: GRASHOFF, 59, W. Sumatra (S-PA).
- L. repens* (BORY) THWAITES f. *truncatiloba* ROSENSTOCK, l.c. 214.—Type: GRASHOFF 60, W. Sumatra (S-PA).

L. longa COPELAND, Philip. J. Sc. 46 (1931) 216; Fern Fl. Philip. 1 (1958) 103.—Type: EDAÑO B.Sc. 77978, Mt Balabag, Palawan (MICH; dupl. in GH).

L. sagincola WAGNER & GREYER, Un. Cal. Publ. Bot. 23 (1948) 34, pl. 9.—Type: GREYER & WAGNER 4010, Los Negros, Admiralty Is. (dupl. in MICH, US).

L. cultripinna COPELAND, Philip. J. Sc. 81 (1952) 6; Fern Fl. Philip. 1 (1958) 103.—Type: SULIT P.N.H. 8718, Mt Katanglad, Mindanao (MICH).

? *L. roxasii* COPELAND, Philip. J. Sc. 81 (1952) 6; Fern Fl. Philip. 1 (1958) 102.—Type: COPELAND P.P.E. 259, Mindanao (MICH).—Fig. 43-45.

Rhizome long-scandent, castaneous; scales triangular, narrowly triangular, or lanceolate, with a very short uniseriate apex, the larger ones 2½-3½ mm long. *Leaves* one to a few cm apart, issuing under a small angle; petioles stramineous to pale brown with dark base, quadrangular, the faces not sulcate. *Lamina* linear, simply pinnate, narrowed at both ends, or sometimes little narrowed at the base; rachis stramineous, quadrangular, adaxially at the base ± convex, the pinnules inserted below the edges, upwards sulcate, bearing the pinnules at its edges. *Pinnules* numerous, herbaceous, elongate-triangular, ligulate, or ¼-elliptic, the upper ones gradually and strongly reduced, a few confluent into a pinnatifid leaf-apex. Upper margin shallowly incised. *Juvenile plants* with deeply (bi)pinnatifid, thin pinnules, sterile; but in transitional cases leaves may be fertile in the upper part and bear sterile pinnules of the juvenile shape in the basal part. Veins immersed free, once or twice forked. *Sori* interrupted. Spores pale brown, trilete, smooth, c. 22-26 µ.

Distr. Mascarenes, Ceylon, Assam, Indo-China to *Malesia*, Queensland, and Hawaii.

KEY TO THE VARIETIES

1. Rhizome delicate, less than 1 mm ø
 2. var. *delicatula*
1. Rhizome of full-grown plants (1½)-2-3 mm ø.
 2. Indusium with strongly concave base, subhippocrepiform; most sori uninerval and round, occasionally some binerval and crescent-shaped; margin regularly incised, the incisions reaching down almost twice the distance from receptacle to margin; most lobes rounded; sporangia at full maturity strongly laterally spreading; petiole very short
 1. var. *sessilis*
 2. Indusium with weakly concave, straight, or somewhat convex base, or, if more strongly concave, the sori almost marginal; sori uni- to plurinerval.
3. At least the broader basal lobes of fully fertile pinnules truncate; most or all sori straight and plurinerval (except in incomplete fertile pinnules); most incisions not reaching the level of the receptacle.

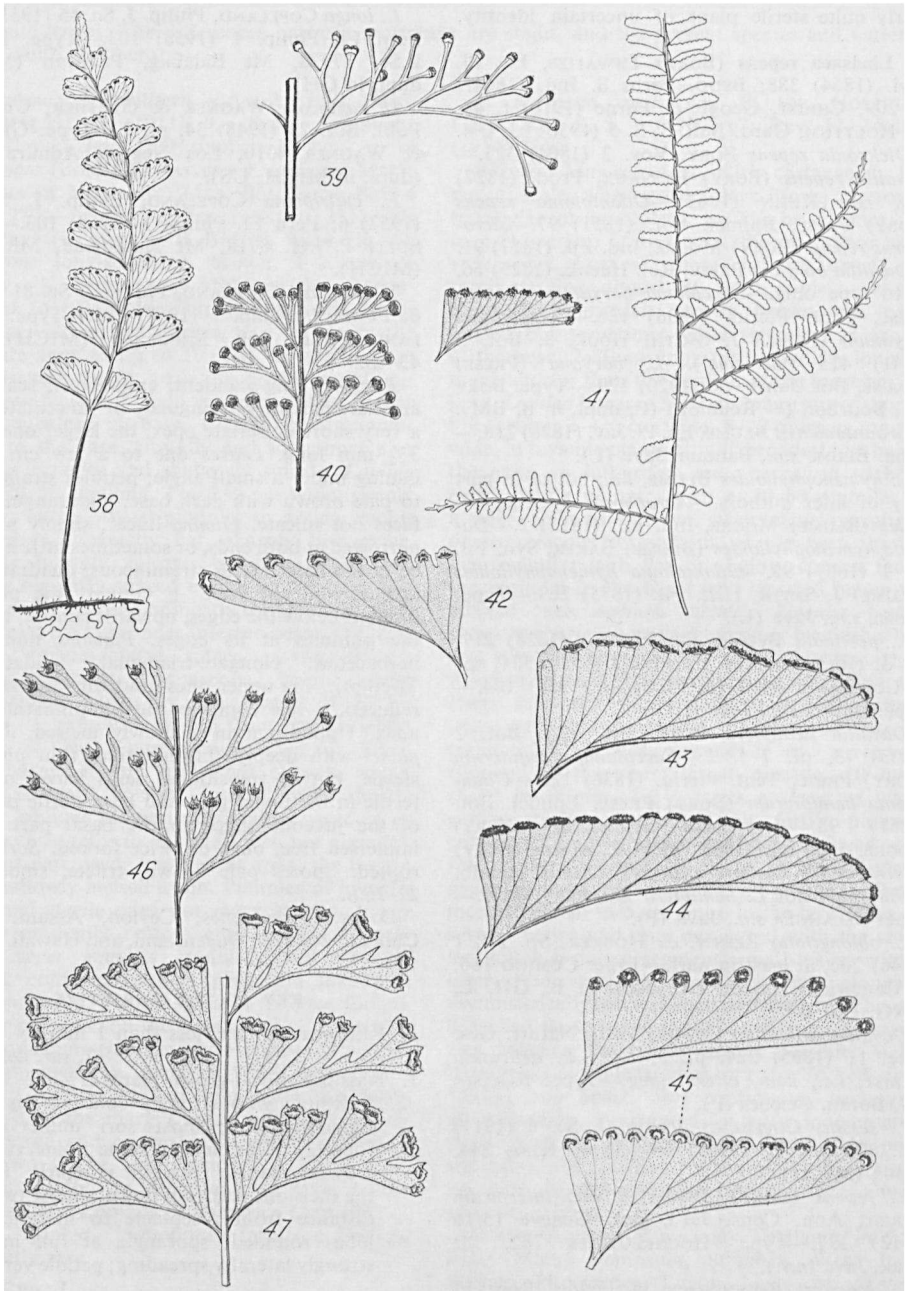


Fig. 38. *Lindsaea wernerii* ROSENSTOCK. Leaf, $\times \frac{1}{2}$ (SURBECK s.n., L).—Fig. 39. *L. versteegii* (CHRIST) v.A.v.R. Pinnule and part of rachis, $\times 2\frac{1}{2}$ (VERSTEEG 1222).—Fig. 40. *L. rosenstockii* BRAUSE. Part of a pinna, $\times 1\frac{1}{2}$ (WOMERSLEY 8346).—Fig. 41. *L. microstegia* COPEL. Basal part of lamina, $\times \frac{1}{2}$, pinnule, $\times 1\frac{1}{2}$ (DARBYSHIRE 275).—Fig. 42. *L. merrillii* COPEL. ssp. *merrillii*. Pinnule, $\times 2\frac{1}{2}$ (ELMER 13488).—Fig. 43–45. *L. repens* (BORY) THWAITES.—Fig. 43. var. *pectinata* (BL.) METT. ex KUHN. Pinnule, $\times 1\frac{1}{2}$ (BACKER 530).—Fig. 44. var. *submarginalis* KRAMER. Pinnule, $\times 2$ (SURBECK 946).—Fig. 45. var. *sessilis* (COPEL.) KRAMER. Pinnules of two forms, above, $\times 3$ (NGF 8493), below, $\times 2$ (BRASS 23394).—Fig. 46. *L. capillacea* CHRIST. Part of a lamina, $\times 4$ (ELMER 17635).—Fig. 47. *L. fissa* COPEL. Part of a lamina, $\times 2\frac{1}{2}$ (MERRILL 9527).

4. Sori very close to the margin, the sporangia at full maturity often adaxially visible; pinnules 3-4 times as long as wide

4. *var. submarginalis*

4. Sori more distinctly intramarginal, the sporangia never adaxially visible; pinnules 2½-3 times as long as wide. 3. *var. pectinata*

3. Lobes narrowed-rounded, irregular, with nearly marginal, mostly uni- or binerval ± round sori; incisions mostly reaching 3 or more times the distance from margin to receptacle; petiole often well-developed.

5. *var. pseudohemiptera*

1. *var. sessilis* (COPELAND) KRAMER, *Blumea* 15 (1968) 568.—*L. sessilis* COPELAND.—*L. foersteri* ROSENSTOCK.—*L. longa* COPELAND.—*L. cultripinna* COPELAND.—Fig. 45.

Rhizome c. 2 mm ø; scales honey-coloured to medium brown, to over 20-seriate at the broadened base but usually narrower, to 3½ by 1 mm. *Petioles* to 5 cm long but usually much shorter, less than 1 cm. *Lamina* 20 by 2 to 70 by 6 cm, with c. 40-80 pinnules to a side, rather suddenly, shortly, and strongly narrowed at both ends. *Pinnules* sessile, spreading, or slightly ascending or the basal ones somewhat falcately decurved, 15 by 4 to 28 by 8 mm, 3-4 times as long as wide, rarely less. Margins little convex except if pinnules falcate, the outer margin rounded, subtruncate, or virtually absent. Colour mostly dark green when dry. Incisions of upper/outer margin ⅓ to 1½ mm deep, occasionally deeper, mostly progressively deeper from base to apex, reaching almost to the level of the receptacle to considerably beyond; lobes regular, rounded or narrowed-rounded, often 1 mm wide. *Basal pinnules* reduced, often decurved, sterile, not rarely deeply pinnatifid. Veins single or rarely paired in the lobes. *Sori* on one, or on two connivent vein-ends (rarely a few on two more divergent vein-ends, then more elongate and the lobe subtruncate), roundish, distinctly intramarginal even in more deeply incised pinnules; indusium with concave base, reniform or subhippocrepiform, pale, entire, 0.4-0.8 mm long, 0.2-0.3 mm wide, not reaching the extremity of its lobe by its own width or more.

Distr. Malesia: Borneo (Sabah: Mt Kinabalu), Philippines (Palawan), Celebes, S. Moluccas, Aru and Kei Is., New Guinea, Admiralty Is., Solomon Is., Santa Cruz Is.; Western Polynesia.

Ecol. On trees, rarely epilithic, in moist forests, from sea-level up to c. 1800 m.

Note. The specimens from Mt Kinabalu have relatively shorter, less incised pinnules. In the W. part of its range there are some transitions to *var. pectinata*; there is probably some hybridization.

2. *var. delicatula* (CHRIST) KRAMER, *Blumea* 15 (1968) 569.—*Davallia delicatula* CHRIST.—*L. sagincola* WAGNER & GREYER.

Rhizome slender, c. ¼-¾ mm ø; scales honey-coloured, to 4 by ½ mm, to c. 16-seriate at the

base. *Petioles* to 1½ cm long, brownish and pale-angled. *Lamina* c. 12-25 by 2-3 cm, with up to c. 27 pinnules to a side; rachis adaxially shallowly grooved. *Pinnules* spreading or slightly ascending, mostly pale green when dry, the larger ones 12 by 5 to 15 by 7 mm, 2-3 times as long as wide, narrowed from the base to the narrowed-rounded or subacute apex; upper and lower margins almost straight, a distinct outer margin not developed. Upper margin crenately incised, the lobes rounded, often with irregular margin, mostly broader than long; incisions 5-6 per pinnule, ½-1 mm deep, rarely deeper, reaching to the level of the receptacle or beyond. Veins lax, once forked or simple. *Sori* uni- or binerval, roundish to oblong; indusium pale, entire, ½-2½ mm long, c. 0.4 mm wide, not reaching the margin by its width or more.

Distr. Malesia: Celebes, Territory of New Guinea, Admiralty Is. (Manus, Los Negros), New Ireland; 1 coll. from each locality, 2 from New Guinea.

Ecol. Epiphytic on sago palms, in swamps at sea-level.

3. *var. pectinata* (BLUME) METT. *ex* KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 277.—*L. pectinata* BLUME.—*L. hymenophylloides* BLUME.—*L. bantamensis* BLUME.—*L. boryana* (PRESL) BRAUSE.—*L. pectinata* BLUME *f. dimorpha* ROSENSTOCK.—*L. repens* BLUME *f. truncatiloba* ROSENSTOCK.—*L. repens* BLUME *var. hemiptera* (BORY) V.A.V.R.—*L. repens* BLUME *var. intermedia* CHRIST.—*L. macraeana* (HOOKER & ARNOTT) COPELAND of HOLTUM, Rev. Fl. Mal. 2 (1954) 324; COPELAND, Fern Fl. Philip. 1 (1958) 101, *etc.*, at least in part.—Fig. 43.

Rhizome 1½-2½, mostly 2 mm ø, eventually dark brown and devoid of scales; scales medium brown, to 3½ by ½ mm, to 16-seriate at the base. *Petiole* usually 2-5, sometimes up to 8 cm long. *Lamina* c. 30-80 by 2½-5 cm; rachis usually adaxially sulcate only near the apex. *Pinnules* c. 40-100 to a side, spreading or, especially the basal ones, falcately decurved, less often somewhat ascending, variable in shape, subtrapezoidal, decurved-ligulate, or ¼-elliptic, the apex broadly rounded, subtruncate, narrowed-rounded, or subacute, usually the lower margin almost straight and the lower outward increasingly convex, but sometimes the opposite, occasionally chartaceous; larger pinnules 12 by 5 to 27 by 9 mm, 2½-3 times as long as wide, but mostly less than 3 times. Upper/outer margin with up to 12 incisions, these to 1 mm deep, the inner ones shallow, reaching at the most to the level of the receptacle, the outer ones deeper; or sometimes the pinnules with only vestigial or rarely without any incisions. Lobes truncate, even most or all small ones, their margin sometimes a little irregular. *Sori* straight, bi- to plurinerval, interrupted by the incisions of the margin, even interrupted if these do not reach their level, or in entire pinnules, but seemingly confluent with age if the interruptions are short. Indusium entire or

sinuate, 0.3–0.5 mm wide, not reaching the margin by a little more than its width to almost reaching it, strongly reflexed and often quite concealed at maturity.

Distr. Assam, Ceylon, Thailand, Indo-China, in *Malesia*: Malay Peninsula, widespread and often common on the Greater Sunda Is., Mentawai Is., Bawean, Philippines.

Ecol. Epiphytic in moist forests, 600–1500 m, sporadically to sea-level.

Note. In Mindanao, Luzon, and Leyte an aberrant form is found, with little or not incised pinnules 9 by 5 to 15 by 8 mm, 2 to less than 1½ times as long as wide. It may be distinguished as *f. angusta* (COPELAND) KRAMER, *Blumea* 15 (1968) 568 (*L. angusta* COPELAND).

4. *var. submarginalis* KRAMER, *Blumea* 15 (1968) 569.—Type: BARTLETT 6603, Karo Plateau, Sumatra (L; dupl. in GH, MICH).—Fig. 44.

Rhizome scales to 3½ by ½ mm, medium brown, to *c.* 16-seriate at base. *Lamina* often basally little reduced, with a well-developed petiole of several cm. *Pinnules* often ascending and falcately upcurved, narrowed-rounded or subacute at apex, without an outer margin, the largest 20 by 5 to 26 by 6 mm, *c.* 3½ to over 4 times as long as wide, mostly dark when dry. Upper margin shallowly and regularly incised, the incisions to ½ mm deep, up to twice the distance from margin to receptacle; lobes truncate, the smaller ones truncate-rounded. *Sori* bi- to quadrinerval, straight with concave extremities or the shorter ones basally quite concave. Indusium entire, *c.* 0.3 mm wide, practically equaling the margin, strongly reflexed and quite concealed at maturity.

Distr. *Malesia*: Sumatra (7 coll.; some doubtful ones).

Ecol. Epiphytic in mountain forests, *c.* 1200–1800 m.

Note. Not quite sharply distinct from *var. pectinata*.

5. *var. pseudoheiptera* v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 157, f. C.—Lectotype: BÜNNEMEIJER 5419, Mt Merapi, Sumatra (BO; dupl. in L, SING, U, US).

Rhizome dark, 1½–2 mm ø; scales medium to rather dark brown, to 2½ mm long, to *c.* 13-seriate at base. *Petioles* a few cm or up to 10 (exceptionally to 15) cm long. *Lamina* *c.* 30–50 by 3–4 cm, with *c.* 40–70 pinnules to a side. *Pinnules* spreading, slightly ascending or slightly decurved, often trapezoidal, narrowed to the apex or not, there subacute to truncate, mostly very dark when dry, the larger ones 20 by 5 to 30 by 6 mm, 3½ to over 5 times as long as wide; incisions of upper/outer margin rather regular, shallow, *c.* ½ mm deep, or, especially towards the apex of the pinnules, deeper, oblique, to 4 mm deep and then irregular and reaching to the middle of the pinnule, the pinnule-apex then sometimes protracted, with 1 or more pinnatifid prolongations. Lobes ligulate, narrowed-rounded, uni-

quadrinerval, with rather broad sinuses. Veins rather irregularly spaced. *Sori* uni- to quadrinerval, often on strongly connivent vein-ends, nearly marginal; indusium *c.* ½–2 mm long, 0.2 mm wide, pale, subentire, with concave base, not reaching the margin by its width or less, strongly reflexed and usually entirely concealed at maturity by the sporangia that spread in all directions, mostly somewhat beyond the edges of the soral lobes.

Distr. *Malesia*: Sumatra, Borneo (Sabah: Mt Kinabalu, etc.).

Ecol. Epiphytic in mountain forests, 1500–1800 m.

Notes. Several juvenile plants from N. Borneo with rigid bipinnatifid pinnules may belong to this variety.

The very irregularly and deeply cleft pinnules, as described and figured by VAN ALDERWERELT VAN ROSENBURGH, occur in the two syntypes and some other specimens, but usually the incisions are much less deep and more regular.

This variety may be a distinct species; the scales are darker than in the other varieties.

47. *Lindsaea apoensis* COPELAND in Perkins, *Fragm. Fl. Philip.* (1904) 182, pl. 4 f. A; *Fern Fl. Philip.* 1 (1958) 103.—Type: COPELAND 1181, Mt Apo, Mindanao (*n.v.*); paratype: DE VORE & HOOVER 365 (dupl. in K, S-PA).

L. havicei COPELAND, *Philip. J. Sc.* 1 (1906) Suppl. II, 149; *Fern Fl. Philip.* 1 (1958) 103.—Type: COPELAND 1758, Mt Balabac, Mindanao (MICH; dupl. in B, P).—Fig. 50.

Rhizome long-scandent, brown, 1–1½ mm ø; scales deciduous, dorsally more persistent, golden-brown, to *c.* 2½ mm long, elongate-ovate, to *c.* 20-seriate at base, with a very short uniseriate apex. Leaves 1–3 cm apart, issuing at a small angle but usually curved to right angles with the rhizome; *petioles* stramineous to pale brown, rarely darker and then pale-margined, quadrangular, laterally ± sulcate, 5–20 cm long, shorter than the lamina. *Lamina* linear, 20–40 cm long, 3–6½ cm wide, shortly to very shortly acuminate, shortly narrowed or more often abrupt at the base, with 20–50 pinnules to a side; rachis stramineous, adaxially shallowly sulcate, or flat at the base. Some *basal pinnules* inserted below the edges of the adaxial face of the rachis, spreading or slightly ascending, rather variable in shape, narrowly triangular to subtrapezoidal, narrowed from base to apex and acute or less narrowed and with truncate apex, the apex occasionally caudate-protracted; texture herbaceous, colour medium to dark green when dry. *Larger pinnules* 2–3 cm long, 4–7 mm wide, 4–5 times as long as wide; lower margin mostly at least at the base concave, upper margin straight or ± convex, with *c.* 6–8 major incisions, these slightly oblique, almost parallel, towards the apex of the pinnule progressively deeper, the inner ones 1–2 mm deep, reaching to ¼–½ (rarely deeper and reaching beyond the middle), the outer ones at least 2 mm deep, reaching to the middle or far beyond; inner lobes often more shallowly incised again;

lobes little narrowed, almost parallel-sided, rounded at apex, uni- or binerval. Pinnule-apex sometimes protracted into a pinnatifid cauda. *Lower pinnules* not remote and reduced or very few more remote and/or slightly reduced; some upper pinnules gradually reduced, confluent into a pinnatifid leaf-apex. *Juvenile plants* without the deeply incised pinnules found in *L. repens*. Veins immersed, evident, once or twice forked, or the outer ones simple. *Sori* bi- or more often uninerval; indusium entire, if binerval elongate and with concave base, if uninerval reniform to hippocrepiform, $\frac{1}{2}$ -1 mm long, 0.6 mm wide, falling short of the margin by $\frac{1}{2}$ -1 times its width, strongly reflexed, often shrivelled and not visible at maturity. Spores pale yellowish, hyaline, trilete, smooth, *c.* 23 μ .

Distr. *Malesia*: Philippines (Luzon, Negros, Leyte, Mindanao).

Ecol. Epiphytic in moist mountain forests, 1200-2100 m.

Note. The basally truncate or almost truncate lamina and the pinnules incised to the middle at least near the apex are distinctive.

48. *Lindsaea merrillii* COPELAND in Perkins, *Fragm. Fl. Philip.* (1904) 181; TAGAWA, *Act. Phytotax. Geobot.* 6 (1937) 33, f. 2 E, F; COPELAND, *Fern Fl. Philip.* 1 (1958) 102.—Type: MERRILL 1774, Baco R., Mindoro (MICH; dupl. in B, GH, K, US).

Odontoloma repens auct. non (BORY) PRESL; J. SMITH, *Hist. Fil.* (1875) pl. 18 d.—Fig. 42.

Rhizome long-scandent, dark brown, 1-2 mm \varnothing ; scales deciduous, dorsally more persistent, lemon-coloured to light brown, elongate-triangular, to $3\frac{1}{2}$ by 1 mm, up to *c.* 20-seriate at base, with a very short uniseriate apex. Leaves 1-4 cm apart; *petioles* virtually absent to 8 cm long, stramineous with dark base or brown and then often pale-angled, quadrangular, only if very short sometimes subterete, very much shorter than the lamina. *Lamina* linear, 25-50 cm long, 2.5-4.2 cm wide, moderately to strongly narrowed at base, acuminate, with *c.* 35-60 pinnules to a side; rachis stramineous, sharply quadrangular, adaxially flat or shallowly sulcate, abaxially usually flat. *Pinnules* spreading or somewhat ascending, elongate-triangular or less often semi-ovate, herbaceous, medium to dark green when dry, the larger ones 11-22 mm long, 4-6 mm wide, 2-4 $\frac{1}{2}$ times as long as wide, narrowed from base to apex, the apex subacute or less often narrowed-rounded or rounded; lower margin straight, outward convex; upper margin approximately straight, regularly dentate if sterile, more irregularly crenate or dentate if fertile, the incisions $\frac{1}{2}$ -1 mm deep, not reaching down to the middle except sometimes near the apex; teeth narrowed from base to apex, acute if sterile, obtuse and erose to acute and often very irregularly erose if fertile, the middle more protruding. *Basal pinnules* reduced and remote, often auriculiform and a few mm long, sterile; *upper pinnules* gradually and

strongly reduced, confluent into a pinnatifid leaf-apex. Veins immersed, evident, once forked, less often twice forked or simple, 1 or 2 running to each lobe, their ends *c.* 1 mm apart. *Sori* uni- or binerval, single on the teeth; indusium pale, subentire, semicircular or reniform to oblong, $\frac{1}{2}$ -1 mm long, *c.* 0.3 mm wide, with convex to slightly concave base, not reaching the margin by about its width or more, \pm reflexed and sometimes concealed at maturity. Spores pale brown, trilete, smooth, *c.* 22 μ . Juvenile plants have deeply divided pinnules, but less regularly so than in *L. repens*.

Distr. *Malesia*: Philippines (Samar, Polillo, Batanes, Leyte, Camiguin, Mindanao, Mindoro, Luzon); these plants belong to *ssp. merrillii*. Another subspecies in the Ryu Kyu Is. and Taiwan.

Ecol. Epiphytic on palms and other trees, from sea-level up to 700 m.

Note. *Davallia boryana* PRESL was described from a specimen from Sorzogon belonging to this species; but PRESL cited *Dicksonia repens* as a synonym, and *D. boryana* must therefore be regarded as a new name for that species.

49. *Lindsaea carvifolia* KRAMER, *Blumea* 15 (1968) 569.—Type: BEGUIN 1116, Ternate (BO; dupl. in L).—Fig. 48.

Rhizome long-scandent, brown, 1-2 mm \varnothing , deciduously scaly; scales honey- to fawn-coloured, narrowly triangular, to 2 mm long, to *c.* 16-seriate at the base, scarcely uniseriate at the apex. Leaves remote, *c.* 1-5 cm apart; *petioles* stramineous, or with brown base, adaxially flattened or sulcate, abaxially convex, rounded to obtusely bi-angular, extremely short to 4 cm long. *Lamina* linear, 20-50 cm long, $1\frac{1}{2}$ -4 cm wide, tapering at both ends, with *c.* 50-80 pinnules to a side; rachis adaxially flattened or sulcate, abaxially bi-angular to broadly and shallowly sulcate. *Pinnules* herbaceous to chartaceous, dark green when dry, spreading or somewhat ascending, at least in the basal part of the lamina inserted somewhat below the level of the adaxial rachis face, often more remote in the lower part of the lamina, the larger ones 6 by 2 to 20 by 6 mm, 3 times as long as wide, almost evenly narrowed from base to apex, subtriangular; upper margin deeply incised, the primary segments 5-7, all but the smallest once, the largest twice bifid; lobes little divergent, linear to capillary, (0.3-) 0.5-1 mm wide, often seemingly narrower when dry because of the revolute margins, sometimes somewhat broadened at the sorus, the apex rounded; wing connecting the primary segments *c.* $\frac{1}{4}$ mm wide at the narrowest points. Veins immersed, evident, single, rarely paired in larger, scarcely bifid lobes. *Sori* uninerval or very rarely binerval, one per ultimate lobe, mostly roundish; indusium pale, with straight or concave base, flattened-elliptic to hippocrepiform, 0.3-0.5(-0.7) mm long, *c.* 0.2 mm wide, almost reaching the margin to not reaching it by more than its width, reflexed and \pm concealed at maturity, the spo-

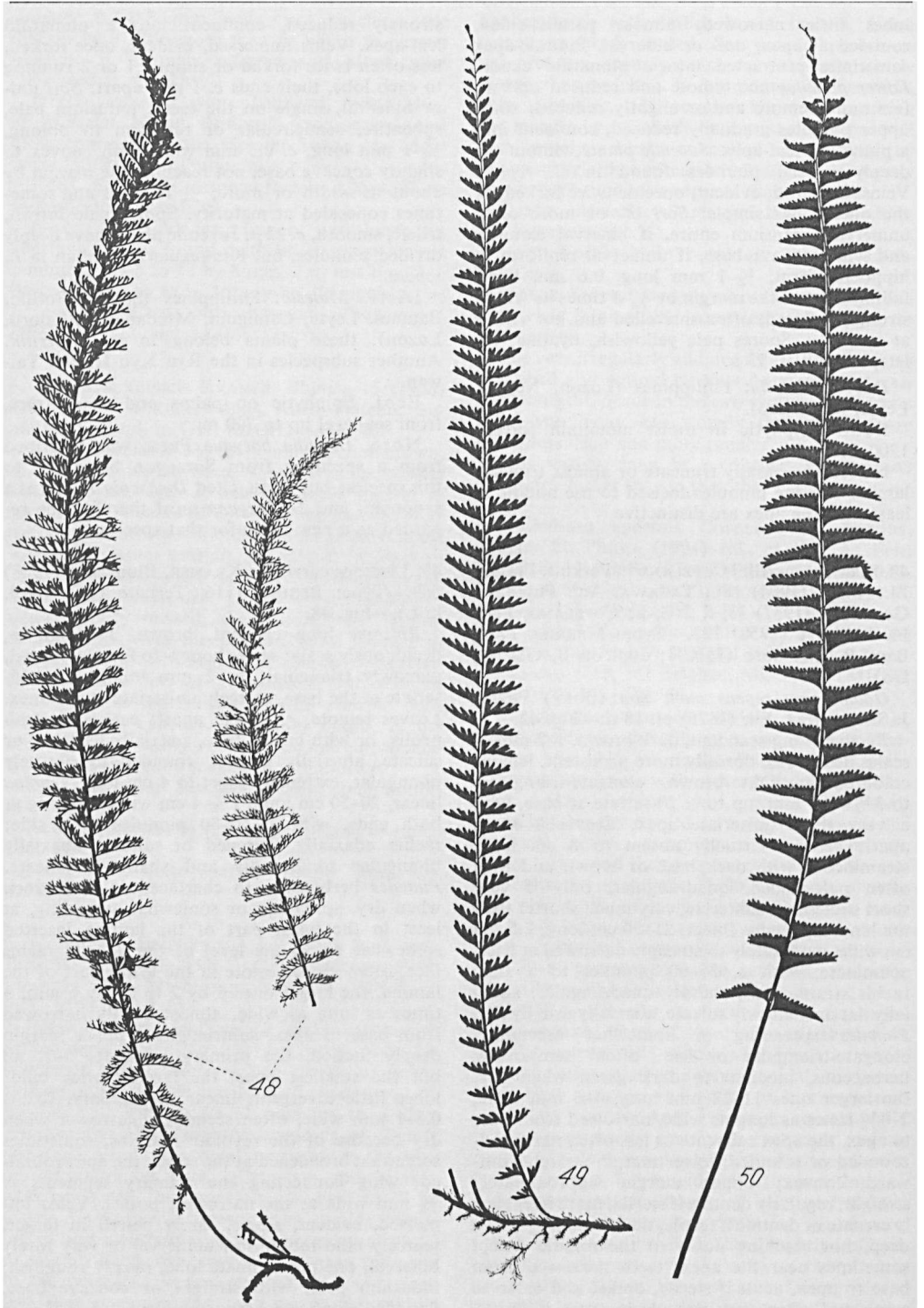


Fig. 48. *Lindsaea carvifolia* KRAMER. Two laminas, $\times \frac{2}{5}$ (ANDERSON S 20179).—Fig. 49. *L. glandulifera* v.A.V.R. Leaf, $\times \frac{2}{5}$ (VAN HEURN 196).—Fig. 50. *L. apoensis* COPEL. Lamina, $\times \frac{2}{5}$ (EDAÑO 5229).

rangia often spreading beyond the edges of the segment. Spores pale brown, trilete, smooth, c. 25 μ .

Distr. *Malesia*: Borneo, Celebes (?), Moluccas (Morotai, Halmahera, Ternate).

Ecol. Epiphytic or rarely terrestrial, in mountain forests, 500–1700 m.

Note. The single collection from Celebes (WARBURG 16527, B) may belong to *L. rosenstockii*, but the occurrence of that species in Celebes is unlikely.

50. *Lindsaea fissa* COPELAND, Philip. J. Sc. 38 (1929) 143, pl. 1; Fern Fl. Philip. 1 (1958) 105.—Type: MERRILL 9527, Mt Capoas, Palawan (MICH; dupl. in BM, BRI, GH, L, P, US).

L. hymenophylloides auct. non BLUME; COPELAND, Fern Fl. Philip. 1 (1958) 105.—Fig. 47.

Rhizome long-scandent, $\frac{3}{4}$ –2 mm ϕ , dark brown, deciduously scaly; scales dorsally more persistent, golden brown to fawn-coloured, triangular, to 3 by 1 mm, to c. 22-seriate at the base, there the cell partitions sometimes bulging beyond the margin, the apex very shortly uniseriate. Leaves rather remote, $\frac{1}{2}$ –4 cm apart; *petioles* dark or reddish brown, or paler above, abaxially terete at the base, upward gradually bi-angular, laterally often sulcate, adaxially flattened to shallowly sulcate, 1–5(–10) cm long, much shorter than the lamina. *Lamina* linear, tapering at both ends, (10–)15–40 cm long, ($\frac{1}{2}$ –)2–3 cm wide, with c. 20–60 pinnules to a side; rachis stramineous, quadrangular, adaxially at least upward sulcate. *Pinnules* thinly herbaceous, dark green to olivaceous or blackish when dry, spreading or falcately deflexed, rarely ascending, rather close or contiguous, approximately $\frac{1}{4}$ -elliptic in outline, the larger ones (7–)10–15 by 3–5 mm, 2–3 times as long as wide; upper margin outward gradually more convex, deeply incised, larger pinnules consisting of 4–5 primary segments, the inner, larger ones usually forked (occasionally twice forked); ultimate segments divergent, linear-cuneate, $\frac{1}{2}$ –2 mm wide at the apex, narrowed just below the sorus, little or not narrowed to the base, there connected by wings of $\frac{1}{4}$ – $\frac{1}{2}$ mm; apex of segments truncate-sinuate or -erose, not rarely with two slightly larger lateral protuberances, sometimes also with 1–2 smaller ones between them. Few upper pinnules reduced and confluent into a pinnatifid leaf-apex; some to many basal ones remote and gradually reduced, usually inserted just below the lateral ridges of the adaxial rachis face. Veins immersed, evident, single or paired in the ultimate lobes. *Sori* uni- or not rarely binerval; indusium thin, pale to brown, subentire, $\frac{1}{2}$ –2 mm long, 0.4 mm wide, at least laterally convex at the base, not reaching the margin by about its width to almost reaching it, not reflexed at maturity.

Spores very pale brown, trilete, smooth, c. 25 μ .

Distr. *Malesia*: Philippines (Luzon, Palawan, Panay, Negros, Mindoro, Biliran, Mindanao).

Ecol. Epiphytic in humid mountain forests, 860–1400 m; few ecological notes given.

51. *Lindsaea capillacea* CHRIST, Bull. Herb. Boiss. I, 6 (1898) 144, pl. 4 f. 7; COPELAND, Fern Fl. Philip. 1 (1958) 106.—Type: LOHER s.n., Mt Maquiling, Luzon (P; dupl. in B, K, S-PA).—Fig. 46.

Rhizome long-scandent, dark brown, $\frac{1}{2}$ mm ϕ , deciduously scaly; scales golden brown, narrowly triangular, to $1\frac{1}{4}$ mm long, up to 9-seriate at base, scarcely uniseriate at apex. Leaves 1–2 cm apart; *petioles* dark brown; lustrous, adaxially flattened or sulcate, abaxially terete at base, obtusely or acutely bi-angular above, 1–5 cm long, much shorter than the lamina. *Lamina* linear, 4–15 cm long, 1–2 $\frac{1}{2}$ cm wide, narrowed at both ends; rachis brown at the base, upward stramineous, adaxially often quite stramineous, at least above sulcate, abaxially bi-angular. *Pinnules* c. 15–60 to a side, thinly herbaceous, dark green when dry, spreading or slightly ascending or the basal ones deflexed, the larger ones 4–15 mm long, 2–4 mm wide, 2 to almost 4 times as long as wide, $\frac{1}{4}$ -elliptic to almost triangular in outline, the upper margin straight or more often outward increasingly convex, deeply incised; larger pinnules with 2–5 primary lobes, the largest one or two forked; segments 0.4–0.8 mm wide near the apex, narrowed to the base, there about half as wide, joined by wings of 0.1–0.3 mm, \pm divergent; fertile segments at the apex bi-apiculate, with two lateral horn-like projections of 0.3–0.4 mm, the margin between them subentire, erose, or with similar but shorter projections. *Upper pinnules* reduced, confluent into a pinnatifid leaf-apex; *lower pinnules* more remote, scarcely to rather strongly reduced. Veins immersed, evident, single in the lobes. *Sori* strictly uninerval; indusium pale, brownish, subentire, $\frac{1}{4}$ –1 mm long, $\frac{1}{4}$ mm wide, with straight or slightly concave, laterally convex base, not quite reaching the margin, scarcely reflexed at maturity. Spores pale brown, trilete, smooth, c. 25 μ .

Distr. *Malesia*: Philippines (Luzon, c. 25 coll.).

Ecol. Epiphytic or occasionally terrestrial, in moist mountain forests, 600–2200 m.

Note. This might be taken for a small form of *L. fissa*, and small specimens of that species may resemble *L. capillacea*, but they lack the well-developed latero-apical horns of the segments. The fact that in Luzon the two species occur together shows that they are not geographical variants.

11. Section Pseudolancea

KRAMER, *Blumea* 15 (1968) 563.

Type and sole species: *Vittaria parasitica* ROXB. ex GRIFF. = *L. parasitica* (ROXB. HIERON.

L. parasitica is probably related to *L. oblanceolata* in sect. *Odontoloma*. But *L. parasitica* has bipinnate fronds on fully developed plants, whereas the fronds of all species of sect. *Odontoloma* are simply pinnate; the separation of *L. parasitica* thus leaves a more clearly natural sect. *Odontoloma*. It seems probable that the bipinnate condition has arisen on more than one evolutionary line within *subg. Odontoloma*; this subject will be further discussed elsewhere.

52. *Lindsaea parasitica* (ROXBURGH ex GRIFFITH) HIERON. *Hedwigia* 62 (1920) 14; KRAMER, *Blumea* 15 (1968) 570.—*Vittaria parasitica* ROXBURGH ex GRIFFITH, *Calc. J. Nat. Hist.* 4 (1844) 510.—Type: ROXBURGH *s.n.*, Prince of Wales' Island (Penang) (*n.v.*).

L. scandens HOOKER, *Sp. Fil.* 1 (1846) 205, pl. 63 B; BEDD. *Ferns Brit. Ind.* 2 (1868) pl. 298; HOLTUM, *Rev. Fl. Mal.* 2 (1954) 325, f. 186; COPELAND, *Fern Fl. Philip.* 1 (1958) 105.—Lectotype: CUMING 405, Luzon (K).

L. lancea auct. non (L.) BEDD. of various authors, as to Asiatic specimens, in part.

Rhizome long-scandent, often knotted, fuscous, 2–3 mm σ ; scales castaneous, to 4 by 1 mm, triangular, to c. 25-seriate at base, the uniseriate apex very short. Leaves one to many cm apart; *petioles* stramineous or with dark base, stout, up to 3 mm σ at base, adaxially with a very narrow groove across which its borders often touch, abaxially terete, c. 7–30 cm long in bipinnate leaves, much shorter than the lamina, almost wanting to c. 5 cm long in simply pinnate leaves. *Lamina* simply pinnate or bipinnate; if simply pinnate c. 20–35 cm long, 2½–5 cm wide, very narrowly oblong, gradually narrowed at base, shortly and abruptly narrowed at apex; if bipinnate c. 35–50 cm long, c. 20–35 cm wide, oblong, c. 1½ times as long as wide, not narrowed at base, with 1–6 primary pinnae to a side and a conform terminal one; primary rachis of bipinnate leaves similar to the petiole but the adaxial groove mostly more open, with flat or convex bottom. *Primary pinnae* ascending or spreading, usually alternate, remote, up to 8 cm apart, subsessile, 15–25 by 2–5 cm, acute to shortly acuminate, with c. 20–35 pinnules to a side; simply pinnate laminae similar but narrowed at the base, usually longer and less narrowed at the apex. Pinnule-bearing rachises abaxially terete, adaxially laterally sharply marginate, with a convex-bottomed groove. *Pinnules* firmly herbaceous, drying medium to dark green or blackish, described as glossy by some collectors, close, regularly spaced, usually contiguous,

spreading or slightly ascending, the basal ones sometimes deflexed, dimidiate-elliptic to ligulate or slightly subfalcately decurved, little or not narrowed to the apex, apically \pm rounded, a separate outer margin not developed, sometimes an angle between lower and outer part of upper margin; larger pinnules 11 by 6 to 20 by 8 mm, 2–2½ times as long as wide. Margins entire, shallowly crenate in sterile pinnules, more deeply crenate in juvenile plants. Very few upper pinnules reduced in simply pinnate leaves, more numerous and more strongly reduced in bipinnate ones, none or 1 or 2 connected with the asymmetrically triangular to broadly lanceolate terminal pinnule (segment). Veins immersed, usually evident, often visible as striations, free, mostly twice forked. *Sori* continuous, occupying all vein-ends; indusium pale, entire, 0.3–0.4 mm wide, not reaching the margin by less than its width to nearly reaching it, strongly reflexed and often concealed at maturity. Spores yellowish, trilete, smooth, c. 22 μ .

Distr. Peninsular Thailand; *Malesia*: Malay Peninsula, Singapore, Sumatra, Borneo.

Ecol. Epiphytic or occasionally terrestrial, from sea-level up to c. 1100 m.

Notes. The lectotype of *L. scandens*, CUMING 405, was said to have come from Luzon; a synonym is labelled 'Leyte'. The identity of the latter is doubtful; and as *L. parasitica* is not otherwise known from the Philippines it seems more likely that CUMING's plant, like others of his collection, was mislabelled and came actually from the Malay Peninsula.

Simply pinnate specimens of *L. parasitica* may be very similar to *L. oblanceolata*; the two are probably related. In *L. oblanceolata* the basal pinnules are inserted below the adaxial face of the rachis, in *L. parasitica* they are borne on the edges of the rachis groove.

Another species with strikingly similar foliage but different rhizome and scales is 32. *L. doryphora*. For additional characters serving to distinguish detached leaves see under that species.

12. Section Lindsaenium

(FÉE) KRAMER, *Blumea* 15 (1968) 563.—*Lindsaenium* (or *Lindsaynium*) FÉE, *Mém. Soc. Mus. Hist. Nat. Strasb.* 4 (1850) 201; *Gen. Fil.* (1852) 333.

Type species: *Lindsaea rigida* J. SMITH in Hooker.

Distr. Malay Peninsula to Micronesia and Tahiti; all species occur in Malesia.

Taxon. A very natural group of epiphytic species with long-creeping rhizomes, at least some bipinnate leaves, and interrupted sori. The first four and the last three species are more closely inter-related.

53. *Lindsaea rigida* J. SMITH in Hooker, Sp. Fil. 1 (1846) 217, pl. 63 A; HOLTUM, Gard. Bull. S. S. 5 (1930) 65; COPELAND, Philip. J. Sc. 78 (1949) 19; HOLTUM, Rev. Fl. Mal. 2 (1954) 330; KRAMER, Blumea 15 (1968) 570.—*Lindsaenium rigidum* (J. SMITH) FÉE, Mém. Soc. Mus. Hist. Nat. Strasb. 4 (1850) 201; Gen. Fil. (1852) 333, pl. 27 bis.—Lectotype: LOBB *s.n.*, Mt Ophir, Johore ('Malacca') (K, 2 sh.; dupl. in E).

L. longissima CHRIST, Ann. Jard. Bot. Btzg II, 5 (1905) 131.—Type: JAHERI (exp. NIEUWENHUIS) 958, Lelibulan Teputsy, Kalimantan, Borneo (P; dupl. in BO).

L. monosora COPELAND in Elmer, Leaf. Philip. Bot. 2 (1908) 398; Fern Fl. Philip. 1 (1958) 109; non ROSENSTOCK (1912).—Type: ELMER 10077, Cuernos, Negros (MICH; dupl. in B, BM, BO, BRI, E, GH, HBG, K, L, P, U, US, W, Z).

L. diplosora v.A.V.R. Bull. Jard. Bot. Btzg II, 16 (1914) 21.—Type: MATTHEW, 523, Mt Singalang, Sumatra (BO; dupl. in K).

L. triplosora v.A.V.R. Bull. Jard. Bot. Btzg II, 16 (1914) 21.—Type: MATTHEW 686, Mt Sago, Sumatra (BO; dupl. in K).

L. rigida J. SMITH *f. acutata* v.A.V.R. Handb. Suppl. (1917) 210.—Type: not designated; no specimen so annotated seen from BO.

L. sepikensis BRAUSE, Bot. Jahrb. 56 (1920) 131; COPELAND, Philip. J. Sc. 78 (1949) 22.—Type: LEDERMANN 9423 *p.p.*, Etappenberg, Sepik R. region, Terr. of New Guinea (B; dupl. in BM).

L. diplosora v.A.V.R. *var. acrosora* C. CHR. Gard. Bull. S. S. 7 (1934) 235.—Type: MjöBERG 94, Mt Tibang, Sarawak (BM; dupl. in S-PA).

Rhizome long-scandent, 1½–3 mm ø; scales golden brown, narrowly triangular, to 3 by ½ mm, to *c.* 10-seriate at base, with a short uniseriate apex. Leaves usually 2½ cm or more apart, rarely closer; *petioles* issuing almost at right angles from the rhizome, olivaceous- to dark brown, often with elongate, paler protuberances, abaxially terete, adaxially at least above flattened to sulcate, 10–40 cm long, about equaling to much longer than the lamina. *Lamina* oblong, 20–50 cm long, bipinnate, with 1–7 pairs of usually subopposite pinnae and a conform terminal one; primary rachis abaxially terete or upward obtusely bi-angular, adaxially broadly and shallowly sulcate, with obtuse lateral ridges. *Pinnae* not close, often 6–8 cm apart, ascending, linear, sessile, 10–25 cm long, 10–20 mm wide, gradually tapering from the lower third or the middle upward; *secondary rachises* brown, abaxially sharply bi-angular except for a short terete basal portion, the angles often paler, the face between them flat or concave. Upper pinnae of plurijugate leaves slightly shortened. *Pinnules* herbaceous to rigidly coriaceous, mostly dark olivaceous to blackish when dry, usually spreading, *c.* 25–45 to a side, their width apart or less but not contiguous, subtrapeziform, obliquely ovate, or ¼-elliptic, the larger ones 7 by 3 to 12 by 6 mm, mostly twice (to 2½ times) as long as wide, narrowed (sometimes very little) from base to apex; *margins* pale-sclerotic, especially in rigid pinnules; lower

margin straight or distally convex, upper margin distally gradually convex, a distinct outer margin usually not developed. Upper margin of sterile pinnules (bi)crenate to dentate, of fertile pinnules crenate with incisions to 1 mm deep, less in rigid pinnules, the lobes subtruncate. Veins immersed and evident in herbaceous, ± elevated on both sides in rigid pinnules, simple or once, rarely twice, forked, free, connivent, or with one anastomosis between upper and lower margin, the anastomoses irregular, often involving only part of the veins and mostly not found in all pinnules. *Upper pinnules* very gradually and strongly reduced, some denticuliform ones confluent into a narrow, lobed pinna-apex. *Sori* 1–4 per pinnule, 1 per lobe, on the outer lobes; larger pinnules only partly soriferous, the inner part of the upper margin sterile; very often only the outermost sorus present, on 2–6 veins, to 5 mm long; inner sori shorter. Receptacle straight or with convex ends; indusium mostly rigid, brownish, subterete to erose, narrowed at the adnate ends, ½–¾ mm wide, not quite reaching the margin, reflexed or not at maturity. Spores dark brown, trilete, slightly pustulate, *c.* 25 μ.

Distr. *Malesia*: Malay Peninsula, Sumatra, Borneo, Celebes, Philippines (Palawan, Negros, ?Luzon), Moluccas (Batjan), Japen, New Guinea; Ponape; Solomon Is.; Tahiti.

Specimens labelled 'New Hebrides' possibly, 'Singapore' and 'Java' probably from elsewhere.

Ecol. Epiphytic or epilithic, or terrestrial, among mosses, not high above the ground (according to HOLTUM); 1000–2000 m, rarely lower. The most rigid specimens are from higher altitude in Malaya, Sumatra, and New Guinea.

Note. In spite of a certain variability this is a distinctive species, and it is surprising that it has comparatively many synonyms and is often misidentified.

54. *Lindsaea monocarpa* ROSENSTOCK in C. Chr. Ind. Fil. Suppl. 1 (1913) 49, based on: *L. monosora* ROSENSTOCK, Nova Guinea 8 (1912) 720, non COPELAND (1908).—Lectotype: VON RÖMER 785, Hellwig Mts, W. New Guinea (L; dupl. in BO).

In most respects like the rigid, little incised form of *L. rigida*. Petiole, primary, and *secondary rachises* dark castaneous, *abaxially quite terete*. Pinnules subtrapezoidal, the larger ones 10 by 4 mm, very shallowly crenate; veins almost hidden, occasionally connivent or anastomosing; pinnules with a single apical sorus.

Distr. Both syntypes, VON RÖMER 785 and 1163a, from the same locality.

Ecol. No data.

Note. Perhaps only a form of *L. rigida*; but that species is so constant in the characters of its axes that in the absence of transitions *L. monocarpa* is better retained as a species.

55. *Lindsaea sarawakensis* KRAMER, Blumea 15 (1968) 570.—Type: MjöBERG 9, Mt Murud, Sarawak (P, 3 sh.).

Rhizome unknown. *Petioles* dark brown, shining, abaxially rounded or upward obtusely bi-angular. *Lamina* c. 35–40 cm long, oblong, bipinnate, with 4–5 pinnae to a side and a conform terminal one; primary rachis dark brown, abaxially rounded or narrowed-rounded. *Pinnae* linear, 15–30 cm by 12–15 mm, acute, with c. 55–95 pinnules to a side; secondary rachises brown at base, otherwise stramineous, abaxially carinate almost to base. *Pinnules* herbaceous, subcontiguous, asymmetrically ligulate, narrowed-rounded, at apex, the larger ones about 7 by 2 to 2½ mm, the upper ones gradually and ± strongly reduced, a few confluent with the small lanceolate terminal segment. Upper margin of larger pinnules with 2 or 3 very oblique, acute incisions reaching down to 1/5; lobes rounded. Veins immersed, not evident, free, simple or once forked. *Sori* only in the outer part of the upper margin (in fully fertile pinnules possibly more extensive), bi- or rarely uninerval; indusium brownish, c. 0.3 mm wide, not quite reaching the margin. Spores pale brown, trilete, smooth, c. 20 µ.

Distr. Only known from the type collection. Ecol. No data.

Note. In the absence of a rhizome the taxonomic position of this species is not quite certain, but it resembles *L. rigida* in several characters.

56. *Lindsaea regularis* ROSENSTOCK, Meded. Rijksherb. 14 (1912) 31.—Type: ELBERT 1789, Mt Pussuk, Lombok, Lesser Sunda Is. (L; dupl. in BO, K, SING).—Fig. 52.

Rhizome long-scandent, 1½–2½ mm ø; scales deciduous, fawn-coloured, triangular-acuminate, to 4 by 2 mm, the base broadened, over 20-seriate, with often laterally projecting cell-walls, the apex shortly uniseriate. Leaves c. 2–10 cm apart; *petioles* medium brown, often scaly at the base, terete, or adaxially in the upper part flattened or subsulcate, 10–25 cm long, about as long as the lamina. *Lamina* oblong, bipinnate (occasionally sterile simply pinnate ones also present), c. 15–30 cm long, with 3–9 pinnae to a side and a conform terminal one; primary rachis terete, adaxially with a distinct but shallow and very narrow groove that is usually not clearly continuous with the grooves of the lower pinnae and occasionally extends to the petiole. *Pinnae* ascending or upcurved, sessile, the lower ones several times their width apart, the upper ones closer, linear, c. 10–20 cm long, 11–16 mm wide, often widest near the middle, gradually and strongly narrowed in the upper ½ or ⅓; secondary rachises abaxially terete at the base, upward gradually bi-angular, then sulcate, or occasionally bi-angular to base, sometimes pale-angled. *Pinnules* c. 20–50 to a side, herbaceous, mostly dark olivaceous when dry, regularly spaced, mostly not contiguous, asymmetrically ovate to shortly ligulate, 6–10 by 3–4 mm, 2–2½ times as long as wide, slightly ascending, the lower margin almost straight, the upper margin distally convex, a distinct outer margin not developed, the pinnule-apex rounded or narrowed-rounded.

Upper pinnules gradually and strongly reduced, several denticuliform ones connected with the narrow, caudiform pinna-apex. *Margins* scarcely sclerotic; upper margin shallowly incised, with 3–5 incisions ¼–½ mm or even less deep, the lobes slightly convex to flat; sterile pinnules crenate to subentire. Veins immersed, evident, simple or once, less often twice forked, free. *Sori* interrupted, mostly 1 per lobe, even though most incisions do not reach to the receptacle, shorter than the lobes, often 3–5 per pinnule, uni- to quadrinerval; indusium pale, stiff, entire or nearly so, with straight base and narrowed adnate sides, ½ mm wide, almost or quite reaching the margin, little reflexed at maturity. Spores hyaline, trilete, smooth, c. 22–25 µ.

Distr. *Malesia*: East Java (2 coll.), Lesser Sunda Is. (Bali, Lombok, Flores, Timor).

Ecol. Epiphytic in primary forest, 600–1700 m, on trees and tree-ferns. Apparently uncommon.

57. *Lindsaea microstegia* COPELAND, Philip. J. Sc. 6 (1911) Bot. 83; *ibid.* 78 (1949) 20.—Type: KING 242, Papua (MICH).

L. pectinata BLUME var. *brevipinnula* ROSENSTOCK, Hedwigia 56 (1915) 351.—Type: BAMLER 126, Mt Sattelberg, Terr. of New Guinea (B; dupl. in P).—Fig. 41, 51.

Rhizome long-scandent, brown, 1–2 mm ø, the older parts loosely scaly; scales honey-coloured, triangular to lanceolate with concave base, there with ± protruding cell-walls, to 2 mm long, to c. 20-seriate at base, the apex scarcely or not uniseriate. Leaves not close, to c. 10 cm apart; *petioles* stramineous to medium brown, adaxially grooved, abaxially terete, or above obtusely bi-angular, 8–20 cm long, mostly shorter than the lamina. *Lamina* bipinnate, occasionally simply pinnate fertile leaves also present, rarely the whole plant with simply pinnate leaves, broadly oblong, 15–60 cm long, with 1–7 pinnae to a side and a conform, often very large terminal one; primary rachis stramineous, abaxially often ± pronouncedly bi-angular. *Pinnae* mostly little ascending, alternate or the basal ones subopposite, sessile, not close, 10–20 cm long, 1¾–3 cm wide, acuminate; secondary rachises abaxially bi-angular and flat or shallowly sulcate almost to base. *Pinnules* c. 20–25 to a side, herbaceous, medium to dark or olivaceous green when dry, regularly spaced, close, spreading, approximately trapezoidal or rarely subligulate or semi-ovate, the larger ones 10–15 by 5–7 mm, 2–2½ times as long as wide, mostly narrowed from base to apex, the apex narrowed-rounded or subtruncate, outer margin distinct or broadly rounded into the upper margin; upper/outer margin sinuate to shallowly crenate, the incisions less than 1 mm deep, not reaching to the level of the receptacle (rarely slightly beyond), the lobes very broadly rounded, 1½–2 mm wide. One or two basal pinnules slightly reduced; upper pinnules gradually and strongly reduced, some denticuliform ones confluent with the narrow, caudiform terminal segment, or rarely much less reduced. *Pinnules of juvenile plants*

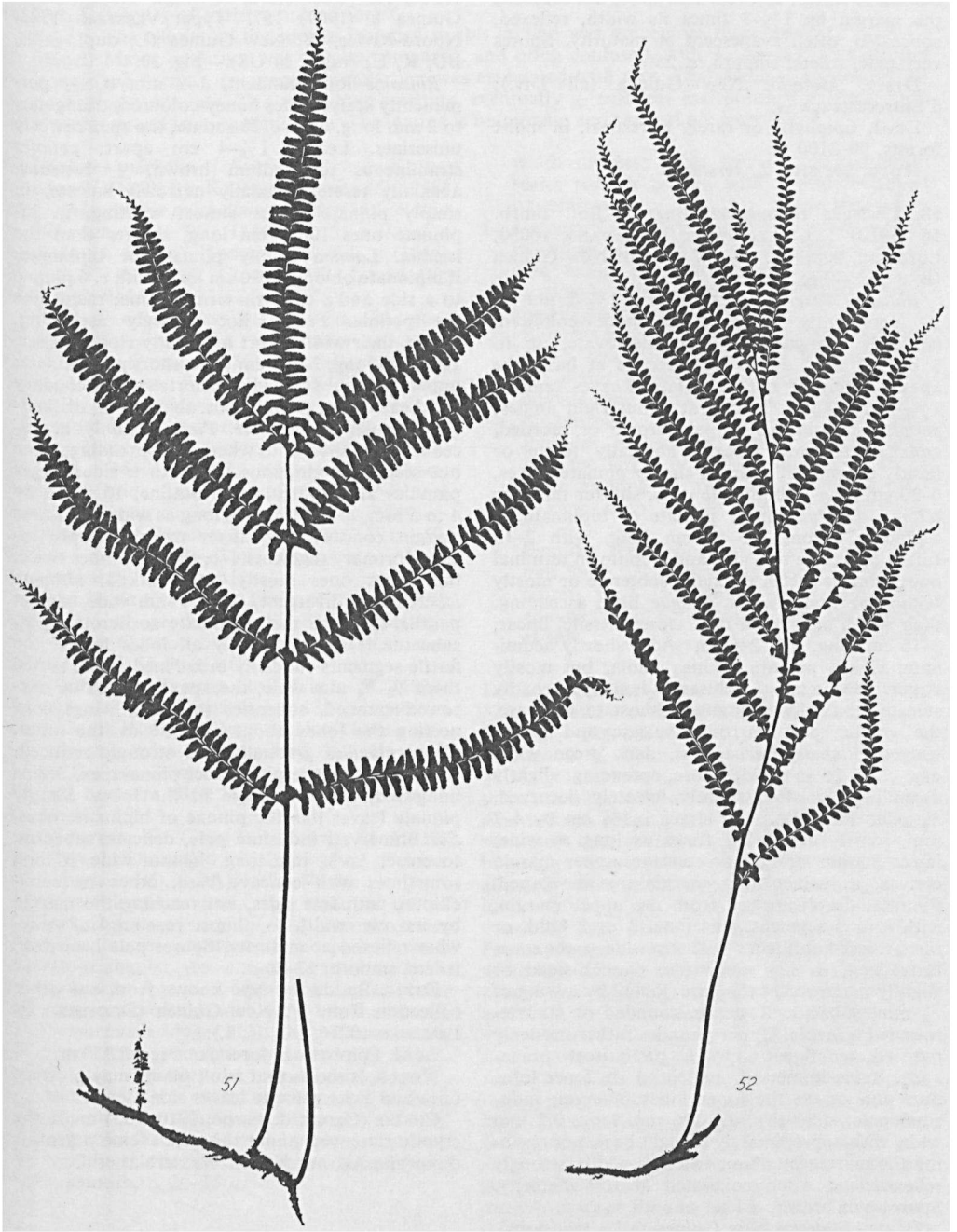


Fig. 51. *Lindsaea microstegia* COPEL. Apex of plant, $\times \frac{1}{3}$ (BRASS 25846).—Fig. 52. *L. regularis* ROSENSTOCK. Leaf, $\times \frac{1}{3}$ (POSTHUMUS 3202).

deeply incised. Veins immersed, evident, mostly once forked, free except if loop-connected by the receptacle. *Sori* 4–12 per pinnule, on (1–)2 (–4) vein-ends; indusium ovate, transversely oblong to linear, 0.15–0.4 mm wide, not reaching the margin by 1½–3 times its width, reflexed, concealed, often evanescent at maturity. Spores very pale, trilete, smooth, *c.* 25 μ .

Distr. *Malesia*: New Guinea (all Div.); d'Entrecasteaux Is.

Ecol. Epiphytic or rarely terrestrial, in moist forests, 80–2100 m.

Note. See after *L. versteegii*.

58. *Lindsaea rosenstockii* BRAUSE, Bot. Jahrb. 56 (1920) 128.—Lectotype: LEDERMANN 10030, Lordberg, Sepik R. region, Terr. of New Guinea (B, 3 sh.).—Fig. 40.

Rhizome long-scandent, brown, 1½–2 mm ϕ , \pm persistently scaly; scales honey-coloured, narrowly triangular or triangular-ovate, up to 3 by 1½ mm, up to *c.* 25-seriate at base, the apex scarcely or not uniseriate. Leaves remote, 1½–15 cm apart, issuing at about right angles; *petioles* stramineous to pale brown or mottled, adaxially narrowly sulcate, abaxially terete or faintly bi-angular, short in simply pinnate leaves, 6–20 cm long in bipinnate ones, shorter than the lamina. *Lamina* simply pinnate or bipinnate; if bipinnate oblong, 15–50 cm long, with 2–13 (often 6) pinnae to a side and a conform terminal one; primary rachis abaxially subterete or mostly bi-angular and convex. *Pinnae* little ascending, their width apart or a little closer, sessile, linear, 8–15 cm long, 1½–2½ cm wide, shortly acuminate; simply pinnate laminae similar but mostly larger. Secondary rachises adaxially broadly sulcate, abaxially bi-angular almost to the base, the greater part narrowly sulcate and green-winged. *Pinnules* herbaceous, dark green when dry, *c.* 15–25 to a side, close, spreading, slightly ascending, or often slightly falcately decurved, ¼-ovate in outline, the larger 1–1¾ cm by 4–7 mm, mostly about 2½ times as long as wide; lower margin straight or concave, upper margin convex, a distinct outer margin not developed. Pinnules deeply incised from the upper margin, with 4 or 5 segments, the inner 1 or 2 bifid, or rarely twice bifid; *lobes* ⅔–2 mm wide, at the sorus broadened, to 1½ mm wide, parallel-sided or slightly narrowed at the base, joined by a wing of ½ mm, subacute if sterile, rounded or sinuate-rounded if fertile. Upper pinnules rather suddenly reduced, confluent into a pinnatisect pinna-apex. Veins immersed, evident, 1 or 2 per lobe. *Sori* uni- or on the inner lobes binerval; indusium pale, subentire, 0.6–1½ mm long, 0.3 mm wide, with approximately straight base, not reaching the margin by about twice its width, strongly reflexed and often concealed at full maturity. Spores pale brown, trilete, smooth, *c.* 28 μ .

Distr. *Malesia*: New Guinea (all 3 Divisions).

Ecol. Epiphytic in moist montane forest, 1000–1800 m.

Note. It is possible that in this species adult

plants may produce simply pinnate leaves.

59. *Lindsaea versteegii* (CHRIST) v.A.v.R. Handb. Suppl. (1917) 206; COPELAND, Philip. J. Sc. 78 (1949) 18.—*Odontosoria versteegii* CHRIST, Nova Guinea 8 (1909) 157.—Type: VERSTEEG 1222, Noord-Rivier, W. New Guinea (L; dupl. in B, BO, K, U; fragm. in US).—Fig. 39.

Rhizome long-scandent, 1–2 mm ϕ , \pm permanently scaly; scales honey-coloured, triangular, to 2 mm long, up to *c.* 20-seriate, the apex scarcely uniseriate. Leaves 1½–4 cm apart; *petioles* stramineous to medium brown, \pm lustrous, abaxially terete, adaxially narrowly sulcate, in simply pinnate leaves almost wanting, in bipinnate ones 10–15 cm long, shorter than the lamina. *Lamina* simply pinnate or bipinnate; if bipinnate oblong, *c.* 30 cm long, with *c.* 6 pinnae to a side and a conform terminal one; rachis like the petiole. *Pinnae* not strongly ascending, sessile, their width apart or slightly closer, linear, 10–15 cm long, 2–2½ cm wide, shortly acuminate; upper pinnae somewhat shortened. Secondary rachises slender, stramineous, abaxially \pm distinctly bi-angular and sulcate. *Pinnules* thinly herbaceous, dark olivaceous when dry, spreading, close but scarcely contiguous, *c.* 25 to a side; larger pinnules arcuate-ligulate in outline, 10 to 12 by 4 to 5 mm, *c.* 2½ times as long as wide, the lower margin concave, the upper margin deeply incised; primary segments 4–6, the basal ones twice, the upper ones mostly once forked; *ultimate lobes* linear, divergent, 0.3–0.4 mm wide, almost parallel-sided to the spatulate soriferous apex, subacute if sterile, usually all lobes fertile, the fertile segments suddenly broadened at the sorus, there ½–¾ mm wide, the apex rounded or narrowed-rounded, subentire to erose; wings connecting the lobes about as wide as the lobes. *Upper pinnules* gradually and strongly reduced, confluent into the pinnatisect pinna-apex. Veins immersed, evident, single in the lobes. Simply pinnate leaves like the pinnae of bipinnate ones. *Sori* unival; indusium pale, delicate, subentire to erose, ¼–¾ mm long, ¼ mm wide, if long sometimes with concave base, otherwise semi-elliptic, with free sides, not reaching the margin by its own width to almost reaching it, somewhat reflexed at maturity. Spores pale brownish, trilete, smooth, 22–25 μ .

Distr. Beside the type known from one other collection from W. New Guinea (DOCTERS VAN LEEUWEN 10276, BO, K, L).

Ecol. Epiphytic in forest; one record 250 m.

Notes. It seems that adult plants may produce once and twice pinnate leaves side by side.

CHRIST (Geogr. d. Farne, 1910, 233) made the cryptic statement about this plant 'eine prächtige dimorphe Art mit halben Wasserblättern'.

The last three species, *L. microstegia*, *L. rosenstockii*, and *L. versteegii*, are very closely related and are perhaps not specifically distinct.

13. Section Penna-arborea

KRAMER, *Blumea* 15 (1968) 563.

Type species: *Lindsaea pulchella* (J. SMITH) METT. ex KUHN.

Distr. Malesia (except Malay Peninsula) to Polynesia and NE. Australia; most diversified in New Guinea. Epiphytes of moist montane forest.

Taxon. The affinity of the species included in this section was not before recognized; *L. pulchella* (J. SMITH) METT. ex KUHN was usually compared, and often confused, with *L. lucida* BLUME (mostly as *L. concinna* BLUME), *L. wernerii* ROSENSTOCK was associated with *sect. Synaphlebium*, because of its anastomosing veins, etc. The wiry, long-creeping, eventually ± scaleless and polished rhizome with open xylem strand is quite distinctive. The lamina is unipinnate and the sori are interrupted.

60. *Lindsaea pulchella* (J. SMITH) METT. ex KUHN, *Linnaea* 36 (1869) 81; KRAMER, *Blumea* 15 (1968) 570.—*Odontoloma pulchellum* J. SMITH in Fielding & Gardner, Sert. Pl. (1844) pl. 51.—*Davallia pulchella* (J. SMITH) HOOKER, Sp. Fil. 1 (1845) 175, pl. 53 B.—Type: CUMING 217, Luzon (K; dupl. in B, BM, E, L, MICH, P, US, W).

Aspidium adiantoides BLUME, En. Pl. Jav. (1828) 145.—*Saccoloma adiantoides* (BLUME) PRESL, Tent. Pterid. (1836) 126.—*Davallia adiantifolia* HOOKER, Sp. Fil. 1 (1845) 176, non *Davallia adiantoides* SWARTZ.—*Odontoloma adiantoides* (BLUME) PRESL, Epimel. Bot. (1851) 97.—*Acrophorus adiantoides* (BLUME) MOORE, Ind. Fil. (1857) 91.—*L. adiantoides* (BLUME) KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 278, non J. SMITH in Hooker (1846).—*L. adiantifolia* (HOOKER) COPELAND, Fern Fl. Philip. 1 (1958) 108.—Type: BLUME s.n., 'Java' (but probably from elsewhere).

L. cyathicola COPELAND, Phil. J. Sc. 1 (1906) Suppl. II, 149, pl. 5; Fern Fl. Philip. 1 (1958) 106.—Type: COPELAND 1938, Mt Bulusan, Luzon (MICH; dupl. in B, SING).

L. marginata BRAUSE, Bot. Jahrb. 56 (1920) 126.—Lectotype: LEDERMANN 11384, Hunstein-spitze, Sepik R. region, Terr. of New Guinea (B).

L. alpestris v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 210.—Type: BÜNNEMEIJER 9907, Mt Kerintji, Sumatra (BO; dupl. in K, L, U; fragm. in BM, US).

L. binervata C. CHR. Bot. Jahrb. 66 (1933) 52.—Type: KJELLBERG 3632, Preho, Celebes (BM; dupl. in BO, S-PA).—Fig. 53-56.

Rhizome long-scandent, dark reddish brown to black, lustrous, wiry, 1/2-1 1/4 mm ø; scales deciduous, more persistent at the petiole-bases, elongate-triangular, to c. 8-10-seriate at base. Leaves one to a few cm apart, issuing at about right angles; *petioles* slender, wiry, less than 1 mm ø. *Lamina* much longer than the petiole, linear, simply pinnate; *pinnules* asymmetrically ovate, semi-elliptic, ligulate, or rounded-trapezoidal, 2-3 times as long as wide; upper margin incised. Upper pinnules gradually and strongly reduced, basal pinnules farther apart and often ± reduced. *Sori* usually uni- or binerval. Spores pale yellow, trilete, smooth, c. 20-25 μ.

KEY TO THE VARIETIES

1. Uninerval sori with straight or convex base; indusium falling short of the margin by its own

width or less; veins free or anastomosing; scales reddish brown, with a well-developed uniseriate apex 4. *var. lomatosora*

1. Uninerval sori mostly with very concave base; indusium falling short of the margin by its own width or more (except sometimes at incisions); veins free; scales golden brown, apically very shortly uniseriate.

2. Pinnules herbaceous, mostly green when dry, 4 1/2-8 mm long, c. twice as long as wide, the major incisions less than 1/2 mm deep; adaxial and abaxial sides of petiole not discolorous 1. *var. pulchella*

2. Pinnules herbaceous, mostly brown when dry, the larger ones 7-12 mm long, up to twice as long as wide, the major incisions 1-3 mm deep; petiole faces not discolorous.

2. Pinnules herbaceous to subcoriaceous, 10-16 mm long, 2 1/2-3 times as long as wide; incisions to 1 (sometimes to 2) mm deep; adaxial face of petiole much paler than abaxial side 3. *var. falcata*

1. *var. pulchella*.—KRAMER, *Blumea* 15 (1968) 571.—*Aspidium adiantoides* BLUME.—*L. binervata* C. CHR. —Fig. 53.

Rhizome 1/2-3/8 mm ø; scales narrowly triangular, golden-brown, to 2 1/4 mm long, to c. 8-seriate at base, with a short uniseriate apex. *Petioles* 1-7 cm long, c. 1/4-1/2 mm ø, stramineous with dark base, or brown, abaxially rounded and bi-angular above or less often largely bi-angular, adaxially often pale-margined. *Lamina* 10-30 cm long, 0.8-1 1/2 cm wide; rachis stramineous, quadrangular, often shallowly sulcate, wiry. *Pinnules* herbaceous, mostly pale to medium green when dry, in larger specimens c. 25-70 to a side, close to contiguous, alternate, spreading, asymmetrically ovate to semi-elliptic, the larger ones 4 1/2-8(-9) mm long, 2-4(-5) mm wide, c. twice as long as wide, mostly narrowed-rounded or subacute at the apex; margin not sclerotic, the upper margin with 1-3 very shallow incisions less than 1/2 mm deep, the lobes truncate-rounded or the outer ones with a small tooth; *upper pinnules* gradually and strongly reduced, several denticuliform ones confluent into a short, narrow, caudiform, pinnatifid leaf-apex. Veines immersed, evident, simple or once forked, ending well within the margin, mostly 1 mm apart. *Sori* uni- or binerval, often absent from part of the lamina; indusium elongate and often, especially

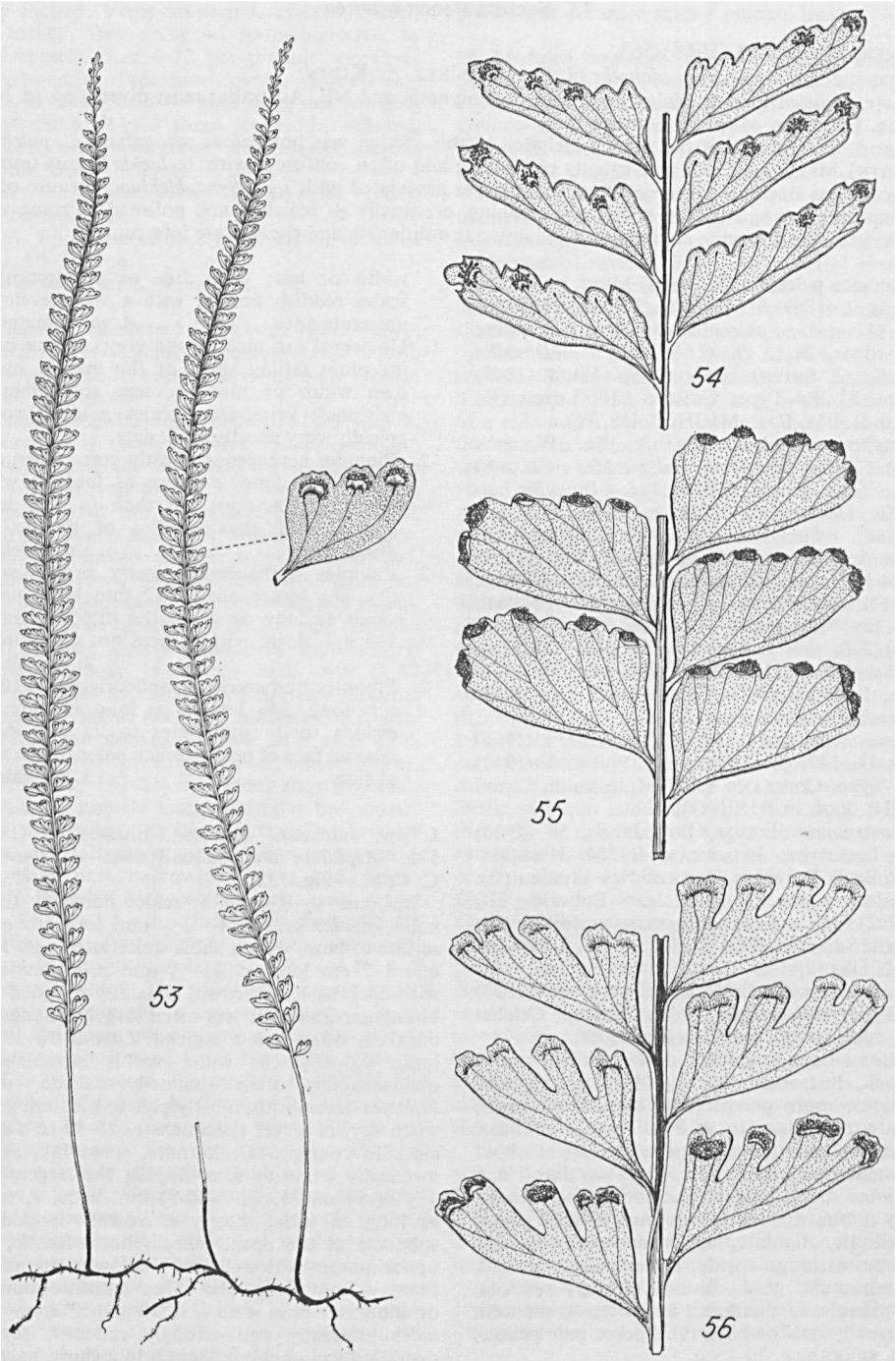
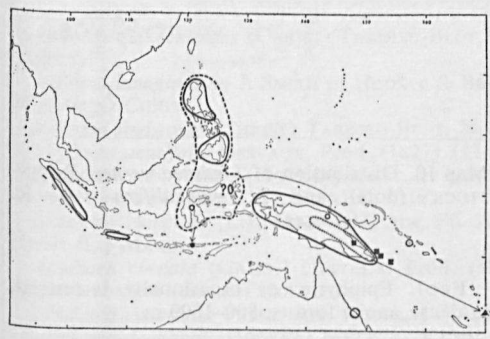


Fig. 53–56. *Lindsaea pulchella* (J. SM.) METT. ex KUHN.—Fig. 53. var. *pulchella*. Part of a plant, $\times \frac{1}{2}$, pinnule, $\times 3$ (FORSTEN *s.n.*, L).—Fig. 54. var. *falcata* (BRAUSE) KRAMER. Part of a lamina, $\times 2$ (BRASS 13494).—Fig. 55. var. *lomatosora* KRAMER. Part of a lamina, $\times 2\frac{1}{2}$ (BRASS 27911).—Fig. 56. var. *blanda* (METT. ex KUHN) KRAMER. Part of a lamina, $\times 3$ (BÜNNEMEIJER 9907).

in outer sori, with concave base, or if uninerval ovate to subreniform and very obtuse to acute, variable in width, usually $\frac{1}{4}$ – $\frac{1}{2}$ mm wide, often with irregular margin, not reaching the margin by less than its width to reaching it, laterally free, scarcely reflexed at maturity.

Distr. *Malesia*: Philippines (Mindanao, Negros, Mindoro, Luzon, Panay, Leyte), Moluccas (Halmahera, Ternate, Tidore, Buru), Celebes, Flores, New Guinea (1 coll.). Map 9.



Map 9. Distribution of *Lindsaea pulchella* (J. Sm.) Mett. ex Kuhn.—*var. pulchella* (lined), *var. blanda* (Mett. ex Kuhn) Kramer (interrupted line, arrows!), *var. falcata* (Brause) Kramer (stippled line, arrow!), *var. lomatosa* Kramer (squares).

Ecol. Epiphytic in moist forests, c. 600–2200 m, on trees and tree-ferns.

2. *var. blanda* (Mett. ex Kuhn) Kramer, *Blumea* 15 (1968) 571.—*L. blanda* Mett. ex Kuhn, *Linnaea* 36 (1869) 80.—Type: WICHURA *s.n.*, Java (B).

L. alpestris v.A.V.R.—*L. cyathicola* COPELAND.—Fig. 56.

Rhizome ($\frac{1}{2}$ –) $\frac{3}{4}$ –1 $\frac{1}{4}$ mm ϕ ; scales often a little longer and broader than in *var. pulchella*. *Petioles* 1–10 cm long, $\frac{1}{2}$ – $\frac{2}{3}$ mm ϕ , dark reddish brown or upward paler, hardly pale-margined, adaxially flattened, upward sulcate, abaxially bi-angular except at the rounded base. *Lamina* 5–30 cm long, 1–2 $\frac{1}{2}$ cm wide; rachis quadrangular, at least adaxially sulcate, stramineous or with darker base, wiry. *Pinnules* herbaceous, mostly olivaceous-brown when dry, c. 20–50 to a side, usually a little ascending, mostly not contiguous, asymmetrically ovate to $\frac{1}{4}$ -elliptic, 7–12 mm long, 3 $\frac{1}{2}$ –6 mm wide, twice as long as wide or slightly less; margins not or little sclerotic, a distinct outer margin usually not or scarcely developed, the upper margin with 1–3 oblique major incisions 1–3 mm deep, reaching $\frac{1}{3}$ to $\frac{1}{2}$ (rarely to $\frac{2}{3}$) down, sometimes with some shallower additional incisions; lobes convex, not rarely erose, \pm divergent. Basal pinnules farther apart but scarcely reduced; upper pinnules gradually reduced, as in *var. pulchella*. Veins immersed, not evident, simple or once forked, free, ending well within

the margin, $\frac{1}{2}$ –1 mm apart. *Sori* uni- or binerval or less often to 5-nerval, $\frac{1}{2}$ –2(–4) mm long, in longer sori the base \pm concave. Indusium pale to brownish, delicate, subentire, with \pm convex free edge, narrowed at the free sides, 0.3–0.5 mm wide, nearly always strongly intramarginal.

Distr. *Malesia*: Sumatra, West and Central Java, Philippines (Luzon, Mindanao), Celebes, ? Ternate, New Guinea (all Div.); Queensland; Solomon Is. Map 9.

Ecol. Epiphytic, often among mosses, on trees and tree-ferns, very rarely terrestrial, from c. 1500 up to 2750 m.

3. *var. falcata* (BRAUSE) KRAMER, *Blumea* 15 (1968) 571.—*L. marginata* BRAUSE *var. marginata* et *var. falcata* BRAUSE, *Bot. Jahrb.* 56 (1920) 126–127.—Type: LEDERMANN 11384, Hunstein-spitze (*var. marginata*) (B), LEDERMANN 12864, Fels Spitze (*var. falcata*), Sepik R. region, Terr. of New Guinea (B; dupl. in BM).

L. rhombifoliolata v.A.V.R. *Nova Guinea* 14 (1929) 29.—Type: H. J. LAM 1892a, crest to Doormantop, W. New Guinea (L).—Fig. 54.

Rhizome 1–1 $\frac{1}{4}$ mm ϕ ; scales to 2 $\frac{1}{2}$ mm long, otherwise as in *var. pulchella*. *Petioles* c. 10–20 cm long, $\frac{1}{2}$ mm ϕ , adaxially flattened or shallowly sulcate, pale at least above, abaxially dark, rounded, bi-angular at least near the apex. *Lamina* c. 20–35 cm long, 2–3 cm wide, with c. 25–50 pinnules to a side; rachis abaxially dark, bi-angular, sometimes pale-angled, upward usually pale and sulcate, adaxially pale, sulcate. *Pinnules* herbaceous or usually subcoriaceous, dark brownish when dry, usually everywhere sclerotic-margined, somewhat ascending, not contiguous, ligulate, the larger ones 10–16 by 4–6 mm (2–) 2 $\frac{1}{2}$ –3 times as long as wide; upper margin with 2–4 narrow major incisions to 2 mm but usually only 1 mm or less deep, sometimes with some smaller additional ones, the lobes rounded, often with one or more teeth. Basal pinnules often more remote but scarcely reduced, upper pinnules gradually and strongly reduced, as in *var. pulchella*. Veins immersed, not evident, simple or once forked, lax, 1–2 mm apart. *Sori* uni- or binerval, usually with distinctly concave base, $\frac{3}{4}$ –2 mm long; indusium pale, rather rigid, subentire to dentate or lobed, subhippocrepiform to crescent-shaped, narrowed at the free sides, usually strongly intramarginal but sometimes with protruding lobes, 0.3–0.5 mm wide, often reflexed at maturity.

Distr. *Malesia*: New Guinea (all Div.), Japen; New Hebrides (Aneityum). Map 9.

Ecol. Epiphytic, or terrestrial on mosses, 1300–1800 m.

4. *var. lomatosa* KRAMER, *Blumea* 15 (1968) 571.—Type: BRASS 27911, Mt Riu, Sudest I., Louisiades (L; dupl. in GH, K).—Fig. 55.

Rhizome scales reddish brown, to 1 $\frac{1}{4}$ mm long, with a well-developed uniseriate apex. Leaves up to 30 by 2 cm; faces of the *petiole* not or hardly discolored; *pinnules* green when dry, spreading

or slightly ascending, mostly ligulate or rounded-trapezoidal, scarcely narrowed at the apex; veins sometimes connivent or anastomosing, the series of areoles usually incomplete. *Margin* scarcely sclerotic, its incisions 1 mm deep or less; *sori* mostly binerval, basally scarcely concave or straight, if short more concave; indusium pale, delicate, 0.3 mm wide, falling short of the margin by less than its width to almost reaching it, often strongly bulging at maturity and then seemingly more strongly intramarginal. Otherwise much like *var. falcata*.

Distr. Louisiades, d'Entrecasteaux Is.; one less typical collection from the Territory of New Guinea. Map 9.

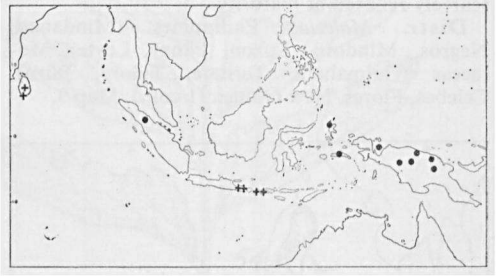
Ecol. Epiphytic on trees and tree-ferns, 250–900 m.

Note. The scales suggest a distinct species; but it is in other respects very much like the other varieties of *L. pulchella*.

61. *Lindsaea wernerii* ROSENSTOCK in Fedde, Rep. 5 (1908) 37; COPELAND, Philip. J. Sc. 78 (1949) 21.—Type: WERNER (ROSENSTOCK-exs. 19), Mt Gelu, Terr. of New Guinea (B; dupl. in E, L, P, S-PA, U).—Fig. 38.

Rhizome long-scandent, fawn-coloured, 0.6–1 mm ϕ , deciduously scaly; scales light golden-brown, narrowly triangular, to 2 mm long, to 10-seriate at base, with a very short or virtually lacking uniseriate apex. Leaves 2–10 cm apart, issuing at about right angles; *petioles* quadrangular and sulcate almost to base, stramineous to reddish brown, often with paler angles, 4–15 cm long, somewhat shorter than the lamina. *Lamina* narrowly oblong, simply pinnate, 7–32 cm long, 3–6 cm wide, with 6–20 pinnules to a side, shortly acuminate; rachis stramineous, quadrangular, sometimes also quadrisulcate. *Pinnules* herbaceous, olivaceous when dry, spreading, alternate except the basal ones, their width apart to slightly overlapping, sessile, subtrapezoidal to semi-ovate-ligulate, 1½–3 cm long, 6–12 mm wide, 2 to almost 3 times as long as wide; upper margin straight or outward convex, a distinct outer margin sometimes developed, then forming an angle of 90° or less with the upper; upper (and outer) margin shallowly crenate, if fertile with *c.* 5 incisions and \pm flat lobes, if sterile with more and closer incisions and rounded lobes, the deepest incisions to *c.* 1 mm, mostly not reaching the level of the receptacle. Few or very few upper pinnules suddenly reduced, one or two connected with the narrow, often caudate, to 4 cm long terminal segment. Veins immersed, evident, lax, anastomosing, forming an often incomplete series of areoles of varying length and 1½–2 mm maximum width between the margins. *Sori* single in the lobes, most often binerval, sometimes tri- or unival, 1–3 mm long, with straight or somewhat convex receptacle; indusium pale, delicate, subentire, free at the sides, 0.3–0.4 mm wide, not reaching the margin by 1½–2 times its width, reflexed and \pm concealed at maturity. Spores pale brown, trilete, smooth, *c.* 22 μ .

Distr. *Malesia*: Sumatra (one coll., SURBECK *s.n.*, L), Moluccas (Halmahera, Ceram), New Guinea (W. New Guinea, Terr. of New Guinea). Map 10.



Map 10. Distribution of *Lindsaea wernerii* ROSENSTOCK (dots) and *L. glandulifera* v.A.v.R. (crosses).

Ecol. Epiphytic, or occasionally terrestrial, in dense, moist forests, 800–1800 m.

62. *Lindsaea roemeriana* ROSENSTOCK, Nova Guinea 8 (1912) 719; COPELAND, Philip. J. Sc. 78 (1949) 17.—Lectotype: VON RÖMER 731, Helligwig Mts, W. New Guinea (L; dupl. in BO).

L. wollastonii v.A.v.R. Handb. Suppl. (1917) 505, based on: *Odontosoria tenera* RIDLEY, Trans. Linn. Soc. II, Bot. 9 (1916) 254; *non L. tenera* DRYAND.—Type: B. KLOSS (WOLLASTON Exp.) *s.n.*, Carstensz Peak, W. New Guinea (K; dupl. in BM).—Fig. 23.

Rhizome long-scandent, wiry, ½–¾ mm ϕ , atropurpureous to blackish, lustrous, soon devoid of scales; scales honey-coloured, narrowly triangular, to 2 mm long, to 8-seriate at base, the uniseriate apex of one cell or wanting. Leaves remote, 1½–5 cm apart; *petioles* stramineous except for the dark base, quadrangular almost to base, at least adaxially sulcate, 4–15 cm long, shorter than the lamina. *Lamina* narrowly oblong, 8–25 cm long, 2–3½ cm wide, with 15–30 pinnules to a side; rachis similar to the petiole, upward narrowly green-margined. *Pinnules* herbaceous, olivaceous when dry, spreading, their width apart to subcontiguous, mostly alternate except the basal ones; larger pinnules semi-ovate in outline, 10–18 mm long, 5–8 mm wide, 2–2½ times as long as wide, deeply pinnatifid from the upper margin, with 3–4 primary segments, the inner one or two forked; *segments* 0.3–0.6(–1) mm wide at the base, 0.5–1.5(–2) mm wide at the sorus, gradually widened below, more suddenly at the sorus, connected by a wing ¼–½ mm wide, rounded and erose to irregularly corniculate at apex. Sterile segments not broadened at apex, acute or subacute. *Basal pinnules* more remote and sometimes slightly reduced; upper pinnules (in the upper ⅓ or ½) reduced, the uppermost confluent into a small pinnatifid leaf-apex. Veins immersed, evident, solitary in the lobes. *Sori*

solitary near the apices of the lobes, uninerval; indusium delicate, ovate to hippocrepiform, subentire, free at the sides, 0.3–0.5 mm wide, 0.5–1 mm long, not reaching the margin by 1–2 times its width, scarcely reflexed at maturity. Spores very pale, trilete, smooth, c. 22 μ .

Distr. *Malesia*: New Guinea (W. New Guinea,

Terr. of New Guinea, 12 coll.).

Ecol. Epiphytic in mountain forests, c. 1200–2500 m.

Note. There are two extreme forms, one with more rounded lobes and sori with concave base, the other with erose lobes and ovate sori, but they pass into each other.

Excluded from *Lindsaea*
(referred to *Isoloma*, *Lindsaea*, *Schizolegnia*, or *Schizoloma*)

Isoloma dicksonioides (CHRIST) TARDIEU-BLOT, Not. Syst. 14 (1952) 331 = *Nephrolepis dicksonioides* CHRIST.

Isoloma lanuginosum J. SMITH in Hooker & Bauer, Gen. Fil. (1842) pl. 102 = *Nephrolepis acutifolia* (DESVAUX) CHRIST.

Isoloma lindsayae (CHRIST) TARDIEU-BLOT, Not. Syst. 14 (1952) 331 = *Nephrolepis spec.*

Lindsaea acutifolia DESVAUX, Prod. (1827) 312 = *Nephrolepis acutifolia* (DESVAUX) CHRIST.

Lindsaea amboynensis (HOOKER) METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279 = *Tapeinidium amboynense* (HOOKER) C. CHR.

Lindsaea chinensis (L.) METT. ex KUHN, Fil. Afr. (1868) 67 (non CHING, 1929) = *Sphenomeris chinensis* (L.) MAXON.

Lindsaea cordata (GAUD.) DESVAUX, Prod. (1827) 312 = *Schizolepton cordatum* (GAUD.) FÉE = *Taenitis cordata* (GAUD.) HOLTUM.

Lindsaea cuneifolia PRESL, Rel. Haenk. 1 (1825) 60 = *Sphenomeris retusa* (CAV.) MAXON.

Lindsaea denhamii (HOOKER) METT. ex KUHN, Verh. Zool. Bot. Ges. 19 (1869) 573 = *Tapeinidium denhamii* (HOOKER) C. CHR.

Lindsaea grandifolia J. E. SMITH in Rees, Cyclop. 21 (1812) no 12 = *Taenitis blechnoides* (WILLD.) SWARTZ teste ALSTON, Philip. J. Sc. 50 (1933) 180.

Lindsaea hosei C. CHR. Ind. Fil. (1906) 394, based on: *L. trilobata* BAKER, J. Bot. 29 (1891) 107 (non COLENZO, 1884) = *Taenitis trilobata* HOLTUM, Blumea 16 (1968) 93.

Lindsaea lanuginosa WALL. ex HOOKER, Sp. Fil. 1 (1846) 210, pl. 69 B = *Nephrolepis acutifolia* (DESVAUX) CHRIST.

Lindsaea lowei hort. = *Arthropteris oblitterata* (R. BROWN) J. SMITH teste C. CHR. Ind. Fil. (1906) 395.

Lindsaea parishii BAKER, Syn. Fil. ed. 1 (1867) 109 = *Stenochlaena sorbifolia* (L.) J. SMITH teste C. CHR. Ind. Fil. (1906) 625 = ? *Teratophyllum*.

Lindsaea pinnata (CAV.) METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279 = *Tapeinidium pinnatum* (CAV.) C. CHR.

Lindsaea pinnata (CAV.) METT. ex KUHN var. *bipinnata* METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279 = *Tapeinidium luzonicum* (HOOKER) KRAMER.

Lindsaea retusa (CAV.) METT. Fil. Lips. (1856) 105 = *Sphenomeris retusa* (CAV.) MAXON.

Lindsaea trilobata BAKER, J. Bot. (1891) 107 = see under *L. hosei* C. CHR.

Lindsaea vittata ZOLL. & MOR. Nat. Geneesk. Arch. N. I. 1 (1844) 400 = *Pteris* ?

Schizolegnia stortii (v.A.v.R.) ALSTON, Bol. Soc. Brot. II, 30 (1956) 24 = *Xyopteris stortii* (v.A.v.R.) KRAMER.

Schizoloma cordatum GAUD. Ann. Sc. Nat. 3 (1824) 507 = see under *Lindsaea cordata* (GAUD.) DESVAUX.

Schizoloma ferulaceum (MOORE) KUHN, Chaetopt. (1882) 346 = *Davallia spec.*

Schizoloma hosei (C. CHR.) COPELAND, Sarawak Mus. J. 2 (1917) 327 = see under *Lindsaea hosei* C. CHR.

Schizoloma retusum (CAV.) KUHN, Chaetopt. (1882) 346 = *Sphenomeris retusa* (CAV.) MAXON.

Schizoloma stortii v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 36 = *Xyopteris stortii* (v.A.v.R.) KRAMER.

Doubtful species and varieties

Lindsaea bipinnata ROXBURGH, Calc. J. Nat. Hist. 4 (1844) 511.—Type: ROXBURGH *s.n.*, Prince of Wales' Island (Pulau Penang) (*n.v.*).

Judging from the description this is a large form of *L. parasitica*, with which ROXBURGH compared it; or it might be *L. doryphora*.

Lindsaea decrescens COPELAND, Philip. J. Sc. 81 (1952) 6, pl. 5.—Type: LOHER 13621, Umiray, Quezon Prov., Luzon (dupl. in MICH).

As stated by COPELAND, this is intermediate between *L. repens* ('*L. macraeana*, *L. longa*') and *L.*

fissa. The isotype in MICH from COPELAND's herbarium is rather scrappy. I doubt whether it represents a distinct species.

Lindsaea longa COPELAND, Philip. J. Sc. 46 (1931) 216.—Type: EDANO B.Sc. 77978, Mt Balagbag, Palawan (MICH; dupl. in GH).

This is probably only an unusually deeply incised form of *L. repens* (BORY) THWAITES var. *sessilis* (COPELAND) KRAMER.

Lindsaea orbiculata (LAMK) METT. ex KUHN var. *integra* METT. ex KUHN in Miq. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 279.—Type: LOBB *s.n.*, Java; also 'Ceylania'.

I have seen no specimen that can with certainty be regarded as the type. It is not impossible that it represents var. *commixta* for which it would then be an older name.

Lindsaea striata BLUME, En. Pl. Jav. (1828) 220.—Type: BLUME *s.n.*, 'in Javae montibus altissimis' (*n.v.*).

The type of this species could not be found at L and is presumably lost. CHRISTENSEN (Ind. Fil. 1906) referred it to *L. orbiculata*; judging from the description and the provenience this is probably correct.

Lindsaea tricrenata BAKER, J. Bot. 28 (1890) 106.—Type: MCGREGOR 24, Mt Musgrave, New Guinea (K).

Compared with *L. rigida* and *L. borneensis* by its author, two species not closely related in the present author's opinion. The type is a detached, very poorly preserved, nearly sterile leaf of uncertain identity, and one can only marvel at BAKER's temerity to describe this as a new species.

Vittaria interrupta ROXBURGH ex GRIFFITH, Calc. J. Nat. Hist. 4 (1844) 511.—Type: ROXBURGH *s.n.*, Prince of Wales' Island (Pulau Penang) (*n.v.*).

Referred to *L. orbiculata* by CHRISTENSEN (Ind. Fil.), to *L. tenera* by BEDDOME (Ferns Brit. Ind. 1, 1866). Judging from the description the latter opinion seems better; it would then be the oldest name for what is here called *L. bouillodii* CHRIST.

Vittaria lunulata ROXBURGH ex GRIFFITH, Calc. J. Nat. Hist. 4 (1844) 510.—Type: coll.?, Prince of Wales' Island (Pulau Penang) (*n.v.*).

Perhaps a simply pinnate form of *L. parasitica*; it is not stated whether the plant was terrestrial or epiphytic, with long or short rhizome, and its identity remains obscure.