THE LINDSAEOID FERNS OF THE OLD WORLD III. NOTES ON LINDSAEA AND SPHENOMERIS IN THE FLORA MALESIANA AREA

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THE GENERA

In the Flora Malesiana area recent authors have distinguished the following genera in the Lindsaea group of ferns: *Isoloma* J. Smith, *Lindsaea* Dryander (often misspelled "*Lindsaya*"; see Copeland 1947, p. 53, and Kramer 1957a, p. 156), *Odontosoria* Fée, *Protolindsaya* Copeland, *Schizoloma* Gaudichaud (or *Schizolegnia* Alston), *Sphenomeris* Maxon, *Tapeinidium* (Presl) C. Christensen, and *Xyropteris* Kramer. In my account of the American species (Kramer 1957a) I included the Asiatic genus *Schizolepton* Fée in the Lindsaea group, on Copeland's authority, without sufficiently looking into the matter. Holttum (1958) has shown since that its affinities are with *Syngramma* and has subsequently (1960) combined it with *Taenitis*, although Pichi-Sermolli (1966) denies any close affinity of the two last-named genera.

As stated before (Kramer 1957a, 1967) I am convinced that *Schizoloma* cannot be maintained as a distinct genus and prefer to treat it as a section of *Lindsaea*. With regard to *Isoloma* I have reached the same conclusion, as explained below. *Odontosoria sensu stricto* does not occur in Asia. *Xyropteris* is still monotypical, as originally described (Kramer 1957b), and *Tapeinidium*, including *Protolindsaya*, as correctly stated by Christensen (1934), forms the subject of a separate paper (Kramer 1968). The notes in the present paper can thus be restricted to *Lindsaea* and *Sphenomeris*.

SUBDIVISION OF LINDSAEA

Infrageneric categories proposed up till now in *Lindsaea* were largely based on leaf architecture and venation; many of these were described as subgenera and some were then raised to generic rank, or vice versa. Although such characters may serve to distinguish natural groups they are in my opinion too weak a basis for separating subgenera or even genera. Consequently *Schizoloma*, in Holttum's (1954) very natural circumscription, *Isoloma*, and *Synaphlebium* J. Smith are not kept separate here from *Lindsaea* but maintained as sections, together with a number of others, as enumerated below.

As regards subgenera I think two very natural groups may be distinguished in the Old World: *Lindsaea*, with an essentially terrestrial, short- to moderately long-creeping rhizome with radially symmetric or almost symmetric stele, and *Odontoloma*, with an epiphytic or scandent, wide-creeping rhizome with strongly dorsiventral stele. Further differences are observed in some but not all species of *Odontoloma* and cannot be used for diagnostic purposes. *Odontoloma* is a purely gerontogean and almost entirely tropical

subgenus, ranging from Madagascar and Assam to Ryukyu, Hawaii, and Queensland. *Lindsaea* is a pantropic subgenus comprising all the New World species and extending considerably into subtropical regions; it is much less homogeneous than *Odontoloma*.

As sections I treat apparently natural species groups that are not necessarily quite sharply defined. So far very few infrageneric categories have been described in *Lindsaea* explicitly as sections. This results in comparatively many new descriptions or combinations on that level.

I. Subgenus LINDSAEA

Rhizome essentially terrestrial, short- to moderately long-creeping, the stele radially symmetric or nearly so. Pinnules always inserted on the edge of the adaxial face of the pinnule-bearing rachis, or (rarely) lamina simple.

In the Flora Malesiana area I distinguish 9 sections of which the following synopsis may be given:

KEY TO THE SECTIONS

1. 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; combinations of both possibilities occur in one species. . . . . sect. 1. **Schizoloma**
1. Lamina bipinnate, with a conform terminal pinna; or simply pinnate, with free veins, or with anastomosing veins and dimidiate pinnules.
   2. Lamina simply pinnate, with ± equal-sided pinnules; rachis ± sclerotic.
      3. An articulation at the base of each pinnule . . . . . sect. 8. **Isoloma**
      3. No articulations at the bases of the pinnules . . . . . sect. 7. **Psammolindsaea**
   2. Lamina bipinnate, or if simply pinnate, with dimidiate pinnules; rachis various.
      4. Lamina simply pinnate, the rachis strongly sclerotic, abaxially sharply carinate. sect. 6. **Tropidolindsaea**
      4. Lamina bipinnate, or, if simply pinnate, the rachis not simultaneously sclerotic and abaxially carinate 5
         5. Veins anastomosing, sometimes only irregularly so. . . . . sect. 3. **Synaphlebium**
         5. Veins free.
            6. Spores monolete; lamina simply pinnate, with abaxially rounded rachis and (except in small forms) interrupted sori . . . . . sect. 5. **Osmolindsaea**
            6. Spores trilete; if lamina simply pinnate and rachis abaxially rounded, the sori continuous . 7
               7. Lamina simply pinnate, basally distinctly reduced and / or with more widely spaced pinnules; petiole and rachis abaxially bi-angular; pinnules not more than 2 × as long as wide, or, if longer, deeply incised . . . . . sect. 9. **Stenolindsaea**
               7. Lamina bipinnate, or, if simply pinnate, basally not reduced nor with remote pinnules and the axes abaxially terete.
                  8. Sori continuous; pinnules entire . . . . . sect. 4. **Lindsaea**
                  8. Sori interrupted, pinnules ± incised . . . . . sect. 2. **Temnolindsaea**

Section 1. **Schizoloma**

(Gaudichaud) Kramer, Acta Bot. Neerl. 15: 571, 1967. — *Schizoloma* Gaudichaud, Ann. Sc. Nat. 3: 507, 1824, as genus. — *Lindsaea* subgenus *Schizoloma* (Gaud.) Hooker, Spec. Fil. I: 219, 1844; Kramer, Acta Bot. Neerl. 6: 271, 1957. — Type species: *Schizoloma billardieri* Gaudichaud (= *Lindsaea ensifolia* Swartz).

This very natural section cannot be defined in few words, as several types of leaf pattern from decompound to simple (in certain forms of *L. ensifolia*) occur in it. With the key given above some forms with simple leaf structure cannot be keyed out to

this section, e.g., simply pinnate forms of *L. orbiculata*, but fully developed specimens of those species are as a rule bipinnate and show what their affinity is.

The only point in which I disagree with Holttum (1954) with regard to the circumscription of this group is that I include some species with quite dimidiate pinnules, e.g., *L. nervosa* Mett. and *L. hainanensis* Ching. In my opinion the absence of a truly conform terminal pinna is decisive, though it is true that these species otherwise show much similarity to species of sections *Temnolindsaea* or *Lindsaea*. The spores are trilete.

Section 2. **Temnolindsaea**

Kramer, Acta Bot. Neerl. 6: 176, 1957. — Type species: *L. klotzschiana* Moritz in Ettingshausen.

As pointed out before (Kramer 1967a), it is not certain that the Old World species classed here really belong with the neotropical ones for which the section was described. They may be closer to the next section; actually one species of section *Synaphlebium* has so irregularly anastomosing veins together with interrupted sori that it might be placed with almost equal justification in the present section.

Species of section *Temnolindsaea* have bipinnate leaves with a conform terminal pinna, dimidiate, free-veined pinnules with incisions that interrupt the sori, and trilete spores. *L. kingii* Copeland is unique in having some strongly reduced basal primary pinnae.

Section 3. **Synaphlebium**

(J. Smith) Diels in Engler & Prantl, Pfl. Fam. I[4]: 221, 1902; Kramer, Acta Bot. Neerl. 15: 582, 1967. — *Synaphlebium* J. Smith, Hook. J. Bot. 3: 415, 1841 (nom. nud.); Hooker & Bauer, Gen. Fil. pl. 101, 1842. — Type species: *Synaphlebium recurvatum* Hooker.

The species cited with Hooker's description of the genus *Synaphlebium* is '*S. recurvatum* Blume'. There is no such species; it seems likely that he confused *Lindsaea nitens* Blume and *L. recurvata* Wallich, a nomen nudum at the time of publication of *Synaphlebium*; three other species referred to that genus in the same place, on J. Smith's authority, are also nomina nuda. It seems to me that *Synaphlebium recurvatum* Hooker should be regarded as validly described by a generic-specific description. It is a heterotypic synonym of *L. cultrata* (Willd.) Swartz.

Synaphlebium is a very natural section, although the delimitation against sect. *Lindsaea* and sect. *Temnolindsaea* meets with some difficulties. The lamina is simply pinnate, or bipinnate with a conform terminal pinna, the pinnules are dimidiate, in most species incised and with interrupted sori, with anastomosing veins; the spores are trilete. The very small and narrow rhizome scales are also characteristic but not confined to this section. Two species, *L. malayensis* Holttum and *L. crispa* Baker, have irregularly anastomosing veins and bridge the gap to related sections, the former to sect. *Temnolindsaea*, the latter to sect. *Lindsaea*.

Anastomosing veins in dimidate pinnules occur also in *L. media* R. Brown (sect. *Schizoloma*) and in some species of subgenus *Odontoloma*, e.g. in *L. werneri* Ros. and sometimes in *L. rigida* J. Smith in Hooker and *L. pulchella* (J. Smith) Mett. ex Kuhn. The character all by itself cannot be used for defining a natural group.

Section 4. **Lindsaea**

Type species: *L. trapeziformis* Dryander = *L. lancea* (L.) Beddome.

As in sect. *Temnolindsaea* I am by no means certain that the two paleotropical species are cognate with the neotropical ones among which is the type. The lamina is once or twice pinnate, in the latter case with a conform terminal pinna; the pinnules are dimidiate and free-veined, if fertile entire, with unbroken sori.

Section 5. **Osmolindsaea**

Kramer, *sect. nov.* — Rhizoma breviter repens, petiolis confertis; lamina simpliciter pinnata; venae liberae; petiolus rhachisque abaxialiter teretes; sporae monoletae. — Type species: *L. odorata* Roxburgh (*L. cultrata auctt. omn. poster., non* (Willd.) Swartz; see p. 565).

Monolete spores are not too rare in the neotropical species but the present, small section is the only paleotropical group with this character.

Section 6. **Tropidolindsaea**

Kramer, Acta Bot. Neerl. 6: 267, 1957. — Type species: *L. seemannii* J. Smith.

This section was described for three Central American-Caribbean species. It was a surprise to find another, closely related species on the other side of the Pacific, namely, *L. adiantoides* J. Smith [non (Bl.) Kuhn], an endemic of the Philippine Islands. It is very close to *L. seemannii* J. Smith of Panama and N.W. Colombia. Phytogeographically they form an interesting species pair. For a definition of the section see the original description which should be emended insofar as *L. adiantoides* has trilete spores. The affinities of this very clear-cut section are doubtful; points of resemblance with sect. *Osmolindsaea* may be fortuitous. The group of Madagascan species segregated as the new genus *Sambirania* by Tardieu-Blot (1956) is probably related.

Section 7. **Psammolindsaea**

Kramer, *sect. nov.* — Rhizoma pro genere longius repens; folia simpliciter pinnata, cum pinnula terminali libera, lateralibus subaequilateralibus, basi non articulatis, venis liberis, soris continuis, sporis triletis. — Type species: *L. walkerae* Hooker.

The only known species of this section was formerly included in *Schizoloma* or *Isoloma* but is not close to the former and doubtfully related to the latter although it has the very narrow rhizome scales found in nearly all species of sect. *Isoloma*. It lacks the articulation at the base of the pinnules of sect. *Isoloma* and the anastomosing veins of the simply pinnate species of sect. *Schizoloma*. It gives the impression of an isolated species specialized for the milieu of sterile sandy soil (hence the name of the section) occurring in widely scattered localities, probably rather old and without obvious relatives.

Section 8. **Isoloma**

(J. Smith) Kramer, *stat. nov.* — Basionym: *Isoloma* J. Smith, Hook. J. Bot. 3: 414, 1841; Hist. Fil. 227, 1875 (not *Isoloma* Decaisne 1848, *Gesneriaceae*).

It is not impossible that this name has been used before in the rank of section, but the only references found referred to it as a genus or a subgenus.

Admittedly the species of this section, treated as a genus by all recent authors, form a very natural group not closely related to any other one, but the differences between *Isoloma* and the other sections of subgenus *Lindsaea* are on a lower level than those between, e.g., the two subgenera distinguished here. As already stated the limits of the genus *Lindsaea* cannot be drawn on the basis of the leaf architecture alone. Consequently *Isoloma* is treated as a section of subgenus *Lindsaea*. It is defined by the following characters: leaves clustered; axes strongly sclerified, mostly very dark; lamina simply pinnate, the pinnules articulate at their insertion, non-dimidiate but with unequal base; sori continuous; veins free; spores trilete. The type species is *L. divergens* Hooker & Greville.

The affinities of sect. *Isoloma* are doubtful.

Section 9. **Stenolindsaea**

Kramer, *sect. nov.* — Rhizoma brevissime repens; petiolus rhachisque quadrangulares; lamina simpliciter pinnata, angusta; pinnulae raro integrae, saepius leviter incisae ad profunde pinnatifidae, superiores et plerumque inferiores abbreviatae; sori interrupti vel in speciminibus parvis saepe continui. Sporae triletae. — Type species: *L. lucida* Blume.

This small section is not too distinct and might be included in section *Temnolindsaea*; it is, however, constantly unipinnate, with linear leaves and comparatively short pinnules, and it is doubtful whether section *Temnolindsaea* really contains its closest relatives. It forms a natural species group, mainly in eastern Malesia to Melanesia, but with one very widespread species, the type.

II. Subgenus ODONTOLOMA

(Hooker) Kramer, *comb. nov.* — Basionym: *Davallia* subgenus *Odontoloma* Hooker, Spec. Fil. 1: 174, 1844. — *Odontoloma* J. Smith, Hook. J. Bot. 3: 415, 1841, as genus, *nomen subnudum* (non H.B.K. 1820, *Compositae*); J. Smith in Hooker & Bauer, Gen. Fil. pl. 114B, 1842; Fée, Gen. Fil. 329, 1852; J. Smith, Hist. Fil. 269, 1875.

Copeland (1947) regarded *Odontoloma tenuifolium* (Bl.) J. Smith (*Lindsaea tenuifolia* Blume) as the type. This choice is incorrect. Hooker (1844) chose no type, but his description of 1842 is stated to be based on *O. boryana* J. Smith, the basionym of which is *Davallia boryana* Presl, a homotypic synonym of *Dicksonia repens* Bory (although the plate represents in my opinion *L. merrillii* Copeland). Fée (l.c.) also based his generic description on *O. boryanum*; and J. Smith (1875) explicitly indicated *Dicksonia repens* Bory as the type. In my opinion the typification by *Dicksonia repens* Bory = *Lindsaea repens* (Bory) Thwaites is unequivocal.

The long-creeping, essentially epiphytic rhizome (but exceptionally epilithic or even terrestrial) with strongly dorsiventral stele is diagnostic for this subgenus. In some of the smaller species the xylem strand is dorsally open, as will be described elsewhere. The larger species have very broad, distinctly obliquely inserted scales with concave base and sometimes faint marginal protrusions of two adjacent cell ends; but the scales of smaller species differ scarcely from those of subgenus *Lindsaea*. All have, i.a., the glandular end cell(s). In some of the smallest species the scales are so much reduced that they are of one row of cells throughout and, as so-called hairs, have served as a basis for the erection of the monotypic Madagascan genus *Humblotiella* Tardieu-Blot, in my opinion an extremely reduced *Odontoloma*. The larger, constantly unipinnate species have a feature that is not otherwise found in the genus. The lower pinnules are inserted somewhat below, i.e., to the abaxial side of, the adaxial face of the rachis, and the lateral

ridges of the adaxially often scarcely concave rachis are continuous over the pinnule bases. This is, however, not observed in the upper pinnules nor in the smaller species and is therefore of little diagnostic value.

The rhizome often branches from the axil of a petiole which is then as it were inserted at a bifurcation. In the knotted rhizomes of subgenus *Lindsaea*, with aggregated petioles, this is hardly ever noticeable.

At higher altitude species of subgenus *Odontoloma* not rarely grow on moss-covered boulders, etc., and are then no longer epiphytic. On the other hand species of subgenus *Lindsaea* may grow on the bases of tree trunks or, at higher elevations, truly epiphytically on stems among mosses, but the general rule: subgenus *Lindsaea* — terrestrial, subgenus *Odontoloma* — epiphytic, in most cases holds good. In cases of doubt the rhizome anatomy is conclusive.

Subgenus *Odontoloma* seems to be derived from sect. *Schizoloma* of subgenus *Lindsaea*. At present there are some closely related species of *Odontoloma* in Madagascar that on account of their long-creeping rhizome and dorsiventral stele must be placed in subgenus *Odontoloma* though their leaf pattern is very much like that of some species of section *Schizoloma*. Examples are *L. goudotiana* (Kunze) Mett. ex Kuhn and the species called *Sphenomeris emirnensis* (Hooker) Tardieu by Tardieu-Blot (1958), an invalid name as its basionym, *Davallia emirnensis* Hooker, was not accepted by its author. The rhizome characters exclude these species from *Sphenomeris* where both were placed by Tardieu-Blot (l.c.).

Copeland (1947) already commented on the strange phenomenon of the presence of epiphytes in the originally terrestrial genus *Lindsaea*. I agree that the epiphytic habit is derived in the genus. It is even stranger that in the morphology and anatomy of the epiphytes there are no visible adaptations to their habitat, insofar as they can at present be interpreted. It is unfortunate that hardly any prothallia of the terrestrial and none of the epiphytic species are known.

In the Flora Malesiana area I distinguish the following sections:

KEY TO THE SECTIONS

1. Rhizome wiry, not over 1½ 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. sect. 13. **Penna-arborea**

1. 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.
   2. Lamina simply pinnate, the rachis on the adaxial side not grooved to the base (exc. often in *L. capillacea*) . . . . . sect. 10. **Odontoloma**
   2. Lamina bipinnate, in some species occasionally also simply pinnate leaves present, these with the rachis on the adaxial side grooved to the base.
      3. Pinnules entire, with uninterrupted sori . . . . . sect. 11. **Pseudolancea**
      3. Pinnules incised, with interrupted sori, or with only one short sorus near the apex, otherwise sterile . . . . . sect. 12. **Lindsaenium**

Section 10. **Odontoloma**

This is the largest section, consisting of species more or less closely related and often very similar to *L. repens* (Bory) Thwaites. Taxonomically this proved to be a difficult group, second only to sect. *Synaphlebium*. It is distributed from the Mascarene Islands to Hawaii.

Section 11. **Pseudolancea**

Kramer, *sect. nov.* — Rhizoma validum, longe scandens, non lucens, squamis sat latis, structura interna valde dorsiventrali, xylemo clauso. Lamina bipinnata, sed folia nonnulla unipinnata saepe etiam adsunt; pinnulae integrae; sori haud interrupti, marginem superiorem-exteriorem totum occupantes; venae semper liberae. — Type species: *L. parasitica* (Roxb. ex Griff.) Hieronymus.

Section 12. **Lindsaenium**

(Fée) Kramer, *stat. nov.* — Basionym: *Lindsaenium* Fée, Mém. Soc. Mus. Hist. Nat. Strasbourg 4: 201, 1850 (teste Pichi-Sermolli 1953, not seen); Gen. Fil. 333, 1852 (here spelled "*Lindsaynium*"), as genus.

Rhizome as in the preceding section; leaves bipinnate, in several species often a few simply pinnate ones also present. Sori interrupted, or sometimes confined to the apex of the pinnule, the margin otherwise non-soriferous. Veins free, except sometimes in *L. rigida*. — Type species: *L. rigida* J. Smith in Hooker.

Section 13. **Penna-arborea**

Kramer, *sect. nov.* — Rhizoma filiforme, squamis angustis, maturitate plerumque ad bases petiolorum plus minusve limitatis; xylema apertum. Lamina unipinnata; venae liberae vel reticulatae. — Type species: *L. pulchella* (J. Smith) Mett. ex Kuhn.

NEW AND CRITICAL TAXA ARRANGED BY SECTION

Section 1. **Schizoloma** (Gaud.) Kramer

Lindsaea cambodgensis Christ, Not. Syst. 1: 58, 1909.

This name is adopted here for the species previously called *L. tenera* Dryander, e.g. by Holttum (1954). The type of *L. tenera*, '*Ind. or. Soc. Unit. Fratr. 1785*' (BM!) is without collector and exact locality. I do not believe that it is conspecific with the Malesian species to which the name has been currently applied. Its status remains somewhat uncertain; it will be discussed in the account of the continental Asiatic species. *L. bouillodii* Christ, published simultaneously with *L. cambodgensis*, is a heterotypic synonym.

Lindsaea hemiacroscopica Kramer, *spec. nova*

Rhizoma breviter repens, ca. 0,6 mm crassum, squamas minutas rubro-fuscas lanceolatas, ca. 0,3 mm longas, cellulis biseriatis, apice uniseriatis 1—3 gerens. Folia conferta; petiolus lamina paulum brevior, abaxialiter biangularis, fuscus, angulis pallidis. Lamina herbacea, ovata, basi truncata, ad 5—6 cm longa et 3—4½ cm lata, pinnata et profunde pinnatifida (basi paene bipinnata), pinnis superioribus sensim abbreviatis et simplicioribus, pinna conformi terminali nulla. Pinnae majores pro latere ca. 10, basales 20 × 7 mm, acuminatae, profunde pinnatifidae, inaequilaterales. Segmenta cuneata ad ligulata, basalia solum latere acroscopico pinnae, 3—4 × 2 mm, latere basiscopico ibi anguste alato, segmentis nullis. Segmenta minora superiora utroque latere pinnae inserta, anguste cuneata; omnia basi angustata et alis juncta. Segmenta superiora sensim minora, confluentia. Apices segmentorum retusi, subintegri, vel in segmentis sterilibus subacuti. Venae immersae, manifestae, singulae vel in segmentis maximis binae, vel una furcata, ergo ternae. Sori uni-trinervii; indusium ½—1½ mm longum, 0,4 mm latum, marginem

non attingens spatio paulum minore, haud reflexum, lateraliter liberum. Sporae triletae.

Only known by the type collection: *Hallier 3244*, Borneo, Kalimantan, Mt. Amai Ambit (BO). No ecological data.

This species is unique in its group in having basally dimidiate but apically ± equal-sided pinnatifid primary pinnae. The type may be a juvenile plant; but the leaf architecture is so outstanding that there is no doubt as to its representing an undescribed species.

Lindsaea ensifolia Swartz

This is one of the most widespread and, not surprisingly, most variable species. The only author who seriously attempted a subdivision was Domin (1915, p. 74/81). In my opinion his attempt was not successful. He not only included as varieties such distinct species as *L. heterophylla* Dryander, *L. media* R. Brown, and *L. fraseri* Hooker, but he also based his subdivision on characters of size and shape of pinnules which cannot be used here as there are no limits whatsoever between the forms so distinguished. Mr. E. Hennipman, Leiden, kindly informed me that populations observed by him in the field in Thailand often seemed to differ slightly in characters of size, width, etc., but I strongly doubt whether they represent what could be called varieties, and for the taxonomy of herbarium material the criteria are useless.

As shown before (Kramer 1967a) in *L. ensifolia* two distinct subspecies exist, one with a conform terminal pinnule, ssp. *ensifolia*, the other with a pinnatifid leaf-apex, ssp. *agatii* (Brack.) Kramer.

In Malesia there is a third subspecies that agrees with ssp. *ensifolia* in the leaf architecture but differs in the rachis structure: ssp. **coriacea** (v. A. v. R.) Kramer, *stat. nov.* — Basionym: *Schizoloma coriaceum* van Alderwerelt van Rosenburgh, Bull. Dép. Agr. Ind. Néerl. 18: 10, 1908. Type: *Hallier 1934*, Borneo, Kalimantan (BO!). In this subspecies the rachis is always dark, abaxially rounded or almost keeled; the margin of sterile pinnules is entire. In ssp. *ensifolia* the rachis is usually stramineous, abaxially bi-angular or even sulcate up to or into the terminal pinnule; the margin of sterile pinnules is nearly always dentate, at least in the basal part.

L. ensifolia ssp. *coriacea* is apparently confined to coastal swamps of Malaya, Singapore, Riau, Sumatra, and Borneo (I have seen a single doubtful collection from Java in L); see Anderson 1963. I am indebted to Professor Holttum for the information, gained by Professor Manton, Leeds, that it is apparently diploid (n = 44 or 45), whereas typical *L. ensifolia* is tetraploid (n = 87 or 88). I think this is an additional argument for treating *Schizoloma coriaceum* as a subspecies of *L. ensifolia*, although it seems possible and even likely that some cytological variation will also be discovered in what is here called ssp. *ensifolia*.

Section 2. **Temnolindsaea** Kramer

Lindsaea tetragona Kramer, *spec. nova*

L. tenuifoliae Blume valde affinis, differt praecipue petiolo rhachidibusque primariis et secundariis abaxialiter bi-angularibus nec unicarinatis, ideo sectione transversa fere tetragonis.

var. **tetragona**: segmenta pinnularum $\frac{1}{3}$—$\frac{3}{4}$ mm lata; pinnulae incisae ad $\frac{2}{3}$ vel $\frac{3}{4}$; indusii margo a margine pinnulae spatio latitudinem ejus aequante vel minore remotus. — Type: *Binnendijk 160*, Ambon (U). Distribution: Mindanao, Celebes, Moluccas, Louisiades, Solomon Islands, Fiji, Tahiti; a specimen from New Caledonia probably incorrectly labelled (see Kramer 1967a).

var. **brassiana** Kramer *var. nova*: segmenta pinnularum ¾—1 mm lata; pinnulae incisae ad ⅓ vel ¼, prope apicem ad ½; indusii margo a margine pinnulae spatio latitudinem ejus aequante vel superante remotus. — Type: *Brass 27919*, Louisiades, Sudest Isl. (L; isotype GH). Known from one other collection from the Louisiades: *McGregor s.n.* (BRI, K).

This species has so far always been confused with and included in *L. tenuifolia*. The areas of the two species overlap slightly; *L. tenuifolia* is distributed from Sipora (off W. Sumatra) and Java east to New Guinea but seems to be common only on the latter island. It is strange that *L. tetragona* which occurs both to the east and the west of New Guinea has never been found on that island itself.

Lindsaea polyctena Kramer, *spec. nova*

L. tetragonae (vide supra) similis petiolis rhachidibusque abaxialiter biangularibus, differt pinnulis magis tenuisectis, segmentis capillaribus, basi 0,2—0,4 mm latis, apice bis latioribus, ala eiusdem latitudinis conjunctis, basalibus vel plurimis furcatis vel maximis bis furcatis, margine exteriore saepe irregulariter eroso. — Type: *Cuming 309*, Philippine Is., Leyte (US; isotypes B, BM, HBG, K, L, MICH, P). Other specimens seen: Mindanao: *Bolster 340* (MICH); *Merrill 7327* (MICH, P); *Copeland s.n.* (GH); *Copeland 1740* (MICH, P). Samar: *Edaño 24746* (US); *Ramos 17464* (MICH).

Section 3. **Synaphlebium** (J. Smith) Diels

On the species level this proved by far the most difficult group in the genus. Older authors often determined species with dimidiate pinnules and anastomosing veins rather indiscriminately as *L.davallioides* or *L.decomposita*, as shown by their herbarium annotations. Even Christensen (1943), working with the limited assortment in Samoa, listed three 'forms' of *L. decomposita*, none of them in my opinion truly belonging to that species. Not until Holttum's work (especially 1954) was the chaos somewhat cleared up. My treatment in Flora Malesiana will be a further attempt in this direction. I should like to stress the word attempt as I am well aware that particularly in the present section it is a beginning. Notably the delimitation of what I assign to *Lindsaea obtusa* J. Smith in Hooker (*L. davallioides* of Holttum, l.c.) is still somewhat unsatisfactory, but the extremes found in what may actually be a species complex are connected by so many intermediates that they defy classification with the means at my disposal. Some of the other species of the section are also connected by intermediates that are, however, so few in number that they do not challenge the distinctness of these species, even in the absence of any evidence for hybrid origin.

Another factor which I fear will at least at first tend to enhance rather than diminish the confusion is the nomenclature. The two best known or at least most widely (mis)used names, *L. davallioides* Blume and *L. decomposita* Willd., after re-examination of types, must be replaced by the earlier names **L. lobata** Poiret in Lamarck and **L. cultrata** (Willd.) Swartz, respectively. The last name was up till the present universally in use for another species, *L. odorata* (see section 5). Besides, the name for the most widespread species, *L. obtusa*, was scarcely used in recent times. Fortunately, if I may say so, section *Synaphlebium* has been greatly overdescribed, and for all the forms treated as valid species in the Flora Malesiana area a name of certain application could be found, with the sole exception of the peculiar species described below as new.

Lindsaea modesta Kramer, *spec. nova*

Rhizoma pro sectione longius repens, capillaceum, 0,4 mm crassum, fuscum, impolitum,

squamis sat persistentibus, brunneis, acicularibus, vix 1 mm longis, apice uniseriatis, basi biseriatis obtectum. Petioli ca. ½—¾ cm remoti, ad 7 cm longi, lamina paulum longiores, praeter basim extremam straminei et quadrangulares, graciles, ¼—⅓ mm crassi. Lamina ca. 4—6 cm longa, 3 cm lata, ovata, basi truncata, simpliciter pinnata, pinnulis pro latere 4—5, superioribus vix abbreviatis, et terminali libera. Rhachis petiolo similis. Pinnulae herbaceae, tenues, translucentes, paulum adscendentes, inaequaliter triangulares, basi cuneatae et subpetiolulatae, apice subacutae, a basi ad apicem fere aeque angustatae, maximae 15 × 4—5 mm, margine anteriore incisionibus ca. 1 mm altis valde obliquis plerumque 3, lobi margine exteriore recto sed paulum vel saepius forte et valde irregulariter eroso. Pinnula terminalis flabellato-cuneata, 1—2 cm longa, saepe semel profunde et leviter semel vel bis bifida. Venae immersae sed manifestae, valde obliquae, semel vel bis furcatae, anastomosantes, seriem macularum simplicem efformantes, ad apicem pinnulae haud raro liberae. Sori plerumque bi-trinervii, receptaculo basi recto vel ad extremitates leviter concavo. Indusium 0,3—0,4 mm latum, subintegrum vel saepius erosum, marginem fere attingens vel attingens. Sporae triletae. — Type: *Aet & Idjan 297*, Japen (Schouten Is.), Waniami near Seroei (BO). Only known from the type collection. No ecological data, but the rhizomes are interwoven with *Hymenophyllaceae* and mosses and the plants were probably epiphytic.

A close relative of *L. obscura* Brause (twice collected in the Terr. of New Guinea) from which it differs by thinner texture, more elongate pinnules, pale petioles, shorter sori, and a much narrower terminal pinnule.

Section 4. **Lindsaea**

Lindsaea doryphora Kramer, *spec. nova.* — *L. scandens* Hooker var. *terrestris* Holttum, Ferns Mal. 327, 1954, *nom. inval.* (not typified).

Rhizoma breviter repens, squamis pallide brunneis lanceolatis ad 1½ mm longis vestitum. Petiolus stramineus, abaxialiter teres vel rarius supra obtuse biangularis, laminae aequilongus vel bis longior. Lamina chartacea, statu vivo saepe (semper?) azureo-refulgens, uni- vel bipinnata, 15—35 cm longa, pinnis pro latere 1—6 et terminali conformi vel pinnulis solum instructa; rhachides petiolo similes. Pinnulae saepe 20—25 pro latere, ligulatae vel minores rotundato-rectangulares, 2—3 × longiores quam latae, saepe 15—20 mm longae et 6—8 mm latae, subcontiguae, superiores foliorum minorum paulum abbreviatae, haud vel vix confluentes cum pinnula terminali magna, oblique hastata, foliorum majorum nonnumquam magis abbreviatae, plures confluentes cum segmento terminali minore, lanceolato, basi lobato. Venae immersae sed manifestae, liberae, saepe bis furcatae. Sori in pinnulis omnino fertilibus continui, venas omnes vel haud raro proximas solum conjungentes. Indusium integrum, ¼—⅕ mm latum, marginem non attingens. Sporae triletae. — Type: *Alston 13358*, Borneo, Kalimantan, Permantang, S. of Kwala Kwajan (U; isotype BM).

This is a widespread species, distributed from Mergui (Tenasserim) to West Java and Borneo, where it seems to be most common, and sporadically to the Philippine Islands. I have seen almost 150 collections. It was formerly included in the neotropical *L. lancea* (L.) Beddome, then in the sympatric *L. scandens* Hooker [= *L. parasitica* (Roxb. ex Griff.) Hieron.], but it is distinct from both. I have not been able to find a validly published name for it, unless one of Roxburgh's names in this group proves to apply to this species. In several cases where no types could be found their identity remains quite obscure.

Section 5. **Osmolindsaea** Kramer

Lindsaea odorata Roxburgh, Calc. J. 4: 511, 1844.

The type of the species universally known as *Lindsaea cultrata* (Willd.) Swartz in the Willdenow herbarium (B!) proved to belong to what is otherwise called *L. decomposita* Willd., a later heterotypic synonym. The oldest name for the present species I have been able to find is Roxburgh's name *L. odorata*. Fortunately the application of the name is in this case unambiguous. In the Icones Roxburghianae in the Kew library plate no. 2578 that bears this name undoubtedly represents the species under consideration, and the plate should be regarded as the type as long as no specimen turns up.

The misapplication of Willdenow's name is not surprising in view of the very brief and not entirely correct description. I think it goes back to Schkuhr's Kryptogamische Gewächse (1809) where on plate 114, left, clearly *L. odorata* is depicted as '*L. cultrata*'; it was perpetuated by Hooker & Greville, Icones Filicum plate 144 (1829), and in other books by W. J. Hooker.

Section 9. **Stenolindsaea** Kramer

Lindsaea lucida Blume

The name *L. gracilis* Blume is often applied to this species [and misapplied to *L. pulchella* (J. Smith) Mett. ex Kuhn]. The type of *L. gracilis*, a Blume specimen from West Java (L!), is a small, rather poorly developed plant, probably juvenile. I therefore choose for the two combined species the simultaneously published name *L. lucida* Blume, based on a well-developed plant, also collected by Blume in West Java (L!). It is a widespread and variable species with a number of further synonyms. In the Flora Malesiana area there are two subspecies, ssp. *lucida* and ssp. **brevipes** (Copeland) Kramer, *stat. nov.*, basionym: *L. brevipes* Copeland, Philip. J. Sc. 6. Bot.: 83, 1911; type: C. King 237, Papua (MICH!). The latter has a basally very gradually and strongly reduced lamina with auriculiform lowermost pinnules. It has a more easterly distribution than ssp. *lucida*; there are a few intermediates.

Lindsaea bakeri (C. Chr.) C. Chr.

Although this is a well-marked species, simply pinnate with deeply uni- to tripinnatifid pinnules with capillary segments and strongly clustered leaves, it has three heterotypic synonyms, *L. trichophylla* Copel., *L. schlechteri* Brause, and *L. ledermannii* Brause. It is apparently not very rare in New Guinea; otherwise I have seen only one collection from Morotai (Main & Aden 1137, L). The following, aberrant specimens seem to merit varietal recognition:

var. **pycnophylla** Kramer, *var. nova*

Petiolus rhachisque brunneae vel fuscae, pallide marginatae; lamina ad 12 × 3 cm, basi paulum angustata; lobi pinnularum 0,6—1,2 mm lati, ad sorum 0,8—1,2 mm lati, haud capillares; lobi primarii minus divisi, segmenta minus divergentia, apice paulum vel non erosa; venae minus manifestae; sori haud raro binervii, ad 1 mm longi; basis indusii nonnumquam forte concava. — Type: *Brass 6838*, Papua, Fly R., 528 Mile Camp (GH). Paratypes: *Brass 6902*, Papua, Palmer R., 2 mi. below junction Black R. (BM, GH).

Section 10. **Odontoloma**

Lindsaea repens (Bory) Thwaites

The combination under *Lindsaea* is usually credited to Beddome. It was, however, made by Thwaites in his "Enumeratio Plantarum Zeylaniae" (1864). It is possible that the reference in Beddome's 'The Ferns of Southern India' (p. 72, pl. 209; prob. 1864) is earlier; then the combination should be cited as Thwaites ex Beddome. I am indebted to Professor Pichi-Sermolli, Genova, for help with this bibliographical problem which is as yet not quite solved.

The most common and widespread species of subgenus *Odontoloma* was for a time known by the name *L. repens*. Then Brause (1920, p. 129) maintained that *L. repens* was confined to the Mascarene Islands and used the name *L. Boryana* (Presl) Brause for the Indo-Malayan specimens. This is a nomenclatural blunder, as *Davallia boryana* Presl, the basionym, was published as a new name for *Dicksonia repens* Bory, the basionym of *L. repens*, the two names being homotypic. Copeland (1929) corrected this and took up the name *Davallia macraeana* Hooker & Walker-Arnott, published for a Hawaiian plant, with a new combination under *Lindsaea*. By this name it is called in most of the recent fern literature. Study of a very large series of specimens from all over the range has convinced me that the Mascarene plants are conspecific with the Malesian and the Polynesian, including the Hawaiian, ones; certainly the Hawaiian plants are not closer to the Malesian ones than the Mascarene. Holttum (1954), probably misinterpreting Christensen's key (1932), stated that the plant from Réunion described as *D. repens* was closer to *L. 'cultrata'* (*odorata*), but that is not the case.

Still *L. repens* in its restored broad sense is very variable, and a number of geographically more or less limited infraspecific categories can be distinguished. These are here treated as varieties, as the limits are nowhere entirely sharp, small numbers of intermediates being found in most cases, and as the segregation is never so strict as to make the forms geographically exclusive. An exception to this rule are the Mascarene var. *repens* and the Hawaiian var. *macraeana*, but they are so close to other varieties that it seems logical to treat them also as such. Some taxa that are undoubtedly also very close to *L. repens* I have left as species, e.g. *L. apoensis* Copeland and *L. merrillii* Copeland. In these cases the differences are sufficiently sharp and large. It is, however, quite possible that additional material will make some changes of rank in the group of *L. repens* necessary.

A key to the varieties distinguished in the Flora Malesiana area will be provided in the Flora. Here only the taxonomic and nomenclatural novelties will be mentioned.

var. **sessilis** (Copeland) Kramer, *stat. nov.* Basionym: *Lindsaea sessilis* Copeland, Philip. J. Sci. Bot. 6: 82, 1911. — Type: *C. King 244*, Papua (MICH!). — *L. foersteri* Rosenstock, Fedde, Rep. 12: 527, 1913. — Type: *Keysser 193*, Sattelberg, Terr. of New Guinea (B!). — *L. cultripinna* Copeland, Philip. J. Sci. 81: 6, 1952. — Type: *Sulit 8718*, Mindanao, Mt. Katanglad (MICH!). — *L. longa* Copeland, Philip. J. Sci. 46: 216, 1931. — Type: *Edaño 77978*, Palawan, Mt. Balagbag (MICH!).

An East Malesian variety, but some intermediates are found in Central Malesia where it overlaps with the following.

var. **pectinata** (Blume) Mett. *ex* Kuhn.

The western variety, distributed from Assam and Ceylon to the Philippines and the Moluccas. This is not *L. pectinata* of Holttum (1954). A narrow-leaved form confined to Mindanao, Luzon, and Leyte seems to deserve recognition as forma **angusta** (Copeland) Kramer, *stat. nov.*; basionym: *Lindsaea angusta* Copeland, Philip. J. Sci. 81: 5, pl. 4, 1952. Type: *Edaño 8791*, Mindanao, Mt. Kampalili (MICH!).

var. **delicatula** (Christ) Kramer, *stat. nov.* Basionym: *Davallia delicatula* Christ, Verh. Naturf. Ges. Basel 11: 224, pl. 3 f. 1—3, 1895. *Lindsaea delicatula* Christ, ibid., *nom. altern. invalid.* — Type: *Sarasin & Sarasin 937*, Celebes, Borau (P!). — *Lindsaea sagincola* Wagner & Grether, Un. Cal. Publ. Bot. 23: 34, pl. 9, 1948. Type: *Grether & Wagner 4010*, Admiralty Is., Los Negros (MICH, US, isotypes!).

A small, apparently reduced, and uncommon variety. I have seen one collection from each of the islands Celebes, New Guinea, Los Negros, Manus, and New Ireland. Wagner & Grether, l.c., reported it from sago-palm trunks in swamps. This is also true for the other collections, insofar as they have any ecological data.

var. **submarginalis** Kramer, *var. nova.* Rather like var. *pseudohemiptera* v. A. v. R., Bull. Jard. Bot. Btzg. II, 2: 157, 1920. The following combination of characters is typical: Lamina basaliter haud raro paulum angustata, tunc petiolo manifesto, nonnullos cm longo. Pinnulae saepe falcato-adscendentes, apice angustatae vel subacutae, maximae 20 × 5—26 × 6 mm, 3½ — ultra 4 × longiores quam latae, statu sicco plerumque obscurae; margo anterior regulariter et non alte incisus, sinus ad ½ mm alti, duplum spatii inter marginem et receptaculum attingentes; margo sterilis non profunde crenatus; lobi margine exteriore truncato, minores truncato-rotundato. Sori bi-quadrinervii, receptaculo recto, extremitatibus concavis, vel in brevioribus omnino paulum concavo; indusium integrum, ca. 0,3 mm latum, marginem fere aequans, maturitate reflexum et sporangiis obtectum et absconditum. Sporangia maturitate ultra marginem protrusa. Type: *Bartlett 6603*, Sumatra, Deleng Singkut, Karo Plateau (L; isotypes GH, MICH).

Known from seven (and a few doubtful) collections from Sumatra. It is not impossible that it is a hybrid between var. *pseudohemiptera* and var. *pectinata*, but the series of specimens at hand seems to warrant recognition. *Lörzing 6852* (BO), also from Sumatra, connects it with var. *pectinata*.

Lindsaea carvifolia Kramer, *spec. nova*

Rhizoma longe repens, scandens, 1—2 mm crassum, brunneum, squamis anguste triangularibus melleis vel brunneis, ad 2 mm latis obtectum. Folia remota, petiolis vix manifestis ad 4 cm longis. Lamina linearis, 20—50 cm longa, 1½—4 cm lata, supra et infra angustata, simpliciter pinnata. Rhachis abaxialiter biangularis vel late canaliculata. Pinnulae herbaceae vel chartaceae, statu sicco atrovirentes, pro latere ca. 50—80, haud contiguae, 6 × 2—20 × 6 mm, ter longiores quam latae, a basi ad apicem fere aeque angustatae, a margine superiore profunde incisae, segmentis primariis 5—7, fere omnibus bifidis, majoribus bis bifidis; lobi paulum divergentes, lineares vel capillares, plerumque 0,5—1 mm lati sed saepe margine reflexo et aspectu angustiores, apice rotundati nec erosi. Sori fere omnes uninervii, singuli in lobis, saepe suborbiculares; indusium basi recta vel concava, subellipticum vel hippocrepiforme, marginem non vel fere attingens, maturitate reflexum. Sporae triletae. Type: *Beguin 1116*, Ternate, Moluccas (BO; isotype L). Other specimens seen: Halmahera: *Pleyte 328* (BO, K, L); Morotai: *Main & Aden 1094* (BO, juv.); Ternate: *Beguin 1308* (BO, juv.); Celebes: *Warburg 16527* (B; doubtful, perhaps belonging to *L. rosenstockii*, but phytogeographically more probably the present species); Sarawak: *Mjöberg 9* (BM), *Anderson S 20179* (L); Sabah: *G. H. S. Wood 2041* (K); Kalimantan: *Endert 4247* (B, BO, L).

Most specimens of *L. carvifolia*, and of *L. fissa* Copeland, were determined as *L. hymenophylloides* Blume. The type of *L. hymenophylloides* is a juvenile specimen of *L. repens* with deeply incised pinnules from Java (L!). Blume described it as 'soris subrotundatis', but it is quite sterile.

Section 11. **Pseudolancea** Kramer

Lindsaea parasitica (Roxburgh ex Griffith) Hieronymus

Holttum (1954) called this species *L. scandens* Hooker. An older name is *Vittaria parasitica* Roxburgh ex Griffith, Calc. J. 4: 510, 1844. I have not seen the type, collected on Pulau Penang by Roxburgh, but the description leaves no doubt as to its identity. Hieronymus (1920), commenting on the distinctness of the Asiatic species from the neotropical *L. lancea* with which it had been confused, attributed the name to Wallich, but in his "List" it appears as a nomen nudum. The combination under *Lindsaea* is best attributed to Hieronymus.

Section 12. **Lindsaenium** (Fée) Kramer

Lindsaea rigida J. Smith in Hooker

I quite agree with Holttum (1954) that *L. diplosora* v. A. v. R. and *L. triplosora* v. A. v. R. cannot be separated from *L. rigida*. *L. monocarpa* Ros. seems, however, to be separable by the shape of its secondary rachises, but it is only known from the two syntype collections and little is known about its variability. Other synonyms are *L. longissima* Christ, *L. monosora* Copeland, and *L. sepikensis* Brause. This is one of the few species where the veins are sometimes free and sometimes reticulate.

Lindsaea sarawakensis Kramer, *spec. nova*

Rhizoma non visum. Petiolus fuscus, lucidus, abaxialiter teres vel supra obtuse biangularis. Lamina ca. 35—40 cm longa, bipinnata; rhachis primaria fusca, abaxialiter teres vel angustato-teretiuscula. Pinnae 4—5 pro latere et terminalis conformis, lineares, 15—30 cm longae, 12—15 mm latae, acutae. Rhachides secundariae stramineae praeter basim brunneam, abaxialiter fere ad basim carinatae. Pinnulae herbaceae, subcontiguae, ca. 55—95 pro latere, asymmetrice liguliformes, apice angustato-rotundatae, majores ca. 7 × 2—2½ mm, superiores sensim et plus minusve forte abbreviatae, paucae confluentes cum segmento terminali parvo lanceolato. Margo superior pinnularum majorum incisionibus 2 vel 3, valde obliquis, acutis, partem quintam latitudinis pinnulae attingentibus, lobi rotundati. Venae immersae, obscurae, simplices vel unifurcatae. Sori (pinnulae partim fertiles solum suppeditant) ad apicem marginis superioris, binervii vel rarius uninervii; indusium fuscescens, ca. ⅛ mm latum, marginem paene attingens. Sporae triletae. — Type: *Mjöberg 9*, Sarawak, Mt. Murud (P, 3 sheets). Only known from the type collection.

The absence of the rhizome leaves some doubt whether this is a member of sect. *Lindsaenium* or of sect. *Temnolindsaea*. It is here described in the former because of the restriction of the sori to the apical part of the anterior margin of the pinnules, a feature in which it closely resembles *L. rigida* which is generally similar. The shape of the secondary rachises is distinctive.

Sect. 13. **Penna-arborea** Kramer

Lindsaea pulchella (J. Smith) Mett. *ex* Kuhn

Most authors call this species *L. adiantoides* (Blume) Kuhn, based on *Aspidium adiantoides* Blume, but that is a later homonym of *L. adiantoides* J. Smith in Hooker (sect. *Tropidolindsaea*). Copeland (1958) renamed it *L. adiantifolia* (Hooker) Copeland, based on *Davallia adiantifolia* Hooker, a homotypic synonym of Blume's name, coined for transfer

to *Davallia* where Blume's epithet was preoccupied. When *Odontoloma pulchellum* J. Smith is treated as conspecific an earlier name is available.

Like *L. repens*, *L. pulchella* is a widespread and variable species with several infraspecific taxa here treated as varieties, for the same reasons as in *L. repens*.

Var. **pulchella**

The most common and widespread variety in the Philippines (the type is *Cuming 217* from Luzon, K!), extending to Celebes, the Moluccas, and Flores, but unknown from Western and, apart from a single collection from New Guinea (*Nyman 478bis*, B), also from Eastern Malesia. Blume's type of *Aspidium adiantoides* belongs to this variety; it was said to have come from Java, but this seems unlikely. Var. *pulchella* is characterized by herbaceous, free-veined, very shallowly incised pinnules, sori, insofar as they are uninerval, with a very concave base, and concolorous petioles.

var. **blanda** (Mett. ex Kuhn) Kramer, *stat. nov.* Basionym: *Lindsaea blanda* Mettenius ex Kuhn, Linnaea 36: 80, 1869. — Type: "Java", without indication of collector. A specimen in B collected in Java by Wichura bearing the annotation 'L. blanda M.' from Mettenius's herbarium is very probably the type.

Differing from var. *pulchella* by usually larger, more deeply incised pinnules with divergent lobes. More widespread than var. *pulchella* and apparently common in most parts of its area, extending from Sumatra and West Java to the Philippines, New Guinea, and Queensland (one collection), but strangely enough from Borneo not recorded and only by a doubtful specimen from the Moluccas (*Steere s.n.*, Ternate, MICH, US). *L. cyathicola* Copeland and *L. alpestris* v. A. v. R. are synonymous with this variety.

var. **falcata** (Brause) Kramer, *comb. nov.* Basionym: *L. marginata* Brause var. *falcata* Brause, Bot. Jahrb. 56: 127, 1920. — Type: *Ledermann 12865*, Terr. of New Guinea, Felsspitze, Sepik Region (B!). — *L. marginata* Brause var. *marginata* (implic.), Bot. Jahrb. 56: 126, 1920. Lectotype: *Ledermann 11384*, Terr. of New Guinea, Hunsteinspitze, Sepik Region (B!).

In this variety the pinnules are more elongate than in the two preceding ones and often, but not always, sclerotic-margined. The petiole is adaxially much paler than abaxially. The sori are as in var. *pulchella*. I have seen 14 collections from the three divisions of New Guinea and Goodenough Island, and a single one from Aneityum, New Hebrides. *Brass 5079* from Papua (BO, BRI, GH, US) is intermediate between var. *falcata* and var. *blanda*.

var. **lomatosora** Kramer, *var. nova*

Var. *falcatae* similis. Facies petioli haud vel vix discolores. Incisiones pinnularum haud ultra 1 mm altae. Margo vix scleroticus. Venae nonnumquam conniventes vel anastomosantes, tunc series macularum plerumque incompleta. Indusium in soris brevibus basaliter haud concavum, potius convexum; margo indusii marginem pinnulae fere attingens. — Type: *Brass 27911*, Louisiades, Sudest I., Mt. Riu (L; isotypes GH, K). Other specimens seen: *Brass 27028*, Fergusson I. (GH, K, L); *Brass 25641*, Normanby I. (A, L, LAE); *Womersley & Millar 8411*, Terr. of New Guinea, near Skindewai, Morobe Distr. (A).

SPHENOMERIS

Sphenomeris chinensis (L.) Maxon *)

In the recent literature this species is almost universally met with under the names *Sphenomeris chusana* (L.) Copeland or *Stenoloma chusanum* (L.) Ching. When Ching made the combination under *Stenoloma* (Sinensia 3: 337, 1933) he stated that of Linnaeus's two simultaneously published names applying to this species, *Adiantum chusanum* and *Trichomanes chinense*, the former had to be chosen because of page priority. He had overlooked, however, that J. E. Smith (in Rees, Cyclopedia, vol. 11, sine pag.) had already in 1808 combined the two species under *Davallia chinensis* (L.) J. E. Smith.

There is no specimen named *Adiantum chusanum* in the Linnaean herbarium. A sheet of the species under consideration is marked "10", the number of the species in the 2nd edition of the Species Plantarum. It bears an annotation by J. E. Smith that it belongs to *Davallia chinensis* and agrees with both *Trichomanes chinense* L. and *Adiantum chusanum* L. It seems unlikely that this is Linnaeus's original specimen. His description agrees with *Sphenomeris chinensis* but might also apply to several other species of *Sphenomeris* (but only one other species occurs in China where *A. chusanum* was collected) and of other, superficially similar genera. The doubtful application of the name is another argument against adopting it.

The type of *Trichomanes chinense* L. is in herb. S-PA, collected by Osbeck in China.

Sph. chinensis is a very widespread and variable species. Manton & Sledge (1954) reported the occurrence of two cytotaxonomically distinct forms in Ceylon, a tetraploid and a more finely dissected hexaploid. With large series of specimens at my disposal I feel unable to distinguish these forms in the herbarium. The great variability of the leaves of *Sph. chinensis*, at least partly under influence of the milieu, was already noted by Holttum (1954), and this, together with differences between apparently juvenile yet fertile and full-grown plants, obscures the differences between the two forms. In the Flora Malesiana area I feel compelled to retain a rather wide circumscription for var. *chinensis*. The extremes are connected by many intermediates and are constant in characters of rhizome scales and of spore size, the spores being under 50 μ long, mostly between 42 and 48 μ. Much more study of living material and chromosomes would be required to justify further splitting of var. *chinensis*. The suggestion of Kurita & Nishida (1963) that one of the 'races' of *Sph. chinensis* could be identified as *Sph. chusana* is nomenclaturally impossible as long as there is no type specimen of *Adiantum chusanum* L.

The two following varieties seem to be sufficiently distinct for recognition even on the basis of herbarium material only.

var. **divaricata** (Christ) Kramer, *comb. nov.* Basionym: *Odontosoria chinensis* (L.) J. Smith var. *divaricata* Christ, Journal de Botanique Sér. 2, II: 23, 1909. — *Sphenomeris chusana* (L.) Copel. var. *divaricata* (Christ) Tardieu-Blot, Fl. Madag. Com. 5e fam. I: 29, 1958. — Type: *Chevalier 14309*, São Tomé (P!, 2 sheets). — *Sph. chusana* (L.) Copel.

* Dr. F. R. Fosberg, Washington, D. C., in a forthcoming article (Taxon 17) draws attention to the fact that Maxon's citation of the basionym, when making the combination *Sphenomeris chinensis*, was incorrect; he cited *Adiantum chinense* L., a contamination of *Adiantum chusanum* L. and *Trichomanes chinense* L. His conclusion is that Maxon's transfer was invalid, being based on a non-existent basionym, and that the earliest place where the valid combination appears is my paper (Kramer 1967). It seems to me, however, that Maxon's citation may be corrected as an error, especially since, at the time of publication, the rules with regard to the bibliographic citation of basionyms were much less strict than they are now, and I shall continue to cite the name as *Sphenomeris chinensis* (L.) Maxon 1913. (Note added in proof, with Dr. Fosberg's kind permission).

var. *tenuifolia* of Holttum, Ferns Mal. 341, 1954, and of other authors, under *Odontosoria chinensis*, *O. chusana*, *Sph. chinensis*, etc.; not *Adiantum tenuifolium* Lamarck.

Holttum (l.c.) showed that this variety is distinct and gave a good illustration in his fig. 198. Typically the segments are very narrow, at the base ca. ½ mm wide, upward not or very little widened, at the sorus rather abruptly twice as wide, with rounded lateral margins. An additional character is found in the size of the spores which are over 50 μ long, often 55—60 μ, rarely longer. This, and the finer cutting in comparison with the hexaploid form from Ceylon (the tetraploid being even less divided), suggest that it has a higher ploidy level, but I do not know of any chromosome counts that explicitly apply to this variety. A mature sporangium that seemed still to contain all its spores had 16 of them which would point to an apogamous taxon, as reported in the following species. Some specimens approach the narrower forms of var. *chinensis* in the shape of their segments but have larger spores. This induces me to treat the taxon under consideration as a variety. It is widespread in Malesia but seems to be most common in Sumatra, Java, and New Guinea, where it usually grows between 800 and 2000 m in open or partly shaded places but rarely, if ever, in the full shade of a closed forest canopy.

Lamarck's name *A. tenuifolium* or Swartz's combination under *Davallia* have served as basionyms for various names for this variety. The name is suggestive, but the type (*Commerson s.n.*, 'India orientalis', P) belongs to var. *chinensis*.

var. **rheophila** Kramer, *var. nova*

Lamina pro specie brevior, 15—20 cm longa, basi tripinnata + pinnatifida vel rarius bipinnata + bipinnatifida; segmenta rigida, saepe margine subrevoluto, anguste cuneata, plura monosora, et tunc 4—5 × longiora quam lata. — Type: *Bartlett 6718a*, Sumatra, Asahan, waterfall of the Asahan R., Si Monung-monung, near Udjung Batu, above Bandar Pulu (L; isotypes GH, MICH, S—PA, US).

In the rhizome scales and the size of the spores it does not differ from var. *chinensis*. It might be taken for a purely phenotypic form of that variety, but the combination of habitat by creeks, torrents, and waterfalls, and the limited distribution seem to warrant varietal recognition. The New Caledonian *Sph. angustifolia* (Bernh.) Brownlie is rather similar.

MALAY PENINSULA. Pahang: *Seimund 534* (SING); *Ridley s.n.* (SING). — SUMATRA: Bartlett *6718a*, type coll. (GH, L, MICH, S-PA, US); *Docters van Leeuwen 3283* (BO, L); *Yates 1054* (BO, GH, MICH, SING), *1919* (L, MICH, SING); *Forbes 2221* (GH, L); *Surbeck 315* (L), *921* (L).

Sphenomeris biflora (Kaulf.) Tagawa

This taxon might be taken for another variety of *Sph. chinensis* which it sometimes closely resembles, and it has been treated as such. The rhizome scales are, however, distinctive; they are paler and less narrow than in *Sph. chinensis*, with a suddenly broadened pluriseriate base. The spores are a little larger than in *Sph. chinensis* var. *chinensis*, from 40—45 μ long. Kurita & Nishida (1963) studied it cytotaxonomically and also arrived at the conclusion that it is a distinct species. They reported it to be apogamous, 2 n = 48 (diploid?). It would be desirable to supplement their results with more data from other parts of the range. I have seen specimens from Japan, some small islands off the S.E. coast of China, the Bonin Islands, Guam, Taiwan, and Luzon.

The authors who treat this taxon as a variety of *Sph. chinensis* usually call it var. *biflora* or var. *litoralis* (Tagawa), but the oldest name on the varietal level is *Davallia tenuifolia* (Lamk) Swartz var. *lata* Hooker ex Moore, Ind. Fil. 2: 301, 1862, based on var. β (not named) of the same species in Hooker's Species Filicum 1: 186. Lectotype: *Exped. Imp. Acad. Petersb. 44*, Bonin Islands (K!).

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REFERENCES

ANDERSON, J. A. R. 1963. The flora of the peat swamp forests of Sarawak and Brunei, etc. Gard. Bull. Sing. 20: 131—228.

BRAUSE, G. 1920. Bearbeitung der von C. Ledermann .... aus dem Papuagebiete früher mitgebrachten Pteridophyten etc. Bot. Jahrb. 56: 31—250.

CHRISTENSEN, C. 1932. The Pteridophyta of Madagascar. Dansk Bot. Ark. 7: 1—253.

—— 1934. Index Filicum. Supplementum tertium pro annis 1917—1933. Copenhagen.

—— 1943. A revision of the Pteridophyta of Samoa. Bull. Bish. Mus. 177.

COPELAND, E. B. 1929. Ferns of Fiji. Bull. Bish. Mus. 59.

—— 1947. Genera Filicum. Waltham, Mass.

—— 1958. Fern Flora of the Philippines I. Manila.

DOMIN, K. 1915. Beiträge zur Flora und Pflanzengeographie Australiens. I. Bibl. Bot. 20.

HIERONYMUS, G. 1920. Kleine Mitteilungen über Pteridophyten. III. Hedwigia 62: 12—37.

HOLTTUM, R. E. 1954. A revised flora of Malaya. II. Ferns of Malaya. Singapore.

—— 1958. Notes on Malaysian ferns, etc. Kew Bull.: 447—455.

—— 1960. The problem-species: Schizoloma cordatum Gaud. and Syngramma pinnata J. Smith. Am. Fern J. 50: 109—113.

HOOKER, W. J., & F. BAUER. 1842. Genera Filicum. London.

KRAMER, K. U. 1957a. A revision of the genus Lindsaea in the New World with notes on allied genera. Acta Bot. Neerl. 6: 97—290.

—— 1957b. A new genus of Lindsaeoid ferns. Acta Bot. Neerl. 6: 599—601.

—— 1967. The Lindsaeoid ferns of the Old World. I. New Caledonia. Acta Bot. Neerl. 15: 562—584.

—— 1968. Id. II. A revision of Tapeinidium. Blumea 15: 545—556.

KURITA, S. & M. NISHIDA. 1963. Cytotaxonomy of Japanese Sphenomeris. J. Jap. Bot. 38: 4—7.

MANTON, I., & W. A. SLEDGE. 1954. Observations on the cytology and taxonomy of the Pteridophyte flora of Ceylon. Philos. Trans. Roy. Soc. London Ser. B 238 (no. 654): 127—185.

PICHI-SERMOLLI, R. E. G. 1953. The publication date of Fée's 'Genera Filicum'. Webbia 9: 361—366.

—— 1966. Adumbratio Florae Aethiopicae, 13. Hemionitidaceae. Webbia 21: 487—505.

TARDIEU-BLOT, M. 1956. Sur les Lindsayoideae malgaches avec description de deux genres nouveaux. Mém. Inst. Sci. Madag. Sér. B., VII: 33—39.

—— 1958. Polypodiacées (5,1 Dennstaedtiacées — 5,10 Aspidiacées), in: H. Humbert, Flore de Madagascar et des Comores. Paris.