THE GENUS LOMAGRAMMA

By R. E. Holttum

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1. HISTORICAL

Among the curious groups of climbing ferns of the Eastern tropics, Lomagramma seems to have attracted little attention, and there is no general account of the genus, chiefly perhaps owing to the inadequacy of collections. The various species, as indicated below, have been described by various authors at different times, and in many cases descriptions are very incomplete, so that a comparison based on published descriptions is quite impossible.

My interest in this genus was aroused when I undertook the study of Stenochlæna and the genera confused with it, all of them climbing ferns of similar habit to Lomagramma. I studied these ferns in the field in many places in the Malay Peninsula, and became also acquainted with all the stages of the life history of the two Peninsula species of Lomagramma. I then realised that these climbing ferns (except Stenochlæna proper) have two distinct leaf-forms, produced in response to the two different environments occupied by the plants: the moist shady lower levels of the forest, and the lighter and more airy upper regions reached by the climbing stems. This distinction has not been fully appreciated by most authors, and the low-level fronds have usually been ignored, or regarded as "abnomal". These fronds clearly play an important part in the life of the plants; they have distinctive characters and are important diagnostically. Having discovered these facts by observation of the local species, I feel that I am perhaps in a better position than others to deal with this genus, and have accordingly attempted to piece together an account of it, based upon the available specimens.

The genus Lomagramma was founded by John Smith in 1841 (*Journ. Bot.* 3 : 402). He cited the species *L. pteroides*,

which he based upon Cuming's no. 223, collected in the island of Luzon, and his description is as follows:—

> The single species upon which this genus is founded has the habit of Stenochlæna, but differs in the venation being reticulate. It is distinct in habit from the following, and in the sporangia forming a broad marginal line or sorus; and therefore in that respect partaking of the character of Lomaria, but differing in having reticulate veins, and being without a special indusium.

It is curious that the author should have happened to take as the type of his genus a species which is unique (so far as present knowledge goes) in having a marginal sorus instead of fully acrostichoid fertile pinnæ, and should have based the name of the new genus on that very character.

In his next paper (*l.c.* 4: 152), John Smith gave a further diagnosis of the genus, and added "presumably this fern may be the *Leptochilus lomarioides* of Blume, but his description is too brief to enable me to determine with certainty." The remark about Blume's description is correct. An examination of the types of both species, and of a number of other specimens, leads me to believe however that they are quite distinct; they differ constantly in various characters at all stages of their life history.

John Smith overlooked a yet earlier species, *Aspidium sorbifolium* Willd. This species, based on a young plant, was ignored by most later authors. Christensen in his *Index Filicum* doubtfully identified it with *Lomagramma polyphylla* Brack. Ching, examining the type in the Berlin herbarium, considered it to be identical with *Leptochilus lomarioides* Bl., but I give below reasons for believing him to be mistaken. In my opinion, *Aspidium sorbifolium* is one of the species *L. sumatrana, L. grosseserrata* and *L. Mathewii,* but I do not think it is at present possible to say which. Therefore I leave it as dubious species.

L. pteroides and *L. lomarioides* were lumped together by Hooker in *Species Filicum* under the name *Acrostichum Blumeanum* (*Chilolepton Blumeanum* Fée, based on specimens from Java). Hooker also included a specimen from Samoa, which I now describe as a new species *L. cordipinna.*

The next well founded species was *L. polyphylla* Brack. (1854), a very remarkable outlier in Fiji, having bipinnate fronds. Twenty years later Baker described another peculiar species from the same region, *L. cultrata* (Solomon Islands), having deeply lobed pinnæ, both sterile and fertile; this still remains known only from the original collection.

Beddome came next with *Lomagramma perakensis* (1892), a very distinct species from the mountains of the Malay Peninsula. Copeland distinguished the Bornean *L. Brooksii* in 1908; but he appears to have misunderstood the Philippine species in making two new varieties of L. pteroides the same year. Van Alderwerelt van Rosenburg, recognising for the first time that

there were two species of the genus in Java, described *L. abscondita* in 1922; unfortunately he omitted to examine the type of *L. lomarioides,* and the type of *L. abscondita* is identical with *L. lomariodes,* so that the second Java species still lacked a name. Van Alderwerelt described also *L. sumatrana* in the same year; this species occurs also in the Malay Peninsula.

In 1920 Brause described *L. novoguineensis,* a very distinct species from New Guinea. Two years later, Christensen described *L. sinuata,* from a specimen from Celebes; this species is in my opinion represented also in Borneo, East Java, and New Guinea, and our knowledge of it is increased by a recent collection from Java, including bathyphylls, kindly sent to me by Dr. Posthumus. *L. melanolepis* was described by van Alderwerelt from Ternate in 1922; it is probably closely allied to *L. sinuata.*

In 1930 Ching described *Campium Matthewii* from south China. The specimens were clearly bathyphylls of a Lomagramma. Ching subsequently recognised the genus, and regarded the species as identical with *Aspidium sorbifolium* Willd. This however appears doubtful, and I am still in doubt about assigning acrophylls to *L. Mathewii.*

Among the specimens I have examined, there are in my opinion four additional species which I here describe as new: *L. Copelandii,* a common Philippine species which has hitherto not been clearly distinguished from *L. pteroides; L. Merrillii,* an interesting small species from Mindanao; *L. cordipinna* from Samoa; and *L. grosseserrata* from Siam. The lowland species from Java remains unnamed, as it may prove to be identical with one of the species already described. It is likely that there are other distinct bipinnate species in Fiji and neighbouring island groups.

Among the specimens also are several which cannot definitely be assigned to any of the known species, but which are not adequate to serve as types for new species. It is possible that some of them represent bathyphylls of known species, but there are no definite connecting links. A list of these specimens is given at the end of this paper; they are from Celebes, Luzon, New Guinea, and Tahiti.

Ching has included in the the genus a species from South America, *Leptochilus guianensis* (Aubl.) C. Chr. I give elsewhere in this paper my reasons for excluding this species from Lomagramma, which thus appears as a genus extending from Assam and southern China through the Malayan region to the Pacific. Within this region occur also other species which have by some authors been regarded as belonging to Lomagramma but are here excluded, namely *Polybotrya Wilkesiana* Brack. and its allies; these I regard as allied to Teratophyllum.

2. BIOLOGY AND MORPHOLOGY

The species of Lomagramma are very interesting biologically. They are climbing plants, starting life (in all recorded cases) on rocks beside streams in shady forest, and later climbing high up large trees. As with some other climbing plants, the fronds they hear in their low creeping condition are different from those borne by the high-climbing stems. In an account of Teratophyllum, I proposed the name *bathyphylls* for the fronds produced in the low levels of the forest. A term is also needed for the high-level fronds; these will be called *acrophylls,* a term suggested to me by Dr. Christensen. There is sometimes more or less of a transition between the two, and there is a further difficulty that the bathyphylls are not all similar, those borne by the very young plants naturally being smaller than those produced later. There is however a real distinction between the two. A plant may go on creeping on the rocks for a considerable period with a quite slender rhizome and fronds which do not increase beyond a certain size. When it starts to climb a tree, the rhizome increases very quickly to a much greater thickness, and bears the much larger acrophylls. The production of fertile fronds appears in most species to be rather infrequent, or possibly seasonal; at least in the Malay Peninsula, where we have relatively slight seasonal change, fertile fronds have rarely been found. Probably, as in Stenochlæna and other ferns, the fertile fronds are produced during dry seasons. I once found fertile fronds of *L. sumatrana* on a plant which had been suddenly exposed by the fall of a neighbouring tree; this may have had a similar effect to that of a dry season. The spores are very thin-walled, without perispore. They appear unlikely to be able to withstand dessication, and the character may be connected with the streamside habitat of the plants.

The acrophylls of all species except *L. polyphylla,* and *L. cultrata* are simply pinnate with almost entire pinnæ. They are thus all very similar, differing in rather small characters, and some not very easily distinguishable. On the other hand, the bathyphylls are usually much more distinct, and from my field observations of the Peninsula species, and herbarium study of the large number of bathyphylls of the unnamed Java species which I have received from Buitenzorg and Pasoercean, I am convinced that the bathyphyll characters are good and constant. It is of course necessary to compare bathyphylls of similar size.

This state of affairs is almost exactly paralleled in Teratophyllum, and as in Teratophyllum, the earliest stages of growth, bearing immature fronds, are often quite distinctive. Full-size bathyphylls have usually all the pinnæ articulated; but in some species the earlier fronds, of smaller size, have the apex not articulated, but consisting of a narrow lobed lamina continuous with the rachis and different from the lateral pinnæ. I believe this character to be a good one; it certainly is so in the Peninsula

species, which are the only ones of which I have examined all stages in the field. The larger bathyphylls have pinnæ which are characteristic in number and spacing, size and shape, characters of base, margins, apex, texture and venation. The marginal teeth are more pronounced than in the acrophylls. I have not seen bathyphylls of all species; and in some cases, where bathyphylls have been collected separately, I am uncertain to which species they should be ascribed. I have not described them definitely unless I am sure of their species.

3. ESSENTIAL CHARACTERS OF THE GENUS

The essential characters which are common to all species of the genus are as follows :

Rhizome dorsiventral, when creeping slender, when climbing much stouter; the vascular system in section a single ring with several leaf-gaps, the ventral vascular strand (bearing the roots) double; fronds rather distant, especially on the creeping rhizome; surface with several longitudinal ridges, with grooves between them. The ridges are pale in colour in the living rhizome. They are decurrent continuations of the bands of aerating tissue on either side of the stipe; beneath them are gaps in the cortical sclerenchyma.

Scales abundant on younger parts of rhizome, and on young stipes, rachis and lamina, all similar in structure but differing in size according to their position; the base of the scales (especially the smaller ones) more or less bullate, the apex narrowed and sometimes acuminate, the cells usually translucent, with thin dark lateral walls; occasionally some of the larger rhizome scales not translucent (*L. sinuata* and *L. melanolepis*).

Stipes with an open ring of vascular strands, to at least 18 in number.

Rachis with anatomy as stipe; more or less winged towards the apex, the wing sometimes almost absent in the largest fronds, and often present throughout the rachis in the smallest.

Sterile pinnæ all articulated to the rachis (except the apex of small fronds of some species); the base rather unequal; the margins more or less toothed; venation without any main lateral veins, consisting of several series of areoles, the costal ones usually largest, without free veins (except sometimes at the margin).

Fertile pinnæ articulated, usually much narrower than the sterile; the lower surface, except for the midrib, entirely covered with sporangia (except in *L. pteroides* where the sporangia are confined to marginal bands towards the base of the pinnæ), the sporangia when young accompanied by peltate paraphyses of the same structure as the scales; the venation as in the sterile pinnæ but the areoles smaller, usually clearly visible on the upper surface.

Spores thin-walled, without perispore or tubercles, usually quite transparent.

The most distinctive of these characters are the scales, the venation, and the spores.

4. DISTRIBUTION AND STATUS OF SPECIES

So far as I can understand, no one species of Lomagramma is very widely distributed geographically as compared with the others. Our knowledge of the geographical distribution may be summarised as follows:

ASSAM, TONKIN & S. CHINA. L. Matthewii.
SIAM. L. grosseserrata.
MALAY PENINSULA & SUMATRA. L. perakensis, L. sumatrana (L. lomarioides in S. Sumatra).
JAVA. L. lomarioides, L. sp., L. sinuata.
TERNATE. L. melanolepis.
BORNEO. L. Brooksii, L. sinuata
CELEBES. L. sinuata.
NEW GUINEA. L. sinuata, L. novoguineensis.
PHILIPPINES. L. pteroides, L. Copelandii, L. Merrillii.
SOLOMON ISLANDS. L. cultrata.
NEW HEBRIDES. L. polyphylla?
FIJI. L. polyphylla, L. cordipinna.
TONGA. L. polyphylla?
SAMOA. L. cordipinna.
TAHITI. Species unidentified, new?

It is evident that much still remains to be discovered regarding these species, especially as regards their distribution. Collections are on the whole meagre, no doubt due to collectors being discouraged from collecting sterile materia[1]. Sterile fronds of Lomagramma (bathyphylls and acrophylls) would usually enable a species to be determined, and would be invaluable as indications of the distribution of the species, and of the constancy or otherwise of characters of the bathyphylls. They would also give definite correlation between the bathyphylls and acrophylls, which is lacking or doubtful in some species.

The species of Lomagramma are certainly closely allied together but I believe that they are distinct, and that sufficient material is available for an account such as the present paper to be of value. It is clear however that to characterise the species fully a description of all stages of their development is necessary. Some species are most easily distinguished in their young stages

or bathyphylls, some in their sterile acrophylls, and some in the fertile fronds. Therefore we shall not have a full understanding of the genus until we know all species in all stages, and we are still very far from this. For the same reason I find it very difficult to construct a key to the species.

Here is one of the many cases in which field observation is essential to supplement herbarium study, and if this paper should reach any persons who may be in a position to undertake such field study, or to instruct collectors, I would appeal to them to bear in mind the case of Lomagramma.

5. EXCLUDED SPECIES

L. guianensis (Aubl.) Ching, Amer. Fern Journ. 22 : 17. 1932.

Leptochilus (Aublet) C. Chr. Index, cum syn.

I examined a specimen of this species at the British Museum. The spores have a large perispore, which I have never found in any species of Lomagramma. Further, the apical pinna is not articulated, but is continuous with the rachis. The venation is connected to typical Bolbitis venation by *Bolbitis serrata,* which has the pinnæ not articulated. In the British Museum Herbarium is also a specimen from Mexico (C. A. Purpus no. 7246); labelled *Leptochilus Turckheimii* C. Chr.; this has main lateral veins as in Bolbitis, but pinnæ articulate. It is evident therefore that the American Bolbitis species have produced a number of variants from the typical condition both in venation and articulation of pinnæ, and I suggest that *Lomagramma guianensis* (Aubl.) Ching is only a rather unusually aberrant species of Bolbitis which simulates the condition found normally in Lomagramma.

Lomagramma Wilkesiana (Brack.) Copel. Phil. Journ. Sci. 3C : 32. 1908.

L. articulata (J. Sm.) Copel. l.c. *L. bipinnata* Copel. Phil. Journ. Sci. 11C: 114. 1916. These three species, and perhaps also *Lomariopsis Balansæ* Fourn. (Ann. Sci. Nat. V, 18 : 271. 1873), evidently all belong to the same genus, but I do not think that they are members of the genus Lomagramma. They have spores with perispore, and their venation is that of Teratophyllum, not Lomagramma. I have not yet been able to examine sufficient material of the species to understand them well enough to found a new genus for them, but I believe that this should be done when the material is forthcoming. The species are in my opinion closely allied to Teratophyllum and could possibly be included in that genus; to do this would necessitate an emendation in the definition of the genus which I gave in this Bulletin, Vol. 5, p. 277, a new section being constituted for the species under consideration.

6. KEYS

Owing to the fact that the species of Lomagramma in some cases differ most strikingly from each other in one only of the three leaf-forms, and also to the fact that in a few cases bathyphylls are still unknown, it is hardly possible to make a satisfactory key. It appears to me more useful to summarise briefly the distinctive characters of the various species under the headings bathyphylls, sterile acrophylls, and fertile fronds; whichever frond-type is then available, this summary should at least locate it within a small group of species, the detailed descriptions of which will provide further information.

BATHYPHYLLS

Pinnæ of largest fronds 25–30–jugate; apex of frond continuous with rachis, except in some of the largest fronds.
- pinnæ entire ... ... *L. lomarioides*
- pinnæ toothed
  - pinnæ to about 2.5 cm. long, drying reddish ... ... *L. pteroides*
  - pinnæ to 5 cm. or more long, not reddish when dry ... ... *L. grosseserrata*, *L. Matthewii*, *L. sumatrana*

Pinnæ of largest fronds 10–18–jugate; apex of frond always an articulated pinna, except in young plants of some species
- pinnæ entire ... ... *L. perakensis*
- pinnæ toothed
  - margins shallowly lobed, lobes about 5 mm. wide, each with 2–4 teeth ... ... *L. Copelandii*, *L. sp.* (Java)
  - margins not lobed
    - upper base suddenly subtruncate from a narrow beginning; lower base very narrow; apex blunt ... ... *L. sinuata*
    - base unequally cuneate; edges sharply serrate; apex acute ... *L. Merrillii*
    - upper base broad subtruncate; lower narrow; edges toothed towards apex; apex in small fronds somewhat rounded ... *L. Brooksii*

Bathyphylls unknown in *L. cordipinna, L. cultrata, L. melanolepis, L. novo-guineensis;* incompletely known in *L. polyphylla.*

STERILE ACROPHYLLS

Bipinnate ... ... *L. polyphylla*

Pinnæ lobed to costa ... ... *L. cultrata*

Pinnæ at most shallowly lobed

Pinnæ, at least of old fronds, subcoriaceous, veins not distinct

Stipes 4 cm. long ... ... *L. Brooksii*

Stipes at least 15 cm. long

Pinnæ to 26 cm. long ... *L. perakensis*

Pinnæ not usually more than 12.5 cm. long

Pinnæ entire ... ... *L. lomarioides*

Pinnæ closely toothed towards apex ... ... *L. Merrillii*

Pinnæ thin in texture, the veins raised and distinct

Pinnæ with a winged stalk to 1 cm. long ... ... *L. sinuata*

Pinnæ hardly stalked

Base of pinnæ cordate, to 2.9 cm. wide ... ... *L. cordipinna*

Base of pinnæ at best subcordate, narrower

Edges deeply crenate-serrate *L. grosseserrata*

Edges not more than slightly toothed

Pinnæ to 11 by 1.3 cm. *L. novoguineensis*

Pinnæ larger, usually to 2 cm. wide

Pinnæ to 18 by 3 cm. edges not toothed *L. Copelandii*

Pinnæ smaller, edges slightly toothed ... *L. Matthewii*
L. melanolepis
L. sumatrana
L. sp. (Java)

FERTILE FRONDS

Fronds bipinnate ... ... *L. polyphylla*

Pinnæ lobed to costa ... ... *L. cultrata*

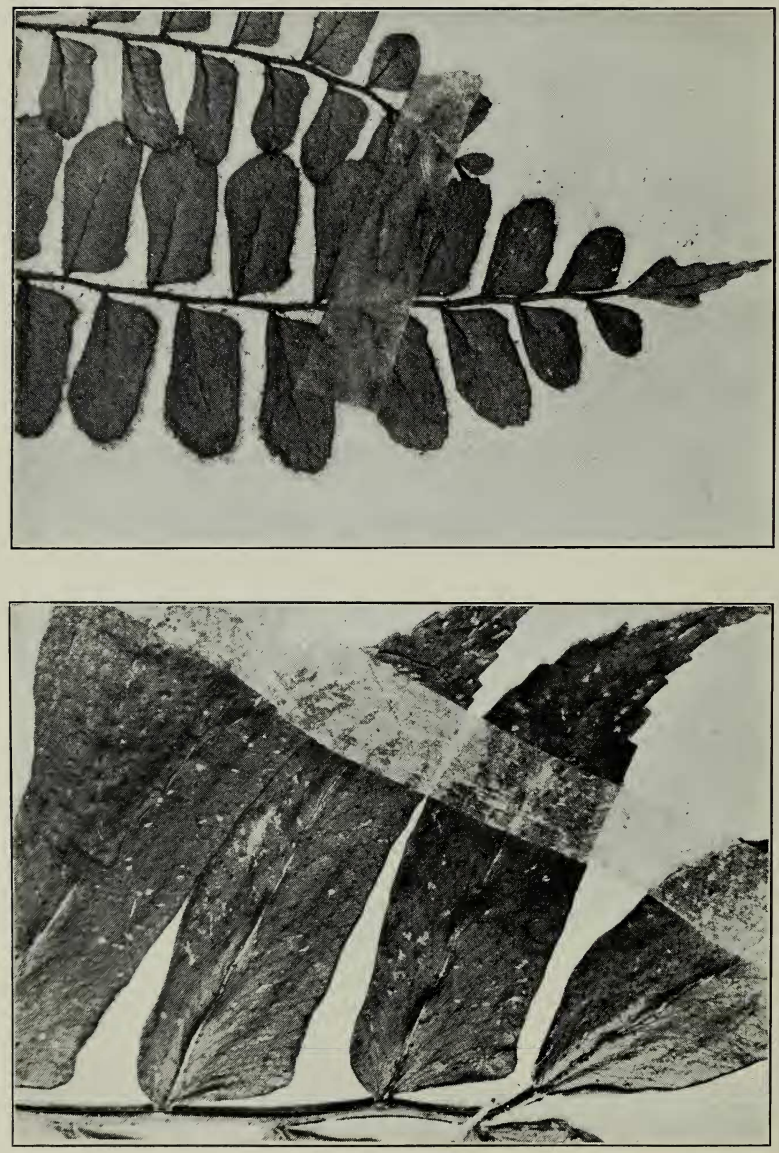
Pinnæ entire

Base of pinnæ always dilated, fertile at the edges only ... ... *L. pteroides*

Base of pinnæ not dilated, whole lower surface soriferous

Widest pinnæ 8 mm. or more wide

Pinnæ about 4.5 cm. long, apex rounded ... ... *L novoguineensis*



Lomagramma borneensis. Above: apex of bathyphyll from young plant (Penrissen, Shelford). Below: apex of full-sized bathyphyll, showing articulated pinna (Holttum 25251). Both x 1.5.

Pinnæ usually not less than 10 cm. long, apex acute ...	*L. cordipinna* *L. grosseserrata* *L. Matthewii* *L. sinuata*
Widest pinnæ to 5 mm. wide	
Pinnæ with stalks at least 3 mm. long	
Pinnæ about 9 cm. long ...	*L. Merrillii*
Pinnæ at least 15 cm. long	*L. perakensis*
Pinnæ almost sessile	
Pinnæ 1–2 mm. wide when dry	*L. lomarioides*
Pinnæ mostly wider ...	*L. Brooksii* *L. Copelandii* *L. melanolepis* *L. sumatrana*

7. DESCRIPTION OF THE SPECIES

In the following pages I have usually given the original description of the species, with an amplified description of my own, based on all material which I have examined. Critical remarks and notes on the diagnostic characters are also included.

For permission to examine specimens, and for loan of material, I am indebted to the heads of the following Herbaria: Buitenzorg (B), Manila (M), U.S. National Herbarium, Washington (W), Kew (K), British Museum (B.M.), Calcutta (C), Pasœrœan (Pas.). The herbaria are referred to by the initials in brackets after the citation of specimens; Singapore herbarium is indicated by the letter S. I am also indebted to Prof. H. J. Lam for the loan of the type of *Leptochilus lomarioides* Bl. and to Dr. L. Diels for a photograph of the type of *Aspidium sorbifolium* Willd.

Lomagramma Brooksii Copel. Phil. Journ. Sci. **3c:** 345. 1908. Also l.c. **7c:** 60. 1912. **Plate 8.**

Rhizomate alte scandente, stipiteque 4 cm. longo paleaceis; rhachi deorsum paleacea, sursum fere glabra et anguste alata; pinnis sterilibus ca. 8 cm. longis, 15 mm. latis, fere integris, coriaceis, nisi ad costas glabris, basibus truncatis, apicibus falcatis breviter acuminatis, venulis immersis, areolis costalibus parvis, lamina viride, venulis infra rubellis; pinnis fertilibus plus falcatis, ca. 3 mm. latis, basibus dilatatis non auriculatis.

Sarawak, Bongo Mountain, leg. Hewitt and Brooks.

Near *L. pteroides* var. *subcoriacea* and *L. perakensis* Bedd. In the specimen sent me the pinnæ are sterile throughout the most of the frond, the apical ones being fertile. The occurrence of sterile and fertile pinnæ on the same frond is hitherto unknown in the genus. It is possibly abnormal in this case, but I believe the species is sufficiently distinct without this character.

In the latter publication above cited Copeland writes: Mr. BROOKS has sent me a very complete specimen, collected at Bau. It has the fertile and sterile fronds distinct, as in other species of the genus. The frond of a juvenile plant "which germinates on the limestone and may grow in large masses before reaching a trunk, and becoming scandent", has membranaceous, serrate, and very oblique pinnæ. Fronds of adult plants are as described, except in size. The sterile fronds are a meter or more long and 30 cm. wide. The fertile frond is still wider, its pinnæ 2 to 4 mm. wide, and straight or curved.

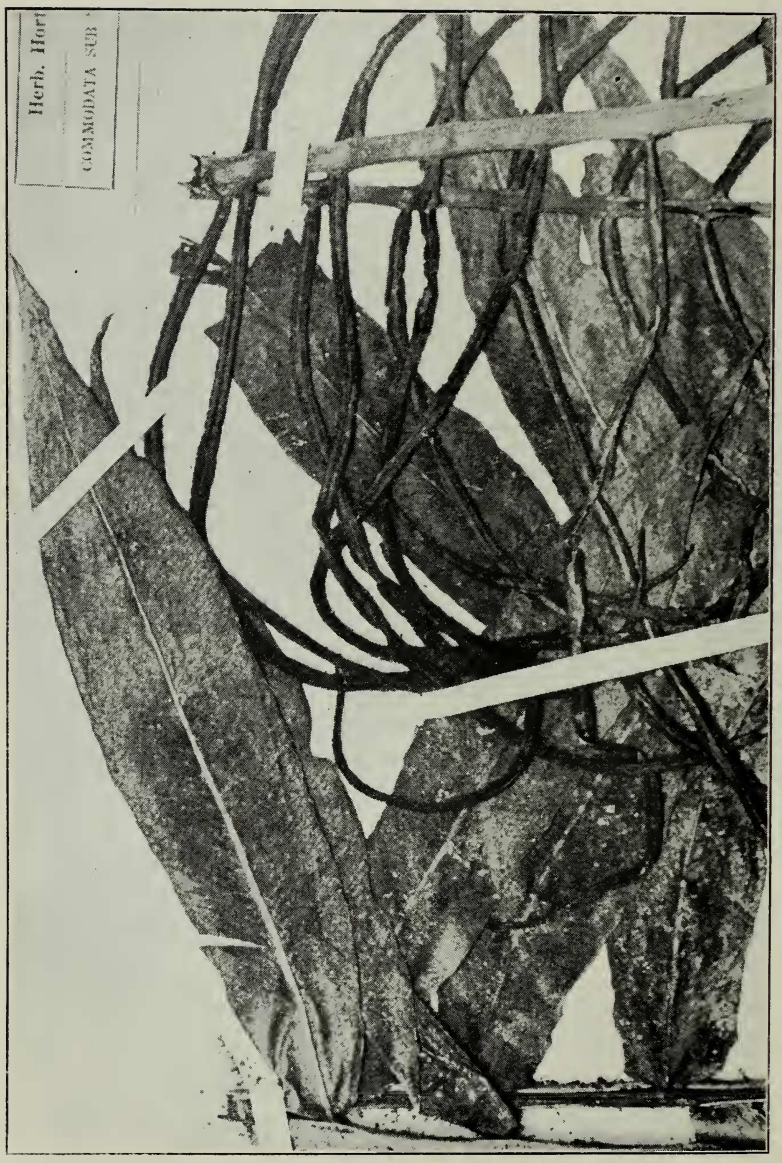
The species is nearest to *Lomagramma perakensis* Bedd, differing conspicuously in the very short stipes and persistent scaliness.

I have not seen the type of this species, but I have seen a considerable number of other specimens from Borneo which clearly belong to one species and agree pretty well with Copeland's description, except that I have seen none so large as indicated by Copeland's note of 1922 and I would not describe the pinnæ of bathyphylls as very oblique. The following description is based on specimens examined by me.

Immature Bathyphylls. Stipes to about 10 cm, fronds up to about 20 cm. long and 7 cm. wide with 12–15 pairs of pinnæ; apex continuous with the rachis; the lower pinnæ at right angles to the rachis, the upper oblique; pinnæ close, largest usually about 4.5 cm. long and 1.5 cm. wide; the upper base broad subtruncate, sometimes slightly auricled; lower base very narrowly cuneate or narrowly rounded in lowest pinnæ; midrib fulcate towards apex; edges toothed towards apex only, apex rounded in youngest plants, usually acute in older ones, width greatest about one third from apex. Texture thin; veins distinct and slightly raised on both surfaces, in 2–3 series of areoles, costal areoles not much larger than others.

Largest bathyphylls. Stipes to 10 cm. lamina to 40 cm. long and 12 cm. wide, pinnæ to at least 18 pairs, uppermost pinna articulate and like the others, largest pinnæ about 6 cm. long and 2 cm. broad, lower base rounded, much narrower than subtruncate upper base, margins toothed towards falcate acute apex.

Sterile acrophylls. Stipes usually about 4 cm. long. Fronds (Copeland's specimen to 1 m. long and 30 cm. wide; largest specimen below cited 75 by 20 cm. Largest pinnæ in middle third of frond, upper and lower gradually reduced. Middle pinnæ at right angles to rachis, to about 2 cm. wide, sessile, lower base a little narrower than the upper, and coming closer to the rachis, rounded to subcordate; upper base subtruncate; edges entire, sometimes wavy especially towards apex, but not toothed; apex acute, gradually narrowed from widest part of the pinna which is usually one third from apex. Texture thin but very firm; veins in three series of areoles, slightly raised and usually quite distinct on both surfaces. The lowest pinnæ usually slightly stalked, the base equal and subcordate.



Lomagramma Copelandii, Type, showing the sessile narrow fertile pinnæ, with base not dilated. 2/3 nat. size.

Fertile fronds. In the specimen seen by Copeland these are more than 30 cm. wide, the pinnæ 2–4 mm. wide. The only fertile fronds seen by me are those of Clemens from Penibukan, Kinabalu; these have stipes to 10 cm. long, and lamina to about 30 cm. long and 10 cm. wide. The pinnæ are up to 7 cm. long by 2 mm. wide, on winged stalks 2 mm. long; the veins usually distinct, the costal areoles elongate, the others almost round.

BORNEO. Kinabalu: Tenompok, 5,000 ft., Clemens 28638 (B); near Dallas, 3,500 ft., S.F.N. 25251, Holttum (S); Penibukan 4,000 ft., Clemens 30636 (M), 5,500 ft. Clemens 50263 (M). Exp. Nieuwenhuis, Jaheri 574 (B). N. Borneo Grens Comm. Amjah 517 (B), 525 (B), 417 (B), 585 (B). Penrissen, Sarawak, Shelford, s.n. 1899 (S, very young).

CELEBES. Menado, afd. Donggala, Kœlawi, 1000 m. Posthumus 2335 (Pas).

This species has been found in various parts of Borneo, and I believe also in N. Celebes; the Celebes specimen consists of rather large bathyphylls, which I cannot assign to any other species. The occurrence of the species in north Celebes, separated by a relatively narrow sea from B. N. Borneo, is not unlikely.

L. Brooksii (as here interpreted) is certainly similar to *L. perakensis* in its sterile acrophylls, differing in somewhat smaller pinnæ of rather thinner texture with more rounded base. The bathyphylls of the two species are very different, those of *L. perakensis* having quite entire pinnæ, the apical one articulate, from a very early stage.

Lomagramma Copelandii Holttum sp. nov. **Plates 9 & 10.**

L. pteroides auctt. p.p. non J. Sm.

L. pteroides var. *negrosensis* Copel. Leafl. Philip. Bot. II: 393. 1908.

A L. pteroidei differt: pinnæ bathyphyllorum maximorum c. 15-jugatæ, ad 6.5 cm. longæ, 1.8. cm. latæ, apicales articulatæ; pinnæ acrophyllorum sterilium ad 18 cm. longæ, 3 cm. latæ, basi superne late cuneatæ inferne rotundatæ, textura tenues; pinnæ fertiles ad 20 cm. longæ, 4 mm. latæ, sessiles, basi non dilatatæ.

Bathyphylls. Stipes from 2 cm. long in fronds of 12 cm, to 18 cm. long in fronds of 40 cm. In fronds to about 15 cm. long apex a narrow lamina continuous with the rachis; in full-sized bathyphylls, apical pinna like others and articulated, but smallest. Bathyphyll pinnæ to about 15-jugate, largest seen 6.5 cm. long, 1.8 cm. wide; base unequal, upper broadly cuneate, lower narrower, rounded except in lowest (somewhat reduced and reflexed) pinnæ in which lower base is narrowly cuneate; edges broadly crenate (lobes to 5 mm.), each lobe with 2–4 short teeth, largest pinnæ toothed only towards apex; apex not falcate, acute in pinnæ of larger fronds, blunt in pinnæ of smaller

fronds; texture thin; veins slightly raised on both surfaces, areoles in two series, costal ones usually largest.

Sterile Acrophylls. Stipe 15–25 cm. long. Pinnæ to 18 cm. long, 3 cm. wide, sessile; upper base usually broadly cuneate to subtruncate, more narrowly cuneate in the upper pinnæ; lower base usually rounded; edges slightly undulate, not toothed; apex acuminate, hardly falcate.

Fertile pinnæ to about 20 cm. long, 4 mm. wide when dry, sessile, the base not dilated, whole lower surface except midrib soriferous, areoles long and narrow.

TYPE. Luzon: Mt. Binuang, Prov. Tayabas, Bur. Sci. no. 28826, Ramos and Edano, in Philippine National Herbarium (duplicate in Herb. Buitenzorg).

This species differs very strikingly from *L. pteroides* in the various characters mentioned in the latin diagnosis. The bathyphylls with their large broad pinnæ are very distinct, being nearest to those of the unnamed species from Java; the pinnæ of sterile acrophylls are very broad and thin in texture, never subcordate as is often the case in *L. pteroides;* the fertile pinnæ are never dilated and partly sterile at the base, and are practically sessile.

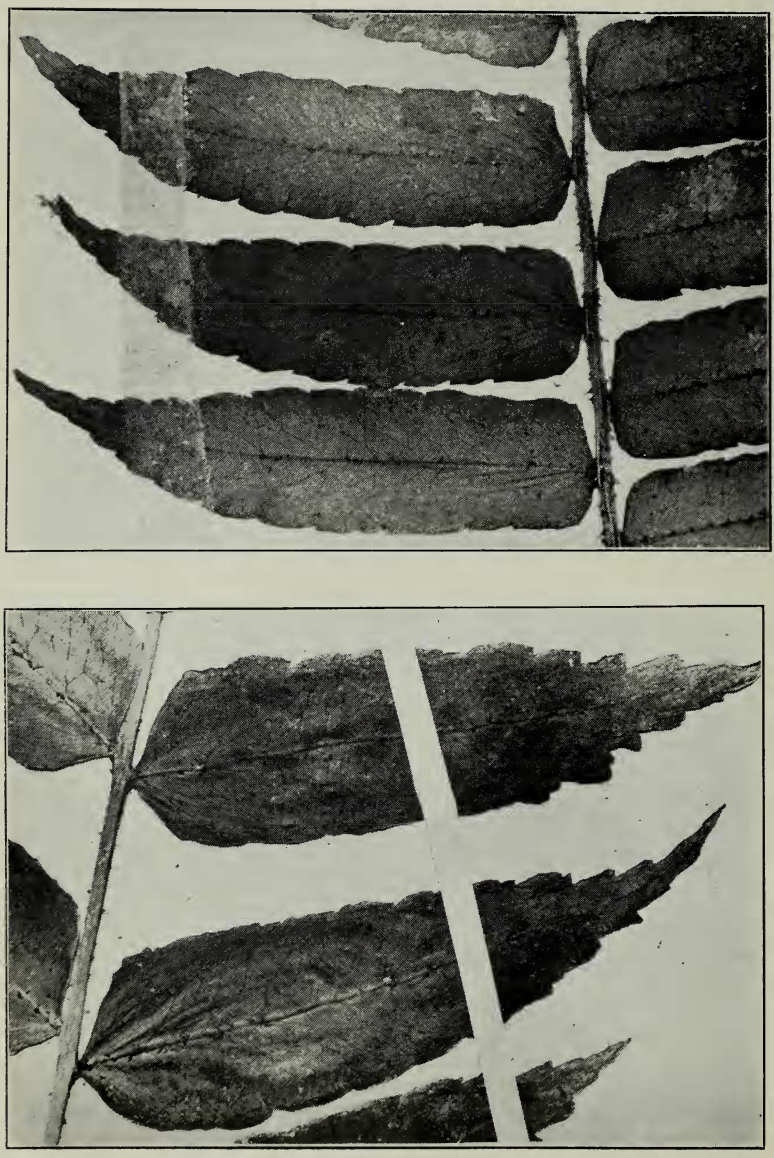
L. pteroides var. *negrosensis* seems to me to belong here, and probably consists of rather small plants of this species, perhaps from a shady place. The specimens show fronds on a rather slender rhizome, the pinnæ about intermediate in size between those of the largest bathyphylls and of the typical acrophylls, and somewhat toothed towards the apex.

L. Copelandii, like *L. pteroides,* is apparently distributed throughout the Philippine Islands. The specimens examined are as follows.

Luzon: Irosin (Mt. Bulusan), Prov. Sorzogon, Elmer 16919 (B, M.); Los Banos, Laguna, Copeland s.n. Mar. 16, 1906 (M, bathyphylls); Infanta, Tayabas Prov. Bur. Sci. no. 9331, C. B. Robinson (M, bathyphylls). *Catanduanes:* Bur. Sci. no. 30358, Ramos (B, M). *Samar:* Catubig River, Bur. Sci. no. 24810, Edano (M). *Bohol:* Bur. Sci. no. 42972, Ramos (M). *Mindanao:* Surigao Prov. Bur. Sci. no. 34816, Ramos and Pascasio (M); Mt. Apo, Cotabato Prov., Phil. Nat. Herb. no. 3244, Copeland (M); Camp Keithley, Lake Lanao, M. S. Clemens s.n. Sept. 1907. *Negros:* Dumaguete (Cuernos Mts), Prov. of Negros Oriental, Elmer 9678 (M, W, B; type of *L. pteroides* var *negrosensis*).

Lomagramma cordipinna Holttum sp. nov.

Bathyphylla ignota. Acrophylla sterilia ad 33 cm. lata; pinnæ mediæ 3.5–5 cm. inter se remotæ, breviter petiolulatæ, ad 17.5 cm. longæ et 2.9 cm. latæ, basi inæqualiter cordatæ vel subcordatæ, margine integræ vel leviter undulatæ, apice



Above: *Lomagramma grosseserrata,* pinnæ of bathyphyll.
Below: *L. Copelandii,* pinnæ of bathyphyll. Both x 1.5.

acuminatæ; textura tenues; venulæ prominentes, areolas 3–4 seriatas formantes; pinnæ apicales minores, basi rotundatæ apice leviter serratæ. *Pinnæ fertiles* petiolulatæ (petioluli ad 5 mm. longi), ad 12 cm. longæ et 1.1 cm. latæ, tota pagina soriferæ.

SAMOA. Pango-pango Bay, W. E. Safford, March 1888, U. S. National Herbarium (Type, 3 sheets). U. S. South Pacific Exploring Expedition 1838–42, s.n. (W).

FIJI. Korumbamba, July 1932, A. Meebold 16856 (B.M.)

This remarkable species is well represented by the fine collections of Safford. Though these include only the central and upper portions of the fronds of acrophylls, the pinnæ are so distinctive that there is no doubt of this being a good species. The cordate or subcordate base of the middle pinnæ, combined with the long-stalked and very broad fertile pinnæ (which are completely soriferous) are the peculiar features of the species.

Of the Fiji specimen, I have seen only a single pinna which I judge to be from the base of a frond; it is short and broad (8 cm. by 3.3 cm.) with almost equally subcordate base and rounded apex, the margins minutely irregularly crenulate towards the apex.

Lomagramma cultrata (Baker) Holttum comb. nov.

Acrostichum cultratum Bak. Syn. Fil. 524. 1874.

Baker's original description is as follows :

A. (*Chrysodium*) *cultratum* Baker; climbs on trees with fronds 6 ft. long; *barren pinnæ* ligulate, 6–8 in long, 1–1½ in broad, cut down to the rachis or a narrow wing into entire close blunt obovate lobes ⅜–½ in broad, cuneately narrowed to a broad base, or rarely produced and oblong, often several of the lower and sometimes the central lobes confluent; *texture* moderately firm; *surfaces* green, naked; *areolæ* small, exappendiculate; *fertile pinnæ* and lobes like those of the barren fronds, but the latter distant, 2–2½ lin. broad.

Hab. San Christobal, Solomon Isles, H. Richards, in Herb. Macleay.

The type sheet at Kew consists of pinnæ only. Most of the lobes are obovate, but some are almost evenly elliptical with a narrow base, almost like separate pinnules but not stalked nor articulate; these elliptical lobes vary in length. The fertile pinnæ are 10–12 mm. broad, the lobes almost circular and rather distant. The scales are typical of the genus, and the spores also.

This species is referred to *L. lomarioides* in Christensen's *Index Filicum*. It seems to me a very distinct and interesting species, a possible link between the pinnate and bipinnate species of the genus.

Lomagramma grosseserrata Holttum, sp. nov. **Plates 10 & 11.**

Species L. sumatrana affinis, differt pinnis acrophyllorum sterilum magnis, longe acuminatis, margine late crenato-serratis, pinnis fertilibus ad 1 cm. latis.

Bathyphylls. Stipes 8 cm. long (in the available specimen); lamina 40 cm. long, 10 cm. wide, lowest pinnæ slightly reduced, reflexed and more separated, upper six pairs gradually reduced; apex continuous with the rachis. Pinnæ 29 pairs, almost touching (except the lowest), largest 5 cm. long and 1.3 cm. wide, at right angles to the rachis, base only slightly unequal, upper base subtruncate, lower broadly rounded, apex slightly falcate acute, edges shallowly crenate-serrate, the teeth 4–5 mm. apart; texture thin translucent; venation in 2–3 series of areoles, the costal ones largest, the veins distinctly raised; scales with bullate base numerous.

Sterile acrophylls. Stipe to at least 20 cm. long. Pinnæ about 3 cm. apart, to about 19 cm. long and 2.5 cm. wide, sessile, the upper base broadly cuneate, the lower rather broadly rounded, margins rather deeply crenate-serrate, especially towards the apex, at intervals of 5–7 mm, the distal third gradually long-acuminate; colour dark dreen when dry; texture thin; veins slender, raised, brown on both surfaces, in about 3 series of areoles; scales numerous.

Fertile fronds. Stipe 18 cm. long. Lower pinnæ on stalks to 5 mm. long, pinnæ to 20 cm. long and 1 cm. wide, the upper pinnæ gradually more shortly stalked and smaller (in the specimen at hand the upper pinnæ are incompletely expanded); colour dark; veins distinct on the upper surface, in about 3 series of areoles, areoles more or less rounded except the costal ones; sporangia covering the whole lower surface except the midrib.

TYPE. Siam: Præ, Me Sai, 620–880 m. Winit no. 1019 (27-11-22), in Herb. Singapore.

This species is clearly allied to *L. sumatrana* and *L. Matthewii,* but it differs in the points mentioned in the diagnosis so strikingly that I cannot but consider it distinct. The bathyphylls are similar to those of the other species mentioned, but they differ from those of *L. sumatrana* in their greater length, and from those of *L. Matthewii* in the greater number of pinnæ, very regular and closely placed. As regards the apex of the bathyphylls, the specimens at hand has indications of articulation, but it is a very large bathyphyll, and I believe that smaller ones would have the apex clearly continuous with the rachis.

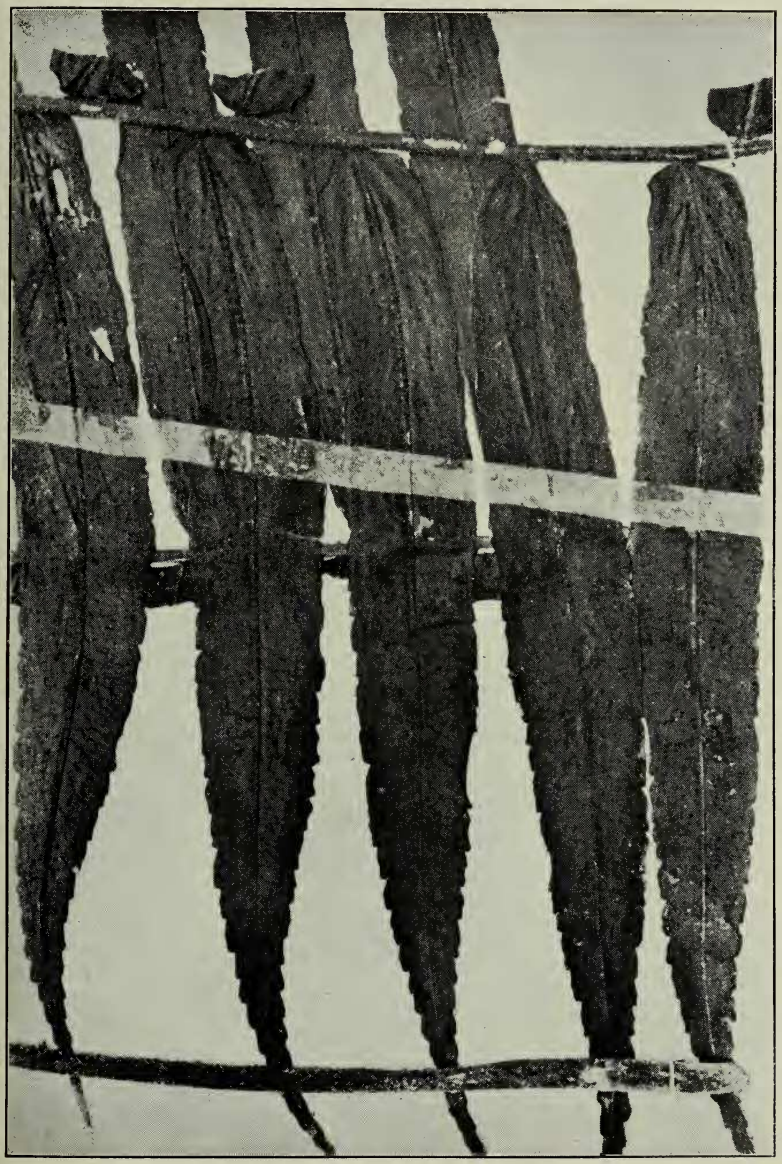
To this species should probably be referred the specimen cited by Beddome on p. 106 of the Supplement to his Handbook (Makum Forest, Lukhimpore, Assam). I have not seen this specimen.

Lomagramma lomarioides (Bl.) J. Sm. Hist. Fil. 143. 1875. **Plates 12 & 13.**

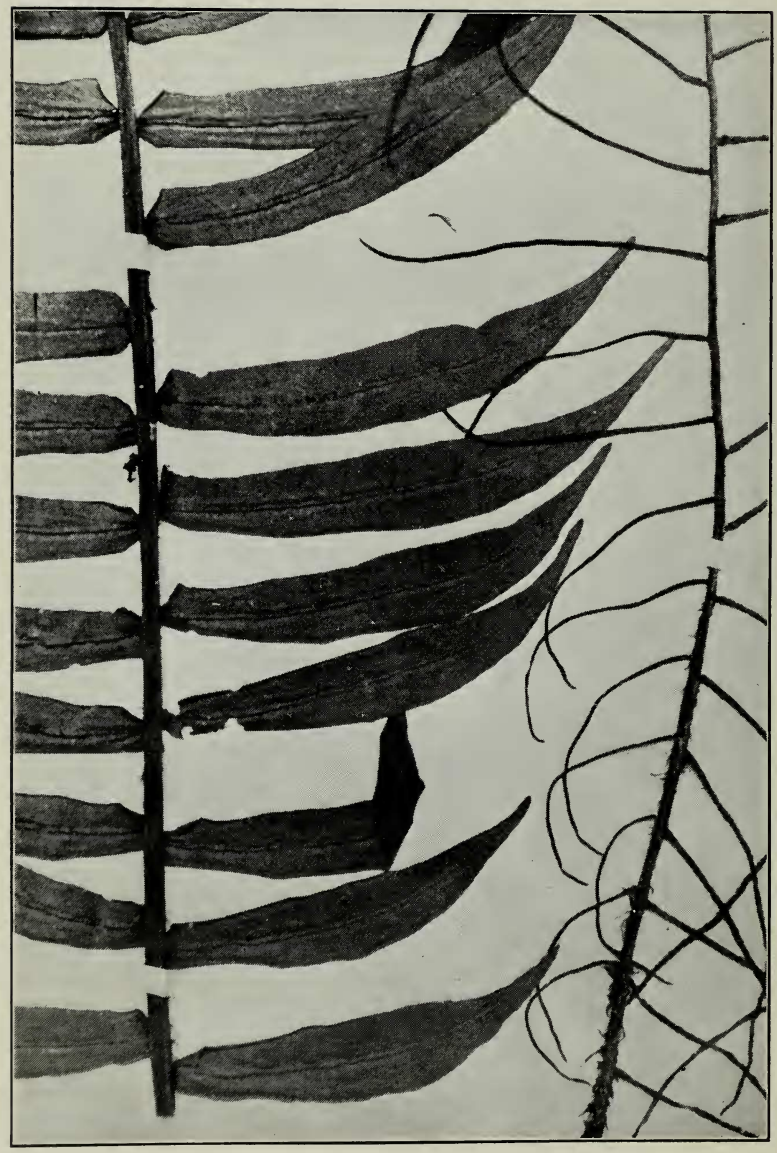
Leptochilus lomarioides Bl. Enum. 206. 1828.

Chilolepton Blumeanum Fée, Hist. Acrost. 89, t. 51. 1845.

Acrostichum Blumeanum Hk. Spec. Fil. **5:** 268. 1864. p.p.



Lomagramma grosseserrata, Type; sterile acrophyll. 3/4 nat. size.



Lomagramma lomarioides, specimen from Blume's herbarium, showing sterile and fertile acrophylls. 2/3 nat. size.

Lomagramma abscondita v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 16. 1913. *Ibid.* III ser. **2:** 159. 1920.

This species was described by Blume as follows:

"L. frondibus pinnatis, pinnis sterilibus lineari-lanceolatis, fertilibus angusto-linearibus elongatis stipite rachique paleaceis".

By the courtesy of the Director of the Rijksherbarium at Leiden, I have been able to examine Blume's specimens of this species. There are four sheets, one bearing the name in Blume's hand, the other three all clearly from one collection (perhaps the same collection as the type), and one of them labelled "Herb. Dr. Bl." Judging from the fact that Blume described the fertile pinnæ, which are not represented on the sheet actually bearing his writing, it seems probable that all four sheets were actually seen by him. In any case, they are quite certainly all of the same species, and they agree closely with the type *L. abscondita* v.A.v.R. and a number of other specimens from Java at Buitenzorg. I can therefore with confidence give a full description of the species, except that there are only three specimens which could be regarded as bathyphylls.

Bathyphylls. (description based on three collections from Tjibodas: Fleischer 276, Burck s.n., Palmer & Bryant 1190). Stipes to 15 cm. long, frond to 40 cm. long by 9 cm. wide; pinnæ to 25-jugate, the terminal ones articulate but smallest, with very narrow base. Middle pinnæ to about 5 cm. long and 1.0 cm. wide, the upper base broadly cuneate to subtruncate, the lower base narrowly rounded, edges quite entire, often slightly sinuate especially towards the apex, the apex falcate, acuminate. Texture firm, veins hardly visible on the upper surface, slightly prominent below, the areolæ rather small, usually in 2 rows. Palmer and Bryant's specimen from Salak represents a much younger stage, stipes 22 cm., frond 21 cm. pinnæ 16 pairs.

Sterile acrophylls. Young stipes and fronds very scaly, the scales thin and rather pale, mostly falling as the frond developes. Stipes to 20 cm. frond to 1 m. long and 20 cm. wide, the upper and lower pinnæ gradually reduced, the lowest only 5 cm. long, and more distant. Largest pinnæ to about 12.5 cm. long and 1.5 cm. wide, the upper base broadly cuneate to truncate, the lower base narrowly rounded, occasionally the upper base or both subauriculate. Pinnæ usually widest about the middle, apex gradually acuminate, falcate, the edges entire or undulate, often inrolled when dry. Texture of old fronds subcoriaceous, veins hardly visible on upper surface, usually somewhat raised below but rather broad. Blume's type has the veins more clearly visible than most of the other specimens; young fronds show the veins much more clearly than old ones.

Fertile fronds. Pinnæ sessile, to at least 18 cm. long, 1–2 mm. wide.

This species appears to be common on the mountains in the west of Java, and there are also specimens from east Java which I believe must also be referred to it, though they are not typical. The characteristic features are the narrow rather coriaceous pinnæ of the sterile acrophylls, the very narrow pinnæ of the fertile fronds, and the numerous narrow entire pinnæ of the bathyphylls. The sterile acrophylls are perhaps nearest to *L. Brooksii*, but *L. lomarioides* differs markedly from that species in the narrow fertile pinnæ and the narrow pinnæ of the bathyphylls.

TYPE: Java, Salak, Blume (Leiden).

Other specimens. Res. Preanger: G. Malang, Raciborski s.n. (B, M); G. Rasamala, Raciborski s.n. (B), Hallier s.n. (M); Tjibodas, Arsin 19624 (B), Burck s.n. (B), Bruggeman 438 (B), Palmer & Bryant 1190 (W), 212 (W), M. Fleischer 276 (M); Tjitibo, Tjidadap, Tjibeber, 1000 m., Bakuizen 2402 (B); Tjadas Malang, z.v. Tjibeber, 1000 m., Winckel 1699 (B); Mt. Salak 1000 m., Palmer & Bryant 550 (W), 557 (W); 700 m., 700 (W). *Res. Besoeki:* G. Idjen 1000 m., Posthumus 3774 (B); Weg *v.* Lidjen halfweg Kawah Idjen, 1025 m., Posthumus 378 (Pas); Mont. Tengger 1200 m., M. Buysman 108 (W).

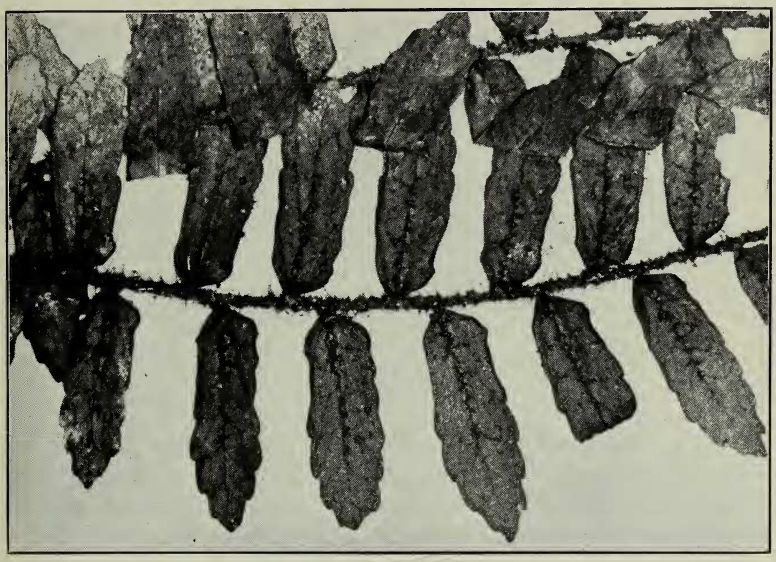
Lomagramma Matthewii (Ching) Holttum comb. nov.

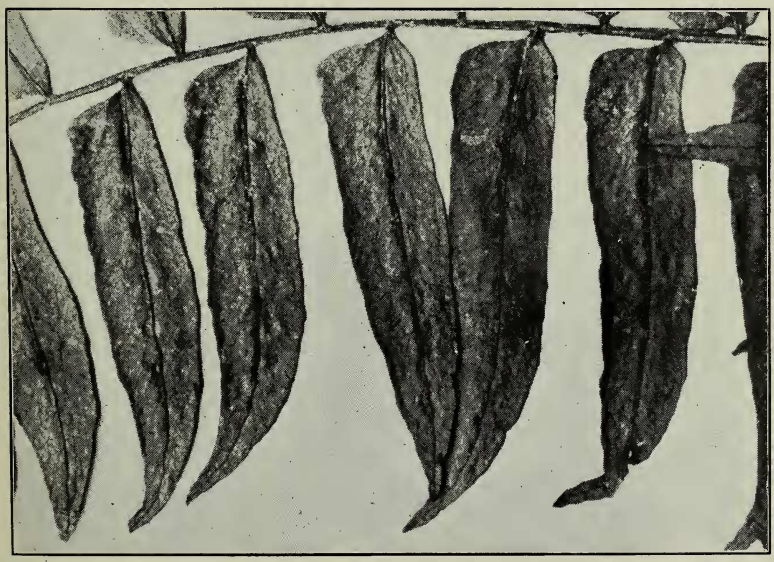
Campium Matthewii Ching, Bull. Fan. Mem. Inst. Biol. **1:** 158, fig. 3, 1930.

This species was based on a collection of large bathyphylls made by Dr. C. G. Matthew in Kwangtung. It was subsequently identified by Mr. Ching (Lingnan Sci Journ. **12:** 566. 1933) with *Aspidium sorbifolium* Willd. This identification however appears very doubtful, as explained under *Lomagramma sorbifolia* at the end of this paper.

I have seen Matthew's specimen in the Hong Kong herbarium, and judging from this and Mr. Ching's description I think it probable that certain specimens of bathyphylls from Assam are to be referred to this species. Also from Assam, and from Tonkin, are specimens of sterile acrophylls which are certainly not *L. grosseserrata* and perhaps belong to *L. Matthewii*. The only fertile frond which might be associated here is on the same sheet as one of the bathyphylls from Assam.

It is clear from the original collection of bathyphylls that *L. Matthewii* is closely related to *L. grosseserrata*, and in the absence of the quite distinct sterile acrophylls above mentioned, I should be inclined to include it with that species; these acrophylls show however that another species is present, but whether that species is *L. Matthewii* is another matter. The present collections are in fact inadequate for more than a tentative account of the species in the region between Assam and southern China to be given. I here quote the original description of *Campium Matthewii*, and add some notes about the other specimens which I think may belong to the species. It is just





Above: *Lomagramma pteroides,* a bathyphyll.
Below: *L. lomarioides,* a bathyphyll. Both x 1.5.

possible after all that the type of *Campium Matthewii* may represent bathyphylls of *L. grosseserrata.*

Campium Matthewii. Rhizome wide-creeping, naked, fleshy, light stramineous, terete, 5 mm. in diam.; stipes remote, pale green, 12–17 cm. long, terete below, deeply bisulcate throughout the rachis above, moderately paleaceous throughout the rachis, paleæ small, brown, membranaceous, lanceolate, acuminate; frond 35–50 cm. long, 10–13 cm. broad, linear oblong, slightly narrowed at base with the apex of rachis often lengthening out into a stout naked prolongation with proliferous tip, pinnate, pinnæ close, 20–27 on each side under the impari-terminal one, 7 cm. long, 1–1.5 cm. broad, gradually decrescent upwards, the uppermost ones 4 cm. or less long. sessile throughout, broadly linear-lanceolate, broadened downward, truncate or cuneato-truncate, acute, margin shallowly crenate above the base, texture thin papery, glabrous except the midrib which is sparsely scaly; venation distinct, main veins wanting, veinlets pauci-anastomosing in 2–3 rows of oblique irregular rhombic areolæ, of which the costal ones much the largest, extending to the half breadth of the pinnæ, all without included veinlets, the marginal areolæ mostly close, very rarely with excurrent free veinlets; fertile fronds not seen.

Distribution: Kwangtung: Lienchow, Dr. Matthew, No. 5108, Dec. 1907.

There is one curious point in the above description, namely "apex of rachis often lengthening out into a stout naked prolongation with proliferous tip". This I have not seen in any specimen of Lomagramma. The apex of the specimen of the type collection of *L. Matthewii* in the Hong Kong herbarium is missing, so that I am unable to verify the matter.

Bathyphylls of other collections. The following agree very well with Matthew's specimen, chiefly differing in the fact that the costal areoles are not so very much larger than the others.

ASSAM. Wallich, s.n. (C, from T. Moore's Fern Herbarium). Chima Forest, Garo Hills, 300 ft., Dec. 1890, Gustav Mann (W).

Sterile acrophylls. I have seen one good collection from Manipur (Meebold 6233, in Calcutta herbarium). This has pinnæ very like those of *L. sumatrana,* differing chiefly in the very broadly cuneate bases of the middle pinnæ. The pinnæ are up to about 12 cm. long and 2 cm. wide, margins entire except towards apex where they are rather sharply toothed.

There is another collection from Tonkin (Province de Hoa Binh, vers 500 m., Avril 1926, U.S. Nat. Herb.) with rather stout climbing rhizome, but the frond a rather intermediate one, having apex continuous with the rachis as in typical bathyphylls. It is in fact rather intermediate in character between the bathyphylls and acrophylls from Assam and Manipur above mentioned, and forms the strongest link connecting these specimens together.

Fertile fronds. Mann's specimen from Garo Hills, Assam, above cited, has part of a fertile frond, attached to a typical stout climbing rhizome, along with a large bathyphyll. The

fertile frond has a stipe 28 cm. long, and pinnæ to 16 cm. long and 8 mm. wide, on stalks 3 mm. long.

I am reasonably certain that the specimens above described from Assam, Manipur and Tonkin are one species, but I do not feel so sure that they are *L. Matthewii.* They are also rather near *L. sumatrana.* There the matter must be left until fresh collections are made.

Lomagramma melanolepis v.A.v.R. Bull. Jard. bot. Buitenz. ser. III, **5:** 212. 1922.

L. pteroideæ J. Sm. affinis.—Squamæ rhizomatis, stipitum, rhachidum costarumque sparsæ, nigræ vel obscure castaneæ. Frondes steriles c. 60 cm. longæ; rachis apicem versus anguste alata; ala ad basin pinnarum superiorum brevius vel longius dentiformi-auriculata. Pinnæ flaccidæ firmiter herbaceæ, subapproximatæ, sessiles, patentes, in sicco olivaceæ, supramedianæ maximæ, lineares, 12–13 cm. longæ, 1.75–2 cm. latæ, integerrimæ vel apice acuminato, recto vel subfalcato remote subserrulato-crenulatæ, basi obliquæ et plus minusve inæquilateræ, rotundatæ vel late rotundato-cuneatæ; venæ distinctæ, pallidæ (colore pinnarum). Frondes fertiles minores, usque as 40 cm. longæ, pinnis remotis, horizontalibus, contractis. Sori capsulis juvenilibus paraphysis longe stipitatis, peltatis copiose intermixtis.

Fertile frond of the specimen on hand still young, with the pinnæ 5 cm. long, 3 mm. broad.

TERNATE: Foramadjahi, in forest, 700 m. Beguin 1114 (B).

I have examined the type of this species. Like *L. sinuata,* it has narrow black scales on the rhizome and on the very young unexpanded fronds. Through an ordinary hand lens these scales appear black with irregular narrow paler margins. Through a microscope, the central cells are seen to have very thick black lateral walls, and the lumen is a brownish colour. The marginal cells have thin walls and some of them are elongated to give an irregularly fringed condition. The small scales on the frond are few; they are rather dark, but of typical bullate form and the cells normal.

The sterile pinnæ are hardly toothed, in which they agree with *L. sinuata;* but they are much smaller than the pinnæ of that species, and are sessile, lacking the peculiar basal characters. The fertile pinnæ are up to 4 mm. wide (not 3 mm. as stated in the description above quoted). They seem to be practically mature and are almost sessile.

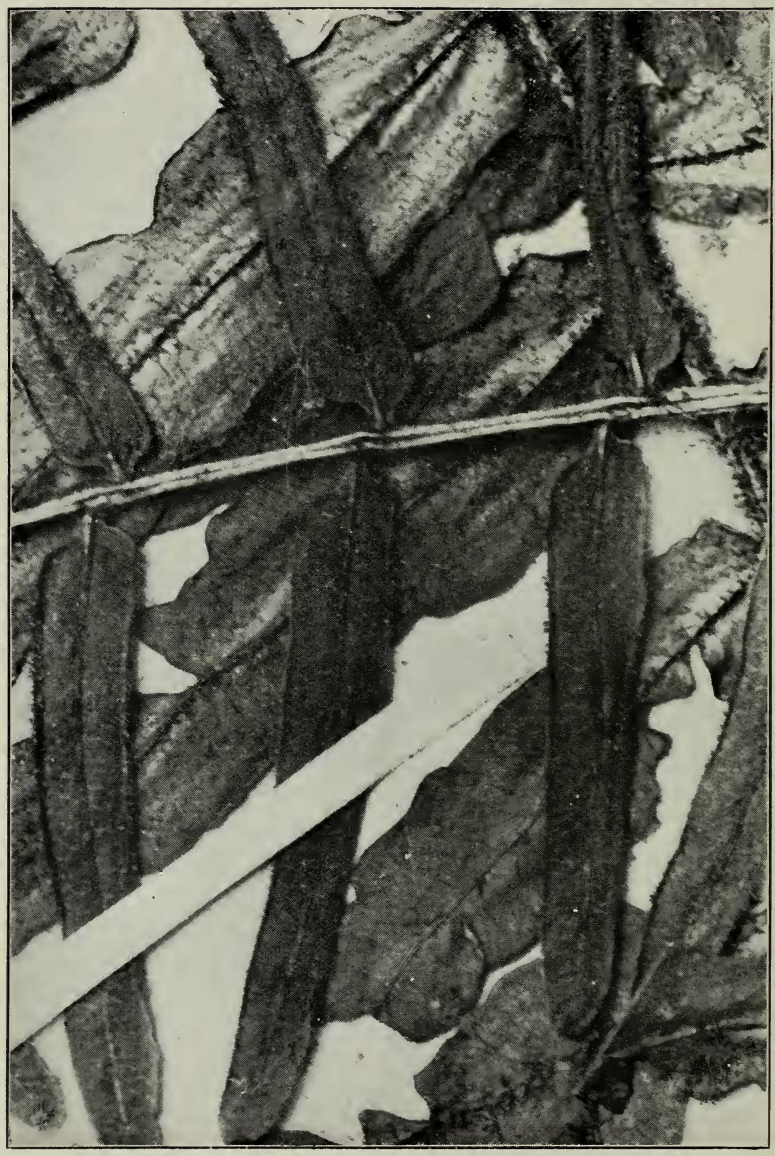
The distinctive characters therefore are the rhizome scales, the medium sized almost entire sessile sterile pinnæ and the subsessile short and relatively broad fertile pinnæ.

At Ternate, this species falls within the range of distribution of *L. sinuata* and is presumably a local derivative. Further collections may possibly show it to have a range of variation bridging the gap with *L. sinuata.*

Lomagramma Merrillii Holttum sp. nov. **Plate 14.**

Bathyphyllorum lamina 16 cm. longa, 4 cm. lata, pinnæ c. 10-jugatæ; pinnæ laterales maximæ, 3.5 cm. longæ, 1.2 cm.

Lomagramma Merrillii, Type. The fertile frond is incompletely expanded. Twice nat. size.



Lomagramma novoguineensis (Docters van Leeuwen 9616), showing the upper surface of the broad blunt fertile pinnæ. Twice nat. size.

latæ, basi supra late infra anguste cuneatæ, margine acute serratæ, apice acutæ; pinna apicalis 6 cm. longa, 1.4 cm. lata, acuminata; textura tenuis, venulæ infra elevatæ, supra haud elevatæ.

Acrophyllorum sterilium stipites ad 15 cm. longi, lamina ad 45 cm. longa et 15 cm. lata; pinnæ superiores maximæ, inferiores sensim reductæ, infimæ c. 4 cm. longæ, stipitatæ 3 mm.; pinnae maximæ 9 cm. longæ, 1.7 cm. latæ, basi superne late inferne anguste cuneatæ, apice acutæ, falcatæ, margine apicem versus irregulariter dense sæpe obtuse serratæ, (margines pallidæ cartilagineæ), textura subcoriaceæ, venulis inconspicuis areolas parvas formantes præditæ. *Pinnæ fertiles* stipitatæ 5 mm., ad 9 cm. longæ, 3 mm. latæ.

TYPE: Mindanao, Dist. Zamboanga, Merrill 8282 (M), "very damp shaded ravine, on trees climbing, at 400 m.".

Other specimens. Mindanao, Camp Keithley, Lake Lanao, M. S. Clemens s.n. May 1907, Sept.–Oct. 1907 (3 sheets, M).

Merrill's specimen is the only one showing bathyphylls, for which reason I take it as the type. His sterile acrophyll is thinner in texture and more toothed than those of Mrs. Clemens; *i.e.* it is nearer to the bathyphyll condition. I believe however that all represent the same species. It is a rather small species, and is characterised by the combination of characters: small narrow bathyphylls with large articulated apical pinnæ, subcoriaceous pinnæ of sterile acrophylls, fertile pinnæ with stalks 5 mm., the pinnæ of moderate length. A character which seems to be almost general is that the stipes and rachis are usually reddish when dry; some are however stramineous.

The species has so far only been found in the island of Mindanao. It is very different from the two other species occurring in that island, *L. pteroides* and *L. Copelandii.*

Lomagramma novoguineensis (Brause) C. Chr. Index Suppl. III, 124, 1934. **Plate 15.**

Leptochilus novoguineensis Brause, Engl. Jahrb. **56:** 117. 1920.

Rhizoma scandens, validum, 5–7 mm. crassum, radices numerosas 1.5–3 cm. longas, fusco-pilosas gerens paleisque fuscis, sublinearibus, acuminatis margine subintegris, ca. 7 mm. longis 0.7 mm. latis, dense instructum, folia dimorpha interstitiis ca. 20 cm. longis emittens. Foliorum sterilium petioli 7–9 cm. longi, 4–5 mm. crassi, supra sulcati infra teretes, untrinque paleis iis rhizomatis subæqualibus densissimis muniti; lamina coriacea, ca 62 cm. longa, 22 cm. lata, supra glabra infra paleolis bulbosis prædita, ambitu oblonga, basi vix angustata, ad apicem versus e media laminæ parte decrescens pinnaque terminali sublineari, ca 3.5 cm. longa 2–3 mm. lata, basi leviter incisa desinens; pinnis articulatis, subsessilibus, e basi paulo angustata, subrotundo-truncata lineari-lanceolatis acuminatis, ad apicem versus levissime serratis, cetera in parte subintegris, 1–2.4 cm. inter se (costis) distantibus, alternis vel suboppositis, superioribus patentibus, intermediis inferioribusque horizontalibus, infimis 1–2-jugis interdum paulo

abbreviatis et deflexis, maximis (intermediis) 11 cm. longis, 1.3 cm. latis; rachibus petiolis similibus paleatis; costis utrinque paleis similibus sed minoribus supra sparsis infra densis armatis; nervis inconpiscuis areolas obliquas formantibus, nervis apice liberis nullis. Folia fertilia differunt petiolis paulo longioribus, ca. 12.5 cm. longis, pinnis e basi truncata, non angustata linearibus abrupte in apicem obtusiusculum desinentibus, margine subintegris, subpetiolulatis, maximis 4.5 cm. longis, 0.8 cm. latis. Sori totam inferiorem pinnarum partem occupantes.

TYPE: N. E. New Guinea, Kaiserin-Augusta (Sepik) River, Etappenberg, 850 m., Ledermann 9524.

I have not seen the type, but have examined another specimen from New Guinea: Mamberamo bij Albatros Bivak, 50 m., Docters van Leeuwen 9616 (Expeditie Nieuw Guinea 1926), in Herb. Buitenzorg. The striking feature of this specimen is the fertile pinnæ which are about 4.5 by 0.6 cm., with short stalks and blunt apices, as described by Brause. The sterile pinnæ are all somewhat damaged, and are rather smaller than described (to 9.5 cm. long), but I have little doubt that this is Brause's species.

Lomagramma perakensis Bedd. Handb. Suppl. 107. 1892. **Plate 16.**

Beddome's description is as follows:—

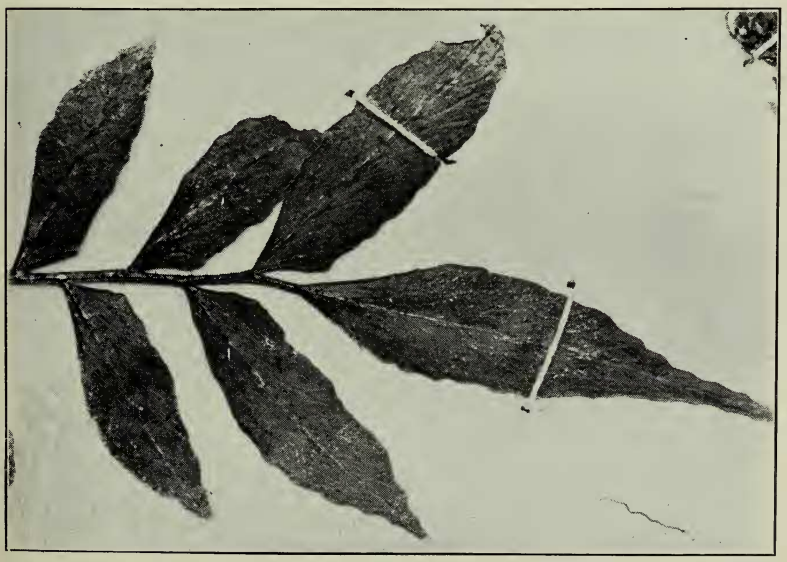
Rhizome 40–50 feet long, 1 in. diameter, epiphytic on trees; stipes 6–8 inches apart, about 1 foot long, slightly scaly, but scales soon deciduous, rachis not winged upwards; frond 3–4 feet long, very similar to those of Blumeana, but coriaceo-herbaceous in texture, pinnæ entire or obscurely crenated, quite glabrous or costa very slightly scaly, veins sunk and scarcely visible, venation very similar to Blumeana but closer and costal areoles smaller; fertile pinnæ 1–1½ lines broad.

Perak, 400 ft. alt. (Day). Referred by me to Blumeana in my list of Day's Perak ferns. Perak, 2,500–3,000 feet alt. (Dr. King's collectors, No. 8345), the pinnæ all fall off in drying, much more so than in Blumeana.

In Beddome's list of Day's collections (J. Bot. 1888, p. 2), the altitude is given as 4,000 ft.; the 400 ft. of the Handbook is doubtless an error. I have not been able to find Day's specimen, and it seems rather doubtful whether the specimen exists. It would therefore be best to take Kunstler's collection as the type of the species; specimens were distributed to several herbaria.

Th following description is based on the specimens in the Singapore herbarium.

Bathyphylls. Largest fronds commonly about 30 cm. long and 12–15 cm. wide, the stipe to about 25 cm.; pinnæ about 10–15 pairs, or even less, the apical pinna articulate and similar to the others; lower pinnæ largest in larger fronds, apical pinnæ largest in fronds of very young plants; rachis winged almost throughout. Pinnæ distinctly oblique or the lower ones sometimes horizontal, sessile; middle pinnæ with upper base cuneate



Above.: apex of bathyphyll of *L. sumatrana* (the rachis continuous). Below: apex of bathyphyll of *L. perakensis,* from a young plant (apical pinna articulate). Both x 1.5.

about 45° to the midrib, lower base very narrow; edges entire, usually somewhat undulate, not toothed; apex subacuminate; midrib often somewhat falcate; texture thin but firm; veins slightly prominent above and below, often not distinct.

Plants with fronds only 4 cm. long have the apical pinna (15 by 4 mm.) articulate, the veins free or forming an incomplete series of areoles. Smaller fronds sometimes have an equally forked not articulate lamina at the apex.

Sterile acrophylls. Stipes to 40 cm. long; fronds to about 1.25 m. long. Rhizome to at least 1.5 cm. in diameter, densely scaly towards apex; stipes to 1 cm. thick at base, roughened from bases of scales. Pinnæ oblique, gradually smaller towards apex. Largest pinnæ 26 cm. long, 2.5 cm. wide, base rather narrowly unequally cuneate (upper base as much as 45° to midrib, lower always very narrow), edges slightly undulate, not toothed, more or less reflexed when dry, apex acuminate; midrib often slightly falcate towards apex. Texture of fully matured fronds subcoriaceous; colour olive green, often rather pale; veins usually more prominent on lower surface, but often almost immersed in the substance of the frond, rarely very sharply defined on the surface, usually in three series of areoles, the costal ones often smaller than the next series.

Fertile pinnæ to 40 cm. long (commonly 15–20 cm.) and 3–5 mm. wide when dry, on stalks 3 to 7 mm. long; midrib with two dorsal and three ventral vascular bundles (one in small pinnæ); venation in two or three rows of small areoles. The Pulau Tioman specimen has pinnæ only 12 cm. long; its sterile pinnæ are small also (13 cm. long, 2 cm. wide).

MALAY PENINSULA (all in H. S.). Sungei Ujong: Hullett s.n. Aug. 1880. Penang: Curtis 618. Pahang: Cameron Highlands 4,500 ft., Holttum s.n. 31.3.30; Robinson's Falls, 4,600 ft., S.F.N. 24994, 23259 (Holttum); Sungei Terla, 3,900 ft., S.F.N. 31329 (Holttum); Fraser's Hill, 3,600 ft., Holttum s.n. 18-9-23, 4,000 ft., Holttum s.n. 21-3-29; Bukit Kajang, Pulau Tioman, 2,000 ft., S.F.N. 18945 (Henderson). Ferak: Taiping, 2,500–3,000 ft., King's collector 8345.

SUMATRA. G. Kœrintji, 1600 m., Bunnemeijer 8711 (B, two sheets, fertile only).

Bunnemeijer's specimens have long pinnæ, agreeing with *L. perakensis,* but in the absence of sterile fronds there is some doubt of the identity. They cannot be either *L. sumatrana* nor *L. abscondita;* if not *L. perakensis,* they represent a new species.

This very fine species appears to be quite distinctive in its bathyphylls; in its acrophylls it is nearest to *L. Brooksii* and *L. lomarioides,* which are mountain plants of Borneo and Java respectively.

Lomagramma polyphylla Brack. Cryptogamia, Filices, in Wilkes, U.S. Expl. Exped. **XVI:** 83, t. 12. 1854.

L. rhizomate scandente; stipitibus sulcatis furfuraceo-squamosis; frondibus bipinnatis; pinnis petiolatis alternis; rhachi marginata paleaceo-hirsuta; pinnulis glabris approximatis subalternis sessilibus oblongo-lanceolatis crenatis; costis sparsim paleaceis.

Hab. Ovolau, Feejee Islands: on trunks of trees.

Stipes thick and of a pale straw colour, about 8 inches long, with a few brown *furfuraceous scales,* which extend to the rhachis. Sterile *fronds bipinnate,* large, 2 to 3 feet long. *Pinnules* numerous, *approximate, glabrous, subalternate, sessile,* about 1 inch long and 3 to 4 lines broad, *oblong-lanceolate,* the margin irregularly *crenate.* Rhachis of the pinnæ with two broad marginal lines in front (a character not well represented in the figure), beset with slender fugacious paleæ. Fertile fronds wanting.

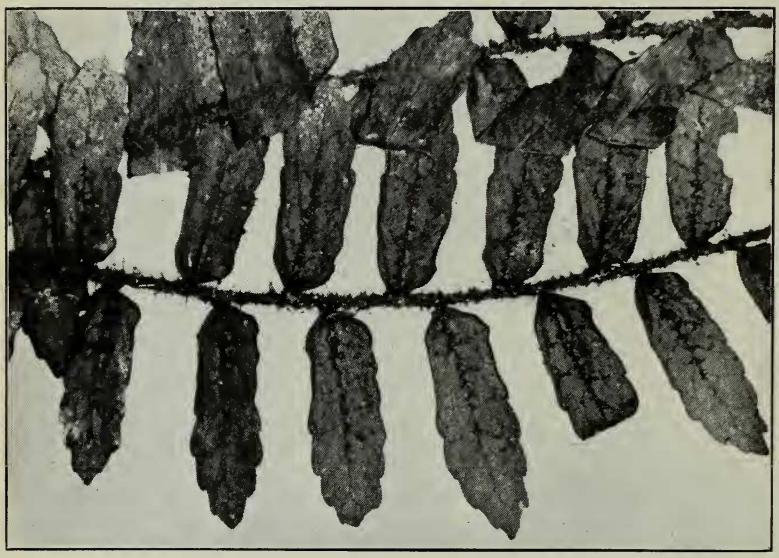
In the absence of the fertile fronds we infer from the habit of the sterile ones, with their articulated pinnæ and uniform reticulated venation, that our plant belongs to the present genus.

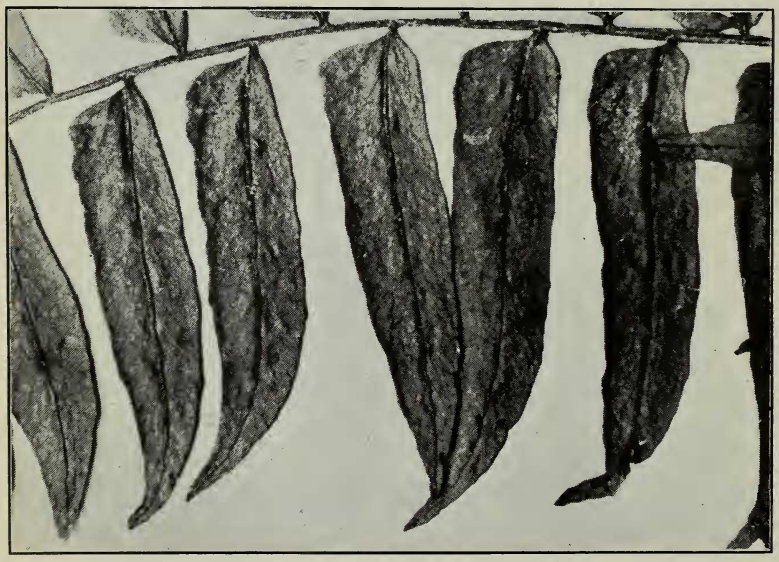
I have seen the type specimen in the U.S. National Herbarium. It has 9 pairs of pinnæ, oblique, all articulated; the middle pinnæ largest, about 20 cm. long and 5 cm. wide; pinnules all articulate about 20 pairs, slightly oblique, about 1 cm. apart, the largest about 2.7 cm. long and 0.7 cm. wide, the base not quite equally cuneate, the apex gradually tapering and slightly falcate, colour rather pale, veins distinct, pale, in two series of rather narrow oblique areoles, about 9 areoles in the costal series.

At the British Museum and Kew there are several other collections of bipinnate fronds from Fiji and the New Hebrides (Aneiteum); in the U.S. National Herbarium are also specimens from Eua Island, Tonga. Both the Aneiteum and Tonga specimens differ rather strikingly from the type of *L. polyphylla* and possibly represent distinct bipinnate species. The other specimens from Fiji however show in some cases intermediate characters. I think therefore that we must wait for further information before attempting to describe any new bipinnate species. Probably the matter will not be settled until someone makes careful field observations on these plants in the various island groups concerned.

The characteristic feature of the Aneiteum specimens is the very short pinnules (to about 1.4 cm. long), with few rather large marginal teeth and areoles to correspond. The specimen from Eua Island, Tonga, has pinnules slightly larger than those of the type of *L. polyphylla,* the margins broadly and slightly lobed, the costal series of areoles about 6 in number, to correspond with the lobes.

Bathyphylls are present in one of the Fiji specimens at the British Museum (Harvey), in one collection from Aneiteum and in the Tonga collection. In all cases they are simply pinnate, the pinnæ larger than the pinnules of the acrophylls, with shallowly lobed margins. One collection from Fiji (Meebold





Above: *Lomagramma pteroides,* a bathyphyll.
Below: *L. lomarioides,* a bathyphyll. Both x 1.5.

16885, B.M.) is a small bipinnate frond with rather large pinnules (to 4.8 cm. long and 1.5 cm. wide); this is perhaps a stage intermediate between typical bathyphylls and acrophylls, but it might possibly represent a distinct species.

Fertile fronds are present in one collection from Aneiteum (McGillivray, Kew) and in the Tonga collection. Both are very similar, the fronds bipinnate, of much the same size as the sterile ones, the pinnules reduced in size, to about 10 mm. long by 3 mm. wide. The spores are characteristic of the genus.

The following list includes all the bipinnate specimens I have seen.

FIJI. U.S. South Pacific Exploring Expedition 1838–42 (2 sheets, W, type collection). Seeman 713 (2 sheets, B.M.), 421 (B.M.). W. H. Harvey (2 sheets, B.M.). Nine miles above Suva, Meebold 16885 (B.M.). Korumbamba Hill, near Suva, Meebold 16831 (B.M.).

NEW HEBRIDES. Aneiteum, McGillivray 44, "woods, climbing trees" (Kew). Moore 1890, no. 17 (B.M.).

TONGA IS. Eua Island, H. E. Parks 16311 (W, 3 sheets). "Johannsen's plantation, climbing tall trees, alt. 150 m. Fruiting branches in top of tallest trees only. Vines many feet long".

Lomagramma pteroides J. Sm. Journ. Bot. **3:** 402. 1841. *ibid.* **4:** 152. 1841. Hook. Gen. Fil. t. 98. **Plate 13.**

Lomagramma subcoriacea Copel. Phil. Journ. Sci **40:** 308. 1929.

L. pteroides var. *subcoriacea* Copel. ibid. **3C:** 32. 1908.

The type of this species is Cuming 223, from Luzon. I have examined the specimens of this collection at Kew and the British Museum, and I can see no distinction from Copeland's species, of which I have seen the specimens of the type collection in the herbaria of Manila and Buitenzorg and also several specimens later distributed by Copeland. Copeland's specimens have rather narrower firmer pinnæ, drying reddish; but the essential characters of the broad base of the sterile pinnæ and the stalked fertile pinnæ with part of the lamina sterile towards the base are the same in both. The reddening of the fronds on drying is rather variable, and is perhaps to some extent connected with the method of drying and perhaps with the position of the plant and age of the fronds at the time of gathering.

The following description is based on all the specimens at my disposal. The description of the bathyphylls, which are quite distinctive, is taken from Merrill 780 (Paragua) and Copeland 1736 (Mindanao). These are perhaps not of a fully mature size.

Bathyphylls. Stipes short (longest seen 4 cm.). Largest frond seen about 28 cm. long by 4.5 cm. wide. Pinnæ to about

28-jugate, gradually reduced from the middle of the frond to the base, the lowest very small (7 mm. by 3 mm.) but not much more distant, the upper pinnæ gradually reduced towards the apex, which is continuous with the rachis and narrow, unlike the other pinnæ. Largest pinnæ about 2.5 cm. long and 0.7 cm. wide, the base unequal, the upper side broadly, the lower narrowly cuneate, the edges crenulate (teeth 2–3 mm. apart), the apex acute to somewhat blunt; bases and apices of lower pinnæ more rounded. Stipe, rachis and costæ rather densely scaly; scales rather dark. Pinnæ reddish when dry; veins strongly raised on both surfaces, in one or two series of areoles.

Sterile acrophylls. Rhizome with up to 5 leaf-gaps in transverse section, very stout in well-grown plants. Stipes usually 20–30 cm. long. Largest pinnæ seen 22 cm. long, 2.2 cm. wide; pinnæ commonly about 12–15 cm. long and 1.2 to 1.8 cm. wide, the base slightly unequally subtruncate to subcordate, the lower base narrower and more rounded to cordate, the sides subentire parallel, the apex acuminate, somewhat falcate, irregularly undulate or bluntly toothed; the uppermost pinnæ gradually smaller, often less truncate at the base, the apex more clearly toothed; lowest pinnæ (except on very small fronds) not much reduced, the base often equally cordate and distinctly stalked. Texture thin; colour often reddish; veins raised slightly on both surfaces, usually more or less brown on lower surface, the areoles rather small, in 2–3 series. Scales rather numerous, dark.

McGregor 235 from Negros shows an interesting transition from bathyphyll to acrophyll. The Washington specimen has the apex continuous with the rachis, the Manila specimen has the apical pinna articulate; in each case a fertile frond is attached to the same rhizome as the sterile.

Fertile fronds. Pinnæ to 27 cm. long, commonly about 20 cm., base unequally cuneate, widening rather suddenly from a winged stalk up to 1 cm. long; base of pinna 7–10 mm. wide, only the edge fertile, the upper part gradually narrowed, the distal half sometimes entirely covered with sporangia, but often with a narrow sterile lamina on either side of the midrib to the apex.

TYPE. LUZON, Cuming 223.

Other specimens. LUZON: Lucban, Tayabas, Elmer 9068, fert. (W, B). PARAGUA: E-wi-ig River, Merrill 780, bath. (W, M). NEGROS: Dumaguete (Cuernos Mts.), Prov. Negros Oriental, Elmer 10175, fert. (B, M, W). PANAY: Mt. Bulilao, Capiz Prov., Bur. Sci. no. 35754 (Martelino & Edano, S, M). MINDORO: Baco River, McGregor 235, fert. (W, M); Alag River, Merrill 5654, fert. (M); Mt. Halcon, Bur. Sci. no. 40657, fert. (Ramos & Edano, M). MINDANAO: Camiguin de Mindanao, Bur. Sci. no. 14764, fert. (Ramos, M); Cotabato, Distr.

of Zamboanga, Copeland 1736, fert. & bath. (W, M). SULU ARCH: Jolo, Clemens 9371, fert. (M).

This species has only so far been found in the Philippines, but within those islands it is widely distributed. It is very clearly characterised by the fertile pinnæ, which are the only ones having regularly a partial sterile lamina that I have seen in the genus. The bases of the sterile pinnæ are also distinctive but this character varies from base to apex of the frond and needs careful observation. There is much variation in the width of the pinnæ of the sterile acrophylls; and in the development of the reddish colour.

Lomagramma sinuata C. Chr. Svensk Bot. Tidskr. **16:** 98, f. 5. 1922.

Rhizomate ad caudices arborum late repente, lignoso, longissimo, 1.5–2 cm. crasso, inferne radicibus brevibus dense radicante, superne 5-sulcis, rimis acutis separatis, profunde sulcato, squamis minutis anguste lanceolatis adpressis atrofuscis sparse obtecto, denique dunudato. Foliis difformibus ex schedula pendentibus, valde remotis. Stipitibus foliorum sterilium cum rhizomate continuis ad 25 cm. longis, basi 6 mm. crassis, cinnamomeis, glaberrimis, superne auguste profundeque sulcatis. Lamina sterilis ovato-lanceolata, verisimiliter 1 m. vel ultra longa herbacea, siccitate brunnea, glaberrima; rachi non alata. Pinnis 10–15-jugis, usque ad 6 cm. inter se remotis alternis, erecto-patentibus (nec falcatis), petiolis 1 cm. longis stipitatis ad rachin articulatis, facile deciduis, e basi postice cuneata actice rotundato-truncata in petiolum decurrente oblongis, breviter acuminatis, 20 cm. longis 4 cm. latis, sinuato-repandis, margine ipso integerrimis, pinna terminale conformi. Venis distinctis reticulatis inferne elevatis, areolas 4–5 inter costam et marginem formantibus, areolis elongatis plerumque 5-angulatis, costalibus valde inæqualibus.—*Foliis fertilibus* minoribus, lamina ad 35 cm. longa, pinnis configuratione sterilibus similibus, 10 cm. longis, 8 mm. latis; stipite rachique paleis minutis lanceolatis adpressis centro atris marginibus basique lutescentibus onustis; sporangiis breviter pedicellatis paginam inferiorem excepto spatio mediano 1 mm. lato sparse paleaceo (paleis adpressis e basi peltata suborbicularibus in apicem longum acuminatum contractis) occupantibus; marginibus ipsis soris destitutis.

Bolaang-Mongondou, Modajag, North Celebes, 750 m., on stems of living trees, leaves pendent, fertile ones rare. W. Kaudern, no. 73 (B).

The characteristic features of full-sized acrophylls of this species are the long, very broad, thin, almost entire sterile pinnæ with their long narrowly winged stalks and the broad fertile pinnæ, also stalked; the venation of the sterile pinnæ is in several series of areoles, those towards the margins being very small. The scales on rhizomes and very young fronds resemble those of *L. melanolepis*.

I have seen a pinna of the type. I have also seen an entire fertile frond of another collection from Celebes, which agrees with Christensen's figure and description. These specimens have no bathyphylls.

There are specimens (including a fertile frond) from British North Borneo which appear to me to be referable to this species;

there are also specimens from East Java. From New Guinea (Papua) are specimens of sterile and fertile acrophylls collected by Carr; these agree exactly with Celebes specimens, except that the sterile pinnæ are rather long-acuminate. There is another specimen, from southern Dutch New Guinea (von Romer 216), which has smaller (but still acuminate) sterile pinnæ than the Papuan specimen, and the pinnæ are unstalked; the specimen consists of the apical part of frond, and it is possible that the basal part might have had larger and stalked pinnæ.

Of all these collections, only that of Dr. Posthumus shows bathyphylls, and it is fortunate that there can be no doubt of their authenticity. The collection consists of several fronds, both bathyphylls and sterile acrophylls. The latter are in my opinion typical of *L. sinuata* and Dr. Posthumus writes "the material belongs to one and the same plant". The bathyphylls are very similar to those of the unnamed Java species, and it might be difficult to distinguish them with certainty.

Bathyphylls. Stipes about 4 cm. long, fronds commonly to 22 cm. long and 7 cm. wide; pinnæ about 12-jugate; lowest pinnæ short and somewhat deflexed; apical pinna articulate, the base almost equal and the apex rather acute; middle pinnæ usually largest, commonly about 3.8×1.2 cm., the lower base very narrowly cuneate, the upper subtruncate but suddenly narrowing near the very base and so forming a sigmoid curve, the edges slightly and rather distantly toothed, especially towards apex, the apex rather bluntly rounded, texture thin, venation distinct, of two series of areoles; wing of the rachis rather unusually pronounced with an auricle below each pinna; scales fairly numerous on rachis, a medium brown colour.

The bathyphylls differ from those of the unnamed Java species in the sigmoid curve of the upper base, the less toothed margin, and the blunt apex; also perhaps in the rather large wing to the rachis and paler scales.

The specimens show another feature not mentioned in the original description, namely that the sterile acrophyll pinnæ are not always so long-stalked as described. The smaller acrophylls, and often the upper pinnæ of larger ones, would perhaps hardly be described as stalked, but they all have the sigmoid curve of the upper base described in the bathyphyll, only in a more pronounced degree. In the larger pinnæ this curve is exaggerated, and combined with a similar but much flatter curve in the narrow lower base gives a winged stalk. The lowest pinnæ of large acrophylls are rather short (not much more than half the length of the longest ones), and the lower base much broader, sometimes almost equal to the upper base, the winged stalk still present. In the pinna from the type collection in the Buitenzorg herbarium the winged stalk is only 5 mm. long, and this seems a common length.

Another correction of the original description (so far as complete specimens examined by me are concerned) is that the pinnæ may be up to 22-jugate.

CELEBES. N. Celebes: Kaudern 73 (type, as cited above). S. Celebes: Kosali-Porema, 650 m. Kjellberg 2608 (B).

BORNEO. B. N. Borneo: Menetendok, Kinabalu, 2,500 ft., Clemens s.n. 1-3-33 (S); above Koung, 2,500 ft., Clemens 51308 (M).

JAVA. Res. Pasoeroean, Tangkil Zuidergeberte, 400–500 m. Koorders 23554b (B). Res. Probolinggo, Mt. Lamongan, 450 m., Posthumus 3975 (S).

NEW GUINEA. Papua: Veiya, sea level, Carr 11677 (S). Dutch N. Guinea: von Romer 216 (B).

Lomagramma sumatrana v.A.v.R. Bull. Jard. bot. Buitenz. III. Ser. **2:** 158. 1920. **Plate 16.**

Leptochilus cuneatus R. Bonap. Notes Pterid. **XIV:** 453. 1923.

The original description of this species was as follows:—

L. lomarioideæ J. Sm. affinis sed pinnis sterilibus integerrimis vel ad apicem solum serratis, in sicco viridi-vel fusco-olivaceis, subtus quam supra pallidioribus, pinnis fertilibus anguste linearibus, 4–5 mm. latis subtus unique soriferis basi interdum sterilibus dilatatisque.

Forest; to 5 m. high scandent; alt. 350–500 m.—Originally determined by me as *L. pteroides* J. Sm.

SUMATRA (Deli, Sibolangit, J. A. Lörzing nos. 5564, 5623, 20th March–8 April 1918).

It is evident that by *L. lomarioides* in the above description the author meant the unnamed lowland species of Java, not the true *L. lomarioides* (=*L. abscondita* v.A.v.R.), which has quite entire pinnæ. I have examined the type of *L. sumatrana,* and believe it to be identical with the lowland species of the Malay Peninsula, which is well represented in the Singapore herbarium by bathyphylls as well as acrophylls. The following full description is based on Peninsula specimens so far as bathyphylls are concerned, and on both Sumatran and Peninsula specimens for the acrophylls.

Bathyphylls. Stipes 3–10 cm. long; lamina to about 40 cm. long and 9 cm. wide. Pinnæ 20 to 30 pairs, lowest rather reduced, more distant and reflexed, upper pinnæ gradually smaller, the uppermost grading into lobes on the apex of the frond which is not pinna-like and not articulated to the rachis. Largest pinnæ about 5 cm. long by 1.2 cm. wide, commonly about 4 cm. by 0.9 cm., at right angles to the rachis, upper base broadly subtruncate subauriculate, lower base half as wide, rounded or sometimes nearly cuneate, sides almost parallel for two-thirds of their length, than gradually tapering to acute or subacute apex; edges shallowly crenate with one or two sharper teeth at the distal end of each lobe, the teeth or groups of teeth 3–5 mm.

apart. Texture thin, colour usually green when dry but sometimes brown; midrib pale, raised above and below, veins distinctly prominent on both surfaces when dry, concolorous with the surfaces, slender.

Sterile acrophylls. Stipes to 20 cm. long; frond to at least 90 cm. long and 25 cm. wide. Lowest pinnæ somewhat reduced and more distant, uppermost gradually smaller, apical pinna articulate and same shape as others. Middle pinnæ to about 14 cm. long and 2 cm. wide (occasionally to 2.5 cm.), at right angles to the rachis or slightly oblique, sessile or stalked less than 1 mm., base broadly cuneate above, rounded to cuneate below and about half as wide, edges usually distantly toothed towards apex, otherwise entire, sides approximately parallel for ⅔ of their length, apex acuminate; texture thin but firm, veins raised above and below, in 3 series of areoles, the costal areoles not considerably larger than the next series.

Fertile fronds. Pinnæ 2.5 to 3 cm. apart, to about 15 cm. long by 5 mm. wide, stalked to 2 mm., the base unequal; upper pinnæ gradually reduced to about 4 cm. long; venation in 2 or three series of areoles, usually prominent above; lower surface soriferous throughout except for the midrib and the thin pale edges.

The characteristic features of this species are the long narrow bathyphylls with many pinnæ and the apex not articulate, the broad sterile acrophyll pinnæ, thin in texture and slightly toothed at most towards the apex, and the broad slightly stalked fertile pinnæ.

I have not seen Brooks's specimen from southern Sumatra which was described by Bonaparte as *Leptochilus cuneatus,* but from the description (especially of the broad fertile pinnæ) it appears almost certainly to belong here. Bonaparte quotes also under *Leptochilus cuneatus* a specimen of Raciborski from Java (Salak). It seems possible that this is a paratype of *L. abscondita* (*L. lomraioides*) but if so the description would not apply to it. I have seen no specimens from Java to which the description of *L. cuneatus* would apply.

In his description, v.A.v.R. has the phrase "basi interdum sterilibus dilatatisque", referring to fertile pinnæ. The type collection has a frond which is partly fertile and partly sterile, and at the transition region some pinna are sterile at the base with fertile apical half. This is of course not a character of the species, but just a chance occurrence.

L. sumatrana occurs in the low country and foothills of the Main Range in the Peninsula, and, so far as recorded, in low country also in Sumatra. The mountain species is *L. perakensis,* which is very different at all stages.

SUMATRA. Sibolangit, 475 m., Lörzing 5564 (B, S, M), 5623 (B). Benkœlen, Lebong Tandai, Brooks 4678 (type of *Leptochilus cuneatus* R. Bonap., not seen).

MALAY PENINSULA (all S). Selangor: Ginting Simpah, 1,500 ft., S.F.N. 26104 (Holttum). Negri Sembilan: Ulu Bendul, S.F.N. 9859 (Holttum). Pahang: Pulau Tioman, W. of Joara Bay, S.F.N. 1138 (Burkill). Perak: Chanderiang, 500–1,000 ft., King's Collector 5778 (distributed as *Acrostichum perakense* Bedd.).

Lomagramma sp.

As noted by van Alderwerelt van Rosenburgh, there are two species of Lomagramma in Java (in addition to *L. sinuata,* which has been twice collected in East Java); van Alderwerelt accordingly decided to provide a name for the second species. Owing to the fact that he evidently never saw the type of *L. lomarioides,* he gave a new name to that species instead of the other, which therefore still lacks a name. The unnamed species is evidently a fairly common one in some parts of Java, but curiously enough it has never been collected in a fertile condition. It is very similar to *L. Copelandii,* and might possibly be identical with that species. In view of this uncertainty, I do not name it here, but give a description of the bathyphylls and sterile acrophylls. The bathyphylls are rather similar to those of *L. sinuata,* but the pinnæ are much more toothed, more inclined to have an acute apex, and the scales are more numerous and darker. The acrophylls lack the characteristic base of *L. sinuata* and are distinctly toothed towards the apex.

Bathyphylls. Smallest fronds seen, with lamina 12 cm. long, have the apical pinna largest and articulated like the others. This condition persists in bathyphylls up to 25 cm. long; in larger fronds the largest pinnæ are about one-third from the apex, the apical pinnæ somewhat reduced. Middle pinnæ of typical fronds about 4 cm. long and 1.1 cm. wide, the upper base truncate to broadly cuneate, the lower base very narrowly cuneate, the apex gradually tapered to an acute point (or rounded in the smaller pinnæ), the midrib slightly falcate, the margins slightly lobed, the lobes about 4 mm. wide, each with 2 or 3 teeth, the basal ones sometimes not toothed; lowest pinnæ with lower base more broadly rounded, and apex rounded. Pinnæ to about 18-jugate, usually separated by about half their own width; texture thin; veins raised on both surfaces, areoles in two series.

Sterile acrophylls. Stipes to 15 cm. or more; frond to 60 cm. long and 20 cm. wide; pinnæ to at least 20-jugate. Largest pinnæ about 12 cm. long and 1.8 cm. wide, midrib slightly falcate, upper base broadly, lower more narrowly cuneate, sides parallel for more than half their length, entire except for the apical third which is distantly toothed (teeth 4–5 mm. apart), apex acuminate. Texture thin; veins raised on both surfaces, usually pale on the lower surface, areoles in about 3 series, costal ones somewhat larger than the next. Lowest pinnæ somewhat reduced, the base more broadly cuneate.

Fertile fronds not seen.

This species is certainly very like *L. Copelandii*. The youngest plants differ from that species in having the apical pinnæ articulate from a very early stage and larger than the others; larger bathyphylls differ in having the lower base of the pinnæ broader, and in a larger number of basal pinnæ reduced and reflexed; acrophyll pinnæ differ in being distinctly toothed towards the apex.

JAVA: *Res. Pasœrœan:* vœt G. Smerœ, 400 m. Posthumus 1613 (P); helling G. Smerœ, 700 m. Posthumus 1621 (P); bij Waterval Sœmberwangi, 300 m. Posthumus 1508 (P, S); helling G. Smerœ 825 m. Posthumus 549 (P, B); helling G. Smerœ 400 m. Posthumus 1608 (P). *Res. Batavia:* Buitenzorg 240 m. Bakhuizen fil. 3123 (B); Sitœhiang 500 m. Bakhuizen 6452 (B,S); Kloof v/d Salak, Bakhuizen 6304 (B); Gœnong Batœ, 250 m. Bakhuizen fil. 3664 (B); Botanic Gardens, Buitenzorg (B), Posthumus s.n. 1925 (P).

SUMATRA. Aer Telani Kloof, 11 km. N. van Banging Agœng, Ranau N. W., 400 m. van Steenis 3951 (B).

8. SPECIES DUBIA

Lomagramma sorbifolia (Willd.) Ching, Lingnan Sci. Journ. 12: 566. 1933.

Aspidium sorbifolium Willd. Sp. Pl. 5: 23. 1810.

This species was described by Willdenow as follows:—

A. frondibus pinnatis, pinnis lanceolatis alternis obtusiusculis, serratis, basi superiore truncato-subauriculatis, inferiore cuneatis, rachi paleacea. W.

Habitat in India orientali.

Caudex filiformis repens glaber, *Stipes* pollicaris glaber. *Rachis* paleis brevibus obsita. *Frondes* quinquepollicares pinnatæ. *Pinnæ* mediæ pollicares, inferiores et superiores sensim breviores, lanceolatæ obtusiusculæ remote serratæ serraturis 5 vel 6 in utroque latere, basi superiore truncatæ, vix manifeste auriculatæ, inferiore cuneatæ. *Costa media* paleis parvis ventricosis obsita. *Soros* perfectos non vidi. W.

Prof. Diels has very kindly sent me a photograph of the type of the species, which is in the Berlin herbarium. As one would anticipate from the description, the specimen consists of bathyphylls from a young plant. The pinnæ are similar in many respects to the lowland species from Java and also to *L. sumatrana, L. grosseserrata,* and *L. Matthewii.* These species however differ very markedly in the apex of the bathyphyll. In the Java fern the apical pinnæ are similar to the others, subequal, and articulated. In the other species the pinnæ are gradually reduced to the apex of the frond, which consists of a narrow lamina continuous with the rachis. Willdenow's specimen has the latter character, and is quite unlike any specimen I have seen from

Java. It is probably one of the other three species, but our present knowledge is not adequate to say which. The only course therefore is to ignore Willdenow's name for the present.

9. DOUBTFUL SPECIMENS

There are several doubtful specimens, some of which may represent new species, but the material is inadequate for a full description to be possible. Some of the specimens may represent bathyphylls of known species; but there is no definite evidence of this. It is clear from the foregoing descriptions that for a full characterisation of a species of Lomagramma all stages of development must be available; species resembling each other at one stage may differ strikingly at another.

LUZON. Rizal Province, Loher 23150 (M). This specimen consists of bathyphylls about the same size as those of *L. Copelandii,* but differing in the shape of the pinnæ, which are more oblique and falcate, the upper base subauriculate, the lower base more narrowly cuneate, the edges not lobed and only irregularly toothed towards the apex. Judging by the bathyphylls of those species in which a number of specimens are available, I do not think it likely that this specimen comes within the range of variation of *L. Copelandii.* It is probable therefore that there is another Philippine species and to it may possibly belong some of those specimens which I have referred to *L. pteroides* or *L. Copelandii,* but until full collections of all stages are available nothing further can be said.

NEW GUINEA. N. New Guinea, H. J. Lam no. 1200, 13-9-1920 (B). This specimen consists of very small bathyphylls, all of about the same size, to about 7 cm. long (including the stipe) and 2.8 cm. wide. The collector noted that the fern was very abundant on the ground and on roots (of trees presumably) but that no fertile fronds could be found. This specimen might perhaps be a very young stage of *L. novoguineensis,* or even of *L. sinuata,* but there is no character in the bathyphylls of Lam's specimen to give a definite connecting link with either species.

CELEBES. Manado Resid., Tomeolama, 700 m. C. A. Wisse no. 71 (B). This specimen consists of four bathyphylls rather similar to those of the specimen from Luzon above quoted, but the pinnæ more regularly toothed. It might well be the same species.

TAHITI. M. Vesco 1847 (M, ex herb. Mus. Paris.). This specimen is the apical half of a sterile acrophyll, which is very near the unnamed Java species in appearance.